1976

Naval Postgraduate School Monterey, California Report 1975 1976

Monterey, California: Naval Postgraduate School

https://hdl.handle.net/10945/51409

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REPORT

The past year has been an important one for graduate education and for the Naval Postgraduate School. The pressure on graduate education programs in all of the armed services which has continued over the past four years remains a matter of serious concern, but there are promising indications that a better understanding of the need for such education is developing.

Questions raised in the past about graduate education and budget cuts made in these programs have caused a disruption in programs and have led to a reanalysis and reevaluating of their size and direction. In the case of the Navy, so dependent on technology for its operational effectiveness, it seems strange indeed to question the need for concentrated study of this technology. Now voices are being raised to describe this dependence on the educated officer and to explain the urgent requirement for these programs.

Admiral Harold E. Shear, Vice Chief of Naval Operations, in an address to the December 1975 graduates, made several points:

Maintaining our country’s free access to the seas...has been the function of our Navy for 200 years.

We face a first rate, professional blue water navy...whose primary objective is to be able to deny us control and unimpeded use of the seas.

In light of this sophisticated and growing challenge, one thing is clear—our Navy can no longer adequately meet the threat by a 'seaman's eye.'

We cannot rely on the part-time ASW expert to counter the nuclear submarine...
To survive at sea, and to accomplish our assigned missions when called on, requires that we add a new dimension to professional seamanship. In addition to leadership, courage and loyalty, a professional sailor must now possess technical competence...

Operationally, you must have the ability to automate and then to integrate men and machines to insure timely response to each new and expanding threat.

The Washington environment...calls for a special blend of operational experience, technical expertise, human resource management and understanding of financial feasibility.

We must continue to bring fleet experience into the laboratories through officers educated to speak the R&D language, for this is the place where our options for the future will be developed.

Let there be no doubt that each of you graduating today, regardless of your service or the country you represent, is a front-runner on a fast track.

We know that much of human progress is the result of improving human know-how. Some years ago Edward F. Denison demonstrated that a most significant factor in explaining the United States' economic growth has been investment in education. In fact, the education contribution significantly exceeded the contribution due to physical capital. More recently, other thoughtful leaders, most notably Theodore W. Schultz of the University of Chicago and the National Bureau of Economic Research, have estimated the return to graduate education as about 15 per cent. Since the armed services must be at the forefront of technology, we would expect the payoff to be even higher. This evidence suggests that we are acting in haste when we reduce graduate military education. One mistake in a major weapon development or procurement program can cost as much as the entire DOD graduate education budget for 10 years or more. But of more fundamental importance, the ability to understand and react to new enemy technology quickly in wartime may well make the difference between disaster and success.

Since its last Annual Report, the Naval Postgraduate School has changed, has broadened its mission, and has improved its academic excellence. Existing curricula have been modified and new curricula (such as the operationally oriented Electronic Warfare program) have started development. The off-campus programs and the academic counseling mentioned in last year's report have improved and have gathered momentum even though severe budget constraints have retarded their progress. This Report describes these changes and defines the basis for our planning for the future.

We cordially welcome Kermit Hanson, Gerald Lieberman and Russell O'Neill as new members of our Advisory Board. Upon completion of their term as members of the Board of Advisors, we extend our most sincere appreciation to Mark N. Christensen, William R. Gould, Neil H. Jacoby, and George J. Maslach for their outstanding service and wise counsel.

There have been continuing pressures on graduate education, and certainly budgetary and other pressures may be felt in future years. The faculty and staff at the School have responded very positively to meet these challenges. The School is in a much improved position to serve the needs of the Navy and the Department of Defense.
Isham Linder  
Rear Admiral, U. S. Navy  
Superintendent  
Naval Postgraduate School

A Naval Academy graduate and a naval aviator, RADM Linder has commanded USS Cleveland (LPD-7), USS Intrepid (CVS-11), and Air Antisubmarine Squadron 25. After promotion to flag rank, he was assigned as Commander Cruiser Destroyer Flotilla Two. RADM Linder holds the Ph.D. in Engineering Sciences from the University of California at Berkeley. He has qualified as a naval nuclear propulsion supervisor by study at the Naval Reactor Training Schools at Mare Island, California and the National Reactor Testing Station, Idaho. In his last assignment before coming to Monterey, RADM Linder served in the Office of the Chief of Naval Operations as head of Nuclear Powered Aircraft Carrier (CVAN) Coordination.

Jack R. Borsting, Ph.D.  
University of Oregon  
Provost and Academic Dean

Dr. Borsting was appointed to the School's top academic post on January 1, 1974. He is past president of the Military Operations Research Society and the Operations Research Society of America, and a Fellow of the American Association for the Advancement of Science. He has been an Advisory Board member of the Naval Personnel Research and Development Center, San Diego; a Planning Committee member, Unified Science and Mathematics for Elementary Schools, Educational Development Corporation (National Science Foundation Project), and U. S. Representative, International Committee for NATO Conference on Education in Operations Research.

STUDIES AND SURVEYS

The year 1975 was marked by a series of reviews which probed the Navy's graduate education program and the operation of the Naval Postgraduate School. Two of these studies were an extension and a continuation of the general analyses of graduate education in the armed services initiated by Congressional committees two years ago. Previous reviews had included the Bayne Study of 1974—a voluminous Navy study of the identification of requirements for graduate education and of the utilization of graduate-educated officers—and other studies of these personnel actions. In 1975 the Department of Defense Committee on Excellence in Education examined the graduate education programs of all services. In addition, the Secretary of the Navy impanelled a select committee to examine individual education programs. Other reviews included the normal accreditation and internal management processes of the Naval Postgraduate School.

Department of Defense Committee on Excellence in Education

The DOD Committee on Excellence in Education is the name given to a small group of senior officials (the Deputy Secretary of Defense, chairman, together with the Secretaries of the three services and the Assistant Secretary of Defense - Manpower and Reserve Affairs) who establish fundamental policies for all DOD educational programs. After previous studies of the Service Academies and of the War Colleges, the Committee turned in 1975 to examine post-baccalaureate education. The Committee staff compiled extensive studies of these programs early in the year, and preliminary meetings of the Committee with the Superintendent and Provost were held in Washington in June. The Committee visited the Naval Postgraduate School in August. Policy decisions resulting from this review of DOD graduate education programs were published by memorandum in November.
The Committee recognized the need for a "career force of officers who are capable of overcoming the multiplicity of complex problems which arise in providing for the national defense." It found that post-baccalaureate education is essential to ensure that there are sufficient numbers of officers with the requisite knowledge and skills. "Indeed, officers who have had such educational experiences are absolutely vital to defense programs."

The Committee directed that a number of initiatives be undertaken by the Department of Defense in the management of the educational programs. These include:

1) Development of a DOD policy on post-baccalaureate education which places this education in the context of career development and defines its relationship to other educational programs.

2) Improved management of the determination of educational requirements, the supervision of the educational programs, and the assignment of graduates.

3) Development of uniform methodologies for determining costs and for assessing the value of the various DOD programs.

4) Better utilization of existing programs and initiation of improved methods for developing new programs and for phasing out obsolescent programs.

5) Development of closer ties between the Naval Postgraduate School and the Air Force Institute of Technology.

Appended to this formal action memorandum were additional comments on the two DOD graduate level institutions. In the case of the Naval Postgraduate School, the Committee recommended:

1) An expansion of efforts to reduce the time officers are in residence as students.

2) A broadening of the student population to include more participation by other services and from foreign countries.

3) Continuation and expansion of the Continuing Education program.

4) Development of additional interdisciplinary, operational curricula on the pattern of the Antisubmarine Warfare curriculum.

5) Greater support from other services in providing qualified officers for assignment to the faculty.

It is apparent that these initiatives and recommendations can have a profound effect on graduate education policies and procedures in the future. To the extent that they are implemented and monitored, they will cause shifts in the management methods of the services, and will produce changes in NFS programs.

