

Oceanography: The Making of a Science
The Oregon State Story
People, Institutions, and Discovery

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"There is a tide in the affairs of men, which taken at the flood leads on to fortune. Omitted, all the voyage of their life is hound in the shallows and in miseries. On such a full sea are we now afloat and we must take the current when it serves or lose our ventures."

—Brutus to Cassius, Scene 3, Act IV of Shakespeare's *Julius Caesar*

The Wilkes Expedition of the 1830s and 1840s, the work of Matthew Fontaine Maury, and the Challenger Expedition of the 1870s have all been regarded at one time or another as the beginning of modern "Oceanography." If any of these are truly the beginning, then the last half of the 20th century must be regarded as the "golden age" of scientific ocean discovery. By today's standards and methods, the techniques used in the 1800s by oceanographers and the knowledge of the oceans were fundamental but primitive. At the end of World War II, mathematical calculations were made with the use of mechanical calculators or slide rules. The hand-held calculator, computers, the Internet and the World-Wide Web did not exist. Satellite navigation was a vision. There was no GPS. Satellites did not exist and TV itself was in its infancy. There was no deep sea drilling program and no theory of plate tectonics. Systematic measurements of residual magnetism (the Rosetta stone of plate tectonics) had not been made. The structure of the DNA molecule was unknown. Nonetheless, amazing progress in ocean science would be made during the last half of the 20th century.

Getting Started: 1954–1959

The awakening of scientific research in the United States following World War II started with the establishment of the Office of Naval Research (ONR) in 1946, followed by the creation of the National Science Foundation (NSF) in 1950. ONR took the lead in emphasizing the need for ocean research during the 1950s and began funding oceanographers at existing laboratories, notably Woods Hole, the Scripps Institution of Oceanography and the University of Washington. In 1956 ONR asked the National Academy of Sciences (NAS) to create a Committee on Oceanography (NASCO) to study the needs of oceanography and identify the opportunities before it.

During the fall of 1958 the geophysics branch of the Office of Naval Research proposed a ten-year program for an expansion of Navy-sponsored oceanographic research. It was called "Project TENOC: A Ten-Year Plan for Oceanography." The plan called for Navy support of at least ten institutions of oceanography throughout the United States over a ten-year period. The primary objective would be to create knowledge relevant to naval operations through basic research.

Wayne Burt, who had come to Oregon State College (since 1961, Oregon State University) four years earlier, learned of that program and was excited by it. Louise Burt, in her comprehensive history of the first two decades of the School of Oceanography, recalls, "On the evening after learning of the TENOC proposal, Wayne came home and told me about its possibilities. Perhaps even Oregon State would be one of the institutions selected. He had a restless night and the next morning at breakfast he asked me to look up a quote from Shakespeare's *Julius Caesar*, 'There is a tide in the affairs of men which taken at the flood leads on to fortune. Omitted, all the voyage of life is bound in shallows and in miseries. We must take the current when it serves, or lose the venture.' Wayne was bold enough to take the tide at the flood and it was the right thing to do at the right moment. What an appropriate quote for a physical oceanographer." (Burt and Ludwig, 1998)

Wayne Burt (Figure I) came to Oregon State College in 1954. Previously, he had served a year in the oceanography program at the University of Washington and before that had been the Associate Director of the Chesapeake Bay Institute in Maryland. But for Wayne, who grew up there, Oregon was home. It was in Oregon that he wished to establish an oceanography program. While at the University of Washington, he had been in contact with Francois A. Gilfillin, Dean of the School of Science at Oregon State. Gilfillin apparently agreed that if Wayne could obtain funding from ONR, Oregon State would create a position for him. Wayne took the challenge. He wrote a proposal to ONR which would support his salary at OSc. In a letter to Burt, Gilfillin stated. "If the grant is allowed, we will request the State Board of Higher Education to have you appointed with the proper professorial title so you may appear on the college staff roster. This would be on an annual basis until such time as our instruction and research programs on state funds might warrant a permanent appointment." Gilfillin and Oregon State College had nothing to lose and everything to gain. The proposal was approved. ONR provided the grant money, and in September 1954 Wayne Burt started a project on the coastal oceanography of Oregon waters. He had an appointment in the Department of General Science in the School of Science at OSc. He would be paid \$7,000 for twelve months of employment.

