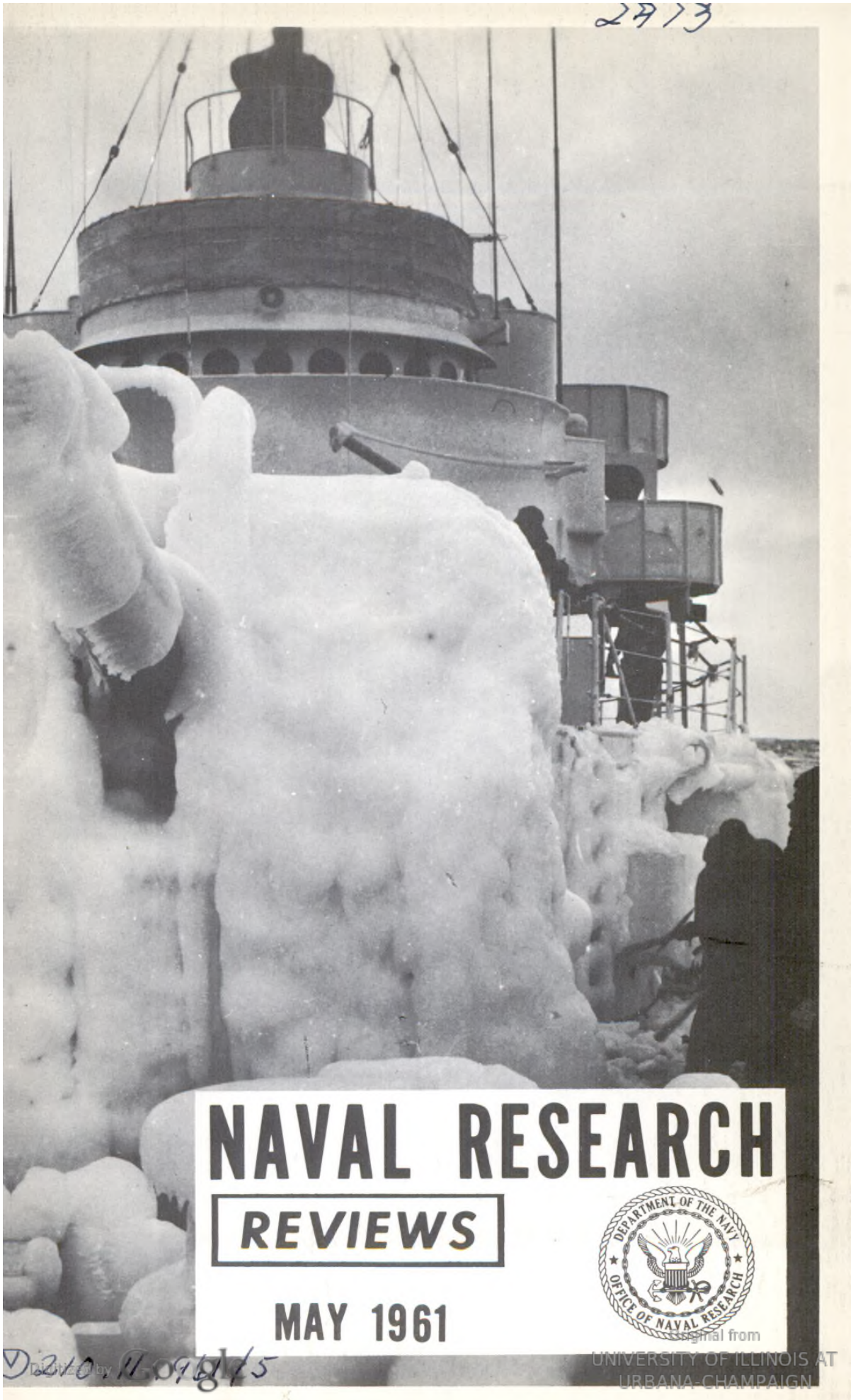

NAVAL RESEARCH

REVIEWS

MAY 1961

A 50-foot enclosed platform was recently fastened under the Chesapeake Bay Bridge. Overlooking water 90 feet in depth, the platform and the midget submarine (shown below) will be used in NRL oceanographic studies (see story on page 29).

The Navy's only active midget submarine—the X-1, built in 1955—was recently taken out of mothballs to participate in research in the Chesapeake Bay (see story on page 29).

