NAVAL RESEARCH REVIEWS

SEPTEMBER 1961

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH

ONR's Fifteenth Anniversary: 1946-1961

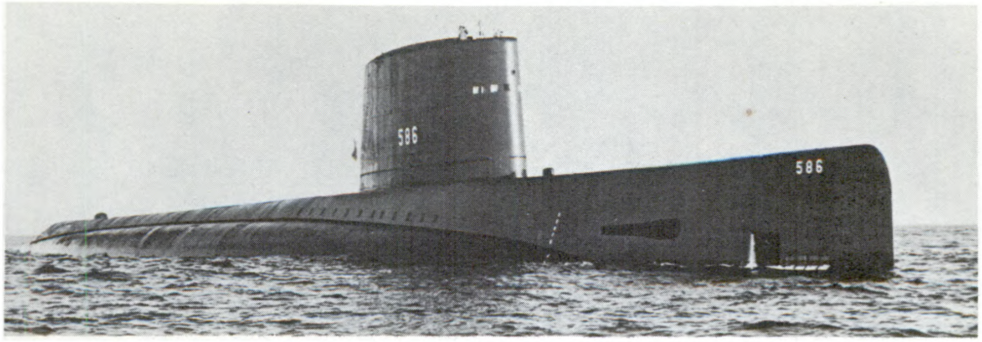
"You can take that thing home and worship it. It will not be idolatry, because it is the likeness of nothing in heaven above, in the earth beneath, or in the water under the earth." With such words were John Ericcson and his model of the MONITOR dismissed from a Navy Department office in 1861. Fortunately for America, SecNav Gideon Welles was a man who did not shudder at a new idea. Ericcson was recalled, and within a few months the most revolutionary naval development of the Nineteenth Century became a reality. But it was a chancy thing.

Three generations later, as the Second World War was drawing to a close, a far-sighted Admiral—H. G. Bowen—had a recurrent nightmare. His horror was that after the last gun had been fired U. S. Naval development would again be left to chance. As the Navy's Chief for Patents and Inventions, and as a former Director of the Naval Research Laboratory, he knew that the best weapons of modern warfare are forged in times of peace. So he threw all his energy and determination and influence into the creation of a powerful agency that would see to it that scientific research would be continued in the post-war Navy. His efforts were rewarded, in October 1945, by an Executive Order establishing the Office of Research and Inventions. By Act of Congress, effective 1 August 1946, the agency was given permanent status and redesignated Office of Naval Research—with VADM Bowen as first Chief.

Of course, the Navy has had the help of civilian scientific groups before. Examples are the Ironclad Board of Civil War days and the Office of Scientific Research and Development of World War II. But these were ad hoc bodies that went out of business as soon as the danger was past. Or, like the Naval Consulting Board of World War I and the present Naval Research Advisory Committee, their function was limited to bird-dogging and giving advice.

ONR has, from its inception, been much more; it has had bureau-level authority within the Navy, and it has had a deal of money to spend. It has thus been able to stimulate and support research, outside and within the Service, in any line that showed promise of adding to America's store of technical knowledge. Particularly, ONR has not had to limit itself to research or development that would result in immediately forseeable naval use. It has been able to sponsor research in higher mathematics, in chemical theory, in abstract biology, in upper atmosphere research, and in radio astronomy. By providing support for all disciplines of science, after the opulent wartime scientific agencies terminated their contracts, ONR has made it possible for colleges and universities and nonprofit laboratories to retain thousands of young men and women who otherwise would have had to turn their energies to developing better soaps, or television circuits, or automobiles. Concurrently, ONR's financial aid has permitted basic and applied research to become more and more prominent in the Navy's own laboratories.

These, we believe, are ONR's larger contributions to the Nation's defense effort and to its industry, far overshadowing the specific achievements and occasional "breakthroughs" noted from month to month in this magazine.—The Editor



Oceanography Aboard the TRITON

M. Smalet, N. Mabry, and G. Wilkes
U. S. Navy Hydrographic Office
Washington, D. C.

In February 1960, the Hydrographic Office was presented with a unique opportunity for a trio of scientists to conduct coordinated research in geophysics and oceanography. The Commander of the nuclear submarine TRITON, had chosen, as a shakedown cruise, to make an epochal circumnavigation of the globe while submerged (Figure 1). Inasmuch as this circumnavigation would provide the means of obtaining continuous data profiles through many relatively untraveled and unknown areas, the Hydrographic Office hastened to install on board equipment for oceanographic, bathymetric, and geophysical surveys.

The development of the modern submarine has emphasized the general lack of knowledge concerning the submarine environment, the ocean. To utilize fully the speed, range, and unlimited submersion capability of the new ships, techniques had to be developed whereby the submariners, by monitoring certain environmental factors, could determine and predict sea state and other oceanographic variables; further, they had to be able to navigate, or make corrections to inertial navigational and guidance devices. Much of this monitoring had been done, of course, by the Office during routine surveys. It remained, then, only to make modifications in existing instruments and techniques to adapt known principles to the special needs of the submerged submarine. In effect, the oceanographic, bathymetric, and gravimetric installations on board TRITON offered the use of extra "senses" while performing the normal surveying function.

The oceanographic installation enabled the technical staff to evaluate certain oceanographic conditions at varying depths under severe surface conditions without using the cumbersome winches and other pieces of oceanographic equipment required of surface ships. Some of the oceanographic variables measured directly were temperature, salinity, and surface waves. Additional equipment has since been developed to measure other oceanographic parameters from a submarine and to provide immediate data results for operational use.

A technique for measuring wave heights from below the surface, by an inverted fathometer, was tried and was completely successful.

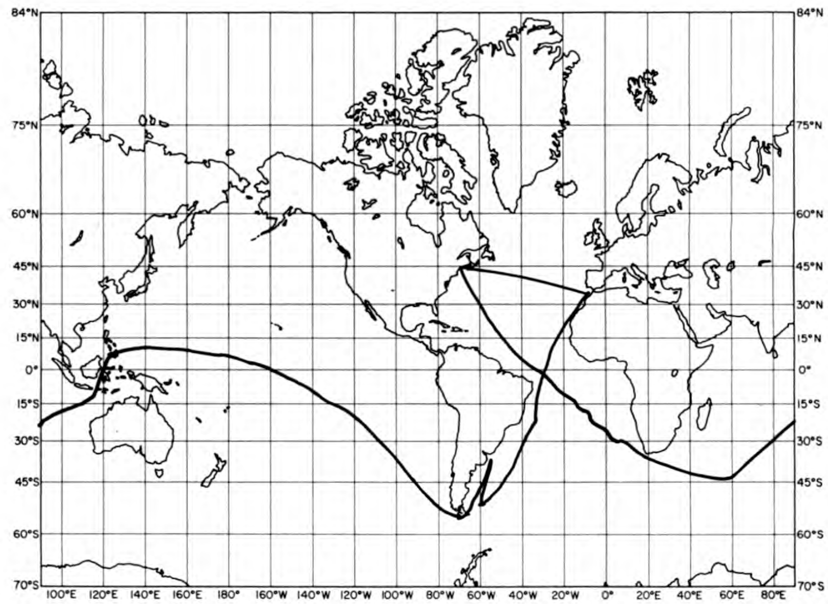


Figure 1 - The course of the 1960 epochal shakedown cruise of the nuclear submarine TRITON that followed approximately Magellan's route. The entire cruise, accomplished submerged, took almost 85 days; the circumnavigation portion took almost 61 days.

An EDO fathometer transducer with a 12-degree beam width was installed on top of the sail, pointing upward. This arrangement had proved very successful for under-ice work during previous submarine cruises in the Arctic, so the idea was applied to the TRITON's special need for determining wave conditions without surfacing. While crossing the Indian Ocean during a heavy storm, the EDO record indicated surface waves approximately 20 feet in height (Figure 2); however, at TRITON's keel depth of 300 feet, scarcely any motion was noted. Nevertheless, such surface conditions would have precluded certain operational phases, and the fact that measurements of the oceanic environment can be made under such conditions is of considerable value. On-the-spot comparisons of visual (through periscope) and machine-recorded wave heights were essentially in agreement. Later on, the EDO records were analyzed at the Hydrographic Office by means of power spectra and from these data statistical wave heights were derived.

The water temperature was measured by a Foxboro temperature probe installed in the leading edge of the sail. The data were recorded on a 24-hour circular Foxboro chart which maintained a continuous analog record of temperature for the entire cruise. Because induction water temperature was also monitored at the keel, the presence of temperature strata could be noted immediately. Vertical water samples were taken periodically during the voyage by diving to selected depths and pausing long enough to draw the sample and to note the temperature. The water samples have since been analyzed at the Hydrographic Office by salinometer.

Water temperature and salinity measurements are useful in determining the sound velocity, sound-ray paths, and density of the water and to differentiate between water masses. Variations of temperature and density determine general oceanic movements which, in turn, affect the stability characteristics of the submarine. Data acquired during the TRITON cruise were incorporated into the mass of general oceanographic data which, through statistical analysis, are used to predict sea conditions that probably will be encountered at any place, at any time. Variations from these probable norms can be measured and evaluated by the operating submarine, and the submarine's tactical operations can be modified accordingly.

The oceanographic instrumentation aboard TRITON was partially experimental. Since then, the instrumentation has been developed and packaged as shown in Figures 3a and 3b. Direct measurements of temperature, sound velocity, waves, and depth are automatically recorded on a digital tape along with position and time. The tape can then be fed into a computer for electronic analysis. This installation records, locates, and converts the data into dimensional units automatically and permits instant use of the data.

The TRITON cruise offered an equally significant opportunity to make around-the-world gravity measurements. Scientists have known since 1849 that the earth's exact shape could be computed from many gravity measurements taken from all parts of the earth, including the oceans. But, until recently they have had neither adequate instruments nor a vital need for the information. Today, however, the exact shape of the earth must be known to direct our missiles, satellites, and inertial guidance systems. The Hydrographic Office is charged with the responsibility for obtaining the gravimetric data required in the ocean areas and for developing and/or acquiring the instruments necessary to do the job. From 1923 to 1956, an instrument called the Vening Meinesz pendulum was the only one available for obtaining gravity measurements at sea. Although accurate, this instrument was completely inadequate for the immense task of taking large gravimetric surveys of the oceans. Then in 1956, an improved meter, the LaCoste and Romberg submarine gravity meter, was developed. This original meter has since been modified to the point where it is now possible to obtain continuous gravity profiles aboard submarines or surface ships (Figure 4). The

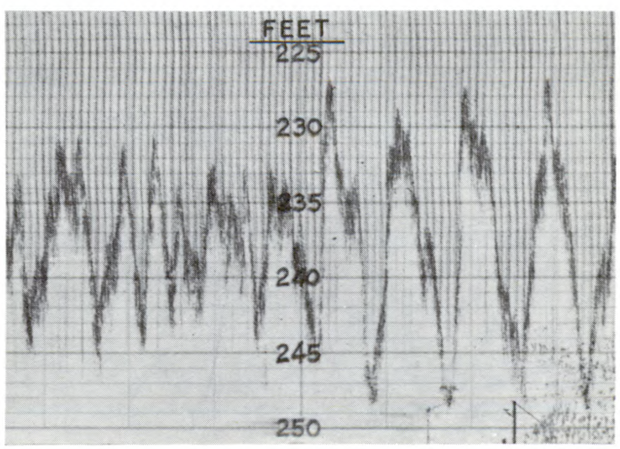


Figure 2 - An inverted EDO fathometer transducer was used to record wave heights from the TRITON. This portion of a tracing, taken in the Indian Ocean, shows waves over 20 feet from peak to trough.

