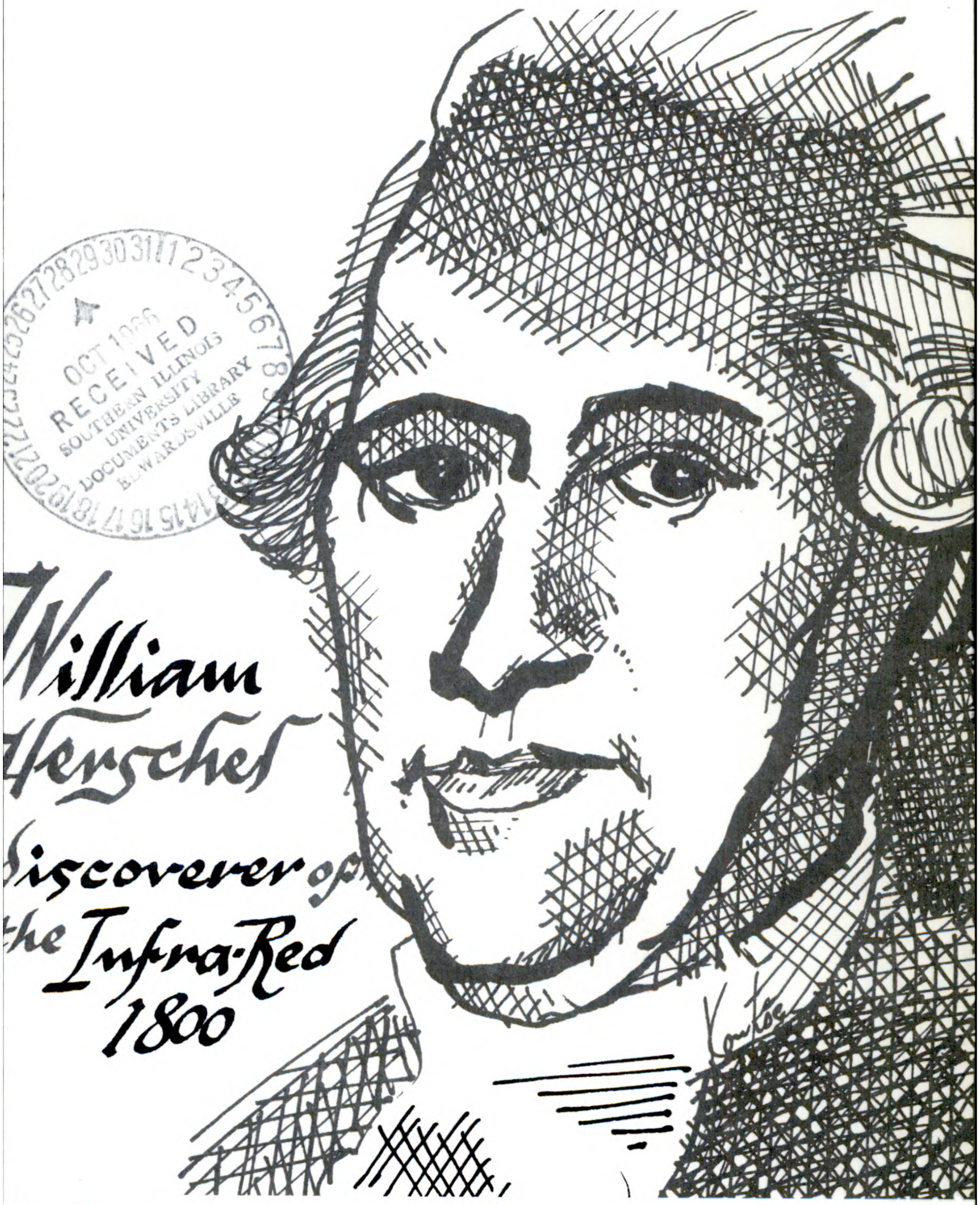
NAVAL RESEARCH REVIEWS

SEPTEMBER 1966



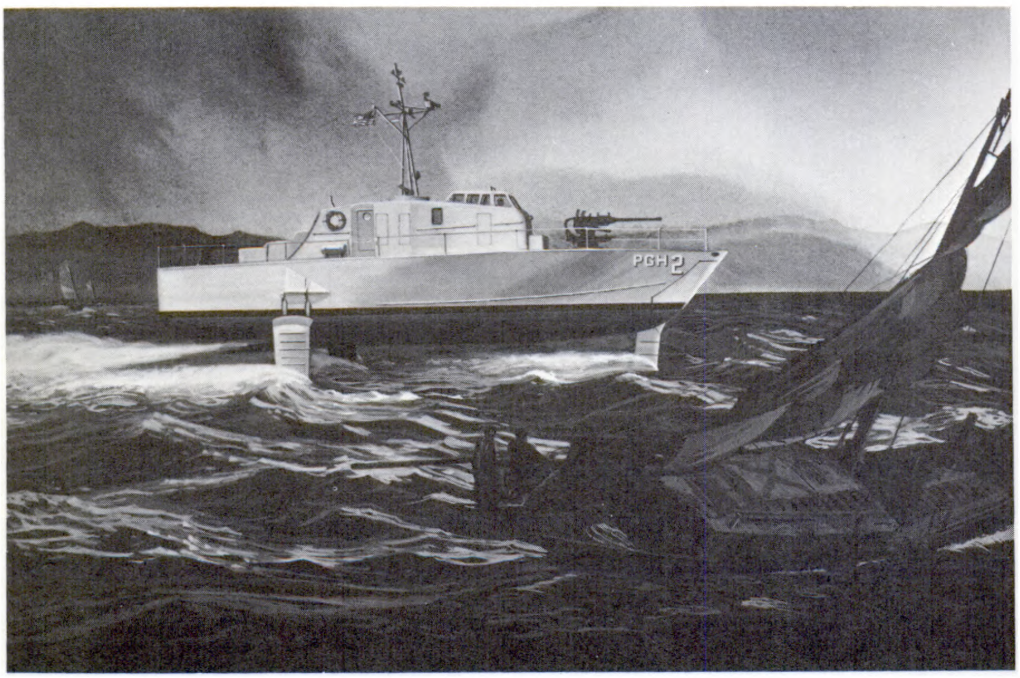
20th Year on the Frontier of Science

"Flying" Gunboat

A hydrofoil gunboat, 71 feet long and 25 feet at the beam, that will "fly" at speeds of at least 40 knots on three fully submerged foils is now being built by the Boeing Company, Seattle, Washington, for the Naval Ship Systems Command. The boat, which has been designated "Patrol Gunboat Hydrofoil" (PGH) will be powered by waterjet for both hullborne and foilborne operations. The hull and superstructure will be made of aluminum and the foils and struts of stainless steel. For quick, unerring handling of the boat, an automatic electronic control system will be installed.

In the waterjet propulsion system, water is drawn through rear struts into a centrifugal pump, then jetted through nozzles near the stern. The system is simple, easy to operate, and easy to maintain. For example, a waterjet has no need for the complicated power transmission system required by propeller craft, thus obviating the lubrication problems involved in keeping hundreds of moving transmission parts running smoothly. The waterjet engine is connected directly to the high-speed pumps.

A 40-mm gun will be mounted forward and an 81-mm mortar aft. Twin 50-caliber machine guns will be placed on each side of the bridge. The Boeing Company plans to deliver the gunboat late in 1967.



The hydrofoil gunboat.

Naval Training Device Center Moves to Florida. The Naval Training Device Center has moved from Port Washington, New York, to Orlando, Florida. The command and support responsibilities for the Center remain with the Chief of Naval Research.

Dr. Michael J. Pelczar, Jr., Professor of Microbiology at the University of Maryland and principal investigator for the Office of Naval Research on a contract dealing with "Biology of the Neisseria," has been appointed Vice President for Graduate Studies and Research at the University. Dr. Pelczar, who assumed the new position on September 1, also accepted an appointment recently as a member of the ONR Advisory Panel on Microbiology.

The Role of ONR in the Development of a Military Infrared Research Program

Frank B. Isakson
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Vicennial Article

In 1800, the astronomer Sir William Herschel discovered the infrared region of the electromagnetic spectrum. However, it was more than a century later before any use was made of infrared energy, and 150 years later before a serious, continuing program in applying the infrared phenomenon to military use was initiated. This is the story of the leading role played by the Office of Naval Research in generating a major program in infrared research and the use of infrared devices by the military services.

Early Military Infrared Developments

The first practical application of infrared was demonstrated in 1917 by T. S. Case, who found that thallous sulfide is photosensitive in the infrared. This discovery led to the development of a device which could transmit and receive blinker signals over an 18-mile range in average weather. Although such systems were used by the military forces during the latter part of World War I to guide airplanes to landing strips and to keep convoys together, interest in the field died out after the war.

Germany revived interest in the infrared in the 1930's and by World War II had developed devices which were used for secret signaling between infantry groups, the surveillance of Russian tanks in darkness, and the detection of Allied night bombers at times when German radar was confused by chaff. Under the wartime Office of Scientific Research and Development, Division 16, Optics and Camouflage, the United States commenced work on imaging devices, communication by voice and code, recognition and identification of targets, ranging and direction of targets, and the development of detectors and receiving equipment. Probably the most significant infrared development in the United States during the 1930's was the RCA infrared image tube. By means of a cesium-oxygen-silver photoemissive surface, the device accepted an infrared image at one end and delivered a corresponding visible image at the other. This photocathode is the same one that is used in the infrared-sensitive photomultiplier—the S-1 photocathode, which is sensitive to wavelengths between 0.75 and about 1.2 microns. The photocathode emits electrons when it is exposed to infrared radiation in this spectral region. Its primary use was in the Army's Snooperscope and Sniperscope, but it also made possible airplane landings on a dark runway marked out with infrared sources and night communication between ships.

Infrared detection devices incorporating phosphors also were developed. They were called metascopes. The phosphors are capable of converting infrared radiation of about 1 micron wavelength into the visible region. These photoluminescent phosphors consist of a strontium sulphide-selenide host material activated by europium-samarium impurities. In operation, the electrons in the host material are excited to higher energy states by ultraviolet radiation or particle emission from a radium button. Some of these electrons are trapped in the higher energy levels by the impurity atoms. They are freed in a short period of time only by the application of radiation in the 1 micron region, which causes them to radiate visible light corresponding to the energy lost in the process. Such devices were lighter, cheaper, less fragile, and simpler than the image tube, but they were inferior in sensitivity and resolution. A number of them were used by the Army and Navy in both the European and Pacific Theaters, particularly for paratroop reconnoitering.

When the war ended and the OSRD was disestablished, the military infrared program in this country was taken over by the individual services and coordinated by the Research and Development Board, Panel on Infrared. Infrared activity on the part of industry began to focus in the rapidly developing southern California area. This fact was recognized by the Office of Naval Research, which, through its Pasadena Branch Office, decided to assist in the coordination of the effort and to aid in the dissemination of the increasing volume of detector knowledge.

It was noted that research and development activity was increasing in the use of infrared for search and detection, for photographic reconnaissance, and for the guidance of missiles. Theoretical estimates showed that the potential of infrared was highly attractive but that major problems in infrared physics, optics, and signal processing remained to be solved.

Just as progress in unclassified basic science requires the free flow of technical information among scientists working in the same or closely associated areas, so the wide dissemination of technical data necessary in classified research and development areas is vital to defense needs. On the other hand, dissemination must be accomplished in ways that are consistent with security regulations. In the case of the infrared research and development underway in California, most of which was classified, security procedures had created the usual delays in the issuance and receipt of progress and technical reports and had severely limited the circulation of the reports. As a result, certain contractors were not even aware of the existence of research efforts almost identical to their own that were being conducted by other contractors.

As a means of alleviating these restrictions, the ONR Pasadena Branch Office, on August 11, 1949, held the first meeting of what was then called a "Continuing Conference on Infrared Instrumentation" under the guidance of Dr. Warren N. Arnquist. Later, such meetings, which became known as the "Infrared Information Symposia" (IRIS), were authorized by a formal charter approved by the Chief of Naval Research and held under the general chairmanship of Dr. Arthur R. Laufer, Chief Scientist of the Branch Office. The Air Force and Army joined in sponsorship of and participation in the series of symposia, which was devoted to the military applications of infrared radiation and to speeding up the flow of technical information among contractors.