Ice-Phobic Coating for De-icing Naval Vessels*

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In order that the Arctic and Antarctic be completely practical operating areas for the Navy, means for facilitating the removal of ice accumulations from Naval vessels must be found. The urgency and importance of shipboard ice removal stems primarily from the vital need for maintaining the ship's stability and navigational responses and thus its ability to carry out its mission. Under the extreme environmental conditions which exist in the frigid zones, ice weighing several tons can accumulate within a relatively short time. This added tonnage — sometimes acting as a top-heavy sail — results in loss of freeboard and, as the weight is placed well above the vessel's center of gravity, can seriously impair the designed stability of a vessel. Ice coatings can also render much of a ship's exposed operational and ordnance equipment temporarily useless. Rotating antennas, winches and other deck machinery, gun mounts, missile launchers, catapults, vents, vision surfaces, running lights, life-saving equipment, hatches, walkways ... on all of these and more, ice is at best a nuisance but is much more often a serious hazard which could lead to disastrous results.

One approach to the problem of shipboard ice removal is the development of a coating to which ice would have little or no adhesion.

Figure 1 - If this had been coated with an ice-phobic material, these seamen might have found their task easier.

*This is a condensed version of a report prepared for presentation at the Fifth Navy Science Symposium, Annapolis, April 18-20.

Such an ice-phobic coating would greatly reduce the amount of work necessary to remove ice by the ordinary methods of hammering, chopping, or scraping (see Figure 1). Ice, however, sticks remarkably well to almost all surfaces and coatings — a fact as well known to the ice-cube tray manufacturer as to the seaman. Ice-phobic film-forming materials have been, until recently, unknown. The development of such a film-forming material — to which ice would not adhere, and which would have good film integrity, sufficient abrasion resistance, and adequate substrate adhesion — would represent a unique and important advance toward mitigating the problem. Chemists at the Naval Material Laboratory, New York Naval Shipyard, have been working for some time toward the development of a coating that would facilitate the manual removal of ice. Since 1957 their interest has turned toward certain silicone polymer compounds of the polysiloxane group which appear to offer the most promising ice-phobic coatings.

Reaching a solution to practical problems of ice adhesion, and the designing of test methods and apparatus, involves a compromise among many theoretical and technological concepts. Many of the adhesion phenomena are little understood; it has been shown, for example, that the actual "measured strength" of adhesion may be greatly different from the theoretical "maximum adhesive bond." It was discovered, in the course of the de-icing research at the Material Laboratory, that there was no satisfactory means of testing ice adhesion or of duplicating the ice-adhesion values reported by other researchers. To meet this need, an apparatus for the laboratory determination of ice adhesion to surfaces and coatings was developed (see Figure 2). This device measures ice-adhesion values in terms of the actual force required to shear the ice horizontally from a surface.

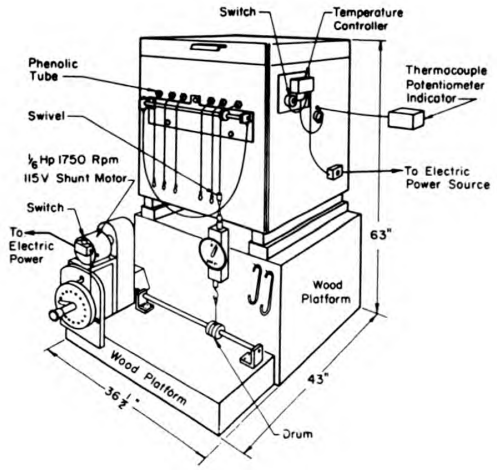


Figure 2 - Ice-adhesion apparatus

APPARATUS TO MEASURE ICE ADHESION

Essentially the mechanism consists of a thermostatically controlled chamber, with an inside volume of about four cubic feet, in which ten mild-steel specimen panels may be rigidly fastened to a stainless-steel base plate. Each specimen panel (7-1/2 by 2 by 1/4 inches thick) can accommodate three stainless-steel, inch-square ice holders, not unlike individual compartments of an ice tray (see Figure 3). The test panels, with the ice holders resting on them, are bolted down to the base plate in the adhesion apparatus, which is maintained at 10° F. After one hour at this temperature, six milliliters of distilled water at 50° F.

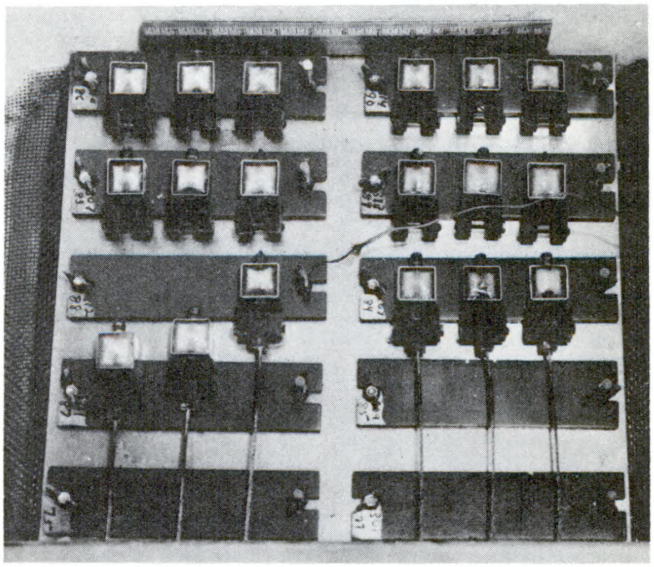


Figure 3 - Interior of ice-adhension apparatus showing ice holders in place.