By September 1958, Burt had been at OSC for four years, teaching courses in oceanography and carrying on research funded by ONR along the Oregon coast and in its estuaries. The total Oceanography budget for 1958 was approximately \$25,000, most of it coming from the Office of Naval Research. During his four years at Oregon State, Burt had been in frequent contact with people in ONR, notably Gordon Lill and Art Maxwell. He had convinced them that an oceanography program at OSC was feasible with ONR support and, with the announcement of the TENOC program, he was ready to move forward. He submitted a detailed proposal for TENOC support and also indicated to the OSC administration that he was confident the Navy would support a "department of oceanography at a significantly higher level." He had a verbal agreement with those at ONR that, with the approval of the creation of a department, ONR would provide both operating funds and funds for capital improvement: \$250,000 in fiscal 1960 for a research vessel and \$200,000 for the construction of an oceanography laboratory, classrooms, and administration building on the campus. A detailed proposal was submitted to President. A. L. Strand on November 24, 1958. The report explained the TENOC proposal and specifically requested that "a graduate department of oceanography be established at Oregon State College with the authority to grant the Master of Science degree in Oceanography and a minor in Oceanography for the Ph.D. degree. The Navy has selected Oregon State College as one of nine

universities where it would like to sponsor an increased program in oceanographic instruction and research over the next ten years. The immediate establishment of a department here would place us in a favorable position for obtaining a \$250,000 research vessel, a \$200,000 building and between \$69,000 and \$129,000 each year for operating funds for the department, if present plans mature. The department would be almost entirely funded from outside the state." He further pointed out to Strand that an expanded education and research program would benefit other departments in the college and the research undertaken would have direct economic application to fisheries, engineering, and geological survey work within the state of Oregon.

On December 26, 1958, OSC President A. L. Strand, received the following letter from Gordon G. Lill, head of the Geophysics branch of the ONR.

Dear President Strand:

The news that Oregon State College is planning the establishment of a Department of Oceanography is very encouraging to those of us who feel that the country must place considerably more emphasis on this field of science.

Project TENOC has not yet received official approval from the Department of Navy but will be considered, together with the National Report on Oceanography which will be released from the National Academy of Sciences in a few months.

We are pleased with the positive action taken at Oregon State College and extend our best wishes for success.

Sincerely yours,
Gordon G. Lill

With that letter as ammunition, President Strand approached the Oregon State Board of Higher Education and received approval to establish a Department of Oceanography at Oregon State College. It would become effective on July 1, 1959. The Department of Oceanography was officially established.

1959–1968: A Decade of Growth and New Beginnings

Under Wayne Burt's enthusiastic leadership, oceanography at Oregon State expanded rapidly. Faculty were added, new programs of instruction and research initiated, students attracted and new facilities acquired. With little to offer but opportunity and potential growth, Burt persuaded a core of scientists to join him. Development was to follow the traditional disciplines of oceanography: physical, chemical, biological, and geological/geophysical. Some came as faculty, some as support staff, some as students. In 1959, Herb Frolander (biological) and June Pattullo (physical) signed on. In 1960, John Byrne (geological) and Bill Percy (biological), Bruce McAlister (physical) came as a student, Bruce Wyatt as support staff. In 1961, Andrew Carey, Herb Curl, Jim McCauley, Larry Small (all in biological oceanography), Kilho Park (chemical) and Joe Berg (geophysical) all joined the group. At the end of ten years, in 1968, there were thirty-one faculty and a total staff of 122.

