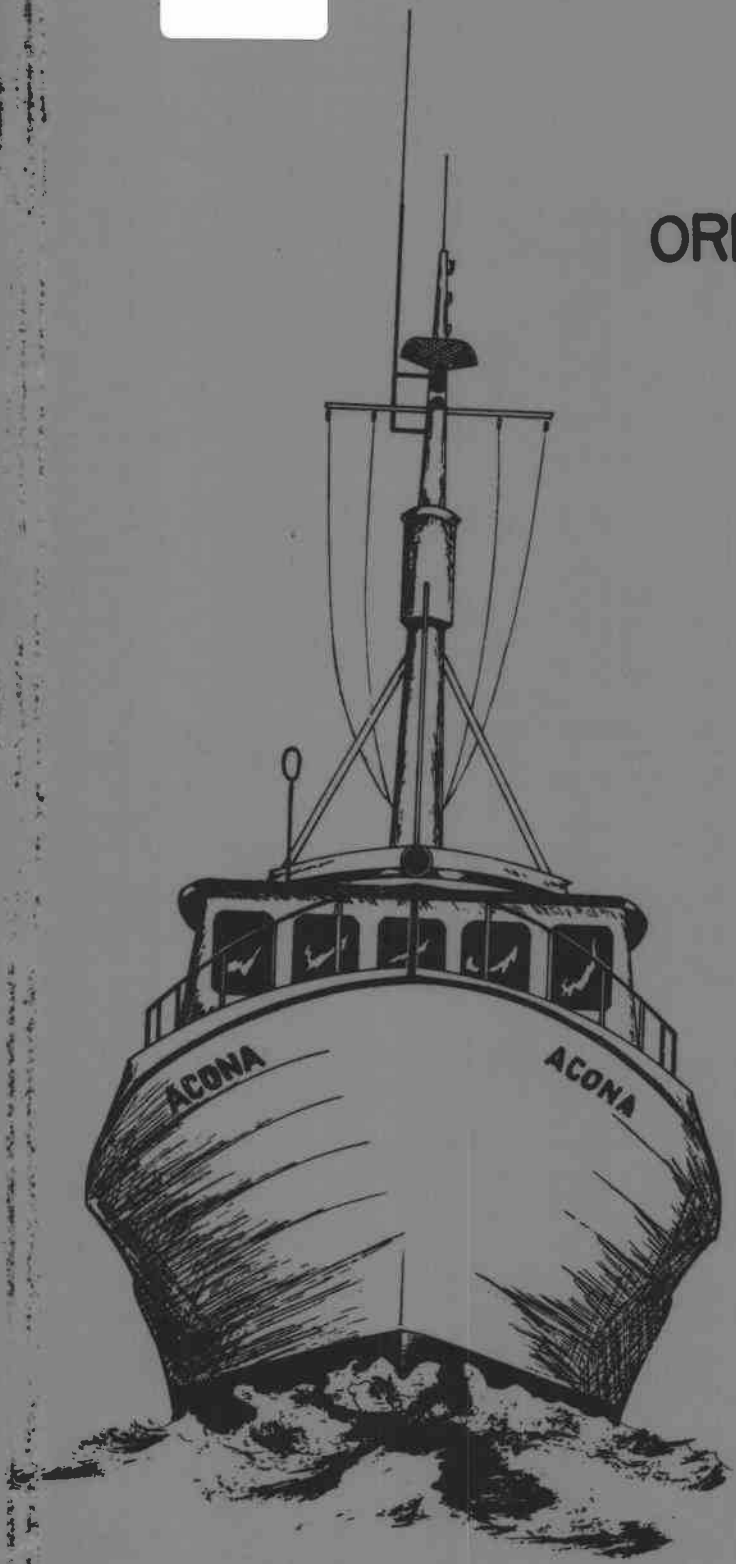
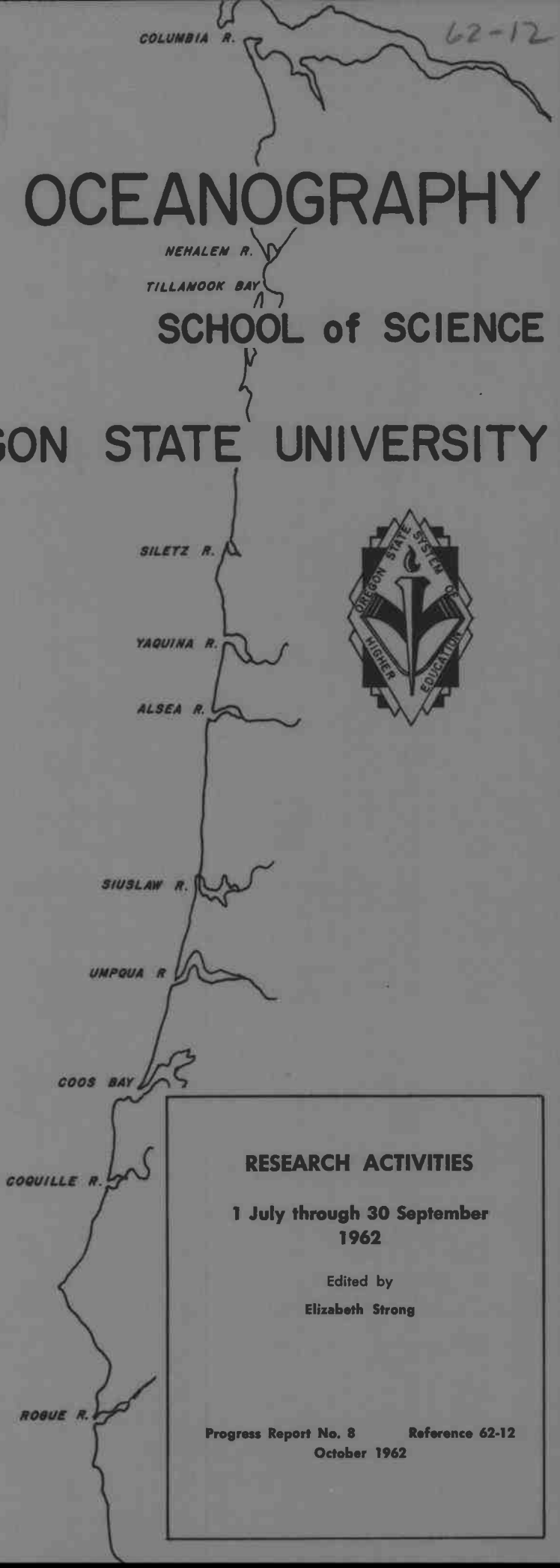
DEPARTMENT of OCEANOGRAPHY