are poured into each ice holder and the ice is allowed at least four hours to form and reach the 10° F temperature of the apparatus before the ice is sheared from the panels. This shearing takes place in the following manner: Each ice holder has been previously provided with a yoke to which a wire rope is attached. This wire rope passes through a small opening in the front wall of the chamber and is connected to a shaft which is rotated by a meter at one-half rpm. This rotation — regulated so that the pulling force is increased at the rate of three pounds per second — increases the tension of the wire rope, causing the ice to be sheared from the panel. The force necessary to accomplish this shearing is measured in pounds per square inch on a scale. After the initial ice-adhesion tests are completed, the test panels are immersed in a water bath at room temperature for 16 hours. This readies the apparatus for further ice-adhesion tests. The determination of ice-adhesion values for many materials and coatings has been made possible through the use of this device (see Table I).

FINDINGS

Laboratory tests have confirmed that ice adhesion varies with the freezing rate. Further testing revealed that the temperature of the ice at the time of ice release also influences ice-adhesion values.

Table I

Value of Ice Adhesion for Various Materials and Coatings

Material	Ice-Adhesion Value (Shear, psi)
Metals	
Mild steel	120
Stainless steel	115
Copper	125
Aluminum	90
Nickel	85
Zinc	90
Galvanized steel	110
Woods	
Douglas Fir	45
Courbaril	65
Lignum Vitae	80
Plastics	
Polymethyl methacrylate	40
Cellulose acetate	25
Glass	65
Rubber	20 to 150
Paints	
Gray deck paint (Navy)	80
Haze Gray paint (Navy)	100
Resin films	
Acrylics	80 to 130
Alkyds	75 to 95
Epoxys	80 to 130
Polytetrafluoroethylenes	60 to 70
Polytrifluorochloroethylene	90
Phenolics	30 to 110
Silicones	40 to 95
Urethanes	95 to 130
Vinylidenes	50 to 80
Vinyls	90 to 115

These findings may be stated as follows: Within a temperature range of -25° to + 30° F, it was observed that:

- The higher the temperature at the time of freezing (and thus the slower the rate of freezing), the greater the degree of ice adhesion.

- The higher the temperature at the time of ice removal, the lesser the degree of ice adhesion.

Although seemingly related, it is believed that different causative forces are involved in these two phenomena. Other findings indicate that more accurate ice-adhesion values are obtained when the ice-adhesion test panels are thick and rigid rather than thin and flexible; the rate of application of the shearing load is not allowed to go above five pounds per second; four or more hours have elapsed between the freezing and the shearing of the ice; and when each test coating receives a repeated cycle of testing comprising ice formation and adhesion testing, followed by exposure of the test panels to a period of water immersion between tests.

Experience has shown that it is not possible for a person who is removing ice accumulations (by the usual manual means under service conditions) to detect differences in ice-adhesion values above 15 psi. In other words, whether the numerical measured adhesion value is 15 psi, 50 psi, or 150 psi, the effort necessary to perform the ice removal is essentially the same. It can be seen, therefore, that coatings which succeed in yielding ice-adhesion values of 20 psi, or one-fourth the ice adhesion of Navy gray deck paint, will not succeed in reducing to one-fourth the amount of work required to remove the ice. It was found that ice-removal facility decreases considerably between 5 and 10 psi. Therefore, for practical purposes, it is suggested that a measured adhesion value of 5 psi should be established as a sort of "ice-adhesive barrier" above which ice accumulations become difficult to remove.

The following standard is proposed as the minimum requirement for a shipboard ice-phobic coating:

> For a material to be considered ice-phobic, its ice-adhesion values should remain below 5 psi for at least 5 repeated ice releases with water immersion for 16 hours between successive releases, when the adhesion is measured by the methods described in this article.

ICE-REMOVAL SIMULATION

The test apparatus and procedures, described herein, for the determination of measured adhesion values are extremely useful for a quick, accurate judgment of the potential ice-phobicity of large numbers of materials and coatings. However, an investigation of a material's ice-release effectiveness must be carried one step further than the measurement of the numerical value for ice adhesion. The value of the measured adhesion must be correlated with the facility with which ice accumulations may be removed in service. For this purpose, the Material Laboratory has developed a drop-ball type of ice-adhesion test

whereby a one-foot-square layer of ice one-half inch thick is frozen onto a half-inch-thick test panel. This ice is then subjected to a number of regulated drop-ball blows. The percentage of ice thus removed from the surface of the coated panel is indicative of the ice-phobicity of the coating system. This laboratory test is considered to be simulative of ice removal from large areas under shipboard service conditions.