Initial actions in response to this memorandum are underway. The Navy immediately began the development of a statement of graduate education policy to describe in detail the objectives of the education program and to delineate the responsibilities of the Chief of Naval Personnel, the Chief of Naval Education and Training and the Superintendent of the Naval Postgraduate School. The Chief of Naval Operations approved this statement of policy in April 1976, and directed that it be published and distributed widely in the Navy. It is reproduced in this report. A Navy/Air Force cost study is underway to identify a common methodology for determining graduate education costs. Other actions are evident in this Report in subsequent discussions of changes occurring at the Naval Postgraduate School.

Secretary of the Navy Select Committee

The Navy Graduate Education Program Select Study Committee was formed by the Secretary of the Navy to "study the curricula of the Navy graduate education program and recommend which unique Navy specialty and subspecialty requirements can most effectively be provided by the Naval Postgraduate School and which can best be provided at civilian universities."

The Committee's membership included both educators and executives. Its chairman was Provost George Maslach
of the University of California. Members were Fred Burgess, Dean of Engineering, Oregon State University; Robert Duffy, President, Draper Laboratory, Cambridge, Mass.; Carl Hall, Dean of Engineering, Washington State University; Guilford Hollingsworth, Technical Director, Naval Weapons Center, China Lake; William Perry, President, Draper Laboratory, Cambridge, Mass.; Donald Rice, President, The Rand Corporation; and Frank Sanders, Vice President, The Signal Companies.

The members of this Committee made several visits to the Naval Postgraduate School and spent many hours with the faculty and staff studying the curricula offered in the Navy's total graduate education program. Their report to the Secretary of the Navy, presented in two volumes, contained some 13 recommendations in six general areas.

1) Recommended locations were given for all of the Navy's graduate education curricula. Changes recommended were moving of the Advanced Science curricula from NPS to other universities, and moving of certain management programs from various universities to NPS.

2) An incremental cost analysis technique was developed for use in determining future curriculum location decisions.

3) Three recommendations supported the development of continuing education and other non-traditional methods of instruction.

4) It was recommended that NPS be the repository for academic records of all naval officers and that NPS undertake educational counseling for purposes of officer career development.

5) An increase in total Navy utilization of NPS was recommended, with a reduction in year-to-year fluctuations of student levels.

6) The Committee urged the Secretary of the Navy to encourage all DOD activities to make greater use of NPS capabilities.

The Secretary of the Navy has approved the report of this Committee, and has directed that the recommended actions be undertaken. The few shifts in curricula recommended by the Committee will occur in the next year and will result in some additional emphasis on management studies at NPS. The recommendations concerning increased Navy utilization together with reduced student load fluctuations and those concerning support of the Continuing Education program will require actions and continued interest by the Chief of Naval Personnel and the Chief of Naval Education and Training.

Faculty Utilization and Productivity

Provost Emeritus F. E. Terman, Stanford University, generously responded to an invitation by the Superintendent to examine the School's utilization of its most important resource, its faculty, and to make recommendations as appropriate for improvement. Dr. Terman noted that the operation of the Naval Postgraduate School is well planned and comparable in efficiency to that of the typical high quality graduate program in civilian universities in spite of restraints imposed on the School. He suggested that it might be possible to introduce certain modifications which would not adversely affect quality but would achieve, over a period of time, some significant but not spectacular increase in faculty productivity.

Among his recommendations were suggestions upon enlarging the student population within classrooms, either directly or through other methods which would permit more flexible programs within the school structure. A reduction in the number of courses taught could be effected through the consolidation of separate but similar courses into combined single courses, and through the modification of curricula to incorporate existing or other like courses. He stressed flexibility in the curricular programs through use of alternative scheduling patterns for students.

Dr. Terman also emphasized the use of innovative methods for education through use of new technologies and ideas. He noted the prospects for the Personalized System of Instruction (PSI) in its application to
graduate programs at NPS and the possible use of the shorter unit concept for some courses.

Dr. Terman's recommendations are being incorporated as curricular reviews and schedule planning permit the course modifications to be accomplished.

Accreditation Review

The Naval Postgraduate School is accredited by the Western Association of Schools and Colleges. Due to its record in previous accreditation reviews the School has been granted accreditation for the maximum period permitted by the policies of the Association. An Accreditation Committee visited the School in 1975, reviewed the academic activities, and prepared a report which again reaffirmed full accreditation.

The Accreditation Committee's report contained a number of comments on the academic procedures and policies of the School. The high academic standards maintained in all School programs were particularly noted and the School was commended for insisting on them. The Committee recommended that the library continue to be supported adequately in this period of constrained finances, and commented on the importance of aggressively marketing the new Continuing Education program.

The Committee concluded that the Naval Postgraduate School's "educational programs have academic substance and are of high quality..."
**Student Input to Graduate Programs at NPS**

<table>
<thead>
<tr>
<th></th>
<th>1974</th>
<th>1975</th>
<th>1976*</th>
</tr>
</thead>
<tbody>
<tr>
<td>U. S. Naval Officers</td>
<td>381</td>
<td>364</td>
<td>323</td>
</tr>
<tr>
<td>U. S. Marine Officers</td>
<td>13</td>
<td>31</td>
<td>32</td>
</tr>
<tr>
<td>U. S. Army Officers</td>
<td>10</td>
<td>7</td>
<td>26</td>
</tr>
<tr>
<td>U. S. Air Force Officers</td>
<td>8</td>
<td>17</td>
<td>39</td>
</tr>
<tr>
<td>U. S. Coast Guard Officers</td>
<td>17</td>
<td>13</td>
<td>18</td>
</tr>
<tr>
<td>N. O. A. A.</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DOD Civilians</td>
<td>3</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>International Officers</td>
<td>94</td>
<td>75</td>
<td>63</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>523</td>
<td>511</td>
<td>531</td>
</tr>
</tbody>
</table>

*estimated

The number of naval officers entering graduate programs continues to decline over this period. While the Congressionally-imposed student ceiling is a factor, this decline is due primarily to competing requirements to man fleet units and training activities while total naval officer strength has been reduced. Total requirements for graduate-educated officers remain high and the naval officer student reduction has been greater proportionally than any change in these total requirements.

The reduced naval input at NPS is compensated for by the arrival of additional officers from other services and of Department of Defense civilian employees — evidence of the broader utilization of NPS directed by Deputy Secretary of Defense Clements' Committee on Excellence in Education.

Significantly, during this three year period of reasonably constant input the average number of students in residence has declined.

**Average Number of Students Enrolled at NPS in Graduate Programs**

<table>
<thead>
<tr>
<th></th>
<th>1974</th>
<th>1975</th>
<th>1976*</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. O. B. (Graduate)</td>
<td>1175</td>
<td>1053</td>
<td>960</td>
</tr>
</tbody>
</table>

*estimated

While this decline is due in part to graduation of students who entered in the larger annual classes prior to 1974, it also reflects an active effort by NPS to shorten the average time in residence needed to complete an educational program. Shorter average programs are being realized by actions in three areas:

1. Complete flexibility is now emphasized in student scheduling. Validation of previous study is readily accomplished and students are scheduled only for the courses they must have to meet the objectives of their specialty area. As one example, 21 of 23 officers who arrived in 1975 to study electronics and communications validated enough courses to permit advanced placement in the curricula.

2. Curricula are being reviewed to determine where they can be shortened. A recent example of this is a decision to shorten an operations research curriculum by two quarters.

3. Curricula recently offered to satisfy new service requirements have tended to be shorter. The Naval Intelligence program at 18 months and the new National Security Affairs (Area Specialization) program at 12 months are shorter than the previous average course length.
Projections of these student enrollment statistics would indicate that the Naval Postgraduate School can expect student numbers to stabilize at or slightly above the 1976 estimated levels. The number of naval officers entering in 1976 is fully justified by Navy requirements for graduate-educated specialists and is within Congressionally imposed ceilings. The pressure of these requirements should prevent further reduction in Navy numbers. The numbers of officers from other services have gone through some perturbations as each service has adjusted to the Congressional mandate. It is now expected that they will show a slight rise as the defense-wide capabilities of the Naval Postgraduate School are more widely understood.

