NAVAL RESEARCH

REVIEWS

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DEPARTMENT OF THE NAVY · OFFICE OF NAVAL RESEARCH

ONR Supports Study of Everest Climbers

A psychological study of the behavior of members of an American mountaineering team while attempting to climb the highest mountain in the world will be performed next spring under the sponsorship of the Office of Naval Research. The $35,000 investigation will be conducted by Dr. James T. Lester, Jr., Director of Psychological Services for the Los Angeles Orthopedic Hospital. The observations made on Mount Everest are expected to produce new information regarding individual and group behavior under conditions of great stress. Such information is expected to help psychologists and physiologists understand better the performance of certain military tasks–for example, of leadership in small groups of men isolated for long periods in submarines or at Arctic posts.

Five other research projects will be carried out during the ascent, which will be led by documentary-film producer Norman G. Dyrenfurth, a veteran of four previous Himalayan journeys.

The American Mount Everest Expedition, as the undertaking is called, will be the first American attempt on the 29,028-foot mountain, which was climbed for the first time in 1953 by a British expedition under the leadership of Sir John Hunt. The group expects to leave this country for Nepal in January in order to complete its climbing schedule before the monsoon season beings in early June. The schedule calls for attempts on two peaks adjacent to Mount Everest–Lhotse and Nuptse–as well as on the world's highest mountain. About 19 climbers will make the ascent, supported by 36 Sherpas and 500 porters.

Dr. Lester has already begun his study of individual members of the mountaineering team through a series of interviews and questionnaires. Other information will be collected just before the group departs for Nepal. Each climber then will visit the Institute of Personality Assessment and Research at the University of California in Berkeley, where he will receive a complete personality assessment during a three-day "living-in" period. Data obtained by these means will provide a background for understanding individual variations in behavior observed by Dr. Lester during the climb. No tests will be given on the mountain, although portable tape recorders may be carried along to obtain some data.

Another scientific study to be made during the climb will be of communication feedback in small groups under stress. Dr. Richard M. Emerson, a University of Cincinnati sociologist, will conduct this research under a grant from the National Science Foundation. Although the ONR and NSF studies have been planned separately, Lester and Emerson are expected to coordinate their work. Funds for the expedition are being provided also by the National Geographic Society, which is sponsoring a study of the glaciers in the area, and will make the first terrestrial measurements of solar radiation from such a high elevation.

Other scientists on the team are Dr. William E. Siri, a physicist at the University of California's Donner Laboratory, where he specializes in glaciology in the Department of Geology at Michigan State University. Mr. Barry Bischop, a physical geographer on the staff of the National Geographic Society, will make the solar-radiation studies.

Research on Physiological Stress

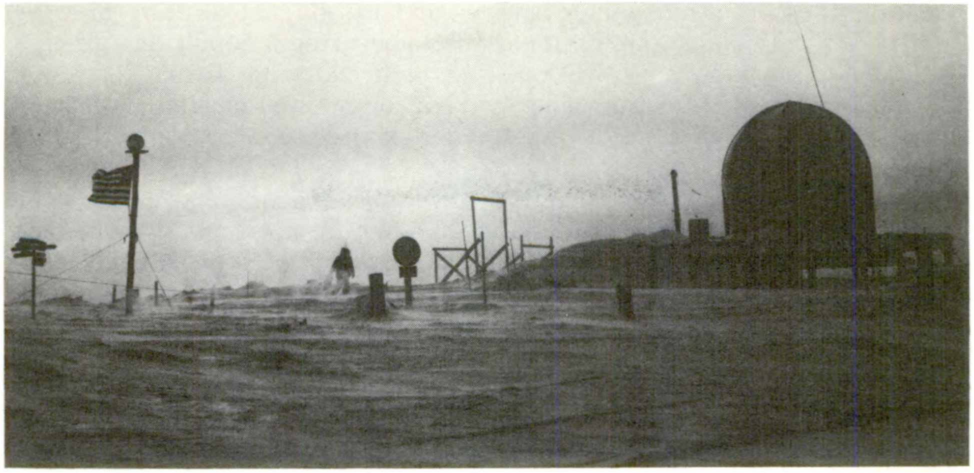
L. M. Libber
Head, Physiology Branch
Office of Naval Research

A downed pilot in the Arctic braces himself for retrieval by rescue aircraft.

To make accurate laboratory determinations of the strengths and weaknesses of such inanimate materials as wood and steel, samples of these substances are stressed to the limit of their endurance—until they crack or crumble or melt or burn. To make such determinations on man, the investigator cannot carry his experimental stresses to such an extreme. Because of this fact, the so-called "tolerance limits" established in the laboratory for man may really be measures only of maximum discomfort or they may simply represent the maximum stress permitted because of safety considerations. We know, for example, that during combat an individual's motivation often is so strong that he endures great stress—far in excess of any that is likely to be tested in the laboratory. Generally, such stresses are coupled with some powerful, overriding psychological factor that temporarily raises the "tolerance" threshold.

Many of the physiological stresses encountered under operational or combat conditions, however, are not acute. They present above normal stimuli to the regulatory systems of the body over relatively long periods of time. Although they usually are not fatal, they can have a debilitating effect, impairing a sailor or soldier's performance, and they may even cause bodily injury. The body's regulatory mechanisms attempt, through the various physiological systems, to adjust to the stresses and restore tissues to normal. These regulatory mechanisms are usually under the control of the nervous system, the endocrine system, or a combination of both. Therefore, the objectives of investigators doing research on stress are to delineate the nature of all of the mechanisms involved, to determine how these mechanisms bring about

Below, on, and above the surface of the oceans, as well as on land in virtually all latitudes, Navy men are subjected to unusual stresses. The photographs on these pages, described individually at right, depict a few of them.



A lone Navy man trudges through blowing snow at an Antarctic station.

On facing page, top left, the Navy's Blue Angels execute a precision maneuver at high speed; top right, Navy deep sea divers await decompression before being hauled to surface ; and at bottom, the Marines land.

adaptations to stress; and to devise equipment or techniques that will protect against or alleviate the effects of the stress.

Because of the serious consequences of stresses to naval personnel, the Department of the Navy maintains several research laboratories of its own that are staffed in part by military and civilian physicians, scientists, engineers, and technicians versed in stress studies. In addition to having a unique mission and cadre of personnel, most of these laboratories have highly specialized facilities. The investigations conducted at these places are oriented primarily toward specific, immediate problems of the Navy or toward the specific problems of agencies outside the Department of the Navy under a contractual agreement.

The Office of Naval Research, through its contract research program, finances considerable basic research on stress which is conducted primarily outside the Navy. Funds are provided to investigators with a wide variety of scientific interests at universities, medical schools, hospitals, and, to some extent, in private industry. In this way, the number of scientists studying basic physiological mechanisms of particular importance to the welfare of naval personnel is greatly increased.

The impetus for the ONR research program stems from the fact that naval personnel are exposed to a considerable amount of stress from two major sources: the environment and the operational situation. Sometimes it is difficult to differentiate between stresses arising from the two sets of conditions because the stresses frequently interact. Although this interaction may serve to lessen the total stress, the opposite is usually true.

Environmental stresses caused by extremes of temperature and humidity, abnormally high or low barometric pressures, abnormal concentrations of atmospheric gases, and similar conditions may be coupled with stresses arising from such operational conditions as high 'G' loading, mechanical vibration, and high radiation level. Some or all of these conditions may be met by naval or marine personnel on land or water, in the sky, or below the surface of the sea.

Because military personnel may have to be transported in a matter of hours from temperate climates to hot-humid, hot-arid, cold-moist, or cold-dry environments, studies are underway to obtain a clearer picture of the thermoregulatory mechanisms and adaptive processes involved in these changes. Some of these investigations concern the influence of physical fitness on an individual's tolerance to stressful environments. Obviously, if the means could be found to enable man to acclimatize within hours to new climatic stresses, instead of relying on natural adaptation which usually requires from one to two weeks' time, our military position would be strengthened considerably. For this reason, the Office of Naval Research has funded field investigations into the peculiar adaptive abilities of some native populations. Basic investigations into such subjects as temperature sensation, endocrine involvements, and hibernation mechanisms have also been supported to help solve the acclimatization problem.

Research in aviation physiology is centered around very basic studies of respiratory mechanisms. Low oxygen partial pressures in the tissues (called hypoxia) are usually insidious and may incapacitate flyers before they are even aware of being exposed to this stress. But fatal aircraft accidents occur even when the aircraft and the breathing equipment designed to protect against hypoxia are functioning perfectly. Through attempts to discover the causes of these accidents, much is being learned about the transport, exchange, and diffusion of breathing gases; the mechanics of breathing; the effects of carbon dioxide; the interplay between carbon dioxide, hydrogen ion concentration, and oxygen and the subsequent effects of this interplay on the regulatory mechanisms; as well as the phenomenon of adaptation to low oxygen partial pressures.

Investigations are also being undertaken on high-pressure effects, particularly as they relate to underwater operations. These studies concern the mechanisms of oxygen toxicity, nitrogen narcosis, carbon dioxide poisoning, and bends–the major problems encountered in diving and underwater swimming. Research is also being supported on the use of helium-oxygen mixtures and other gas mixtures in an endeavor to increase man's capacity for longer and deeper dives without fear of the harmful sequelae. Furthermore, exploratory studies are being undertaken to reduce appreciably the length of time required for decompression after prolonged or deep dives.

Harmful physiological effects may occur as a consequence of an individual's proximity to microwave radiation emitted by radar devices. Therefore, environmental hazards of this type are also being investigated through ONR support. It is well-known that irradiation by radar has a powerful thermal effect. To protect personnel from this danger, limitations on the power intensity and sweep pathways of the beam have been built into radar devices. Radar beams, however, have side lobes from which a certain amount of microwave radiation could be reflected into areas where personnel may be working. This radiation would probably be at a lower level than the primary radiation and would not produce thermal effects. Nevertheless, there are some indications that it may have nonthermal effects, for example, by causing insidious changes in enzyme systems in various tissues of the body.

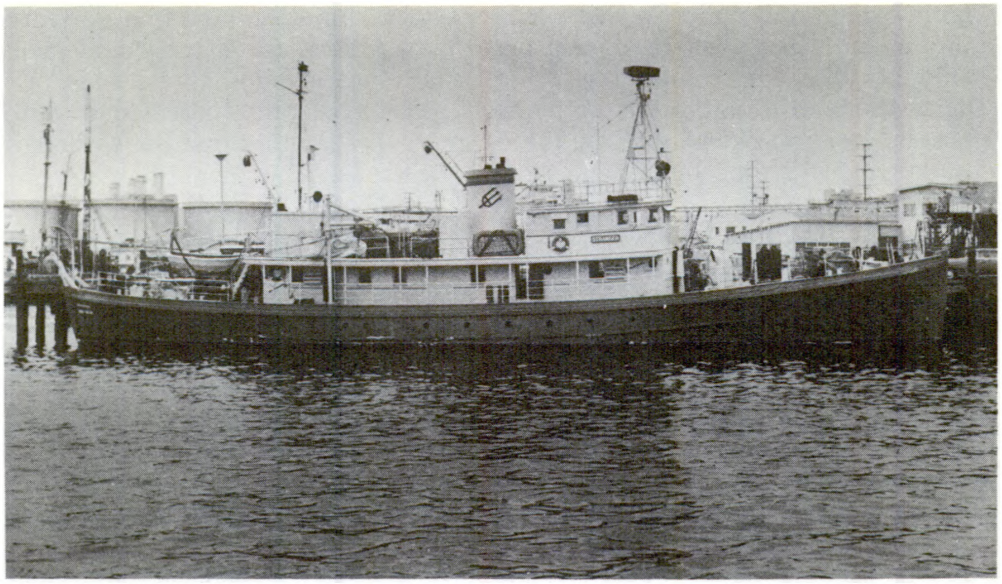
ONR-financed investigations on the physiology of stress are directed, in addition, at the regulatory processes in the body. Particular emphasis is being given to the role of the nervous system, with individual studies concerning such subjects as neuronal function, sensory mechanisms, neuronal transmission, and integrative and behavioral functions. Other research is being conducted on basic biophysical and biochemical properties of the circulatory system and the blood contained therein in order to obtain a better understanding of the body's reaction to stress.