Although this early series of symposia proved to be quite useful in focusing attention on infrared activity on the Pacific Coast, it also made glaringly evident the fact that the military services were really not quite sure about the potential of infrared devices. On the surface, it appeared that military utility was obvious. Stated simply, any object at a temperature above absolute zero (and every object is) that has an emissivity greater than zero (and every object has) radiates electromagnetic energy, much of which is in the infrared. Therefore, all objects, including heavenly bodies, jet aircraft, and human beings, are natural radiators of invisible infrared energy and thus can be detected by means of passive instrumentation which does not reveal the presence of the observer. Furthermore, infrared detection is virtually jam-proof (as contrasted with radio and radar), many military targets are copious emitters of infrared, and the shortness of infrared wavelengths permits resolution far higher than that attainable even with our highest-resolution radars.

Nevertheless, as late as 1951 there were strong doubts in the minds of many Navy officials as well as of officials in the other services as to the utility of infrared techniques in solving military problems. Therefore, firm thresholds of performance at which infrared systems would meet bonafide military requirements and the technical feasibility of achieving them needed to be established. A Summer Study—one of the Navy's first endeavors of this kind—was organized to resolve these issues.

Project METCALF

This Summer Study, called Project METCALF, for the Metcalf Research Laboratory, was officially established at Brown University under a contract with ONR.* The chairman of the group was Dr. Donald F. Hornig, who was then a professor of chemistry and associate dean of the graduate school at Brown and who at present is Science Advisor to the President. Under him was a group of scientists with broad and varied backgrounds. They consisted of seven experimental physicists, four theoretical physicists, two physical chemists, one astronomer, and an engineer. Three of the members were actively working in the infrared field and one had previous experience in it. Their World War II military experience ranged from work on the atomic bomb to work on proximity fuzes. The group included such people as J. H. Van Vleck, who, during World War I, served in the Navy as an apprentice seaman but during the METCALF study was dean of engineering and applied sciences of Harvard; Robert Hofstadter of Stanford, who later won the Nobel Prize in physics; W. K. H. Panofsky of Stanford, now director of the Stanford (two-mile) Linear Accelerator Center; Eugene Fubini, later Deputy Director of Defense Research and Engineering for the Department of Defense; Charles H. Townes of Columbia, another Nobel Prize winner in physics; and Leo Goldberg, now director, Harvard College Observatory.

At the first meeting of the group, which was held in August 1951, the following four principal goals were established:

- To gain an understanding of the fundamental physical factors on which all military applications of infrared must depend and to gain an appreciation of the assets and liabilities of infrared systems.
- To gain an understanding of the operational problems to which infrared might be applied and to compare the virtues and liabilities of infrared and radar in solving them.
- To make an intensive study of a small number of applications in order to understand the practical engineering problems involved in military infrared devices.
- To evaluate the Navy's infrared research and development program in terms of overall balance between fundamental research and development, organization, and information exchange.

An international flavor was imparted to Project METCALF through visits made by the group to British establishments concerned with infrared research and development for the purpose of relating that country's efforts with those of the United States. The British participants included representatives of the Navy Staff of the British Joint Services Mission, the Royal Aeronautical Establishment, and the Telecommunications Research Establishment (TRE)—now Royal Radar Establishment (RRE). One of the British Navy Staff members, Mr.

*Mr. Frank B. Isakson, now head of the Physics Branch of ONR, was responsible for initiating this study.

Aubrey W. Pryce, later joined the staff of the Office of Naval Research and is now director of Acoustic Programs.

The study was concluded in September 1952. Its report noted, among other things, the importance of target discrimination as distinct from total sensitivity. It also pointed out that infrared radiation cannot be transmitted over great distances because of its degradation by fog, haze, rain, and smoke and that infrared techniques may not be the best choice even for situations in which they might be applicable.

The METCALF group concluded that its survey of the present state of science and the progress of the military developments underway had convinced it "that important contributions to the military art will be made by using infrared radiation and that a vigorous basic research program is worthwhile." It also made the very practical recommendation "that because of the special limitations imposed by background and weather, a high degree of selectivity should be maintained in the development work undertaken, and all projects should be weighed carefully from an operational viewpoint at an early stage."

Toward the end of the METCALF study, it became clear that the Sidewinder missile was the most advanced air-to-air missile then in the research and development area. Yet it was on the verge of cancellation for reasons other than scientific. Some members of the METCALF committee discussed this problem with the Chief of the Bureau of Ordnance, urging continuance of the program. These discussions were successful, and the missile later proved its worth under operating conditions.

Infrared Research

Early infrared systems had employed photoemissive tubes as imaging devices. However, photoemissive tubes have a fundamental wavelength limit of sensitivity, which is short. Since the radiation emitted by the target usually is concentrated at longer wavelengths, infrared research has focused on detectors that depend upon the photoconductive or photovoltaic effect.

Whereas lead salts have been used predominately since World War II, a host of different detector materials, such as indium antimonide and germanium doped with gold, mercury, copper, or other elements recently have become available. However, the use of these materials must be coordinated with advances in cryogenics, since the detectors operate best at temperatures between those of liquid nitrogen and liquid helium.

Effective utilization of the infrared region has depended also on progress in signal processing. Because most infrared systems are passive—that is, they detect radiation emitted by the target and have no active source such as that of radar devices—the system must find a relatively steady point source of radiation in a background whose radiation varies with time and from point to point. Such techniques as spatial frequency filtering or detection by arrays can be applied to correlate signals received at different times or at different positions in order to concentrate attention on the steady signal, which might be a target. Advances in these areas of signal processing have made infrared systems more effective.

Infrared Information Management

In line with earlier ONR experience and METCALF recommendations, a special effort was made to provide as much freedom of information exchange as was consistent with national security. As a matter of fact, the problem of information exchange was not related primarily to military security but stemmed rather from the lack of rapport between different cognizant branches of the armed forces, institutional rivalries, the desire of commercial concerns to keep secret their own technical procedures, and the absence of unifying meetings and reports. In order to sweep away such needless barriers, the IRIS symposium was expanded in 1954 by relaxing the geographic restrictions on membership and increasing the quota of participants. This expansion resulted in an increase in the attendance at the symposia from an average of 30 persons to an average of 80 persons. Included among the participants was a substantial number of representatives of eastern organizations. In 1956, therefore, an eastern group of the IRIS organization was set up under the chairmanship of Mr. Thomas B. Dowd of the ONR Boston Branch Office. Earlier that year, publication of the proceedings of IRIS was begun, and before the year had ended, the reports of both the eastern and western groups were being printed in a single classified national journal on military infrared physics and technology.

As a further aid in information exchange, ONR proposed, in 1951, the formation of a "Joint Infrared Statistics Agency," whose duty would be to accumulate and evaluate data in the infrared field. Project METCALF subsequently endorsed the idea of a central information center and library for infrared documents. Such a center, known as the "Infrared Information and Analysis Center" (IRIA), was established at the University of Michigan in 1955 under joint service sponsorship. The expressed purpose of IRIA is "the collection, evaluation, and dissemination of all information concerning research and development in the fields of infrared physics and technology" on a continuing basis. IRIA collects information by securing reports from military laboratories and contractors, by visits to these organizations, and by attendance at appropriate symposia. The information is analyzed, abstracted, catalogued, stored on punch cards, and made available to those who furnish the required "need to know." In addition, annotated bibliographies and occasional "state-of-the-art" summaries are prepared and distributed by IRIA.

Project METCALF was a landmark in the military infrared research field. By laying the foundation for a sound, orderly program in infrared research and development and stimulating information exchange, it provided the impetus for significant advances in the broad area of military optics. The primary contribution of ONR to these developments was the initiative it gave in an area that in general had been defined only vaguely and was not fully appreciated—the role of promoting and coordinating research. Without Navy-wide coordination and without an agency such as ONR assuming the responsibility and taking the interest to examine critically and to spur, where necessary, the fulfillment of the important potential of infrared to Naval operations, the advance of Naval technology would have been much slower. Although ONR is not now involved directly with the development of specific new infrared systems, it has influenced their development through such activities as IRIS, IRIA, and Project METCALF, and it will continue to do so in the future in order to make certain that infrared research is applied where it will be of the most benefit to the military services.

NOL Commander Selected for Rear Admiral

CAPT James Ashton Dare, USN, Commander of the Naval Ordnance Laboratory, White Oak, Maryland, has been selected for promotion to rear admiral by the 1967 flag board. He assumed command of NOL on July 19, 1965.

CAPT Dare's 26-year Naval career began with his graduation from the Naval Academy in 1939. His assignments at sea included service aboard the USS ARIZONA and USS MARYLAND and as commander of the USS DOUGLAS H. FOX and USS COMPASS ISLAND.

After receiving his Master of Science degree in ordnance special physics at the Massachusetts Institute of Technology, in 1947, he served on various weapons projects at the Los Alamos Scientific Laboratory, New Mexico. In 1959, he was appointed Assistant Director of the Instrumentation Laboratory at MIT. Next, he was Director, Advanced Technology Group, Office of the Deputy Chief of Naval Operations (Development). In 1962, he was assigned to the Joint Staff, Commander-in-Chief, Pacific, then served as Commander Amphibious Squadron Ten, Norfolk, Virginia.

For commanding the amphibious force that evacuated 4000 civilians from the Dominican Republic and that was the first to land Marines there in 1965, CAPT Dare was awarded the Presidential Legion of Merit.

Fifth of a series of articles highlighting oceanographic instutitions that receive support in large measure from the Office of Naval Research.

OCEANOGRAPHIC INSTITUTIONS

The University of Rhode Island's Graduate School of Oceanography

A diversified marine science center is growing on the campuses of the University of Rhode Island. Coming together under University auspices are not only traditional academic and research activities but a broad spectrum of applied investigations into oceanographic problems. The fountainhead of many of the projects which are engaging a widening portion of the university population is the Graduate School of Oceanography, an institution of national importance which has been nurtured consistently for a number of years by major support from the Office of Naval Research, other federal agencies, and the State of Rhode Island.

The University's Narragansett Bay campus, six miles from the main campus at Kingston, is shared by three major federal laboratories and the Rhode Island Nuclear Science Center, which operates a one megawatt research reactor. Its waterfront dock, near the juncture of the bay and Block Island Sound, is home base for the R/V Trident, a 180-foot ocean-going research ship, and smaller craft engaged in coastal and estuarine research tasks.

The federal neighbors are the U.S. Public Health Service's Northeast Shellfish Sanitation Research Center, a multimillion dollar facility; the Bureau of Sport Fisheries and Wildlife regional laboratory, which is scheduled to open this fall; and the federal Water Pollution Control Administration's water quality laboratory, which has been funded and is now being planned. The 88-acre campus, which is still undergoing expansion through a judicious land-purchase program, is spacious enough to permit extensive development for many years to come.

Here, a faculty of 18 works with a graduate-student group of 70. Most of the faculty receive research support from federal sources—during the past fiscal year well over a million dollars in grants—and many of the graduate students study and conduct research with the help of federal fellowships and assistantships. A back-up force of administrative, technical, and maintenance personnel of 71 is employed.

Although a survey course in oceanography is available to undergraduates on the Kingston campus, only graduate degrees are given in oceanography. Training in ocean studies is considered by the University as a final step, to be taken only after thorough preparation in one of the basic sciences, such as physics, chemistry, geology, biology, meteorology, and mathematics. The graduate students in oceanography generally take two years to earn their master's degrees and five years to win their Ph.D.'s.

Developing on the Kingston campus is one of the country's first ocean-engineering programs, the activities of which complement the work of the Graduate School of Oceanography. Degrees are awarded in a major discipline, such as chemical, electrical, civil, industrial, and mechanical engineering, with a minor in oceanography based on course requirements completed at the Graduate School of Oceanography.