An interesting and promising new development has occurred with the arrival of the first government civilians as students. The Naval Postgraduate School's concentration on the defense requirements allows for a particularly efficient directed educational process which can be closely tailored to the needs of the Federal civilian employee and his sponsor. Discussions between the Department of Defense and other interested personnel indicated the feasibility of, the existence of, and the advantages of civilian utilization of Naval Postgraduate School programs. In late 1975, the General Counsel of the Department of Defense advised the Navy that Federal Government civilian employees could be accepted for regular enrollment in courses, curricula and degree programs in the Naval Postgraduate School. Civilian enrollment commenced in 1975 with the entrance of one student into the Financial Management curriculum and two students into the Systems Acquisition Management curriculum (all three are employees of the Naval Weapons Center, China Lake). In addition, NPS faculty have begun a one-year defense executive management program for the Naval Aviation Executive Institute with classes conducted at NMC Point Mugu. It is expected that future defense executive management education for civilian employees of the Naval Air Systems Command will be provided at Monterey.
EDUCATIONAL PROGRAM CHANGES

New educational requirements and changing educational objectives provide the impetus for curricular development and adjustment at the Naval Postgraduate School. Programs cannot be static; they must change to meet changing needs of the services. The past year has provided a number of examples of this educational dynamism.

Weapons Engineering Graduate Education (revision of curricula)

A review of the Weapons Engineering programs occurred in conjunction with a broader Navy study of the weapons subspecialty identification codes. This has resulted in a general consolidation of both the codes and the weapons curricula. Three separate weapons curricula have now been consolidated into two—Weapon Systems Technology and Weapon Systems Science. The Weapon Systems Technology curriculum provides a broad, multidisciplinary sequence of studies. Systems integration is a major feature of the program, and the application of computers in weapon systems (particular software implications of computer development) is thoroughly studied. Option sequences permit concentration either in weapons electronics (development of fire control radars, weapon control systems, etc.) or in applied science (systems engineering, materials science, computers, etc.). The Weapon Systems Science curriculum is more heavily oriented toward the application of physics, chemistry and analysis to weapons development. Electro-optic and laser applications to weapons are thoroughly studied. Nuclear physics, solid state physics, and other developments in modern physics that relate to weapons development or to weapons control systems are included.

Air-Ocean Science (revision of curricula)

A decision by the Navy to gather meteorologists and oceanographers together into one specialist community (geophysicists) required the development of an associated graduate education program. This Air-Ocean Science curriculum combines appropriate features of the existing Meteorology and Oceanography curricula, but has required a significant amount of course development to provide an integrated interdisciplinary sequence of studies. The geophysics specialist will study the air-ocean environment—a full range of oceanography, including underwater sound and acoustic forecasting, together with meteorology, leading to dynamic analysis of the atmosphere and the worldwide numerical forecasting methods now used in support of fleet operations. The enrollment of the first class in the Air-Ocean Science curriculum occurred in September 1975.

The existing Oceanography curriculum will remain in use by Navy line officers who are chosen to study in this field as a subspecialty. The Meteorology curriculum will no longer be needed for naval officers, but is retained for officers of other services (particularly the Air Force) who require this academic discipline.

The advent of the geophysics specialist will probably mean that specialists previously educated in either meteorology or oceanography will return to Monterey for additional education in the other environmental discipline and for supplementary study in the interrelationship of these two sciences.

National Security Affairs (Area Specialization) (new curriculum)

A new curriculum has been developed, in cooperation with the Defense Language Institute of Monterey, to meet a multiservice requirement for officers qualified by graduate education and by language fluency for assignment to posts in foreign countries. The Naval Postgraduate School phase of the curriculum is divided into two parts: 1) requirements in the field of National Security Affairs, and 2) requirements in the area of specialization (areas now available for study are the Soviet Union, Middle East, Asia and the Pacific, and Western Europe). The National Security Affairs studies cover such matters as problems of security assistance and arms transfers, the law of war as
observed and enforced by the United States, weapons and foreign policy, and related studies of the armed forces' role in international relations.

The studies of the area of specialization cover the problems of government and security in the selected region, languages and cultures, history, and special problems of U.S. security interests in the area.

After initial studies at the Naval Postgraduate School, the officer student enters a language program at the Defense Language Institute. Along with language training, he continues his area studies through joint NPS-DLI colloquia.

The first class in this new program entered in July 1975, with subsequent classes scheduled to enter at six-month intervals. All students in the first two classes were Army and Air Force officers.

Electronic Warfare (new curriculum)

The success of the interdisciplinary, operationally oriented Antisubmarine Warfare curriculum has led to an interest in having this educational philosophy extended to another important warfare area—Electronic Warfare.

Spurred by the interest of the Under Secretary of the Navy, the Navy surveyed its requirements for specialists in this warfare area, and identified those billets that should be filled by officers with a firm educational background in the sciences that govern electronic warfare and in associated technology and analysis.

The Commander, Naval Electronics Systems Command was designated as the responsible officer to supervise the development of an operational electronic warfare curriculum. This process is now underway at the Naval Postgraduate School. The faculty committee developing this program has now proposed that it be based on a suitable mixture of studies of electronic signals and processing systems, electromagnetic propagation and radiation, electro-optic devices and systems, operations analysis, meteorology, computer applications in weapons systems, signal intelligence, and related subjects.

Course development will continue through 1976 with the first class expected to enter in March 1977. Class scheduling and course development are being conducted to provide as much commonality with the Antisubmarine Warfare curriculum as is feasible.

Aeronautics (modular development of curriculum)

The modified Aeronautical Engineering curriculum, designed to permit entry of students into the program at any time they can be ordered to the Naval Postgraduate School, has demonstrated the expected advantages in flexibility that warrant continued course development. The program was made possible by reduction of the preparatory phase to two quarters and by development of this preparatory material in the format of one-unit, self-study modules. In this manner a student can be scheduled to study the sequence of individual modules best suited to his intended area of specialization. And he can proceed initially at his own pace.

Initial experience has shown that students generally complete this preparatory phase in a shorter time than was true under the formal classroom schedule method. The model, although not yet fully tested, is attractive for the promise it holds of reducing education costs by reducing time in residence.

Course development continued in 1975 to produce one-unit modules covering such subjects as engineering dynamics, structural fundamentals, thermodynamics, fluid dynamics, gas dynamics, compressible flow, and reaction propulsion systems.

Management and Industrial Engineering (change in location of curriculum)

A relatively small educational program to provide Engineering Duty Officers with the fundamentals of industrial and defense management, the Management and Industrial Engineering Curriculum has been transferred from a civilian university to the Naval Postgraduate
School. This curriculum was examined by the Select Committee on Graduate Education with the conclusion that such a transfer would strengthen the course by orienting it to Navy/Defense issues. Students select an appropriate sequence of studies from existing NPS courses emphasizing statistics, operations analysis including systems and decisions analysis, government accounting procedures, organization and management, and related topics in industrial engineering. The first students in this curriculum entered NPS in September 1975.

**Advanced Science (change in location of curriculum)**

Fundamental studies in mathematics, physics, and chemistry were provided to a small number of officers at the Naval Postgraduate School and at various civilian universities. The Select Committee on Graduate Education recommended that this requirement be met entirely by civilian universities. The Postgraduate School will continue to provide academic expertise and to offer courses in these fields as needed by other curricula, but will no longer offer the concentrated science curricula.