Space for faculty, staff, and students was a problem. With its earliest offices and laboratories in the Food Technology Building, Oceanography began to claim neighborhood houses destined for destruction. (On campus the oceanographers developed a reputation as "space gobblers.") By 1962 Oceanography had moved to the Physics-Chemistry Building. In March 1964, the oceanographers had their own building, a four-story, 30,000 square foot research building constructed at a cost of \$676,000—\$500,000 from the National Science Foundation and \$167,000 from the state of Oregon (Figure 2). Burt had been persuasive and the program managers recognized the potential of the early OSU oceanographers. Additional space was to follow: in

1965, the Marine Science Center on the coast in Newport, Oregon, a major research laboratory for fisheries and biological oceanography, and a ship support facility (Figure 3); and a second Oceanography Building on campus in 1970.

Vessels were essential. The 16-foot fiberglass outboard run-about Burt used for early research in the pre-department days continued to be used in Yaquina Bay and would be for years. But it was the ACONA, the vessel promised by ONR that provided the early impetus for attracting oceanographers to the new department (Figure 4). It was not only a sea-going vessel; it was a promise of things to come. Commissioned in May, 1961, the ACONA was an 80-foot, 154 ton vessel that would accommodate fifteen scientists and crew. With this vessel, all the waters off Oregon to a distance of 165 miles offshore became available to OSU oceanographers. Although capable as a platform for sophisticated research, the ACONA was a rough-riding vessel for the waters of Oregon. On one occasion it rolled sixty degrees from the vertical, an event well remembered by those aboard.

The ACONA was replaced in September 1964 by the YAQUINA (Figure 5), a converted World War II FS. Originally constructed in 1944, the FS became a popular conversion for a number of oceanographic institutions (e.g. Rhode Island, Texas A&M, Miami, Scripps Institute of Oceanography). With a length of 180 feet and displacing 800 tons, the YAQUINA provided the capability to work in all but the most severe ocean areas of the world. It had quarters for forty scientists and crew. It would serve academic oceanographers from Oregon State and other U.S. laboratories until 1976, when it was replaced by the newly constructed WECOMA.

In 1968 the CAYUSE (Figure 6), an 80-foot research vessel, joined the YAQUINA and expanded OSU's sea-going research capability. Designed for coastal ocean research, the CAYUSE had quarters for seven scientists and seven crew members. It could be at sea for up to fourteen days.

The development of facilities was important to the growth of Oceanography during its first decade, but of far greater importance was the development of programs of research and instruction by faculty, staff and students at OSU.

The department was established primarily as a graduate department with instructional programs leading to the master and doctoral degrees. Undergraduate courses included a general survey course in Oceanography and a few courses at the senior level. The department relied heavily on grants and contracts from outside sponsors and received financial support from the institution only for its limited instructional efforts and for the administration of the externally funded research. A percentage of the indirect costs of each research grant was returned to the department. As the research program expanded, these "returned overhead" funds were used not only for administrative services but also to provide equipment and facilities that enabled the oceanographic program to grow. Over the years, "returned overhead" was used to purchase small vessels, buildings, computers, and other equipment.

Prior to the creation of the department, little was known about the ocean, its biota, or the earth beneath it off Oregon. Limited primarily to this geographic area, research by physicists, chemists, biologists, and geoscientists resulted in both disciplinary and interdisciplinary discoveries. Early studies tended to focus on a description of the previously undescribed oceanic environment in this area. The physical oceanographers studied the motion of Oregon water (waves, tides, currents) and air-sea interactions. The winter north-flowing Davidson Current was mapped in greater detail and was described farther offshore and farther north than ever before. Coastal upwelling during the summer was described in some detail for the first time.

The ocean chemists traced the plume of relatively fresh water from the Columbia River in time and space. Measures of carbon dioxide and dissolved oxygen were found to be better indicators of upwelling than conventional measures of temperature and salinity. The relationship of the water

of the bays and estuaries to that of the open ocean became better understood. Determinations were made of the rate of exchange of gases across the ocean-air interface, and theoretical studies resulted in new ideas on the circulation of deep waters, the paleochemistry of the ocean, and the cause of glacial periods.