An interdisciplinary approach in both training and problem solving in the marine environment has been developing throughout the University which gives promise of maintaining the Rhode Island institution in a prominent national position. This interplay and coordination has provided a team effort for a number of research projects in the past, with oceanographers, engineers, chemists, physicists, and others joining forces to attack complex questions. It seems likely that this pattern will become more apparent.

While the Graduate School of Oceanography is charged primarily with the training of future scientists and the search for basic ocean knowledge, several supporting programs round out the university's research role. During the past year, a Law of the Sea Institute was established to work on the complicated international, national, and State legal puzzles which are developing through increased world-wide interest in the exploitation of marine resources. The Institute, during the past summer, held the first conference of its kind in this country, with 110 participants from many States and five foreign countries exploring aspects of the Geneva Convention of 1959-60 and problems which have arisen since. Proceedings of the week-long conference will be published shortly, and a second conference of similar scope is planned for next summer. Activities of the Institute are financed in part by ONR.

On nearby Point Judith Pond, a tidal basin rich in marine life, the Graduate School of Oceanography has established a Marine Experiment Station where practical problems related to marine resources are studied. Some of the initial assignments of the station involve development of techniques for improving the rearing and harvesting of food from the sea, but it is anticipated that the station will grow and move into many other marine-resource areas. Dr. Sual B. Saila, an associate professor of oceanography, is director of the experiment station.

The applied approach to engineering problems involves the interest of another university organization. The new Institute of Ocean Technology, under Dr. Richard F. Hill, professor of ocean engineering, is expected to work with industrial organizations and other groups on

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the designing and testing of structures, instruments, and other equipment needed in the many-sided penetration of the sea frontier.

Meantime, food and resource economists of the University's School of Agriculture are engaged in a variety of research chores ranging from the testing of fishing gear to studies of new seafood products and economic surveys of the marine potential in the southern New England area. The School of Agriculture also will administer a new two-year fishermen's school where students will learn the latest techniques for catching, processing, and marketing seafood.

While many of the programs surrounding the Graduate School of Oceanography are new, the school itself has roots which go back to the early years of interest in the marine sciences. It has grown from beginnings in the 1930's, when Dr. Charles J. Fish, chairman of the Zoology Department, established the Narragansett Marine Laboratory in a two-story stone building at Ft. Kearney, one of the coast artillery fortifications which guarded Narragansett Bay during World War I. The original one-acre site now has been absorbed in the present Narragansett Bay campus. Growth of the laboratory was slow at first, and the staff was limited largely to Dr. Fish and his wife, Marie Poland Fish, a prominent icthyologist. Mrs. Fish created important scientific news during the 1925 Arcturus expedition to the Sargasso Sea with William Beebe when she found and identified eggs of the American eel in sargassum weed, which was the first indication of the eel's migratory habits.

During World War II, the laboratory was closed while its director was on research assignment with the Navy. It was opened again shortly after the war with Navy funds providing much of the basic financing. Mrs. Fish brought back to Rhode Island work she had started at Woods Hole on fish and mammal sounds, which was touched off by her analyses of the war-patrol reports of American submariners. Today she continues her bioacoustical studies while her husband continues his work with ocean plankton populations, although both have retired from active teaching assignments at the university. The graduate school today is a basic link in the Navy's bioacoustical research effort. Mrs. Fish plays a key role in tracing and identifying unknown mammal and fish sounds, works on training programs for sonarmen, and for more than twelve years has served as chairman of the Navy's Kingfish committee. The Navy honored her with its highest civilian service award in ceremonies at Washington, D.C., last spring.

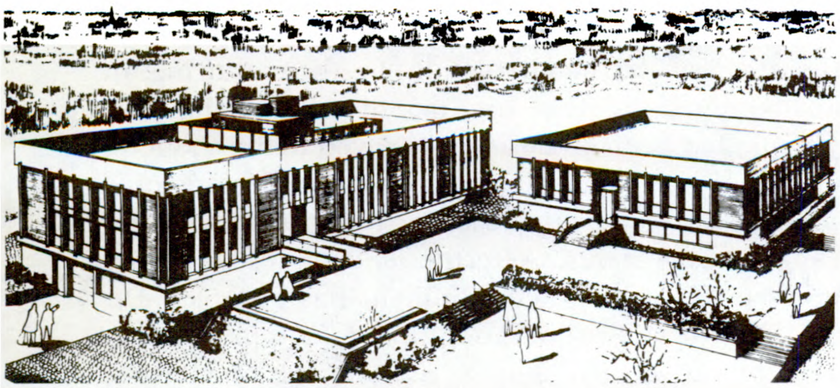
The University launched a master's degree program in biological oceanography in 1949. A Ph.D. program was started in 1959. Today, degrees are offered in biological, chemical, geological, and physical oceanography. Although biological oceanography still dominates the research interest of the largest portion of the faculty and student body, balance has been growing among the other disciplines through the establishment of the graduate school in 1961 and the arrival of Dr. John A. Knauss that year as dean. Dr. Knauss, who had been a physical oceanographer at the Scripps Institution of Oceanography, brought with him his data on ocean circulation and the Cromwell Current, which he obtained while in California; he completed his studies of the latter while at Rhode Island. Shortly after his arrival, the R/V Trident was obtained, affording for the first time a floating base for field research virtually anywhere in the ocean environment.

Since the inception of the M.S. program in 1949, a total of 35 master-of-science degrees have been awarded. Before 1965, two Ph.D.'s had been earned. In 1965, four more were awarded, and in June 1966, another four were granted. Of the ten Ph.D.'s, two are assistant professors at Lehigh and North Carolina State, one is at Oak Ridge, two are with the Puerto Rico Atomic Energy Commission, two are with the Public Health Service and Bureau of Commercial Fisheries, respectively, one is assistant director of the Bermuda Bilogical Laboratory, one is an assistant professor at City College of New York, and one is employed at General Dynamics Corporation's Electric Boat Division.

The research interests of the staff are wide ranging, from theoretical investigations of the general ocean circulation to the culturing of phytoplankton, from investigations of the continental shelf to behavioral studies of fish. Dr. Knauss has been extensively involved in the cooperative international studies of the Indian Ocean, concentrating on equatorial circulation patterns. He is working also under a continuing program on Gulf Stream measurements. A fertile field of research into pro- and anti-bacterials in the marine environment has occupied Dr. John McN. Sieburth, professor of oceanography; isotope studies, utilizing the resources of the nearby atomic reactor, are of concern to Dr. James T. Corless, an assistant professor of oceanography. In addition to plankton investigations, biological oceanographers on the staff have made continuous investigations of benthic plants and marine algae, the marine life of salt ponds and estuaries, and effects of pollution on the marine environment. In addition to their studies of the continental shelf, geological oceanographers are carrying out wide-ranging bottom research along the equator and off the west coast of Africa.

While much of the early work of the original Narragansett Marine Laboratory was confined of necessity to biological studies in the estuaries and coastal waters of the southern New England region, steadily increasing faculty strength and the services rendered by the R/V Trident have served to widen the research effort on many fronts.

The graduate school's major research vessel began her maiden scientific expedition on September 15, 1962, after being outfitted in San Diego. Through September 15 of this year, she had logged 800 days of sea time, an average of 200 days a year.



Above, Mrs. Marie Po
Fish records underw
biological sounds. At
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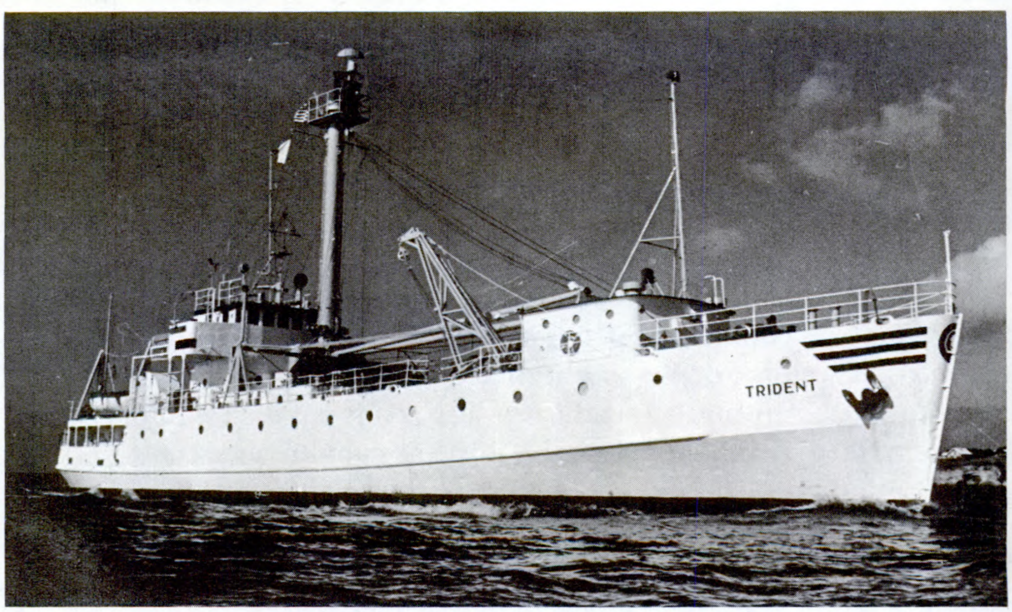
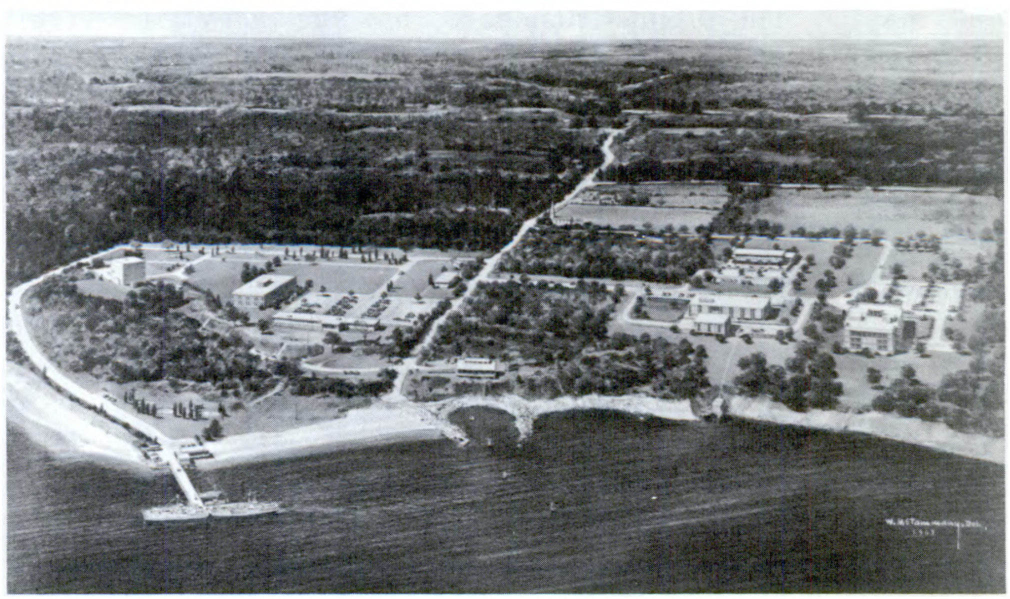


The Asherah, leased by URI from the General Dynamics Corporation, is lowered into the water in preparation for a dive. →

← The 45-foot Gail Ann, one of three vessels operated by URI.

Aerial view of the 88-acre Narragansett Bay campus of URI. University, State, and federal laboratories are all included on the grounds. At far left (block shaped building) is the State's atomic reactor.



The Trident is 180 feet in overall length, has a 32-foot beam, and weighs 865 gross tons. She is powered by two 500-horsepower GM diesels and has fuel and storage capacity for continuous sea duty for 30 days. The ship is a former Army maintenance and supply vessel that was constructed in 1944 and that has been extensively modified for her scientific mission. With more than 2000 square feet of laboratory space below decks, a wet lab in a forward deck house, and bow and directional hydrophone installations, the ship supports a wide variety of research capabilities. The Trident's complement consists of her captain and 19 crew members, and she can carry a scientific party of 13. Special quarters have been provided for women in the scientific party.