SCHOOL of SCIENCE

OREGON STATE UNIVERSITY





RESEARCH ACTIVITIES

1 July through 30 September 1962

Edited by

Elizabeth Strong

Progress Report No. 8 **Reference 62-12**
October 1962

Department of Oceanography
School of Science
Oregon State University

Wayne V. Burt
Chairman

Progress Report No. 8

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Office of Naval Research
Contract Nonr 1286 (02)
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National Science Foundation
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October 1962

INTRODUCTION

This report summarizes the research conducted during the third quarter of the calendar year 1962 by the Department of Oceanography, Oregon State University, under contract Nonr 1286(02) Project NR 083-102 with the Office of Naval Research, grants G 19783, G 23103 and G 24353 with the National Science Foundation, contracts AT(45-1)-1726, AT(45-1)-1750 and AT(45-1)-1751 with the Atomic Energy Commission, and grant AF-AFOSR-62-376 with the Advanced Research Projects Agency.

PHYSICAL OCEANOGRAPHY

Hydrographic Survey of Oregon Coastal Waters - Wyatt, Kujala, Oliphant, Stanley

Two hydrographic cruises were made during the quarter. The cruise from 23 July to 4 August consisted of four lines of stations to 165 miles west of Astoria, Newport, Coos Bay and Brookings. The hydrographic cruise from 4 to 7 September consisted of one line of stations to 165 miles west of Newport.

