1964

Annual Report 1964 United States Naval Postgraduate School Monterey, California

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Annual Report 1964

United States Naval Postgraduate School Monterey, California

From the desk of the Superintendent

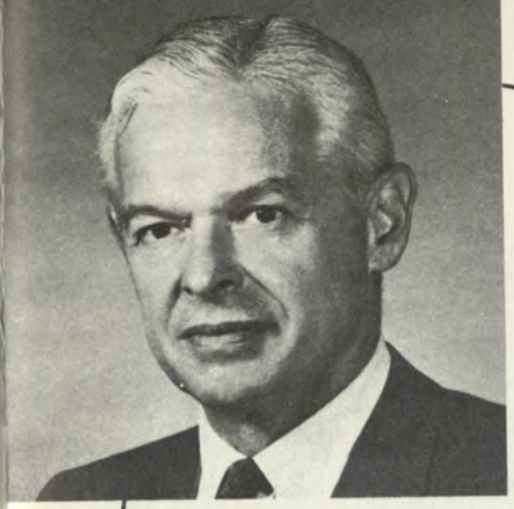
It is with pleasure that I forward this annual report on the accomplishments of the Naval Postgraduate School for 1964.

As a newcomer to the present school I have been greatly impressed by the zeal and sense of commitment of all hands — faculty, postgraduate officers and staff. The professionalism of the Navy is greatly strengthened at this school.

1964 was an important year in the development of the Naval Postgraduate School. This report briefly describes events and progress during that period.

E. J. O'Donnell

EDWARD J. O'DONNELL
Rear Admiral, U. S. Navy



THE SECRETARY OF THE NAVY
WASHINGTON

The Naval Postgraduate School is charged specifically with the mission of conducting advanced education of naval officers. The need for a major increase in the number of officers with advanced education is manifested in the requirement that they be effective in the complex environment of our ships, aircraft and equipment, as well as in the politico-military arena.

An officer's performance potential can invariably be enhanced by an acquired ability to cope with the rapid advances in technology and management in addition to the omnipresent area of international relations. Performance in all duty assignments, of course, will continue to be the hallmark of success.

I fully support this fine institution which is a major contributor toward improving the educational base of the officer corps. Our future leaders, enlightened by graduate-level education, provide assurance that our Navy will continue to be second to none.

Paul H. Nitze

PAUL H. NITZE

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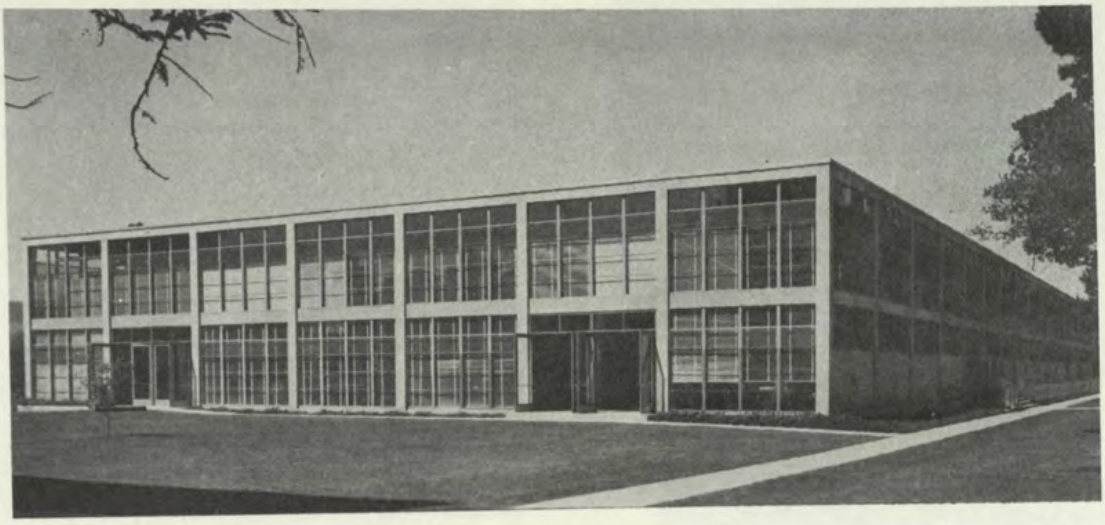


SECNAV Board Review

At the invitation of the Secretary of the Navy, the Survey Board on Graduate Education for Naval Officers convened at the Naval Postgraduate School last summer.

Five civilian scientists and educators, four senior naval officers, and two members of Congress, with Dean Joseph M. Pettit of Stanford University serving as chairman, comprised the board.

They reviewed morale and discipline, curriculum, instruction, physical equipment, academic methods, fiscal operations, and other aspects of the Navy Postgraduate Educational Program.

Twenty-eight specific recommendations were included in their final report. Action is underway on virtually all of these recommendations.

SCAN Committees

An extensive curricular review was concluded in 1964.

At the Superintendent's invitation, eight School Curriculum Advisory and Needs (SCAN) Committees were formed to evaluate the School's curricular programs. Special attention was given to program objectives and their execution in relation to the peculiar needs of the Navy.

Among the SCAN recommendations which have been accepted and implemented are:

1) A lighter first term load which permits easier student adjustments to academic pressures,

2) An augmented academic counseling program for students,

3) Improved liaison with sponsoring Navy Department Bureaus and Offices, and

4) Increased orientation and participation in naval operations, organization and requirements for faculty members.

A significant recommendation in the curricular area called for greater emphasis in probability and statistics, computers, systems analysis, and quantitative methods in a number of programs.

These recommendations, with numerous others, are now in effect. Efforts to give Postgraduate School students a dynamic and progressive educational experience are continuing.

Astro-Aeronautical Laboratories

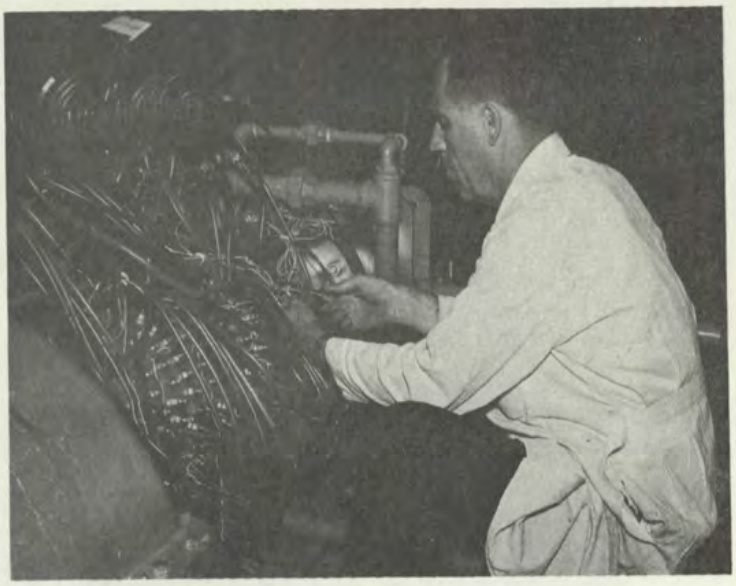
The equipping and staffing of the Astro-Aeronautical Propulsion Laboratories neared completion in 1964 with partial occupancy of the Cascade, Rocket and Jet Engine Laboratories. The Compressor Laboratory will be completed in the near future.

The Subsonic Aerodynamics Laboratory consists of a low turbulence subsonic wind tunnel with a 32x45 inch test section and a speed range up to 185 knots. Force and moment beam balances measure aerodynamic reactions. A small classroom wind tunnel 7x10 inches in cross-section and a small two-dimensional smoke tunnel are also in use. Equipment for operating powered propeller aircraft models is available. Experiments in boundary layers, pressure distribution, component aerodynamics, performance, and dynamics can be performed.

The Structural Test Laboratory contains testing machines with varying capacities up to 600,000 pounds for demonstrations and analysis of relatively small structures. Large aircraft components such as a P2 wing, and F8B wing, and an A3 tail are accommodated on the loading floor of the laboratory where static and vibration tests are carried out. Several electromagnetic shakers are used for vibration testing of turbomachine components and other aeronautical structure components.

The facilities of the Compressibility Laboratory include a transonic wind tunnel having a 4"x16" test section and operating in the Mach number range from 0.4 to 1.4; a supersonic wind tunnel having a 4"x4" test section and a vertical free-jet of 1"x1" cross-section both operating in the Mach number range from 1.4 to 4; and a 4"x16" shock tube. Instruments associated with these facilities include a 9" and a 6" Mach-Zehnder interferometer and a 9" and two 5" Schlieren systems for flow observations.