Since 1962, Trident has worked along much of the east coast of the United States, has made numerous trips to the Sargasso Sea and Bermuda area, has worked in the Caribbean, off the coast of Brazil, along the west coast of Africa, around Spain, and in the western Mediterranean. The replacement cost of the ship was estimated at $1,200,000 at the time of her transfer from the federal government to the university for a token $500 payment. Since that time, extensive adaptations have been made under ONR sponsorship during periodic shipyard overhaul visits. Her operation and maintenance is financed by grants from ONR and the National Science Foundation.

For inshore work, the graduate school relies on a 40-foot dragger, Billie II; a 45-foot boat, Gail Ann, a gift from Harlan T. Moses, Rhode Island insurance company executive; and several smaller craft from the fleet maintained by the State Department of Conservation, which cooperates closely with university research workers.

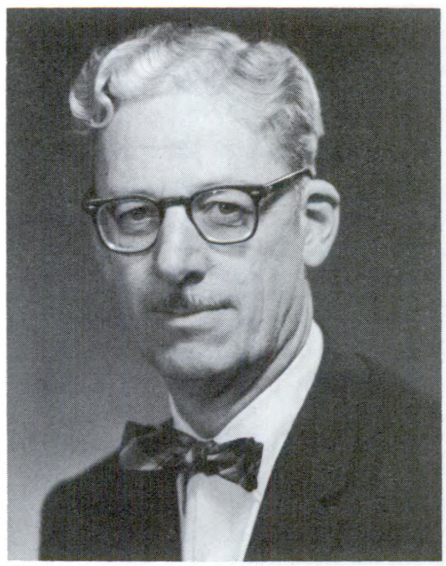
At the Narragansett Bay campus, the Graduate School of Oceanography is rich in land but extremely cramped for laboratory and office space. The original stone-faced building housing the former Narragansett Marine Laboratory burned down in 1959 and was replaced by a modern one-story structure commanding a sweeping view of the west passage of Narragansett Bay. Additional work space in the old artillery bunkers of the original Ft. Kearney was quickly filled by the expanding staff and graduate researchers, and a nearby wooden structure, called the North Laboratory, was kept in service.

The acute space needs are expected to be eased by major construction during the next two years. Funds are available and plans have been completed for a two and a half story laboratory-office building costing about a million dollars, which, with 30,000 square feet of space, will afford five times the area of the present Charles J. Fish Oceanographic Laboratory, the replacement for the original fire-demolished structure. In addition, a modern research library containing lecture and conference rooms, microfilm facilities, and a data-processing center linked to the computer center on the main campus six miles away will rise as part of the same contract. A unique feature of the library is a cooperative plan under development for joint maintenance support from the graduate school and neighboring federal laboratories. The federal scientific and technical staffs, which are expected to total several hundred persons in the near future, will share the resources of the library.

Funds for the new buildings have come from a substantial National Science Foundation grant, a smaller grant from the funds administered by the Department of Housing and Urban Development, and a State bond issue.

With the space problem solved, hopefully by some time early in 1968, a planned major increase in all activities of the graduate school is anticipated. A graduate student body of 100 and an augmented faculty is forecast. Expansion into all aspects of oceanographic research and education became a mandate in 1959 in a report by Dr. Francis H. Horn to the Board of Trustees of State Colleges. Since that time, oceanography has experienced its greatest period of growth. During the next decade, even greater acceleration in growth seems inevitable.

Dr. Peter King
Chief Scientist of ONR



Dr. Peter King has been named Chief Scientist of the Office of Naval Research. He came to ONR after serving for the past two years as Chief Scientist and Scientific Director of the London Branch of the Office of Naval Research.

Dr. King began his government career as a chemist at the Naval Research Laboratory in 1939, became a branch head in 1949, Superintendent of the Chemistry Division in 1954, and Associate Director of Research for Materials in 1956. In that position he supervised the Laboratory's four research divisions in the materials area. In 1960 he was awarded the Distinguished Civilian Service Award for his contributions to the development of a long-range atmospheric radiation detection program. This program resulted in the system which provided conclusive evidence of the first atomic explosion by a foreign power. By measuring the amount of fissionable material in rain water, Dr. King was able to determine the bomb material and to fix the approximate time of explosion.

Born in Boston, Massachusetts, Dr. King attended the University of Notre Dame and the University of California at Los Angeles, where he received his bachelor's degree. He received the Ph.D. in chemistry from Catholic University.

Dr. King is a member of the American Chemical Society, the Washington Academy of Sciences, the Scientific Research Society of America, the American Association for the Advancement of Science, and the Philosophical Society. He is the Navy representative to the National Research Council. He is also the author and co-author of numerous technical papers and has numerous patents to his credit.

The Deep Submergence Systems Project

The lack of United States capability to explore the deep ocean and to rescue men trapped in the ocean depths became painfully apparent when the USS THRESHER sank in more than 8000 feet of water in April 1963. Shortly after that tragedy, the Navy set up the Deep Submergence Systems Review Group under the chairmanship of RADM E. C. Stephan, USN (Ret.), to comprehensively review the Department's plans for locating, identifying, and recovering objects from the deep-ocean floor and rescuing personnel from disabled undersea craft, and then to recommend courses of action that would lead to both expeditious and long-term improvements in those plans.

The study made by this group illustrated two important facts: One was that the Navy could not recover sunken missiles, space vehicles, torpedoes, and submarines simply by dangling hooks at them from the ocean surface miles above the bottom; and the second was that rescue missions cannot wait weeks or months until weather conditions are favorable for conventional operations.

On May 28, 1964, Secretary of the Navy Paul H. Nitze announced that he had assigned a deep submergence systems program to the Navy's Special Projects Office under the Chief of Naval Material. On May 26, 1966, after nearly two years under this management, the Deep Submergence Systems Project was officially established as a separate endeavor under the Chief of Naval Material. Dr. John P. Craven, Chief Scientist of the Special Projects Office, was named director of DSSP.

Specifically, the DSSP is concerned with the development of capabilities in the following five areas:

- Submarine location, escape, and rescue.
- Deep-sea search and small-object recovery.
- Man-in-the-Sea accommodation.
- Large-object salvage.
- Construction and operation of a nuclear-powered deep-submergence research and ocean-engineering vehicle.

Submarine Location, Escape, and Rescue

Location. Ways are being devised for determining the exact position of a disabled submarine and the cause and nature of the disablement.

Escape. A three-part program is planned to improve procedures that now govern the escape of personnel from submarines and other undersea vehicles. The first part calls for the fabrication of immersion suits and one-man life rafts to increase the chances for survival of escapees. The second provides for improved escape training for undersea-vehicle personnel. And the third involves an experimental 600-foot open-sea free ascent to demonstrate the feasibility of making emergency exits from a disabled submarine in deep water.

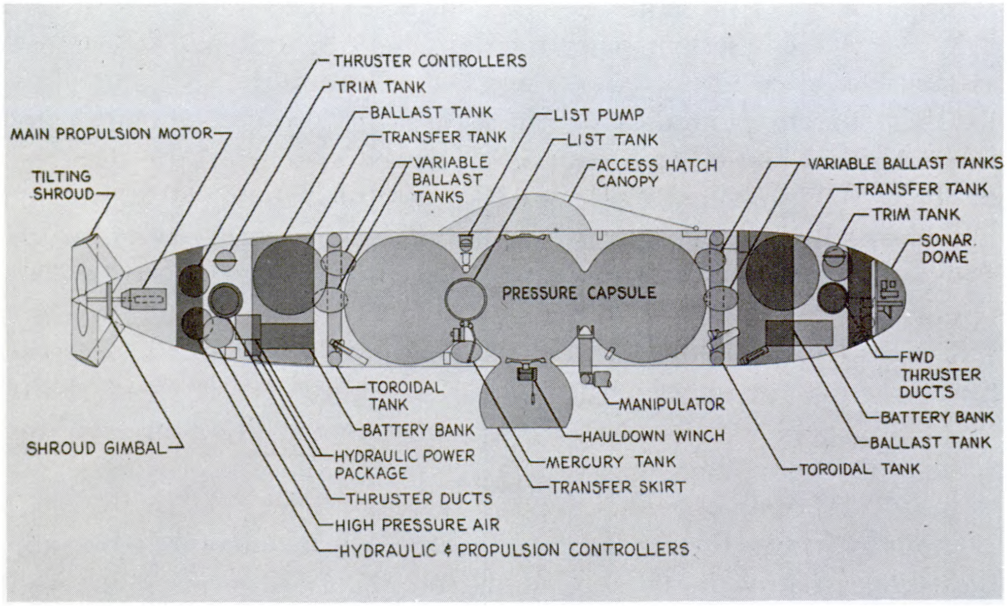
Rescue. A new system is being designed for rescuing men from submarines anywhere in the world, even under the ice, under any weather conditions, and at depths as great as present submarine collapse depths. The central component of the system will be the Deep Submergence Rescue Vehicle (DSRV), a 50-foot-long, 60,000-pound highly maneuverable submersible that will carry as many as 24 men in addition to its crew of three (two pilots and a medical corpsman). Other major components of the system will be C-141A aircraft, which will transport the DSRV to a port near the submarine in distress; nuclear submarines, which will carry the submersible "piggyback" from that port to the distress site; and new surface support ships, which will be designed to assist in rescue operations, provide rescue training, and carry out other support activities.

Upon reaching the distress site, which will be identified by radio buoys released by the striken submarine, the DSRV will detach itself from the mother submarine and dive toward the disabled vessel, which it will locate by means of high-resolution sonar and high-intensity lights. It will then attach its rescue skirt to the submarine's escape hatch, pump the skirt dry, equalize the pressure between the two craft so that hatches can be opened, and commence shuttling personnel to the surface. Because the life-support capacity of the stricken submarine may be quite limited, the DSRV will be required to complete the rescue of all personnel from the submarine within 50 hours following disablement.

Six and one-half million dollars were appropriated for the program for fiscal year 1966, and an additional $25 million have been earmarked for 1967.

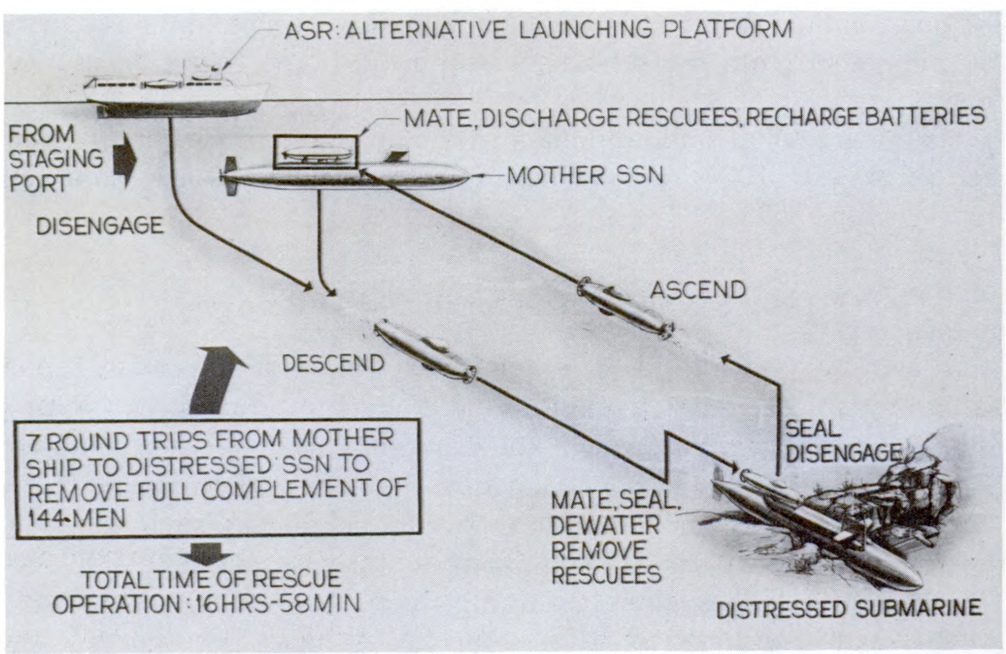
Deep Sea Search and Small Object Recovery

A rapidly growing need is being experienced in oceanographic circles for the capability to explore the 80 percent of the ocean volume that lies below levels at which the Navy now can operate routinely. In particular, a system is needed to permit surveys to be made, investigate bottom features, and to recover small objects, such as bombs, instruments, and parts of ships from depths as great as 20,000 feet. A test vehicle will be designed and a deep-sea test range developed, enabling investigators to study concepts, vehicles, equipment, and systems at great depths under controlled conditions. Special attention will be given to materials problems associated with vehicles designed for operation at depths as great as 20,000 feet.