Compounds which have shown considerable promise as constituents in ice-phobic coating systems are polysiloxanes. (It is interesting to note that our regard for, and appreciation of, polysiloxanes is now shared by Soviet scientists who are apparently embarked on a program

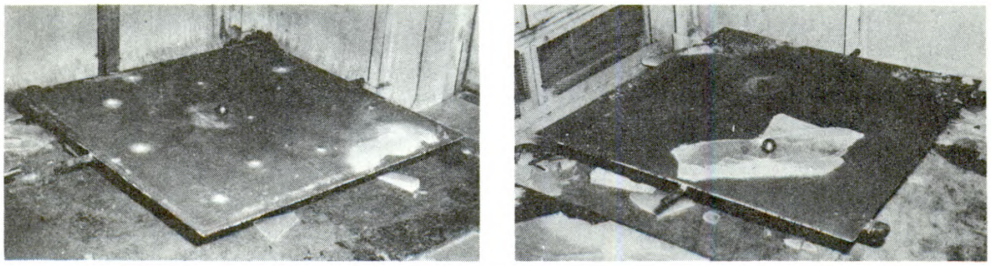


Figure 4 - Results of drop-ball tests on ice-coated panels. Left: No ice could be removed from the panel coated with standard Navy gray deck. paint. Right: Eighty percent of the ice was removed from the polysiloxane-coated panel.

of ice-phobic studies of considerable scope.) Figure 4 shows the results of a large-scale drop-ball test of a polysiloxane coating. Two panels, each 16 square feet in area, were used for this test. One was coated with the standard Navy gray deck paint, and the other with the polysiloxane compound. A one-half-inch layer of ice was formed on each panel and a two-pound steel ball was then dropped 10 times on each panel from a height of three feet above the ice. No ice was removed from the panel that was coated with gray deck paint. On the other hand, about 80 percent of the ice was removed from the polysiloxane-coated panel.

SEA TRIALS

The most promising of the polysiloxane-type coatings was tested to a limited extent during the winter of 1959-1960 aboard the Navy icebreaker USS STATEN ISLAND (AGB-5). On one occasion it was noted that an ice coating up to 1/8 inch in thickness could be readily removed by lightly running a gloved hand over a treated area on the forward breakwater. Use of the same pressure on an untreated area did not remove the ice. On another occasion an ice coating was applied artificially. In this instance the ice came loose from a treated bulkhead in a large sheet. More service trials on several Coast Guard vessels were planned for the following winter.

Before polysiloxane coatings will be ready for shipboard use, however, some problems concerning their production and use must still

Table II

Correlation of Ice-Adhesion Data From Three Test Sources

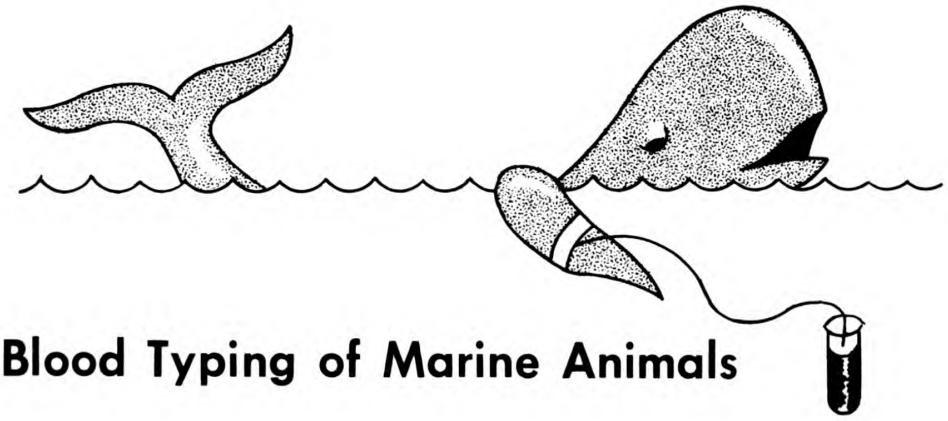
Material	Ice-Adhesion Value (Shear, psi)	Percent Ice Removed by Drop-Ball Test	Ease of Ice Removal by Manual Means
Steel	120	0	Very difficult
Gray deck paint	80	0	Very difficult
Gray deck paint with silicone additive	35	0	Very difficult
Polysiloxane coating-system No. 1	8	15	Difficult
Polysiloxane coating-system No. 2	4	80	Easy

be solved. For one, it appears that different batches of seemingly identical formulation yield polysiloxane coatings that exhibit widely differing ice-adhesion values. Also, it has been noted that these coatings last through only about two ice releases before they lose their effectiveness. This indicates a relatively short service life for the coatings in their present state of development. The continuing program at the Material Laboratory will include attention to these problems as well as investigation of new materials, such as substituted polysiloxanes and organometallic polymers.