Through the ONR research program, a number of new techniques and equipment have been produced for measuring physiological reactions and thereby helping in the diagnosis or prevention of harmful physiological effects.

One such instrument recently developed is the phonocatheter, which applies knowledge gained through studies of underwater acoustics to the diagnosis of heart disease. The problem has been that in the study of certain congenital heart conditions, conventional X-rays and other techniques have proved unsatisfactory as a means of pinpointing the defect or describing it to the diagnostician. The tiny phonocatheter, incorporating a barium titanate element, can be inserted into the blood stream to "map" the heart. This new technique promises to provide the Navy with a better basis for evaluating cardiac status in physical examinations.

Another example of a tangible benefit derived in part from the program is the development of ultrasound, both as an instrument of biophysical research and as a new surgical technique. It has been found that controlled ultrasonic radiation can destroy selectively large nerve cells in the central nervous system and portions of the brain without harming blood vessels and surrounding tissue. This technique has already been successfully used in therapy for Parkinson's Disease. As a research tool, ultrasonic radiation employed on experimental animals should give us more information about the function of the pituitary gland, the physical mechanisms of the action of intense sound on biological structures, and the acoustic properties of blood and its components, as well as contributing to the study of various soft tissues, including cancerous tissues.

ONR's research program on stress physiology is a coordinated effort intended to yield the basic scientific knowledge that is required to provide naval personnel with the maximum protection and the capacity for the highest possible performance under stressful conditions. The enrichment of the scientific literature that results from this so-called "mission oriented" research is of value not only to the Navy, but to a large part of the scientific community.



The research ship STRANGER of the
Scripps Institution of Oceanography

A Search for the Mohole Drilling Site

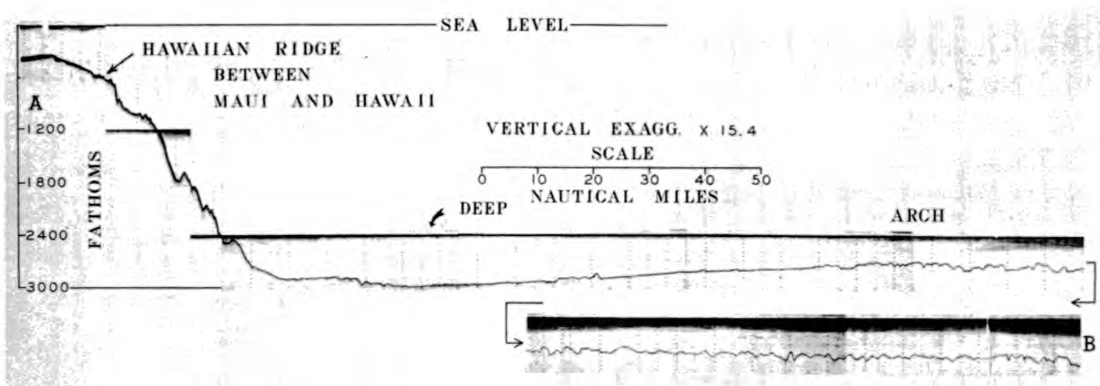
Marston C. Sargent
ONR Scientific Liaison Officer
Scripps Institution of Oceanography

Last spring, the research ships HUGH M. SMITH and STRANGER of the Scripps Institution of Oceanography sailed back and forth over the Hawaiian Arch, northeast of the chain of islands that extends from Hawaii to Kauai, in search of potential sites for drilling through the earth's crust to the mantle. Mohole, as this ambitious drilling project is called, has been undertaken to obtain–for the first time–samples and direct measurements of the 1800-mile-thick layer of material beneath the crust which, seismic studies have revealed, is strikingly different from the crustal material. The project is being sponsored by the National Science Foundation and assisted logistically by the Office of Naval Research through Scripps.

Knowledge of the structure and composition of the mantle rests almost wholly on indirect evidence. The most direct knowledge we have is that the velocity of seismic waves (natural and artificial) increases rapidly at a depth of about 3 miles below the bottom of the ocean, and relatively slowly at greater depths. Other evidence includes the weight and rotational inertia of the whole earth, the value of gravity at the surface, the heat flux outward near the surface, the assumed distribution of radioactivity and of density along a vertical profile, and calculated temperatures and pressures at depths. On the basis of laboratory observations on their properties, it is possible, in principle, to select minerals which at the pressures and temperatures calculated would form a mantle having the values of density, elasticity, heat conductivity, etc., which satisfy all the measurements, assumptions, and calculations listed. Great assistance in deciding among the numerous possible solutions is obtained by observing rare minerals ejected from volcanos and the composition of stony meteorites. From volcanos and other structures reaching relatively deep into the earth are obtained a number of minerals which are rare elsewhere in the crust. Some of these fit, fairly neatly, the requirements listed, and it is a reasonable guess that they are indeed samples of the mantle. The argument that stony meteorites are samples of an earth-like body was first advanced over a century ago. Since then, many correspondences between the elementary compositions of the sun, stars, and meteorites have appeared. Because the mantle comprises 85 percent of the earth's volume, it is easy to believe that its composition also is like that of these other bodies. Therefore, it has been possible to deduce a mantle which is distinctly different from the overlying crust and although not entirely homogeneous, is relatively uniform from top to bottom.

Samples and measurements obtained at the top of the mantle would refine and check the argument in several ways. The influence of 3 miles of crust (under the sea bottom) and 10 miles of crust (under the continents) on the measurements could be greatly decreased. Calculations of the distribution of properties within the mantle are very sensitive to the values assumed for the density of the material and the heat flux outward at the top of the mantle. These could be checked. Chemical and mineralogical analysis of a sample would show how reliable are the inferences from volcanic and meteoritic material. Also, as RADM Hess has pointed out, study of the surface of the mantle would give us valuable guidance in formulating questions about the surface of the moon.

Profile made from photographs of echo sounder traces of the Hawaiian Ridge, Deep, and Arch, which were traversed by Scripps vessels searching for Mohole drilling site. The photographs, which are much reduced in size and have greatly exaggerated vertical scales, show strikingly the topographic differences between the Arch and Ridge, the latter of which is one of the outstanding topographic features of the entire earth. The profile was prepared by E. L. Hamilton of the Navy Electronics Laboratory, San Diego.



Criteria of importance in selecting a site are that the top of the mantle (called Mohorovicic Discontinuity, or Moho) be as close to the sea surface as possible and that the crust be as thin as possible. These conditions exist, in general, on rises and arches on the sea floor. Thus, an investigation made by Scripps in 1955 indicated strongly that beneath the crest of the Hawaiian Arch, in 15,000 feet of water, the Moho occurs at a depth of 30,000 feet below sea level. Other considerations are that the ocean bottom at the drilling site be flat enough to anchor buoys, that the area have favorable weather, and that it be within convenient distance of a large port. Strong variable currents would be disadvantageous, as would exceptionally high temperatures in the sediments and crust, such as are often found on rises.

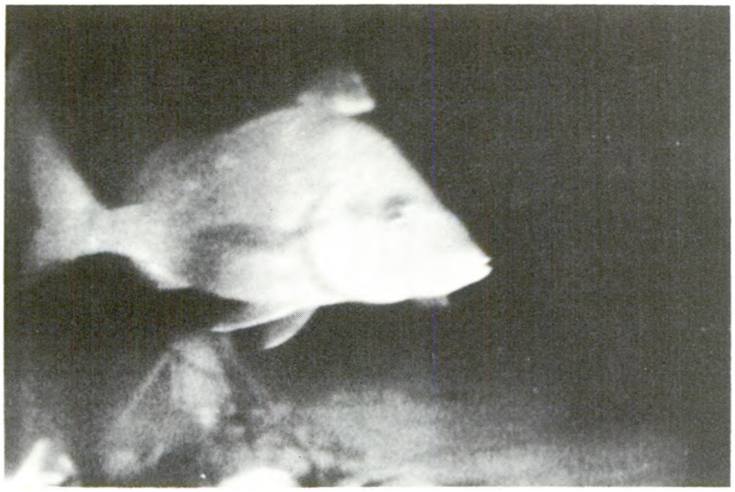
In last spring's operations, the SMITH and STRANGER obtained a series of refraction profiles running northwest and southeast and extending from first to last for a distance of 150 miles along the crest of the Arch. These profiles indicated that the average depth of the Moho is 30,000 feet in 13,000 feet of water. At some localities in this region the depth of the Moho is expected to be less than the average figure. The heat flow through the bottom was measured at a number of stations and found to be moderate (between 0.5 and 2.0 μcal. cm^{-2} sec^{-1}), indicating that no excessively high temperatures occur in the crust to interfere with the operation of logging equipment. A great deal of variation in structure was revealed, most of it occurring probably in the shallow layers. Reflection studies undertaken to map these structural changes will be relied upon heavily in making the final selection of a drilling site.

Leader in Arctic Research Given Award

At a luncheon given in connection with the Arctic Ocean Symposium in Hershey, Pennsylvania, last month (see article on page 24), the Honorable James H. Wakelin, Jr., Assistant Secretary of the Navy (Research and Development) presented the Distinguished Public Service Award to one of today's leading figures in Arctic Research. He is Max C. Brewer, director of the Arctic Research Laboratory at Barrow, Alaska. ARL was established in 1947 and is operated by the University of Alaska under contract with the Office of Naval Research. (See photograph, inside back cover.)

The citation points out that Mr. Brewer has been "charged not only with the operation of the Laboratory itself, but with the planning and support of numerous trail parties and camps extending over the whole area from the Brooks Range to 800 miles out in the polar ice pack...." Of these activities, the ones for which he is perhaps best known concern the establishment of drifting ice stations in the Arctic Ocean. He planned, selected the ice, established the camp, and supported the ONR ice island ARLIS-1 (Arctic Research Laboratory Ice Station-1) in 1960, and he made the first landings on the site of the newest drifting station, ARLIS-2, in 1961.

RADM L. D. Coates, Chief of Naval Research, last month designated Dr. John E. Flynn as Chief Scientist of ONR's New York Branch Office. Dr. Flynn, who served many years as a scientific liaison officer in the New York office, replaces Dr. Saul Berman, who has been appointed Deputy Research Coordinator at ONR's headquarters in Washington, D.C.



Margates swim in floodlight beam before
underwater camera at night

Underwater TV and Hydrophones Placed in Gulf Stream

The first underwater audio-visual research facility designed for making simultaneous sight-and-sound studies of marine life in its natural environment has been put in operation at the Lerner Marine Laboratory, a field station of the American Museum of Natural History located on the island of Bimini, Bahamas, British West Indies. Officiating at the dedication ceremony, which took place in September, was RADM L. D. Coates, USN, Chief of Naval Research.