Two drogue cruises were also made, one in July and one in September. During both cruises, current measurements were made at 10, 50, 150, 200 and 1000 meters depth

Summary of Samples Taken on Hydrographic and Drogue Cruises

Hydrographic Casts	71
BT Casts	115
Surface Temperature and Salinity Observations	144
Plankton Tows	60
Drift Bottles Released	672
Midwater Trawl Hauls	21
Anchor Dredge Hauls	7
Drogue Current Measurements	15

Data Processing with Computers - Borden

Computer programs for the IBM 1620 have been developed to process hydrographic data for interpolation of standard depths, computation of dynamic heights and correction of temperatures. Using these programs, data have been processed and put out in preliminary form for hydrographic cruises for June, July, August, October, December, 1961, and January, March and June, 1962.

Shore Station Observations - Oliphant

Shore station observations of temperature and salinity are being continued at 11 locations along the Oregon coast and at one location

in Northern California. Stations are visited each quarter.

Data from these stations have been compiled for the calendar year 1961 and are ready for publication as Data Report No. 8.

Temperature Variability Studies - Denner, Pattullo

Throughout most of the 1961-62 school year, coastal data were collected at Oceanlake and Newport, Oregon. The program was partially suspended during the summer but has been reinstated during September.

Oceanographic Fronts - Pattullo, Wyatt, Maughan

Five cruises distributed throughout the past year have provided clear-cut evidence of large vertical shear in current flow in the upper thousand meters. Currents were measured by parachute drogues. The shear zone is associated with a permanent layer of high stability which appears to have the characteristics of an oceanic front. Observations and analyses are continuing.

Coastal Temperatures Related to Wind Direction - Lane

Comparison of shore station temperature data with the direction of the offshore geostrophic wind during the summer revealed a startling day-by-day relationship. At present, it is felt that significant changes in the pattern of sea surface temperatures near shore during the summer can be predicted from a simple forecast of wind direction. A note on the data, including a brief discussion of the possible uses of such an analysis to the tuna fishing industry, is being prepared for publication.

Water Masses off the Oregon Coast - Rosenberg, Pattullo

The study was completed during the summer quarter and was submitted and accepted as Mr. Rosenberg's thesis for his Master of Science degree in Oceanography. A brief summary of the results was presented at the national meeting of the American Society of Limnology and Oceanography held here at Corvallis during August. (The paper was presented by Dr. Pattullo). The principal features of the results are being incorporated into a paper on the hydrography of Oregon coastal waters; this paper is being prepared by Bruce Wyatt and June Pattullo.

Hydrography of Oregon Coastal Waters - Wyatt, Pattullo

Brief comments on the results of regular hydrographic cruises have appeared in data reports issued as technical reports. See, for example, Physical Oceanographic Data Offshore from Newport and Astoria, Oregon, for July 1959 to June 1960, by Bruce Wyatt and Norman F. Kujala,

Oregon State University, Department of Oceanography, Data Report No. 5, Reference 61-3, 1961. Rapid accumulation of data has made possible the preparation of a discussion of the basic distribution of physical variables in the survey area, and their main seasonal variations. A paper on this material is in preparation.

Subsurface Current Measurements - Smith

The Department intends to initiate a series of subsurface current measurements with neutrally bouyant (Swallow) floats. At first the floats will be used in conjunction with the parachute drogues.

Twelve floats were purchased and the pingers modified. The electronic circuits for receiving the pinger signals are nearing completion. Preliminary tests of equipment have been made in the Willamette River. Mr. G. D. Ewing of the Electrical Engineering Department is interested in the instrumentation aspects of this work and has designed a solid-state tuned amplifier for use with the hydrophones.

GEOLOGICAL OCEANOGRAPHY

Geology of the Oregon Continental Terrace

Lithology - Byrne, Bushnell, Maloney

Analysis of the 129 bottom samples collected on the shelf and upper slope between 43°30'N and 45°00'N continues. A Franz isodynamic magnetic separator was used to separate glauconite from the sand-size fraction of all samples. The percentage of glauconite in the sand fractions ranged from zero to ninety-eight. The lowest amounts were found in the nearshore sands, the highest in the coarse sediments collected from submarine highs. Sand-size fractions of the silty and clayey samples, collected from the outer shelf and upper slope, contain from 20 to 30 per cent glauconite.