The Rocket and Jet Engine Laboratory facilities provide for full scale operation of current and future Naval aircraft jet engines, and small rocket engines of 2,000 pounds thrust or less. Two separate and complete test cells are provided in one building for the operation of a J57 engine with after-burner and a T56 turboprop engine. A separate engine maintenance shop is located adjacent to these test cells. A separately located external

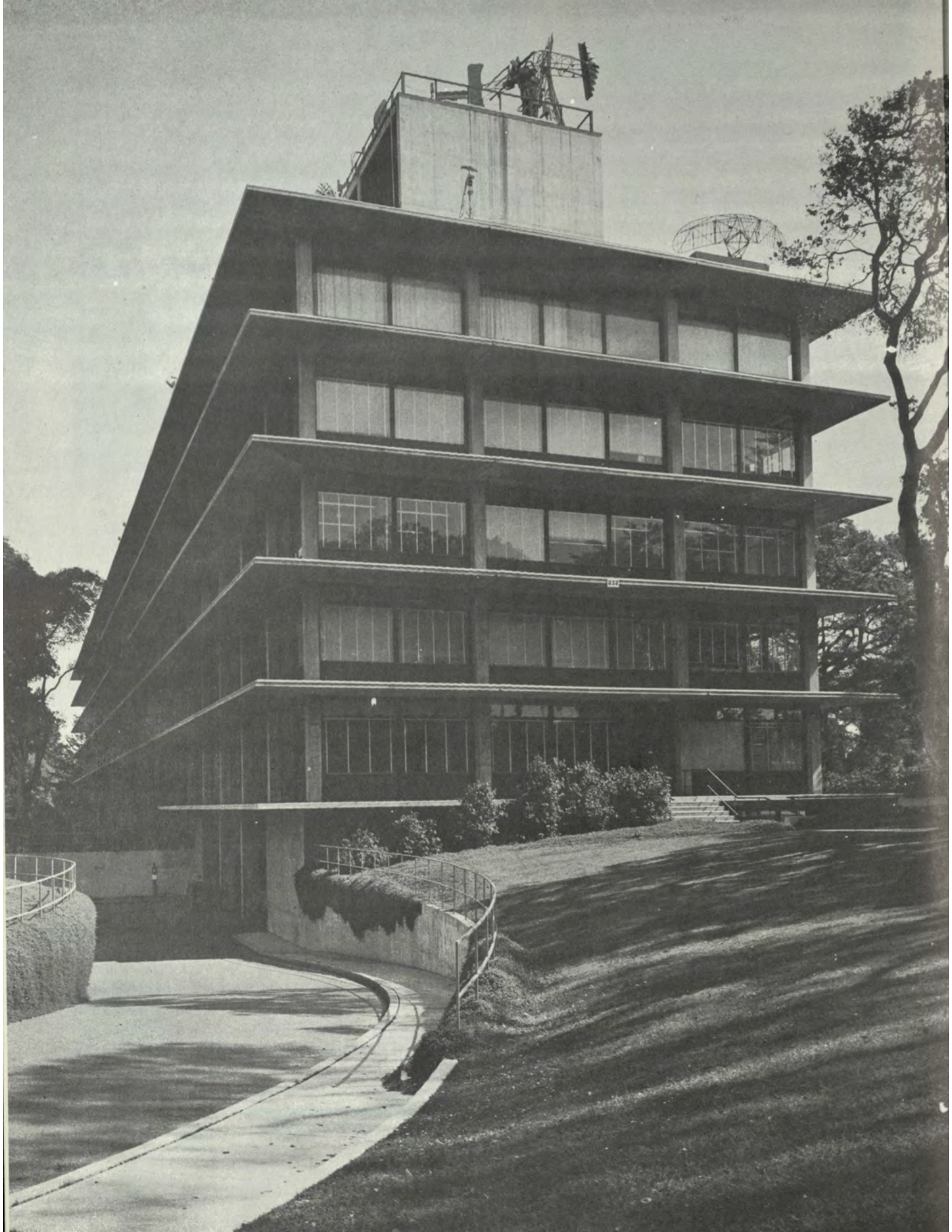


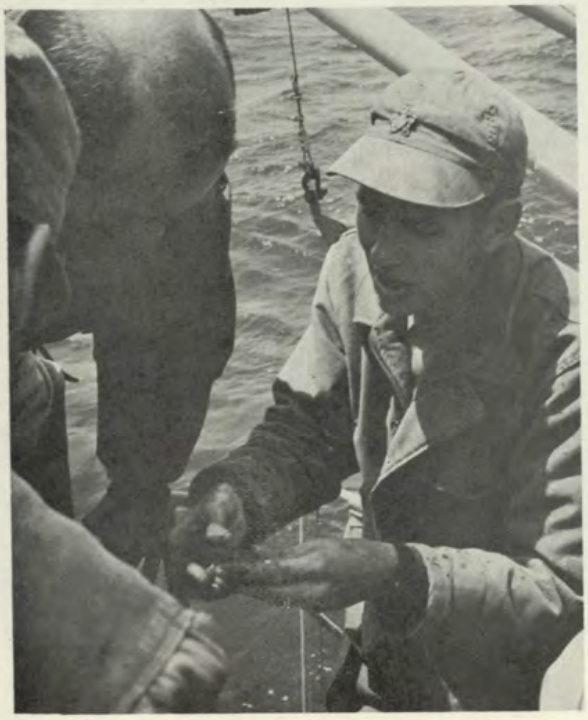
pad and control house are also in use for the operation of a J34 jet engine and a Boeing XT-50 turboprop engine. Rocket engine tests can be run from a common control room in three test cells housed in the rocket engines building, which also contains a propellant chemistry laboratory. The three test cells provide for operation of solid rocket engines, liquid rocket engines, and hybrid engines.

The advanced facilities of the Cascade and Turbomachinery Laboratories are distributed in three buildings. One provides low speed tests with rectilinear, cylindrical, and rotating cascades of large dimensions. The source of air is a 700 HP fan, used either to draw or to blow air through the test items. Delivering about 100,000 cfm of air at a pressure difference of about 40 inches of water the fan can be run at speeds of 50% and 75% of design speed. This source can also be used to perform model tests with flow channels, inlet and discharge casing, scrolls, and diffusors. The special rectilinear cascade test rig is equipped with semi-automatic instrumentation; data are obtained with an electric logging system for later reduction on digital computers.

A second building houses a centrifugal compressor test rig, instrumented for conventional performance measurements and for special investigations of three-dimensional flows about the stationary and the rotating vanes. In the third building high speed tests are run in three cells and monitored from a central control room. Instrumented for interstage measurements, a 1250 HP variable speed axial-flow compressor produces high pressure air either for testing turbines or driving test compressors, pumps, and other items. The compressor is capable of delivering 10,000 cfm of air at sea-level conditions. The design pressure ratio is three and speed control is possible between 40% and 100% of design speed by means of a hydraulic drive. A surge-suppressing device makes it possible to operate test items with varying flow rates. Data acquisition is carried out with an electronic logging system as well as with conventional instrumentation.

Adjacent to this building is a hotspin test unit, where disks and propellors can be rotated at speeds up to 50,000 rpm. Heating and cooling elements make it possible to impose radial temperature gradients. Instrumentation is provided to conduct stress work with strain gauges up to 27,000 rpm at maximum temperatures of 1800°F.





Environmental Sciences

The Environmental Sciences program is concerned with the atmosphere, the oceans, and their interactions in order to educate and train graduate meteorologists and oceanographers for the Navy.

During 1964 the School introduced Satellite Meteorology in the curriculum and installed the first phase of ground station equipment for the reception of Automatic Picture Transmissions (APT) from APT equipped satellites. Final installation will be completed during August 1965.

Continuing emphasis on the utilization and application of high speed digital computers in meteorological and oceanographical numerical analysis, prognosis, climatology and communications has made this one of the most dynamic and rapidly expanding environmental science programs in the nation.

The Oceanography program was augmented by the assignment of an oceanographic vessel to the school thereby allowing students and faculty opportunities for underway observation and research.

In addition to the normal audio-visual aids, a high precision closed circuit television system linking four Meteorology/Oceanography laboratories and a classroom was installed.

Future plans call for construction of a new Environmental Sciences building. Its completion will place the Meteorology/Oceanography facilities of the Postgraduate School among the world's finest.

"There is work of great importance going on which contributes markedly to the scientific and technological store of our Country and has given rich opportunity for postgraduate officers to participate in original work."

REAR ADMIRAL EDWARD J. O'DONNELL
Superintendent, Naval Postgraduate School

Engineering Electronics and Communications Engineering

Several major steps in the continuing progress of the Electronics and Communications Engineering Curricula were realized in 1964.

A masters program in Communications Engineering was initiated with the Fall 1963 input. First graduates from this program are expected in 1966.