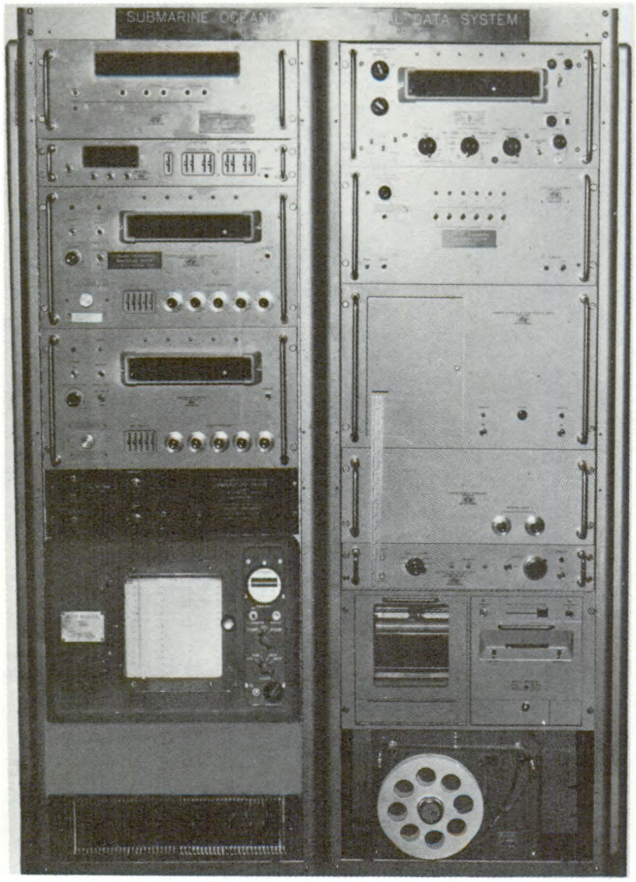
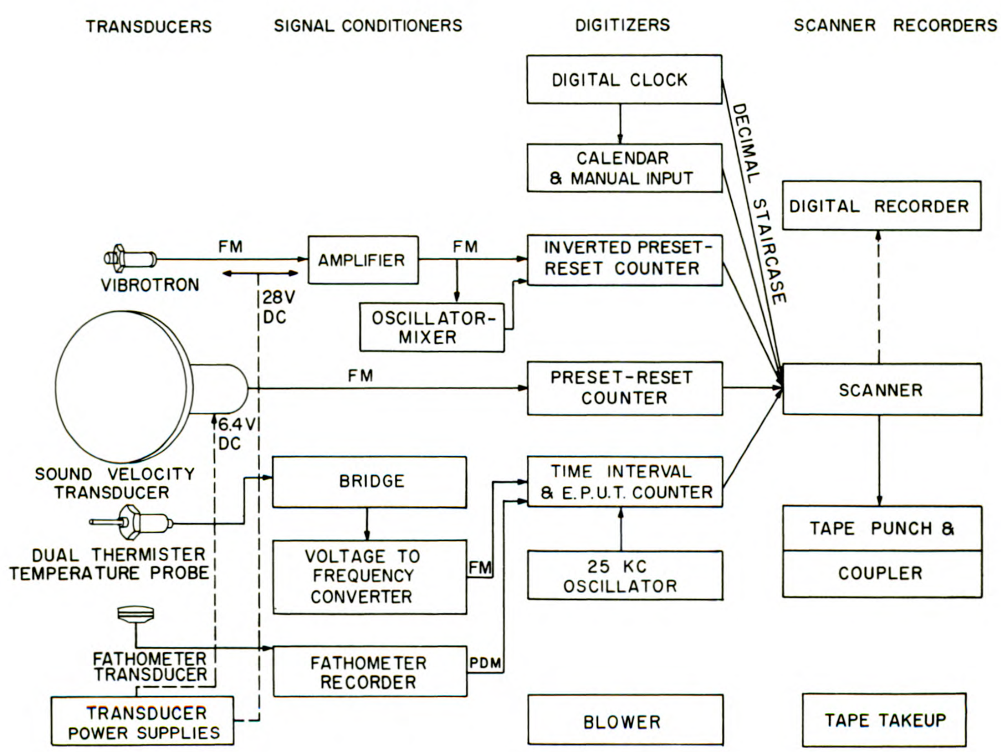


Figure 3a - (Left) Assembled submarine oceanographic digital data system presently aboard submarines. This system automatically records ocean temperature, sound velocity, waves, and depth.

Figure 3b - (Below) Block diagram of individual components of above system.



gravity meter that was installed on board the TRITON is a LaCoste and Romberg model that was developed for the purpose by the Hydrographic Office.

To date, this type of meter is the only one in the world capable of obtaining accurate gravimetric data under varying degrees of motion at sea without the use of a stable platform. The ship's motions are transmitted to the meter where they are undistinguishable from the motions produced by gravity variations; hence, the ship's motions must be monitored and applied to the observed gravity. This is accomplished automatically through the use of very sensitive accelerometers, which also provide an accurate record of the horizontal and vertical motions of the submarine as a by-product. Such motions are of interest in the tactical employment of the modern submarine.

In addition to obtaining the gravimetric data required for geodetic and geological purposes (and indirectly for military guidance systems), the gravity meter can be used in other ways that are directly applicable to the problems of a modern submarine. For one, the meter could be used as a navigation instrument when the ship is traversing a previously surveyed area, since the gravimetric features of the earth are probably more unique than topographic features. Furthermore, the gravity meter not only is sufficiently accurate in repeatability to reproduce gravimetric features but also can easily detect changes in the proximity and density of the underlying material. This meter could also provide an added safety factor in silent, submerged sailing, since it can passively note

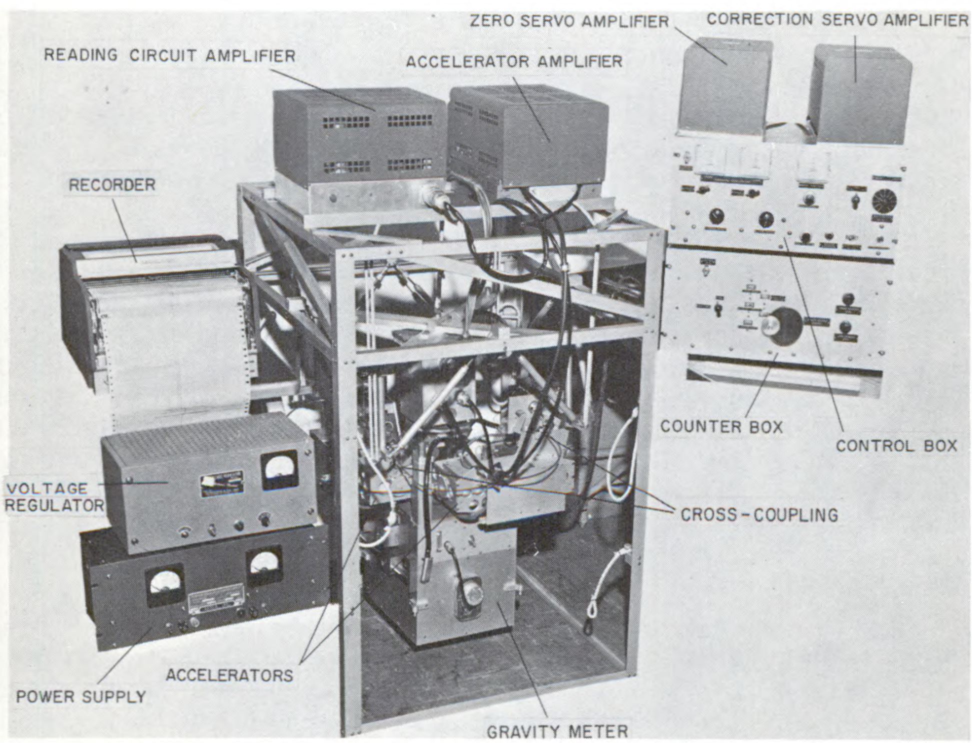


Figure 4 - Latest model of the LaCoste and Romberg submarine gravity meter, (essentially the same as the one used on the TRITON).

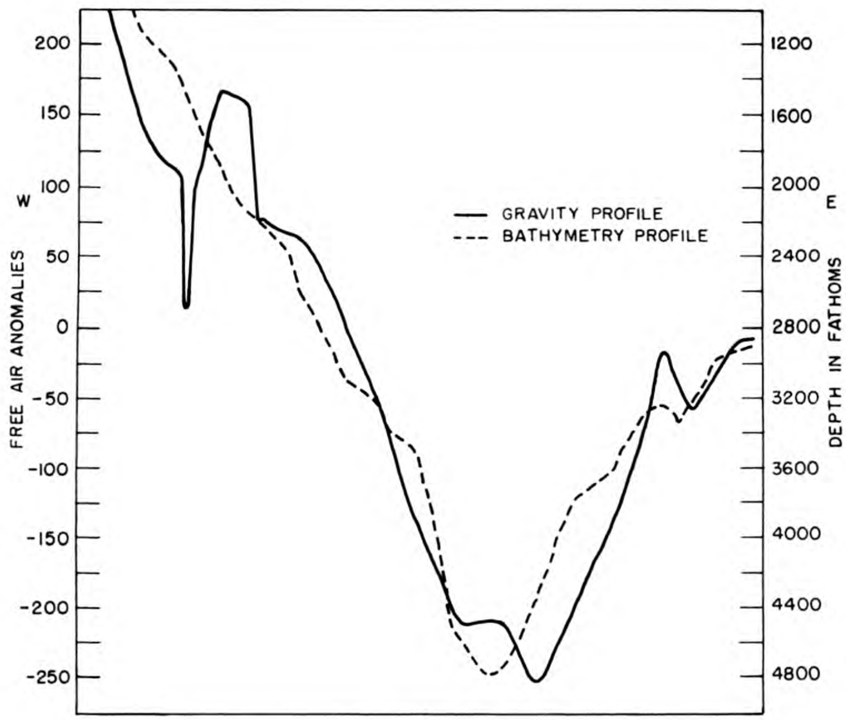


Figure 5 - Profiles taken across the Marianas Trench from Lat. 13 41.5 N, Long. 145 .08 E to Lat. 13 40.5 N to Long. 148 .05 E. The large dip in the gravity profile on the left indicates a volcanic structure in the southeast edge of the Trench.

unusual departures from regional normal bottom conditions, such as seamounts and submarine ridges. It is realized, however, that the gravity meter can never replace standard echo-sounding equipment.

