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The Naval Postgraduate School Sixty Years Young

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Articles



Capt. Paul R. Schratz, USN (Ret.)

Red Star Over the Southern Sea

22

The significantly increased presence of Soviet warships in the Mediterranean dramatizes the need for wholesale reappraisal of U. S. political, military, and economic policies in the region.



Dennis Rawlins

Peary and the North Pole: The Lingering Doubt

32

The evidence continues to mount that Peary never reached the Pole. It now seems clear that, even if he did, he might as well not have, so questionable was his scientific documentation.



Gail J. Borden

L. S. O.

42

That solitary figure, who used to use his signal paddles to guide carrier pilots to safe landing, is harder to spot now, but he's still back there on the platform, and his job is no less important.



Cdr. Harry W. Bergbauer, Jr., USN

The Near West

47

The so-called "Far East" is far and east only to Europeans. To Americans, it is west—and near enough to make whatever happens in the Orient particularly significant.



Frank O. Braynard

Unidentified Floating Objects

52

There was a resemblance, no doubt of it, between the two old vessels in the separate photographs that arrived within months of each other from sources half a world apart.



Howard R. Simpson

Counter-Guerrilla Operations

56

It has always been so—the regular forces are at a disadvantage when pitted against guerrillas. But, does that mean that it must always continue to be so?

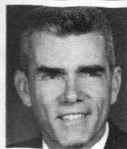


Lt. Cdr. James W. Corey, Jr., USN

A Wetter, Better NROTC

64

Most NROTC courses—and the midshipmen themselves—would profit from a move away from the increasing turmoil of the campus to the more realistic environment of the sea.



Rear Adm. Robert W. McNitt, USN

The Naval Postgraduate School: Sixty Years Young

68

The present superintendent of the Naval PG School tells how that school intends to continue offering the best possible service to its students and to the Navy in the years ahead.

Pictorial—PG School

79

Photography by Ted Jorgenson

Cover

Naval and academic worlds are blended in this 1969 graduation ceremony at the Naval Postgraduate School at Monterey, where, this June, degrees will be conferred upon some 300 more officer students from the United States and the navies of 24 free world nations.

Departments

The Old Navy	94
Comment and Discussion	97
Book Reviews	113
Professional Reading	117
Professional Notes	121
Notebook	129

The opinions or assertions in the articles are the personal ones of the authors and are not to be construed as official. They do not necessarily reflect the views of either the Navy Department or the U. S. Naval Institute.



The Naval Postgraduate School

Sixty Years Young

By Rear Admiral Robert W. McNitt, U. S. Navy

When the Navy's first in-house graduate program began at Annapolis in 1909 with ten officer students, the future of the School of Marine Engineering, as it was then called, was uncertain although the need for advanced education in marine engineering was quite apparent. Two years later, however, as the first class graduated, a prophetic statement was made by Assistant Secretary of the Navy Beekman Winthrop, who said, "There will be some day a postgraduate course to call all the officers of the Navy together. This school is the beginning and may be the one on which the Navy Department of the future may have to depend."

The General Line curriculum was added to the Postgraduate School in Annapolis in 1927 to teach professional naval subjects. A separate General Line School was established in Newport in 1946, another one in Monterey in 1948, and the two combined as part of the relocated Naval Postgraduate School in 1951. The General Line School was disestablished in August 1962, as the Fleet and functional schools were by then teaching most of the professional naval subjects. At this time, the Engineering and Management Schools at Monterey were combined to form the Naval Postgraduate School as it exists today.

The story of what has been going on at the PG School during the last three or four years is not well known. Many visitors are surprised to find that for 23 years it has been authorized to award degrees through the doctorate, and that it has 1,600 officer students on board, including some officers from all of the U. S. armed forces and from the navies of over 20 allied countries, all taught by a predominantly civilian faculty.

Statisticians might ask, "How many officer students have been educated at the Naval Postgraduate School in the past ten years?" The answer is, "All of them—but there were not nearly as many as we had hoped." For, we have not been able to meet our own quotas for the program since 1960 and we have fallen farther behind since 1965 in the technical curricula in particular.

We have not met these quotas for two related reasons. Since 1960, not enough officers have entered the regular Navy with the undergraduate background needed to qualify them for entering the technical curricula. At the same time, many of those who were academically qualified entered high priority programs where their services were so badly needed that they have not been available for assignment to the postgraduate program. This has been particularly true for officers in the nuclear power program and in naval aviation. The availability of such officers is now improving. However, effective methods of raising the proportion of newly commissioned regular officers with the undergraduate preparation needed to enter the technical curricula confidently have not yet been found.

The chief conclusion of a recent year-long study of the Navy's future professional manpower requirements is that the minimum annual input to the postgraduate program for at least ten years must be 50% greater than the average annual input over the last five years.

A far more satisfactory number, and one which will allow proper tour lengths when the graduate serves later in his specialty or subspecialty, is 100% greater than the average annual input over the past five years.

But, while concern about quotas has occupied us in the past and no doubt will in the future, 1970 is a particularly good time to pause and take stock. This year, as the school enters its second 60 years of service, is a good time for all of us in the Navy to take a careful look at our own graduate school, and to consider where this lively institution is headed.

At present, 80% of the students in the Navy's postgraduate program are studying at Monterey, with the others enrolled in 52 universities in the United States and in England. The U. S. graduate schools predict that the rapidly increasing demand for enrollment will far exceed their capacities during the next five to ten years—

and military and naval officers already are finding a less-than-enthusiastic welcome on some campuses. Many graduate schools will give preference for admission to students who indicate at least an interest in proceeding to the doctorate. The student who seeks admission for only a master's degree program may be at a disadvantage regardless of his qualifications.

It seems likely, therefore, that the PG School will more than ever become "the one on which the Navy Department of the future will have to depend." Fortunately, the school is ready in competence, programs, and carefully planned growth of facilities to respond to this challenge.

We might look at each of these factors in turn, examining the matter of competence first, because even if there were no problem at all with admission to other graduate schools, the special and unique nature of the PG School makes it a necessary part of what Admiral James Holloway used to call the "great naval university"—the many and varied educational experiences available to an officer through a lifetime of naval service.

Competence in any school begins with the faculty. The school's faculty represents a cross section of graduates from the finest colleges and universities in the United States and overseas, many of whom have had prior service in the Armed Forces or are still active in the Naval Reserve. Between 1960 and 1969, the percentage of the civilian faculty holding the doctorate increased from 47% to 73%, and now compares favorably with the best schools in the country. The military faculty varies from 10% to 20% of the total, with the proportion changing as large fluctuations in student input occur. They, too, are well qualified, with 86% holding advanced degrees and 20% having the Ph.D. A number of the faculty are authors of widely accepted textbooks in their fields, and many are nationally and, in some cases, internationally recognized for their professional contributions and their research.

The school has increased its research activity from an annual support level of \$30,000 in 1955 to \$1,900,000 in 1969. About one-third of this money represents independent research funded through the Office of Naval Research, and independent exploratory development supported by the Director of Navy Laboratories, and is distributed by the school at its discretion.

The remaining two-thirds of this research was sponsored in 1969 by 26 activities of the Department of Defense, the Atomic Energy Commission, and the National Aeronautics and Space Administration, in response to specific proposals initiated by faculty members. As a result of all of this effort, students can do significant research on Service-oriented problems in support of their thesis work, and faculty members are involved and interested in Service-related problems.

No faculty member devotes more than half of his time to research. Teaching is the primary concern of the school, and although there are some outstanding scientists on the faculty, the students know that these men will regularly and personally conduct their classes throughout the year.

All of the school's courses are taught by the professional faculty and none by graduate students, with a student/faculty ratio only slightly higher than that found in the best graduate schools. Every student and faculty member has free access to computer time and other school facilities, and the resources of the Navy's laboratories and research facilities can be tapped for equipment, projects, and field trips.

The faculty maintains a close relationship with the students, both on and off campus. When, for example, Commander Gene Cernan planned his historic Apollo 10 flight around the moon, an invitation to watch the liftoff from Cape Kennedy was sent to his aeronautical engineering professor and thesis advisor at Monterey.

There are other areas of competence which make the PG School unique and provide a rather special kind of service to officers who want very much to obtain a first rate graduate education, but who also want to return as quickly as possible to operational and staff assignments.

Perhaps most important, then, is the manner in which the curricular programs are constructed and kept up to date, with both the Navy's specific objectives and academic degree requirements in mind.

The curricular programs of the PG School are the result of years of experience, experiment, and a continuing interchange with the Navy offices most concerned with the eventual employment of the graduate. These offices, called the "curriculum sponsors," express the Navy's requirements through formal meetings and informal discussions with two very important people at the school.

At Monterey each curricular program is represented by a curricular officer who is a graduate of the program and has served as a specialist or subspecialist in the field. At his side is a member of the faculty called an academic associate. Judgments reached by these men as to curricular structure and sequencing of courses will therefore reflect Navy needs on the one hand, and academic appropriateness and degree requirements on the other. The advice and approval of the department chairmen, the academic dean, and in some cases the superintendent, are also introduced as needed. In this way, responsiveness to the Navy is ensured without sacrifice of academic quality.

Authority to confer degrees through the doctorate was authorized by an Act of Congress in 1947, and in

1955, following its move from Annapolis to California, the school was initially accredited as an institution by the Western Association of Schools and Colleges in 1955 with re-accreditation every five years.

Visiting committees of distinguished professors and college administrators have been used in a continuing program for the last three years to provide an independent assessment of the school's academic departments. Special blue ribbon committees have also been assembled from time to time to advise on special problems, such as a recently developed five-year plan for an ocean science program.

The superintendent has the additional benefit of the advice of a board of advisors, initially appointed by the Secretary of the Navy in 1967.

The efficient use of time at Monterey reflects a deep concern for the student as an individual in the planning of programs, validation of course credits and setting up of schedules.

Many officers in the Navy still think of a Master's degree program at Monterey as a three-year curriculum which is so demanding as to be within the reach of only a select few. They have not heard that, in 1967-1968, a major overhaul was made of every curricular program offered at the PG School, reducing the time required in residence by about a half year for most programs.