The facility was installed and is operated by the University of Miami's Institute of Marine Sciences under contract to the Office of Naval Research. Dr. John C. Steinberg of the Institute, world-famous authority on marine acoustics, directed the development of the facility and is in charge of its operation. At present, the audio-visual equipment consists of a single closed-circuit television camera and underwater hydrophones, which are operated conjunctionally at a depth of 65 feet in the Florida Straits west of Bimini. The hydrophones are situated at the points of a triangle to permit positive location of sound sources by triangulation. Both the sounds and pictures are carried by cable to a receiving installation in the Lerner Laboratory. This arrangement enables scientists for the first time to make direct studies of underwater sounds, with their points of origin known, made by animals in their natural habitat.

An additional set of hydrophones is in operation at a deeper site in the Gulf Stream and is being monitored for sounds produced in that vicinity. Television cameras will be placed at this site later if satisfactory results are obtained from the camera-hydrophone installation already in operation.

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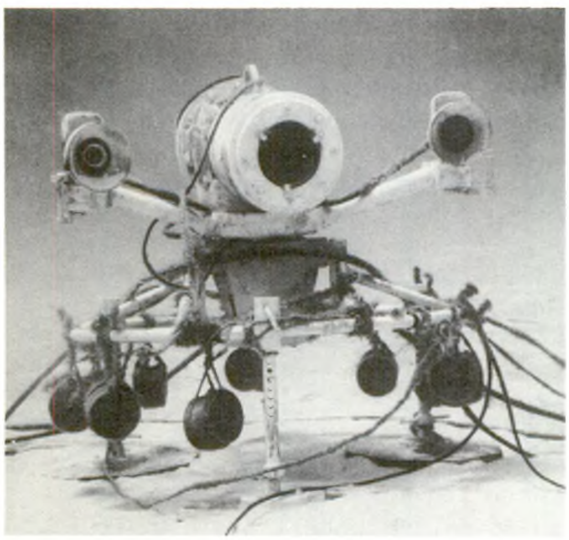
The Navy became interested in the Lerner Marine Laboratory because of the unusual advantages it affords for field experiments in marine biology. The waters in the vicinity of the Laboratory are uncontaminated, undisturbed, and are deep near shore, thus being ideally suited to biological acoustic and visual studies. An even more important advantage of the location is that it straddles the Gulf Stream, which is the main highway for the wide variety of fishes that migrate up and down the Atlantic coastal waters. Here one can study marine life ranging in size from the smallest to the largest forms that inhabit the Atlantic, including predatory types which find good hunting in the Gulf Stream. Bimini is also one of the few tropical-subtropical land areas available and accessible to United States scientists.

Of the many sounds heard in the sea that are apparently of biological origin, only a relatively few so far have been identified directly with their sources under field conditions. Furthermore, rarely has the biological or behavioral significance of these sounds been determined satisfactorily. With the increasing use of passive sonar systems, noise of biological origin is becoming a more important problem in the Navy, especially in coastal waters. In these localities, the sounds–unless identified–can serve to mask a marauding submarine. Another reason the Navy is interested in learning more about underwater sound is its possible application to communication systems. It is now known that some varieties of marine life are able to communicate with each other at ranges and speeds man-made devices cannot equal. Further studies of these phenomena might provide a key to improved underwater communications.

Present plans call for the eventual modification of a special sound source for use in the vicinity of the audio-visual installation to study animal reactions to different kinds of sounds. This investigation will supplement work now being done on other projects concerning methods of repelling venomous and carnivorous fish. Another study which could be made by means of the sound source is of sonar echoes–aimed at identifying various targets in terms of their echoes so as to prevent false interpretations.

For a number of years a cooperative program of research between the Lerner Marine Laboratory and the Office of Naval Research has been underway, implemented by research contracts and grants awarded to the American Museum. From time to time other academic institutions are awarded contracts by ONR for specific research projects at Lerner, as in the case of the University of Miami's Institute of Marine Sciences, which operates the new Audio-Visual Facility. Among the ONR-supported research projects now being conducted at the Laboratory are the following:

Operation of the Shark-Behavior Research Facility: The purpose of this project, which is directed by Robert Mathewson of the American Museum of Natural History, is to provide a field research facility for use by scientists engaged in investigations of Atlantic and Carribean species of sharks. The facility consists of a unique system of shark pens which permit laboratory and field investigations of the biology and behavior of sharks. One of the pens is equipped to enable scientists to



Above: Large stingray approaches TV camera at depth of 65 feet. Stake in front of ray is 25 feet from camera. Hydrophone lies beside stake.

Left: Head-on view of camera and tripod set up on ocean bottom. The two lamps hold 300-watt bulbs. Lead discs, used to obtain stability, weigh a total of 480 pounds.

Below: View of monitoring equipment. Video monitor and remote control panel for camera operation are at left. Hydrophone hook-up panel and tape recorders are at right.

anesthetize very large sharks and perform experimental surgical operations on them as part of physiological, biochemical, and pharmacological investigations. After the operations have been completed, the sharks are returned to an observation pen where their reactions and behavior are noted.

Studies of the Nature of Fish Sounds: Dr. William N. Tavolga of the American Museum of Natural History is studying the ecological significance of sounds produced by fishes. The reasons for most fish noises are as yet unknown, although preliminary research indicates that sound is used among some species for orientation with respect to other fish, as in the formation and maintenance of schools. Dr. Tavolga is studying the characteristics of the sound made by fishes under specific conditions, such as when alarmed, undisturbed, or breeding. He is also studying the role of the swim bladder as a sound-producing or resonating organ; in this connection he has constructed an artificial swim bladder–a mechanical system which, when placed in the water, can be made to simulate the sounds produced by some species of fish.

Investigations of the Schooling of Fishes: Dr. Evelyn Shaw of the American Museum of Natural History is investigating the development of the schooling habit in young fish in an effort to determine the sensory factors responsible for the phenomenon. Among the factors which Dr. Shaw is studying and which is considered to play a part in schooling are visual cues. To facilitate this work a large optokinetic device is used which measures the responses of fishes to various moving patterns. Schooling responses of blinded fish are also being investigated. The location of the Lerner Laboratory is excellent for such studies because of the presence of large numbers of grunts and groupers, as well as great schools of small pilchard.

Studies of Porpoises: Dr. Margaret Tavolga of the American Museum of Natural History is engaged in research on porpoises, using the newly constructed special porpoise pens at Lerner. This work concerns some of the unusual capabilities of porpoises, particularly their ability to detect and determine the nature of objects underwater.

The Navy's most potent fire-fighting equipment was placed on duty at the Pentagon early this month to extinguish fires that may break out on the Defense Department's helicopter pad. It consists of a pressurized spherical container filled with 400 pounds of "Purple-K Powder," a potassium bicarbonate chemical, and dispensing gear mounted on a small "quick response" truck.

The spherical container releases its contents upon the opening of a single valve. The powder is then forced through two hoses and nozzles, which firemen direct at the flames. Large, heavy clouds of harmless white powder are then blasted on the fire, smothering it almost instantly.

The new powder and dispensing equipment, which were designed and developed at the Naval Research Laboratory, are already in use at Naval air stations all over the world.

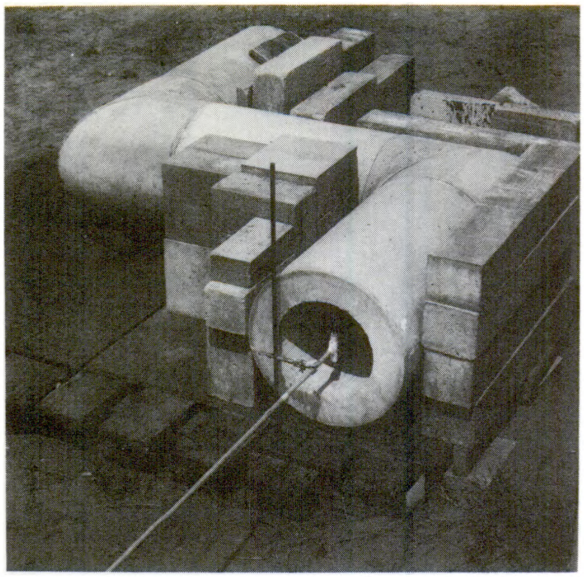
Radiation Shielding Studies at The Naval Civil Engineering Laboratory

H. E. Stanton
Associate Physicist
Argonne National Laboratory

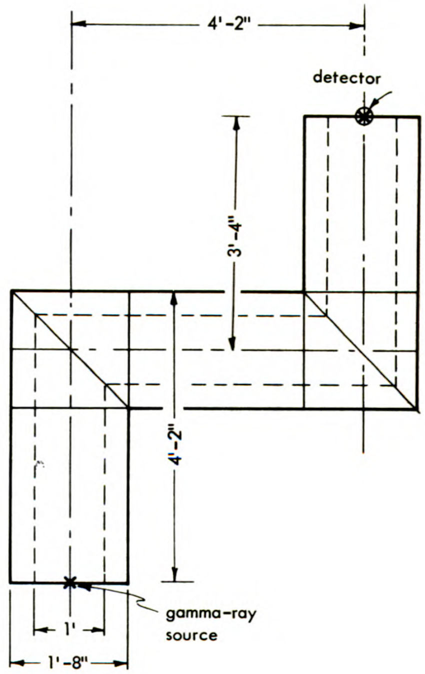
Although the need for shielding people and equipment from high levels of atomic radiation has been well established in recent years, the effectiveness of various materials and shielding configurations in blocking the particles has not yet been accurately determined. Because of this fact, investigators at the Naval Civil Engineering Laboratory, Port Hueneme, California, have been studying certain aspects of the problem. Their work, which has been underway for more than a year, has concerned particularly the streaming of gamma radiation through straight and right-angle ducts of various sizes and shapes(see page 14) –the ducts corresponding to passageways leading to shielded areas or to containers for such equipment as cables, wires, and shafting.

The approach taken in the shielding research at NCEL has been two-pronged. On the one hand, theoretical studies have been underway to determine the scattering properties of bulk shielding for gamma rays. While the nuclear physicist has determined in some detail the scattering and absorption of gamma rays as the result of collisions with single atoms and molecules, the effects of massive material like concrete or earth on radiation have been treated almost exclusively on an empirical basis. Unfortunately, empirical approaches have the serious defect of giving rather crude indications of what one would expect from a change of material–the substitution of sand for concrete, for instance. Concrete contains calcium and water, which may not be present in high-quality sand except as small impurities. The various compositions of shielding materials frequently have markedly different scattering and absorption properties for nuclear radiations, and therefore must be examined individually if design data of an empirical nature are to be derived which will be sufficiently reliable to be useful. There are many other similar phases of the shielding problem which are very difficult for the design engineer to deal with in the absence of some sort of theory.

One theoretical approach which has been made to the problem of the scattering of gamma rays takes the following point of view: Primary gamma rays enter the shield–a bulk material whose gross nuclear properties are known. As a result of scattering in the material, the rays which emerge from the surface are of two classes–those which have taken part in a single scattering event and consequently bear a definite relationship with their incoming direction and energy, and those which have been scattered so many times that they no longer retain a relationship with their initial direction and energy. Rays of the latter class are assumed to emerge in all directions. Starting from these premises it is possible to calculate the radiation field in a duct with some success.