VANGUARD I

The VANGUARD I satellite, placed in orbit three years ago (Mar. 17), is still emitting radio signals and could possibly continue to transmit information for hundreds of years. The satellite has now orbited the earth 11,786 times, travelling 409,257,000 miles. By means of the satellite, scientists have made radio fixes which prove the earth is not round but slightly pear-shaped. VANGUARD I's radio transmitter is powered by the sun, drawing energy through six square window-like frames on the skin of the satellite, each containing banks of solar batteries.

To date VANGUARD has been useful in five respects: in determining variations of atmospheric density with respect to the rotation of the sun, in demonstrating the effectiveness of solar cells as sources of space power usable over long periods of time, in demonstrating that the gravitational fields of the moon and sun modify the orbits of earth satellites, in demonstrating that the radiation pressure of the light from the sun modifies the movement of a satellite in its orbit, and in demonstrating the effect of magnetic drag in slowing the rotational motion of metallic satellites. Originally, VANGUARD was a project of the Office of Naval Research, carried out at the Naval Research Laboratory. Responsibility for the project was transferred to the National Aeronautics and Space Administration in 1958.



Blood Typing of Marine Animals

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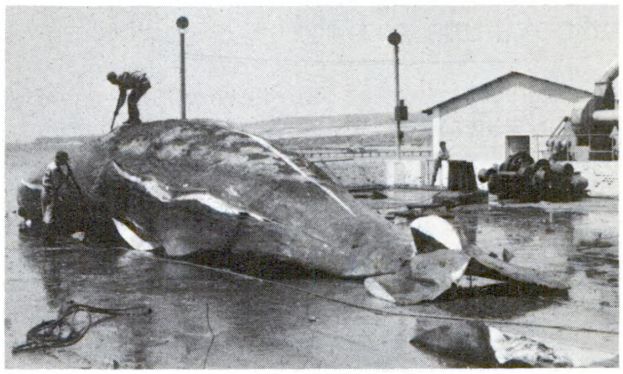
Studies in recent years indicate that blood-typing can identify certain subpopulations of marine animals, notably whales, fur seals and some fishes. The application of blood-typing concepts and techniques to the study of populations of marine animals began independdently in Japan and in this country about a decade ago. Interest in the subject has expanded rapidly, so that now there are four principal investigators in Japan, an equal number in the United States, and one in the Netherlands; there are others who have varying degrees of interest in the subject.

The investigators draw their background data and techniques from the remarkable research conducted for some sixty years by students of the blood groups of humans and domestic animals. The discipline in which this research falls is called immunogenetics, a field that combines the concepts of genetics and immunology.

Blood typing involves the detection of variations among individuals with respect to the kind and number of molecules, termed antigens, adhering to the surface of their red blood cells. The presence or absence of molecules of any particular kind of antigen on the red blood cells of an individual depends on whether or not he has inherited the gene that controls their synthesis. If the individual has the gene, the molecules will be present; if he lacks the gene, they will be absent. A variety of genes exists in any one species, each of which determines one of a variety of blood-typing antigens. Genetic studies make it possible to classify the genes concerned into a series of related groups. In man, for example, a certain group of three genes determines the A, B, and O blood-group antigens, and so on through more than nine major systems of blood-group antigens.

The genetics of these systems is such that they operate independently and simultaneously. Any individual, therefore, has a large number of different kinds of blood-typing antigens on his red blood

cells at once, selected according to the laws of inheritance from among the total variety of molecules possible. The large number of possible combinations in humans and in cattle makes it possible to distinguish many different kinds of individuals, providing that suitable detectors (typing reagents) are available. These reagents are usually serums that contain specific molecules, termed antibodies. Each kind of antibody is capable of combining with only one particular kind of antigen. This leads to observable phenomena, such as cell clumping (agglutination), by which the presence of the antigen can be detected.



The author collected blood from this and other sperm whales at a shore whaling station near Paita, Peru.

Populations of individuals that interbreed freely are characterized by their ability to perpetuate from one generation to the next statistically predictable groups of individuals characterized by different kinds of antigens. This characterization is maintained according to the rules of population genetics. Differences among populations may arise when these are not interbreeding freely; that is, when they are isolated from each other. These differences have been extensively studied among human races and populations, and also within various species of domestic animals, notably cattle and chickens. These studies have led to the conclusion that differences in the blood-type characteristics of populations can often show that these populations are essentially separate ones and behaving as independent genetic units.