The addition of radionuclides to the Pacific Ocean by the Columbia River as a result of using Columbia River water to cool the atomic reactors at Hanford, Washington led to a major program in radiochemistry and radioecology. Research findings in this area had an impact on the research in all the other oceanographic disciplines. Radioactivity was used as an ecological tracer: it was measured 350 miles from the mouth of the Columbia River; it was measured in marine organisms hundreds of miles from the mouth of the river; it was measured in organisms collected from a depth of two miles, implying a much greater vertical transport rate than had been thought possible; molting of Crustacea was found to be important to the dispersal of radioactivity to the sea floor ... and much more.

The biological oceanographers did research concerning all the major categories of marine organisms: microbes, phyto- and zooplankton, nekton, and benthic organisms. A better understanding of the food-web off Oregon and its relation to oceanographic conditions resulted. New species were discovered and the ranges of known species extended. Studies of the distribution of phytoplankton resulted in a better understanding of the amount, the conditions and the rates of food production in the waters off Oregon.

Geological and geophysical research focused on the nature of the Oregon Continental Margin, its structure and sediments, and also the adjacent deep sea environment including the submarine canyon off the mouth of the Columbia River, the Cascadia and Tufts Abyssal Plains, and the Blanco Fracture Zone. Studies of living Foraminifera were made in order to determine the habitats of their fossil counterparts. From these studies it was determined that sedimentary rocks exposed atop the continental shelf were originally formed in water at great depth, implying significant uplift of the rocks forming the present continental shelf. Investigations involving the recent sediments of the shelf revealed distribution patterns over the shelf, along the shore, and into coastal estuaries.

Geophysical measurements of gravity, magnetics, and heat flow added to the understanding of continental margin structures. The geophysicists were also responsible for upgrading the OSU seismograph station with six new seismographs. The Corvallis Seismic Station became part of a 180-station global seismic network established by the U.S. Coast and Geodetic Survey. Seismic stations were also operated by the geophysics group at two other Oregon sites (Klamath Falls and Portland), creating the first Oregon network of seismic stations and filling the seismic station gap between California and Washington. In addition, a full-dimensional geophysical instruction program supplemented the research program.

Finally, Project THEMIS, a program instituted to strengthen the nation's academic institutions, awarded Oregon State a \$290,000 per year grant for the study of the "use of on-line computers in environmental research." The Oregon State project was jointly conducted by investigators from Oceanography, Engineering, and the Computer Section of the University. Objectives of the study were: (1) to apply modern electronic computer techniques to the study of oceanographic processes on a real-time basis; and (2) to understand the processes involved in air-sea interaction and upwelling along a coastal boundary. The initial work under this project involved the construction of meteorological instrument platforms. TOTEM I, a 185 foot spar buoy, was developed as a prototype at a cost of \$20,000 of Oceanography Department funds. It was successfully deployed at sea for a period of five months during the spring and summer of 1968. TOTEM II was experimentally moored on Cobb Seamount off the Washington coast (Figure 7).

Unfortunately, it failed structurally and collapsed shortly after being mounted, and therefore failed to obtain the measurements for which it was designed.

The first decade following the creation of the Department of Oceanography in 1959 was marked by significant expansion and by the achievement of scientific and educational goals (OSU Department of Oceanography, 1968). Full-time faculty expanded from one to thirty-one; total staff expanded from five to 122; the number of students increased from one to 108 (Figures 8 and 9). Facilities that were developed include two research vessels (ACONA and YAQUINA) and several smaller boats, major building to house the oceanographers on campus, and the OSU Marine Science Center at the coast at Newport. It was a decade of beginnings and expansion. The decade to come would firmly establish Oregon State University as a national center for oceanography and related marine activities. None of this would have been possible without the continued support of the Office of Naval Research.