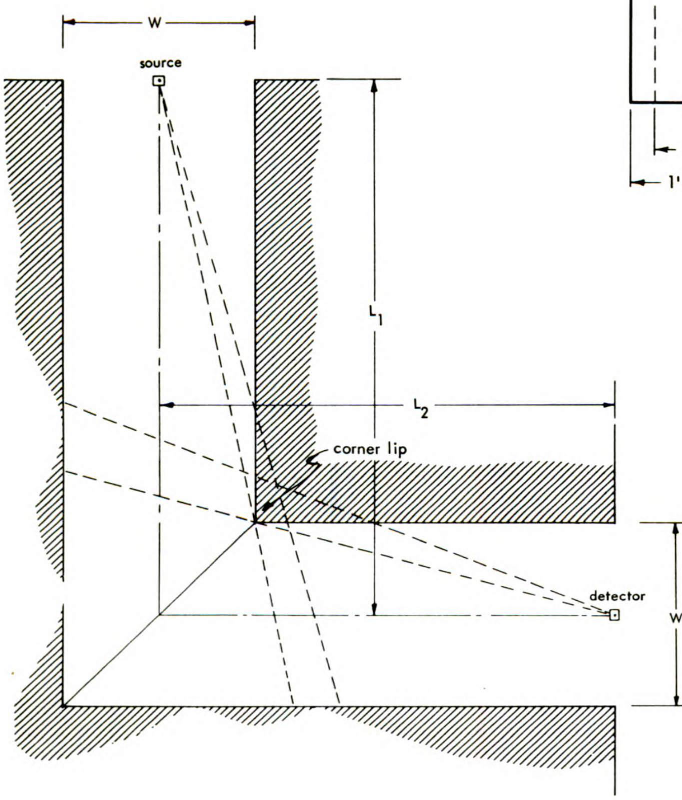


Experimental duct, with an offset, made of pieces of standard concrete pipe of 1-foot internal diameter. Concrete blocks were placed at corners to simulate earth shielding and to reduce direct radiation from source to detector. An intense cobalt source of gamma rays is shown in the opening to the duct; detectors are at other end.



Plan view of experimental duct pictured above (turned 180°).

Below, drawing of an experimental duct with single right-angle bend. Duct geometry indicates scattering areas. The duct was square in cross section.



W, 3 feet
Total centerline length, about 16 feet
L_1, about 9 feet
L_2, about 7 feet

Recently, this theory has been used in conjunction with another method of calculating gamma-ray entrance and movement in bulk materials (called the Monte Carlo method) to demonstrate the compatibility of the two approaches. The Monte Carlo method in effect uses a fast digital computer to recreate an experimental situation and find the answers. The computer, having been supplied with the nuclear and bulk data of the two mediums involved (air and concrete, for example) assumes that a gamma ray enters the shield at a certain point (selected on a statistical basis by the machine). It then calculates the ray's trajectory in the shield material, using the known probabilities, from collision to collision until the ray either emerges or is lost. By following a sufficient number of gamma rays one can, in principle, determine the shielding properties of a material in any assumed configuration. Unfortunately, because of the large amount of computer time required, such determinations are practical only for the simplest of problems. It was possible to show, however, by following this procedure, that the theory concerning gamma-ray scattering was useful. The NCEL experiments further bear out this fact.

The second prong of attack on the basic shielding problem is made by way of the experimental approach. By this means more data are provided from which additional engineering design information of an empirical nature can be obtained. The experimental approach can be applied also to test designs which may be directly useful in practice and to check existing theories. The experimental procedure followed in the past has been to construct a duct, place a source of gamma radiation at one end, and then measure the intensity of the radiation at selected points down the duct, or at the other end. This work is directed toward the measurement of the decrease in radiation in ducts with sharp right-angle bends. It has been found, for instance, that an earth-covered concrete duct 3 feet square in opening and about 15 feet long with a sharp right-angle bend in the middle (see page 14) will reduce the intensity of gamma rays from a point source at one end about 10,000 times at the other end.

One of the problems the experimenters have found is how the results "scale"—in other words, can one apply values obtained for a duct 6 inches in diameter to a similar duct 2 feet in diameter with a suitable "scale factor" or proportionality? This consideration is obviously important, because ducts large enough to walk through are much more expensive to construct than ducts a quarter that size. Also, investigations involving the former are more time consuming to carry out; consequently, many more design arrangements could be tested if the smaller size could be used.

One of the factors, discovered in the NCEL investigations, that influences proportionality determinations is the "corner lip" effect. The corner lip is the inside corner at the bend. Because of its "thinness," the material comprising the lip permits the penetration of many gamma rays, either by scattering from the corner directly or by reflection from the walls. In small ducts (6 inches in diameter) the corner lip was found to account for up to one-third of the total radiation passing through the ducts. But in larger ducts (3 feet in diameter) of similar design, the corner lip contributed only 5 percent of the radiation detected. Because of this effect, correcting terms have to be introduced in any sort of proportionality calculation made in designing large ducts from measurements made on small ducts. A further adjustment has to be made in the calculation if the concrete corner lip is replaced by one made of lead, which reduces scattering because of its much greater capacity for absorption of gamma rays.

Gamma radiation is one of the principal forms of radiation created by nuclear reactions, whether the reactions take place for explosive or for power purposes. A second one of great importance is neutrons. The properties of bulk materials which determine the scattering and absorption of neutrons are very different from the properties affecting gamma rays, although in materials such as concrete the effects may be similar in some respects. One fundamental difference between the two types of radiation is revealed by the following description of the activity of neutrons: These particles are usually absorbed as a result of being slowed down, which permits them to be captured by nuclei. When capture occurs, gamma rays are often emitted. These "capture gammas" not only add to the number of gamma rays present, but they are frequently very energetic. Consequently, if neutrons are present, the shield will become a source of gamma rays. Provision must be made, therefore, to keep these rays from forming dangerous levels of radiation.

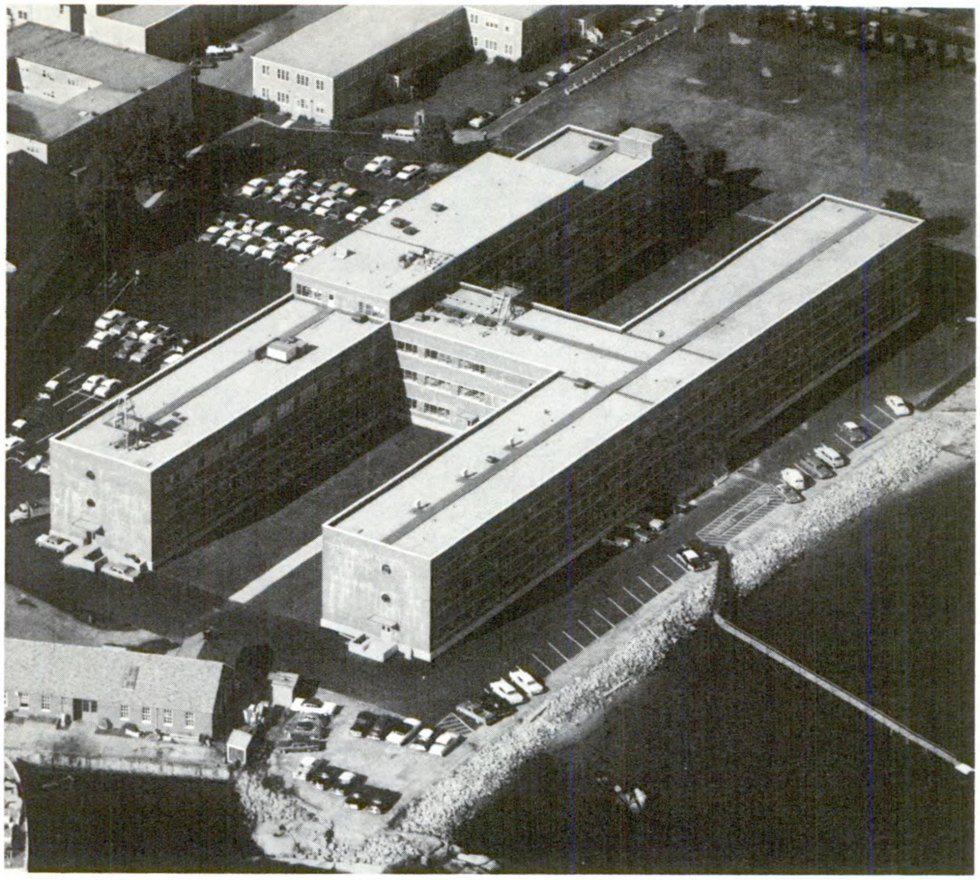
The examination of the streaming of neutrons down ducts has been less extensive than of gamma rays. In order to improve further the knowledge of the overall shielding capacities of materials, the Laboratory has recently installed some new facilities. One of these is a small "atom-smasher" capable of generating high-energy neutrons (which are the hardest to shield against). It has been placed in a building in an area surrounded by about 75 to 80 large Navy pontoons filled with sand to protect operating personnel and others who may be working in the vicinity. When this installation is completed, probably before many months, a better understanding of the shielding problem should be forthcoming.

Chief's Award Presented

Thomas Ramos of the Material Laboratory, New York Naval Shipyard, received the Chief, Bureau of Ships Award for Scientific Achievement last month for his development of the polyamide-epoxy compound (ML-D2) which has shown good damping qualities for use on ship hulls. The presentation was made by RADM R. K. James, Chief of the Bureau of Ships (see photograph, inside back cover), as a feature of the annual meeting of the Bureau of Ship's Laboratory Directors' Conference.

Other advantages of the compound developed by Mr. Ramos are its relatively low manufacturing cost, ease of application, its fire retardant characteristic, and its availability in large quantities. Its use to date and that anticipated in the future will probably save the Navy approximately $6,000,000.

Mr. Ramos is the second winner of this award since its inception in 1961 when Dr. Pao C. Pien of the David Taylor Model Basin was honored. As a result of receiving the award, Mr. Ramos will automatically become the Bureau's nominee for the Navy-wide Robert Dexter Conrad Award.



USL's Undersea Warfare Research Building

Near New London, Connecticut's old Fort Trumbull, built in the 1770's to protect the coastline from attacks from the sea, a much larger, modern-day "fort" has just been built whose mission, although entirely different from its predecessor's, also concerns the sea. Whereas the old stone ramparts were thrown up as an emplacement for a battery of cannon–to be aimed at approaching enemy ships–the 20th century structure was erected as a laboratory for scientists. These men deal in ideas instead of 18- and 24-pound shot, and they direct them not only to problems arising off the shores of Connecticut, but throughout all the oceans.

The new structure is the Undersea Warfare Research Building, part of the Navy Underwater Sound Laboratory, which is managed by the Bureau of Ships. It was erected at a cost of $4 million to replace wartime structures which have been utilized as the Laboratory's operations expanded over the years. The new building, which is four-stories high, houses laboratories, conference rooms, computing facilities, model shops, a technical library, and offices, including those of the commanding officer of USL.

The facilities afforded by the Undersea Warfare Research Building will be used to carry out the Laboratory's mission, which–in a few words–is to pursue certain well-defined research and development objectives in undersea warfare. Foremost among these aims is the perfection of sonar ocean-surveillance systems for continental defense against missile-launching submersibles; complete sonar detection, attack, and communication systems for the submarine forces; anti-submarine detection systems for surface craft; submarine radio communication systems; optical communications systems; and Polaris Command Communications.

Much of the Laboratory's energy is devoted to enlarging its knowledge and understanding of the ocean environment. Particularly noteworthy is USL's program of acoustic research in the Arctic Ocean. These studies have revealed that the Arctic Ocean is acoustically quite unlike other oceans; thus sonar systems intended for use there must be designed so that these differences are taken into account. USL is now developing many new techniques to improve the performance of sonars in the new environment.

The New Undersea Warfare Research Building takes its place among USL facilities that have been contributing to Fleet advances since World War II. Noteworthy among the others are two laboratories which were operated originally by Columbia and Harvard Universities. The former, known as the Columbia University Division of War Research, was located at New London and was concerned largely with the development of passive sonar detection devices, first for use in the anti-submarine phase of the battle for control of the Atlantic, and later for the pro-submarine phase of the conflict in the Pacific. The other laboratory was the Harvard Underwater Sound Laboratory, located at Cambridge, whose attention was directed to sonar of the echo-ranging type. It was here that the early scanning sonar techniques originated.

As World War II drew to a close, the decision was made to continue the work being done at the Harvard and Columbia laboratories under direct Navy cognizance; therefore, in July 1945, that portion of the Harvard Laboratory conducting the sonar investigations was transferred to New London and merged with the Columbia Laboratory. USL thus emerged as a permanent Navy research and development laboratory.

A report which catalogues courses in the marine sciences offered at American universities during the current academic year has been prepared by the Interagency Committee on Oceanography of the Federal Council for Science and Technology. This first edition of the annual "University Curricula" gives the names of all departments offering courses in marine sciences and information about the faculty, degrees offered, and courses given in marine sciences.

Single copies can be obtained free from the Interagency Committee on Oceanography, Office of Naval Research, 17th and Constitution Avenue, Washington 25, D. C.

Research Notes

Part of Earth's History to be Viewed through Ocean Sediments

At the Scripps Institution of Oceanography a group of scientists is attempting to unveil large intervals of the earth's surface history through studies of deep-sea sediments. Under Dr. Gustav Arrhenius and Dr. Enrico Bonatti, the investigators are developing a method for making rapid quantitative determinations of minerals in deep-sea sediments. Application of the procedure to samples taken from beneath the oceans in many areas will throw considerable light on the geological and biological character of both oceanic and continental realms, past and present. The work is being sponsored by the Office of Naval Research.

The fundamental step in making the determinations is to prepare a number of amorphous powder standards for each of the many different minerals to be surveyed, each powder standard containing a different concentration of a given mineral. For each standard, the angular distribution of scattered x-ray energy is determined. The great amount of data needed is obtained rapidly by an automatic step-scanning device which steps one increment of angle, prints out the energy received after a standard time, and then steps again. It is planned to use the method to measure the concentrations of quartz, biotite and disordered micas, montmorillonite, feldspars, pyroxenes, amphiboles, phillipsite, and barite. The investigators hope to extend the procedure to cover silicas of biological origin, also. Together with manganese oxides, which will have to be removed from sediment samples before measuring the diffraction, and volcanic glass, these minerals account for essentially 100 percent of many deep-sea sediments. Sediment is collected by mechanically skimming or grabbing a sample from the ocean floor, or by driving a pipe as deep as it will go, and extruding the contents on shipboard.

Measurements of the concentrations of minerals in marine sediments combined with knowledge of the sources and processes of formation can lead to conclusions about winds and currents, biological activity, and even extra-terrestrial occurrences, of both the present day and the past. For example, quartz, feldspar, and mica are formed by the weathering of igneous and metamorphic rock. They are formed on continents and islands and are carried to the sea by wind and water. They are mostly deposited within a few hundred kilometers of land, and their distribution on the sea bottom indicates the rate of supply by strong persistent winds, and further distribution by currents. Mica is found in notable quantities at high latitudes in the North Pacific, where the chief source is glacial debris. On the other hand, phillipsite and barite are formed from solutes in the sea. Barite forms as nodules in fecal pellets, probably because hydrogen sulfide derived from protein decomposition is concentrated in the fecal material. This is oxidized by dissolved oxygen in the sea water to sulfate, which forms the insoluble barium sulfate. Barite is, therefore, an indicator of biological activity in the water. Montmorillonite forms in an entirely different way, by decomposition of volcanic glass on the sea floor. Some pyroxenes have a still more exotic origin, being rare in igneous rocks on earth but occurring in meteorites. The proportion of these minerals in the sediments may possibly be used as an indication of the rate of accretion of meteoritic material on the earth. More common pyroxenes found over large areas of the South Pacific are taken as indicators of extensive local vulcanism. The distribution of amphiboles, which exist in a wide variety of compositions, may be linked to individual continental sources.

Analysis of samples from different horizons in cores can be correlated with dates obtained for the same horizons by other methods. It is thus possible to make maps of the sediments which occurred on the ocean bottom at any known date. Although these maps will be much less detailed than maps of sediments of present-day origin, they can yet fill huge gaps in our knowledge of the earth's history–for example, on the distribution of rocks, on weather, on ocean currents, and on other conditions of the past.

Marston C. Sargent, ONR Liaison Officer
Scripps Institution of Oceanography

TRIESTE Improved

Since the bathyscaphe TRIESTE's memorable descent to the 37,800-foot bottom of the Pacific Ocean several years ago, the unusual craft has continued to serve the Navy–in particular the Navy Electronics Laboratory–in dives off the coast of southern California. Although the vessel has carried out these assignments admirably, she is nevertheless an experimental craft, and efforts have constantly been made to improve her performance. Among modifications of the TRIESTE made recently are several which will go a long way toward increasing her usefulness. These innovations and their effect on the diving program are reported here by LCDR D. L. Keach, present bathyscaphe project officer:

● "Perhaps the most important recent innovation we have made in the TRIESTE has been the improvement of her propulsion plant. The TRIESTE now has the capability of horizontal as well as vertical mobility. Her maximum speed is now approximately one knot; and her endurance at maximum speed, three hours. The increase in horizontal mobility was made possible by modification of two propulsion motors and the rudder, or steering, motor. The modification consisted of cutting a helical groove for improved oilflow on the commutators of the motors.

● "With an increased battery supply which will be installed during forthcoming upkeep, the TRIESTE will have available approximately 60 kilowatts of power instead of the approximate 33 kw currently available, giving her greater endurance. Most of TRIESTE's battery system now consists of lead acid cells. These are contained in pressure compensated boxes mounted externally on the float.

● "With the increase in mobility, it became necessary to provide a system of maintaining TRIESTE neutrally buoyant just above the sea floor. To do this, we reverted to Professor Piccard's long-abandoned theory of using a guiderope; only in our case, the guiderope has been modified considerably. In effect, we now have a stainless-steel cable extending to a point eight feet below the sphere. On the lower end of this cable we have installed a spherical 170-pound weight. During our traverse across the sea floor, the weight travels on the bottom. Thus by controlling the TRIESTE's buoyancy within 170 pounds, we can keep the sphere above the sea floor, reducing the possibility of damage to the sphere and increasing the efficiency of her propulsion horizontally.

● "The diving program of the TRIESTE has also been modified in the past few months. With the vastly increased horizontal propulsion mobility and the increased reliability and efficiency of other systems of the TRIESTE, we have been able to increase the tempo of operations to the point where weekly scientific dives are standard procedure. For example, the TRIESTE has made 62 dives with the U.S. Navy since 1958. Thirty-three of these dives have been for scientific purposes. From January to mid-September 1962, the TRIESTE made 18 dives for scientific purposes, or more than half of the total number of dives made for that purpose previously. Six more of these dives have been planned as part of the current diving series, which will be completed in November.

● "The current diving series is concerned with the area 12-20 miles off the lower California coast; specifically, La Jolla Canyon, Coronado Canyon, and the San Diego Trough. Depths in these areas range from 2,000 to 4,000 feet."

TRANSDEC

The Navy Electronics Laboratory has broken ground on Point Loma in San Diego, California, for a huge new sonar transducer test and evaluation center. The main feature of the research installation will be a cement-lined anechoic tank 300 feet long, 200 feet wide, and as much as 38 feet deep, to be filled with fresh water–probably the only tank of this kind in the world. Research, development, and test functions to be performed at the new sound calibration center–called TRANSDEC–will be directed primarily toward the improvement of weapons systems for antisubmarine warfare, mine hunting, and ASW and mine countermeasures.

The center will replace the former NEL Sweetwater Lake Sound Calibration Station, which is no longer in use because of the lowering of the lake's water level. Although the new tank is large, the cost of constructing it will be relatively small, because the designers have taken advantage of natural deep-canyon contours on Point Loma. Construction is advancing on schedule, with completion expected by mid winter.

The surfaces of the pool will be sloped in such a way that the pool's sound field will not be affected by noises originating outside the pool. A sound-absorbent trap, 10 feet deep, will be established, supplemented by a four-foot layer of an absorbent mud on the bottom. To keep the water in the pool from stagnating, a water-circulating system will be installed. The water also will be treated with copper sulphate to prevent growth of algae.

The main calibration building at the center will be suspended from a truss across the water. Thus any noise generated by the structure will not enter the water and influence the sensitive measurements that will be taken. An adjacent building will house the filtration and pumping plants and other service facilities, as well as work areas.

Waste Oil Pollutes Seas

Oil from sunken tankers of World War II is still seeping to the ocean surface and contributing to what has become a serious international problem–the pollution of the sea and its shores by oil. This unfortunate situation was discussed before the International Conference on Water Pollution Research in London recently by Claude E. ZoBell, professor or marine microbiology at the University of California's Scripps Institution of Oceanography and formerly an ONR contractor.

ZoBell's nearly 20 years of study of the oil pollution of beaches and bays indicate that the greatest increases in oil contamination are occurring in the North Sea and along the eastern seaboard of the United States. In addition to World War II wastes that have accumulated in the oceans, between 50,000 and 250,000 tons of oily substances are discharged annually at sea by ships, ZoBell estimates. And he says a much larger amount may come from natural oil derived largely from decomposing organic materials.

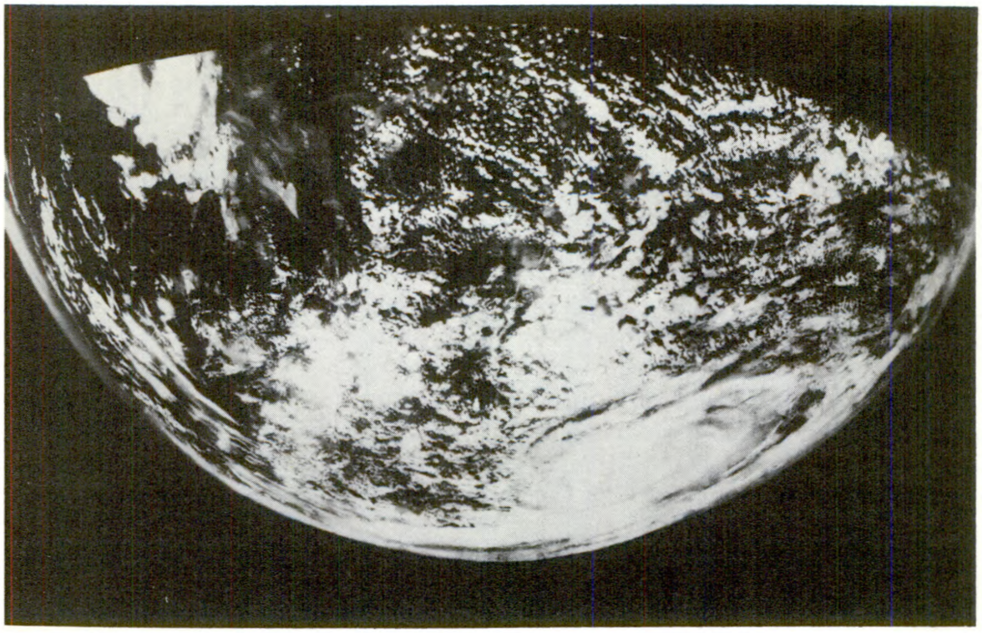
Oil wastes sometimes occur in concentrations high enough to be harmful to sea birds. The oil displaces air in the feathers or down, thereby destroying the bird's natural insulation and buoyancy. In cold weather, many birds freeze. Some sink. Others are washed helplessly ashore.

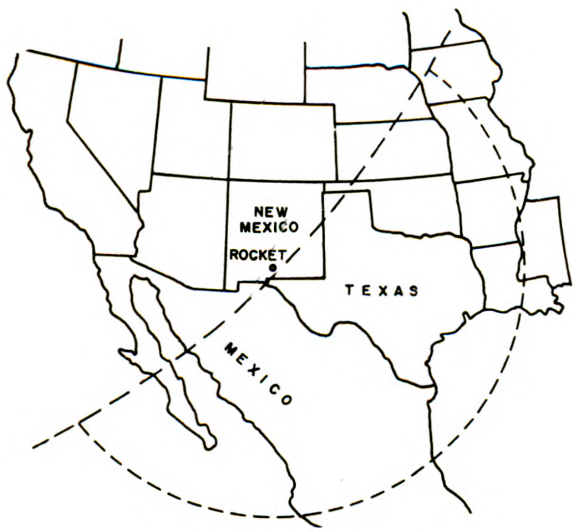
Oil-oxidizing bacteria have been found to play an important part in freeing the sea of oil wastes–the chief end product of their activities being carbon dioxide. More than 40 different species of these bacteria have been found in marine materials. ZoBell's proposed solution to the oil-pollution problem, aside from minimizing the amount of oil deposited in the ocean, is to see that it is dispersed as finely as possible, thereby making it more susceptible to bacterial activity.

Famous Photo Mosaic Given to Museum

On October 5, CAPT A. E. Krapf, Director of the Naval Research Laboratory, celebrated the eighth anniversary of a now famous NRL rocket flight by turning over the product of that flight–a remarkable photo mosaic–and the camera responsible for it to the National Air Museum, a branch of the Smithsonian Institution.

The mosaic, which is reproduced on page 23, was pieced together from 16-millimeter film enlargements exposed at an altitude of 100 miles over the deserts of New Mexico. The film and the camera that carried it were lifted to the high vantage point by a two-stage Navy





Above, photo mosaic compiled from NRL rocket photos taken in 1955 and turned over to the Smithsonian Institution last month. Map at left shows area covered by the photos.

Aerobee rocket. The series of photos which was taken was unusual because the rocket was rolling slowly as it reached the apex of its flight path. Thus the camera, mounted perpendicular to the axis of the rocket, viewed successive, overlapping strips of earth.

After the rocket fell back toward the earth, the camera-carrying nose cone separated from it, as planned, and was lowered gently to the ground by parachute. The camera was in good condition, and the film, after developing, exhibited excellent definition. About 90 enlargements of different frames of this film were put together to form the mosaic, which covers an area of 1,250,000 square miles and spans 2,500 miles of horizon. The most outstanding feature of the mosaic is a cyclone 1,000 miles in diameter (near lower right edge of picture) situated over southern Texas and Mexico. At the time of the rocket flight its presence had not yet been detected by meteorologists.

The Arctic Basin Symposium

The Arctic Basin Symposium was held at Hershey, Pennsylvania, last month to appraise the present knowledge of the polar region, to exchange information on current programs of research, and to obtain from leading scientists recommendations for future scientific programs. The total environment of the Arctic Basin–not just the ocean–fell under the careful scrutiny of about 150 authorities on the subject, representing all countries in the world having an interest in Arctic research except Russia. The Symposium was sponsored by the Arctic Institute of North America for the Office of Naval Research.

The papers presented dealt with numerous important aspects of the large topic under review, as is indicated by the following list of titles: Submarine structure of the Arctic Ocean from earthquake surface waves; Geomagnetism and gravity of the Arctic Ocean; Benthic fauna and its environment; Water, salt, and heat balance of the north polar sea; The major features of ice movement in the Arctic Basin; Interaction between the Polar Basin and peripheral seas, particularly the Altantic approach; Aspects of turbulence in the polar seas; Waters of the Canadian Archipelago; Water masses of the Arctic; Arctic Ocean plankton; Arctic submarine acoustics; Ice budget; Energy exchange, air, ice, water; Ecology of ice substrates; The major factors of Arctic climate; Research on the polar upper atmosphere; The Arctic ionosphere, aurora, airglow.

Featured speakers were Dr. Waldo K. Lyon, head of submarine and Arctic research at the Navy Electronics Laboratory, San Diego, and recent recipient of the President's Award for Distinguished Civilian Service; and Mr. Max Brewer, director of ONR's Arctic Research Laboratory, Point Barrow, Alaska. Dr. Lyon discussed "The Nuclear Submarine as a Tool in Arctic Oceanography," and Mr. Brewer spoke on "Drifting Stations in the Arctic Ocean." During the symposium, Mr. Brewer was presented the Distinguished Public Service Award (see p. 8).

One of the important determinations reached during the symposium was that more accurate navigational techniques than are now available are required for many phases of Arctic research. Methods and equipment perfected for this purpose should permit position determinations to within 1/10th of a mile.

Physiological Experiments Conducted on 14,000 Foot High Mountain

Six eminent scientists who participated in the international high-altitude expedition to the Chilean Andes in 1935 have held a unique reunion at the University of California's White Mountain Research Station, located near the top of 14,232-foot White Mountain Peak. Their purpose in gathering at the high-altitude laboratory, which is supported chiefly by the Office of Naval Research, was to undergo the same strenuous physiological experiments that they were the subjects for in 1935.

The Chilean expedition was undertaken to help solve physiological problems involved in aviation at the time when commercial and military planes first began flying near stratospheric levels. The knowledge gained in the Andes proved valuable during World War II and contributed to the understanding required to make manned space flight possible.

The goal of the present research is to provide scientific criteria for aging-measures based on changes in the body's ability to function well, rather than on the mere passage of years. The current experiments were organized by Dr. David Dill of Indiana University under the auspices of Dr. Nello Pace, University of California. When the data have been compiled, they will enable investigators to compare, for the first time, the range of physiological functions in a group of people in youth and again 27 years later in life.

Thermal Radiation Studied at Sea

During the past summer a series of unique thermal-radiation observations were made in the Gulf of Mexico and Carribean Sea from the research vessel HIDALGO of the Department of Oceanography and Meteorology, A and M College of Texas. The venture, which was sponsored by the Office of Naval Research through the Texas A and M Research Foundation, is part of a research effort dealing with interactions between sea and air.

Measurements of various components of thermal radiation were made by ship-mounted and balloon-borne instruments. The former were mounted in gimbals at the end of a beam off the bow of the vessel. These instruments included two Eppley pyrheliometers, to measure incoming and reflected solar radiation; and a Suomi-Kuhn radiometer, to permit assessment of the upward and downward fluxes of terrestrial radiation. Similar Soumi-Kuhn sensors, made available by the U.S. Weather Bureau, were launched with modified radiosonde units to permit evaluation of the vertical distribution of terrestrial radiation streams. The flights, referred to as radiometersondes, represent the first known observations of this type to be made from aboard a vessel.

Since the ocean surface is relatively uniform (in a radiational sense) over large areas, such observations also furnish a desired reference for satellite observations of radiant energy. During the observation period, four U.S. satellites–Explorer VII, Tiros III and V, and the recently launched Tiros VI–were in orbit and functioning. Through informal arrangements with Dr. P. Kuhn of the U.S. Weather Bureau, simultaneous overflights of high-level aircraft and reconnaissance planes of the National Hurricane Research Project were made in a coordinated venture. Similar observations, currently planned to extend through the 1962 hurricane season, will become a standard part of meteorological observations to be made on future cruises of the HIDALGO and the newly acquired research vessel ALAMINOS, which will become operational in 1963.

–Guy A. Franceschini and Robert Boudreau
Department of Oceanography and Meteorology,
A and M College of Texas

On the Naval Research Reserve

The Biological Defense Seminar

The first Biological Defense Seminar, held September 9-22, 1962, was jointly sponsored by the Office of Naval Research and the U.S. Army Biological Laboratories. It was held at Fort Detrick, Frederick, Maryland, under the direction of the members of Naval Reserve Research Company 5-3. In attendance were 42 Reserve officers—12 from the Army Reserve and 30 from the Naval Reserve from all naval districts east of the Rocky Mountains.

The objective of the seminar was to acquaint the officers with the capabilities, limitations, and problems concerning biological weapons and defense; subject matter was considered from both a scientific and military point of view.

The seminar was opened by COL Carl S. Casto, USA, Commanding Officer, U.S. Army Biological Laboratories, who extended a hearty welcome to the members and emphasized the mutual benefit that could be derived by an active participation in the discussions. He stated that the doors of the Biological Laboratories as well as the minds of its personnel were always open and that comments and suggestions would be welcomed. A "welcome aboard" was expressed by Dr. Riley D. Housewright (CDR, MSC, USNR), the Scientific Director, USABL; Dr. Leroy D. Fothergill (CAPT, MC, USNR Ret.), the Scientific Advisor, USABL; COL Dan Crosier, MC, USA, Commanding Officer, USA Medical Unit; and CDR Leon P. Eisman, USN, Commanding Officer, U.S. Naval Unit, COL John J. Hayes, USA, Deputy Commander, CBR Agency, representing BGEN Fred J. Delmore, C.G., CBR Agency, spoke on the philosophy of the use and the place of biological agents and chemicals in modern warfare. He stressed the specialized effects of incapacitating weapons, pointing out that they would cause little or no loss of life or property and that they can be controlled.

The seminar was most fortunate in having as the guest speaker for the opening day RADM L. D. Coates, USN, Chief of Naval Research, who spoke about the Navy's vital concern, role, and support of the program on biological weapons and defense. He further discussed the role of naval research with emphasis on the recent technical advances made possible by support of ONR—namely, the aerosol monitor for hospitals and the whole-blood preservation. The admiral expressed hope that the seminar would do much to promote a better understanding of mutual problems in the area of biological weapons and defense.

CAPT E. F. Lathrop, USNR, Commanding Officer, USNRTC, Baltimore, Maryland, representing RADM W. F. Peterson, USN, Commandant, Fifth Naval District, spoke about the role of the Naval reservists in the recent emergency. He spoke from first-hand experience, having been in command of a Reserve destroyer squadron. His closing remarks were that reservists had a job to do, and they did it well, as always.

The formal program on the opening day was concluded by Dr. Riley D. Housewright, who spoke on "Why Fort Detrick—and Integrated R&D Effort." After a brief historical introduction, complete with pictures of the early facilities and personnel, he launched into a most comprehensive discussion of the program at the Biological Laboratories. His discussion covered the budget, disposition of authority, coordination of the overall effort, and the positions now occupied by USABL in the CBR Agency, and the Munitions Command in the Department of Defense. Dr. Housewright stressed the uniqueness of the Biological Laboratories and the fact that nearly all of the research effort of the Department of Defense on biological weapons is centered at USABL and that this includes most of the effort for the free world. The day was concluded with a "smoker" in the Fort Detrick Officer's Club.

The light vein and generalities were soon forgotten as the anchor was raised and the cruise began into the details of the program. A well-plotted course had been laid out by the navigators, commencing with a day concerning potential agents (choice, characteristics, and related research). Subsequent ports of call on the following days included process research, development, production, dissemination theory and devices, conventional and unique weapons systems for delivery, physical defense (early warning, protection and decontamination) and medical defense (early identification, treatment and research) and chemical weapons and defense. Arriving at the home port, reservists received the latest information on intelligence and use concepts from the CBR Agency Briefing Team. Along our cruise, we anchored briefly for tours of the Simulant Production Plant, the Animal Farm, Medical Bacteriology Division, Crops Division, Aerobiological Facilities and Test Chambers, Physical Defense Division, and Test Area "B" where the Munitions Division gave a demonstration of munitions, dissemination devices, and methods used to study aerosols. At the port known as the Chemical Research and Development Laboratories, Edgewood Arsenal, Edgewood, Maryland, reservists were given an excellent briefing on the Chemical Agents Research Program, including medical aspects and chemical munitions. Tours were conducted through the Chemical Production and Filling Plants, the Medical Unit, Aerosol Test Facilities, and Physical Defense Unit. At the latter stop, emphasis was placed on early-warning alarms. Several members of the party volunteered for and then underwent an actual riot control agent demonstration.

On Thursday evening of the first week a banquet was held. CAPT J. W. Jockusch, Jr., USNR, Special Assistant to the Chief of Naval Research (Research Reserve) was the guest speaker and gave an outstanding talk on the role of the Research Reserve in the overall Naval Reserve Program. He attested to the preparedness of the Reserves and the extremely vital part they play in the program of national defense, especially in this crucial period of our history.

The seminar was officially concluded by BGEN Adam W. Meetze, USA, Deputy Commanding General, Munitions Command, who spoke on the recent Army reorganization and the role of the Munitions Command in the overall picture of the Departments of the Army and Defense.

--LT Robert E. Boyle, MSC, USNR, Co-Chairman,
Biological Defense Seminar

Roster of Research Reserve Companies

There are 116 Research Reserve companies located throughout the United States. These companies are listed below by states and cities within states. For each company the meeting place, time of meeting, and the commanding officer is given.

ALABAMA

Auburn
NRRC 6-2
204 Funchess Hall, Auburn University
1900, Mondays (no set schedule)
CDR Roy D. Rouse

Huntsville
NRRC 6-17
Naval Reserve Training Facility
Canal and Barnett Streets
1900, 2nd and 4th Tuesdays
CDR John D. Beal, Jr.

ARIZONA

Phoenix
NRRC 11-6
USN&MCRTC, 2042 West Thomas Road
2000, 2nd and 4th Thursdays
(No meetings during July and August)
CDR Joseph A. Chambers

Tucson
NRRC 11-7
USN&MCRTC, 1100 South Alvernon Way
2000, 1st and 3rd Thursdays§
(No meetings during July and August)
LCDR James M. Miller

CALIFORNIA

Los Angeles
NRRC 11-1
USN&MCRTC, 851 Chavez Ravine Road
2000, 1st and 3rd Tuesdays
CDR Silas E. Johnson

Pasadena
NRRC 11-2
USNRTC, 2727 Paloma Street
2000, 1st and 3rd Thursdays
LT Paul E. Caplan

Los Angeles
NRRC 11-3
Conference Room MC 105/33
U.C.L.A. Medical Center
2000, 1st and 3rd Mondays
LT W. J. J. Klein

Compton
NRRC 11-4
USN&MCRTC, 600 North Alameda
CDR Victor H. Hunsaker

San Diego
NRRC 11-5
USNRTC, Camp Decatur
1930, 2nd, 3rd, and 4th Tuesdays
LT David A. Kindig

Point Mugu
NRRC 11-8
Room 203, Bldg. 351, Pacific Missile Range
1645, 1st and 3rd Wednesdays
CDR Lyle C. Read

Azusa
NRRC 11-9
Aerojet-General Corporation
2000, 2nd and 4th Wednesdays
CDR Elvin W. Diehl

Ventura
NRRC 11-10
Ventura College, A6
1930, 2nd and 4th Wednesdays
LCDR George B. McNeely

Santa Monica
NRRC 11-11
USN&MCRTC, 3400 Airport Avenue
2000, 1st and 3rd Mondays
LCDR John N. Harvey

San Francisco
NRRC 12-1
Third Floor, 1000 Geary Street
1930, 2nd and 4th Mondays
CDR Ralph W. Beecher

Livermore
NRRC 12-2
Room 219, Building 143
Lawrence Radiation Laboratory
1645, 1st, 2nd and 4th Mondays
CDR William H. Johnson

Stanford
NRRC 12-3
Room 101, Physics Lecture Hall
Stanford University
1930, 1st and 3rd Wednesdays
CAPT Frank E. Ridley

Fresno
NRRC 12-4
Room 119, Agriculture Building
Fresno State College
2000, 1st and 3rd Wednesdays
LCDR Max E. Kimberly

Berkeley
NRRC 12-5
Room 247, Cory Hall, Univ. of California
1930, 2nd and 4th Wednesdays
CDR David B. Todd

Davis
NRRC 12-6
246 Academic Office Bldg., Univ. of California
1930, 1st, 2nd and 4th Thursdays
LCDR Orren H. Turner

Monterey
NRRC 12-8
Room S-136, USN Postgraduate School
2000, 1st and 3rd Wednesdays
CAPT George J. Haltiner

COLORADO

Fort Collins
NRRC 9-12
Room 220, Chemistry Building
Colorado A&M College
1930, 2nd and 4th Thursdays
LCDR Earl E. Julson

Boulder
NRRC 9-17
University of Colorado
1930, 1st and 3rd Wednesdays
LT Martin T. Decker

Denver
NRRC 9-21
John Greene Hall, Denver Research Institute
2000, 1st and 3rd Thursdays
LCDR Gus Francis

CONNECTICUT

Hartford
NRRC 3-5
Hartford Electric Building
186 Cumberland Avenue
2000, 1st and 3rd Thursdays
CDR Otis R. Gilliam

New London
NRRC 3-12
Building 137, USNRTC
U.S. Naval Submarine Base
2000, 2nd and 4th Tuesdays
LT James W. Parker

New Haven
NRRC 3-13
Grace-New Haven Community Hospital
789 Howard Avenue
2000, 2nd and 3rd Thursdays
LT Lucas S. Van Orden

DELAWARE

Wilmington
NRRC 4-5
UNS&MCRTC, 3920 Kirkwood Highway
2000, Alternate Mondays
CAPT Russell Remage

DISTRICT OF COLUMBIA

NRRC 5-8
National Academy of Sciences
2101 Constitution Avenue, N.W.
2000, 1st and 3rd Thursdays
CDR James R. Patton, Jr.

NRRC 5-9
U.S. Naval Research Laboratory
4555 Overlook Avenue
1630, 1st and 3rd Fridays except during first quarter meetings are Alternate Wednesdays
CDR Henry D. Cubbage

FLORIDA

Gainesville
NRRC 6-4
USNRTC, 1300 N.E. 8th Avenue
1915, 1st and 3rd Tuesdays
LT Harold D. Wallace

Orlando
NRRC 6-8
USNRTC, Livingston and Parramore St
1930, 1st and 3rd Tuesdays
CDR Merlin C. Herold

Miami
NRRC 6-10
Processings and Research Building 20
2030, 1st and 3rd Thursdays
Research, 2nd and 4th Thursdays
LCDR Henegar D. Shamblin

Fort Walton Beach
NRRC 6-15
Army Reserve Center, Ocean City
1900, Mondays
CAPT Robert C. Hoffman

Patrick Air Force Base
NRRC 6-16
PFAB Chapel Annex, B Street
1630, 1st and 3rd Tuesdays
LCDR Sylvester A. Demars

GEORGIA

Atlanta
NRRC 6-1
USN&MCRTC, 274 Fifth Street, N;W.
1930, 1st, 2nd and 3rd Thursdays
1st two months of each quarter
1930, 1st and 2nd Thursdays
3rd month of each quarter
(No meetings during first quarter)
LCDR Clarence W. James

Athens
NRRC 6-9
Smith Hall, U.S. Navy Supply Corps School
1900, 1st, 3rd and 4th Mondays
CAPT John C. Craig

IDAHO

Idaho Falls
NRRC 13-6
U.S. Naval Reserve Armory, Tautphaus Park
1930, 2nd and 4th Thursdays
CDR Robert G. Nisle

ILLINOIS

Chicago
NRRC 9-1
Navy Pier Campus, University of Illinois
1900, 2nd and 4th Tuesdays
LT Roger E. Oesterreich

Urbana
NRRC 9-2
"E" Law Building, University of Illinois
1930, 2nd and 4th Tuesdays
LCDR John B. Gartner

Evanston
NRRC 9-10
Elder Hall, Northwestern University
1800, Alternate Tuesdays
LT Edmund D. Blum

Decatur
NRRC 9-18
USNRTC
1930, 2nd and 4th Wednesdays
LCDR Edward B. Freyfogle

Forest Park
NRRC 9-23
Naval Ordnance Plant, 7500 W. Roosevelt Rd.
1930, 2nd and 4th Wednesdays
LT Mahlon D. Burkhard

INDIANA

Lafayette
NRRC 9-7
Room 1, New Heavilon Hall, Purdue Univ
1900, 2nd and 4th Tuesdays
LCDR V. M. Hoeche

Indianapolis
NRRC 9-25
USNRTC
1930, 1st and 3rd Wednesdays
LT A. S. Humphrey

IOWA

Ames
NRRC 9-5
USNROTC Building, Iowa State College
1900, 1st, 2nd and 3rd Wednesdays
LT Melvin B. Larsen

Des Moines
NRRC 9-13
USN&MCRTC; Fort Des Moines
1930, Every Wednesday
LT John H. Wetherell

Iowa City
NRRC 9-19
Psychopathic Hospital, State Univ. of Iowa
1930, Every Monday
LT Marvin Schwartz

Waterloo
NRRC 9-24
USNRTC, 200 Riverside Drive
1930, 1st and 3rd Wednesdays
LT L. A. Simester

KANSAS

Lawrence
NRRC 9-20
104 Military Science Bldg., Univ. of Kansas
1930, Alternate Thursdays
LCDR James R. Thomen

LOUISIANA

New Orleans
NRRC 8-1
USNROTC Building, Tulane University
1930, Alternate Tuesdays
LCDR Idas W. Lohmann

Baton Rouge
NRRC 8-2
USNRTC, 500 S. First Street
1900, 1st and 3rd Thursdays
LT Stewart H. Fowler

MARYLAND

Frederick
NRRC 5-3
Building S-426, Fort Detrick
1930, Tuesdays
CDR Robert F. Jaeger

Baltimore
NRRC 5-4
School Board Administration Building
3 East 25th Street
2000, 1st and 3rd Thursdays
LCDR James C. Wiltse

Bethesda
NRRC 5-10
Naval Medical Research Institute
National Naval Medical Center
2000, 2nd and 4th Tuesdays
CDR Eugene G. Kovach

Annapolis
NRRC 5-11
Auditorium, USN Engineering
Experimental Station
2000, 1st and 3rd Tuesdays
CDR W. Donald Pennington

MASSACHUSETTS

Cambridge
NRRC 1-1
Room 4-270, M.I.T., 77 Massachusetts Ave.
1930, 1st and 3rd Mondays
CAPT Arthur H. Healy

Amherst
NRRC 1-3
Room 10-11, Dickinson Armory
University of Massachusetts
1930, 1st and 3rd Tuesdays
LCDR Herschel G. Abbott

Worcester
NRRC 1-5
Stratton Hall, Worcester Polytechnic Institute
2000, 1st and 3rd Mondays
(No meetings during July and August)
LT Lawrence C. Neale

Woods Hole
NRRC 1-8
Woods Hole Oceanographic Institute
1930, 1st, 2nd and 3rd Thursdays
LCDR Max C. McLean

MICHIGAN

Ann Arbor
NRRC 9-3
112, N. Hall, University of Michigan
1930, 1st and 3rd Mondays
(Varied dates July, August and September)
LCDR Robert C. Fitzpatrick

Midland
NRRC 9-15
Grace Dow Library
1900, 2nd and 4th Tuesdays
LCDR Ralph W. Barr

East Lansing
NRRC 9-16
Room 313, Electrical Engineering Building
Michigan State University
1930, 1st and 3rd Mondays
LCDR Ross W. Matteson

MINNESOTA

Minneapolis
NRRC 9-6
Room 211, Mechanical Engineering Building
University of Minnesota
1930, 2nd and 4th Mondays
LCDR A. C. Wagenknecht

MISSISSIPPI

Gulfport
NRRC 6-5
USN&MCRTC
1930, 1st, 3rd and 5th Mondays
LCDR John S. Howkins, Jr.

MISSOURI

St. Louis
NRRC 9-8
Webster Groves Public Library
Webster Groves, Missouri
1900, 2nd and 4th Wednesdays
LCDR Leon U. Jameton

Kansas City
NRRC 9-9
USN&MCRTC
1930, Alternate Mondays
CDR F. J. Taylor, Jr.

NEBRASKA

Lincoln
NRRC 9-22
Agriculture Engineering Building
University of Nebraska
1930, Tuesdays
LT Howard W. Ottoson

NEW HAMPSHIRE

Hanover
NRRC 1-7
Wentworth Hall, Darthmouth College
2000, 1st and 3rd Tuesdays
(No meetings during July and August)
CDR Sumner E. Atherton, Jr.

NEW JERSEY

Princeton
NRRC 4-1
10 Guyet Hall, Princeton University
2000, Alternate Wednesdays
CDR Richard E. Borup

NEW MEXICO

Albuquerque
NRRC 8-7
USN&MCRTC 1805 Yale Avenue, S.E.
1930, 1st and 3rd Wednesdays
LT E. F. Johnson

Los Alamos
NRRC 8-9
Lecture Room, Administration Building
Los Alamos Scientific Laboratory
1700, 1st, 2nd, and 3rd Tuesdays
LCDR William J. McCreary

NEW YORK

New York
NRRC 3-1
3rd Floor, 663 Fifth Avenue
1845, 1st and 3rd Thursdays
CDR Evans Kahn

Long Island
NRRC 3-2
Engineering Building, U.S. Naval Training Device Center, Port Washington
1930, 2nd and 4th Mondays
CDR John H. Hickey

Buffalo
NRRC 3-3
Room S-1, Sherman Hall, Univ. of Buffalo.
2000, 2nd and 3rd Mondays
CDR Rapier H. McMenamy

Rochester
NRRC 3-4
Harkness Hall, University of Rochester
2000, 1st and 3rd Tuesdays
LT Robert B. Taylor

Syracuse
NRRC 3-6
General Electric Company, Electronics Park
2000, 2nd and 3rd Mondays
LCDR Henry B. Latimer

Scotia
NRRC 3-7
USNRTC
2000, 2nd and 4th Tuesdays
CDR Arleigh H. Markham

New York
NRRC 3-8
16th Floor, 285 Madison Avenue
Young and Rubicam, Inc.)
1900, 2nd and 4th Tuesdays
LCDR Russell M. Wickett

Upton
NRRC 3-9
Brookhaven National Laboratory
1930, 2nd and 3rd Wednesdays
LCDR Wilmer H. Poulson, Jr.

Kingston
NRRC 3-14
USNTRC, 75 Oakley Street
Poughkeepsie, New York
1800, 1st, 2nd and 3rd Tuesdays
CDR Norman J. Smith

New York
NRRC 3-15
Room 1511, 90 Church Street
1845, 2nd and 4th Tuesdays
CDR John D, Strachan

NORTH CAROLINA

Chapel Hill
NRRC 6-6
2nd Quarter: Chapel Hill Naval Armory
3rd Quarter: USN&MCRTC Raleigh
4th Quarter: USN&MCRTC Durham
1800, 1st, 2nd and 3rd Mondays, 1st two months of each quarter
1800, 1st and 2nd Mondays, 3rd month of each quarter
(No meeting during first quarter)
CDR James E. Wadsworth

OHIO

Columbus
NRRC 4-7
Research Foundation, Ohio State University
1314 Kinnear Road
1930, Alternate Thursdays
(No meetings during August)
LCDR Robert W. King

Cleveland
NRRC 4-8
USN&MCRTC, 1089 East 9th Street
2000, Alternate Mondays
CDR Francis J. Callahan, Jr.

Dayton
NRRC 4-9
U.S. Armed Forces Training Center
410 Gettysburg Avenue
1930, 2nd and 4th Mondays
LT Jean C. Cassel

Cincinnati
NRRC 4-11
Room 54, Albers Hall, Xavier University
1900, 2nd and 4th Tuesdays
LCDR George W. Pomeroy

OKLAHOMA

Bartlesville
NRRC 8-8
American Legion Building
1930, 1st and 3rd Tuesdays
LCDR Howard W. Bost

Stillwater
NRRC 8-13
Room 2, Union Building
Oklahoma State University
2000, 2nd, 3rd and 4th Thursdays
LCDR Douglas E. Bryan

OREGON

Portland
NRRC 13-4
USN&MCRTC, Swan Island
2000, 2nd and 4th Tuesdays
CDR Milton W. Belsher

Corvallis
NRRC 13-5
132 Agriculture Bld., Oregon State Univ.
1930, 2nd and 4th Mondays
LCDR Russell L. Lincoln

PENNSYLVANIA

Philadelphia
NRRC 4-2
Franklin Institute, 20th Street and Parkway
1930, Alternate Thursdays
(No meetings during July and August)
LCDR Peter F. Suffredini

Pittsburgh
NRRC 4-3
Room 1112, Engineering Hall
Carnegie Institute of Technology
2000, Alternate Thursdays
CDR John J. Hession

State College
NRRC 4-4
303 Wagner Hall, Military Science Bldg.
Pennsylvania State University
1900, Alternate Mondays
LCDR Earl P. Strong

Bethlehem
NRRC 4-6
USN&MCRTC, Rodgers and Lewis Streets
1930, 2nd and 4th Tuesdays
LCDR Frank D. Sills

Willow Grove
NRRC 4-12
Tech. Training Bldg., U.S. Naval Air Station
1930, Alternate Tuesdays
(No meetings during July and August)
CDR Carlton J. Nelson

Philadelphia
NRRC 4-13
Navy Science Bldg., Univ. of Pennsylvania
2000, Alternate Mondays
CAPT Robert Mayer

RHODE ISLAND

Providence
NRRC 1-2
USN&MCRTC, Fields Point
1930, 1st and 3rd Wednesdays
LCDR Warren M. Hagist

SOUTH CAROLINA

Clemson
NRRC 6-11
1 Physics Building, Clemson College
1930, Wednesdays
CDR Willie E. Park

Aiken
NRRC 6-13
American Red Cross Bldg., Laurens Street
1900, 2nd and 4th Thursdays
CDR Robert M. Radford

SOUTH DAKOTA

Brookings
NRRC 9-11
Room 330, Agricultural Hall, S.D. State College
2000, 2nd and 4th Wednesdays
(Varied dates July and August)
LT Ernest J. Hugghins

TENNESSEE

Oak Ridge
NRRC 6-3
Oak Ridge High School, Providence Road
1930, 2nd and 4th Wednesdays
LCDR James N. Robinson

Nashville
NRRC 6-18
Room 311, S-R Building, Peabody College
2000, 1st and 3rd Mondays
CAPT William D. McClurkin

TEXAS

College Station
NRRC 8-3
Biological Sciences Bldg., Texas A&M College
1930, Mondays
CAPT Richard H. Ballinger

Houston
NRRC 8-4
UNSRTC, 4415 Cullen Boulevard
1930, 1st and 3rd Wednesdays
LCDR Milton G. Gugenheim, Jr.

Austin
NRRC 8-5
Experimental Science Bldg. 137, Univ. of Texas
1900, Mondays
CDR Jim T. Barton

Dallas
NRRC 8-12
USN&MCRTC, 9638 Bachman Boulevard
2000, 1st and 3rd Tuesdays
LCDR Charles F. Davis

UTAH

Logan
NRRC 12-7
Room 212, Union Building, Utah State Univ.
2000, 1st, 2nd and 4th Thursdays
LCDR Lloyd E. Rich

VIRGINIA

Newport News
NRRC 5-1
USN&MCRTC, Warwick Blvd. and 75th Street
1930, 1st and 3rd Tuesdays
LCDR Harold L. Dehoff

Blacksburg
NRRC 5-2
Room 312, Hutcheson Hall
Virginia Polytechnic Institute
2000, Mondays
LCDR Charles H. Powers

Richmond
NRRC 5-5
4th Floor, Biochemical Lecture Room
Medical College of Virginia
1700, 2nd and 4th Mondays
CDR Charles M. Preston

Dahlgren
NRRC 5-12
University Center, U.S. Naval Weapons Lab.
1900, 1st and 3rd Mondays
CAPT John J. Glancy

WASHINGTON

Seattle
NRRC 13-1
USN&MCRTC
1930, 1st and 3rd Mondays
CAPT Frederick A. Wiggin

Richland
NRRC 13-2
Richland Community House
650 George Washington Way
1900, 2nd and 4th Tuesdays
CDR William A. Burns

Pullman
NRRC 13-3
Room 411, Holland Library
Washington State University
1930, 2nd and 4th Mondays
CDR Irven O. Buss

WISCONSIN

Milwaukee
NRRC 9-4
USNRTC
2000, 2nd and 4th Tuesdays
LCDR John E. Housiaux

Madison
NRRC 9-14
119 Babcock Hall, University of Wisconsin
1930, Alternate Mondays
LCDR Stanley L. Inhorn

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RADM R. K. James, Chief of the Bureau of Ships, presents the Bureau's 1961 Award for Scientific Achievement to Thomas Ramos, Material Laboratory, New York Naval Shipyard. A report on the award is given on page 16.

Max Brewer of ONR's Arctic Research Laboratory, and Dr. Maurice Ewing of the Lamont Geological Observatory inspect an exhibit of the ARLIS-2 drifting ice station during the Arctic Basin Symposium. Mr. Brewer was presented the Distinguished Public Service Award at the meeting. For accounts of the symposium and the presentation see pages 8 and 24.

Research reservists in attendance at the first Biological Defense Seminar held September 9-11, 1962, at Fort Detrick, Maryland. Story on page 26.

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NAVAL RESEARCH reports highlights of technical progress in research by Navy laboratories and contractors and the development of important naval research facilities. The magazine is listed for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. Subscription price: $1.50 per year in U. S. and Canada; $2.00 per year, foreign; $0.15 per individual copy. Changes of address should be sent to Code 740, Office of Naval Research, Washington, D. C. The issuance of this publication approved by the Secretary of the Navy on 1 March 1961.

Technicians don special protective clothing and breathing apparatus before beginning the tedious job of fueling a Navy rocket. For a report on studies of the physiological responses of human beings to such stress as these men may undergo, see page 1.

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