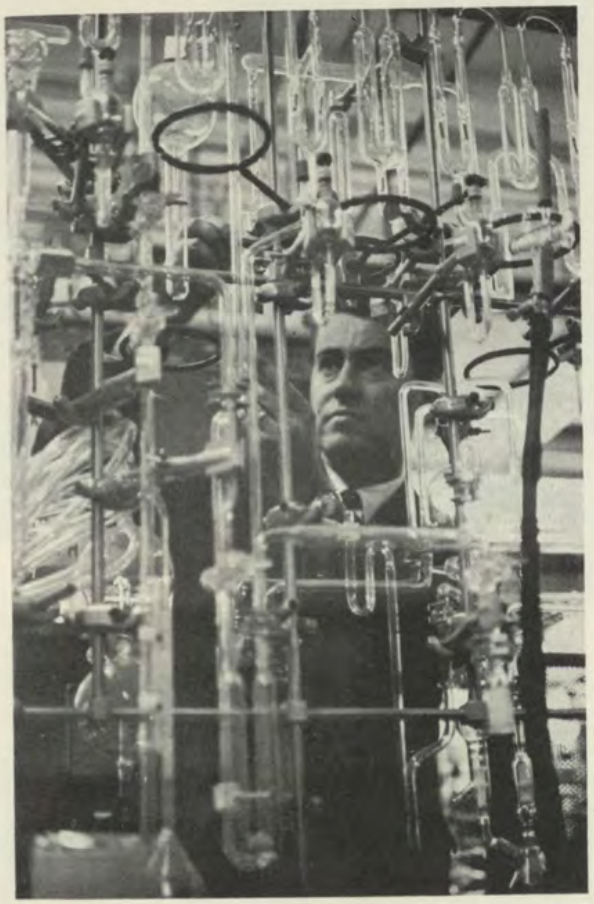
The basic six term course, taken by both electronics and communications engineering students was subject to major modifications and updating.

These changes, with others effective in 1965 will provide greater continuity of subject material for students as they eventually branch out into more specific areas of electronics and communications study.

Another important step in 1964 was the acceleration of programs for students with previous education which could be validated and made part of their course requirements at the Postgraduate School. In most cases curricula have been accelerated as much as two terms.

Physical facilities available to these curricula will be enhanced by the completion of a metrology laboratory within the Electrical Engineering Department. It is anticipated that this laboratory, started in 1964, will be part of the Navy's Calibration Program.

To complement these changes in program and improvements in facilities this program noted a 16% increase in students over 1963.



Ordnance Engineering

This fifty-five year old program continued its growth and development this year in response to present and future challenges of our Nation's ever improving weapons systems.

A modified Weapons Systems Engineering (General) Curriculum was implemented during 1964. New courses in Probability and Statistics and Electrical Engineering including feed-back networks and control system components were added. Several others were deleted to make room for these additions, which update the curriculum.

Ordnance Engineering's two principal programs — Weapons Systems Engineering and Nuclear Engineering (Effects) — lead to a wide assortment of advanced courses at the master and doctorate levels.

Officer students in the Advanced Weapons Systems Engineering program earn a Master of Science Degree in Electronics, Material Science, Chemistry, or Physics.

The Nuclear Engineering (Effects) Curriculum, sponsored by the Defense Atomic Support Agency, leads to a Master of Science degree in Physics.

Additionally, several small programs provide opportunities beyond the masters level for highly qualified students. Nine officers are currently enrolled in doctorate programs.

Ordnance Engineering shares with other curricula a recognized need for an expansion of anti-submarine warfare oriented courses. This year a group of Postgraduate School physicists specializing in underwater acoustics initiated and developed a proposed Underwater Physics Systems Curriculum.

The planned integration in 1965 of management courses in the Weapons Curricula will aid graduates in their preparation for future technical-managerial positions.

Aeronautical Engineering

1964 was a notable year and began with one of our three-year students being selected for the Astronaut program.

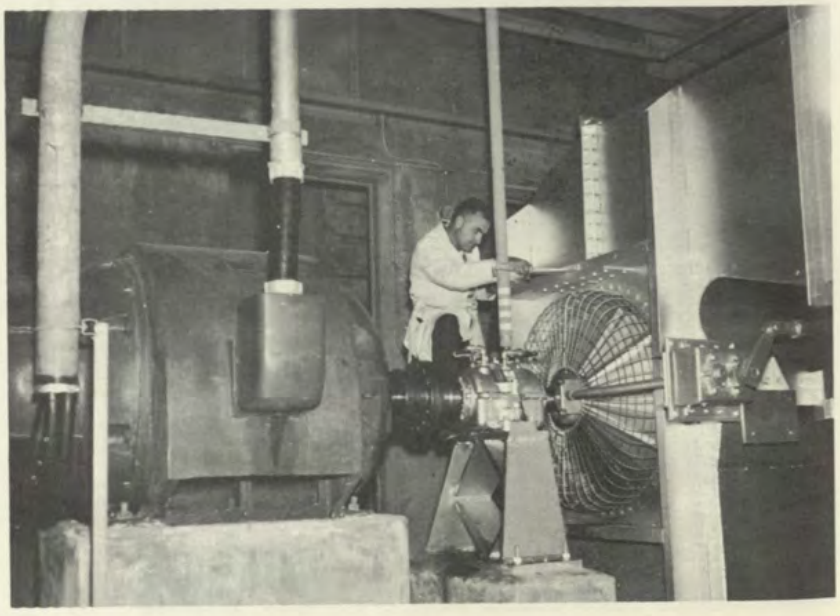
At the close of the year construction of our new Astro-Aeronautical Propulsion Laboratories neared completion. Several facilities, including the Cascade, Jet Engine and Rocket Motor Laboratories with their associated Engine Maintenance Shops have already been accepted for partial occupancy. A detailed report on these facilities appears on pages four and five of this report.

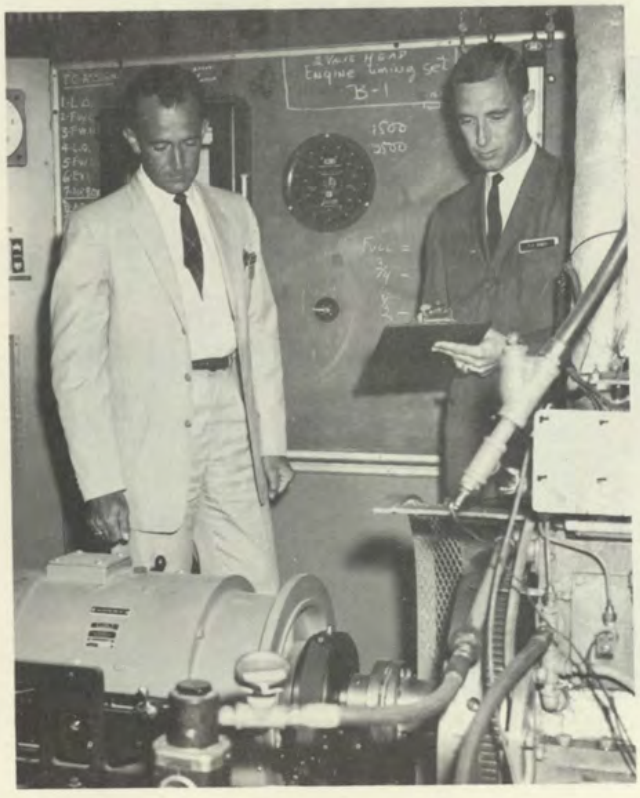
In another development, the School Curriculum Advisory and Needs (SCAN) Committee reviewed the Aeronautical Engineering Programs. These programs are based on flight vehicles including aircraft, missiles and satellites. The Naval Postgraduate School continues to "tailor" these curricula to meet the requirements of our spage-age Navy.

A three year course leading to the degree of Aeronautical Engineer will soon be offered. Students in this program will be able to major in any of the following disciplines: Aerodynamics; Aerophysics; Rocket Propulsion; Turbo Machinery; Structures; and Avionics.

"The U. S. Naval Postgraduate School, Monterey, California, will continue to provide the majority of the graduate level education required for the technical and management training needed. Officers selected for courses at the school may anticipate a 'tough' assignment."

VICE ADMIRAL B. J. SEMMES, JR.
Chief of Naval Personnel





Naval Engineering

Rapid progress in science and engineering technology gives "Seapower" new definition and growing importance to our Nation's security.

Polaris submarines, guided missile destroyers, the nuclear powered attack aircraft carrier, cruiser and destroyers, plus modern ships of every description are the basic instruments of United States seapower and demand ship engineering of the highest quality.

The Naval Engineering Curricula provides select naval officers with advanced education in mechanical and electrical engineering to meet the technical and administrative needs in related shipboard areas.

A comprehensive review of course content was conducted this year by the Curricular Officer and his Academic Associate. Their recommendations for updating several areas have been approved and are presently being incorporated.