During the past quarter, the Leco inductance furnace and gasometric carbon analyzer were put into operation and techniques developed for analysis of total carbon and carbonate content. The clay-size samples were found to contain 2.5 per cent organic carbon, which represented the highest total content among the fine-grained sediment samples analyzed. The well-sorted sands were found to be essentially free from organic carbon. The carbonate content of the shelf samples is presently being analyzed.

Rock samples have been collected from 16 locations on the continental slope and from 39 locations on the continental shelf between latitudes 43°50'N and 44°44'N. Siltstones, shales and argillaceous limestones

constitute most of the samples dredged from the shelf; argillaceous sandstones and limestones have been dredged from the continental slope.

Ten gravity cores from the continental slope have been taken in water less than 400 fathoms deep. These generally consist of glauconitic sandy silt overlying dark gray clay.

Topography - Byrne, Maloney

Precision depth records from a series of sounding lines totaling more than 1200 miles across the continental slope and portions of the continental shelf between 43°50'N and 44°40'N are being used to develop a detailed chart of this area. Preliminary examination of the PDR traces reveals a number of deep-water terraces. These may be structural and may indicate that faulting has played an important part in the formation of the continental terrace in this area.

Astoria Canyon and Cone - Byrne, Kulm

A preliminary survey of the bathymetry and bottom materials in the vicinity of Astoria Canyon and Cone was made during August. Precision depth records were obtained from more than 600 miles of sounding lines both transverse and longitudinal to the canyon and cone. Preliminary examination of the traces across the canyon suggests that slumping has been more active on the north side than on the south side of the canyon.

Thirty-nine short gravity cores were taken along traverses across the canyon and adjacent continental shelf; two 20-foot piston cores were collected from Astoria Cone in approximately 1500 fathoms of water. The top sediment layer from 24 of the gravity cores is presently being analyzed for radionuclides from Columbia River outflow.

CHEMICAL OCEANOGRAPHY

Total Cation Equivalent in Sea Water - Park, Latimer

Sea water samples were passed through Dowex-50 cation exchange resin columns. The exchanged H^+ in the effluents was titrated against standard base. We found the total cation equivalent of 3.17 milli-equivalent/liter/chlorinity.

Radioanalyses of Marine Organisms - Osterberg, Larsen

All equipment items authorized under the Atomic Energy Commission contract have been received except the special 5" x 5" NaI (Tl) crystal. Calibration of the crystal will begin in October after delivery is received from Harshaw Chemical Company.

The spectrometer at Hanford Laboratories has been used to analyze approximately 75 samples of marine nekton for gamma emitters. The marine organisms analyzed were obtained from midwater trawl collections made by Dr. Pearcy. Detritus and phytoplankton samples were also analyzed, and special analyses were made of albacore livers and the snail Olivella.

Radionuclides found included zinc-65 and chromium-51, principally from the Columbia River, and the fission products zirconium-95, niobium-95, ruthenium-103, and cerium-141, principally from fallout. Isotopes detected from fallout have steadily diminished since the rise after the Russian tests of 1961; to date we have not analyzed any samples which show an increase from the 1962 tests.

Analyses of the albacore livers revealed the presence of cesium-137 and cobalt-60, isotopes not previously encountered in our study.

Mr. Ingvar Lauren Larsen, a recent graduate of Portland State College joined the staff in September as an Assistant in Oceanography.

Surface Area and Porosity of Marine Sediments - Stump

Surface area and pore size distribution data have been compiled for 20 sediment samples. Pore size distributions have been coded for computer calculation. Comparisons of surface area and glauconite content of these sediments have been made. Details of the data are given in a forthcoming technical report.

Total CO_2 Determination - Freund, Park

A conductometric total CO_2 analyzer is currently being built by the Analytical Chemistry Laboratory of this University. Apparatus will be tested at sea in the near future.