The TRITON cruise was unique in that it provided the first continuous, round-the-world gravity profile recorded from a submerged platform. The track, in addition to traversing much new territory, passed through several previously surveyed areas and over many regions of unusual geological interest. For example, the profiles in Figure 5 are the result of measurements made while transiting the Marianas Trench. The rather sudden dip in the gravity profile at the left indicates a definite volcanic structure in the southeast edge of the Trench. Although such information is of considerable interest to the marine geologist or geophysicist, the data are of even greater significance to submariners because such radical departures from gravimetric norms have a marked effect on inertial guidance systems.

Bathymetric data taken during the cruise were obtained with a Precision Depth Recorder Mark V. This instrument, used by Hydrographic Office personnel for all ocean surveys, is capable of obtaining a continuous profile of the sea floor within an accuracy of one fathom. Soundings are made as frequently as one per second.

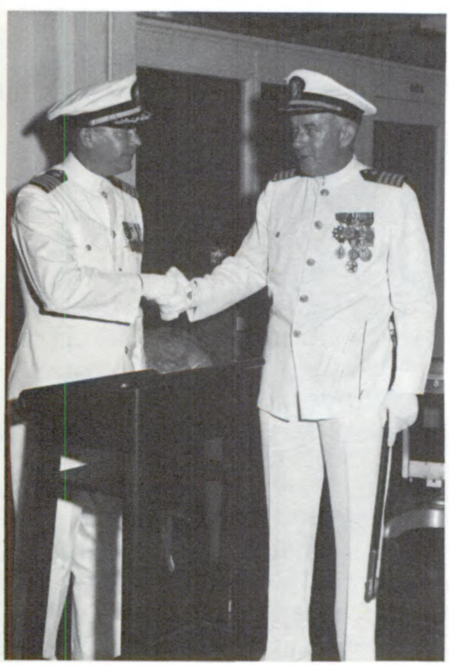
The primary application of bathymetric data is for the maintenance and preparation of bathymetric charts. However, the data can provide considerable information of a geological nature and, when combined with gravimetric surveys, can be used for extrapolating gravimetric data for short distances beyond the limits of the survey. Various tests indicate that the PDR can be used to good advantage as a navigation instrument as well. A technical report incorporating the techniques used and the interpretation of all data obtained on the TRITON cruise will be prepared and published in the near future.

The historic voyage of the TRITON was more than a unique shakedown cruise. It proved that a nuclear submarine is indeed an admirable ship type for scientific studies of the seas.

Changes of Command

The Office of Naval Research Branch Offices in New York, Boston, and San Francisco have all had recent changes of command:

- CAPT C. W. Heywood, USN, assumed duty at the New York Office relieving CAPT H. S. Knerr, USN.
- The Boston Office is now under the command of CAPT W. C. Hilgedick, USN, who relieved CAPT G. K. Williams.
- The San Francisco Office's new commander is CAPT F. D. Kellogg, USN. He relieved CAPT R. B. McLaughlin, USN.



CAPT Hilgedick (left) relieves CAPT Williams at ONR-Boston.

CAPT Kellogg, new CO of ONR-San Francisco, enters a P2V-7 Weapons System Trainer during a recent tour of the NAS, Alameda, Calif. His host was CDR J. I. Leonard (right) CO of Det. 1, Fleet Airborne Elect. Trng. Unit, Pac.

The Ceramics Program of ONR

Cyrus Klingsberg
Office of Naval Research

The word "ceramics" to many people is still a substitute for the word "pottery." This connotation is much too narrow and reflects the fact that the science of ceramics had its origin in an art form. We are all familiar with the vases, ash trays, and knick knacks that decorate our homes. On a larger scale, ceramic frescoes are used to decorate buildings. Ceramics, however, is also a technology, and in this sense ceramic materials surround us everywhere: window panes, common brick, firebrick, sewer pipe, bathroom fixtures, glass bottles, and electrical insulators, as well as the inevitable pottery.

About the time of World War II, science made great demands upon this technology. Suddenly it became necessary to provide sophisticated materials for highly specific physical uses. Memory cores and switching devices for electronic circuitry of the sort found in computers, windows for ultraviolet and infrared transmitting equipment, energy-conversion devices, and semiconductors of specific characteristics were all demanded of the ceramist. Also military applications such as radomes, nose cones, and rocket nozzles created new requirements for these high-temperature materials (Figure 1).

As the art progressed to the technology and then to the science of ceramics, the definition of the subject had to keep pace. A suitably broad definition for today's purposes might be: "Ceramics is the study of nonmetallic inorganic materials which are prepared at high temperatures or have their primary use at high temperature." High temperature for this purpose is about 500°C. The expression "ionic solid" is sometimes used as an abbreviated definition of ceramic materials, but here the intention is more to discriminate between metals and plastics than to describe accurately the material in question.

ONR RESEARCH PROGRAMS

The immediate goal of the ONR program is to improve the <u>understanding</u> of the behavior of ceramic materials by supporting basic research in this area. To this end, the two most important criteria that have to be satisfied before a research proposal is accepted into this program are these: First, the individual research task should direct itself to the relationship of structure to properties; which structures and which properties? They may be micro, macro, or submicro, chemical or physical. There is no vested interest on this point so this decision is left to the prospective investigator, thereby allowing him to propose research in the area of his particular competence. The second criterion is that the work be generic. That is, the research should be of such a nature that it can be treated as a model study. When this point is satisfied, then a greater long range effect may be obtained from our research dollars. For example, one contractor is studying cation and anion diffusion in single crystals of lead sulfide. We are not specifically interested in lead sulfide, but to the extent that this research increases our knowledge of diffusion, and particularly diffusion in a particular structure (in this case the rock salt structure) under controlled chemical conditions, this work can be supported enthusiastically. Also, and this is not a criterion, most of our support goes to universities. This means that in addition to the research performed, the education of innumerable graduate students becomes our most important by-product. In addition to diffusion studies, there are many other research areas that are supported as well. The following are typical:

- The mechanisms and kinetics of sintering or densification in oxide systems.

- Attempts at synthesizing new minerals at high temperatures and pressure, to determine the structures and properties of these materials and the conditions under which phase transformations may be induced by the application of heat and pressure. Also under study are the crystal-chemical relationships and phase equilibria which exist at high temperatures and pressures.

- Techniques for growing single crystals having high melting points, and the study of factors which influence the structural perfection, stoichiometry, and purity of the resulting crystals.

- The theoretical and experimental thermoelectric behavior of ionic crystals.

- The constitution or structural chemistry of glasses by nuclear magnetic resonance, and the relationships between the structure and physical properties of glass.

CERAMIC MATERIALS

Ceramic materials fall into three major chemical groups: oxides, graphites, and intermetallics (borides, carbides, nitrides, silicides, and beryllides). Each group has its own physical and chemical characteristics and therefore its own area of useful application.

The oxides include almost all useful glasses as well as most crystalline bodies. More is known about the preparation and behavior

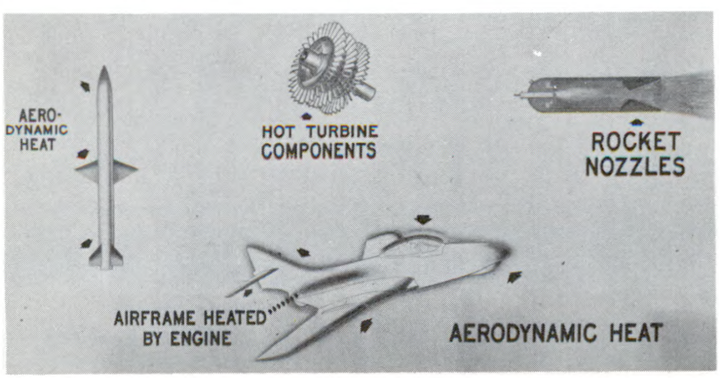


Figure 1 - Modern propulsion technology demands ever-increasing operating temperatures. Arrows indicate areas of particular heat buildup.

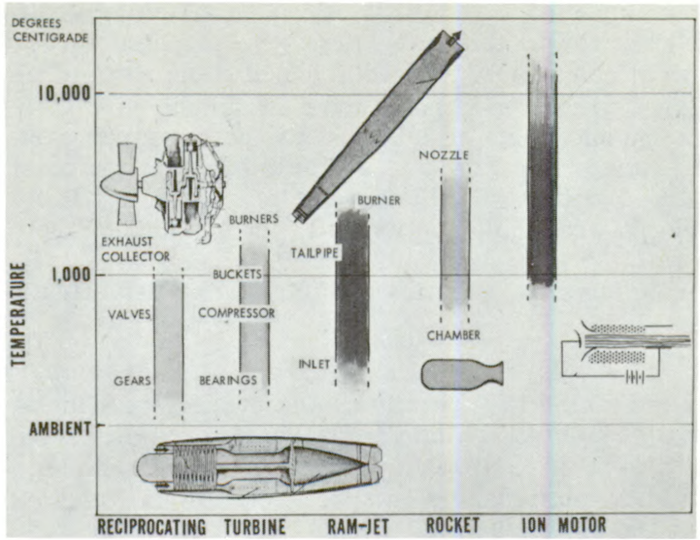


Figure 2 - Temperature regimes of propulsion devices showing a few of the areas which require protection from high temperatures.

of oxides than other ceramic materials and this in itself tends to guarantee their usefulness. They have high melting points and by their very nature are the most oxidation-resistant materials known.

Interest in graphite grows as continued research indicates an ever greater potential for high temperature applications. An outstanding feature of this material is the way its physical and chemical properties differ in different directions (anisotropy). This means that it may be possible to "tailor make" desirable properties in graphite.

In the intermetallic group, the carbides of tantalum, hafnium, and zirconium have some of the highest known melting points (close to 4000° C). The borides are highly refractory, hard, strong, and unusually oxidation-resistant for non-oxides, thus offering some promise as structural members for high-temperature applications. Unfortunately they are very brittle—as are other intermetallics—so their usefulness at the present time is limited.