This conclusion has been the basis for carrying on the program of blood typing of marine vertebrates, for the results can provide valuable evidence as to whether or not single species of fishes and mammals — that otherwise appear identical — may be separated into discrete sub-populations. The detection of such sub-populations — termed demes, races or stocks — will add to our store of knowledge concerning the distribution of animals in the oceans, and has practical significance for the management of fisheries.

METHODS OF STUDY

The study of the blood type of any species of marine animal passes through three stages. First, suitable reagent antiserums must be developed for the discovery and characterization of antigens suitable for population studies. Second, when these antigens are properly characterized, determinations of their frequencies are made by typing the blood of statistically significant samples of populations from various parts of the range of the species under study. Third, comparisons are

made of the data and these are equated in terms of other data available on the populations, such as those obtained from tagging, studies of parasites, comparisons of size and shape, and so on.

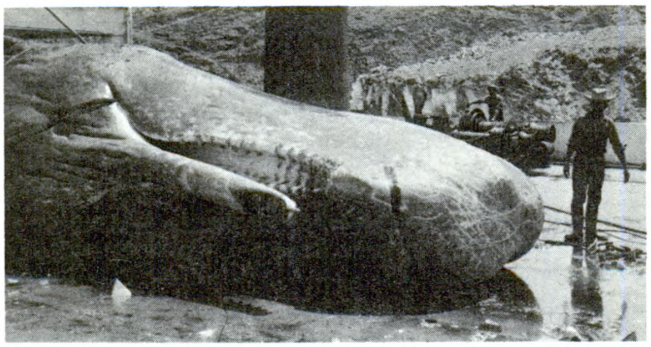
It can easily be imagined that blood typing offers no easy panacea for the solution of population problems, for a great deal of hard and careful work must yet be done. In spite of this, however, the blood-type antigens do offer a series of genetically determined "tags" that have the potential of supplying specific information that might not be obtained otherwise.

DISCOVERIES TO DATE

Investigators to date have detected individuals antigenic differences within a number of different marine species; these in turn are already proving to be of use in making sub-population distinctions in some species. Notable are studies conducted on species of Pacific salmon and tuna, Atlantic herring, California sardines (pilchard), and whales.

The blood-typing of whales was developed by Fujino, biologist with the Japanese Whales Research Institute in Tokyo. His materials come from Japanese whaling stations ashore or from factory ships operating in the North Pacific and Antarctic Oceans.

In 1958 the author received a Guggenheim Fellowship that enabled him to work with Fujino in the laboratory of Prof. Suyehiro at Tokyo University. Since then, the writer has made similar studies using samples of finback and humpback whale blood obtained through the courtesy



Detail of head and jaw of large sperm whale at the Paita, Peru, Whaling station.

of the Del Monte Whaling Company of San Francisco — under the support of the Office of Naval Research, and with the assistance of Mr. Dale Rice, biologist for the U.S. Bureau of Commercial Fisheries. Samples of this blood are then frozen in glycerol and shipped to Santa Barbara, where they are subsequently analyzed. The information now being collected will be compared later with that obtained by Fujino for other parts of the Pacific.

Last summer, while located at a shore whaling station near Paita, Peru, the author obtained and studied blood samples from some forty sperm whales. The results of this study should be useful in extending concepts of the nature of whale blood antigens. Data published in 1960

by Fujino indicates promising advances in the discovery, in several species of whales, of antigens that are suitable for sub-population analyses, and that, for the finback whale, such analyses are already underway.

Fur seals also have antigens that could prove useful in population studies. This was dramatically shown recently when individuals with similar antigens were collected at the same highly localized time and place by Fujino and the author in two successive seasons.

An overall review of the use of immunogenetics in marine population research will be made this next summer in Hawaii through a symposium to be given at the Tenth Pacific Science Congress. It is the first time that all persons engaged in this area of study will be able to meet together and discuss mutual problems and advances in this expanding area of marine research.

Oceanographic Legislation

Both Houses of Congress have introduced bills aimed toward the support of an increased program of oceanographic research. The House of Representatives bill (H. R. 4276) would "expand and develop the aquatic resources of the United States including the oceans, estuaries and rivers, and the Great Lakes and other inland waters...." To carry out this program, it would establish a six-member National Oceanographic Council composed of the Secretaries of the Treasury, Defense, Interior, and Commerce, the Chairman of the Atomic Energy Commission, and the Director of the National Science Foundation. The Council's responsibilities would include setting up a National Instrumentation Test and Calibration Center, and developing long-range plans for research, development, studies, and surveys of aquatic environments.