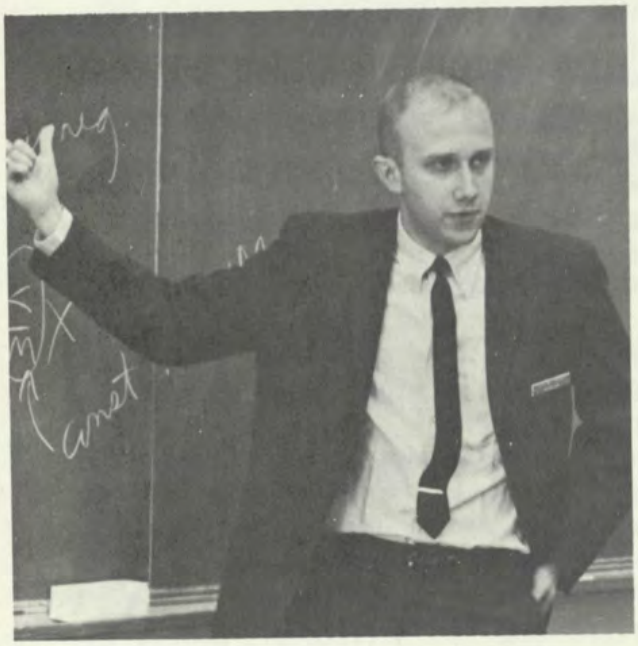
Another significant study resulted in a proposed curriculum in Deep Ocean Engineering which is presently under review at the Department of the Navy level.

A member of the June 1964 graduating class received the first "Captain Wœlfel Award for Academic Excellence in Naval Engineering."

The award consists of a wrist watch presented to the U. S. Naval officer student who has achieved a record of academic excellence in Naval Engineering and demonstrated the attributes of an outstanding naval officer.

Additional basic management courses, an increase in the use of computers in technical laboratory and thesis work, and updating the nuclear science and engineering courses are planned for these curricula.

Engineering Science



The Engineering Science Curriculum provides commissioned officers with postgraduate education in the fundamentals of science and mathematics by extension of their undergraduate studies in order to prepare them for subsequent sub-specialization, to stimulate a desire for maintaining and improving their basic education, and to broaden their professional knowledge through graduate education.

Approximately one-half of the Engineering Science students have been transferred to other technical curricula with a large percentage of these entering programs leading to a master's degree. The remaining students complete the basic engineering science curriculum. Assignment to the operating forces of the Navy finds the officers better prepared to cope with the challenge of increasingly complex technology in ships, aircraft and weapons systems.

It is planned to offer four programs in Engineering Science. Two upper level curricula have been designed to provide a review to prepare academically qualified officers for advanced technical studies of their choice.

A one year program consisting of two lower level curricula will assist students in preparing for advanced functional training in areas such as data systems, Polaris and other weapon systems. instructor duty or test pilot billets.

Baccalaureate

The Baccalaureate program is designed to raise the educational level, broaden the mental outlook, and increase the professional knowledge of naval officers not holding a baccalaureate degree.

This program includes Bachelor of Science and Bachelor of Arts Curricula which provide specialized study to meet the professional needs of the officer considering the varied educational backgrounds and service experiences which he might have.

The Bachelor of Science Curriculum stresses science and engineering disciplines with appropriate courses in government and humanities. Naval professional courses comprise approximately one-fifth of the total curriculum.

The Bachelor of Arts Curriculum emphasizes the social environment without neglecting the physical. Appropriate electives are offered to permit a choice as to specific group or area concentration leading to a major in Political Science (International Relations).

General Line

This curriculum for allied naval officers considers United States Navy organization, technology, operations and tactics.

The ten month course helps prepare these students for more responsible duties in their own navies or for service with combined staffs of allied forces.

A course in American Life and Institutions was added in 1964, which includes appropriate field trips to key governmental and cultural centers.

Through their experiences and observations here these students are better prepared to understand the operations of our government and society as well as the United States Navy.

"In the graduate work we are constantly adjusting our courses so that the disciplines that are studied will furnish adequate support to the Navy of the future and more immediately to today's Fleet . . ."

REAR ADMIRAL EDWARD J. O'DONNELL
Superintendent, Naval Postgraduate School

Naval Management and Operations Analysis

During 1964 the Naval Management Curriculum was extended from ten to twelve months. This extension permits the introduction of refresher material at the program's start, earlier completion of "core" course requirements, and additional time for advanced study.

Plans were prepared this year for the inclusion of several basic management courses in selected graduate science and engineering curricula.

The pilot twelve month Management (Data Processing) program was successfully concluded in June 1964.

Objectives of this course included equipping the officer student with a broad education in computer theory and practice and the ability to analyze data processing systems and manage computer-based installations.

Operations Analysis

Operations Analysis has previously been known as "Operations Research." This redesignation in 1964 indicates the broadened scope of this program to include both operations research and systems analysis.

Computer Facility

The Computer Facility directly supports the academic programs of the Naval Postgraduate School in the classroom and research laboratory.

This support includes the preparation and processing of computer programs, computer science consulting services and the presentation of advanced courses in systems programming. These services are available to all students in connection with any course, computer oriented or not.

At present, the School owns and operates, on a three-shift basis, four computers—a CDC 1604, an IBM 1401 and two CDC 160s.

During 1964 twenty-five computer courses were offered in five different departments. Students exposure to this rapidly developing technology increased this year to 77% of the enrollment. This figure is expected to increase to 90% in 1965 and near the 100% level by 1966.

FORTRAN 60 and USNPGS SCRAP assembly programs continued as the main computer programming languages. The COOP MONITOR, a sophisticated new executive system, saw increased use during the year. This system is open-ended and includes FORTRAN 63, ALGOL and COBOL as compilers and CODAP as the assembly language.

Significant projects completed or nearing completion during 1964 include: (1) Project SABIRS (Semi-Automatic Bibliographic Information Retrieval System) for the Technical Reports Section of the USNPGS library; (2) a class scheduling program including class and flight assignments for aviator students; (3) a series of programs for curve and surface fitting; (4) a variety of administrative jobs of both an academic and military nature; (5) high-accuracy algorithms for linear and non-liner algebraic problems; (6) comparative studies of computational methods in optimal control theory; (7) an analog simulator program; and (8) graph and contour plotting subroutines.

Research continued in the areas of artificial languages, numerical analysis and list processing. Preliminary work began in computer-assisted instruction, centered on the IBM 1401 with two IBM 1311 disc drives and a remote typewriter terminal, the IBM 1050.

Future plans call for the development and acquisition of a time-shared computer system permitting simultaneous access by many users at different locations on the campus. This will provide an effective central computer complex for further development of school research in the areas of hybrid computing, in-line laboratory data acquisition and processing, non-machine communication and multi-processing.

Fleet Numerical Weather Facility

The Fleet Numerical Weather Facility located on the Naval Postgraduate School grounds operates under the direct control of the Director of Naval Weather Services, Washington, D. C.

During 1964 the FNWF expanded its operations as the hub of the Naval Weather Service Computer Network. High speed data links were established between Monterey, Pearl Harbor, Guam and Norfolk. Input of raw observations and output of finished numerical products now move at a rate of 4,000 words per minute.

The Defense Communication Agency has authorized the extension of this network to Japan, the Philippines and Spain, with feeder lines up and down the coasts of North America.

1964 saw the completion of the new Fleet Numerical Weather Facility Computer Building on the Postgraduate School Grounds. Point Pinos, the formed Naval Air Intercept Training Facility, was reactivated and now houses the offices and shops of the FNWF Communications Division.

The Numerical Weather Facility scored a first in high-speed RF transmission of weather data in 1964 when a series of tests were conducted using SYNCOM Communication Satellites. Raw data and finished charts were transmitted error-free from Monterey to Hawaii and Guam at rates averaging better than 3,000 wpm.

Numerical analysis and prediction have expanded to more and more environmental parameters both in the atmosphere and in the oceans during the past year. Entirely new products include predictions of freezing level, condensation trail probability, ocean current transport, clear air turbulence and cloud cover. To carry out the increased computational load, a CDC 3200 medium computer was purchased in October 1964 and by the end of the year neared full time usage.

Guest Speakers

The Naval Postgraduate School's Guest Speaker Program is designed to inform and challenge our officer students on a wide spectrum of subjects related to and outside of their immediate areas of interest.