One concept of a Deep Submergence Rescue Vehicle (DSRV).

The DSRV rescue operation.



For 1966, $4.3 million, and for 1967, $8.0 million were appropriated to carry out this program.

Man-in-the-Sea

Perhaps the most exciting of the DSSP efforts is that being made to give man the capability to live and work for long periods of time deep in the ocean. Such a capability would prove to be of great value in support of rescue and salvage operations, in maintaining bottom-mounted equipment, in the exploration and exploitation of the continental shelf, and in military operations, such as those associated with mine defense and amphibious assaults. The effort, called "Man-in-the-Sea," will involve the following approaches:

- Physiological research and experimentation.
- Development of mobile equipment needed for decompression.
- Surface-ship modifications to support diving operations.
- Development of advanced sea habitations to provide underwater living and storage accommodations for future aquanauts.
- Development of auxiliary facilities, such as improved diver-to-diver communications and underwater propulsion devices.

The study and testing of techniques and equipment designed to enable man to live and work deep in the ocean, both in and out of his habitat, for long periods of time has been proceeding for several years both in laboratory pressure chambers and in the ocean. SeaLab I, during which four Navy divers lived and worked at a depth of 192 feet for 11 days, was conducted during the summer of 1964 in the Atlantic Ocean near Bermuda; and SeaLab II, which involved 28 men, was conducted at a depth of 205 feet for 45 days off the coast of southern California last summer. SeaLab III, the next experiment, will be held off the coast of San Clemente Island, southern California, late in 1967. It will involve three or four teams of divers, each consisting of from six to eight men, which will live in and around an ocean-bottom habitat for 15-day periods at a depth between 400 and 500 feet. In preparation for this third underwater-living experience, much equipment used during earlier SeaLab projects will be refurbished. In addition, the DSSP is coordinating its effort with those of other branches of the Navy to obtain data for the biomedical, physiological, and hydrobiological tests to be made during the period of the dive.

Present planning calls for the extension of the Man-in-the-Sea depth capability to levels below those of the continental shelf and eventually to the greatest depths that man is physiologically capable of attaining.

Funding for the program amounted to $2.2 million for fiscal year 1966. For 1967, $7.3 million have been appropriated.

Large Object Salvage

The objective of this program is to provide the equipment and techniques required to recover large objects—for example, sunken ships having a deadweight lift of 1000 tons—from a depth as great as 850 feet, which is about 600 feet lower than conventional methods and equipment can be employed.

The investigation, preparation, and rigging of the sunken ship is to be accomplished by divers equipped with special tools and possibly with the aid of deep-submergence vehicles developed under other DSSP programs. Buoyancy materials will be developed to lighten objects and to exert external lift.

During 1966, work began on a life-support system for salvage operations and for the Man-in-the-Sea experiment that will be conducted in 1967. This system consists principally of a personnel transfer chamber, a rest and refuge habitation, and a large decompression chamber that will be mounted on a surface support vessel. For 1967, funds amounting to $417 million have been programmed to develop and then procure underwater work equipment, such as drills, hull attachment devices, power sources, cutting devices, and collapsible pontoons. In addition, a detailed design will be made of a dynamic winch lift system.

In the planning stages is research on gas generation under ambient pressures, displacement and dewatering materials, the controllability of pontoon systems, and the adaptation of deep-submergence vehicles for salvage operations. The medical and physiological research and development required to assure the safe conduct of deep-diving work is to be provided by the Man-in-the-Sea program.

Nuclear-Powered Research and Engineering Submersible

The capabilities of manned underwater research vehicles developed to date are limited by the short endurance of their propulsion and auxiliary power sources. Because of this fact, the Department of the Navy and the Atomic Energy Commission are jointly developing a nuclear-powered deep-submergence research and ocean-engineering vehicle, designated "NR-1," whose vastly increased endurance will enable it to roam over the ocean bottom for weeks at a time.

Overall responsibility for the NR-1's development has been given to the DSSP. The Naval Ship Systems Command is responsible for vehicle design, development, and construction (most of this work will be done at General Dynamics Corporation's Electric Boat Division, Groton, Connecticut); the AEC's Division of Naval Reactors, for the design, development, construction, and testing of the nuclear propulsion plant; and the AEC's Knolls Atomic Power Laboratory, Schenectady, New York, for design, development, and testing of the reactor.

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ERRATUM

Page 20: In the third paragraph, the amount of money specified as having been appropriated for Fiscal Year 1967 ($417 million) is incorrect. The correct amount is $4.7 million.

A pressurized water reactor of low power that will be located in the vehicle so as to minimize shield weight will provide propulsion and auxiliary power. The pressure hull will be fabricated of HY-80 steel. Observation ports and lights for viewing outside the vehicle, cameras for taking pictures of scenes of interest, and apparatus to pick up objects from the ocean bottom will be provided.

The area of the ocean floor to be made accessible by NR-1 includes all of the world's continental shelves. Because of its great endurance underwater, the vehicle will be able to perform tasks heretofore only imagined. It will be able to perform detailed studies of, and to map, the ocean bottom for commercial and scientific purposes; to obtain information leading toward greater exploitation and control of the ocean's resources, including marine life and minerals; and to locate and retrieve objects of commercial, scientific, and military value. The NR-1 will be made available for use by agencies other than the Navy.

The cost to the Navy is estimated to be $30 million, all of which is derived from fiscal year 1965 funds. The AEC has programmed $3.0 million for fiscal year 1967 for development and procurement of the vehicle's reactor system.

Advanced Data-Processing Equipment to be Developed for Survey Ship

A contract amounting to about $400,000 has been awarded Texas Instruments, Inc., Dallas, Texas, by the Naval Oceanographic Office to provide measuring and recording equipment for the 285-foot survey ship USNS KANE, which is expected to be in operation in mid-1967. The new equipment, called "central data-recording system," will act as a nerve center of one of the most advanced sea-going data-handling processes developed for oceanographic work.

A digital computer will control data input and apply the necessary calibrations and corrections. While the ship is underway, special subsystems, to be provided by other contractors, will simultaneously measure bathymetric depth, total magnetic intensity, gravity, sea-surface temperature, and sub-bottom structure. When the ship is occupying an oceanographic station, on-station sensors will continuously measure and record depth, temperature, salinity, sound velocity, and ambient light to a depth of over three miles. The central data-recording system will display and process this information, then record it on magnetic tape in a format compatible with the National Oceanographic Data Center's computer facilities.

About 20 billion measurements are being made every day in this country—in science, in industry, and in everyday life—according to Dr. Robert D. Huntoon, Director of the National Bureau of Standards' Institute for Basic Standards.

Research Notes

More Power for Muscles

The Office of Naval Research is renewing a contract with the Philco Corporation, Willow Grove, Pennsylvania, to continue its research in myoelectricity. The Navy program involves the use of electric signals, generated by the movement of muscles, to activate and control a powered external device which can supplement the movement of limbs. By amplifying muscle signals, the device would enable a man to "operate" his arm even though physical movement would be impossible or extremely limited. For example, the device might be used by an aircraft pilot who is severely constrained by high-g forces; by a barely perceptible movement of his arm, the pilot could activate and direct a powered device to control his aircraft. Men working in the ocean depths or in tightly confined areas might also apply the device to perform tasks that would be impossible to do otherwise.

The pioneering aspect of the Philco research in the new field of myoelectricity is the use of a pattern-recognition computer that sorts out the signals from individual muscles. The computer can consistently identify the pattern of signals necessary to carry out the motion or action desired by the human operator and ignore the signals not related to the desired motion. Philco has fabricated a microminiatured computer and control circuit no larger than a pack of king-size cigarettes that is connected to the skin surface by silver electrodes. This device, the concept of which came from the Navy contract, is being applied to the development of a system for controlling artificial limbs under a separate contract with the Vocational Rehabilitation Agency.

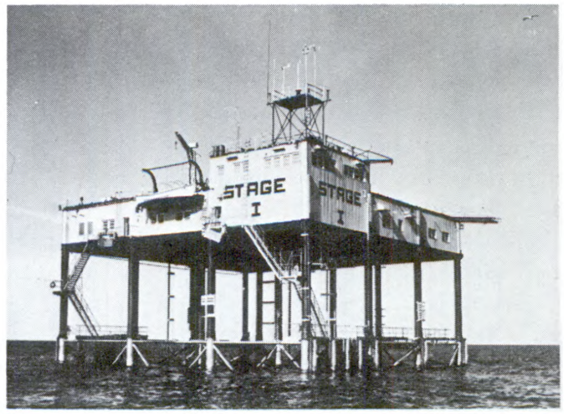
The renewal of the Navy contract, which has been in effect since 1963, will permit improvements to be made in the reliability of the experimental system by supplementing the control patterns of the arm with additional control signals originating in nearby muscle sites, such as the neck, chest, and back. Experiments will be conducted with human subjects who have special knowledge of physical performance. These subjects will be trained to operate the system and, on random command, to activate the supplemental signal, thereby providing reliable control of a number of simultaneous functions. When the system is perfected, a man with a single muscular movement will be able to carry out an operation by the normal use of his arm and simultaneously perform an unrelated operation by activating and directing a powered device.

Oceanography from Space

An intensive study of photographs taken from Gemini spacecraft over a number of ocean and coastal areas has revealed that such photographs can be of significant value to ocean scientists. Arthur G. Alexiou, of the Naval Oceanographic Office, states in a recent scientific paper that large-scale ocean features observed on color photographs taken from space can be utilized for such purposes as correcting charts, tracking river effluent, and detecting shoal areas. Observations from spacecraft might also be applied to the surveillance of sea-ice conditions, measuring of sea-states, and mapping of currents. Radar, infrared, and passive microwave devices would be among the instruments relied upon for such work.

Mr. Alexiou says that a few years ago the words "spacecraft" and "oceanography" were incompatible. Now, however, oceanographers may have both scientific and cost-saving reasons for making observations from space. Satellites, which spend two-thirds of their time over the water, could survey ocean areas constantly, thereby providing a better understanding of oceanic phenomena.

Offshore Towers Available for Research by Qualified Scientists



Navy offshore tower Stage 1.

Two Navy-owned ocean towers located in the Gulf of Mexico two and 12 miles off Panama City, Florida, have been declared available for use in connection with the conduct of any appropriate government-sponsored research projects. The towers, called "Stage 1" and "Stage 2," stand in 100 and 80 feet of water, respectively.

For the past several years, the towers, which belong to the Navy Mine Defense Laboratory, have been used for oceanographic research by Texas A&M University through arrangements made by the Office of Naval Research (see *Naval Research Reviews,* June 1966). Previously, they were used in connection with mine-countermeasures experiments carried out by NMDL.

Government agencies or contractors conducting research sponsored by government agencies that might wish to explore the possibilities of occupying the towers as an aid in achieving their scientific objectives should contact CAPT R. T. Miller, USN, Commanding Officer and Director, Navy Mine Defense Laboratory, Panama City, Florida 32402.

The New Assistant Secretary for R&D

On July 1, Dr. Robert Alan Frosch, Deputy Director of the Advanced Research Projects Agency, was sworn in as the new Assistant Secretary of the Navy for Research and Development, succeeding Dr. Robert W. Morse, who vacated that post to become President of the Case Institute of Technology.

Before serving with ARPA, as Director of Nuclear Test Detection and then as Deputy Director of that Agency, Dr. Frosch was Director of Hudson Laboratories of Columbia University. He has had wide experience in underwater acoustics and sonar developments and has served on a number of Department of Defense committees studying underwater acoustics and undersea warfare.