The Second Decade

The end of the 1960s was marked by unprecedented attention to the sea. In 1966 the National Sea Grant College Act was passed. The United Nations convened the U.N. Law of the Sea Convention that would continue for years. Passage of the Marine Resources and Engineering Development Act created the National Council on Marine Resources and Engineering Development, with Vice President Hubert H. Humphrey as its chair. The same act called for a fifteen member Advisory Commission on Marine Science, Engineering, and Resources. The Advisory Commission was chaired by Julius Stratton and was henceforth known as the Stratton Commission. The rapid expansion of oceanography during the 1960's had been stimulated by the NASCO and TENOC reports of 1959. During the 1970s, oceanography would be shaped by the Stratton Commission report, "Our Nation and the Sea," released in 1969. The national posture regarding the oceans was changing rapidly. Changes were also taking place at Oregon State University.

In 1968 Wayne Burt resigned as Chairman of the Oceanography Department and assumed the role of OSU Associate Dean of Research for Oceanographic Programs. He would continue as Principal Investigator of the ONR contract. John V. Byrne was appointed Chairman of the Oceanography Department. During that same year, OSU received one of the first Sea Grant College awards and Professor Herbert Frolander was appointed coordinator of the Sea Grant program. Later, OSU would be officially named one of the first Sea Grant Colleges.

Expansion of the OSU Oceanography department continued. In 1968, eight new faculty were added; in 1969, five more; and in 1970 another five. Many of these faculty were transferring from other established oceanography programs. OSU's reputation was growing.

In the early 1970s, two major changes at a national level would affect the manner by which ocean research was conducted, and OSU oceanographers were not exempt from the impact of those changes. In March, 1968, President Richard Nixon proposed an "International Decade of Ocean Exploration (IOOE) for the 1970s." In 1969 IOOE was assigned to the National Science Foundation (NSF) and Feenan Jennings of ONR was appointed to head the program. IOOE would support major multi-disciplinary, multi-institutional programs. OSU oceanographers would participate and, in fact, would provide leadership for a number of the programs. All the IOOE research efforts would include researchers from a number of institutions throughout the United States and overseas. The Coastal Upwelling Experiment (CUE) conducted off the Oregon coast addressed the physical aspects of coastal upwelling. It included researchers from Florida State, Woods Hole, the University of Washington, the University of Chicago, and OSU. It led to the Coastal Upwelling Ecosystem Analysis (CUEA) project, which included investigators from ten U.S. institutions, including Oregon State, and from twelve other countries. OSU oceanographer

Lou Gordon participated in the Geochemical Ocean Sections (GEOSECS) program. The Climate Long-Range Investigations Mapping and Prediction (CLIMAP) program involved Ross Heath and Ted Moore. The Seabed Assessment Program included the Nazca Plate project off South America led by Vern Kulm and the Galapagos Rift study, during which hot vents and their unique faunal communities were first discovered by OSU scientists Jack Corliss, Jack Dymond, Lou Gordon, and Jerry van Andel. Big science had arrived at Oregon State. The decision to participate in the Seabed Assessment Program was not taken lightly, for it would mean the YAQUINA would be away for months at a time, precluding its use at home. Participation in IDOE was significant in elevating OSU's Oceanography program to a national level.

A second major change in the way oceanographic research was accomplished resulted from a change in the manner by which ships were operated. This change happened with the adoption of the University National Oceanography Laboratory System (UNOLS) in 1972. Prior to UNOLS ships were operated by each institution for its own scientists. Ship operations were block-funded by ONR and then jointly by ONR and NSF. With the rapid expansion of the research funded by ONR and NSF, the National Science Foundation declined to continue block-funding and funded only those ship operations which were in direct support of NSF-sponsored research grants. OSU has been fortunate in having outstanding marine superintendents who have insisted on the highest possible standards for the operation of Oregon State's vessels. Captain Richard Shafer (USN Ret.) was the first marine superintendent, from 1962 to 1964. He was succeeded by Captain Ellis Rittenhouse (USN Ret.), who served OSU from 1964 to 1976. These two men set the standards of excellence carried on by their successors: Cmdr. Richard Redmond (USN Ret.), Ken Palfrey, and Fred Jones. All contributed to the excellent reputation of OSU ship operations both before and after the adoption of UNOLS.

UNOLS resulted in the cooperative use of the nation's oceanographic fleet operated by academic institutions. The system made efficient use of vessels, standardized equipment, created uniform safety requirements, and often meant that OSU vessels would operate without an OSU researcher aboard, or that OSU oceanographers would conduct their research from another institution's ship. The UNOLS concept was adopted following almost two years of vigorous debate between the laboratory directors and leadership at NSF; it has operated successfully during the past twenty-eight years (Byrne and Dinsmore, 2000). John Byrne was one of the five laboratory directors who drafted the original proposal; he served as the first chair of the UNOLS committee that monitored the program. Both IDOE and UNOLS have fostered a cooperative approach to the conduct of ocean research in the United States. OSU oceanographers have certainly benefitted.

A Department Becomes a School

In 1967, President James H. Jensen appointed a committee of three well-respected OSU faculty to develop a statement of long-range goals for Oregon State. This group, which came to be called the Goals Commission, presented its report to the new OSU president, Robert MacVicar, on August 24, 1970. Among its recommendations, the Commission included the following: "The Commission recommends that the Department of Oceanography be formed into a School of Oceanography, administered by its own Academic Dean." Further, the Commission suggested that the activities of the School of Oceanography remain essentially those of the department, that it offer only graduate degrees, that it seek cooperative arrangements with other schools on campus, and that work in fisheries presently located in Oceanography either be transferred to the Department of Fisheries and Wildlife or that the oceanographic faculty involved have joint appointments with that department. In January 1971, Wayne Burt and John Byrne submitted a proposal to the Dean of Faculty calling for the creation of such a school. Following the usual academic debate and approval by the OSU Faculty Senate and by the State Board of Higher Education, the School of Oceanography became a reality in March, 1972, with Byrne as its first

dean. In 1983, the School of Oceanography was re-designated the College of Oceanography. In 1993 the Department of Atmospheric Sciences was transferred to Oceanography from the College of Science and the College was re-designated the College of Oceanic and Atmospheric Sciences (COAS). During its existence as a department and then as a college, Oceanography has had the leadership shown below:

Wayne V. Burt	1959–1968
John V. Byrne	1968–1976
George Keller	1976–1978
G. Ross Heath	1978–1984
Douglas Caldwell	1984–1993
Lawrence F. Small	1993–1994
G. Brent Dalrymple	1994–present [written 1/13/2000]

During its history as a department, school, and college, Oceanography demonstrated its leadership in innovation, on campus and nation-wide. In the mid-1960s, Dr. Roderick Mesecar formed the Technical Planning and Development Group. The group was funded primarily by ONR to develop specialized equipment for use by researchers. Starting with "surplus property" made available as a result of the ONR contract, Mesecar was able to develop a service group that gained a national reputation for creating innovative oceanographic research equipment. During the 1970s five patents were obtained for specialized equipment. Developed under the ONR contract, these patents were assigned to the Secretary of the Navy. Mesecar provided national leadership in establishing annual meetings of ocean technologists and also a newsletter, "Exposure," which was eventually selected by a United Nations agency for circulation to libraries in ninety-eight countries.

Other examples of innovation included special efforts in instruction. In 1966 Dr. Victor Neal was charged with developing cooperative programs between OSU and appropriate Latin American colleges and universities. The first students to enroll were Saul Alvarez-Borrego from Mexico and Jose Canon from Chile. They have both become oceanographic leaders in their respective countries. In the years that followed, students came from Argentina, Brazil, Colombia, Costa Rica, Ecuador, Honduras, Panama, Peru, Uruguay, and Venezuela. The "Latin American Program" has not only contributed to international education but has benefitted cooperative international research endeavors as well.