The Senate version (S. 901) would advance the marine sciences; establish a comprehensive ten-year program of oceanographic research and surveys; promote commerce and navigation; secure the national defense; expand ocean, coastal, and Great Lakes resources; authorize the construction of research and survey ships and laboratory facilities; expedite oceanographic instrumentation; and assure systematic studies of effects of radioactive materials in marine environments. To implement this program, the bill would set up a Division of Marine Sciences in the National Science Foundation, the divisional committee of which would include representatives of government agencies (including ONR and the USN Hydrographic Office) and private institutions and industries having an interest in oceanographic research. In particular, the Navy's part in the ten-year program would include the replacement, modernization, and enlargement in the number of research and survey ships, the development and aquisition of new or improved vehicles and instruments for oceanographic research and exploration, and the establishment of an advanced-level, five-year scholarship program. The bill is designed to continue and expand current and long-range Navy plans for support of marine studies.

Residual Gamma Radiation in the Vicinity of Nuclear Weapons

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Research at the USNRDL has been concerned with many aspects of the effects of nuclear weapons including physical, chemical, biological and operational problems. One specific area of the nuclear weapons effects problem is the nature of gamma radiation originating from residual radioactivity produced by nuclear detonations. Traditionally residual radiation is defined as that radiation which exists later than one minute after a nuclear detonation. For the purposes of this article, however, residual radiation refers only to those radiations from radioactive isotopes that remain after all the initial weapon-detonation processes have ended, such as those associated with fallout and from neutron-induced radioactivity. For example, the base surge from an underwater detonation may last longer than one minute following the time of detonation. Therefore, the radiations from the base surge are considered a part of the early phenomena, and will not be considered here as part of the residual radiation.*

Whenever a nuclear weapon or device is detonated, some residual radioactivity is formed; how it is distributed depends on both the location of the detonation and the environmental conditions existing at the time. Weapons exploded within a few hundred feet of the surface of the earth (either above or below) yield considerable quantities of local fallout. When the detonation is deep underground or deep underwater, the resulting radioactivity is initially contained within the vicinity of the explosion. For the deep underground detonation this radioactivity remains fixed. For the deep underwater detonation, however, much of the radioactivity rises to the surface with the steam bubble that is formed. Later, diffusion processes distribute residual radioactivity through a larger volume of the water.

If a detonation is sufficiently high above the earth, so that it does not pick up an appreciable amount of material from the surface, there will not be enough condensible material within the vicinity of the explosion to produce large quantities of local fallout. In this case the radioactivity may be carried through the air — either as a gas or a very fine aerosol — for many hundreds of miles before finally diffusing to the earth's surface or being brought down by rain.

If, on the other hand, the air burst is not too high above a land surface, there will be residual radioactivity in the vicinity of surface zero

*A rather extensive research effort known as Project Hydra is currently in progress at the USNRDL to determine the characteristics and effects of underwater detonations including the nuclear radiations that exist in the base surge.

in the form of neutron-induced radioactivity in the soil or other materials near the detonation site. For a conventional weapon the amount of neutron-induced activity produced in materials external to the weapon is always considerably smaller than the amount of fission-product activity, and this neutron-induced activity becomes important only when there is little or no local fission-product fallout.

Because of the differences in the mode of deposition of radioactive isotopes after air and surface bursts over land, radiation contours from air bursts are quite different from those of surface bursts. (Available evidence indicates that corresponding differences occur for detonations over or at the surface of the ocean. However, the rapid diffusion of radioactivity through the ocean water has not allowed as thorough an investigation of the distribution of radioactivity over the ocean after a detonation as over land.) Because a limited number of radioactive species (isotopes) are produced as neutron-induced activity, all with reasonably short half-lives, a radiation field produced by an air burst disappears at a much more rapid rate than the fallout radiation field produced by a near-surface burst. For example, two sets of contours are shown in Figure 1, one for a 10-KT air burst (A through E) and the other for a near-surface, 1-KT detonation (F through I). All maps of the radiation contours in Figure 1 have the same scale. The radiation field for the near-surface burst, even though produced by a smaller yield device, covers a much larger area and decays much more slowly than the radiation field of the air burst. The measured radiation fields for the near-surface burst form nearly typical and predictable elongated fallout patterns. On the other hand, the radiation fields produced by the air burst are distributed very nearly symmetrically around ground zero, as would be expected if the radioactivity results strictly from interactions initiated by neutrons radiating from a point source.

One aspect of the study of residual radiation is the collection of radioactive samples from various Pacific and Nevada weapons-testing sites in order to determine the spectral characteristics of the emitted radiation. From these spectral patterns, the various isotopes responsible for the radiation can be ascertained. Typical small samples have been investigated by using the experimental arrangement shown in Figure 2. Here, radiation from the sample is first collimated into a 4-inch diameter by 4-inch high, thallium-activated, sodium-iodide [NaI(T1)] crystal and photomultiplier-tube system. This system produces pulses whose relative magnitudes can be electrically analyzed as a function of energy, a pulse-height distribution.