**Procurement Management; Financial Management (change in location of curricula)**

The Select Committee on Graduate Education examined the various Navy curricula in the management area and recommended, on the basis of marginal cost analysis and the School's focus on defense problems, that certain of these be concentrated at the Naval Postgraduate School. All Navy requirements for Financial Management will be met by NPS beginning in 1976. The Procurement Management curriculum and two related small programs will be offered at NPS in 1977. All of these management curricula derive from studies of government accounting, purchasing, material management, statistics, budgeting, procurement, contracting, production, negotiation, decision making, and related courses. Academic expertise and associated research programs are solidly established at the Naval Postgraduate School and can readily provide these curricula.

**All Officer Academic Records Centralized at the Naval Postgraduate School**

The role of the Naval Postgraduate School in the Navy's graduate education program has been extended in the last year by decisions to centralize academic records of all officers at Monterey and by directions to the School to inaugurate an academic counseling program.

The Naval Postgraduate School has for several years evaluated the academic records of officers being considered by the annual graduate education selection board. These evaluations were often hampered by missing records and frequently slowed by incomplete files. Under new procedures, undergraduate academic records for all newly commissioned officers are being sent to NPS by the Naval Academy, Naval ROTC units or other commissioning activities.

Procedures have now been established to evaluate these academic records, reduce the evaluation to a convenient code, and then inform each junior officer of the results. Dr. Brooks Lockhart, Dean of Curricula, has acted as consultant to the postgraduate selection board in the past and is developing these procedures.

To inaugurate this program, NPS is now in the process of sending letters to all officers of year group 1974 (except those in the healing arts) reporting on their evaluations (or requesting that they provide their college transcripts if none have been found in the files). These undergraduate evaluations are expressed in terms of a three-number Academic Potential Code. One number of the code represents the highest level of mathematics studied, one reports the science studied, and one the general grade average for all undergraduate studies. Entry requirements in terms of the Academic Potential Code have been established for all Navy graduate programs. The officer who receives such a letter from NPS can determine how his academic code compares with those required for the various graduate curricula, and he will be advised of self-study programs and other measures he may use to continue his education and to prepare himself for formal graduate studies.
Dr. W. M. Woods was appointed Executive Director and Dean of Continuing Education in June 1974 to develop and administer educational programs and functions that lie outside traditional classroom studies. Under his direction, Continuing Education functions at the Naval Postgraduate School are evolving in three distinct directions:

1) preparation of self-study, full-credit courses in a format best suited to the needs and interests of the fleet officer;

2) development of short courses on specific technical and management subjects for delivery both at NPS and at other locations; and

3) expansion of educational counseling.

This Continuing Education program was formally established by CNET Instruction 1520.8 in September 1975.

Self-Study Courses

Continuing Education self-study courses are being developed following the general format of the Personalized System of Instruction (PSI). The PSI Technique is a mastery-oriented learning method that has evolved in recent years through imaginative work by some of the nation's leading universities. It permits self-paced study of a subject and, as modified by NPS for Navy use, relies on the assistance of a fellow officer who has previously studied at the graduate level and acts as a tutor.

The Naval Postgraduate School Continuing Education catalog for fiscal year 1976, issued in the fall of 1975, lists courses initially in preparation together with tentative dates for issuance of the first group of courses. These first courses are concentrated in the area of graduate preparatory work. It is intended that most of the material presented in the first two quarters of the standard curricula will be made available
in the PSI or other self-study mode. Since the cost to the government of graduate education is primarily a function of the time an officer is in residence at an educational institution, a program that will permit an officer to complete some work while still in his fleet assignment can lead to significant education cost savings.

Two special workshops were conducted in 1975 for faculty members of the Naval Postgraduate School by members of the Center for PSI, Georgetown University, to introduce techniques needed for writing and delivering these courses. From these workshops and from a careful study of the requirements of the operational naval officer, a course development process has been devised. As courses are developed by individual faculty members they are carefully reviewed by a faculty committee, then class tested, evaluated again and revised as necessary. Field testing off campus completes the development process for each course. If satisfactory in all phases of this development, evaluation and testing, the courses are ready for general distribution.

The first courses completed and issued to interested applicants are: Precalculus Mathematics, Linear Algebra, Circuits Signals and Systems, Physics I, and Probability. By mid-1976 a full calculus sequence will be available, the remainder of the physics sequence, and a full range of aeronautical engineering preparatory courses. Other courses will become available as the year progresses. This course development has been slowed by funding restraints.

Initial response by officers to the announcement of the program has been good. Applications are arriving at NPS at a steady rate. Between the fall of 1975 when the catalog was issued and the end of the year, approximately 200 officers requested enrollment. Since courses are being released only after a careful development cycle, a number of early applicants have been asked to wait until the courses they requested are ready. Officer volunteer tutors have responded enthusiastically to the program and will readily fulfill the current requirements for tutors. The present rate of enrollment is approximately 30 per month.
Short Courses

Naval Postgraduate School faculty have conducted more than twenty short courses in the past year on Navy related subjects. The majority of these were delivered at various naval activities throughout the country while others were provided on campus. Course length varied from one day to six weeks. Attendees numbered more than five hundred, including both officers and civilians. Topics covered in these short courses ranged from electronic warfare through shipboard electromagnetic compatibility to military utilization of microcomputers, and into the field of Navy Financial Management. Continuing Education Units were awarded for completion of the courses.

A catalog of short courses available for delivery off-campus and on-campus was issued in 1975 with full information on the range of expertise in the NPS faculty and with data on program costs. The courses are delivered on a reimbursable basis. Additional details for initiating new courses or obtaining available courses is contained in the Chief of Naval Education and Training (CNET) Instruction 1520.8.

A special seminar-workshop was developed for the Director of Naval Research on "Science, Technology, and Public Policy." Outside consultants and authorities in related fields were invited to participate in the lectures, seminars and discussions, augmenting the NPS faculty.

Educational Counseling

"It is by no means enough that an officer of the Navy should be a capable mariner. He must be that, of course, but also a good deal more..." That quotation, which introduces the famous letter by John Paul Jones on the qualifications of the naval officer, has served for two centuries to remind officers that they must continue to study and to learn throughout their careers. The Navy is a highly technical service whose weapons and tactics undergo continuous change as technology moves forward. Officers must have a solid background of educational fundamentals and must continue to broaden their knowledge and develop their technical and scientific expertise.

Opportunities for this continuing learning vary with duty assignments and operational requirements. Full-time graduate education is available for only a fraction of all officers. Other means of education—self-study, "classes of opportunity," other programs—are available to all.

In order to assist naval officers to discover the educational opportunities available to them, the Naval Postgraduate School has established an educational counseling office. Efforts are being made to inform officers of the availability of this educational counseling (by mail or by autovon telephone), and suitable informational materials are being prepared for distribution.

The first efforts to inform officers of this service were made in letters to all officers selected as principals or alternates for graduate education programs by the 1975 selection board. This counseling service is also being described in letters written to junior officers informing them of the academic evaluations made of their undergraduate college records (described in another section of this report).

A package of counseling materials for programmed counseling is now under preparation. This will provide planning manuals that constitute a brief self-study course in how to plan an individual educational program. These will be distributed to junior officers who request them. Materials designed to assist senior officers in counseling in the area of graduate education are also under development.

The basic purpose of this program is to provide officers, early in their careers, information on educational requirements within the Navy which are consistent with their chosen area of specialization. This will permit appropriate educational planning which can realistically be implemented and pursued throughout their careers. In the case of those who will attend full-time educational programs, this planning will permit completion of preparatory material before arrival at NPS or other university, thereby shortening the full-time program and resulting in significant education cost savings.
RESEARCH

Background

The basic NPS mission statement relates the research program to academic excellence. The graduate educational process necessarily involves teaching of principles which come from the frontiers of technical and professional knowledge. The research program provides the means for faculty scholarly activities at or near these frontiers and permits officer students, in the limited time available for their advanced education, to complete a meaningful thesis project. Almost all NPS students are required to submit an acceptable thesis as part of their educational program. Most of these theses are directly related to the research project of the faculty advisor. Also, as in most higher educational institutions, the research program is the activity by which the institution carries out its traditional function of generation of new knowledge. At NPS this function contributes to the Navy's RDT&E knowledge and technology base.