Giant Wave Phenomena Explained

During the early months of the 1966 tourist season, would-be travelers were shocked to learn that the ultra-modern Italian passenger liner Michelangelo was severely damaged by a freak wave. The massive body of water smashed bridge windows 81 feet above the waterline, inundated the forward half of the ship, tore aside heavy steel flaring on the bow, and killed three people.

Dr. Richard W. James of the Naval Oceanographic Office has offered an explanation of these rare occurrences. He reports that under the influence of strong wind, the ocean's surface develops mounds and hollows in chaotic motion. Observation of waves passing a ship indicate a variety of heights running in random fashion. Waves of an average height occur almost consistently, but interspaced with them are waves that are much higher and much lower. Based on mathematical percentages, if 1000 waves pass a ship there is one chance in 20 that a wave 2.22 times higher than the average might occur.

Since the waves encountered by the Michelangelo were approximately 30 feet in height, there was a mathematical possibility that the ship would encounter a wave from 52 to 66 feet high. With reported wave periods of 12 seconds it would have taken over three hours for 1000 waves to pass. The probability would then have been one in 20 that a monster wave 66 feet high would form during that time.

Buoyant Body Armor

A combination body armor and life vest that protects its wearer from explosive ordnance and provides buoyancy has been developed by the Navy's Clothing and Textile Laboratory at the Naval Supply Center, Bayonne, New Jersey. It is now being tested in Viet Nam.

The buoyant armor weighs only 46 ounces, the same as a standard life preserver, compared with the eight pounds or more that conventional body armor weighs.

The lightness of the vest reduces fatigue in hot weather, while the buoyancy makes it possible for the wearer to stay afloat if he is forced into the water. In addition, the newly developed armor provides at least 80 percent of the protection given by standard, eight-pound armor.

The armor is made of silicone-treated acrylic fiber batting enclosed in a waterproof cover. The silicone makes the fiber highly water repellent and lubricates the fibers, reducing friction between them. When the batting is hit by a high-velocity metal fragment, the lubricated fibers build up a fibrous "snowball" around the fragment. The "snowball" enlarges and acts as a brake on the speed of the metal as it forces its way into the batting.

ALVIN Resumes Atlantic Diving

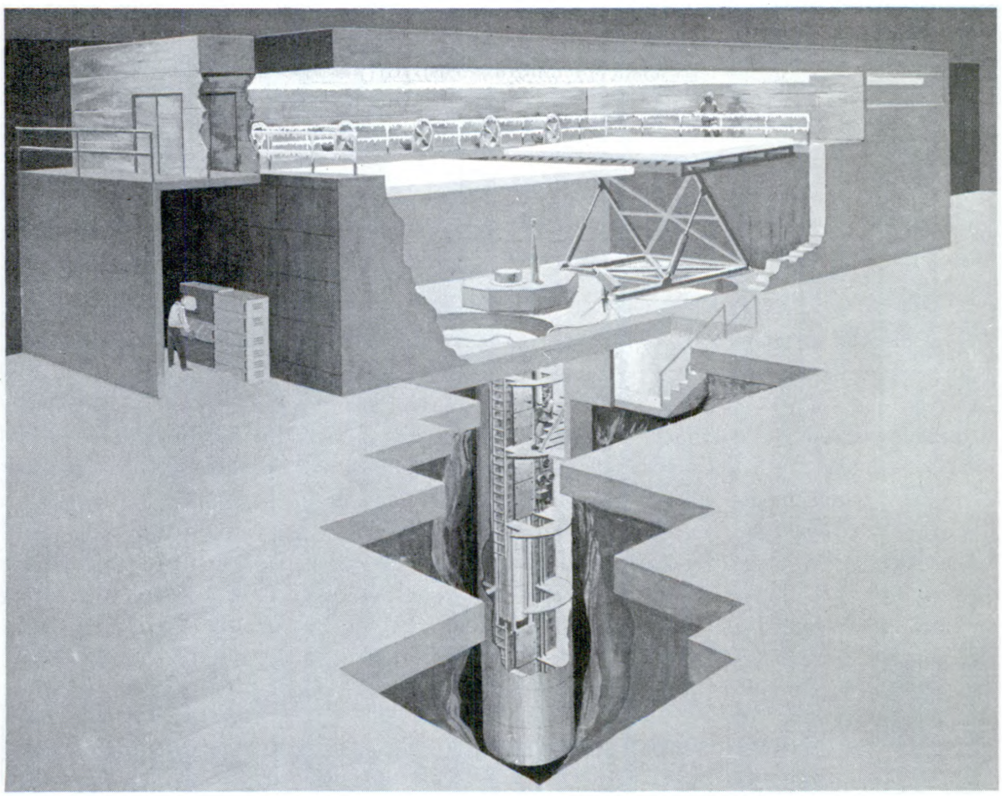
After completing its role in the search for the H-Bomb lost off the coast of Palomares, Spain (*Naval Research Reviews,* June 1966), the deep-submersible ALVIN went back into operation off Bermuda. On all but two of the dives made during July, ALVIN reached or came close to reaching the 6000-foot maximum depth to which it was designed to descend. The primary purpose of the diving program was the inspection of underwater installations.

On July 17, ALVIN carried a marine biologist and a plankton net deep into the ocean. The net was attached to an aluminum frame that was mounted on the bottom of the vehicle. The biologist, from the Woods Hole Oceanographic Institution, was able to observe bottom conditions, choose sites of particular interest, note their exact location, and visually direct the collection of samples. He was also able to observe the activities of marine organisms that had not been observed previously in the natural environment of these organisms.

The dives were continued during the month of August, the schedule calling for ALVIN to inspect the AUTEC installation in the Tongue of the Ocean and to explore the bottom off New Providence Island.

A SCUBA-diving scientist prepares to descend through a hole cut in sea-ice grown in the Arctic Pool.

Artist's cutaway drawing of the Arctic Pool. The chamber under the pool permits scientific control of experiments from the under side of the ice.



The Arctic Pool

For the study of many features of arctic sea ice and of equipment used during under-the-ice Naval operations, the Navy Electronics Laboratory utilizes a 30- by 75-foot pool in which sea water pumped from the Pacific Ocean can be frozen to a thickness of several feet under simulated blizzard conditions. Under the floor of the pool is a circular chamber 45 feet deep in which equipment and instruments are placed to study the breaking strength, acoustical properties, and other features of sea ice. Construction of the pool, which occupies a former Army gun battery enclosure on Point Loma, began in 1943 and continued for 8 years.

A hydraulic jack, or rafting device, in the pool rafts and stacks the ice to desired thicknesses to speed test procedures. A cold front is simulated above the pool by a cooling coil system and heat exchanger covering the ceiling. The system can drop the temperature to −80°F while the water below the ice is kept at 29°F.

Other features of the plant are two cold rooms for specialized study of ice growth and its effects on shipboard equipment; the hydro-physics facility, which includes high-pressure tanks; an underwater reverberant chamber and super-pressure equipment; and the radiographic/spectroscopic facility, which includes a betatron, low-voltage X-ray, and spectroscopic devices.

Arctic investigations undertaken by NEL began with the first successful dive under the sea ice into the Chukchi Sea on August 1, 1947, aboard the USS BOARFISH.

The Navy in Antarctica

Operation Deep Freeze, the Navy's logistic support program for U.S. Antarctic research, maintains five all-year stations and two summer stations in Antarctica. Nearly a thousand men of different nationalities live in Antarctica during the cold, dark polar winter. Over 200 of these men are members of the Navy's Operation Deep Freeze. With the summer comes the annual all-out logistic support program, and the U.S. population swells to nearly 1000 at the seven U.S. Antarctic outposts.

Antarctica has been called the "stepping stone to space." High atop its Polar Plateau, four U.S. Navy men and four U.S. scientists of the Antarctic Research Program are living from February to December 1966 to determine man's adaptability to isolation under severe climatic conditions.

The history of shark attacks on man dates back to the beginning of written records. For example, a vase, believed to have been painted about 725 B.C., shows a shark-like fish devouring a sailor. These fish may have traveled through history under several different labels, the word "shark" probably not making its debut until the middle of the sixteenth century, when English sailors are supposed to have adopted the German word "schurke," which means villain.

One of the several measures a threatened person can take to avoid an attack by sharks is shouting under water. An early account of the successful application of this procedure comes from three survivors of a German submarine that sank off the west coast of Africa in 1943. The men were attacked and bitten by sharks, but by ducking their heads below the surface of the water and "rearing," they succeeded in frightening the sharks away.

From "Pilot Chart of the North Atlantic," August 1966, a monthly publication of the Naval Oceanographic Office.

Government R&D reports, by law and inter-agency agreement, are available to the public from the Clearinghouse for Federal Scientific and Technical Information, U.S. Department of Commerce. The Clearinghouse is the center in the Government for the collection, announcement, reproduction, and sale of unclassified Government R&D reports and translations to the public. The documents are sold at the cost of reproduction and handling. Currently the Clearinghouse is collecting almost 50,000 R&D reports and translations a year and selling a million copies.

Further information on this service can be obtained from: Clearinghouse for Federal Scientific and Technical Information, U.S. Department of Commerce, Springfield, Virginia 22151.

On the Naval Research Reserve

Roster of Research Reserve Companies

There are 94 Research Reserve companies located throughout the United States. These companies are listed below by Naval Districts. For each company the time of meeting, meeting place, and the commanding officer and his address are given.

FIRST NAVAL DISTRICT

NRRC 1 1
1930, 1st & 3rd Mondays; Room 4-270, Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge, Mass. 02138. (CDR Paul St. George, USNR, 58 Elmhurst Rd., Newton, Mass. 02158.)

NRRC 1-2 .
1930, 1st & 3rd Wednesdays; U.S. Naval & Marine Corps Reserve Training Center, Fields Point, Providence, R.I. 02905. (LT Raymond B. Larter, USNR, 147 Harbor Rd., S. Swansea, Mass. 02777.)

NRRC 1-3
1930, 1st & 3rd Tuesdays; Room 10-11, Dickinson Hall, University of Massachusetts, Amherst, Mass. 02103. (No meetings during July and August.) (CAPT Charles Henderson, USNR, 173 Main St., East Hampton, Mass. 01027.)

NRRC 1-5
1930, 1st & 3rd Mondays; Higgins Laboratories, Conference Room, Worcester Polytechnic Institute, Worcester, Mass. 01609. (No meetings during July and August.) (LT Joseph C. Curtis, USNR, Putnam Rd., Holden, Mass. 01520.)

NRRC 1-7
2000, 1st & 3rd Tuesdays; Dartmouth Medical School, Room 524, Hanover, N.H. 03755. (CAPT Eugene C. Winslow, USNR, Windham College, Putney, Vt. 05346.)

THIRD NAVAL DISTRICT

NRRC 3-1
1830, 1st & 3rd Thursdays; 820 United Nations Plaza, New York, N.Y. 10017. (CDR Martin A. Rizack, USNR, 318 Warwick Ave., Teaneck, N.J. 07666.)

NRRC 3-2
1930, 2nd & 4th Mondays; Engineering Bldg., U.S. Naval Training Device Center, Port Washington, L.I., N.Y. 11050. (CDR Andrew J. Hangarter, USNR, 4 Sea Wall La., Bayville, N.Y. 11709.)

NRRC 3-3
2000, Alternate Mondays; Room G14A, School of Medicine, University of Buffalo, Buffalo, N.Y. 14214. (CDR Maurice Taylor, USNR, 5363 Elm Dr., Lewiston, N.Y. 14092.)

NRRC 3-4
2000, Alternate Mondays; Bausch & Lomb Hall, Room 106, University of Rochester, Rochester, N.Y. 14627. (LCDR William R. Smith, USNR, 38 Woodhill Rd., Pittsford, N.Y. 14534.)

NRRC 3-5
2000, Alternate Thursdays; Hartford Electric Bldg., 176 Cumberland Ave., Wethersfield, Conn. 06169. (LCDR James E. Halle, USNR, 30 High Ct., Apt. 2, East Hartford, Conn. 06118.)