THE BRITTLENESS OF CERAMIC MATERIALS

In their traditional role as thermal insulators, ceramics have easily satisfied the demands of mechanical strength. For instance, firebricks laid one upon another never created a compressive load severe enough to become a major problem. But now, with missile technology upon us, we not only have the problem of ever-increasing temperatures (Figure 2) but also the constant demand that insulators bear an increasing share of the overall stresses and strains that develop in the adverse environments associated with space flight. Fully half of the ONR ceramics program is directed toward the improved understanding of the brittle behavior of ceramic materials, since we believe the major shortcoming of ceramics today is their inability to serve as high-temperature structural materials.

Most metals, because of their ability to deform by plastic flow before breaking (ductility), make good structural materials. This feature provides a built-in mechanism that reduces stress from such sources as scratches, impacts, or thermal shocks. On the other hand, when a brittle material, such as a ceramic, fails, it does so suddenly, in a catastrophic manner. Obviously then, brittle materials are less desirable as structural members.

If enough can be learned about how cracks form and propagate, perhaps in time ceramic structural members will be fabricated. If so, we would then be able to extend our competence with materials into thermal environments where even metals fail. The most reliable service ceramics provide today is in the form of coatings on metallic substrates; the ductile metal provides structural reliability and the oxide coating protects the metal, not only from high surrounding temperatures but also from oxidation as well.

It has been in the tradition of the ceramist to accept the brittle nature of ceramics as an insurmountable obstacle. However, the dislocation theory, which has been successful in explaining the behavior of metals under stress, is now being applied to the more complicated problems of ceramics. This theory states that stresses upon a material cause its atoms to slip along a line or a plane, thus creating imperfections (dislocations). Groups of these imperfections can pile up at certain inherent barriers within the material and this, in turn, causes local tensile stresses to build up. When these stresses pass the breaking point, a microscopic crack develops. Once formed, a crack nucleus can grow by the addition of dislocations (dislocations move under an applied stress) until the crack reaches the size of a grain diameter. Upon reaching this critical size, further growth of the crack no longer depends upon the addition of dislocations and a catastrophic failure may suddenly result. Predictions based on this theory are, in fact, in good agreement with experimental results.

Ceramic materials offer the researcher in this field an added attraction, in a sense. They are normally transparent so that researchers can use optical methods, such as transmitted polarized light microscopy, to investigate internal phenomena. This particular approach has been denied the investigator of metals, which are characteristically opaque. We are hopeful that, in the next decade, the application of the dislocation theory to ceramic problems will be as rewarding as it has been in the past for metallurgy.

"Out of House" History of ONR

A thoughtful, highly readable history of the evolution of the Office of Naval Research, by several officer-scientists who took part in the founding, appears in the August issue of "Physics Today."

ARLIS II: New Arctic Drift Station

Leonard A. LeSchack, LTJG, USNR
Geography Branch
Office of Naval Research

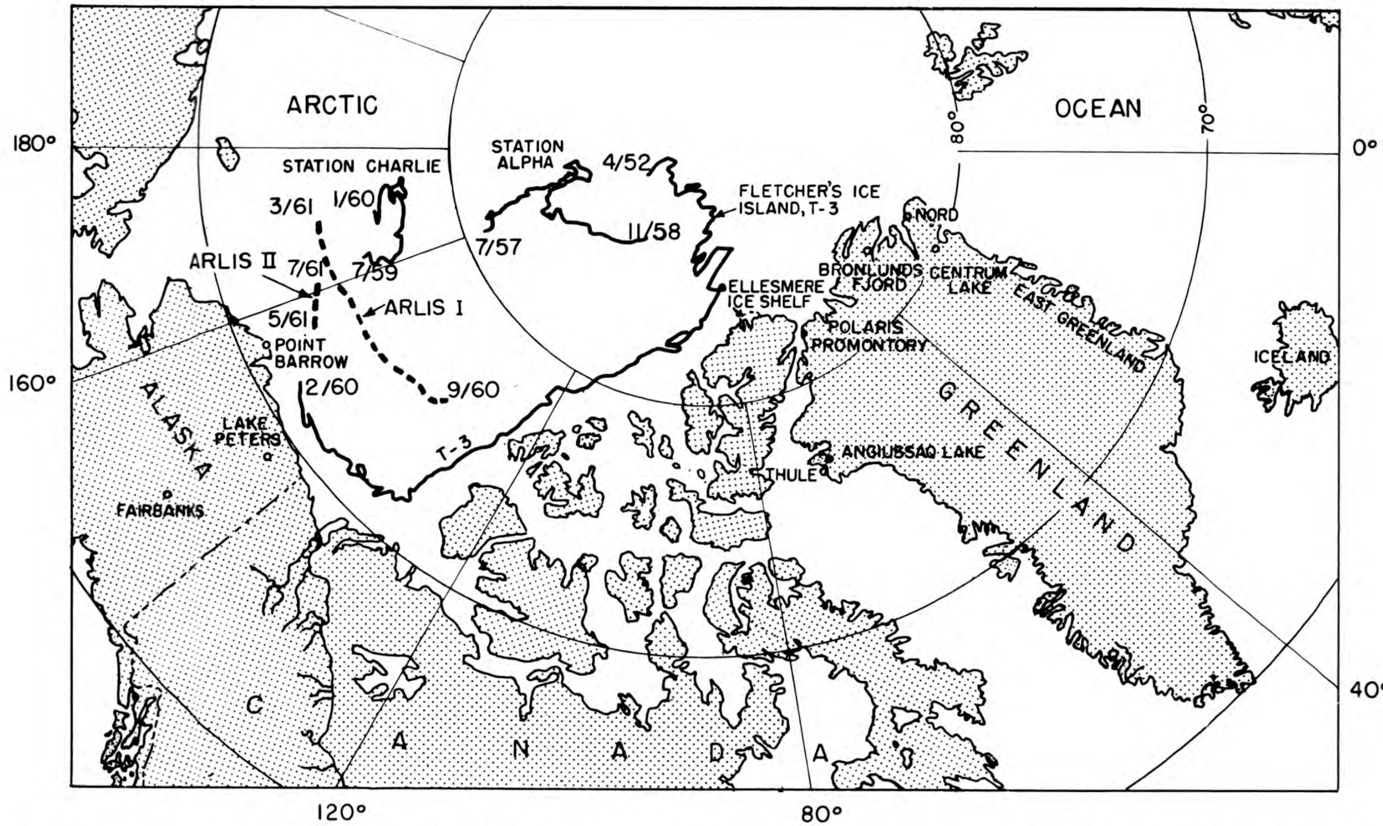
There are no land islands in the central Arctic Ocean. Many flights over this ocean attest to this fact. Yet Admiral Robert E. Peary, on his famous sledge trip in 1906 toward the pole, wrote in his notes that he saw enroute, "snow-clad mountains of a distant land." And Frederic Cook, in 1908, during his sledge trip in the same area, noted that between 87°and 88°N he crossed over old ice that did not have the characteristic pressure lines or hummocks of sea ice. He could not determine whether he was on land ice or sea ice. The Soviets, too, noted islands in the Beaufort and Lincoln Seas, and in 1931 "Takpuk Island" in the Beaufort Sea was "discovered," examined, and photographed by Eskimos. None of these lands has ever been seen again.

These reports have puzzled polar scientists for a long time, for certainly these men must have seen something. It is true that mirages are possible in these regions and images of mountains can often be seen for many miles beyond the line of sight owing to the refraction of light in the cold air. Is this the whole answer? Probably not. A more complete answer to these "discoveries" may now be at hand.

ICE ISLAND ARLIS II

ARLIS II (Arctic Laboratory Ice Station II), a massive island of thick, fresh-water (glacial) ice covered in many places with large piles of glacial debris, was recently discovered (or perhaps rediscovered) drifting with the surrounding pack ice about 130 statute miles north of Pt. Barrow, Alaska. This 3.5 by 1.5 mile ice island with its piles of rocks and boulders looks, even to the most discerning observer, remarkably like a snow-covered land mass. Its gently rolling topography, similar to a snow-covered meadow, differs markedly from the surrounding characteristic pack ice, whose perfectly flat surfaces alternate with thin, jumbled, blocky, broken ice. From "dunes" of glacial debris, the ARLIS II ice slopes gently, like a seashore, until it reaches the pack ice "ocean." This results in broad expanses of "beach" which are seen along many parts of the island. Elsewhere on the island is a more rugged coastline where blocks of sea ice are either pushed up on the shore or butt up against it, forming pressure ridges. At still another point, a river, muddy with glacial silt and pebbles, cascades off the edge of the island to the pack. It was frozen, snap-shot still, in late May, although during the summer melt season it is a torrent. The piles of glacial debris, ranging from large boulders to fine silt, probably represent a terminal morraine that was originally deposited on some ice shelf in the Canadian North. These rock piles look very much like mountains, owing to the faulty depth perception and lack of perspective which so commonly afflict observers in polar areas.

Early explorers might well have been deceived into believing such an ice island was a true land mass. It is now suspected that Peary,



Routes taken by the five drifting U. S. manned ice stations with the dates of the routes. T-3 and ARLIS-II are true ice islands of thick, fresh-water (glacial) ice. The others were thinner, ice-floe ice and have since been abandoned.

Cook, and others actually did see ice islands on their expeditions. Furthermore, it is not inconceivable that ARLIS II was among them. The drift pattern of ice in the Arctic Ocean could easily explain why an ice island seen at one point could be a thousand miles away some years later. The thickness of ARLIS II, about 80 feet, makes it quite durable and it could have been adrift for a century.

THE DISCOVERY

The Navy's Arctic Research Laboratory at Barrow, Alaska, in support of its continuing Arctic Ocean research program, had made all the final preparations for setting up its second Arctic Ocean drift station by airlift. Several reconnaissance flights had been made over the pack ice north of Pt. Barrow during May 1961, and a tentative area had been chosen for the site of a scientific station. This station was to be built on an ice floe in the same fashion as its predecessor, ARLIS I (see NavResRev, December 1960, pp. 1-4). On 23 May, the Laboratory's airlift team was ready. The Lab's two Cessna 180's and a new R4D, loaded down with enough equipment to set up a preliminary station, took off from the Barrow air strip. The R4D carried all the sections for two prefabricated buildings, a Coleman stove, ample supplies of fuel oil, a 110-V generator, radio equipment including a homer beacon, and enough rations for several weeks.