Research at NPS supports the Navy's RDT&E objectives as follows:

Initiates and conducts scientific research of a long-range nature in areas of special interest to the Navy.

Conducts exploratory development deriving from scientific program areas or in other areas specifically requested by the Navy.

Performs scientific research and exploratory development where uniquely qualified, for other agencies of the Department of Defense and in areas related to defense or other Federal Government agencies.

Furnishes consulting services for the Navy and, where specially qualified, for other Government agencies.
The pervasive defense orientation of faculty research interests makes NPS unique among graduate educational institutions in the United States. There is no question that the emphasis is in military-related areas. A second unique advantage is the concentration of young and experienced student officers in one facility. On the average, the student has six years operational experience in his warfare specialty before coming to NPS. Further, the student body is made up of officers from all warfare specialties--aviation, surface, subsurface, and Marines, as well as officers from the staff, sister services, and allied countries. These participants in the NPS research program insure a pragmatic and realistic orientation to most projects. In addition, NPS has the ability to handle classified research projects including special classifications controlled by the Chief of Naval Intelligence.

From an educational standpoint, the research contributes to emphasis and focus of the educational process. Problem-solving is the basis of the technical and management professions. While the basic structure and logic of professional problem-solving tends to be uniform across the professions, the specific problems vary widely. The research program provides numerous examples of the unique militarily related technical and management situations that the officer will encounter in his future career. The principles and skills as they are taught are closely related to military problems, which in turn are derived mostly from a broad research program. Further, the actual thesis work is usually part of the overall focus to the educational process. In addition, because of the classroom and laboratory emphasis on Navy problems, the total environment of the educational process at NPS is well matched to the student officer.

The research program contributes to the excellence of the educational process. The quality of the process is heavily dependent upon the superiority of the faculty. As mentioned before, a major objective of the research program at NPS is the maintenance of the professional competence of the faculty in their professional field.

The program also contributes to the academic reputation of the School. As a graduate institution, NPS maintains close contact not only with the Navy community, but also with the academic community. The research program is a primary means for maintaining this contact and interaction. The result of such interaction is a continuing interest by faculty members in other institutions in the Naval Postgraduate School.

Sponsors of the program include:

- Office of Naval Research
- Naval Electronics Systems Command
- Naval Sea Systems Command
- Naval Air Systems Command
- Various Navy Laboratories
- National Science Foundation
- Energy Research and Development Agency
- Air Force Office of Scientific Research
- National Aeronautics and Space Administration
- and others.

Highlights of 1975 Research at NPS

As mentioned, research at the frontiers of knowledge is fundamental to the graduate education program. The School received notification this year that the continuing research in nuclear physics, carried out on the linear accelerator and supported by the Research Foundation and the National Science Foundation, was considered highly significant. Specifically, in the area of giant multipole resonances in nuclei, NPS researchers have carried on work first reported by Edward Teller (1948). Extensions of the model have suggested the existence of similar giant resonances with other multipolarities, such as the quadrupole mode, which can most simply be regarded as two dipoles oscillating back to back. Two distinct kinds of vibrations exist—"isoscalar" modes wherein all the nucleons (neutrons and protons) move together and "isovector" modes in which the neutrons oscillate against the protons. The isovector giant-dipole resonance of Goldhaber and Teller and the low-energy isoscalar quadrupole and octupole resonances have long been well known.
Electron-scattering experiments at Darmstadt University, Sendai University, and the Naval Postgraduate School, proton-proton scattering experiments at Oak Ridge and recent alpha-alpha experiments at Texas A. and M. have led to the identification of the isoscalar and isovector branches of a higher-energy quadrupole giant resonance; these resonances occur systematically across the nuclear periodic table at excitation energies of 20-30 MeV. There is hope that further detailed study will reveal a monopole giant resonance believed to lie in the same range of excitation energies. This would yield information on an aspect of nuclear matter about which little is known - its compressibility. This research is continuing.

Each year, the Office of Naval Research selects certain projects (about 12) as "Significant Accomplishments." Again, the output of a continuing NPS research program in underwater sound propagation was cited. Specifically, the program developed the first satisfactory stochastic model for the scattering effect on sound transmission of air bubbles in the upper ocean.

In October of 1975, the Office of Naval Research reviewed, at our request, the Foundation Research Program. Their evaluation stated:

"The Foundation Research Program appears to the reviewers to be of good quality and well related to the educational mission of NPS. The DOD orientation of most research areas is clear. Many excellent projects were reviewed: some are fully comparable to the best research at topflight civilian universities.

"In brief, the FRP appears to be well managed and of good quality, with many projects achieving true excellence. Coordination with the academic program is good."

A final noteworthy statistic should be mentioned. The number of National Science Foundation and Office of Naval Research (Contract Research Program) projects now exceeds 25 or about 14 percent of the entire research program. The significance of this may be summarized by ONR reviewers:

"The ONR Contract Research Program (CRP) is composed of the best research with naval objectives that can be found, since the standards of quality in the CRP are meant to be the highest possible. Academic institutions compete on a nationwide basis with industrial, nonprofit, and government laboratories for ONR support. NPS itself received almost as much funding in sponsored research from ONR in FY 1975 as it received in FRP funds. This is clear evidence that, at least in some areas, the research at NPS is fully comparable to research in other institutions, some of which are wholly involved in research and development."

Brief Summaries of a Few Selected Research Projects

During 1975, there were almost two hundred sponsored and foundation research projects at NPS. Each of these is summarized in the Annual Research Summary published by NPS. Here a very small sample of these projects are reviewed.

Professors P. C. C. Wang (Mathematics) and H. Medwin (Physics) have cooperated in modeling fluctuations of sound propagation in the upper ocean. Specifically, mathematical models have been constructed to show how low frequency sound speed fluctuation is influenced by existence of bubbles in the upper ocean.

Experimental verification of preliminary models shows that successful predictions of maximum fluctuation of low frequency sound occurs at the resonance frequency of the bubbles. These preliminary models have been expanded in several more realistic ways, i.e., (1) Wilson's propagation formula is no longer restricted to a linear form, and (2) bubble populations are treated as random variables rather than mean values.

Experimentally, during FY 1975, computerized equipment was developed in situ. Initial data on sound speed dispersion, attenuation and infrared microbubbles in the upper ocean were obtained. The experiment is continuing in search of the interrelations between ocean parameters, bubble presence, and sound propagation under various ocean conditions. (This work was
sponsored by the Office of Naval Research).

Professor C. R. Jones (Operations Research and Administrative Sciences) has been working in the area of procurement research.

A model is specified for a representative defense contractor. The contractor is assumed to maximize the expected utility of managerial emoluments, performance of the contractor's product and corporate annual net income over a finite planning horizon. This maximization is constrained by the technology of research and development, test and evaluation, manufacturing and a centralized warehouse-inventory operation. There are commercial sales as well as a number of ongoing and potential DOD projects. An extensive accounting model of the contractor is included. Corporate financial management involves the issuing and retiring of short and long-term debt and equity in addition to the choice with respect to dividends and retained earnings.

The inputs of the contractor include plant and equipment (both contractor and government supplied), engineering labor (both contractor and government supplied in T&E), engineering support labor (both contractor and government supplied in T&E), administrative labor, manufacturing labor, weapon systems operators (both contractor and government supplied in T&E), material, purchased parts, subcontracted items, and government furnished items. The outputs are a homogeneous product for commercial sale in a competitive market and weapon systems for sale to the government in rival markets for "new" proposals and a bilateral monopoly market in the case of sole sourcing.