NRRC 3-7
2000, 2nd & 4th Thursdays; U.S. Naval Reserve Training Center, Scotia, N.Y. 12302. (LCDR Frederick G. Bailey, USNR, Jockey St., RD No. 1, Balleston Spa, N.Y. 12020.)

NRRC 3-8
1900, 2nd & 4th Tuesdays; 16th Floor, 285 Madison Ave. (Young & Rubicam, Inc., 40th St.) New York, N.Y. 10017. (CDR John F. Place, USNR, 290 Grace Church St., Rye, N.Y., 10580.)

NRRC 3-9
1930, 2nd & 3rd Wednesdays; Brookhaven National Laboratory, Upton, L.I., N.Y. 11973. (CDR Leonard A. Baker, Jr., USNR, Bldg. 535, Brookhaven Nat. Lab., Upton, L.I., N.Y. 11973.)

NRRC 3-14
1800, 1st & 3rd Tuesdays; U.S. Naval Reserve Training Center, 75 Oakley St., Poughkeepsie, N.Y. 12601. (CDR William C. Lang, USNR, Hornbeck Ridge, Poughkeepsie, N.Y. 12603.)

FOURTH NAVAL DISTRICT

NRRC 4-1
2000, Alternate Wednesdays; 10 Guyot Hall, Princeton, N.J. 08540. (CDR Edmund C. Reichard, USNR, Box 353, Main St., Holmdel, N.J. 07733.)

NRRC 4-3
2000, Alternate Thursdays; U.S. Naval & Marine Corps Reserve Training Center, 4902 Forbes St., Pittsburgh, Pa. 15213. (LCDR Howard B. Finley, USNR, 392 Sabbath Dr., Pittsburgh, Pa. 15236.)

NRRC 4-4
1900, Alternate Mondays; 316 Wagner Bldg., Pennsylvania State University, University Park, Pa. 16801. (LT John D. Sink, USNR, 100 Oakmont Rd., State College, Pa. 16801.)

NRRC 4-5
2000, Alternate Mondays; U.S. Naval & Marine Corps Reserve Training Center, 3920 Kirkwood Highway, Wilmington, Del. 19808. (LCDR James S. Linderman, USNR, 1515 Brandywine Blvd., Wilmington, Del. 19809.)

NRRC 4-7
1930, Alternate Thursdays; Battelle Memorial Institute, S. Conference Room., 505 King Ave., Columbus, Ohio 43201. (No meetings during August) (CDR Clarence H. Myton, USNR, 2596 Elliott Ave., Columbus, Ohio 43204.)

NRRC 4-8
1800, Alternate Mondays; U.S. Naval & Marine Corps Reserve Training Center, 1089 East 9th St., Cleveland, Ohio 44114. (LCDR Gordon D. Pred, USNR, 23401 Effingham Rd., Euclid, Ohio 44117.)

NRRC 4-9
1930, 2nd & 4th Mondays; U.S. Armed Forces Training Center, 410 Gettysburg Ave., Dayton, Ohio 45417. (LCDR William B. Askren, Jr., USNR, 266 Shady La., Dayton, Ohio 45432.)

NRRC 4-11
1900, Alternate Tuesdays; U.S. Naval & Marine Corps Reserve Training Center, Gilbert Ave. at Victory Pkwy, Room 37, Cincinnati, Ohio 45227. (LCDR William R. Crawford, USNR, 6973 Miami Bluff Dr., Cincinnati, Ohio 45227.)

NRRC 4-12
1930, Alternate Tuesdays; Technical Training Bldg., U.S. Naval Air Station, Willow Grove, Pa. 19090. (No meetings during July & August) (CDR John P. Burich, USNR, 123 Waverly Rd., Wyncote, Pa. 19095.)

NRRC 4-13
1930, 1st & 3rd Mondays; Franklin Inst., 20th St. and Parkway, Philadelphia, Pa. 19112. (LCDR William W. Dickhart, USNR, 6613 Emlen St., Philadelphia, Pa. 19119.)

FIFTH NAVAL DISTRICT

NRRC 5-2
2000, Mondays; Room 310, Hutcheson Hall, Virginia Polytechnic Institute, Blacksburg, Va. 24061. (No meetings during July and August) (LT Frank "T" West, USNR, 207 Fairview Ave., Blacksburg, Va. 24060.)

NRRC 5-3
1930, 1st & 3rd Tuesdays; Bldg. 560, Fort Detrick, Frederick, Md. 21701. (CDR L. Lee Kupferberg, USNR, 606 Rosemont Ave., Frederick, Md. 21701.)

NRRC 5-4
1945, 1st & 3rd Thursdays; Board of Education Bldg., 3 East 25th St., Baltimore, Md. (CDR Richard A Hay, USNR, 116 Ligon Rd., Ellicott City, Md. 21043.)

NRRC 5-8
2000, 1st & 3rd Thursdays; National Academy of Sciences, 2102 Constitution Ave., N.W., Washington, D.C. (CAPT Ernest J. Zellmer, USNR, 8102 Thoreau Dr., Bethesda, Md. 20034.)

NRRC 5-9
1630, 1st & 3rd Fridays; U.S. Naval Research Laboratory, 4555 Overlook Ave., Washington, D.C. 20390 (during First Quarter, meetings are Alternate Wednesdays). (LCDR George Abraham, USNR, 3107 Westover Dr., S.E., Washington, D.C. 20020.)

NRRC 5-10
2000, 2nd & 4th Tuesdays; Naval Medical Research Institute, National Naval Medical Center, Bethesda, Md. 20014. (CDR Maynard Eicher, USNR, Naval Medical Research Institute, Bethesda, Md. 20014.)

NRRC 5-11
2000, 2nd & 4th Tuesdays; Conference Room, U.S. Navy Marine Engineering Laboratory, Annapolis, Md. 21402. (CAPT William E. McConnaughey, USNR, 2908 Barrister La., Bowie, Md. 20715.)

NRRC 5-12
1900, 2nd & 4th Mondays; Bldg. 1200, Room A135, U.S. Naval Weapons Laboratory, Dahlgren, Va. 22448. (CDR Robert M. Fenn, USNR, Route 4, Box 61A, Fredericksburg, Va. 22401.)

SIXTH NAVAL DISTRICT

NRRC 6-1
1930, 1st, 2nd & 3rd Thursdays; U.S. Naval & Marine Corps Reserve Training Center, 274 Fifth St., N.W., Atlanta, Ga. 30318. (No meetings during First Quarter) (LCDR Raphael B. Levine, USNR, 6455 Bridgewood Valley Rd., Atlanta, Ga. 30328.)

NRRC 6-2
1900, 1st & 3rd Mondays; 204 Funchess Hall, Auburn University, Auburn, Ala. 36830. (LT Robert E. Hammett, USNR, P.O. Box 1069, Auburn, Ala. 36830.)

NRRC 6-3
1930, 2nd & 4th Wednesdays; ORAU Training Bldg., Illinois Ave. (Adjacent to Holiday Inn Motel), Oak Ridge, Tenn. (LCDR Wimmer J. Leonard, USNR, P.O. Box N, Oak Ridge, Tenn. 37830.)

NRRC 6-4
1915, 1st & 3rd Tuesdays; U.S. Naval Reserve Training Center, 1300 N.E. 8th Ave., Gainesville, Fla. (LCDR Harry F. Hollien, USNR, 1000 N.W. 39th Dr., Gainesville, Fla. 32601.)

NRRC 6-5
1930, 1st, 3rd & 5th Mondays; U.S. Naval & Marine Corps Reserve Training Center, P.O. Box 1180, Broad Ave., Gulfport, Miss. 39502. (LCDR John R. Boardman, USNR, 1552 Wilson Dr., Pascagoula, Miss. 39567.)

NRRC 6-6
1800, 1st, 2nd & 3rd Mondays; NROTC Bldg., University of North Carolina, Chapel Hill, N.C. 3rd Quarter: 1st 4 meetings at Raleigh – USN&MCRTC; 4th Quarter: 1st 4 meetings at Durham – USN&-MCRTC. (No meetings during First Quarter) (LT Kenneth L. Penegar, USNR, Cedar St., Mount Bolus, Chapel Hill, N.C. 27514.)

NRRC 6-8
1930, 1st & 3rd Tuesdays; U.S. Naval Reserve Training Center, Livingston & Parramore Sts., Orlando, Fla. (LCDR William G. Chace, Jr., USNR, 1134 Western Way, Orlando, Fla. 32804.)

NRRC 6-9
1900, 1st, 3rd & 4th Mondays; Smith Hall, U.S. Navy Supply Corps School, Athens, Ga. (CAPT William T. Chambers, USNR, Cabin Lane Dr., Athens, Ga. 30601.)

NRRC 6-10
2030, 1st & 3rd Thursdays; Processings

& Research Bldg., Miami, Fla. (CAPT Joseph H. Webb, USNR, 736 Anastasia Ave., Coral Gables, Fla. 33134.)

NRRC 6-13
1900, 2nd & 4th Wednesdays; American Red Cross Bldg., Laurens St., Aiken, S.C. (LCDR Roland H. Windham, USNR, 908 McCormick Pl., S.E., Aiken, S.C. 29801.)

NRRC 6-16
1700, 1st & 3rd Tuesdays; PAFB Chapel Annex, B St., Patrick Air Force Base, Fla. (LCDR Furman J. Clark, USNR, 298 Glenwood Ave., Satellite Beach, Fla. 32935.)

NRRC 6-17
1900, Tuesdays; U.S. Naval Reserve Training Center, 203 Leeman Ferry Rd., S.W., Huntsville, Ala. (LCDR William R. Mixon, Jr., USNR, P.O. Box 244, Hartselle, Ala. 35640.)

NRRC 6-18
2000, 1st & 3rd Mondays; Room 311, S-R Bldg., Peabody College, Nashville, Tenn. (LCDR Charles W. Hawkins, III, USNR, 3646 Knollwood Rd., Nashville, Tenn. 37215.)

EIGHTH NAVAL DISTRICT

NRRC 8-1
1930, Alternate Tuesdays; Southern Regional Research Laboratory, New Orleans, La. (LCDR C. W. Unangst, USNR, 1758 Pressburg St., New Orleans, La. 70122.)

NRRC 8-3
1930, Mondays; Biological Science Bldg., Texas A&M College, College Station, Tex. (CDR R. E. Schiller, Jr., USNR, 510 Crescent Dr., Bryan, Tex. 77803.)

NRRC 8-4
1930, 1st & 3rd Wednesdays; U.S. Naval Reserve Training Center, Houston, Tex. (LCDR Thomas N. Whitaker, USNR, 4606 Rockwood, Houston, Tex. 77004.)

NRRC 8-5
1900, Mondays; Experimental Science Bldg. 115, University of Texas, Austin, Tex. (LT Loy D. England, USNR, 1001 Anderson La., Austin, Tex. 78757.)

NRRC 8-7
1930, 1st & 3rd Wednesdays; NROTC Bldg., University of New Mexico, Albuquerque, N.M. (LT Robert P. Baker, USNR, 313 General Somervell, N.E., Albuquerque, N.M. 87112.)

NRRC 8-8
1930, 1st & 3rd Tuesdays; Post Office Bldg., Bartlesville, Okla. (LCDR Gene H. Wegner, USNR, 1509 Harris Dr., Bartlesville, Okla. 74003.)

NRRC 8-9
1700, 1st, 2nd & 3rd Tuesdays; Lecture Room, Administration Bldg., Los Alamos Scientific Laboratory, Los Alamos, N.M. (LCDR Robert H. Dinegar, USNR, 2317 46th St., Los Alamos, N.M. 87544.)

NRRC 8-12
2000, 1st & 3rd Tuesdays; U.S. Naval & Marine Corps Reserve Training Center, 9638 Bachman Blvd., Dallas, Tex. (LCDR F. D. Colegrove, Jr., USNR, Route 5, Box 664-A, Dallas, Tex. 75204.)

NRRC 8-13
2000, 2nd, 3rd & 4th Thursdays; Room 352, Union Bldg., Oklahoma State University, Stillwater, Okla. (CDR Allen D. Tillman, USNR, 2024 N. Husband, Stillwater, Okla. 74074.)