Another program enjoying considerable success has been OSU's Marine Resource Management (MRM) Program. Initiated in 1974, this master's degree program was designed to prepare people for careers in managing coastal and marine resources. The instructional program includes oceanography courses as well as courses in economics, engineering, fisheries, political science, business, and law. Students have come from throughout the U.S. as well as numerous foreign countries (e.g. Brazil, Canada, Egypt, Indonesia, Japan, Kenya). The program recently celebrated its 25th anniversary.

First established in 1972, COAS has continued to grow. New programs, new facilities, and new faculty have been added. Throughout its existence ONR has provided financial support which funded programs, equipment, and facilities and has had a cooperative hand in shaping many of the programs. The annual ONR site visit was always a major event of the year. ONR managers such as Feenan Jennings, Ned Ostenso, and Gordon Hamilton all helped in the evolution of Oregon State's Oceanography program.

In 1995, OSU's College of Oceanographic and Atmospheric Sciences oceanographic program was ranked fifth in the United States by the National Academy of Sciences' National Research Council. Today, the college includes 189 researchers and support staff, of which 69 are tenure track or senior research faculty, and there are around 100 graduate students. Over the years,

approximately 850 individuals have received OSU Oceanography or Marine Resource Management degrees. They have assumed leadership positions in federal agencies, international laboratories, and universities in the United States and around the world.

In 1998 the college operated on a budget of \$25.8 million, of which ONR provided 18%. COAS now offers graduate programs leading to the M.A., M.S., Ph.D. degrees in Atmospheric Sciences, Geophysics, and Oceanography. For the latter degrees, a specialization in biological, physical, chemical, or geological oceanography is available. Interdisciplinary degree programs that combine two or more COAS fields are also available, as is the Master's degree in Marine Resource Management (MRM).

Members of the COAS faculty excel in a number of important and related fields, with interdisciplinary research a particular strength. An important and unique part of the college is in the application of super-computing methodology to global environmental problems. In this area of research COAS is considered to be the world leader.

OSU's Oceanography program could not be where it is today without the early encouragement and funding by the Office of Naval Research. The partnership of ONR with Oregon State University during the past five decades has led to an expansion of our knowledge of this planet. Numerous men and women who have prepared themselves for careers related to ocean science have benefitted and all of society has benefitted as well.

The growth of Oceanography at Oregon State is a tribute to the vision of Wayne V. Burt (Figure 10) and to the cooperation of its partners, such as the Office of Naval Research. "There is a tide in the affairs of men which taken at the flood leads on to fortune." And so it has been for those who would understand the ocean. Oregon State oceanographers are proud to consider themselves part of that group.

Acknowledgements

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Appendix I

The Early Oceanographers at Oregon State

1959	Wayne Burt Herbert Frolander Bruce McAlister	1966	George Beardsley Richard Couch William Forster Don Heinrichs Steven Pond William Renfro David Tines
1960	June Pattullo William Percy John Byrne		
1961	Joe Berg Andrew Carey Herb Curl Jim McCauley Kilho Park Larry Small	1967	Michael Longuet-Higgins William Quinn
		1968	Doug Caldwell John Corliss William Elliott Ross Heath Ted Moore John Nath Dan Panshin Jerry Van Andel
1962	Peter Dehlinger Dick Morita Charles Osterberg Bob Smith		
1963	Gerry Fowler Ricardo Pytkowicz Peter Weyl	1969	Jack Dymond Lou Gordon Ha Song Pak
1964	Gunnar Bodvarsson Ken DeFeyes Jefferson Gonor LaVerne Kulm Rod Mesccar	1970	Paul Komar Charles Miller
1965	Norman Cutshall Joel Hedgpath Steve Neshyba Dale Pillsbury		

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