Figure 3 shows typical pulse-height distributions for soil samples transported and exposed to neutron radiations near an air burst. The data for these distributions were obtained a few hours after detonation. The characteristic radiations in Figure 3 can be attributed almost exclusively to two isotopes, manganese-56 and sodium-24. Very soon after a burst, gamma radiation from aluminum-28 (with a 2.3 minute half-life) is also found in considerable quantities. Gamma radiation from other isotopes can sometimes be found in soil samples but, to date, is always of a much lower intensity than the isotopes previously described. The relative intensities of the various gamma radiations

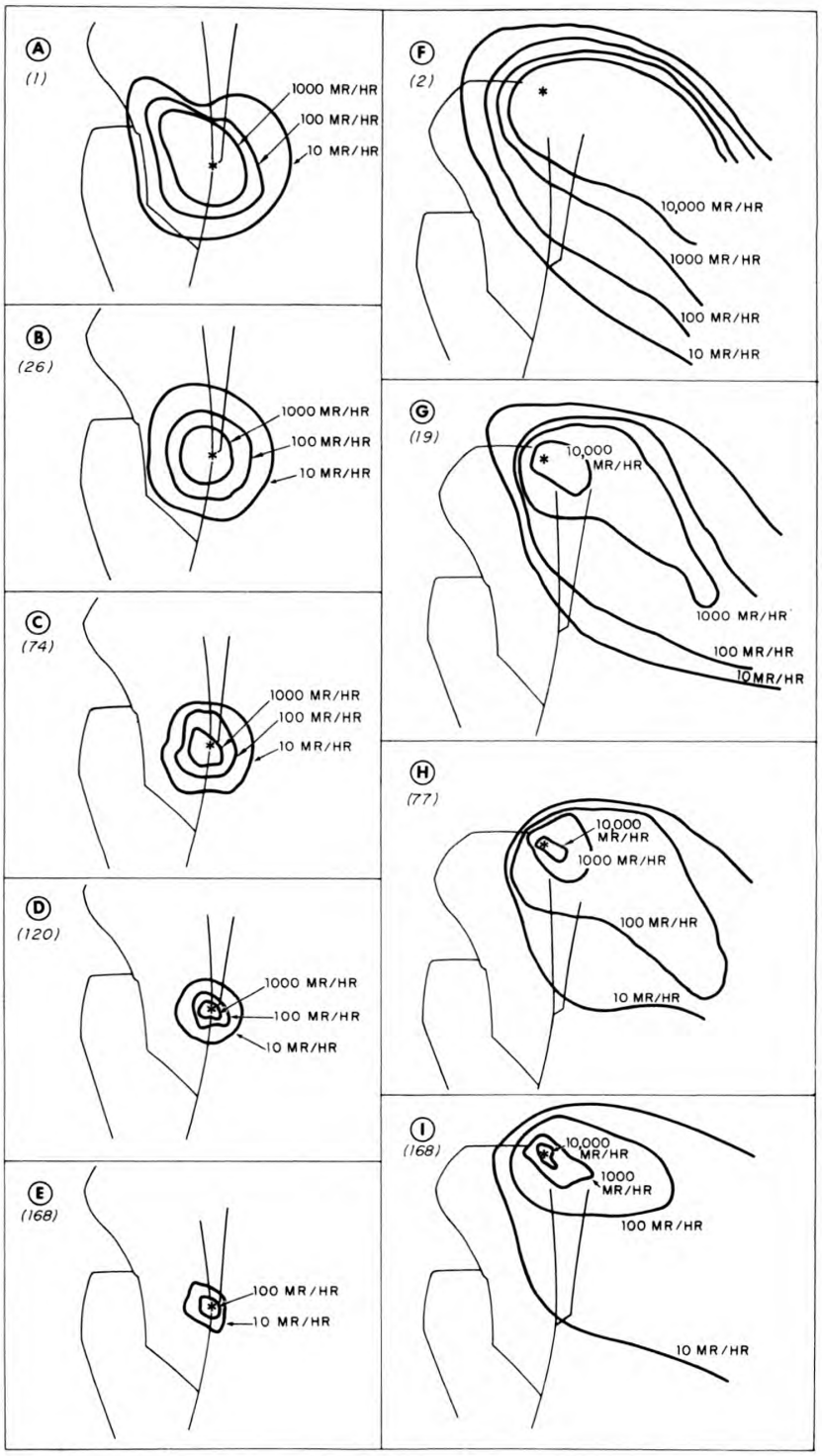

Figure 1 - Radiation contours (thick lines) for an air detonation (A through E) and a near surface detonation (F through I). All charts have the same scale, as indicated by roadways (thin lines). