NAVAL RESEARCH

REVIEWS

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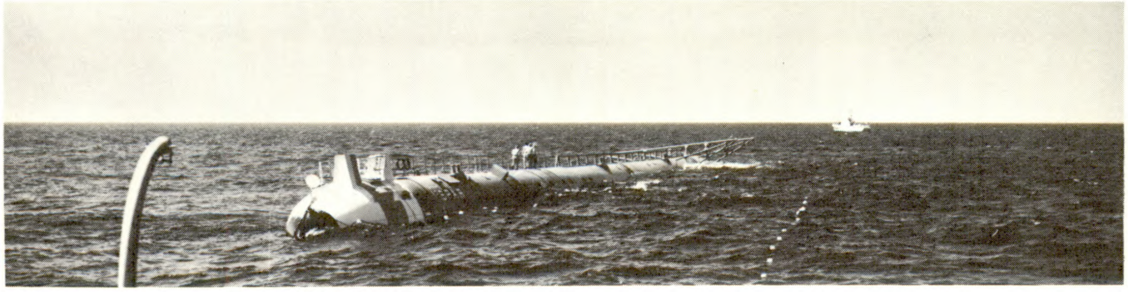
DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH



SPAR rides horizontally on sea surface prior to being pivoted to vertical, operational position.

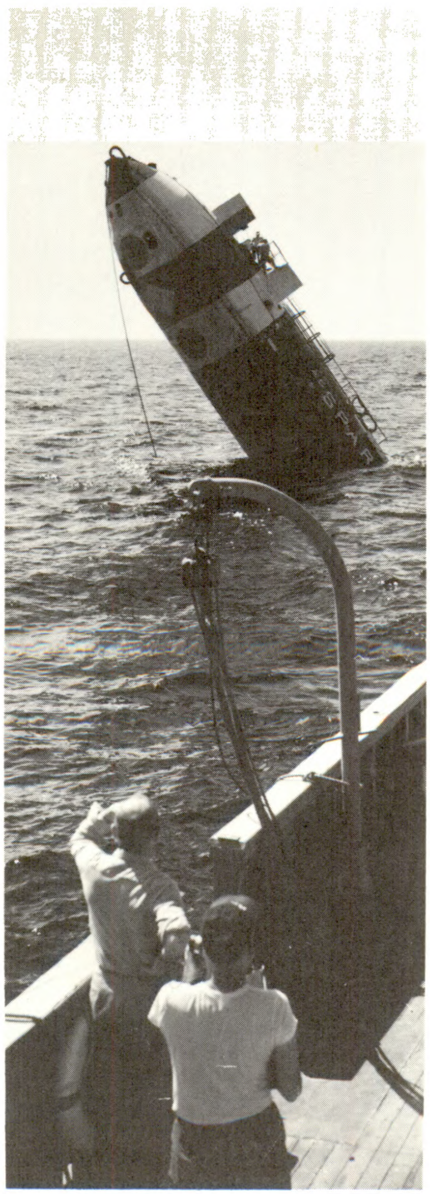
SPAR Goes to Sea for Submergence Trials

The Naval Ordnance Laboratory's 354-foot-long Seagoing Platform for Acoustic Research (SPAR) underwent sea trials in the Atlantic Ocean late in 1964, prior to being equipped with acoustic measurement instrumentation. On the front cover and on this page, the vessel is pictured in three different positions it assumes while being placed on station. Above, it is shown in the horizontal attitude, in which it is towed; at left, it is seen while being pivoted from the horizontal to vertical positions; and on the front cover, it is shown in the near-vertical attitude, with most of its length submerged. In the vertical, operational position, SPAR is highly stable, even in a rough sea, having a maximum heave velocity of one foot per second in sea state 4 (waves from 5 to 8 feet high).

While taking measurements, the research vessel will receive power and be controlled from a tender. Another ship will act as a target, transmitting electromagnetic and acoustic signals, which SPAR will receive and relay to the tender for storage and preliminary analysis. A detailed statistical study of the data obtained by SPAR will be made at the Naval Ordnance Laboratory by means of an IBM 7090 computing system.

SPAR is expected to be operational next summer.

A more detailed account of the vessel is given in *Naval Research Reviews,* October 1964.



SPAR is upended by taking on ballast.

Obtaining Geographic Data From Space

Robert H. Alexander
Geography Branch
Office of Naval Research

In an article which appeared recently in *Science,* R. Jastrow and A. G. W. Cameron defined space science as "the collection of scientific problems to which space vehicles can make some specific contributions not achievable by ground-based experiments."

The science of geography can now be included in "space science." The National Aeronautics and Space Administration (NASA) in collaboration with the Geography Branch of the Office of Naval Research is sponsoring an investigation to identify the potential geographic benefits to be gained from the nation's space program. The investigation is part of NASA's long-range inquiry to determine the kinds of scientific activities which might be carried out profitably on future space missions. Among such future activities which are now being planned by NASA are a series of missions with the objective of gaining more knowledge of our planet from observation platforms in space. Experiments in geophysics, meteorology, and oceanography, in addition to geography, are being discussed as possible objectives of these missions. The question which is being put to geographers is, essentially, what would it mean to geographic research to have an observation satellite (or many such satellites) orbiting the earth, gathering data about earth-surface features and environments?

The investigation is intended to provide the best prognosis that can be made on the values to geography of the capability of gathering data from space. On the basis of this prognosis, a program of research will be drawn up and presented to the scientists in the space agency for their consideration. A committee of the National Academy of Sciences-National Research Council will provide guidance to assure a well-balanced and integrated program of high quality. Both basic research in geography and practical applications of geographic data will be stressed. The entire program, including all of the reports, earth photographs, and other types of data that are derived from it will be open, unclassified, and available to all.

*An adaptation of an article published in *The Professional Geographer* (Association of American Geographers), November 1964, Vol. XVI, No. 6.

Scope and Implications of the Program

The implications of the space geography program might best be thought of in terms of several aspects of the data which could be made available: the special characteristics of geographic data obtainable from space vehicles, the availability of the data in forms most suitable for use by geographers, and the management or systematization of the vast quantities of data which are needed in geography and which could be obtained by orbital sensors.

Data Characteristics. The data which we are talking about might be in the form of photographs, television images, or graphs from radiometers or other sensing devices. Regardless of the form of presentation, the data will be simply a record of the electromagnetic radiation reflected or emitted by the earth's surface. This radiation brings us information on the form and pattern of surface features and on the physical properties of the material at the surface which is reflecting or emitting the radiation.

At least three characteristics of geographic data collection from space seem to be of sufficient significance to warrant the research program; these characteristics are the range in the portions of the electromagnetic spectrum which can be utilized; the range in the scale and, hence, degree of generalization of the observations; and the range in timing for making sequences of observations.

The range in the electromagnetic spectrum which can be utilized for the observations is large because of the existence of a great variety of imaging sensors capable of responding to radiation having wavelengths in ultraviolet, infrared, microwave, and radar bands as well as to visible light. Thus much of the information about our environment which is invisible in the narrow spectral region between red and violet can now be made available to us to increase greatly our knowledge of the earth. The atmosphere is transparent to many spectral bands, in addition to the visible, which can carry important information about surface environments. Surface temperature differences, for example, can be determined quite accurately by the use of properly calibrated sensors in the near infrared. Our awareness of the value of such information to geography is increased when we realize that different types of land use have different and possibly characteristic temperature signatures. Similarly, careful use of information from other selected bands of the spectrum can aid in the diagnosis of such features as chemical composition, roughness, and moisture content of surface materials.

The range in scale of observations which are possible to make from space arises from the great height (150 kilometers or more) of the orbital vehicles. Individual snapshots taken by Project Mercury astronauts show several thousand square kilometers of the earth's surface, and the resulting images have a scale of approximately 1:1,000,000. Thus space photography achieves, with a single integration of the radiation reflected from the earth, a degree of generalization only achievable heretofore through laborious cartographic or statistical integrations. On the other hand, a few calculations will show that by varying the optics of the sensing system, objects of the sizes of individual fields, streams, buildings, and surface transportation facilities and equipment should be clearly discernible from orbiting spacecraft.

The range in timing available for sequences of observations is a consequence of the great speed with which orbiting sensors can sweep over the earth. The Nimbus weather satellite, in its polar orbit, was designed to observe the entire surface of the earth at least once every 24 hours. Repeated observations of the same area, at whatever time interval proves to be most significant, would seem to make possible the injection of dynamic considerations into geographic studies, which have had to be static in the past. Until now, a continent-wide or world-wide view of any geographic phenomenon has had to be obtained by piecing together a great number of observations made at different times. In many cases, the phenomena of interest are changing at such a rate that our "big picture" is obsolete even before we get it put together. A geographic data-gathering facility in space would provide the opportunity of getting essentially synoptic coverage of the whole world for many kinds of phenomena which are of vital geographic interest.

Data Availability. It is, of course, probable that the availability of new data from space will generate new research topics and directions within geography. However, since these topics are largely a matter of conjecture at the present time, this discussion will deal only with topics which are already an accepted part of geographic research, and for which data needs are already acutely apparent. Examples of these topics are outlined below:

- The energy and water balance at the earth's surface, including temporal variations in the distribution of water, snow, and ice.

- Geomorphological factors, such as patterns of stream meanders, changes in coastal configurations, advancing and wasting of glaciers, and distribution of slopes.

- The distribution of vegetation and its seasonal changes.

- The distribution of cropland, rangeland, and woodland.

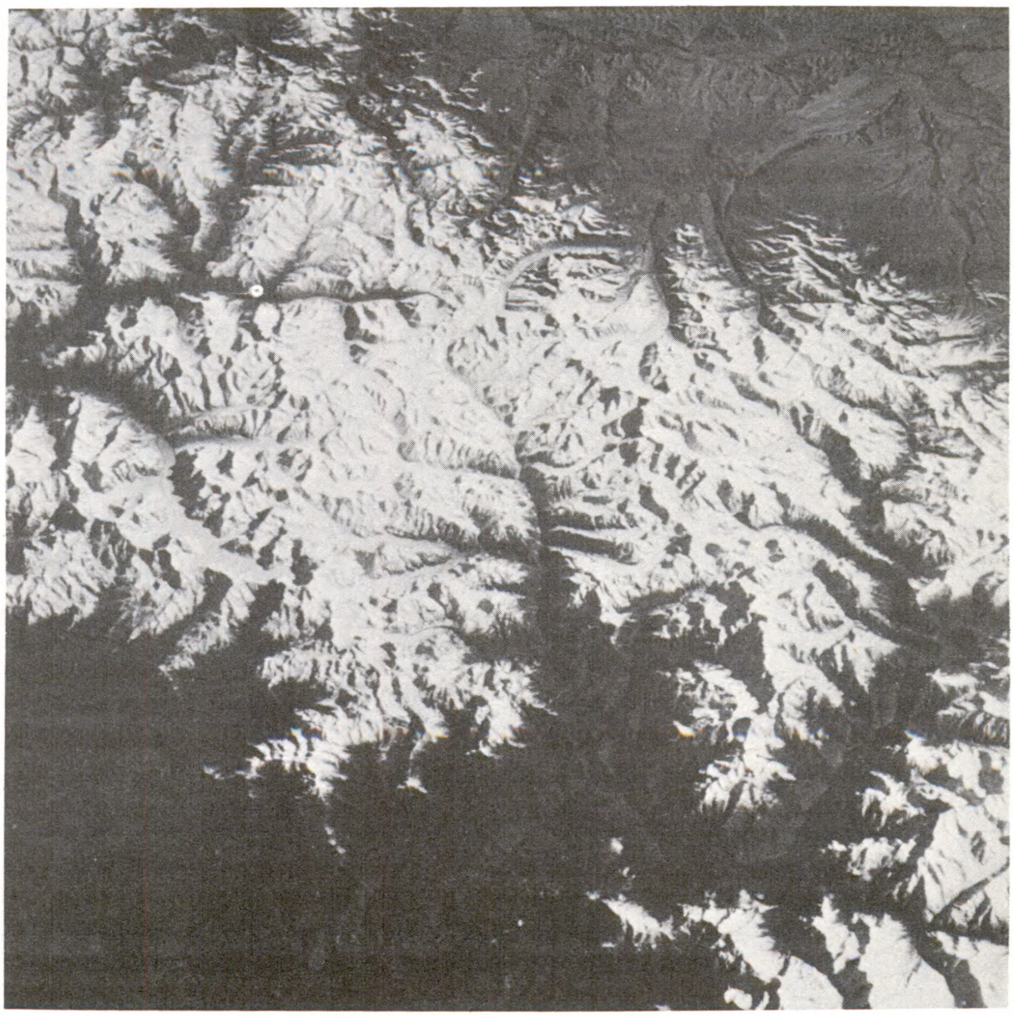
- The spread of cities and the relationships of city growth and structure to changes in transportation systems.

• Assessments of natural resources and man's use and pollution of his environment.

If the potential of utilization of data from space is to be fully exploited, a thorough investigation of the possibility of substituting the space data for data obtained from more conventional sources will be required.

Views from Mercury and Nimbus Satellites

Although the two photographs reproduced on these pages were not taken specifically for the benefit of geographers, they indicate some of the kinds of data that will become available to geographers through the program discussed in the accompanying article. By means of special sensors mounted in the "geographic" satellites, a wide variety of new information from all parts of the world will be obtained.



From Nimbus: This photograph, taken September 15, 1964, from an altitude of 371 miles, shows the northern portions of the Nile River (left) and the Gulf of Suez (right). At the time the photograph was taken, the river was flooding. The flood plain of the Nile Delta is at top left. Cairo is located on the east side of the river where the delta formation begins. The outline of the Suez Canal can be seen leading northward from the Gulf of Suez.

From Mercury: This view, taken on May 15, 1963, by Astronaut L. Gordon Cooper, is of the Himalayan Mountains in the India-Nepal-Tibet border area. The picture was taken from an altitude of 100 miles. North is toward the top right of the photograph. Information revealed here that is of interest to geographers includes the extent of the snow cover and locations of the snowline and glaciers. On the original, even glacial moraines are visible. Apparent, too, are the differences in atmospheric haziness, vegetation, and, by implication, climate on the north and south sides of the range. The influence of rock structure on the pattern of valleys can also be noted.

Geographic Data Management. Since it is apparent that geographic data gathered by orbiting earth-sensors would be made available in prodigious amounts, geographers would need to streamline their facilities for handling such data. A large part of the problem involves the efficient retrieval and use of the kinds of data which are normally stored on maps and photographs; this problem is becoming more serious as the stores of these data increase. The need for efficient methods of data compaction, locational coding, transmission, storage, and retrieval is already apparent. Research on this problem and the creation of either regional or centralized data centers are regarded as integral parts of the full development of a geographic capability in space. The complexity of the problems and the quantity of data obtained will surely dictate a major role for computers as well as for automated input and output devices. The successes as well as the mistakes of intelligence organizations, urban and regional planning studies, and land-use and other natural-resource investigations by government and industry should be considered. One of the greatest mistakes would be to underestimate the quantity of data which will be made available.

Future Activities

Within the next few months a group of leading research geographers will discuss the implications of the space technology and will report to NASA on the potential of the new data source and its impact, across-the-board, on geographic science. In addition, a program of research aimed at proving the capabilities of the orbital sensors as geographic tools will be organized. One aspect of this research will involve the use of special sensors, which will be mounted in aircraft and flown over well-mapped areas. These flights will test both the instruments which might be carried in satellites and the feasibility of various kinds of data-gathering programs. One possible outcome of the "space geography" investigations—one which holds exciting possibilities for geography as well as for all users of geographic data—is the building of a geographic satellite system to monitor the entire surface of the earth and to obtain and continually update an environmental census of our planet.

Determinations of Ship Motions Win BuShips Award — The winner of the highly coveted Chief of the Bureau of Ships Award for Scientific Achievement for 1963 is Dr. M. C. Davis, Project Coordinator, Preliminary Design Branch, Bureau of Ships. The award was given to Dr. Davis in recognition of his development of transient test techniques for determining the motions of ships in waves. Application of the techniques has reduced test time and costs by a factor of 10.

The Patent System: A Sword for Navy Research and Development

Henry Hansen
Patent Counsel
U. S. Naval Air Development Center

As one might expect, the Navy patent organization's primary responsibility is to insure that a bare minimum of monies normally appropriated for procurement is expended for settlement of patent matters. Through defensive maneuvers of acquiring and preserving the rights of the government in the inventions of its employees and of its contractors*, and of avoiding unlicensed use of the patents of others, the government receives legal protection against claims of direct or contributory infringement (unauthorized use of privately owned patents)†.

Wouldn't the Navy be better off without the patent system? After all, patents owned by the Navy are made available for all to make, use, or sell, and the government has never sued for infringement. Indeed, the patent system would be a millstone but for the one benefit which is the point of it all; namely, "To promote the progress of science and useful arts" (U.S. Constitution, Art. I, Section 8). Before granting to an inventor certain exclusive rights, the U. S. Patent Office must receive in exchange a complete description of the invention, so as to enable anyone skilled in the art to which it pertains to make and use the invention in the best mode contemplated by the inventor. Consequently, the Patent Office has become the *world's largest repository of ideas.* These ideas are contained in over three million American and seven million foreign patents, as well as in a large collection of technical books, periodicals, and industrial publications; and each year 50,000 new patents are added to this collection. This library is not a mere by-product of the patent system; it is a fundamental part of it, and it is awaiting exploitation.

The patent system, therefore, has the capability of serving as a "sword" in the hand of the Navy scientist or engineer and not merely as a shield. But to exploit this capability in a way which will cut research and development costs and conserve time places a difficult but important responsibility on the Navy patent organization; namely, to persuade Navy research and development personnel to make use of the Patent

*In FY 1964 the Navy filed 896 patent applications.

†36 Stat. 851 (1910) extended the protection afforded an inventor under the patent system to include recompense for infringement of his patented invention by the Federal government. There are presently pending 63 infringement claims and 33 suits in the Court of Claims.

Office's extensive accumulation of technical information and to advise and help them in doing so.

The experience of the Navy patent organization over the years in the processing and prosecution of Navy-sponsored inventions tempts one to make the conservative generalization that more than one-half of all of those inventions were old when invented. A majority of the inventions were anticipated by existing patents or patent applications filed previously or in other publications filed in the Patent Office, and in many cases the "know-how" was available before commencement of the project leading to the invention. Thus, research and development time and money may have been expended unnecessarily through failure to utilize the facilities of the Patent Office as a resource of "yesterday's know-how."

Just as a traveling salesman might be reluctant to accept the job of canvassing a strange, new territory, it is only natural to expect the researcher to recoil from a vast ocean of information stored in an unfamiliar place. Few scientists realize that the Patent Office classification system and its search facilities make information in any specific technological area quickly and readily available, and that a search room is provided in the Patent Office for furthering the establishment of the necessary and important link between the public and the Patent Office. By subject matter, the patents are divided into more than 300 main classes and 62,000 subclasses, and no special skill is required to conduct an effective search.

Another reaction is that patents are difficult to read because they are written in legal "mumbo jumbo" understood only by a patent attorney. True, a patent rarely reads like a technical article or a thesis, and it cannot be relied on for theoretical explanations; but it can be understood. The law requires that the detailed explanation, called the patent specification, be written "in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same," and that it "shall set forth the best mode contemplated by the inventor of carrying out his invention."* The Patent Office Examiner, who has, a scientific or technical background, is regarded as well qualified to enforce this requirement. In fact, the description required in an invention disclosure is almost always more concise than is found in any other kind of technical publication.

A great majority of the Navy patent advisers were at one time members of the Patent Office Examining Corps, which has considerable experience in Patent Office search techniques; hence they constitute a valuable asset to the scientist or engineer who makes known his desire for an investigation of the patent literature.

*United States Code, Title 35, Section 112.

That a scientist or engineer will make a request for a patent search presupposes, of course, that he recognizes when a search would be effective. For instance, a search would not be of value if the most detailed requirement of the project in question was the following:

> *To conduct a feasibility study and technical analysis of all basic techniques devised by industry and Government laboratories which may have application to ASW airborne display systems.*

This objective is far too broad in scope to be subjected effectively to a patent search. Involved are many separate and remote technological areas, which would entail a search in literally hundreds of the classification subclasses.

An objective which is very narrow in scope cannot be subjected effectively to a patent search, either. An example of such an objective is given below:

> *To design and fabricate a support bracket for mounting the 70 millimeter KA-60 panoramic camera in the RF-8A aircraft to provide forward firing reconnaissance.*

Examples of objectives which do lend themselves to patent searches are given in the two case histories which appear on the next two pages. One of the searches discussed in the case histories was made to best advantage by the project investigator and the other, by the patent adviser.

It would be unfair to presuppose that the project engineers could, without assistance, accurately determine whether or not a Patent Office search would be helpful to their projects. Therefore, the Navy patent adviser should be alert to all scientific effort within the activity to which he is assigned. He would then be in a position to offer assistance to the project engineer in making the decision. At the U. S. Naval Air Development Center, the patent counsel receives, on a continuing basis, notice of all technical tasks and problem assignments given to the activity. Although these notices describe the project by title only, they are valuable as guides to those projects which might lend themselves to searches. After the patent counsel has identified such projects, he studies the detailed objectives and requirements in the actual task or problem-assignment documents. Discussions with the project officer are deferred normally until the patent counsel has ascertained that a search has merit.

Obviously, a Patent Office search cannot satisfy all of the technical-information needs of the scientist. Its usefulness is tempered by the definitiveness and scope of the project objectives and requirements, as exemplified previously, and other factors, such as manpower and funding limitations, the probability that the results of the search will materially supplement the results of customary literature searches, the expectation that the project will lead to inventions or other innovations that might require patent searches, and the rate at which technology is advancing in the field of interest. The last factor relates to areas of scientific effort which have developed or changed dynamically within the last few years. Because of delays in the preparation of patent applications and in their prosecution (there are at all times approximately 200,000 patent applications pending in the Patent Office), most patents, when issued, represent thinking in some areas that is about three years old. To reduce the duration of pendency, the Patent Office has undertaken a "crash" program to cut down the backlog. Thought also has been given to allowing personnel of the Defense Establishment access to pending applications, otherwise kept secret,

Case Histories

The Components Branch at the Naval Air Development Center is responsible for research, design, and development of sonobuoy and sonar system components, such as transducers and hydrophones. Among the research projects assigned to this branch are the two outlined in the following paragraphs. Considerable aid in meeting the objectives of these projects was obtained through patent searches made by the project investigator, in the first case history, and by the patent adviser, in the second case history.

Patent Search by a Project Investigator:

Project Objective: *To increase the reservoir of knowledge relating to the design, development, and manufacture of airborne sonar transducers. This pool of knowledge shall be put into suitable form to be made available to any person, concern, or establishment to which the Navy may deem it advisible to supply such knowledge. The availability of such knowledge would minimize problems arising due to proprietary rights. Thus the information would be readily available for use in writing specifications and to furnish to successful bidders.*

At first thought, the objective might appear to be too broad to be aided by a patent search. Note, however, that it is limited to a particular technological area—sonar transducers. Subject matter relating to it could be found in more than 20 subdivisions spread over four main classes of the Patent Office classification system. For a patent adviser to make an effective search in so many subdivisions, he would have to be given an arduous and comprehensive briefing by the project investigator. Therefore, the investigator, himself, decided to make the search. He was first given instruction on how to proceed. Then he alloted one day of his time, less than one percent of the total project allotin the interest of research and development for national defense; but no legislation exists yet to make such access possible.

The patent files and classification system of the Patent Office are more sophisticated, comprehensive, and detailed than any other single source of technical information, and more professional effort has been devoted to their creation and maintenance than any other known. Apparently, scientists and engineers of foreign countries, especially those behind the Iron Curtain, use their patent offices as technical-information sources to a much greater extent than do those in the United States. It is entirely in keeping with the President's call for maximum utilization of resources and personnel by all agencies of the Federal government to encourage that full advantage be taken of the Patent Office's "treasure trove" of information. The availability of that resource must be increased, and more scientists and engineers must be trained to use it.

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ment, for the undertaking. To narrow his field of search as much as possible, he reduced to writing the four most vexing problem areas. Heretofore, very little technical information useful to the project had been uncovered through the investigator's usual sources of information—technical libraries and personal contacts with other government and industrial activities engaged in related scientific effort. With these four basic problem areas in mind, however, the investigator found over 75 patents within eight of the most pertinent subclasses which applied to his objective. Moreover, some of these patents suggested solutions to ancillary problems not originally contemplated. The Patent Office search generated a major portion of the technical information applicable directly to the project objective. It also generated a desire in the investigator to be apprised of all patents issued subsequent to the search in certain subclasses germane to his project. (The Patent Office, on standing orders, mails patents issuing weekly in any specified subclass. Alternatively, the investigator can review the U.S. Patent Office *Official Gazette,* which is published weekly and contains brief information on recently issued patents).

Patent Search by a Patent Adviser:

Project Objective: *To arrive at a theoretical explanation of the directional resonance effect exhibited by split cylinders of polarized barium titanate, and to determine the feasibility of utilizing the large amplitude displacement in split cylinders to project acoustic energy at frequencies between 50 cps and 500 cps.*

This objective is defined and limited sufficiently so as to be related to a single subclass of the classification system—Class 310 (Electrical generator or motor structure), Subclass 9.6 (Element shape of piezoelectric devices of the non-dynamo-electric type). It was thus possible for a patent adviser to make an effective search. The investigator in this project reported that very little information had been published on the subject before the Patent Office search was made. As a result of the search, twelve patents were brought before the investigator, of which three were considered to be relevant and useful to the project. In this instance, the patent search produced the only substantial accumulation of published information in this specific technological area.

Research Ships of Opportunity

S. R. Galler

Head, Biology Branch
Office of Naval Research

On October 19, 1964, an 18,000-ton American Mail Lines freighter, the S. S. Java Mail, steamed from her dock at Seattle, Washington, bound for Yokohama, Hong Kong, and other ports in the Pacific and the Far East. To all appearances, the ship was setting out on a routine voyage. Her holds were filled with goods to be traded on another continent, and her officers and crew went about their work just as they had on many such voyages in the past. On this occasion, however, a Navy trailer van was parked on the ship's fantail, and a six-man scientific party was quartered in the ship's cabins. Quite incidentally to her task of delivering her cargo to foreign ports, the Java Mail was participating in the U. S. Navy's Project Neptune.

Project Neptune was undertaken to determine the feasibility of collecting biological oceanographic research data from a merchant ship while the ship is on a regular run—without interfering with the routine of the ship's operation. By actually demonstrating this, the Office of Naval Research, sponsor of the undertaking, hopes to establish the practicality of the concept of a fleet of "research ships of opportunity"—namely, the more than 300 ships of the Merchant Marine. These vessels could carry one or more scientists and an instrumented mobile laboratory van, containing expendable and retrievable devices for sampling and measuring many features of the marine environment. By utilizing such ships for marine research in addition to the oceanographic research ships now in existence, which are relatively few in number, the studies conducted on the oceans and the areas covered could be increased greatly.

Project Neptune brought together the interests and resources of the General Motors Defense Research Laboratory in Santa Barbara, which developed special sampling devices for the experiment; the Naval Missile Center at Point Mugu, California, which provided the laboratory van; and the American Mail Lines, which arranged for the S. S. Java Mail to serve as the first experimental "research ship of opportunity." In addition, much encouragement was given to the project by members of the staff of key committees of Congress concerned with oceanography, particularly the House Committee on Merchant Marine and Fisheries.

Since World War II, scientific interests in oceanic phenomena and technological interests in the exploitation of oceanic resources have increased tremendously. Commensurate with this increase has been a rapidly growing requirement for more ocean-going research platforms. In addition, a large array of paraphernalia is needed for detecting and measuring conditions of the oceanic environment. It is not surprising, therefore, that the demand for ocean-going research ships has outstripped the supply, even if the several vessels now being constructed or planned for construction are taken into account. The result is that we are in serious danger of frustrating the interests of many exceptionally competent scientists who are vitally interested in the ocean environment, but who do not possess the ships and equipment necessary to further their intellectual curiosity. Research ships of opportunity, which we call "RSO's," represent an effort to provide many of these scientists with, at least, a limited ocean-going capability and at the same time to offer an opportunity to lighten the trememdous burden of routine survey and data-collection responsibilities now imposed on our ocean-going research fleet.

Pressure is mounting in many disciplines of modern science to obtain costly, modern research facilities and equipment—usually with good reason, because progress in these disciplines is retarded without them. Nuclear physics provides a classic example of this phenomenon. The discovery of the elementary particles of matter requires the development of ever more complicated and expensive facilities, such as cyclotrons, betatrons, and linear accelerators. It is not possible to satisfy more than a tiny fraction of the demand by scientists for facility time. Needless to say, a much smaller fraction of scientists can hope to become the owners of such facilities. The marine sciences are not an exception in this regard. In oceanography, the demand is stimulated by two additional factors. One is a rapidly awakening interest in the marine environment by a growing number of scientists representing a variety of "non-oceanographic" disciplines, such as aquatic biology and biomedical physics. The other is the need for both "high density" coverage of the oceans and elaborate measurement and collecting procedures. Attempts to obtain both sets of data simultaneously from one ship lead to incompatibilities in the scheduling of ship operations. To describe the problem succinctly, one ship cannot be in two places at the same time.

One reason we have fewer ocean-going research ships than we need is the very high cost of ship construction and maintenance. This cost prohibits their acquisition by all but the major oceanographic research institutions in the U.S. It is becoming increasingly unlikely, therefore, that small universities and laboratories can obtain the financial means for mounting oceanic research expeditions which depend for their success on the extended and full-time employment of an oceanographic ship. A way must be found, therefore, to provide the increasing number of highly motivated and competent scientists with reliable platforms for

Mr. Clifford C. Broman a
Dr. William Aron of Proj
Neptune discuss the S.S. Ja
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Captain H. D. Smith, skip
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The Navy's mobile scie
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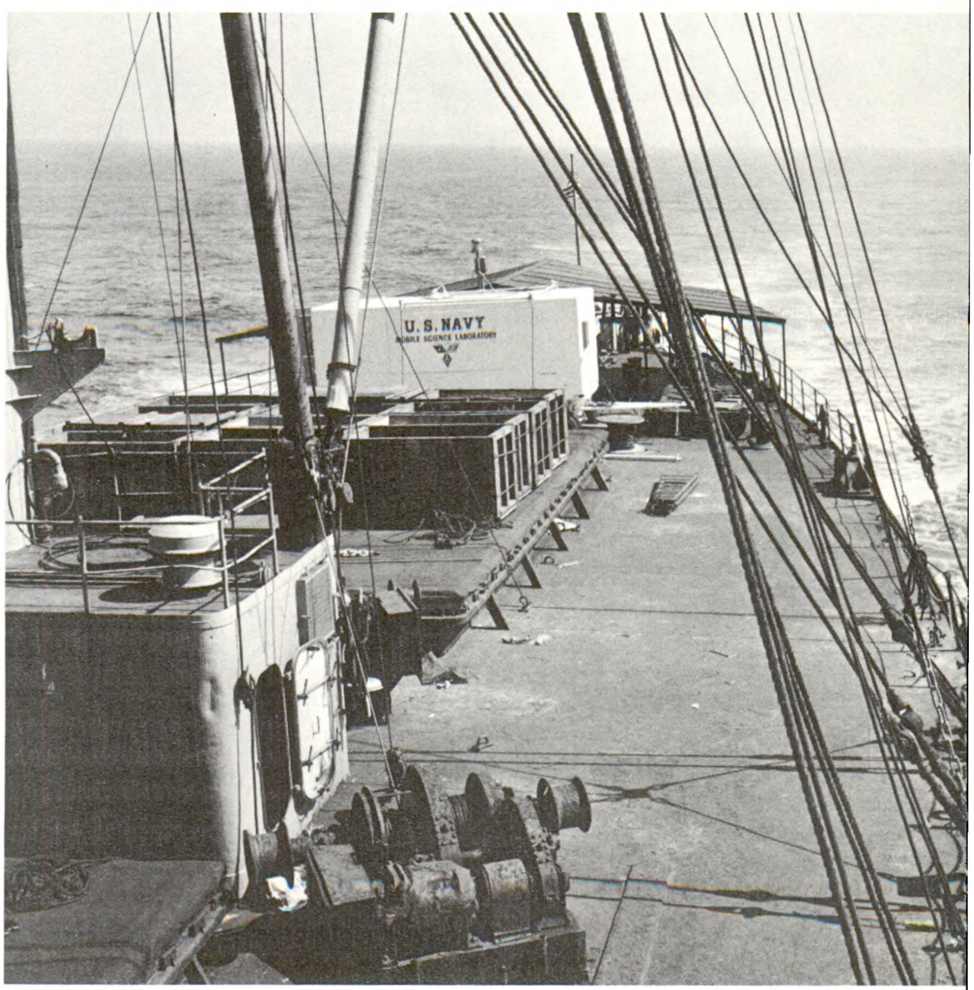
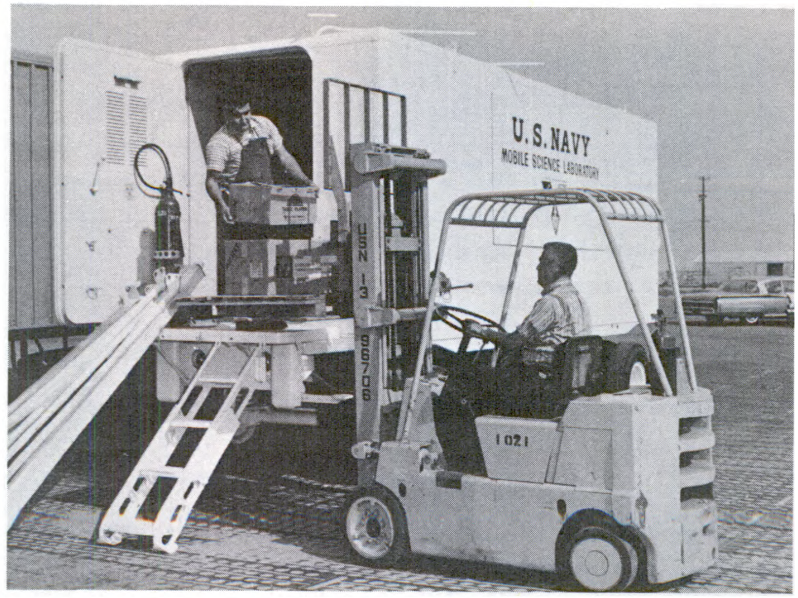
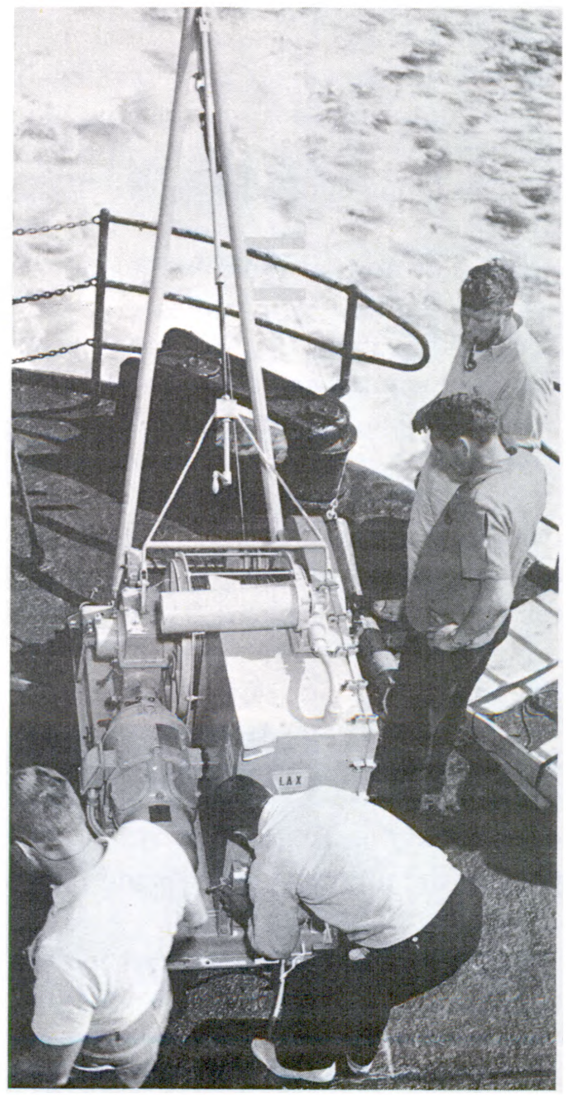




ipment is loaded aboard a
y mobile van in prepara-
for Project Neptune.

Oceanographer Clifford Broman checks sea water temperature during the Pacific crossing of the S.S. Java Mail.



A Project Neptune winch is readied for operation at the stern of the S.S. Java Mail.

the conduct of ocean-based research. The R.S.O. concept suggests one practical solution to this problem.

The mobile vans, or laboratories, designed for the R.S.O.'s would be stored at central or regional depots. When needed, any appropriate group of scientists could draw (rent, lease, or charter) one or more pods or vans from the depot and arrange to have them transported by rail, truck, or aircraft to the port where a commercial ship selected to serve as an R.S.O. is docked. The mobile laboratory unit then would be hoisted aboard the R.S.O. and either fastened to the deck or placed in a hold, as appropriate. When necessary, the laboratory unit would draw upon ships' power and utilities, although, preferably, each pod would be a self-contained unit, independently powered. The scientists and technicians accompanying the laboratory would utilize the tourist accommodations of the host ship. During the cruise, the normal course and speed of the commercial freighter in no way would be affected by the research activities associated with the laboratory pod. In fact, some of the most attractive aspects of this concept are the ability to predict schedules and courses and the high speeds at which modern freighters normally travel (about 20 knots), enabling scientists to obtain measurements and samples rapidly. Some equipment capable of "high-speed" operation is available now. With the incentive provided by the R.S.O.'s, the development of other devices designed for this purpose is sure to be stimulated.

Another attractive aspect of the R.S.O. is its low cost. Although it is very difficult to determine the exact cost of fielding oceanographic expeditions aboard conventional research ships, it has been estimated that the acquisition cost per datum lies somewhere between three and thrity dollars, depending on the accounting procedures utilized. Employing the R.S.O.'s and following similar cost-analysis procedures, it is estimated that the acquisition cost will be somewhere between two-tenths of a cent and twenty and a half cents per datum. These considerations do not encompass the whole financial picture. Perhaps the most significant dollars-and-cents consideration is the saving realized when scientists are relieved of the job of designing, constructing, acquiring, and maintaining oceanographic research ships. Under the R.S.O. concept, these costs are the responsibility of the merchant ship owners and operators. The financial responsibilities of the scientific community are restricted to constructing and maintaining the mobile laboratory vans or trailers and associated equipment, transporting the units to the ship, and paying the usual ocean freight charges and passenger expenses.

A number of problems must be resolved in implementing this concept. For example, information leading to a practical design for a truly mobile laboratory unit must be made available to the design and construction engineers. Similarly, suggestions and data leading to the establishment of specifications for high-speed biological oceanographic sampling and measuring devices must be acquired. Furthermore, experience must be gained to provide a basis for establishing procedures governing the relationships between the scientific community, ship owners and operators, maritime unions, and ships' crews. Also, formulae must be developed to calculate appropriate charges for the spaces occupied by laboratory units and scientific and technical personnel aboard ship.

The first step taken in these directions was Project Neptune, which was carried out aboard the S. S. Java Mail. During its Pacific crossing in October, the Java Mail served as a platform for a variety of oceanographic investigations. Among the devices employed were a thermistor tow, which measured water temperature continuously; an experimental high-speed disposable bathythermograph; and a newly developed "jet net," which successfully collected undamaged samples of plankton at the surface of the ocean while being towed at the normal cruising speed of the ship (15-20 knots). Although the data obtained are valuable in themselves, they were not sought because of that fact. The primary objective of the project was to identify and characterize the principal environmental, technological, engineering, and personnel factors which will have to be considered in the design of a prototype mobile laboratory unit for the full-scale field evaluation of the R.S.O. concept.

As the ship neared Yokohama, late in October, Dr. William Aron, of the General Motors Defense Research Laboratory, who was chief scientist of Project Neptune aboard the Java Mail, reported the following progress:

Three all-weather sampling periods were maintained daily, at 7:00 A.M., 3:00 P.M., and 11:00 P.M. At each of these times the jet net was towed for 15 minutes at the ship's operating speed, phytoplankton samples were taken from the main water-intake pipe by means of a special valve, a load of drift bottles was dropped for the Bureau of Commercial Fisheries, and water samples were taken for chemical analyses. In addition, at 3:00 P.M. a disposable bathythermograph was dropped and a radio transmitter beacon was released and tracked. After corssing the date line, the frequency of bathythermograph drops was increased to four per day, spaced at about six-hour intervals. During the whole cruise, two thermistors—one towed at the surface behind the ship and the other inserted in the main water-intake line continuously recorded water temperatures. With very few exceptions, data were obtained by these means every day.

The major exception took place during a severe storm, which brought winds of 60-65 knots and very rough seas. The decks were awash a good share of the time, thus preventing safe access to the trailer and use of the winches. Even during this bad blow, ship movement was slight, the roll never exceeding 30 degrees. If the scientists could have gone back to the trailer, chemical analysis and data processing could have gone on normally, even though data collection was impossible. They did work quite comfortably in 40-knot winds (confortably, that is, if you ignore fingers rendered icy by Siberian breezes) in sea state 7, as recorded in the ship's log.

Perhaps the most significant point is that they were able to work better than 90 percent of the time, a rather remarkable fact when one considers that the crossing was a typical North Pacific passage for the season. Dr. Aron once described working conditions for oceanographers in the North Pacific as uncomfortable at best, impossible at worst, and uncomfortably impossible on the average. On this trip, the weather was average, and the working platform (S.S. Java Mail) and the very favorable attitude of the officers and crew toward the project took all of the discomfort out of the journey.

At this stage of the project, Dr. Aron held the view that expendable instrumentation is the answer to the oceanographic sampling problem at depth, although the jet-net surface samples were of excellent quality. In addition, the ship could be instrumented easily for sampling the upper waters. Between the two techniques, according to Dr. Aron and other scientist participants, probably 75 percent of the measurements made by oceanographers today from research ships could be made from merchant vessels. The participants in Project Neptune were of the opinion that they had only begun to explore the potential of the R.S.O. concept.

As was pointed out previously, a number of important problems will have to be solved before the R.S.O. idea becomes a practical reality. Nevertheless, the leaders of this effort are confident that a useful system will evolve. That system will not supplant the conventional full-time oceanographic research ships, but will augment them, enabling those ships to be more flexible in carrying out their own creative research programs. At the same time, the R.S.O.'s will provide many of our non-oceanographic biological scientists, especially those located in the interior of the country, with their own ocean-going research facilities. If the program is successful, the R.S.O.'s will bring together, in a unique fashion, academic and commercial organizations seeking a common objective—namely, to advance our National welfare through the improvement of our knowledge of the oceans.

Microelectronics Conference — The third Navy Microelectronics Program Conference will be held at the U. S. Naval Postgraduate School, Monterey, California, April 5-7. The primary purpose of this meeting, which is sponsored by the Office of Naval Research, is the exchange of technical information on the state-of-the-art and progress in microelectronics as applied to Navy systems.

The program will include papers by Naval laboratory personnel, selected Navy contractors, and Navy bureau and office personnel. The conference proceedings will be published.

Determining Exact Latitude-Longitude Positions in High-Speed Aircraft

Pilots flying high-speed aircraft often need to know—instantly—their exact positions over the earth in terms of degrees of longitude and latitude. It is not feasible for them to compute the positions themselves, as the pilots of slow-flying aircraft do, because they have to give their full attention to other tasks, and because in the time it would take them to make the computations they would be far away, and the information would be of little value. What these pilots have required is a device that makes the determinations automatically and displays them continuously. They can then check on their positions at any moment simply by glancing at the display.

Although longitude and latitude indicators have been installed in high-speed aircraft for a number of years, they have not been entirely satisfactory because they have not taken into account the convergence of the meridians from the equator to the poles. Recognizing this shortcoming, the Naval Air Development Center at Johnsville, Pennsylvania, developed a "Secant Function Generator" for use with a longitude-latitude computer. The invention was patented on August 18, 1964, by Glenn B. Shoemaker (U.S. Patent No. 3,145,298).

The Secant Function Generator constantly feeds to the indicator information relative to the curvature of the meridian at the particular latitude the aircraft is flying. This information is contained on a series of conducting metal strips mounted on a rotatable disk. As the aircraft changes latitude, a motor turns the disk proportionately, causing the appropriate conducting strips to make contact with a relay system. A voltage proportionate to the meridional curvature at the new latitude is then produced and relayed to the longitude indicator.

By means of the Secant Function Generator, it is now possible for a pilot to determine his longitude-latitude position between 85° N. and 85° S. latitude with a theoretical error of only 0.5 percent at 85° latitude.

Designing Ships by Computer

In designing and building Navy ships, the various curves and shapes of the hull must be accurately measured and calculated in order to provide the desired displacement and stability. At one time, this task was accomplished by tracing the curves manually on ships' plans—obviously, a very slow process. Later, special-purpose analog and digital computers were used, but they were not satisfactory, either, because they were large, expensive, and difficult to program.

The "Digitized Analog Computer," U.S. Patent No. 3,103,578, issued September 10, 1963, to Mr. Wallace E. Dietrich of the Bureau of

Ships, helped overcome these disadvantages. Although it is a less expensive computer than was used formerly, it is capable of increased accuracy, speed of operation, and ease of feeding-in information. The computer consists of a curve tracer for physically tracing a curve on a plan; an electronic circuit connected to the curve tracer for generating electrical outputs proportional to the value of the curve along two axes at right angles; and additional electronic means for calculating, from the generated outputs, such characteristics of the curve as slope, area, and moment of area with respect to any axis.

The computer was developed to solve a design problem for one particular type of ship, but it has been used extensively by the Navy not only for designing this type of ship, but also other types.

Measuring the Radioactivity of Liquids Aboard Nuclear Powered Ships

The drinking water and boiler water aboard nuclear ships must be monitored at regular intervals, both to safeguard the crew's health and to assure safe operation of equipment. If, through such monitoring, one discovers that radioactivity in the boiler water has increased, he knows immediately that the power plant is not functioning properly or that the water is not sufficiently pure—the particles present having become radioactive as a result of neutron bombardment. Impurities may become excessive despite careful control of such factors as salinity and pH chemistry. Also, if coolant water containing radioactive contaminants is discharged into the sea, and if sea water is then drawn in by the fresh-water distillation system at about the same time or in about the same location, the fresh-water supply may become contaminated by radioactive particles. Regardless of the process by which radioactive contaminants find their way into the water supplies, it is essential that those supplies be monitored at regular and frequent intervals.

Last October 29, U.S. Patent No. 3,109,099 was issued to Ralph C. Maggio and Charles Christianson, employees of the Naval Applied Science Laboratory in New York for their invention, called "Evaporation and Concentration Unit for Dilute Radioactive and Non-Radioactive Solutions." This device receives a measured sample of water, evaporates it, and collects the remnant solid matter. It is so designed that the solid matter is distributed evenly on a disk whose dimensions are small enough to permit accurate radiation measurements to be made by a Geiger-Muller instrument. The unit was designed to monitor the gross beta activity of the drinking water, boiler water, and other liquids utilized aboard ship.

The concentration unit is a major component of the Beta Counting System AN/UDA-1, which measures the radioactivity of samples obtained aboard nuclear-powered ships.

On the Naval Research Reserve

NRRC 3-9 Wins National Competition

A repeat winner for the Research Reserve Award for General Excellence—Naval Reserve Research Company 3-9, Upton, New York—was announced by RADM J. K. Leydon, USN, Chief of Naval Research, on December 10, 1964. This company was the recipient of a similar award for fiscal year 1962.

Nominations for the award, which is given to the most outstanding Research Reserve company, were submitted by commandants of the Naval Districts. During the period to which the award applied, LCDR S. J. Tassinari, USNR, was in command; he is also the present commanding officer of the company. Presentation of the award to NRRC 3-9 is planned for some time early in 1965.

Among the accomplishments of the 35-member Research Reserve company for fiscal year 1964 were the following:

		Percent
Inspection grade	3.907	
Drill attendance		97
Ready Reserve status		94
ACDUTRA participation		60
Correspondence course completion		100
Satisfactory Federal years earned		97
Training grade	3.90	
Presentation of Tenth Annual Research Reserve Seminar in Health Physics		

A panel established to review the records, inspection marks, and other criteria, on which the award is based, and to recommend the winning company was composed of the following officers: CAPT L. B. Blocker, USN, Director, Military Services Division, Office of Naval Research; CAPT R. F. Lewellyn, USNR, Assistant for Budget and Facilities, Office of the Assistant Chief of Naval Operations (Naval Reserve); and CDR D. J. Marker, USNR, Head, Selective Reserve Programs Branch, Bureau of Naval Personnel.

Members of the panel which convened to designate the winner of the Award for General Excellence commented very favorably on the records of the other companies entered in the competition. These companies and their commanding officers for fiscal year 1964 are as follows:

NRRC 1-2, Providence, Rhode Island	CDR Warren M. Hagist, USNR
NRCC 4-8, Cleveland, Ohio	LCDR Edward H. Bollinger, USNR
NRRC 5-10, Bethesda, Maryland	CDR Frank D. Hansing, USNR

NRRC 6-6, Chapel Hill, North Carolina	CDR M. E. Woodard, USNR
NRRC 8-4, Houston, Texas	LCDR Milton Gugenheim, USNR
NRRC 9-14, Madison, Wisconsin	LCDR Stanley L. Inhorn, USNR
NRRC 11-5, San Diego, California	LCDR Harold F. Anderson, USNR
NRRC 12-4, Fresno, California	LCDR Robert Selkirk, Jr., USNR
NRRC 13-3, Pullman, Washington	LCDR Irwin A. Dyer, USNR

To Naval Reserve Research Company 3-9, as well as the other companies listed in nomination for the award, a hearty "Well Done."

NRRC 5-10 Wins Fifth Naval District Award

At the November 10, 1964, drill of Naval Reserve Research Company 5-10, Bethesda, Maryland, CDR Fred Carl, USNR, Group Commander 5-5, Naval Training Center, White Oak, Md., in behalf of the Commandant, Fifth Naval District, presented a plaque to the company in recognition of its first-place standing among 10 Research Reserve companies and third place standing among 61 specialist and composite units in the Fifth Naval District during fiscal year 1964. CDR Frank D. Hansing, USNR, commanding officer of NRRC 5-10 during the period to which the award applied, accepted the plaque in behalf of the company.

The company received an overall grade of 3.75 on the annual military inspection, a grade of 4.0 in Active Duty for Training, and a grade of 3.96 in administration. During the fiscal year, approximately 75

Shown participating in the Fifth Naval District award ceremony are, from left to right, CDR Fred Carl, USNR; CDR Frank D. Hansing, USNR; CDR Frank H. Langdon, USNR, Fifth and Sixth Naval District Research Reserve Liaison Officer; and LCDR Denton W. Elliott, USNR, present commanding officer of NRRC 5-10.

percent of the company's more than 60 members performed Active Duty for Training.

The company membership is composed mostly of reservists having a background in the physical, biological, and medical sciences. The company drills at the Naval Medical Research Institute, National Naval Medical Center, Bethesda, Maryland.

Observations of Korea

At Fort Detrick, Maryland, on September 29, 1964, before a combined meeting of Naval Reserve Research Company 5-3, Frederick, Maryland, and the Army Mobilization Designation Unit 54, Col. Vincent L. Ruwet, USA, commanding officer of Fort Detrick, gave an illustrated lecture on his observations of Korean life and culture. He described Korea as "The Ireland of the Orient," because the armistice in effect there is now the longest in our history. Col. Ruwet, who served as chemical officer with the Eighth U. S. Army, Korea, from July 1962 to July 1963, also gave his impressions of the military situation in Korea.

COL Vincent L. Ruwet, USA

Following Col. Ruwet's talk, CDR Frank H. Langdon, USNR, Fifth and Sixth Naval District Research Reserve Liaison Officer, ONR, inspected the Naval unit and addressed the group on administration and training policies pertaining to the Naval Research Reserve.

The Research Reserve and Patent Law

Among the many professions in which the Naval Research Reserve has an interest is patent law. Two of the ways in which this interest is expressed are indicated in the following paragraphs.

• Training period 11 of the curriculum for Naval Reserve Research companies is intended to familiarize Research Reservists with the operations of the Patent Division of the Office of Naval Research. As an aid in presenting this subject, either as part of the training period or on other occasions, Research Reserve companies may call upon the Navy patent organization to provide speakers to discuss the operations of the organization.

• ONR encourages Research Reservists who work as civilians in patent law to seek active duty for training in patent areas in which they are not engaged as civilians. Such training augments the capabilities of these Reservists in the event of mobilization.

FIRST NAVAL DISTRICT REPORT

NRRC 1-2 Wins It's Second Specialist Units Award

For the second time in three years, Naval Reserve Research Company 1-2, Providence, Rhode Island, won the First Naval District specialist units highest award. The ceremonies, held on November 18, 1964, at the U.S. Navy and Marine Corps Reserve Training Center, Fields Point, Providence, included a personnel inspection.

CAPT Glenn W. Okerson, USN, commanding officer of the Office of Naval Research Branch Office in Boston, was the representative of

CAPT Glenn W. Okerson, USN, center, presents the Commandant's trophy to CDR Warren M. Hagist, USNR, right, commanding officer of NRRC 1-2 for the year of competition for the trophy. CDR Pierre F. Smith, USNR, left, present commanding officer of NRRC 1-2, looks on.

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the commandant of the First Naval District for the ceremonies. He presented the Specialist Company Trophy, emblematic of achievement for the inspection year 1964, to CDR Warren M. Hagist, USNR, commanding officer of the company for fiscal years 1962, 1963, and 1964. Associated with this award was a plaque, entitled "First Naval District Efficiency Award 1964 to NRRC 1-2," which was presented to CDR Pierre F. Smith, USNR, the present commanding officer of the company.

Included in the inspecting party and in the drill program, which followed the inspection, were CDR William S. Adami, USN, Executive Officer and Reserve Assistant of the ONR Branch Office, Boston; CDR William C. Smith, USNR, commanding officer of USN & MCRTC, Providence; and LCDR William S. Barrack, USNR, representative of Naval Reserve Group Commander 1-2(S). Reflecting ONR's dedication to Naval research, CDR Hagist carried out his previously scheduled drill assignment for that evening by giving lesson number 8, "The Naval Research Laboratory," of the ONR curriculum.

Reservist Appointed College President

CDR Eugene C. Winslow, former professor of chemistry at the University of Rhode Island and charter member in 1949 of NRRC 1-2, Providence, Rhode Island, recently was appointed second president of Windham College, Putney, Vermont. CDR Winslow was commanding officer of NRRC 1-2 for two years.

CDR Eugene C. Winslow, USNR

In 1944, CDR Winslow served as an ASW officer on the mine sweeper SHOVELER, AM320, in the Pacific. He is presently a member of NRRC 1-7, Hanover, New Hampshire.

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EDITOR: Richard D. Olson

NAVSO P-510

The cigar-shaped Seagoing Platform for Acoustic Research (SPAR) is upended during trials in the Atlantic Ocean off the coast of Florida. The 354-foot-long unmanned Navy vessel is turned from the horizontal attitude, in which it is towed, to the vertical attitude by taking on ballast. In the vertical position, only about 50 feet of the vessel projects above the ocean surface. SPAR will be utilized for studies of acoustic phenomena. See other photographs on front cover (inside).