Risk is introduced by considering each possible alternate event due to such factors as rival's actions, technological risk, capital market conditions, and variations in government and commercial sales to be grouped in states-of-nature. Thus, the contractor is assumed to plan for a variety of future state-of-nature (contingencies) and chooses a complete plan (inputs, outputs, financing, proposal bids, etc.) for each contingency.

Future research on this project will include characterizing the contractor's response to changes in various aspects of the world beyond the direct control of the contractor, as well as refining the basic model. Also, work will begin on modeling the government side of the DOD-Industry relationship. It is expected that thesis work by officers will be included in this effort. (This work was part of the Foundation Research Program).

Distinguished Professor T. Sarpkaya (Mechanical Engineering) has been working to determine the forces acting on bluff bodies immersed in time-dependent flows.

Experiments were conducted in a recirculating water tunnel, a small U-shaped water tunnel, and a large U-shaped water tunnel with smooth and rough circular cylinders and spheres in the range of Reynolds numbers from 5,000 to 1,000,000. The velocity in the water tunnel consisted of a harmonically oscillating component superposed on a mean velocity. The drag and lift coefficients have been determined in terms of the Reynolds number and the appropriate flow parameters. The velocity in the U-shaped tunnels consisted of a purely harmonic oscillation. The lift, drag, and inertia coefficients have been determined in terms of the Reynolds number, period parameter, and relative roughness.

A potential flow model of two-dimensional vortex shedding behind bluff bodies was developed. The free shear layers which emanate from the sides of the body were represented by discrete vortices through the use of the appropriate complex-velocity potential and the Joukowsky transformation between a circle and the body cross-section. The analysis was then applied to predict the kinematic and dynamic characteristics of the flow for various flow parameters. (This work was supported by the National Science Foundation.)

An interdisciplinary team, led by Professor E. C. Crittenden (Physics and Chemistry) and including faculty members from Meteorology, Oceanography, Mechanical Engineering and Physics and Chemistry, has been developing methods for predicting the optical propagation properties in the marine boundary layer on the basis
of the bulk properties of the atmosphere, and for determining the dependence of the optical properties on the micrometeorology of the marine boundary layer.

Knowledge of the optical properties of the atmosphere over land has been sketchy, and over the ocean, nearly nonexistent. The information is needed for design and determination of the limitations at sea of a wide variety of military applications of electro-optics. The properties of interest are the "seeing" or resolutions through the atmosphere, the scintillations or intensity fluctuations of a transmitted beam, and the extinction or loss of energy from a beam by absorption and scattering caused by fog and aerosols. The "seeing" is characterized by the modulation transfer function (MTF) and the closely related mutual coherence function (MCF) which also determines the signal-to-noise ratio in a coherent detection receiver. Image wander and its frequency spectrum also are involved in seeing. The scintillation is characterized by and is the simplest source of data on the optical turbulence structure function, $C_n^2$. During the past two years techniques have been developed for measuring these parameters under open-ocean conditions with shore to shore paths and ship to shore paths, using the NPS research vessel Acania, for ranges up to 20 km. Both optical and meteorological parameters are measured simultaneously. Measurements have been made under a variety of conditions for wavelengths of 0.633µm and 10.6µm and have been compared with theory. Extension to all of the principal transmission windows of the atmosphere is underway with lasers at 0.488 and 1.06µm and broadband measurements in the 3-5µm and 4.14µm windows. A chemical laser for use at 3.8µm is under construction. An experiment was carried out with Lincoln Laboratory at Massachusetts Institute of Technology (MIT) to compare our MTF results with theirs, obtained for the Air Force. Our measurements are made with a scanning telescope, while theirs are made with a shearing interferometer. Results are not complete, but preliminary results indicated substantial agreement. (This work was supported by the Naval Sea Systems Command).

Professor D. F. Leipper (Oceanography) and a second interdisciplinary team from Oceanography, Meteorology and Physics and Chemistry are studying analysis and forecasting of marine fog. The objectives of this research are to develop an approach to derive economically a credible global climatology of marine fog occurrence and to improve the capability of analyzing the areas of marine fog; second, to analyze statistically data including radiosonde observation from three typical west coast stations. Specifically, the project seeks to establish those factors affecting the height and strength of coastal inversion and to relate the processes which appear to be occurring in the various stages in a west coast fog-stratus sequence, to document the importance of fog in naval operations and to study fog at a weather ship location. Finally, the project is undertaking work at sea so that offshore conditions may be inferred from regularly available observations along the coast and measurements made of turbulent parameters in fog situations at sea.

The climatology of marine fog over the open ocean is poorly documented, and with reference to a source widely used by the Navy, the climatology is incorrect. The Naval Postgraduate School group has developed a unique approach to deriving marine fog frequencies. Information from the marine synoptic report (coming in usually every six hours) is synthesized by computer to give the probable number of hours of fog during the period of the report. Some 12 years of North Pacific ship-report data (over a half million reports, 30-60N) for the major fog season months of June, July, August and September have been processed to derive credible fog frequencies. As a prototype study the results have universal application to all ocean areas.

Until such time that marine-fog areas can be initially specified accurately and completely, the forecasting of marine fog will remain primitive. Conventional ship data, at best sparse, are not adequate. Therefore, weather satellite observations (infrared (IR) and visual) are being utilized as the source to specify areas of marine fog. A statistical approach to identifying critical brightness (visual mode) and temperature (IR mode) values associated with marine fog appears to have promise.

The importance of marine fog in naval operations
has been documented by consideration of some of its ramifications in two important World War II experiences by evaluating its adverse effects during a recent five-year period in flight and surface ship naval operations and by an overall review of the various types of naval maneuvers which would be influenced by visibility.

For fog forecasting at sea, two specific ocean weather stations were selected and a detailed analysis of events in the fog months of May and June 1953 was prepared. Indicated relationships between sea surface temperature, dew point and the trajectory of air masses may be useful in improving at-sea forecasts.

In the west coast studies, selected synoptic scale meteorological parameters were examined for possible forecasting relationships. This study focused attention on the problems of obtaining representative data and upon verification procedures for fog forecasts. Also, work continued on the definition of the sequence of events which seems often to occur in the development of west coast fogs. If such a sequence can be verified as a common occurrence, it would provide for considerable improvement over the present widely used methods of fog forecasting based largely upon persistence.

A cruise was conducted in late summer 1974 off the northern California coast. Micrometeorological and microphysical measurements were made by another institution and reported by them. NPS personnel made upper air observations and provided overall synoptic analyses for the period involved.

Efforts were initiated to measure the turbulent parameters in fog situations at sea. This work is being done in conjunction with personnel of the Electro-Optics Laser Technology Project referred to above.
FACULTY ACTIVITIES

The faculty have received many personal honors and awards during the past year. While the listing of personal achievements would be quite lengthy, a few can be cited as indicative of the accomplishments of the entire group. Provost J. R. Borsting served as National President of the Operations Research Society of America. Dr. S. R. Parker of the Electrical Engineering Department was chosen as a Fellow of the Institute of Electrical and Electronics Engineers and visited the Soviet Union as a member of the Popov Delegation. Distinguished Professor A. E. Fuhs, Chairman of the Department of Mechanical Engineering, was chosen as a Fellow of the American Institute of Astronautics and Aeronautics and was named Editor of the Journal of Aircraft. Dr. R. Kelly of the Physics and Chemistry Department was selected as a Congressional Fellow by the American Society of Mechanical Engineers, and is presently assigned to the staff of the House Armed Services Committee.

A significant number of faculty members were appointed to numerous national boards, editorial boards, and committees in their respective disciplines. Included in these were Professors D. A. Schrady, K. T. Marshall, M. U. Thomas, and T. Sarpkaya, who were appointed as associate editors of technical journals. Research Chair Professor P. J. Parker continued his service on the Chief of Naval Operations' Executive Panel. Professor D. M. Layton from the Aeronautics Department was honored for his distinguished service as editor of the Journal of the Systems Safety Society. Also included were memberships of Defense Science Task Group and NATO panels.