Any officer who meets the qualifications specified in the catalog will have an excellent chance of completing the program. Those with marginal qualifications, however, may be selected for the engineering science curriculum, and if successful can transfer after six months into one of the technical curricula, as indeed 95% of the students in that program did in 1969. The school's academic failure rate in recent years has been a low 3.2% overall, with a rate of less than 1% in the baccalaureate and engineering science programs.

One of the changes which helped reduce residence time, was the shift, in July 1967, from five terms of ten weeks each, which included a very lightly loaded summer term, to a quarter system with four evenly-loaded 12-week terms each year. This arrangement provides year-round instruction, permits maximum use of the physical plant throughout the year, and, compared with the old system, provides a longer term which, academically, is much more effective.

Admission arrangements have been designed for the convenience of officers who become available for assignment to the school at any time throughout the year. The system used accepts officers four times a year, with each curricular program having two inputs annually.

Most schools publish a schedule of available courses which students then take during the terms in which

they are offered. At Monterey, the reverse procedure is followed, with course offerings and schedules being arranged to take care of every student enrolled, assuring him of the most appropriate sequence of courses, and the shortest possible time in residence.

The curricular programs are the reason for the existence of the school and the framework within which is arranged the instruction, the laboratory work, and the project or thesis research required for a degree. Most of the curricular programs involve more than one department. They are the most successful means yet invented for combining the Navy's needs with the academic requirements for the degree and the school's accreditation.

Each one of the graduate programs leads to a special designation called a "P" code, which is given to an officer to indicate a qualification resulting from graduate education. Detailed descriptions of all these programs can be found in the Naval Postgraduate School Catalog and in current Bureau of Naval Personnel Instructions and Notices.

Aeronautical Engineering. This program began at the PG School in 1920. Six of the 48 astronauts in the NASA program in the summer of 1969 have been students in this program.

Qualifications for admission require a bachelor's degree with a grade average of B or better in mathematics, physical sciences, and engineering. Completion of mathematics through differential and integral calculus, one year of engineering physics, and one year of chemistry is considered minimal preparation.

Officers in this program usually have a wide choice of curricula, with options available in general aeronautical engineering, flight performance, aerodynamics, information and control, aero/space physics, flight propulsion, flight structures, air weapons systems, and aeroelectronics.

Today, most of the students come to Monterey at the end of their first operational sea tours as naval aviators or naval flight officers, and complete the requirements for a master's degree in eight quarters (two years). The bachelor's degree, B.S. (A.E.), is granted in seven quarters for those not qualifying for the master's degree, and the exceptional student may go on for the professional aeronautical engineer degree (11 quarters), or the Ph.D. (16 quarters) either at Monterey or at a civilian university. Graduates who volunteer and are selected to serve as aeronautical engineering duty officers are assigned immediately to Air Systems Command billets, while their brother line officers return to fleet assignments.

Ordnance Systems Engineering. For the last 50 years the officers who have led the development of the weapons

systems of the U. S. Navy have studied ordnance engineering at the PG School.

Qualifications for admission are identical to those for the aeronautical engineering program.

The ordnance systems engineering curriculum provides a common core of courses for the first half year, with officers deciding at this point whether to specialize in air/space physics, chemistry, or electrical engineering. Those who choose physics, will take courses in missile technology and may follow sub areas of interest such as plasma, nuclear, or solid state physics. Officers electing a chemistry major concentrate on areas of study such as process control, properties of explosives, principles of unit operations, and the nature of chemical systems. Those majoring in electrical engineering will specialize in control theory, computer theory, electronic systems, or communication and information theory, with research involving extensive use of the digital/analog computer, radar, and electronic laboratories.

Well qualified officers can complete the requirements for a master of science degree in nine quarters or less. On graduation they will be in great demand afloat, with surface officers often proceeding directly to Destroyer School and then to department head billets in ships with a major weapons installation. They will be equally sought-after ashore to fill technical management billets in research, project management, systems design or in the support of the weapons systems of the Fleet.

Naval Engineering. Naval engineering was the first and only course taught when the PG School opened its doors in 1909 and has been a major curricular offering ever since.

Qualifications for admission are identical to those for the aeronautical engineering program, with background courses in statics, dynamics, fluid mechanics, thermodynamics, electric fields and circuits, and electronics considered very desirable.

Two programs of study are offered—one in mechanical and one in electrical engineering. Officers electing mechanical engineering specialize in engineering mechanics, fluid dynamics and heat transfer, nuclear engineering, or ocean mechanical engineering, with thesis research in areas such as resistance of high speed submerged bodies, computer analysis of structures, and fluidic control systems. Officers choosing electrical engineering specialize in control systems, communications and information theory or computer technology.

The master of science degree can be obtained in nine quarters and the professional degree of mechanical engineer or electrical engineer in 12 quarters of study. Graduates will be exceptionally well qualified to manage technological programs in ship systems engineering and in ocean engineering of the future.

Electronics/Communications Engineering. Those officers

choosing this curriculum are provided an education in the basic scientific and engineering fields related to electronics and communications.

Qualifications for admission require a bachelor's degree, and a background with an above average pattern of grades in differential and integral calculus and physics.

Officers study a common curriculum for three quarters and then specialize in advanced electronics, advanced communications, or information and control, completing the requirements for a master's degree in nine quarters or less, or for the professional degree of electrical engineer in 11 quarters, or the Ph.D. in 16 quarters.

Graduates of the electronics engineering program will be in demand for billets controlled by the Naval Ships Systems Command, Naval Electronics Systems Command or the Naval Ships Engineering Command. The communications engineering program graduates will be sought after for billets under the Director of Naval Communications or Naval Communications Command.

Communications Management. This program has recently replaced the Staff Communications Program. Its objective is to provide instruction to officers who will perform as communications managers of new communications system centers, or as communications officers afloat. Graduates will have a basic understanding of computers, management, and communications systems.

Qualifications for admission require a bachelor's degree with mathematics through college algebra and trigonometry.

In the computer science courses, the student will study programming, computer technology, and the organization and operation of computer systems. In the management courses, he will study personal and group behavior, resource management, economics, contract administration and data processing.

In communications courses, the student will study the organization and planning of fleet communications. In electronics, he will be given a non-engineering approach to electronics as applied to communications.

This program will lead to a degree of master of science in communications management, and can be completed by the average student in six quarters (18 months).

Underwater Physics Systems. The engineering duty officer specialist and the ordnance/sonar systems engineering subspecialists who will be the technical managers of the Navy's new antisubmarine weapons systems, can obtain the finest possible preparation in the underwater physics systems program at the PG School.

Qualifications for admission are the same as those for the aeronautical engineering program except that, rather than "an average of B-or-better," only "better

than average" grades are required.

This is an interdisciplinary curriculum with majors in physics, electrical engineering or acoustical engineering, giving a thorough understanding of sound generation and propagation in the ocean, signal processing, and enough physical, chemical, biological, and geological oceanography to understand the ocean environment. Courses are also given in fluid mechanics, control theory, systems engineering and operations analysis.

An officer can complete the requirements for a master's degree in nine quarters or less, and obtain the engineer's degree in 12 quarters.

Nuclear Engineering Effects. This program has been sponsored by the Defense Atomic Support Agency since 1948 for those officers of the Army, Navy, Air Force, Marine Corps and Coast Guard, whose subsequent assignments will require them to have a thorough background in nuclear physics and nuclear weapons effects.

Qualifications for admission require a bachelor's degree with a grade average of B-or-better in mathematics, physical sciences, and engineering. Completion of mathematics through differential and integral calculus is considered to be minimal preparation.

During the first year in the master's degree program, officers study atomic physics, quantum and particle mechanics, electromagnetic theory, thermodynamics and electronics. In the second year, courses are taken in advanced nuclear physics, radio chemistry, radiation and thermal effects, and the generation and propagation of explosive shock waves, with electives available in plasma, solid state, atmospheric or nuclear physics. Those officers who are qualified and available may continue for two more years for the Ph.D. degree.

Operations Research/Systems Analysis. The PG School was a pioneer in this field and has maintained worldwide leadership with an outstanding program ever since. Its objective is to provide officers with a sound education in quantitative methods and to develop their analytical ability so that they can formulate new concepts and define and solve military problems more effectively.

Qualifications for admission require a bachelor's degree with above-average grades in mathematics through differential and integral calculus. For Navy line officers, a one-year course in physics is also required. Students not meeting these requirements will be accepted in certain cases where their undergraduate records indicate that they are exceptional students and there are other possible indicators of success such as graduate record examination scores, correspondence or extension courses in quantitative areas and outstanding motivation for the program.

The curriculum provides eight quarters of study in operations analysis, mathematics, probability and statis-

tics, physics, economics, and computer science, and a six-week experience tour working in the field as a member of an operations research team, leading to a master's degree in operations research.

The demand today for officers with this subspecialty to fill billets at sea and ashore far exceeds the supply, even though the enrollment has doubled in the last three years.

Computer Science. This program, which began in 1967, is designed to provide graduate level education in computer theory and technology, qualifying officers to specify, design and manage computer-based systems.

The qualifications for admission require a bachelor's degree with above-average grades in mathematics through differential and integral calculus.

The program is seven quarters in length and leads to the master of science degree in computer science. Courses are given in mathematics, probability and statistics, operations analysis, management, and computer science, all supported by a great deal of practical experience with the school's highly sophisticated computer facility which provides both batch processing and multi-access time sharing services, with remote terminals available throughout the campus. The school's unique hybrid computer laboratory with its superb digital-analog computer capability is used by these students in logic and simulation studies.

The graduates of this program will be in great demand in P-coded billets requiring the computer science subspecialty, and everywhere in the Navy where computers are in use.

Computer Systems Management. This program which has grown from an enrollment of 13 in 1962 to 110 in 1969, is a five-quarter curriculum leading to a master of science degree in computer systems management. It is designed to give officers a sound understanding of computer technology so that they can effectively manage computer-based activities or data processing centers.

Qualifications for admission require a bachelor's degree with above-average grades in mathematics. For Navy line officers, mathematics through differential and integral calculus is required. For supply corps officers, two semesters at or above the level of college algebra are needed.