Superintendent's Guest Speaker Series

DR. GERALD W. JOHNSON, Associate Director, Lawrence Radiation Laboratory — *"Atomic Energy Used as Explosives in Peaceful Efforts."*

MR. KENNETH V. MACKENZIE, Naval Electronics Laboratory, San Diego—*"USS TRIESTE and the THRESHER Search."*

RADM DENYS W. KNOLL, USN, Oceanographer of the Navy — *"Oceanography and its Contribution to Naval Warfare."*

DR. CHARLES E. ODEGAARD, President, University of Washington — *"Officer Education."*

VADM PAUL D. STROOP, USN, Commander Naval Air Force, U. S. Pacific Fleet—*"Weapons Engineering Duty Officer Program and its Future."*

DR. STEFAN POSSONY, Director of International Political Studies Program, Hoover Institution on War, Revolution and Peace, Stanford University — *"Communist Techniques for Conquest."*

DR. SAMUEL I. HAYAKAWA, Professor of Language Arts, San Francisco State College — *"Success and Failure in Communications."*

DR. ARMIN RAPPAPORT, Professor of History, University of California at Berkeley—*"DeGaulle and His Views of European Integration."*

RADM FLOYD B. SCHULTZ, USN, Commander, Puget Sound Naval Shipyard — *"The Designing of a Ship."*

ADMIRAL DAVID L. MCDONALD, USN, Chief of Naval Operations — *"General Comments on the Chief of Naval Operations and the Naval Establishment."*

VADM CHARLES E. WEAKLEY, USN, Commander Antisubmarine Warfare Force, Atlantic—*"Antisubmarine Warfare."*

RADM JOHN HARLLEE, USN (Ret), Chairman, Federal Maritime Commission — *"The Role of the U. S. Merchant Marine in National Security."*

RADM BERNARD F. ROEDER, USN, Assistant Chief of Naval Operations for Communications and Director of Naval Communications—*"Naval Communications and the Future."*

VADM HORACIO RIVERO, USN, Director, Navy Program Planning, Office of the Chief of Naval Operations — *"Navy Program Planning."*

VADM JOHN S. MCCAIN, JR., USN, Commander Amphibious Force, U. S. Atlantic Fleet — *"Showdown at Sea."*

Departmental Guest Speakers

MANAGEMENT

CDR R. L. BOWMAN, CEC, USN, Bureau of Yards and Docks Representative — "Recommendations 76 and 77 of the Review of Management of the Department of the Navy."

RADM H. F. KEUHL, SC, USN, Commanding Officer Aviation Supply Office — "Data Processing as Applied to Aeronautical Repair Parts Inventory Management."

MR. JAMES PURDUE, Defense Programs Office, General Electric Company, Washington, D. C. — "An Industry View of Current Department of Defense Policies and Practices in Procurement and Contract Administration."

CAPTAIN MARK WOODS, USN, Bureau of Ships Special Projects Program, Port Hueneme, California — "Managerial Problems re Establishment of a Special Projects Office in BUSHIPS in terms of Ship-to-Air Missiles."

AERONAUTICAL ENGINEERING

MR. SELDON SPANGLER, Vidja Corporation — "Submarine Stability."

ELECTRICAL ENGINEERING

MR. S. KOWNACHI, RES Test Operations, Lockheed Missiles and Space Company, Sunnyvale, California — "Long-lasting Effects of Nuclear Detonations."

MR. R. R. MOSIER, Collins Radio Company, Newport Beach, California — "Field of Communications Data Processing Computer Modems, etc."

MR. I. H. GERKS, Collins Radio Company, Cedar Rapids, Iowa — "New Look at Radio Wave Propagation."

OPERATIONS ANALYSIS

MR. S. FLIEGE, System Development Corporation — "Design and Implementation of Military Information Systems."

CDR R. G. HERRON, USN, Naval Missile Center, Point Mugu — "Operations Analysis Projects at the Naval Missile Center."

MR. J. STANDHAMMER, System Development Corporation — "Simulation of Orbiting Vehicles for System Design Verification."

CAPTAIN F. A. ANDREWS, USN, Submarine Development Group TWO, U. S. Naval Submarine Base, New London, Connecticut — "Submarine Force Tactical Analysis Group."

MR. MARK BENDICK, System Development Corporation — "System Analysis of an Air Defense System."

MR. R. TOTSCHEK, System Development Corporation — "A Modelling Study of Weapons Assignment in Air Defense."

MR. M. YOUCHAH, System Development Corporation — "A Waiting Line Simulator Applied to SAC Control System Computer Program Design."

MR. BERT WELIN, System Development Corporation — "An Analysis of Operator-Computer Interaction in a Digital Control System."

MR. R. L. DUGAS, System Development Corporation — "A SAGE Long-Range Radar Simulator Model for System Training."

MR. K. WOOD, System Development Corporation — "Operations Research in Production of System Training Aids."

DR. W. C. CALDWELL, Collins Radio Company, Cedar Rapids, Iowa — "Solid State Electronic Designs."

MR. J. L. WESTCOT, Collins Radio Company, Cedar Rapids, Iowa — "Electronics Program Management."

MR. E. F. READ, Collins Radio Company, Cedar Rapids, Iowa — "Quality Assurance, Value Engineering of Electronics Designs and Production Items."

MR. M. T. LUDVIGSON, Collins Radio Company, Cedar Rapids, Iowa — "HF Antenna Couplers, Multicouplers for Ships and Aircraft Application."

DR. MERLE MORGAN, Electro-Scientific Industries Inc., Portland, Oregon — "Some Comments on Frequency Response Analysis vs Pole-Zero Analysis."

MATERIAL SCIENCE AND CHEMISTRY

DR. RODERICK STEELE, Research Associate in Biophysics, Stanford University — "Thermoluminescence of Amino Acids Irridiated with UV."

DR. GEORGE CONSTABARIS, Senior Research Chemist, California Research Corp., Richmond, California — "Fine Particle Magnetics of Supported Catalysts."

PROFESSOR JORGE SABATO, Director, Metallurgy Section, Argentine Atomic Energy Commission — "Current Investigations in Metallurgy at the Argentine AEC Laboratory."

DR. J. A. PASK, Professor of Ceramic Engineering, University of California, Berkeley — "Mechanical Behavior of Ionic Single-Crystal and Polycrystalline Materials."

DR. A. B. AMSTER, Senior Physical Chemist, Stanford Research Institute — "The Sensitivity of Propellants and Explosives."

DR. GILDA HARRIS, Theoretical Chemical Physics, Lockheed Missile and Space Company, Palo Alto, California — "Equilibrium Properties of Hydrogen Plasma."

DR. O. D. SHERBY, Professor of Material Science, Stanford University — "Influence of Atomic Mobility on the High Temperature Mechanical Behavior of Solids."

DR. RALPH FESSENDEN, Assistant Professor of Chemistry, San Jose State College — "Silicon Substituted Medicinal Agents."

DR. M. B. FRANKEL, Senior Organic Chemist, Stanford Research Institute — "Solid Propellants."

DR. A. S. TETELMAN, Acting Associate Professor of Material Science, Stanford University — "Recent Concepts in the Fracture of Metals."

PHYSICS

DR. H. FURTH, Lawrence Radiation Laboratory, Livermore, California — "Recent Progress Toward Plasma Stability."

CAPTAIN P. M. WOLFF, USN, Fleet Numerical Weather Facility, Monterey, California — "Use of High Speed Digital Computers in Environmental Predictions."

DR. J. R. PETERSON, Stanford Research Institute — "Electron-Impact Ionization of Atoms and Molecules."

MR. FRED WITTEBORN, Stanford University — "Experimental Measurements of Free Fall of Electrons and Positrons."

DR. ALLAN STEWART, Queens University, Belfast, Northern Ireland — "Recent Calculations of Oscillator Strength of Highly Ionized Atomic Systems."

DR. HALL CRANELL, Stanford University — "Electron Scattering from Carbon 12."

DR. R. W. HENRY, California Institute of Technology — "Transmission and Processing of Data in the Nervous System."

MR. S. KOWNACKI, Lockheed Missile and Space Company, Sunnyvale, California — "Ionization of the Atmosphere Due to Beta Particles Emitted by Fission Products."

DR. D. S. POTTER, GM Defense Research Laboratory, Santa Barbara, California — "Acoustic Scattering Measurements as Indicators of Water Imhomogeneities."

DR. H. E. BOMMEL, University of California, Los Angeles — "Ultrasonic and Hypersonic Waves as a Tool in Solid State Physics."

DR. H. E. WEAVER, Varian Associates, Palo Alto, California — "The Study and Identification of a Paramagnetic Center in Electrolysed Crystals of Natural Quartz."

PROFESSOR C. W. BARBER, Stanford University — "Experiments with Colliding Electron Beams."

PROFESSOR J. KISTEMAKER, Mass Separation Laboratory, Amsterdam, Netherlands — "Interaction of Fast Ions with Single Crystalline Material."

Facilities Prospectus

In order to satisfy immediate requirements and to provide for the projected expansion of the student body, the Naval Postgraduate School has drawn up a comprehensive facilities plan with the approval of the Bureau of Naval Personnel, its command and support bureau. Although the plan has been projected to cover a period of about ten years, only those projects included in the Military Construction Component of the Five Year Force Structure and Financial Plan Program Objectives are listed.

Additional Academic Facilities (1st Increment)

This project is designed to alleviate critical space deficiencies in the academic area. It provides for a new classroom, laboratory and faculty office building of 76,494 square feet, and conversion of existing buildings to provide additional faculty offices, physics laboratories and reference center space. The estimated cost of this project is $2.14 million and is programmed in FY 1966.

Conversion to Bachelor Officers' Quarters

As a related line item to Additional Academic Facilities (1st Increment), a project to reconvert the East Wing of Herrmann Hall (formerly Del Monte Hotel) from an interim academic facility back to Bachelor Officers' Quarters is planned in FY 1966, providing accommodations for 110 officers. The BAQ funds saved by these additional Bachelor Officers' Quarters should amortize the cost of conversion ($330,600) in a few years.

Technical Library

Again in December 1964, the Western College Association in its report on accreditation for the school, noted the inadequacies of the library (reference center) facilities, and strongly recommended the construction of a permanent library. A project to replace the present overcrowded interim facility is programmed for FY 1967 and will cost approximately $1.66 million.

Gymnasium

The School's only gymnasium is a small interim facility utilizing a Butler building. With a large number of students whose time is at a premium, the school needs physical fitness facilities of adequate size and diversity. A permanent gymnasium of 17,180 square feet, around which a vigorous physical fitness program can be organized, is planned for FY 1967 at a cost of $375,400.

Chapel and Chapel Annex

The current average attendance at the Naval Postgraduate School Chapel facilities is such that temporary seating must be used. In addition, Sunday School classes are conducted in academic classrooms, necessitating rigging and unrigging of spaces to accommodate small children. A permanent Chapel facility, providing for a 600-seat Chapel and Chapel Annex is programmed for FY 1967. The estimated cost of this project is $581,000.

Additional Academic Facilities (2nd Increment)

While the first increment is designed to alleviate present academic space deficiencies, the second increment of the Additional Academic Facilities project will accommodate the long range projected expansion of the student body. It is similar in scope and design to the academic building program of the first increment, and provides additional classrooms, academic offices and some general laboratories. Its estimated cost is $1.52 million, and is programmed for FY 1968.

Environmental Sciences Laboratory

The need in the Navy for an increasing number of officers with education in the field of Oceanography dictates the establishment of a fully equipped Environmental Sciences Laboratory, encompassing the full spectrum of the Air-Ocean environment. This laboratory will provide an important adjunct to the Environmental Sciences Curricula. It is scheduled for FY 1969 at an estimated cost of $1.30 million.

Compressible Flow Laboratory

This Facility is designed as a supplement to the present Astro/Aeronautical Laboratory. It will provide capabilities in exploring the dynamics of high speed flight and the phenomena encountered at high velocities and temperatures in low density ionized atmospheres. This project is programmed for FY 1970 and its estimated cost is $2.23 million.

Research

a commentary and report

by Carl E. Menneken

Dean of Research Administration
U. S. Naval Postgraduate School

Concern is currently being expressed in academic circles, professional organizations and Congress over the imbalance between research and teaching existing in many universities and colleges. Many groups are disturbed that the increased research activity since World War II, with all of its financial and professional rewards, has siphoned off scientific and engineering talent which otherwise might have concerned itself with instruction and higher education.

Early in the development of the research program at the Naval Postgraduate School it was recognized that, particularly for this institution, effective instruction was the primary goal. Students with relatively short and specified time available require a well integrated and highly selective program, with each course contributing effectively to the total educational pattern.

It was also recognized that a school could not obtain enthusiastic, well-coordinated and authoritative instruction unless the faculty at least kept abreast of recent progress in science and technology.

It has long been recognized that one of the more effective methods of achieving this awareness in a faculty is to have a significant number personally engaged in research. It is neither considered necessary nor desirable that each faculty member be an active researcher. There are other scholarly activities that are required for a balanced faculty whose importance must be recognized and rewarded. Consistent with this concern for a proper balance between research and other activities which support instruction, a criterion has been followed that precludes employment of any pro-

fessional talent solely to engage in research. Each individual doing research is a regular member of the faculty and each has direct contact with the academic program, in that he teaches at least half time. Semi-professional assistance, in the form of technicians, programmers, etc., is, however, provided.

This mode of operation handicaps the researcher, who inevitably is in competition for results, but it has forced the evolution of a research program that is selective in areas of effort and the nature of the problems attacked. The research program stimulates and enriches the instruction, not only of those who do the research but also of their colleagues. The impact on the student body, many of whom participate in the program, is significant.

No school can expect to recruit and retain a select faculty in competition with other universities and industry unless it provides significant research opportunities. Approximately 50 out of a faculty of 165 are supported by the Foundation Research Program, which is funded by the Office of Naval Research. The Research Council reviews the proposals submitted by the faculty and recommends the apportionment of funds. Approximately 30 of the faculty are engaged in other sponsored programs. The sponsors usually are Navy bureaus, offices, or laboratories. The problems range from analytical operations research to laboratory studies of turbine design and heat exchangers.

Several new programs are being initiated. Among the latter is the construction of a 120 million electron volt linear accelerator which is expected to be in operation around January 1966. This project benefits from the generous and significant assistance of the Stanford Linear Accelerator Center and the High Voltage Laboratory at Stanford University. This new facility is in an energy range where few accelerators exist, and will provide excellent opportunities for both fundamental and applied research.

The completion of the new Astro/Aeronautics laboratories has stimulated intense activity in the areas of turbines, heat exchangers, and propellants. This activity will continue to increase. The expansion in cryogenic facilities has stimulated increased research in crystal studies, thermal conductivity, transition phenomena, and interaction studies. New faculty members have initiated programs in electron paramagnetic resonance and nuclear magnetic resonance which give excellent promise.

A significant program in operations research is underway in logistics studies, optimum routing methods, reliability studies, and target models. The programs, specifically revolving around computer facilities, are progressing well. Programmed teaching studies are being tested. The development of hybrid systems is obtaining wide recognition.

The initiation phase of the research program in the Naval Postgraduate School is about complete. Major attention is now being directed toward improvement in quality, selectivity, and evolution of a program best adapted to the special position the School enjoys — an institution with high academic goals and a unique mission, student body, and position in a military organization.

"It is generally agreed that teaching and research are indistinguishable in true scholarship, and that neither can flourish without the other. This is especially true of graduate education, which can truly be described as education in research."

RESEARCH BULLETIN,
Georgetown University Science Center

1964 from a Statistical Viewpoint . . .

At Monterey

ENROLLMENT

Technical Curricula	958
Engineering Science	173
General Line	34
BS — BA	322
Management	125
TOTAL	1612

SOURCES

U. S. Navy	1405
U. S. Army	21
U. S. Marine Corps	59
U. S. Air Force	7
U. S. Coast Guard	23
Allied Nations	97
TOTAL	1612

STAFF AND FACULTY

Officers	129
Enlisted	283
Civilian Faculty	177
Civil Service	394
TOTAL	983

CERTIFICATES AND DEGREES

Bachelor of Arts	53
Bachelor of Science	126
BS — Aeronautical Engineering	34
BS — Communications Engineering	30
BS — Electrical Engineering	55
BS — Engineering Electronics	47
BS — Management	26
BS — Mechanical Engineering	16
BS — Meteorology	18
BS — Environmental Science	4
BS — Physics	16
Master of Science	24
MS — Aeronautical Engineering	4
MS — Aeroelectronics	3
MS — Chemistry	1
MS — Electrical Engineering	12
MS — Engineering Electronics	18
MS — Management	61
MS — Management/Data Processing	7
MS — Mechanical Engineering	8
MS — Meteorology	10
MS — Nuclear Engineering	1
MS — Operations Research	31
MS — Physics	15

TOTALS . . .

Bachelor Degrees	425
Master Degrees	195
Doctor of Philosophy Degrees	5
Certificates of Completion	180
TOTAL	805

At Civilian Schools

DEGREES AWARDED

Bachelor of Civil Engineering	2
Master of Arts	26
MA — Education	4
Master of Business Administration	42
Master of Public Administration	4
Master of Science	42
MS — Aeronautics and Astronautics	1
MS — Civil Engineering	10
MS — Industrial Engineering	2
Degree of Aeronautical Engineer	6
Degree of Electrical Engineer	1
Degree of Naval Engineer	10

TOTALS . . .

Bachelor Degrees	2
Master Degrees	131
Professional Degrees	17
Doctor of Philosophy Degrees	5
TOTAL	155

ENROLLMENT

Advanced Weapons	5
Advanced Science	9
Advanced Meteorology	1
Aeronautical Engineering	13
Business Administration	12
Civil Engineering	44
Economics	1
Electrical Engineering	2
Financial Management	24
Industrial Administration	2
International Relations	40
Junior Line Officer Advanced Science	35
Law (Judge Advocate General)	2
Management and Industrial Engineering	10
Mechanical Engineering	1
Naval Architecture	1
Naval Construction and Engineering	65
Nuclear Power	3
Oceanography	17
Operations Analysis	4
Petroleum Engineering	2
Procurement Management	3
Petroleum Management	6
Personnel Administration and Training	1
Political and Social Science	8
Public Information	4
Retailing	5
Religion	10
Scientific Inventory and Management	1
Subsistence Technology	2
Transportation Management	3
Textile Technology	1
TOTAL	337

Fiscal Data

DIRECT TRAINING COSTS

Labor and Benefits:		
Civilian Faculty	$1,911,750	
Civil Service	584,606	
Labor Benefits	191,000	$2,687,356
Travel		102,600
Rental of Equipment and E. A. M.		18,640
Printing		13,000
Textbooks		67,500
Reference Books		35,000
Services		81,640
Supplies		215,470
TOTAL DIRECT TRAINING		$3,221.206

COSTS AT CIVILIAN UNIVERSITIES

Tuition	482,447
Travel (Field Trips)	14,032
Theses	19,738
Books	19,885
Miscellanenous	407
TOTAL COSTS CIVILIAN UNIVERSITIES	$ 536,509

MAINTENANCE AND OPERATIONS

Labor and Benefits:		
Civil Service	$1,040,434	
Labor Benefits	90,167	$1,130,601
Travel		11,459
Utilities		218,606
Supplies and Services		178,417
TOTAL MAINTENANCE AND OPERATIONS		$1,539,083

FAMILY HOUSING

Labor:	
Civil Service	$ 128,173
Utilities	181,636
Supplies	81,307
TOTAL FAMILY HOUSING	$ 391,116

EQUIPMENT

Training Equipment	$ 174,500
Logistic Support Equipment	12,000
TOTAL EQUIPMENT	$ 186,500

RESEARCH

In House Laboratories (ONR)	$ 332,625
Warfare Analysis (ONR)	25,000
Mathematical Sciences (ONR)	2,500
Physical Sciences (ONR)	628
Glendora (BuShips)	25,000
Base Plant Gas Turbine and Heat Exchange Development (BuShips)	39,000
Adaptive ECM Control (BuShips)	10,000
Adaptive Communication Control (BuShips)	10,000
EDP Programming Support (BuShips)	50,000
Project Seabed (BuWeps)	39,000
Warfare Analysis (BuWeps)	15,000
Weapons Systems (BuWeps)	11,500
Vacuum Ultraviolet Spectroscopy (ONR)	4,780
Weapons Equipment Maintenance (BuWeps)	4,664
Physical Sciences (BuWeps)	15,000
Investigation of Adaptive Control Methods (BuWeps)	10,000
Military Sciences (ONR)	25,000
TOTAL RESEARCH	$ 619,697

During 1964 the Naval Postgraduate School . . .

Accepted and placed in operation the new Astro/Aeronautical Propulsion Laboratory.

Received a formal renewal of its full accreditation from the Western Association of Schools and Colleges for a five-year period.

Implemented the "Dual Input System" with student enrollments each August and January.

Reviewed curricula with the assistance of special committees comprised of academic and military members.

Hosted the first Secretary of the Navy's Board to Review the Postgraduate Education of Officers.

Established the Captain Wœlfel Award for academic excellence in Naval Engineering.

Assumed the task of implementing the "Defense Management Program" sponsored by the Department of Defense.

Hosted and participated in PROJECT SEABED — an Advanced Sea-Based Deterrence Conference.

Was granted congressional approval for construction of 200 additional units of family housing.

Our Future Objectives Include . . .

Increasing the School's contribution toward raising the general educational level of naval officers.

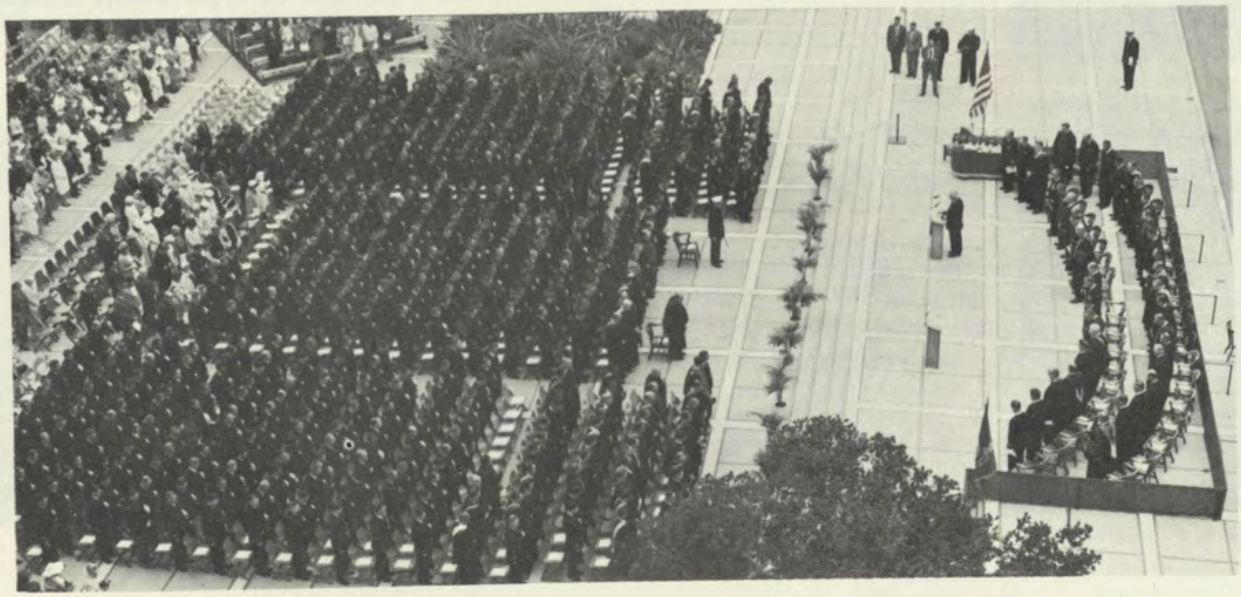
Maintaining dynamic curricula and tailored courses which meet the requirements of the modern Navy.

Enlarging the student body in concert with Bureau of Naval Personnel plans for an expanding educational program.

Strengthening the base of the School's research activities.

Gaining approval for additional facilities to accommodate the increased student load.

Increasing the utilization and diversity of the Computer Facility in academic programs.



Electrical Engineering

CHARLES H. ROTHAUGE received a degree of Bachelor of Engineering from Johns Hopkins University in 1940. He went on to graduate work and had completed one year before joining the Army, serving four and a half years and reaching the rank of Major. He completed his graduate work and received the degree of Doctor of Engineering from Johns Hopkins in June 1949. While working on his Doctorate, he held appointments as Instructor in Mathematics and Electrical Engineering. He joined the Postgraduate School faculty in 1949. Since 1962 he has been Chairman of the Department of Electrical Engineering and doing research in the field of Nonlinear Magnetic devices.

Government and Humanities

Commander WILLARD D. HOOT graduated in 1939 from Pennsylvania State University with a Bachelor of Arts degree in Political Science. He continued his studies at the University of Michigan where he earned a Bachelor of Law degree in 1942. The Commander then entered the Navy as an aviation cadet. He was commissioned an Ensign and designated a naval aviator in 1944. A graduate of the Army Judge Advocate General's School for senior officers, where he earned his Master's degree in Law, Commander Hoot served three years as instructor and head of the Academic Department at the Naval School of Justice. He is also a graduate of the Armed Forces Staff College. Commander Hoot has served on the staff of the Naval Postgraduate School since 1960.

Aeronautical Engineering

After graduating from Oberlin College in Ohio, where he received a Bachelor of Arts degree in Physics, Professor RICHARD W. BELL did graduate work at the California Institute of Technology and earned a Master of Science degree and a Professional Degree in Aeronautical Engineering in 1941. For the next ten years he was engaged in research and development concerning military aircraft. He came to the Postgraduate School in 1951 and is now Professor and Chairman of the Aeronautical Engineering Department. He is currently engaged with problems directly pertaining to the Apollo mooncraft and supersonic aircraft. He is also undertaking theoretical research in the dynamics of hypervelocity vehicles.