Enroute to the selected area, Max Brewer, Director of the Arctic Research Laboratory and Robert Fischer, the Lab's chief pilot, flying in one of the Cessna 180's, suddenly saw anamolous dark patches on the ice below. While the other two planes began circling, Fischer flew down to take a closer look. After they had circled many times over the area, it became apparent that the dark patches were piles of rocks and boulders. Years of experience in arctic flying enabled these men to ascertain from the slight differences in ice surfaces and in ice elevation, that this area was, in fact, an ice island.

This discovery is of major significance to the Arctic Ocean research effort. An ice island, as differentiated from ice floes or pack ice, has permanence. Since ice islands have broken off from thick shelf ice, presumably near Ellsmere Island in the Canadian Archipelago, they have considerable thickness compared with floe ice. After having broken off from a shelf area, the island gets caught in the constantly moving, melting, refreezing and breaking pack ice, and yet is thick and strong enough to remain intact. Thus, if a research station is to be set up on ice, it is much better to have an island which is essentially permanent, than a floe which is liable to break up. Ice islands, however, are scarce; only a few of them have been seen during arctic flights in the past fifteen years. The Air Force's "T-3" (Fletcher's Ice Island) is the only other such island which has been utilized by the United States for a research station, and it is now aground off Pt. Barrow, virtually abandoned.

Mr. Brewer, well aware of the value of this discovery, decided to alter the original plan and attempt to set up a station on the island. Realizing that the planes were rapidly using up their fuel in just circling over the area, Fischer made three trial landings, two on the island and one on the adjacent pack ice. While on the island, Fischer chose a suitable area for the R4D to land, and within a few minutes the heavily laden plane came in, followed by the other Cessna 180. Two buildings were quickly erected, a generator set up, and the radio set and homer beacon connected. With a base established, the R4D returned to Barrow to start the airlift. In the 22 days required to complete the station, 146,100 pounds of equipment and materials were airlifted to ARLIS II, in a total of 28 flights by the R4D and 41 flights by the Cessna 180's. The complete station consists of fourteen 12 by 16-foot prefabricated buildings which house all the scientific equipment, and sleeping and messing facilities for personnel. In the summer group there are eleven scientists, and four ARL employees who do the cooking and maintenance.

RESEARCH ABOARD ARLIS II

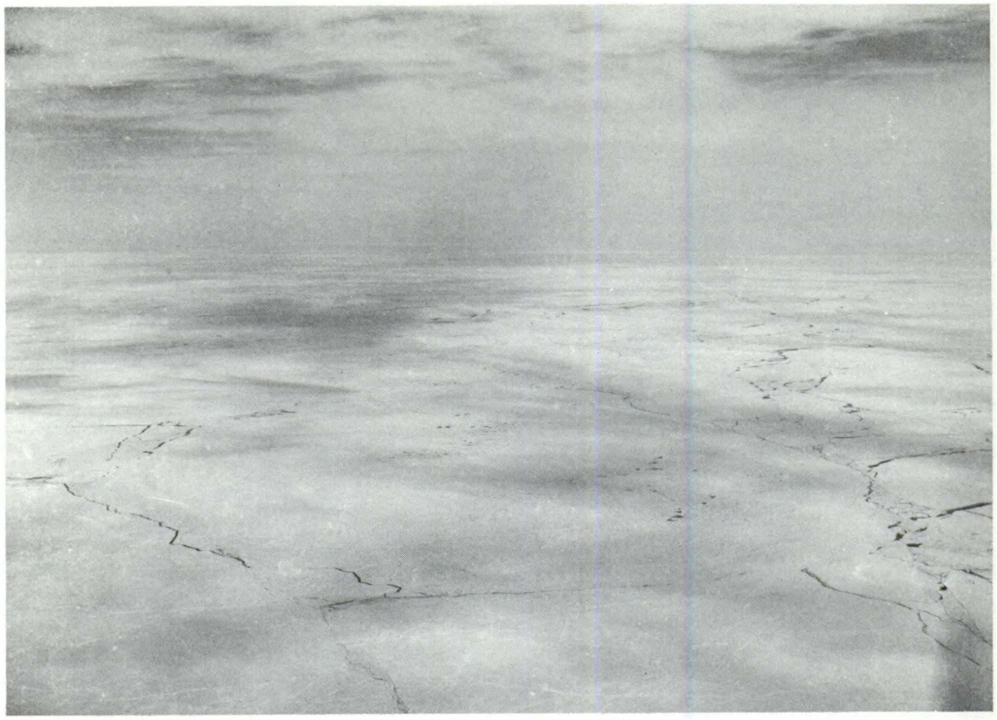
One may speculate about the origin and the destiny of these islands, but the fact remains that, to date, they offer the only stable platforms from which an Arctic Ocean environmental research program may be conducted.

The Arctic Research Laboratory has developed the capability for setting up and supplying this type of research station by aircraft. The research programs are equipped and manned by various universities under contract with the Office of Naval Research and by other government agencies from time to time. Within the capabilities of the Laboratory, a camp is designed to accommodate the individual programs. The buildings, although all the same size, are configured differently inside as to desk, laboratory and special sleeping space, machinery, and the like, since each research study has its own special requirements.

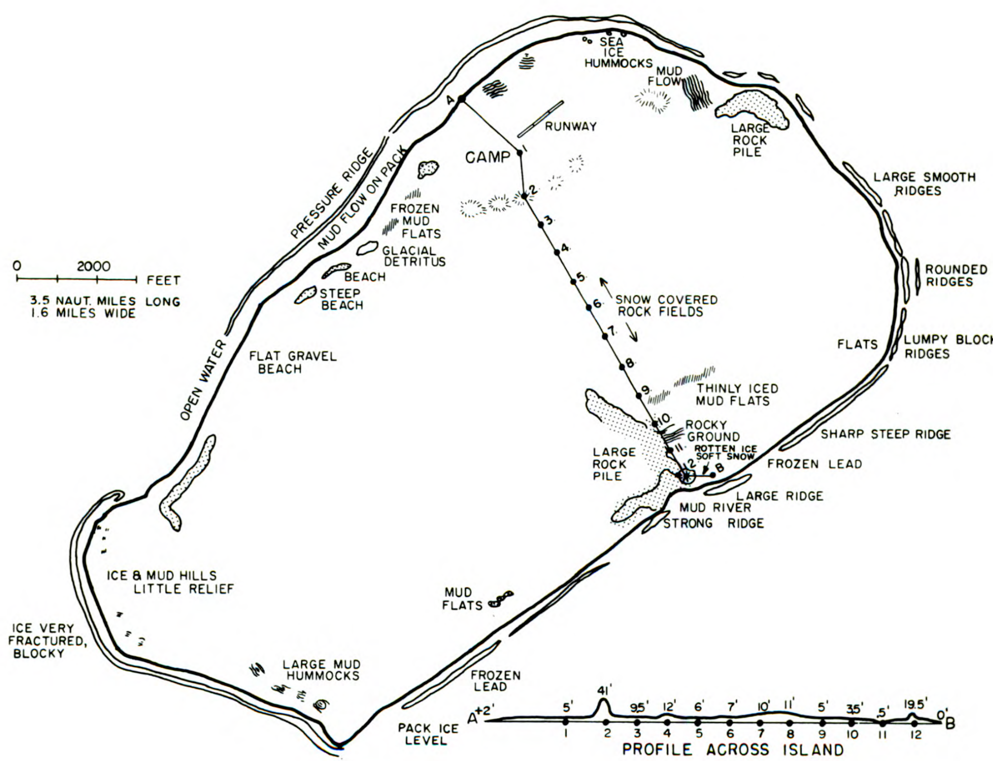
ARLIS II PROGRAMS

During the summer of 1961, the following research programs will be in progress:

1. <u>Underwater Acoustic Studies</u>	
Henry Kutschale	Lamont Geological Observatory
2. <u>Marine Biology</u>	
Donald Robinson	University of Southern California
3. <u>Oceanography</u>	
John Cooper	University of Washington
John Linhart	Arctic Research Laboratory
4. <u>Geology of the Ice Island</u>	
Dr. David Smith	Louisiana State University
Lynn Schraeder	Arctic Research Laboratory
5. <u>Geophysics</u>	
Stephen DenHartog	University of Wisconsin
6. <u>Gravity - Microbarograph</u>	
William McComas	U. S. Navy Hydrographic Office
7. <u>Sea Ice Micrometeorology</u>	
Arnold Hanson	University of Washington
Charles Cooke	Arctic Research Laboratory
8. <u>Strain Measurement on Pack Ice</u>	
Thomas Garrett, AG-1, USN	U. S. Navy Hydrographic Office
William McComas	U. S. Navy Hydrographic Office



Above: Aerial oblique of ice island ARLIS-II taken in May 1961 from 5000 feet. Glacial debris dot the island. Below: Map of ARLIS-II drawn by the author.



Scenes on ARLIS-II. Top: Crew unloading R4D supply plane and setting up camp in May 1961. Center: The completed camp in June 1961. Bottom: The summer melt season poses some problems not entirely unforeseen.

The ARLIS-II Support Group is composed of the following men from the Arctic Research Laboratory: John Beck, station leader; Carl Johnston, cook-baker; Frank Akpik, Mechanic; and Charles Edwardson, Jr., maintenance.

The station leader, John Beck, is directly responsible to the Director of ARL for the operation and safety of the ARLIS camp. Beck, a retired Navy Chief, has had much polar experience and is well suited for this work.

The summer group will remain on ARLIS II until later in September or early October when the ice strengthens sufficiently to allow safe aircraft landings. When they are taken off the ice island, others will continue their work; some programs will be added and others discontinued. It is expected that the station will be maintained on a year-round basis, and as the island drifts farther and farther north, new and unexplored ocean will be traversed and studied.

The drift-station concept has been developed to enable investigations of a continuous nature over this ice-covered ocean. Immediate drawbacks to this type of operation can be seen. Work space is limited, frequency and voltage of camp power fluctuates, plumbing is virtually nonexistent, and good shop facilities are not available. These drawbacks automatically limit the extent and sophistication of many projects, while others are eliminated completely. An obvious solution to these problems is to freeze a research ship, complete with labs, shops, storage spaces and all the convenience of shipboard living, into the pack-ice and allow it to drift through the Arctic Ocean. This idea is not new. Nansen froze his ship, the "FRAM," into this ice over sixty years ago. The ship drifted for three years with men aboard conducting research. Other examples could be cited.

Now, as a result of the drift-station experiences, the advantages of an ice-strengthened ship, frozen into the pack, become increasingly obvious. This, then, is the next step, although when it will occur is not certain. The Bureau of Ships, however, is now carrying out a study to ascertain the requirements that such a vessel would need in order to fulfill its mission. Until these plans become a reality, all the continuous programs in the Arctic Ocean will be carried out from drift stations similar to ARLIS II.