During 1975 the number of faculty publications and technical reports totaled 235. A short summary of the research is given in another section of this report. The faculty also chaired, organized and presented papers at many professional society meetings. The School hosted 17 of these professional meetings.

In the personnel area, Professor D. E. Kirk was appointed Chairman of the Electrical Engineering Department; Professor A. E. Fuhs was named Chairman of the Mechanical Engineering Department; Professor D. Hoisington was named Chairman of the Electronics Warfare Academic Committee, and Professor Paul Spinks was named the School's Librarian.

The faculty have been very active in designing new courses and curricula for the various service sponsors. Those developed are outlined in the current and continuing education sections of this report.

In recent years the School has put added emphasis on visiting faculty tours at DOD installations and other institutions. This last year 12 faculty members were away from Monterey working for such organizations as ONR, OSD(M&RA), the Naval Air Systems Command, the Hoover Research Institution, NASA, Office of Naval Intelligence, Naval Telecommunications Command, Arctic Research Laboratory, etc.
PRINCIPAL SPEAKERS

During the period of this report, many prominent individuals addressed the student body under the auspices of the various speakers programs conducted by the School. Among these were:

Commencement Speakers

The Honorable G. D. Penisten
Assistant Secretary of the Navy
(�Financial Management) (�

Rear Admiral M. Staser Holcomb, U. S. Navy
Director, Systems Analysis Division
Office of the Chief of Naval Operations

The Honorable H. Tyler Marcy
Assistant Secretary of the Navy
(Research and Development)

Admiral Harold E. Shear, U. S. Navy
Vice Chief of Naval Operations

Vice Admiral Daniel J. Murphy, U. S. Navy
Director, Antisubmarine Warfare and
Ocean Surveillance Programs
Office of the Chief of Naval Operations

Superintendent Guest Lecture Series

Mrs. Elizabeth Mann Borgese
Senior Fellow, Center for the Study of
Democratic Institutions

"Third United Nations Law of the Sea
Conference"

Captain J. W. Kehoe, U. S. Navy
Special Assistant for Intelligence
Naval Ship Engineering Center

"Net Assessment of U. S. and Soviet Destroyer
Design Practices, Trends and Priorities"

Colonel Ben M. Pollard, USAF
Deputy Commandant for Military Instruction
U. S. Air Force Academy

"Education - Hanoi Hilton Style"

Mr. Norman Polmar, Editor, U. S. Section of
Jane's Fighting Ships, Vice President, The
Santa Fe Corporation, Alexandria, Virginia

"Future of the U. S. Surface Fleet"

Mr. Edwin M. Hood, President
Shipbuilders Council of America

"Shipbuilding - A National Resource"

Dr. E. L. Woisard, Special Assistant
Program Planning Office
Office of the Chief of Naval Operations

"Net Assessment of U. S. and Soviet Navies"

Bannerman Lectures in Management and Systems
Acquisition

Dr. J. Ronald Fox, former Assistant Secretary
of the Army (Installations and Logistics)

"Weapons Acquisition"

Mr. David Westermann, President and Chief Executive
Hazeltine Corporation

"Professionalism and Principle and the
Government - Industry Relationship in
Defense Procurement"

Dr. Paul McCracken, Professor of Business
Administration
University of Michigan

"Economic Priorities through the 1970s"
ASSOCIATED AND SUPPORTING ACTIVITIES

Aviation Safety Programs

Three-hundred-fifty officers were educated in the NPS Safety Programs in 1975. This number included 302 officers who attended the basic six-week Aviation Safety Officers' Course and 48 who attended the new four-week Advanced Safety Management Course. An Aviation Safety Command Course designed specifically for aviation commanding officers and executive officers was developed with the inaugural course in April 1976.

Defense Resources Management Education Center

The Defense Resources Management Education Center provided a variety of resource management programs to both U. S. Department of Defense personnel and students from other countries. About 800 U. S. students participated in twenty-two courses which included ten four-week Defense Management Systems Courses, and three Flag and General Defense Management Courses in Monterey. Nine other short courses were provided by the Center's Mobile Training Teams.

Approximately 500 international students received instruction through the International Mobile Training teams, providing seven courses in five nations for three-fourths of the students, and courses delivered at Monterey for the remaining students. The Monterey offerings included two 13-week courses, one four-week senior officer course for flag and general officers and a special senior officer course for the Latin American nations. This Latin American course was taught entirely in Spanish; all materials were translated into Spanish and content was tailored toward the needs of those participating. Ten countries of Central and South America were represented.

Faculty, staff and friends of the Postgraduate School and of the Management Center were saddened by the untimely death on March 6, 1976 of Dr. H. Paul Ecker, Executive Director of the Center from its founding in 1965. Dr. Ecker was known around the world for his expertise in defense management education and for his efforts to provide educational programs wherever they were needed.

Dr. J. E. Dawson, formerly deputy executive director, has been appointed Executive Director of the Management Center. He continues to act as a consultant to the new Congressional Budget Officer and has earned an outstanding reputation as an authority on the budget processes of the federal government.

Dudley Knox Library

The Dudley Knox Library has been under the direction of Associate Professor P. Spinks, Acting Librarian, following the retirement of Professor G. R. Luckett at the end of 1974. Professor Spinks was recently appointed as Librarian.

During the year, the Library's collections grew to approximately 161,000 books and bound volume periodicals, 282,000 research and development documents in hard copy or microfiche form, and 1,800 current journal subscriptions. SABIR-2, the Library's information retrieval service, continues to be heavily utilized, with over 10,000 searches generated during the year. Continued support from the Naval Material Command helped to maintain the Research, Development, Test and Evaluation (RDT&E) on-line terminal, with access to the data bank of the Defense Documentation Center in Alexandria, Virginia. The library was also established as a Chief of Naval Education and Training (CNET) Support Depository, which provides a continuous supply of recreational reading materials, with a value of approximately $7,500 per year.

Internal processing of materials has been altered and improved to expedite the flow of incoming books with reduced personnel and handling. Rising costs have imposed limitations but the staff continues to provide high standards of service characteristic of the Naval Postgraduate School's Library.
The Naval Postgraduate School Foundation, Inc., was founded in December 1970 "to solicit and administer contributions... and dispense charitable contributions... and otherwise aid, encourage and support the traditions of the Naval Postgraduate School."

During calendar year 1975, the Foundation continued its outstanding support for the programs and activities of the Postgraduate School. Funds contributed by students, faculty and other friends of the Naval Postgraduate School were received by the Foundation to support the Dependent Scholarship Fund. The Foundation was able to award eight scholarships. These scholarships constitute an annual program to recognize dependents of faculty, civilian staff and military personnel who merit special consideration for past scholastic achievement and individual potential.

The "Rear Admiral John Jay Schieffelin Award for Excellence in Teaching" was funded by contributions to the Foundation and was awarded to Associate Professor Thomas E. Cooper of the Mechanical Engineering Department. The award is given annually to the faculty member most highly regarded as a teacher by his colleagues and students.

Naval Postgraduate School Foundation, Inc.
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APPENDIX

CNO Memorandum of 26 April 1976: "Postgraduate Education Policy"
MEMORANDUM FOR DISTRIBUTION

Subj: Postgraduate Education Policy

Encl: (1) Postgraduate Education Policy Statement

1. The purpose of this memorandum is to forward a statement outlining my policy on postgraduate education in the Navy.

2. It is my firm conviction that maintenance of naval superiority now and in the future depends significantly on force operational readiness as reflected in the full exploitation of technology in all phases of naval operations. The primacy of this country as a sea-power is dependent on our ability to utilize and maintain operational devices and systems, and to translate that ability to peacetime deterrence through improved war-fighting capability. The leaders of the Navy today, and increasingly in the future, must thoroughly understand the capabilities and limitations of the ships, weapons, systems and resources which they manage. Further, they must have developed the capacity for original thought and problem solving technique which, in turn, will enhance perspective and scope of decision-making. Graduate education represents an essential means to this end and, as such, requires a sizable investment of resources by the Navy.