Business Administration and Economics

PAUL ECKER received his Bachelor of Arts in Economics from Pomona College, Claremont, California in 1948. He continued his graduate study at Oberlin College and Claremont Graduate School, where he received the degree of Master of Arts in June 1950. He was advanced to candidacy for the Doctor of Philosophy degree in 1964. Professor Ecker has served as an instructor at San Jose State College; Associate Director of the Institute of Industrial Relations at San Jose State College; and Director of the Northern California Council on Economic Education. Since 1957 he has served on the faculty of the U. S. Naval Postgraduate School. He has been Professor of Management and Chairman of the Naval Management Department. At present he is coordinator of the Defense Management Systems Course and Acting Chairman of the Business Administration and Economics Department.

"These (faculty) are men who have not only inspired naval officers to take on hard academic work but have been influential in keeping the Navy pointed toward the right scientific and professional goals."

REAR ADMIRAL EDWARD J. O'DONNELL
Superintendent, Naval Postgraduate School

Mathematics

After graduating from Amherst College in 1926, W. RANDOLPH CHURCH, now Chairman of the Department of Mathematics, taught mathematics at the University of Beirut in Lebanon for three years. He received the Master of Arts degree from the University of Pennsylvania in 1930. In 1935 the Doctor of Philosophy degree was conferred by Yale University and he accepted a position as Instructor at the United States Naval Academy. Three years later he was transferred to the Postgraduate Department and when this became the United States Naval Postgraduate School in 1947 he was appointed Chairman of the Department of Mathematics and Mechanics. He was commissioned in the U .S. Naval Reserve in 1938 and served on active duty from 1942 to 1946. The Navy Commendation Ribbon was awarded to him in 1946.

Material Science and Chemistry

GILBERT F. KINNEY graduated from Arkansas College in 1928 with a Bachelor of Arts degree. In 1930 he earned his Master of Science degree from the University of Tennessee. The year following graduation he worked as operator and announcer for a New York radio station. In 1932 he enrolled as a graduate student at New York University and received his Doctor of Philosophy degree in 1935. He joined the faculty of the Naval Postgraduate School in 1942 and was appointed to his present position in 1962. Currently his research is concerned with materials processing for microwave tubes. He is the author of a textbook in Engineering Thermodynamics, and two others, one on plastics, and one on explosive shock waves.

Mechanical Engineering

ROBERT E. NEWTON received a Bachelor of Science degree in Mechanical Engineering in June 1938 from Washington University, St. Louis, Missouri. The following year he received his Master of Science from the same school. He served as an instructor in Applied Mathematics and continued part-time graduate study until June 1941 when he joined the staff of Curtiss-Wright. In 1945 Dr. Newton returned to teaching at Washington University. He resumed graduate study at the University of Michigan in 1949 and was awarded the degree of Doctor of Philosophy in June 1951. He joined the faculty of the Naval Postgraduate School in July 1951 and became Chairman of the Mechanical Engineering Department in 1953.

Meteorology and Oceanography

GEORGE J. HALTINER attended college in St. Paul, Minnesota, where he received a Bachelor of Science degree from St. Thomas College in 1940. After doing graduate work at the University of Wisconsin, where he earned a Master of Philosophy degree in 1942, he joined the Naval Reserve and was sent to the University of Chicago for further graduate work. Following his active duty, Mr. Haltiner accepted the position of Assistant Professor of Meteorology at the Naval Postgraduate School. He took leave of absence in 1947 to attend the University of Wisconsin where he was awarded his Doctor of Philosophy degree in Mathematics. On January 1, 1964 he became chairman of the Department of Meteorology and Oceanography. He is presently a Captain in the Naval Reserve.

Naval Warfare

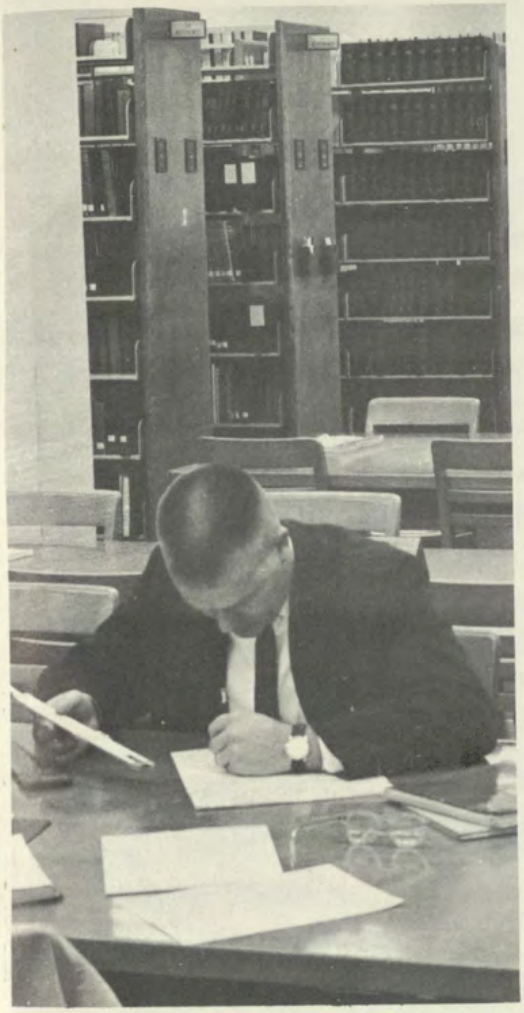
CARL C. SCHMUCK received the degree of Bachelor of Science in Mechanical Engineering in 1939 from Purdue University. He received his designation as a Naval Aviator and commission as an Ensign in August 1940. During World War II, Commander Schmuck spent the majority of his time with operating units of the Pacific Fleet. Commander Schmuck attended the General Line School in Newport, Rhode Island during 1946 and was assigned as an instructor in Marine Engineering at the Naval Academy in 1947. He served in a variety of staff and command billets prior to becoming Chairman, Department of Naval Warfare, in 1963.

Physics

EUGENE C. CRITTENDEN, JR., graduated from Cornell University in 1934 with a Bachelor of Arts degree. He received his Doctor of Philosophy degree in 1938 from the same institution. In September 1938 he joined the faculty of Case Institute of Technology. From 1944-46 he was employed as a research physicist by the University of California at Berkeley. In 1946 he returned to teaching at the Case Institute of Technology. Professor Crittenden came to the Postgraduate School in 1953. In 1964 he was appointed Chairman of the Physics Department. His research is in the field of nuclear and solid state physics. During his career he has directed research projects sponsored by the Office of Scientific Research and Development, the Atomic Energy Commission, and the Office of Naval Research.

Operations Analysis

JACK R. BORSTING received a Bachelor of Science degree in Mathematics from Oregon State College in 1951, a Master of Arts in Mathematics in 1952 and a Doctor of Philosophy degree in Mathematical Statistics in 1959 from the University of Oregon. Prior to 1959 he was an instructor at both the University of Oregon and Western Washington College. From August 1959 to June 1964, Dr. Borsting was a member of the Naval Postgraduate School's Mathematics Department. In June 1964 he was appointed Chairman of the Department of Operations Analysis. His current research is being conducted in the areas of statistical classification theory, statistical weather prediction, and reliability theory.



PRODUCTIVE HOUR

MUTUAL EXCHANGE

AIR SHAFT — CASCADE LAB

GRADUATION

120 MEV LINEAR ACCELERATOR

a partial list of works published in 1964 by our Faculty . . .

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". . . I believe that our most critical continuing need is one that must be met by people like you, for in my opinion our greatest need is for professionals — professionals in every walk of life — including the Armed Forces of the United States.

". . . It is a truism bordering on a cliche to say that men are more important than machines . . . yet I suggest to you that 'men' are not enough. Given all our technical equipment and refined weapons systems, we still need much more than mere manpower. Indeed, trained men are not enough, or skilled men, or daring and courageous men, or sincere men. Training, skill, sincerity, courage — these are certainly desirable qualifications for military service. But of themselves they do not fill the bill. I maintain that we cannot meet our critical needs in the Armed Forces without *professional* men — professional military officers. Need the professional be trained and skilled? Of course. Need he be sincere and courageous? Certainly. But he must be much more.

". . . The defense and preservation of the ideals and values of freedom cannot be left to the mediocre, to the uncommitted. If any task requires the professional — the man who is truly committed — it is the task inherent in the mission of the Armed Forces of the United States."

REAR ADMIRAL CHARLES K. BERGIN

United States Navy

Rear Admiral Charles K. Bergin

1904 - 1964

Superintendent, United States Naval Postgraduate School

1963 - 1964

"To provide qualified officers to meet future requirements of a complex Navy is the goal of the Chief of Naval Personnel. The goal of each individual officer must be to prepare and qualify himself by all means available to meet the challenge of the future."

VICE ADMIRAL B. J. SEMMES, JR.
Chief of Naval Personnel