NINTH NAVAL DISTRICT

NRRC 9-1
1900, 2nd & 4th Tuesdays; Naval Armory, Randolph at The Lake, Chicago, Ill. (LT Thomas McAvoy, USNR, 209 S. Rush St., Roselle, Ill. 60172.)

NRRC 9-2
1930, 2nd & 4th Tuesdays; Law Bldg., University of Illinois, Urbana, Ill. (LCDR R. L. Langenheim, Jr., USNR, 401 W. Vermont, Urbana, Ill. 61801.)

NRRC 9-3
1930, 1st & 3rd Mondays; 62 N. Hall, University of Michigan, Ann Arbor, Mich. (Varied dates July, August & September) (LT John Coates, Jr., USNR, 2477 Bunker Hill Rd., Ann Arbor, Mich. 48105.)

NRRC 9-4
2000, 2nd & 4th Tuesdays; U.S. Naval & Marine Corps Reserve Training Center, Milwaukee, Wis. (CAPT Robert E. Best, USNR, 3124 N. 103rd St., Wauwatosa, Wis. 53213.)

NRRC 9-5
1900, 1st, 2nd, & 3rd Wednesdays; USN-ROTC Bldg., Iowa State College, Ames, Iowa. (LCDR Thomas J. Kieffer, USNR, Box 7, Ogden, Iowa 50212.)

NRRC 9-6
1930, 2nd & 4th Mondays; Room 308, Mechanical Eng. Bldg., University of Minnesota, Minneapolis, Minn. (LT John W. Barber, USNR, 1233 Bellows St., W. St. Paul, Minn. 55107.)

NRRC 9-7
1900, 2nd & 4th Tuesdays; Room 1, New Heavilon Hall, Purdue University, Lafayette, Ind. (CDR William J. Kay, USNR, 695 Sugar Hill Dr., W. Lafayette, Ind. 47906.)

NRRC 9-8
1900, 2nd & 4th Wednesdays; Webster Groves Public Library, Webster Groves, Mo. (LCDR Owen F. Wagner, USNR, 2411 S. 10th St., St. Louis, Mo. 63104.)

NRRC 9-10
1800, Alternate Tuesdays; Elder Hall, Northwestern University, Evanston, Ill. (CAPT Alban Weber, USNR, 619 Clark St., Evanston, Ill. 60201.)

NRRC 9-12
1930, 2nd & 4th Thursdays; Room 220, Chemistry Bldg., Colorado A&M College, Fort Collins, Colo. (LT Wm. M. Hantsbarger, USNR, 609 Duke La., Fort Collins, Colo. 80521.)

NRRC 9-14
1930, Alternate Mondays; State Lab of Hygiene, University of Wisconsin, Madison, Wis. (LCDR Matthias Stelly, USNR, 677 S. Segoe Rd., Madison, Wis. 53711.)

NRRC 9-15
1900, 2nd & 4th Tuesdays; Midland Community Center, Midland, Mich. (LCDR Willis J. Beach, USNR, 4900 Ironwood St., Saginaw, Mich. 48603.)

NRRC 9-16
1930, 1st & 3rd Mondays; 221 Computing Center, Michigan State University, E. Lansing, Mich. (LCDR Harry B. Parks, USNR, 641 Bailey St., E. Lansing, Mich. 48910.)

NRRC 9-19
1930, Every Monday; Psychopathic Hospital, State University of Iowa, Iowa City, Iowa. (LT John E. Stille, USNR, State University of Iowa, Dept. of Chemistry, Iowa City, Iowa 52240.)

NRRC 9-20
1930, Alternate Thursdays; 104 Military Science Bldg., University of Kansas, Lawrence, Kans. (LCDR Wm. B. Allmon, USNR, 2010 University Dr., Lawrence, Kans. 66044.)

NRRC 9-21
2000, 1st & 3rd Thursdays; Student Union, Univ. of Denver, Denver, Colo. (CAPT Abraham F. Myers, USNR, 838 S. Vine St., Denver, Colo. 80209.)

NRRC 9-22
1930, Tuesdays; New Ag. Library, Room 11-17, University of Nebraska, Lincoln, Nebr. (LCDR Kenneth E. Mahlin, USNR, 1214 N. 9th St., Beatrice, Nebr. 68310.)

NRRC 9-23
1930, 2nd & 4th Wednesdays; Naval Ordnance Plant 7500 West Roosevelt Rd., Forest Park, Ill. (LCDR Henry C. Krass, USNR, 4729 Prince St., Downers Grove, Ill. 60515.)

NRRC 9-25
1930, 1st & 3rd Wednesdays; U.S. Naval Reserve Training Center, Indianapolis, Ind. (CAPT Robert O. Jackson, USNR, 1 E. 73rd St., Indianapolis, Ind. 46240.)

NRRC 9-26
1930, Tuesdays; U.S. Naval Reserve Training Center, Colorado Spring, Colo. (LCDR James H. Kruse, USNR, 1011 N. Foote St., Colorado Springs, Colo. 80909.)

ELEVENTH NAVAL DISTRICT

NRRC 11-2
2000, 1st & 3rd Thursdays; U.S. Naval and Marine Corps Reserve Training Center, 2727 Paloma St., Pasadena, Calif. 91107. (LCDR Thomas D. Bair, USNR, 1240 Journey's End Dr., La Canada, Calif. 91011.)

NRRC 11-3
2000, 1st & 3rd Mondays; U.C.L.A. Center for the Health Sciences, 1st Floor Conference Room (1-3-105), Los Angeles, Calif. (CDR Ivan N. Mensh, USNR, 1501 Malcolm Ave., Los Angeles, Calif. 90024.)

NRRC 11-5
1930, 2nd, 3rd, & 4th Tuesdays; U.S. Naval Reserve Training Center, Camp Decatur, San Diego, Calif. 92133. (CDR Raymond D. Tuttle, USNR, 4999 Resmar Rd., La Mesa, Calif. 92041.)

NRRC 11-7
2000, 1st & 3rd Thursdays; U.S. Naval & Marine Corps Reserve Training Center, 1100 S. Avernon Way Tucson, Ariz. 85711. (LCDR Donald M. McEligot, USNR, 1828 East 5th St., Tucson, Ariz. 85719.)

NRRC 11-8
1645, 2nd & 4th Wednesdays; NMC, Bldg. 351, Room 203, Pacific Missile Range, Point Mugu, Calif. 93041. (LCDR Donald D. Paillette, USNR, 1248 Via Cielito, Ventura, Calif. 93003.)

NRRC 11-9
2000, 2nd & 4th Wednesdays; Pitzer College Conference Room, Administration Bldg. 8, Mills Road, Claremont, Calif. 91712. (LCDR Joseph C. Campbell, USNR, 411 Southwind Dr., Whittier, Calif. 90601.)

NRRC 11-11
2000, 1st & 3rd Mondays; U.S. Naval & Marine Corps Reserve Training Center, 3400 Airport Ave., Santa Monica, Calif. 90405. (CDR John G. Hammer, USNR, 913 Chattanooga Ave., Pacific Palisades, Calif. 90272.)

TWELFTH NAVAL DISTRICT

NRRC 12-1
1930, 2nd & 4th Mondays; Room 214S, University of California Medical Center, Parnassus Ave., San Francisco, Calif. (LCDR Muriel E. Johnston, USNR, 33 Fairlawn Dr., Berkeley, Calif. 94708.)

NRRC 12-2
1700, 1st, 2nd, & 3rd Mondays; Conference Room A, Bldg. 111, Lawrence Radiation Laboratory, Livermore, Calif. (CDR Bernard G. Olsen, USNR, 680 Mojave Ave., Livermore, Calif. 94550.)

NRRC 12-3
1930, 1st & 3rd Wednesdays; Room 101, Physics Lecture Hall, Stanford University, Stanford, Calif. (LCDR Dugald R. Campbell, USNR, 10720 Alderbrook La., Cupertino, Calif. 95104.)

NRRC 12-4
2000, Wednesdays as scheduled; Room 119, Agriculture Bldg., Fresno State College, Fresno Calif. (LCDR Charles C. Huey, USNR, 41255 Road 40, Reedley, Calif. 93654.)

NRRC 12-5
1930, 2nd & 4th Wednesdays; Room 247, Cory Hall, University of California, Berkeley, Calif. (LCDR Ulrich H. Koch, USNR, 3826 Victor St., Pinole, Calif. 94564.)

NRRC 12-6
1930, 1st, 2nd, & 4th Thursdays; 192 Physical Sciences Bldg., University of

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California, Davis, Calif. (LT Emerson L. Besch, USNR, P.O. Box 409, Davis, Calif. 95616.)

NRRC 12-8
2000, Wednesdays as scheduled; Room S-136, U.S. Naval Postgraduate School, Monterey, Calif. (CAPT Carl A. Hering, USNR, 1211 Sylvan Rd., Monterey, Calif. 93940.)

NRRC 12-9
1700, Tuesdays as scheduled; Main Conference Room, Bldg. 2001, Aerojet-General Corporation, Nimbus, Calif. (Sacramento) (LCDR Jerome J. Kral, USNR, 10217 Agnes Circle, Rancho Cordova, Calif. 95670.)

THIRTEENTH NAVAL DISTRICT

NRRC 13-1
1930, 1st, 2nd, & 3rd Mondays; U.S. Naval Reserve Training Center, 860 Terry Ave. N., Seattle, Wash. (LCDR Philip H. Stern, USNR, 16500 S.E. 28th St., Bellevue, Wash. 98004.)

NRRC 13-3
1930, Mondays as scheduled; 203 Todd Hall, Washington State University, Pullman, Wash. (LCDR Robert O. Johnson, USNR, 2009 Clifford St., Pullman, Wash. 99163.)

NRRC 13-4
2000, 2nd & 4th Tuesdays; U.S. Naval & Marine Corps Reserve Training Center, Swan Island, Portland, Ore. (CAPT Edward J. Warchol, USNR, 6425 Northeast 39th Ave., Portland, Ore. 97211.)

NRRC 13-5
1930, 1st & 3rd Mondays; U.S. Naval ROTC Armory, Oregon State University, Corvallis, Ore. (LT Richard E. Moffitt, USNR, 8 Mountain View Dr., Corvallis, Ore. 97330.)

NRRC 13-6
1930, 2nd & 4th Thursdays; Rex Delon Moore Armed Forces Reserve Training Center, 1575 N. Skyline Dr., Idaho Falls, Idaho. (CAPT Thomas J. Wadsworth, USNR, 256 Third St., Idaho Falls, Idaho. 83401.)

RAdm Waters Heads Navy's Oceanographic Program

Navy Assistant Secretary Frosch, in addressing a Symposium of the Institute of Electrical and Electronics Engineers, at Honolulu, on August 29, announced the creation of a strong new oceanography office to plan and control the Navy's deep sea studies. Simultaneously, he announced appointment of Rear Admiral Odale D. Waters, Jr., Oceanographer of the Navy and Commander of the Navy's Oceanographic Office, to head the new office.

Rear Admiral Waters will act as Naval Oceanographic Program Director on the staff of the Chief of Naval Operations, under the general policy direction of Navy Secretary Nitze, and will exercise complete control of all naval activities in the field of oceanography. Thus the position of Navy Oceanographer is elevated to the personal staff of the Chief of Naval Operations from that of head of the Navy's Oceanographic Office, with rank equivalent, as an example, to those of the Directors of Naval Intelligence or Naval Communications.

In his address, Assistant Secretary Frosch challenged the symposium "...to keep informed on these programs and national developments in oceanography and to prepare to work with us on these important and fascinating problems in this exciting field. It should be clear that while the Navy will lead in ocean technology, this is really a national project—again, a corporate endeavor—science, industry, and Navy."

He also noted civilian economic and scientific benefits even from oceanographic research performed purely for national defense.

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Editor: RICHARD D. OLSON

NAVSO P-510

Sir William Herschel, discoverer of the infrared region of the electromagnetic spectrum (drawn by James C. Koukos, Office of Naval Research). Not until 150 years after Herschel's discovery was a serious, continuing program in applying the infrared phenomenon to military use initiated. That program is discussed in the article beginning on page 1.