Small Ship's Range Extended

The cruising ranges of small naval vessels, such as minesweepers, have been increased as much as 15 percent through the use of collapsible rubber fuel-storage cells. In the past, small ships stored extra fuel in heavy, 50-gallon drums. The lighter weight of the rubber cells permits the storage of greater amounts of fuel.

Accelerating Cargo Ship* Port Turn-Around

Raymond P. Delrich

Director, San Francisco Office
Maritime Cargo Transportation Conference

ONR contract research in the San Francisco Bay Area is resulting in the development of revamped cargo handling methods which promise considerable improvement in production efficiency and costs as well as less time in port for U.S. merchant shipping. The research work described below is part of the San Francisco Port Study Project, initiated in 1957 by the Maritime Cargo Transportation Conference. This study is designed to identify the factors governing ship turnaround time in port, to analyze those factors, and to make the results available to management and labor. The project has been undertaken with the cooperation and endorsement of labor and management. Both are contributing information, advice, and constructive criticism to the work of the Conference.

A series of cargo-handling work-methods tests recently concluded in the San Francisco Bay Area promise to reduce the in-port time of merchant-type general cargo ships by as much as 30 percent. They also suggest that speedier, less costly, machine-operated handling methods will achieve manpower and dollar savings in the neighborhood of 20 percent. These are the conclusions of the staff of the San Francisco Port Project of the Maritime Cargo Transportation Conference. MCTC is a shipping operations research group of the National Academy of Sciences-National Research Council and is working under an Office of Naval Research contract with funds provided by the Maritime Administration and the Department of Defense.

The conclusions arose from an analysis of results of work performed at the Freight Terminal Department of the Navy's Oakland Supply Center. Here, the Civil Service longshoremen were employed in testing the effectiveness of about 70 streamlined methods for the loading of general cargo. The results were compared to the average productivity for loading the same commodities on the commercial waterfront of San Francisco.

PRELIMINARY WORK

The test program followed a one-year period of analyzing detailed data taken on commercial operations, with the close cooperation of both labor and management. From the analysis, the research staff hypothesized that, with a fairly simple redesign of cargo-handling methods, considerable improvement could be obtained. It appeared to be quite possible to make cargo-handling production more efficient by changing the task, varying the number of men assigned to perform various jobs, and introducing new equipment. Furthermore, this seemed to be possible without either imposing a "speed-up"—increased workload

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*Views expressed in this article are those of the author and not necessarily those of the MCTC, National Academy of Sciences, or U.S. Navy.

on the individual man—or increasing appreciably the amount of capital investment required to finance the new operation.

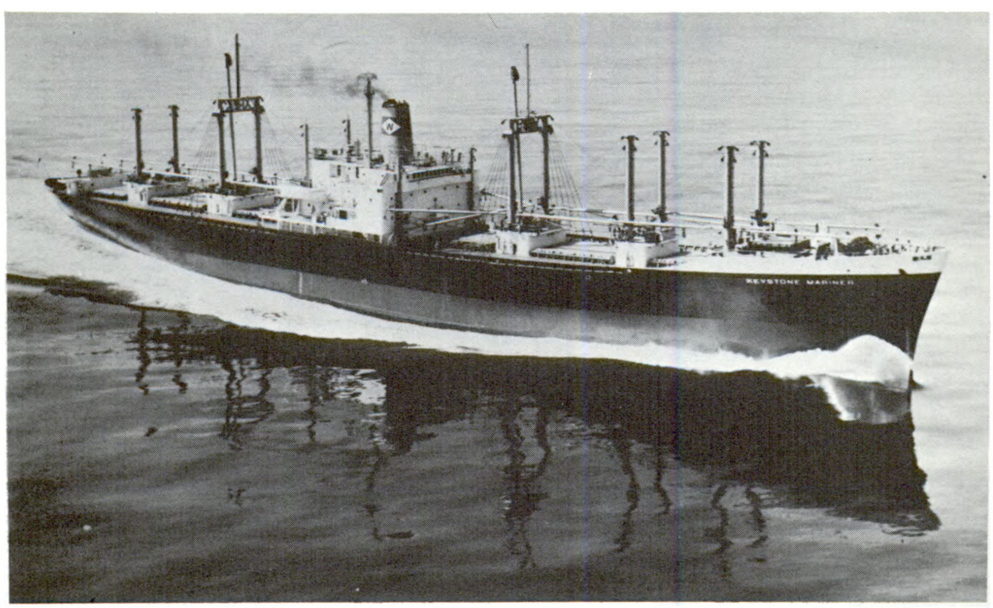
NEW METHODS DESIGNED

The researchers then set about the job of redesigning the cargo-handling systems for the many commodities which they had analyzed. Relying heavily upon the detailed time-activity data collected on the commercial waterfront, they were able to identify the peculiar handling characteristics of various commodities, the location and causes of various bottlenecks and delays to the operations, and the work-performance rates under various circumstances. Each new system was designed to overcome one or more of the many handling difficulties observed in the conventional methods. On paper, at least, the new systems were very attractive. Estimates of improvement ranged from 50 to 100 percent over the older systems.

The urge to test the new methods was overwhelming. So, as a next step, the staff sought the further assistance of port labor and management to permit them to do this. The researchers decided upon the Navy's Supply Center in Oakland, where the Civil Service longshoremen agreed to try out the new systems.

METHODS TESTED

Several experiments were held each week during the nine-month testing period. Although not all of the revised work methods paid off, most of them showed a positive advantage over the corresponding older methods. Upon conclusion of the tests, the data were studied to identify the principal causes of measured improvements. In some cases, an increased gang size accounted for the improvement. More frequently, however, the manner in which machinery was used in the process



A Mariner class dry cargo ship. (Photo courtesy U. S. Maritime Adm.)

A special cargo-handling task. Heavy-duty tackle, special dunnage, and a powerful fork-lift are required to load a massive steel ingot. (Photo courtesy U. S. Maritime Adm.)

triggered the production increases. Changes in the way of lining up the cargo at the work scene also favored the new methods.

PHYSIOLOGICAL MEASUREMENTS

In order to eliminate the possibility that improvement might be the result of "speed-up" of the individual workmen involved in the tests, industrial physiologists from the School of Engineering, UCLA collected energy-consumption data on selected longshoremen. They took data on both groups of workers—union and Civil Service—under normal working conditions, reconciled differences to the extent that they were reasonably certain that they were dealing with the same type of population and then compared these basic measures with the energy-expenditure data obtained during the work-methods tests. In almost all cases, the new work methods required individual energy equal to or less than that consumed under the old methods.

In addition to varying the number of workmen and types of equipment used in the various work methods so as to identify the best combination of men and machines, the researchers also experimented with rest periods. Data from cases where definite relief patterns could be established were compared with those cases where no relief was provided. All other controllable variables were held constant, including number of men working, type of materials-handling equipment used, cargo type, and stowage location. The data revealed no discernible differences in energy expenditure between those cases where planned relief was provided and where it was not. Furthermore, no significant or consistent differences in productivity could be identified between the two circumstances. Thus, it appears that the provision of definite relief patterns in longshore work will not necessarily result in reduced energy expenditure or increased productivity.

	Conventional Cost	Savings	Revised Cost
Total Direct Stevedoring Labor	$25,870		$21,320
Total Stevedoring Supervision	1,180		860
Equipment Operation	560		1,100
Extra Pallet Cost			60
Total Direct Stevedoring Costs	27,610		23,340
Direct Savings in Stevedoring		$ 4,270 (15%)	
Total Ship Costs in Port	21,330		15,180
Total Stevedoring & Ship Costs	48,940		38,520
Total Saving		$10,420 (21%)	

Table I - Cost Comparison Between Conventional & MCTC Methods of Loading a Transpacific Mariner in the San Francisco Bay Area.

The magnitude of production improvements measured by the Oakland tests seemed large. At the same time, however, it was recognized that these gains must be tested in the actual commercial environment for which they were devised. In addition, they must be combined into the total system rather than evaluated singly. Most ships carry hundreds of different items, requiring a variety of handling methods. Hence, it is necessary to evaluate the improvement potential of the test methods in combination with each other.

HYPOTHETICAL TURN-AROUND

In order to estimate this potential, the staff selected one ship which calls at the Bay Area and, ex post facto, applied test-program production rates to the commodities loaded aboard that ship. The ship selected was one of the newer Mariner type merchant ships engaging in the trans-Pacific trade. It has a speed of about 20 knots and about 73,000 cubic feet of cargo space distributed among seven hatches.

The time, manpower, and dollar savings resulting from the theoretical reloading of the ship in San Francisco were impressive. One and a half days of ship time in port were hypothetically saved out of the five actually taken, and three complete stevedore shifts were eliminated, totalling 1335 manhours of work. These time and manpower factors, translated into dollar savings, are shown on Table I. The theoretical net savings in dollars for the exercise were over $10,000.

This is the savings potential for one ship making one port call. To get an idea of the total savings possible, one should consider all the ports at which the ship will call during a year, as well as the other ships of the line which make similar port calls.

PRODUCTION MANAGEMENT REQUIRED

Since completion of the experimental work-methods tests at the Naval Supply Center in Oakland, the staff has been concentrating its attention on the management of cargo-handling operations at several commercial terminals in the Bay Area. This effort recognizes the fact that production increases and cost reductions in cargo handling may be possible through more systematic planning, control, and execution of the cargo-handling task by terminal, stevedore, and ship-operating management. During the tests, for example, it became apparent that the experimental work methods could achieve significant improvement results only when similar commodities were consolidated to permit long runs of those commodities. Short runs, requiring frequent changes of work methods—different equipment and changing manpower requirements—were unable to attain the maximum improvements because of the set-up and knock-down time required between shifts of methods. The set-up and knock-down times—of say a conveyor—on short runs frequently offset the savings in actual work time. In addition, it was found that manpower requirements frequently changed from one hatch to another during the work day, and these changes could, if not properly handled, leave some longshoremen idle. Hence, it appears that the planning of manpower utilization under these revised work methods must be modified to reduce to a minimum those circumstances where the number of men on the job will exceed those required during the workday.

Basically, the researchers are attempting to develop a method of total production planning for shipboard and terminal cargo operations. Production-control systems will also be developed in order to help managers and supervisors implement the plan. There is some optimism among members of the industry that the production planning and control system can achieve some production increases and cost reductions even without the introduction of revised cargo-handling techniques. When this is done, these systems will be tested with several Bay-Area shipping companies along with revised cargo-handling methods.

CONCLUSION

The work of MCTC in San Francisco is not resulting in any radical techniques for tackling industrial production and cost problems. It is, however, helping to create an appreciation for the contributions which research in operations can make toward solving many of the problems which have beset the maritime industry for generations. MCTC is going a step further than is usual for groups of this type. Instead of concluding its work with recommendations to be implemented by others, it is trying out its improvement ideas. The investigators are trying to illustrate by example not only what can be done, but how it can be done.

The success of this effort cannot be determined now. MCTC researchers feel that their purposes will not have been achieved until U. S. shipping, terminal, and stevedoring companies, together with the respective unions, make the most effective use of the tools of science and engineering to tackle their long-range planning problems as well as their day-to-day operating problems.

Research Notes

New Tool for Defense and Research

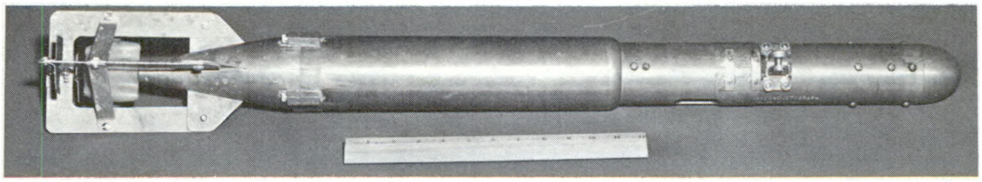
The U. S. Navy Mine Defense Laboratory in Panama City, Florida, has recently developed an interesting new oceanographic device. Although not yet on the production lines, this instrument may soon join a growing family of simple and reliable oceanographic tools that may enable every naval vessel to gather valuable scientific data.

Called the bathyconductograph (or BC), it can measure the electrical conductivity of sea water at various depths from a moving ship (information important in certain Navy mine-countermeasures operations). In addition, since the electrical conductivity of sea water varies with both temperature and salinity (chlorinity) factors, the salinity of the ocean can be determined from coincident conductivity and temperature data. Previously the surface-to-bottom electrical-conductivity profile had to be obtained either by chemical titration of a number of samples or by stopping the ship and lowering a conductivity cell. Both these techniques were time-consuming and in mine countermeasures operations sometimes required the presence of an extra ship.

The torpedo-shaped BC is a second cousin to the ubiquitous bathythermograph (or BT) developed by the Woods Hole Oceanographic Institute. This relationship, far from being an accident, was deliberately planned by NMDL scientists to cut costs by borrowing part of the design from a similar, already proven instrument. The BC is similar in overall appearance to the BT and the two are operationally interchangeable aboard ship. The forward section of the BC houses a depth-sensing bellows, which is the same as that used in the Type OC-1C/S bathythermograph. A watertight compartment enclosing an electronic circuit is located in the after section. The fins at the tail of the BC serve to stabilize the instrument and to protect the conductivity cell.

The specially designed conductivity cell has a streamlined housing so that the rate of exchange of sea water through the cell is consistent with its diving rate. The cell is one arm of a Wheatstone bridge type of circuit which measures the electrical resistance of sea water. The output of this circuit then drives a transistorized, null-seeking servo system, which in turn rotates a recording stylus. This stylus etches a line in the coating of a standard glass BT slide, thereby recording the conductivity values. The slide holder moves longitudinally along the axis of the bellows through a distance proportional to the hydrostatic pressure of the sea water. Thus, this motion of the slide, coupled with the rotation of the stylus, produces a trace of conductivity versus depth as the instrument is lowered to the sea bottom and retrieved.

In addition, the BC is equipped with a three-position, externally operated "off-cal-on" switch. In the "off" position, this switch serves to disengage the mercury power cells when the instrument is not in use. The switch is turned to "cal" to substitute a precision resistor for the conductivity cell when a calibration mark on the slides is desired. The manipulation of this switch is the only operational difference between the BC and the BT.



The bathyconductograph developed by the U.S. Navy Mine Defense Laboratory in Panama City, Florida.

So far, the BC has come through with flying colors in all tests. NMDL scientists have taken conductivity measurements both in the saline Caribbean and in the brackish estuarial waters at the approaches to Norfolk, Virginia. And as a research tool, the BC was used for temperature-salinity data by NMDL oceanographers in the U. S. Navy Electronics Laboratory's 1960 Arctic cruise. From these data they could delineate various layers of ocean water. The new instrument not only has yielded scientific data otherwise difficult to obtain, but also has proved to be simple, reliable, and rugged enough to take an occasional collision with the bottom and still come up with the required data.

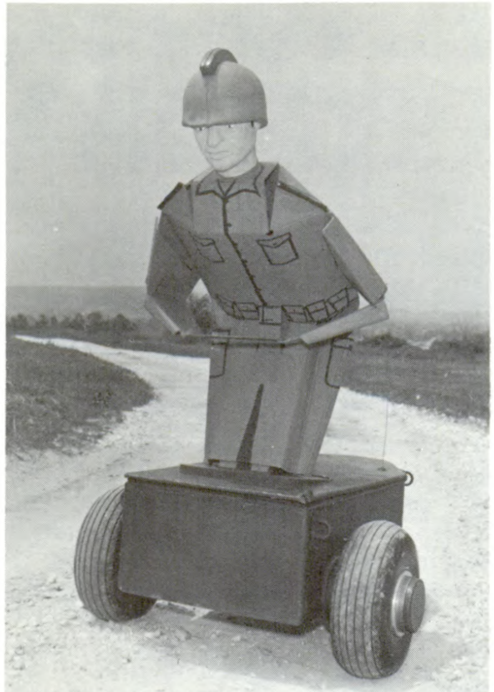
Automaton For Marksmen

Doing the shooting gallery one better, the U. S. Naval Training Device Center of Port Washington, New York, has recently unveiled a self-propelled, lifelike, full-sized "man" for use as a small arms target. Closely resembling a soldier in combat, the target can run upright or at a crouch, crawl up a 30 percent slope with ease, and play dead when hit.

Several years ago, a big game hunter and shooting enthusiast wrote a letter to President Eisenhower suggesting that a new dimension be added to small arms firing training: a lifelike, full-size, "man" target capable of unrestricted and unprogrammed movement. Out of this letter, the Motile Target idea was born. The Army has now developed this target through TDC and Aircraft Armaments, Inc. of Cockeysville, Maryland.

The target material is styrofoam coated with electrically conductive paint. A completely new hit detection system was designed for this device. An electrostatic charge carried by the bullet is picked off as the bullet passes through the material. This charge is then transferred by the conductive coating to electronic components in the vehicle which in turn provide impulses to stop the vehicle, drop the target to the down position, and also to send a radio signal to record the hit on a counter at the operator control pack. The target can detect automatic fire at rates up to 700 rounds per minute.

The target is jointed at the knees to a vehicle which weighs about 850 pounds. This weight is due to its armored hull and the large number of batteries necessary for power. Each wheel is independently powered by an electric motor mounted within the hub. The tires are filled with foam plastic to provide support even when punctured by a large number of bullets. The vehicle has four forward speeds of 1-1/2, 3, 6, and 8



New man-sized mobile target developed by the Navy for Army small-arms fire training goes rolling along. (Photo courtesy of Aircraft Armaments, Inc.)

miles per hour and can run about four hours before recharging. Recharging can be accomplished in about one hour. A steerable tail wheel allows the vehicle to move and turn in any direction.

The operator's controls consist of the control pack and auxiliary unit. The vehicle is operated by pushing the speed control on the control pack forward to any of the four speeds and steered by turning the knob on the speed control to the right or left. Pressing one of the four position buttons selects the desired target posture: either "upright, crouching, crawling, or down." The hit counter on the control pack records the hits as they strike the target.

The Motile Target, because of its inherent flexibility, can be used in a number of different ways. Besides supplementing the present trainfire ranges, several could be used in squad tests to simulate "live" attacking forces or possibly in a mobile combat range. Such a range, operated by a permanently assigned crew and moved from place to place in a van or cargo plane, would be highly desirable for reserve, National Guard, and law-enforcement officer training.

Bubble Screens vs. Shock Waves

The Army's Waterways Experiment Station, Vicksburg, Mississippi, has recently issued a report on the use of bubble-screens in a heretofore unknown area of shockwave behavior. This project, which sought basic information on the effectiveness of a bubble screen in attenuating the intensity of water shock produced by an underwater explosion, was initiated and funded by ONR in 1956 to implement a recommendation of the Mine Advisory Committee's Ship Protection Panel. In recent years the Army has provided all funding for the project. The final report, which should be an important source of reference for a long time to come can be obtained from ASTIA. It contains not only comprehensive water-shock measurements but also detailed information on the behavior of an underwater shockwave which is intercepted by a curtain of air bubbles. The curtain is usually created by pumping air through perforated pipes laid on the bottom of the waterway. A good flow of bubbles does a quite remarkable job in dampening a shockwave. For instance the Canadians have successfully used the bubble-curtain technique to protect dams from underwater blasting operations.

Dislocation-Free Crystals

Professor C. Elbaum of Brown University, a contract investigator for the ONR Metallurgy Branch, has reported in the Journal of Applied Physics the first successful preparation of dislocation-free crystals. (For an explanation of this theory, see page 11). Aluminum crystals were grown from a melt under special experimental conditions designed by Professor Elbaum. Although these crystals are not "useful" in an engineering sense, nevertheless they open a research path in our effort to understand the relationship between the crystal-lattice structure of materials and their physical and chemical properties. For example, breaking strength and electrical behavior are notably dependent upon the concentration and distribution of point defects and other lattice imperfections. Knowledge relating to the formation and elimination of lattice imperfections is essential if we are to achieve ultimate engineering properties for materials.

Jet Noise Suppression Program

As early as May 1955 the Bureau of Naval Weapons initiated programs to investigate noise suppression, including portable ground noise suppressors. This was extended in 1958 to include noise-level surveys of all current Navy jet engines. In 1959 and 1960, the Bureau gave its support to work at Curtiss-Wright for the evaluation of a noise suppressor. In June 1959, General Electric was awarded a contract to continue experimental testing and research to determine the basic fundamentals of noise generation. As a result of these contracts a procedure has been developed making it possible to predict noise reduction capabilities of various suppressors applicable to subsonic non-afterburner cases. New work to include supersonic and afterburner operation is in progress.