3. Fully-funded graduate education should be afforded selected officers who combine superior academic capacity with proven professional performance. The thrust of this education must be directed toward filling future Navy needs in operational, technical, and managerial areas. These needs must reflect real, validated requirements, emanating from the fleet or in support of the fleet. It is most important that the institutional process for establishing these requirements be sufficiently broad and sensitive to respond to the challenges of rapid technological change.

4. In today's austere budget environment, it is essential that we ensure the prudent use of our graduate education assets. Utilization tours must effectively capitalize on investment in time and money, not only in shore assignments but in operational units as well. This is particularly important in those graduate areas that are operationally oriented. Operations at sea are conducted under unique conditions and require unique skills and knowledge. This, in turn, produces an important side-effect that significantly affects the assignment of officers to post-graduate training and the subsequent utilization of their skills. The very fact that the professional naval officer must be thoroughly familiar with the wide range of conditions encountered at sea locks him into a sea-shore rotation pattern that ultimately acts to constrain naval educational programs in terms of opportunity, content, and duration.

5. Advanced education should not be confused with functional training. Both are necessary for an effective Navy, but the methods and objectives of the two are quite different. The training process imparts the skills required for efficient operation and maintenance of today's highly technological forces. The educational process concentrates on imparting the general principles and knowledge necessary for innovative problem solving. It is concerned with the broader laws of science, methods of analysis and principles of management that will provide clear guidance for an officer in his naval activities at sea and ashore throughout his career.

6. It is important that all officers be well informed with respect to our graduate-educated officer requirements, the programs that are available, and the desirability of exploiting all opportunities for qualification in areas of Navy need. They must be encouraged to participate in continuing education programs within the Navy and to seek off-duty education, both to enhance their professional capacity and to prepare themselves for taking advantage of fully funded programs.

7. The enclosed policy statement is not intended to cover all matters associated with graduate education. It is designed to indicate those areas where I believe particular emphasis should be placed and to express my interest in ensuring that we employ the full leverage inherent in graduate education for reinforcing total operational readiness.

Distribution:
Deputy Chief of Naval Operations (Manpower)
Chief of Naval Education and Training
Director of Naval Education and Training
Superintendent, Naval Postgraduate School
A. GENERAL

1. The Navy’s Postgraduate Education Program shall support both fleet and shore establishment requirements for specialized, non-functional learning beyond the baccalaureate level to ensure satisfactory performance of duty and to approach optimum performance of duty. It should be understood, however, that the policy statement to follow considers only the Postgraduate Education Program. A policy statement addressing the graduate-level Professional Military Education Program will be issued separately.

2. The Navy is firmly based on a foundation of technology and depends on the knowledge and experience of its officers for its operational effectiveness. The management abilities required for exercising command and the need to thoroughly understand and apply the fundamental capabilities of technologically complex systems under the varied challenges of operations at sea dictate a very real requirement for naval postgraduate education. A determinant of our future Naval strength will be the ability with which we bring new technology to bear on the development and employment of new and improved naval systems. Graduate education will impart to the professionally qualified officer the knowledge needed for total systems management to ensure a superior capacity for sound and innovative use of our operational forces. It will provide a cadre of officers whose special education and expertise will enable them to represent the Navy with maximum effectiveness in any arena where Naval operations are a consideration.

3. Selection for funded graduate education programs shall be limited to those officers who have demonstrated superior performance in their naval duties and who possess the academic capability to successfully complete graduate studies. These criteria presuppose an educational foundation which renders those selected fully equipped to undertake advanced formal education and should negate a requirement for funded remedial/preparatory courses. With the exception of a small number of scholarships (e.g., Rhodes Scholars), officers shall have completed a minimum of one tour of duty prior to being ordered to postgraduate schooling.

4. The number of officers assigned to pursue graduate studies shall be limited in each area of specialization to that for which validated current and future operational readiness requirements exist. This shall normally be determined on the basis of billets, at sea and ashore, which will require education beyond the baccalaureate for performance of associated duties and for the progressive improvement of our naval capability. Current inventory/requirements dictate a minimal assignment to fully funded programs beyond the Masters level.

5. Current manpower and budget constraints demand stability, economy and effectiveness in all fully funded programs. In this regard, the Navy’s policy on obligated service for postgraduate education, in consonance with Department of Defense policy, will be three years for each year of education, without any maximum limitation.

6. Officers who have completed graduate education programs will be assigned to duties appropriate to their academic specialization. These utilization assignments must reflect the unique demands of sea-shore rotation with emphasis on bringing the benefits of this added education to operating fleet units, both directly and indirectly.

7. A Policy Advisory Board shall be established to assist in policy guidance and direction for the full spectrum of officer professional development. This board will be chaired by the Chief of Naval Operations and will be comprised of the Vice Chief of Naval Operations, the Deputy Chief of Naval Operations (Manpower), the Director of Naval Education and Training, and the Superintendent of the Naval Postgraduate School. Basic policy issues will be handled by these members. Membership will be expanded to include the Director, Navy Program Planning when considering programming and budget policy issues; the Deputy Chiefs of Naval Operations for Submarine, Surface, and Air Warfare and other Primary Consultants when considering policy issues affecting their respective areas of warfare or subspecialty responsibility; the Deputy Chief of Staff (Manpower), USMC, when considering policy matters affecting the Marine Corps; and the President of the Naval War College and Superintendent of the U.S. Naval Academy when considering policy matters having a direct interface with these institutions.

8. The Deputy Chief of Naval Operations (Manpower) and the Director, Naval Education and Training will continue to act jointly as the principal agents of the Chief of Naval Operations in effecting policy level coordination with the Naval Postgraduate School.

B. MANAGEMENT

1. The Postgraduate Education Program is organizationally supported as follows:

   The Deputy Chief of Naval Operations (Manpower) (OP-01) is responsible for the validation and allocation of the Navy’s manpower requirements for graduate education.

   The Chief of Naval Personnel determines graduate education quotas, directs the selection of officers for graduate education, and assures the appropriate utilization of graduates.
The Director of Naval Education and Training (OP-099) establishes policies for resource management (manpower and funding of officer graduate education programs), recommends training loads to the Congress, approves the graduate education programs necessary to meet validated requirements and directs the evaluation of curricular programs to meet those needs.

The Chief of Naval Education and Training directs the Navy's graduate level education programs; coordinates the development of educational processes, programs and packages to support Navy requirements; establishes and maintains the approved graduate education curricula and provides resources required for the graduate education program.

The Superintendent, Naval Postgraduate School is the Academic Coordinator for all postgraduate education programs in the Navy and as such: administers the fully-funded graduate educational programs, both at the Naval Postgraduate School, other service graduate schools, and civilian universities; administers the continuing education/off-duty efforts at the graduate level within established policy guidelines; maintains academic records of all officers, providing academic counseling to them; recommends to the Chief of Naval Education and Training new areas of study and new methodology to improve the quality of service effectiveness of future graduates; and advises the Chief of Naval Personnel and the Commandant of the Marine Corps on the academic competence of officers being evaluated for graduate education programs.

CURRICULA OFFERED
AT THE
NAVAL POSTGRADUATE SCHOOL

Operations Research/Systems Analysis
Computer Systems
Computer Science
Meteorology
Oceanography
Air-Ocean Science
Antisubmarine Warfare
Weapon Systems Engineering
Naval Engineering
Naval Intelligence
Underwater Acoustics
Engineering Electronics
Communications Engineering
Aeronautical Engineering
Telecommunications Systems
Systems Acquisition Management
Administrative Science
National Security Affairs (Area Specialization)