Two separate curricula are offered, one for line officers, which emphasizes programming, use of computers, and quantitative decision making techniques, and the other for supply corps officers, which includes courses in procurement, financial management and logistics.

Officers completing this program will be assigned to P-coded billets in the computer field.

Management. In four quarters, this program provides a quantitatively oriented curriculum in the fundamental

principles and tools of management leading to a master of science degree in management.

Qualifications for admission require a bachelor's degree with overall academic performance of at least C+. Two semesters of mathematics at-or-above college algebra and a C-average in all quantitative courses is considered minimal preparation.

Options are offered in personnel, financial and material management, and in economics or quantitative analysis. Officers accepted include all line, restricted line and staff designators, except for doctors and dentists.

Meteorology. The meteorology program, which began in 1926, offers basic and advanced courses which prepare specialist and subspecialist officers to become operational meteorologists with a working knowledge of oceanography, leading to the master of science degree in seven quarters.

Qualifications for admission require a bachelor's degree with above-average grades in mathematics and the physical sciences. Mathematics through differential and integral calculus, and one year of college physics is considered to be minimal preparation. Courses include sequences in computer, physical, dynamic and synoptic meteorology. Since the Navy meteorologist is intimately concerned with air-sea interaction, he also studies the formation of waves, sea and swell prediction, and the effect of the atmosphere on sonic conditions in the ocean.

A one-year course leading to a meteorology designator, but not including a master's degree, is offered to officers immediately after graduation from officers' candidate school to qualify them to serve in meteorological billets. Upon reassignment to the PG School after one tour in the field, these officers can obtain the master's degree in four more quarters of study.

Oceanography. Recently established under a separate department in recognition of the importance of this program to the Navy and the country, the oceanography program offers two options, leading to a master of science degree in seven quarters. One is physical oceanography, emphasizing the environmental structure of the oceans, prediction of acoustic propagation, and a good understanding of chemical, biological, and geological oceanography. The other, called technology of ocean operations, offers studies in engineering applications in the ocean environment, such as deep and shallow submergence vehicles, underwater structures, buoys, and the protection of materials against deterioration in the ocean.

Qualifications for admission are the same as for the meteorology curriculum. Graduates will be in immediate demand in subspecialty billets at sea and ashore, many of which are directly related to ASW.

Advanced Science. For officers who demonstrate above

average academic ability and an interest in dealing with problems of fundamental and applied research in science or mathematics, an exceptionally fine opportunity is provided to enter the advanced science program sponsored by the Office of Naval Research, leading to a master of science degree in eight to 12 quarters. Studies are in chemistry, hydrodynamics, general physics, applied mathematics, material science, nuclear engineering (effects) or nuclear physics, and the second or third year may be at the Postgraduate School or at another college or university.

Officers are chosen for this program during their first year in one of the technical curricula.

The Immediate Graduate Education Program. This program offers a new and unusual opportunity to exceptional young officers to obtain a master's degree within one year following graduation from the Naval Academy, NROTC, officers candidate or the ROC program. Now in its third year, this program provides advanced education for a select group of unrestricted line officers early in their careers, in nearly all the curricular programs offered at the PG School, and, in some circumstances, at other universities.

Since the officers accepted for this program have well above-average intellectual competence and have usually just completed a major in the field they have chosen for graduate study, they are able to complete 10 to 12 courses and a thesis project for a master's degree in a year—about half the time required for the average officer who returns to PG School after three to four years in the Fleet.

The advantage to the officer, of course, is that he continues his graduate work with his prerequisite studies still fresh in his mind, during a period when he can most easily interrupt his normal career rotation. The maturity, knowledge, and enhanced personal skills which he gains during this year will be applied in every assignment thereafter, whether ashore or at sea, with a resultant gain in professional performance which will far overcome any slight temporary disadvantage resulting from being a year behind his contemporaries who have gone directly to operational assignments.

Plans are being made now to provide an opportunity later in the careers of these officers for a return to advanced graduate education or for an intensive review of advances in technology and instruction in management before assignment to middle management subspecialty billets.

Engineering Science. This program is for officers who have been out of college for many years, or who have not completed all the prerequisites for a graduate course they wish to take, or who are only available for one year and are seeking a good engineering-mathematics-science education.

Qualifications for admission require a bachelor's degree and successful completion of at least one college mathematics course in algebra or trigonometry.

Students enter at four different levels and rapidly develop confidence and competence as they go along. In recent years as many as 95% of those who entered transferred to an advanced technical curriculum within six months.

Baccalaureate. An opportunity is offered in this program for officers to complete their undergraduate education, leading to a B.S. degree in engineering science or a B.A. with a major in government (international relations) in up to eight quarters. The objective is to raise the educational level, broaden the mental outlook, and increase the professional and scientific knowledge of officers who do not have a bachelor's degree.

Qualifications for admission require an advanced undergraduate standing of at least 45 semester hours of acceptable credit, a C-average in all previous college courses. College algebra is required. A minimum of 15 semester hours is required from an accredited educational institution since a maximum of 30 semester hours will be allowed for Service schools.

In addition to the curricular programs, there are two interesting educational activities associated with the Naval Postgraduate School, both of which are staffed by members of the school faculty and supported by the school.

Aviation Safety. This important program which began at the University of Southern California in 1955 and moved to the PG School in 1966, trains 200 aviation safety officers each year to fill billets afloat and ashore, and provides courses to interested officers in the baccalaureate and aeronautical engineering programs. About 25 students are ordered to each 10-week class on a temporary additional duty basis. They study aeronautical engineering, mathematics, physics, physiology, psychology and law, and learn the techniques of accident investigation and the development of accident prevention programs. A one-week course for commanding and executive officers is also scheduled.

Navy Management Systems Center. It is very likely that the PG School is better known throughout Europe and outside the Navy in our own Department of Defense for the contributions of this small but immensely influential group, than for any of its other activities. Established on the campus as a separate activity by the Secretary of Defense in 1966, the center is operated by the Navy as executive agent, with the superintendent of the Naval Postgraduate School doublehatted as its director.

Since the center opened, over 2,000 senior officers and civilians—including 335 flag and general officers—have completed courses in residence, coming from all

the armed forces and some other U. S. agencies, with nearly 300 from other countries.

The center offers a standard four-week defense management system course for 60 participants from all U. S. military departments and NATO nations, a one-week course for 60 flag and general officers, and a four-week station management systems course for commanding and executive officers of shore stations.

The DMSC and flag/general courses examine management problems of strategy, implementation and operation, in terms of the use of analysis and management systems for decision making and management control. The building blocks of decision theory are emphasized—management theory, quantitative reasoning, and economic reasoning. The overall Resources Management Systems of the Department of Defense are studied, including planning, programming, budgeting, and accounting.

The station management systems course was set up in recognition of the fact that the management of a multimillion dollar naval shore station today requires an understanding of managerial functions and current trends. It assists the prospective commanding officer in his transition from "command afloat" to "management ashore." The areas of study are general management theory, managerial economics, managerial controls, personnel management, facilities management and public affairs.

Modern techniques of instruction are used in these courses including force structure games, team teaching, closed circuit television, case studies, and telephone hook-ups directly from the classroom to officials such as the Comptroller of the Department of Defense in Washington.

Three special two-week sessions of the DMSC have been presented at Monterey to senior and experienced teams from the Ministries of Defense of Italy, Greece, and Turkey using simultaneous translation facilities developed by the Center. Faculty teams from the Center have conducted briefings and special courses in Europe for the North Atlantic Council, the NATO International Staff, the NATO Military Planning Staff and for senior members of the Ministries of Defense of many NATO countries. Monterey is looked to by its graduates overseas as the chief source of advice and expertise in this rapidly growing and important area of governmental management.

Looking forward now to a rapid increase from 1,600 students in 1969, to 2,200 in 1972, we might wonder if the School's facilities are adequate for such a growth?

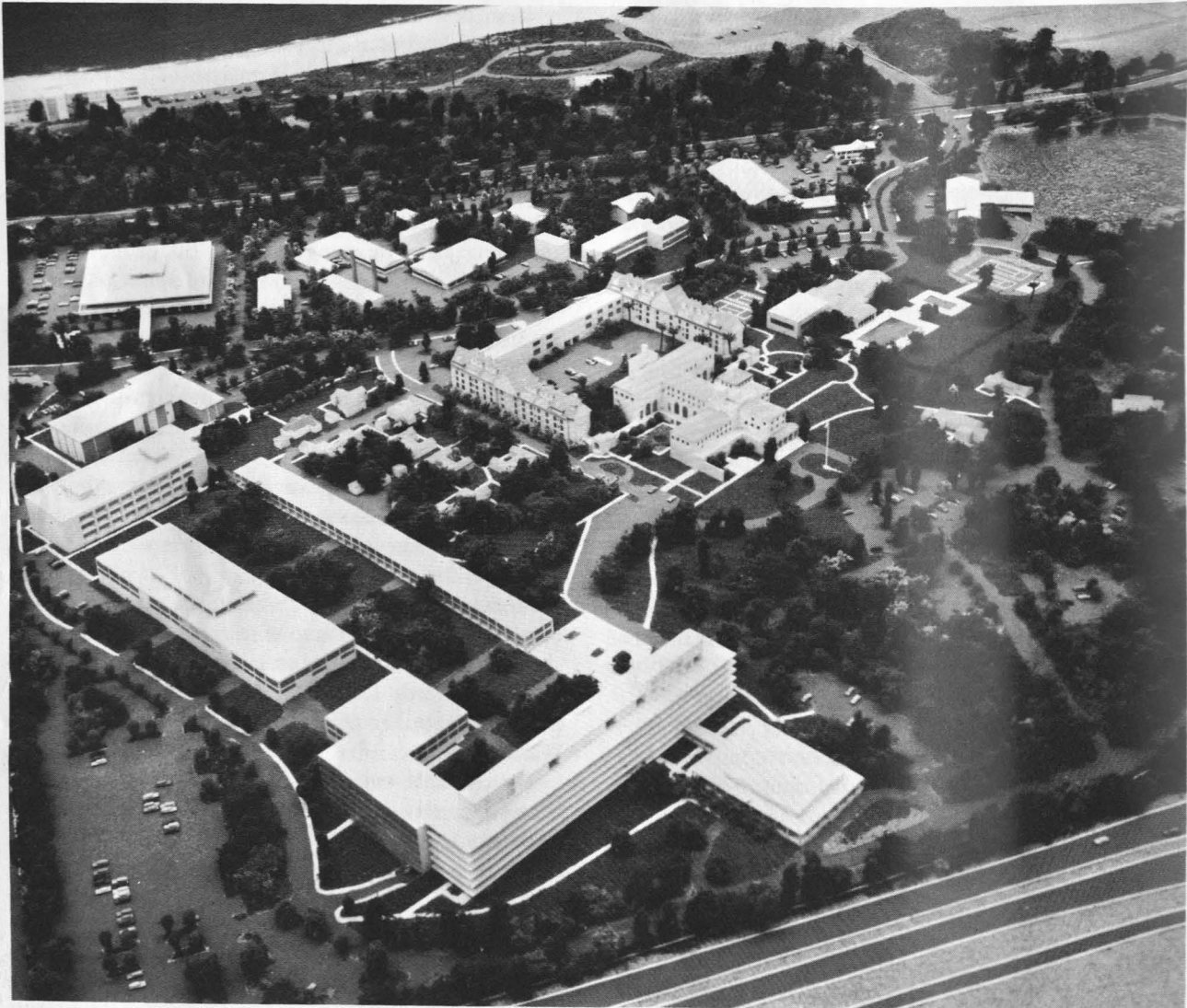
The answer is yes, if the School's carefully worked-out master development plan is followed. Sufficient classroom space and enough student stations are planned

in the buildings proposed to take care of this flood of students. A quick look at the major items in the current and future building plan will give an idea of the growth of the School's facilities during the next few years.

The master development plan involves 38 projects to be accomplished between 1969 and 1975 at an estimated cost of \$35,500,000.

Work in progress during 1969 and 1970 includes 118 new officers' housing units in the conveniently close La Mesa housing area, 90 new housing units for Navy enlisted personnel at Fort Ord, and a new technical library.

Included in the Navy's FY 1972 program is a chapel and educational annex to be built in the La Mesa



This model of the master development plan's ambitious five-year building program shows added academic facilities, a 400,000-volume technical library, and an ocean sciences laboratory on the beach, and such new support facilities as an auditorium, a BOQ and mess, administrative offices, enlisted barracks, a gymnasium, and a dispensary.

housing area located near the School.

The School's highest priority item in the immediate future is the first increment of an ocean science building to be built on the ocean front adjacent to the main campus. The new oceanography department which was established in the fall of 1968 will be the primary user of the building.

The second increment of an addition to the academic facilities, which is planned for fiscal year 1975, will add enough classroom and laboratory space to take care of the estimated 2,200-student load.

There are, however, several future needs which are just now becoming apparent and which are being studied by the school, the Bureau of Naval Personnel, and other interested parts of the Navy.

The first is a need for an advanced and continuing education program at the PG School as suggested by the board of advisors to the superintendent. This refers to the need for an officer to return to the well of graduate education a second or perhaps even a third time in the course of a career, to broaden and diversify his technical knowledge and management competence, and to keep abreast of current developments in his specialty or subspecialty.

There really are two ideas here. Advanced education refers to a program for a limited number of officers who have received a master's degree in science or engineering and who should return after one or two operational tours for the purpose of broadening or building upon their earlier educational programs. The report of a task force set up at Monterey to study this problem showed that the level of engineering education in the United States is steadily rising, with a growth rate of 5% per year for bachelor's degrees, 11% for master's degrees and 12% for doctor's degrees. This overall rise in the scholarship level of the engineering community clearly signals the need for an increased depth of technical understanding among some of the Navy's own personnel. The PG School has programs already in existence for meeting most of these needs.

The graduates of the Immediate Graduate Education Program represent a large group of officers with an excellent potential for advanced education beyond the master's degree. The career patterns of many of these officers should include about 18 months for advanced education, after four or five years of service, in the same discipline or in a second discipline such as systems engineering, to the level of the engineer's degree, or in some cases should provide 30 to 40 months for studies leading to the doctorate.

Continuing education refers to the periodic updating of education in a technical discipline to keep up with the rapid pace of advancing knowledge which can no longer be adequately accomplished by unguided independent study. Universities throughout the country, and many industries, have found it necessary to establish programs of short-term continuing education for practicing engineers and technical managers, varying from weekend seminars to a full term of study.

The Task Force on Advanced and Continuing Education at the Naval Postgraduate School has proposed a continuing education program which has three primary objectives. It will broaden an officer in his general understanding and appreciation of current technology; it will refresh and update him in current knowledge

and practices in his own field of specialization; and it will educate him in the principles and practices needed for effective technical middle management.

The proposed program would provide a 12-week period of intensive study for a prospective technical manager, divided into three parts which would be presented as separate entities but with closely integrated course content to meet the stated objectives. A six-week course is proposed in modern science and engineering which would be a comprehensive review of modern technology, oriented toward naval applications. The second of the three parts would be a two-week course designed to update the officer in his own specialty or subspecialty, and to inform him of current research and future trends in his field. The third part would be a four-week course in technical management intended to prepare an officer for a managerial position by reviewing management principles and techniques with emphasis on decision making, management science, administration, and behavioral science.

These ideas have not yet been thoroughly reviewed or approved, and so it is not yet certain just how these courses will develop. It is clear however that programs similar to those described will be needed soon, and that career planning and the development of educational programs must meet this need.

Another future need being studied by the School is the demand for a graduate program on the part of many officers who majored in history, government, public administration, mathematics or economics. A few of these officers can apply within the small quotas for graduate studies in several universities in international relations, and quite a few would qualify for admission to the Management curricular program at the PG School. There are many others however who do not see any opportunity in the Navy's postgraduate program today to use their undergraduate majors in a program leading to a useful subspecialty in the Navy, or which would clearly strengthen their competence in the unrestricted line officer's specialty of naval warfare and command at sea.

A proposal which appears to be of considerable interest to these students and to potential curricular sponsors, is a possible interdisciplinary curricular program requiring seven quarters of study leading to a master of science degree in national security affairs, a field of concentration which the American Political Science Association has recently approved for political science degrees. The main objective of this curriculum would be to provide education at the graduate level in the analysis, understanding, and control of matters involving National Security Affairs. Students would be selected so as not to compete in any way with the

School of Naval Command and Staff of the Naval War College. The curriculum would not, however, have appreciable overlap, and the officers attending the PG School course would not normally be eligible for the Naval War College course for another five to eight years. The National Security Affairs curricular program would be excellent preparation as well for officers who will eventually serve on large staffs, or in a large number of overseas billets.

It would offer a balanced combination of courses in political science (50%), economics (25%) and systems analysis (25%). The courses in political science would include studies in national security, international relations and public administration. The core of the curriculum would be the study of the contemporary global security system and its structure of national subsystems. An understanding would be developed of the fundamentals of national power, the ideologies that motivate the national subsystems, and the structure and operation of the government of the United States in its pursuit of national security. Systems theory would be used as a methodological approach, taking advantage of the exceptional competence of the School in this field of study.

This program is in the process of development and has not yet been fully reviewed and accepted. It is described here as one of a number of future directions which might be quite useful in the Navy's postgraduate educational program.

A third possible new direction which is being carefully thought out by a task group at the school is the development of engineering curricular programs which, to a greater degree, are practice-oriented. This suggestion proposes that the School might develop and offer graduate programs intended to prepare officers in the application of existing knowledge, perhaps identified by names such as master of engineering or master of mechanical engineering. Such a program would include the carrying out of an internship and/or an exercise in professional practice such as the analysis, plan, or design of a system, under the supervision of an experienced and senior professional.

This suggestion reflects a trend which is slowly gaining headway in a few of the leading engineering colleges and institutes of technology, and in oversimplified terms is a swing away from science and back to engineering practice in engineering education, using a systems approach to problem-solving as one means of achieving a practice-oriented experience for the student.

The PG School has always been strongly practice-oriented in its approach to engineering education,

recognizing that most of its graduates will be concerned with the practical application of knowledge in the design, construction, operation and maintenance of naval systems, and that they will not often become scientists or scholars. The School has insisted that a thesis, or in some cases a project, be completed as part of the requirement for the master's degree, since almost all of its officer students terminate their studies at the master's degree level and usually would not have another opportunity to do original or creative research, or complete an engineering project as a student. Three-quarters of the theses completed in the last three years were practical in nature and directly related to Navy or Department of Defense problems.

This approach does not in any sense deny the value of teaching the fundamental principles of science, mathematics, and engineering, nor does it mean that the School should abandon its carefully developed and time-tested programs leading to the master of science degree. It does suggest that a parallel effort might be considered in the engineering curricula which would be more practice oriented, and that a carefully planned and increasing number of students with the aptitude and need for this valuable educational experience be offered such an opportunity as the program develops. These ideas are being discussed with curricular sponsors and the Bureau of Naval Personnel to help determine the specific direction such a program should take for increased benefit to the officer students and the naval Service.

The constant search for improvement, the realistic responsiveness to the Navy's requirements, the solid reputation for educational excellence, and the unchanging objective of providing the best possible service to the officer student and the Navy—these are the assets which make for an unsurpassed potential for growth as the PG School enters its second 60 years of service to the Service.

A graduate of the U. S. Naval Academy in 1938, Rear Admiral McNitt has served in cruisers, destroyers, submarines, and the USS *Midway*. He has commanded the USS *Taylor* (DD-468), Destroyer Division 322 and Destroyer Squadron 25. He graduated from the Naval Postgraduate School and the Massachusetts Institute of Technology with an M.S. in Mechanical Engineering, and completed a year of study at the Industrial College of the Armed Forces. He served as Commanding Officer and Director of the Atlantic Fleet Anti-Submarine Warfare Tactical School, and Secretary of the Academic Board at the Naval Academy. As a flag officer, he served as Deputy Chief of Staff, Plans, and Commander of the NATO submarines in the Mediterranean on the staff of the Commander in Chief, Allied Forces, Mediterranean on Malta. He also commanded Cruiser Destroyer Flotilla FOUR, and, since October 1967, has been the Superintendent of the Naval Postgraduate School.