The studies thus far have emphasized the rear section of the planes, inasmuch as that is the most critical noise-level area (as far as medical damage to personnel aboard carriers and in small operating areas is concerned). It is anticipated that additional effort will be required and the suppression studies moved from the afterburners to the jet engine themselves. Acceptable noise levels aboard ships (bridge, communications system, sleeping quarters, et cetera) will be established. It is hoped that the testing will result in efficient suppressors that are more economical and have less loss of thrust. - U. S. Navy Medical News Letter

NAMRU-2 Team in Penghu

Eleven Chinese and American staff members from Naval Medical Research Unit No. 2 (NAMRU-2) at Taipei, formed a team for 2 weeks' intensive field research in the Penghu Islands. The team collected hundreds of biologic specimens, many of which are believed to be "firsts" from this geographic area, including rare poisonous sea snakes, whose venom will be studied. After varied studies have been completed in the Taipei laboratories, the specimens will be deposited in museums on Taiwan and in the U. S. The research team also examined hundreds of birds, rodents, reptiles, and fish for parasites during their travels by jeep, fishing boat, and on foot among the inhabited and uninhabited islands of the Penghu group. During the 2-week trip approximately 1000 school children were also examined. Success of these field studies was due in large measure to the full support provided by the Chinese military and public health officials in the Penghu Islands. - U. S. Navy Medical News Letter

New Power Plant for Conventional Submarines

The Navy has disclosed plans to build a new type of submarine electrical power plant that employs fuel cells. These cells are a type of battery that converts fuel into electricity and would replace the storage batteries in present use aboard conventional submarines. Basically, a fuel cell produces electricity directly from a chemical reaction, which is sustained by fuels supplied from outside the battery. The efficiency of the fuel cells can run as high as 80 percent, about twice the efficiency of conventional generation plants.

A land-based prototype plant will be built during the next fiscal year. The Navy plans to convert the first diesel submarine to fuel cells in approximately two years. Eventually, it hopes to build some small attack submarines with this type power plant. The conversion of diesel submarines to fuel cells would make them quieter and increase the duration of submerged operations. At present, a submarine can operate for only a limited number of hours before it must surface or snorkle to recharge batteries, which increases its vulnerability.

In comparing the advantages of nuclear and fuel-cell power plants, the fuel cells would cost less and require a smaller space. This would enable the Navy to build smaller and less expensive submarines. - The Dolphin, U. S. Navy Submarine Base, New London, Conn.

Five radar picket ships of the U. S. Pacific Fleet are slated for transfer to the Naval Reserve training program in September, 1961. The ships, replacing five destroyer escorts, will be based in San Francisco, Seattle, and Long Beach. They will increase Reserve EW and ASW potential.

On The Naval Research Reserve

Research Methods Seminar

Forty-one Reserve officers participated in the Seventh Annual Seminar in Research Methods conducted at The Ohio State University for the two-week period commencing 9 July 1961. Twenty-nine of the officers were from the Navy and twelve participated from the Army. The seminar was again presented by Naval Reserve Research Company 4-7, Columbus, Ohio, with LCDR R. W. King, USNR, Commanding Officer, serving as Seminar Chairman.

The seminar was opened with an address by CAPT H. E. Ruble, USN, Deputy and Assistant Chief of Naval Research. The program for the following days of the seminar were arranged by individual members of NRRC 4-7. These officers and the subject for the day's discussions were as follows: CAPT R. W. Mayhew, USNR, "The Threat and the Defense System;" LCDR I. A. Jacobson, USNR, "Research Methods" and "Social Sciences;" CAPT J. M. Allison, USNR, "The Systems Concept, Weapon Systems;" LT F. Birtel, USNR, "Mathematics and Communication;" LT J. A. Van Echo, USNR, "Physical Sciences;" and LCDR R. J. Thabet, USNR, "Medical and Biological Sciences." Afternoons of these sessions were devoted to group discussions, a panel discussion, and a critique. LCDR King served as chairman for the closing day of the seminar and introduced CAPT J. W. Jockusch, Jr., USNR, Special Assistant for Research Reserve. Two tours were made—one to North American Aviation and the other to the Battelle Memorial Institute.

Conferees were privileged to hear outstanding local speakers as well as some from a distance. Among the latter were: CAPT D. G. Gumz, USN, from the Joint Chiefs of Staff, Department of Defense; COL R. J. Oddy, USMC, Senior Warfare Officer, ONR; Mr. J. R. Marvin, Director, External Studies Division, ONR; Mr. P. Tullier, Command Department, Annapolis, Md.; and Mr. G. Z. Dimitroff, Professor of Astronomy, Dartmouth College.

Idaho Falls Seminar

The Eighth Annual Navy Science Seminar for reserve officers of all services was held in Idaho Falls, Idaho, 23 July through 5 August. In attendance were 25 Naval Reserve officers, 6 from the Army, and one from the Public Health Service. The participants were introduced to the operations at the U. S. Atomic Energy Commission's National Reactor Testing Station, located near Idaho Falls, and were brough up-to-date on current developments in reactor technology.

The seminar, planned and conducted by Naval Reserve Research Company 13-6 in Idaho Falls, was co-sponsored by the Office of Naval Research and the Commandant, Thirteenth Naval District. Cooperating with the Naval Reserve unit were the Idaho Operations Office of the Atomic Energy Commission and operating contractors at the National Reactor Testing Station.

Left to right: LCDR Chad Anderson, USNR, Chairman of the 8th Annual Navy Nuclear Sciences Seminar, and assistants, Miss Lynda Crockett and LT Thomas Bloom, USNR, "log aboard" Army, Navy, and Air Force conferees from all sections of the U. S.

Participants at the Idaho Falls Nuclear Sciences Seminar were, left to right; front row: Mr. W. J. O'Bryant, Mr. W. L. Ginkel; second row: RADM G. C. Towner, USN, RADM L. D. Coates, USN, BGEN R. E. Moore, USAF, MGEN F. Zierath, USA; third row: LCDR C. K. Anderson, USNR, LCDR J. L. Morton, USNR, Research Reserve Program Officer, 13th Nav. Dist.; and CAPT T. J. Wadsworth, USNR.

The several major operating contractors for NRTS—Aerojet-General Corporation, Argonne National Laboratory, Atomics International, Combustion Engineering, Inc., General Electric Company, Phillips Petroleum Company, and Westinghouse Electric Corporation—took the visiting officers on a tour of the 894-square-mile-station, giving them a comprehensive survey of the largest and most varied collection of reactors in the world.

The Seminar's 40 technical presentations covered such fields as: health physics; specific nuclear facilities at the National Reactor Testing Station; basic nuclear physics; and the overall Atomic Energy Commission organization, operations and objectives. CAPT J. W. Jockusch, Jr., USNR, Special Assistant for Research Reserve, concluded the seminar with a discussion of the Research Reserve Program.

Weekend Symposium on Cold War Problems

"Headquarters, Office of Naval Research, should know what a terrific job their San Francisco Branch Office and Reserve Companies did in organizing and presenting a two-day symposium of 'Cold War Problems.' I can only imagine the amount of work that went into getting it set up. There was an outstanding panel of speakers; the sponsoring officers showed great ability not only in organizing the symposium but also in keeping it rolling on schedule."

This unsolicited comment by a Reserve commander described the weekend symposium "Cold War Problems", held 24-25 June 1961 in San Francisco, California. The meeting was presented through the cooperation of the Naval Radiological Defense Laboratory, and sponsored by two reserve companies—NRRC 12-5, Berkeley, California, NRRC 12-1, San Francisco, California—and the Office of Naval Research Branch Office, San Francisco. Attendance at two-day sessions averaged approximately 200 reservists of the Navy, Army and Air Force.

Credit for the presentation of this excellent symposium goes to CDR H. C. Ries, USNR, Commanding Officer, NRRC 12-5 and to LCDR David B. Todd, USNR, Executive Officer of the Company. Assisting these officers with the program were CDR Ralph W. Beecher, USNR, and CDR John S. Walsh, USNR, members of NRRC 12-1.

Professor Witold S. Sworakowski, Assistant Director of the Hoover Institute on War, Revolution and Peace, opened the symposium with a talk on "The History of Communism." He was followed by outstanding lecturers from the University of San Francisco, University of California, Alameda State College, Golden Gate College, Lawrence Radiation Laboratory and Stanford Research Institute. The four sessions of the two day symposium dealt with the following topics: "The History and Nature of Communism," "The Present Communist Threat," "Science and Technology in the Cold War," and "Prospects for the Future."

Another New Company

The Navy's 116th Research Reserve Company was activated effective 1 July 1961 at Dahlgren, Virginia: NRRC 5-12. CAPT R. C. Turner, Jr. USNR, is serving as the first Commanding Officer of this research company, which claims a membership of eighteen members. The Executive Officer is CDR J. J. Jamison, USNR, and the Training Officer has been designated as LCDR T. W. Truslow, USNR.

This company had formerly been organized as a Naval Reserve Ordnance Company; upon its disestablishment as such it was reactivated as a Research company.

Fiscal-1962 NavRes Selection Boards

Selection Boards to select inactive Naval Reserve Officers for promotion are tentatively scheduled to convene as follows:

PROMOTION TO	CONVENING DATE	DATE OF RANK OF JUNIOR MAN IN THE ZONE*
Rear Admiral	3 January 1962	1933 year group
Captain (line)	9 January 1962	1 July 1955
Commander (line)	16 January 1962	1 March 1958
Captain (staff)	27 February 1962	1 July 1955
Commander (staff)	27 February 1962	1 March 1958
Lieut. Cmdr. (line)	6 March 1962	1 September 1956
Lieut. Cmdr. (staff)	24 April 1962	1 September 1956
Lieutenant (line)	10 April 1962	Commissioned in 1959
Lieutenant (staff)	24 April 1962	Commissioned in 1959
Chief Warrant Officer	15 May 1962	4 years in grade

*It is possible that some of these dates may be split so that all officers may not be included.

The Director of the Special Projects Office recently presented the Award of Merit to the U. S. Naval Research Laboratory for outstanding service in developing the Fleet Ballistic Missile (Polaris). NRL's specific contributions were: the development of techniques for the fabrication, inspection, and testing of motor cases; the development of instrumentation for monitoring and conditioning the submarine atmosphere; the assessment of environmental factors in missile telemetry; and the making of recommendations that lead to the development of high temperature materials. The presentation was made on July 20, the first anniversary of the successful firing of a ballistic missile from a submerged submarine.

The Navy Department has signed a contract with Aerojet-General Corporation to produce at Sacramento, California, 420,000 pounds per year of nitro plasticizers for Advanced Polaris propellants. The value of the first year's production is approximately 1.7 million dollars. Aerojet will build the plant at a cost of 3.4 million. This is one culmination of an ONR long-range research program in nitro aliphatic chemistry which was started in 1947.

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Contributions of the nature described may be addressed to the NAVAL RESEARCH REVIEWS: Office of Naval Research (Code 740), Washington 25, D.C. They should have the official sanction of the originating activities. Reprints can be supplied to authors.

IN THIS ISSUE

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.

Hillock of glacial rock on floating ice-island ARLIS-II; see pp. 12-18. (Photo by Alaska Photo, Fairbanks)