Shipboard Salinity Analyses - Park

During the cruise 6209-D of R/V ACONA, approximately 70 salinity analyses were carried out at sea using the Australian inductive salinometer. Identical samples were analyzed at shore a week after the cruise. Average difference between these two analyses were slightly less than 0.004 o/oo salinity.

A constant temperature bath on gimbals reduced the time required for the samples to reach room temperature. This made it possible to complete all the shipboard analyses within one hour after the Nansen bottle casts.

Monthly Variations of Chemical Conditions off the Oregon Coast - Park

Dissolved oxygen and inorganic phosphate concentrations were analyzed at sea for all the hydrographic stations occupied off the Oregon coast during the periods July 1961 to August 1962. Seasonal variations of these chemical parameters, along with salinity, are currently being plotted for further analysis.

Calcium Carbonate Solubility - Park

A study is under way to determine the solubility of calcium carbonate in sea water as a function of the carbonate ion concentration in a pH range of 7.4 to 10.2. The formation of pure aragonite as a function of pH has been investigated. Heavy precipitation of aragonite was observed near pH 7.5 at 25° C.

BIOLOGICAL OCEANOGRAPHY

Plankton Inventories - Frolander

Weekly samplings in Yaquina Bay from July through September were made on 13 sampling days during which the following data were collected at four stations:

Physical Data

Surface and bottom samples were taken at each station; a total of 50 measurements were made each of temperature, salinity and dissolved oxygen.

Biological Data

Quantitative net tows

# 6 mesh tows	48
#12 mesh tows	52

Qualitative half-meter net tows

# 6 mesh tows	22

The volumetric analyses of zooplankton have been completed for the #6 and #12 mesh samples taken from 18 January to 2 February 1962. Zooplankton quantitative counts were made on samples from three #6 mesh hauls taken 24 to 31 August 1961.

Upwelling and Trophic Levels - Laurs, Pearcy

During the two hydrographic cruises this summer (June and August) it was found possible to add a line of stations off Brookings, Oregon, where upwelling is most intense. In addition to the regular hydrographic observations, special observations were made to study possible relationships between physical properties and trophic levels. Tows were made with the quarter-inch mesh Isaacs-Kidd midwater trawl and the one-meter net with "0" mesh, and millipore filtrations for phytoplankton were made.

All mesopelagic fishes collected have been identified and their length measured; macroplankton and nekton have been separated; the macroplankton samples have been split; all phytoplankton filtrations have been analyzed.* Examination of the temperature data collected at the same time is underway.

Oceanic Nekton Studies - Pearcy, Laurs

The program of sampling oceanic nekton over the continental slope off Oregon has been maintained for a full year. Sixty-one collections with the Isaacs-Kidd midwater trawl were taken this quarter.

Deep-water collections were continued 50 miles offshore. Of special interest was the capture of a deep-sea angler, Oneirodes, and a Vampyroteuthis infernalis.

Macroplankton Studies - Hebard, Renshaw, Hubbard, Pearcy

Ecological studies of the oceanic macroplankton populations are being continued. Samples from over 200 midwater trawl collections are currently being analyzed. Identifications have been completed for the siphonophores, medusae, chaetognaths, and salps. About half the samples have been analyzed for euphausiids. Two more large deep-sea ostracods, Gigantocypris sp., were collected this summer and are being compared with previously described species.

A new sampling program was initiated to obtain quantitative samples of the macroplankton at various depths to 1000 meters. Equipment, consisting of one-meter plankton nets with flow meters and opening-closing devices, was tested aboard the ACONA.

Epibenthic Fishes - Day, Pearcy

Fish identifications and data tabulations were made during this quarter for fishes collected by otter trawling on the continental

* See section under Phytoplankton Ecology and Physiology.

slope and shelf. Seventy species of fish in 24 families have been positively identified. One specimen of a rare skate has been identified by Dr. Hubbs and Dr. Ishiyama as Bathyraja spinosissma.

Bottom sediment samples were taken from 100 to 1000 fathoms off Waldport.

Enzyme-Respiration Studies of Oceanic Animals - Curl, Pearcy, Karinen

A preliminary survey of the respiratory potential of various fishes and some planktonic invertebrates was conducted. Specimens were obtained largely through the use of an Isaacs-Kidd midwater trawl on regular oceanic nekton cruises. Both day and night samples were taken to compare respiratory potential at depth and at or near the surface.

The succinic dehydrogenase activity was measured for several individuals of vertically migrating mesopelagic fishes. Enzyme activity of some pelagic crustacea and cephalopods was studied. The Winkler method for oxygen analyses was used to conduct complementary oxygen-respiration studies. Partial analysis of the data suggests a significant difference in respiratory potential between genera of pelagic fishes. Analyses will be continued. Methods for the determination of succinic dehydrogenase activity in marine organisms are being modified to increase precision.

Phytoplankton Ecology and Physiology - Curl, Small

A study has been initiated on the possible relationship between phytoplankton populations and areas of upwelling. Pigment samples and light measurements were taken on the Newport, Coos Bay, and Brookings line. Pigment samples were analyzed. Samples for species composition were taken on the Newport line.

A 24-hour in situ station off Newport was occupied twice. Samples were analyzed for C^{14}, "light-dark" bottle oxygen evolution, pigment, and species composition. Light measurements were also taken.

Programs have been written for the 1620 electronic computer: 1) to compute pigment values from Richards and Thompson equations, 2) to estimate gross productivity from chlorophyll and light data, and 3) to estimate total daily productivity in the water column.

Grazing and Energy Transfer in Lower Trophic Levels - Small, Curl

A gamma-ray counting system, including well-type crystal, shielding and radiation analyzer, has been purchased and roughly calibrated. This counter will be used to measure radioactivity in copepods which have grazed on phytoplankton cultured in the aquastat.

Benthic Fauna - McCauley

Six otter trawl collections and 26 biological dredge hauls this quarter have brought the total to 54 otter trawl samples and 56 biological

dredge samples. Fifty-eight of these samples have been sorted and yielded 1170 species lots of invertebrates. Of these, 411 lots representing 154 separate species have been identified. The last 17 biological dredge samples from rocky areas on Stonewall and Heceta Banks appear to contain a more varied array of invertebrates than samples from less rocky areas.

Benthic Ecology - Carey

During this quarter a quantitative sampling program was started. Samples are being collected at 25-meter depth intervals to 200 meters, at 200-meter intervals to 2800 meters, and on the abyssal plain to 165 miles offshore at 20-mile intervals.

Eleven stations have been occupied on the Newport line with a total of 13 quantitative samples obtained. A deep-sea anchor dredge has been used in various sediment types out to depths of 2800 meters. At sea, sediments are washed through a 0.3 mm aperture sieve and animals preserved. Samples are being sorted in the laboratory and the animals separated from the sediment and debris.

Marine Microbiology - Morita

The last three months have been devoted to setting up the marine microbiology laboratory. Apparatus for the program in marine psycrophile still remains to be delivered.

GEOPHYSICS

Theoretical and Field Studies of Seismic Waves - Berg, Rinehart, Papageorge, Redo, Trembly, Laun, Chiburis, Mecham

All major equipment for the laboratory work has been delivered except the source unit. The laboratory models have been constructed. A theoretical source model has been run on the computer to determine amplitudes of seismic waves as a function of charge size, distance and medium. These data are currently being analyzed.

Seismic Work at Sea - Whitcomb, Rinehart, Berg

Shallow water seismic reflection equipment is currently being installed on a motor launch. Plans for initial trials of the equipment are complete, and the trials will begin early in October.

Standard Seismological Station - Berg, Trembly, Chiburis, Mecham

The "world-wide standard" equipment was installed and the station activated in July. Continuous seismic traces have been recorded, and efforts are being made to improve the reliability of the records. A deeper sod cover is being placed on the vault to try to increase the temperature stability.

Coastal Gravity Range - Rinehart, Berg

The LaCoste-Romberg underwater gravity meter was used to make gravity observations off the central Oregon coast from Heceta Head to Cape Foulweather at 148 stations, with 31 repeat stations. Comparison of the repeat stations indicate that the data are reproducible to within $\pm$ 0.7 mgal. Differences are believed to be due to lack of precision in navigation and depth control. Data are in the final stages of reduction, and a report will be completed during the next quarter.

This work was done with the cooperation of the U. S. Coast Guard by using the Coast Guard Cutter MODOC.

Gravity Transition from Deep Ocean to Continent - Rinehart, Bales, Berg

A report of the preliminary analysis of gravity data for a line of stations extending east and west of Coos Bay was given at the AIBS meetings during August. Additional data has been requested for a similar profile along the Oregon-Washington boundary.

Plans are being made for additional land gravity work in the state to complete gaps in the existing data for the long profiles.

Sea Gravity Measurements - Berg

On August 13 Captain Kellogg (ONR, San Francisco Branch) and Commander Branson (U. S. Coast Guard) met with Dr. Burt and Dr. Berg on the Corvallis campus to discuss the possibility of using a Coast Guard vessel during the spring and summer of 1963 to conduct gravity studies at sea. Negotiations are in progress to use the USCGC YACONA.

Data Analysis - Rinehart, Odegard, Berg

New methods for analyzing gravity data are being investigated. Computer programs are being prepared.

Magnetic and Electrical Study - Berg

Plans are pending for the loan of a magnetometer.

Thermal Studies - Mecham, Berg

A complete bibliography of thermal studies has been compiled. Plans are under way, and equipment for the studies will be ordered within the next few weeks.

FACILITIES

Research Vessel ACONA

The ACONA was at sea a total of 59 days during the quarter. Cruises taken are as follows:

Research Work	Dates	Nautical Miles
Dredging	2 July	80
Drogue and Dredge	5 - 8 July	170
Geology Coring	9 July	60
Midwater Trawl - Phytoplankton	10 - 13 July	390
Plankton	17 - 19 July	100
Hydrographic	23 July - 4 August	1170
Midwater Trawl	8 - 10 August	320
Dredge - Midwater Trawl	13 - 15 August	110
Phytoplankton	19 August	50
Geology Astoria Canyon	20 - 24 August	350
Geology	1 - 4 September	450
Hydrographic	4 - 7 September	350
Geology	11 - 13 September	150
Midwater Trawl - Plankton	17 - 20 September	310
Drogues - Plankton	23 - 27 September	200
Total		4260

Arrangements were made for special demonstrations aboard the ACONA. These included a one-day cruise for the NSF Summer Science Training Program for high school science students and two-hour trips for a special group from the Oregon legislature and a committee of the Rural Redevelopment Administration. In addition, an open house was held at Newport during the AIBS meetings in August.

STAFF

Richard W. Shafer, Captain, USN (Retired), has joined the staff with the rank of Associate Professor. Captain Shafer is not new to Oregon State, however, for he completed his last two years of duty as Commanding Officer of the Navy Reserve Officers Training Corps unit on campus.

Captain Shafer received his degree from the U. S. Naval Academy, Annapolis. Much of his 22 years as a commissioned officer was in the Submarine Service, where he commanded an attack submarine and, at a later time, a division of four submarines. His deep interest in and practical knowledge of ships and the sea are of great value to the Department.

Graduate work, principally in the field of political science and international relations, has been pursued by Captain Shafer at the University of Hawaii, at Oregon State University, and at the University of Oregon. His work with the Department will be for the most part administrative in nature.

Robert L. Smith, M.S., has joined the staff as an Instructor in Physical Oceanography. Mr. Smith received his B.A. from Reed College, and his M.A. in physics from the University of Oregon. He has completed all requirements except the thesis for the Ph.D. in oceanography here at Oregon State; he is currently working on his thesis research.

Mr. Smith was an exceptionally able student and has a strong background in mathematics and physics. He has held teaching assistantships both here and at the University of Oregon, and has worked as a physicist and as an oceanographer at the U. S. Naval Ordinance Test Station, China Lake, California. His present research interests are in the measurement of deep currents and internal waves; he will also participate in instruction by teaching a course in Underwater Sound.

AIBS MEETINGS

The American Institute of Biological Sciences held its annual meeting at Oregon State University in Corvallis 26 - 31 August 1962. Dr. June Pattullo served as Local Chairman for the 25th Annual Meeting of the American Society of Limnology and Oceanography, one of the affiliated organizations meeting with the AIBS.

Oceanographic research vessels docked at Newport during the meetings were R/V ACONA, CNAV OSHAWA and USS MARYSVILLE. Bus trips to the ships were available, and many members and guests took advantage of the open house demonstrations.

Papers presented at the meetings by Department staff:

American Society of Limnology and Oceanography Section

Carey, Andrew G. Jr. The ecology of two benthic animal populations in Long Island Sound.

Hill, Eddie P. and Richard Y. Morita. Hydrostatic pressure effects on the growth and mitochondria of Allomyces macrogynus.

Kulm, LaVerne D. Sedimentation in Yaquina Bay, Oregon.

Lane, Robert K. A model of seawater structure near the west coast of Vancouver Island, B. C.

Latimer, Louis W., Kilho Park, and Donald W. Hood. Use of cation exchange resin in the analysis of sea water.

Maloney, Neil J. Foraminifera of Yaquina Bay, Oregon.

Pearcy, William G. Distribution of bathypelagic fishes over the continental slope off Oregon.

Rinehart, W. and J. Berg. Crustal structure in and off the coast of Oregon from gravity data.

Rosenberg, Donald H. and June G. Pattullo. Water masses off the Oregon Coast.

Wyatt, Bruce, Kilho Park and June G. Pattullo. Chemical properties as indicators of upwelling along Oregon Coast.

National Association of Biology Teachers Section

Small, Lawrence F. Research and teaching in biological oceanography. (To appear in print in the American Biology Teacher, official journal of NABT.)

Papers presented by person whose name is underlined.

PUBLICATIONS AND PAPERS

Published:

Berg, Joseph W. and Charles D. Baker, 1962. Oregon earthquakes 1841-1958. The Ore-Bin.

Byrne, John V., 1962. Here's a look at offshore Oregon. The Oil and Gas J., 60:116-119. (This article was originally published as Geomorphology of the continental terrace off the central coast of Oregon, The Ore-Bin, 24:65-74.)

Curl, H. C. Jr., 1962. The effect of divalent sulfur and vitamin B_{12} in controlling the distribution of Skeletonema costatum. Limnol. and Oceanogr., 7:422-424.

Frolander, Herbert F., 1962. Quantitative estimations of temporal variations of zooplankton off the coast of Washington and British Columbia. J. Fish. Res. Bd. Canada, 19(4):657-675.

McCauley, James E., 1962. Ellobiopsidae of the Pacific. Science, 137(3533):867-868.

Morita, Richard Y. and Roger D. Haight, 1962. Malic dehydrogenase activity at 101°C under hydrostatic pressure. J. Bacteriol., 83: 1341-1346.

Park, Kilho, June G. Pattullo and Bruce Wyatt, 1962. Chemical properties as indicators of upwelling along the Oregon coast. Limnol. and Oceanogr., 7:435-437.

Wyatt, Bruce and Norman F. Kujala, 1962. Hydrographic data from Oregon coastal waters, June 1960 through May 1961, Data Report No. 7, Department of Oceanography, Oregon State University, Ref. 62-6.

Submitted for Publication:

Berg, Joseph W. and Charles D. Baker, Oregon earthquakes 1841-1958. Bul. Seis. Soc. Amer.

Byrne, John V., Bathymetry of Crater Lake, Oregon. The Ore-Bin.

Lane, Robert K., A model of seawater structure near the west coast of Vancouver Island, British Columbia. J. Fish. Res. Bd. Canada.

Park, Kilho, W. T. Williams, J. M. Prescott, and D. W. Hood, Amino acids in deep-sea water. Science (Submitted on July 30, 1962).

Pearcy, W. G., and Voss, G. L. A new species of gonatid squid from the northeastern Pacific. Proc. Biol. Soc., Washington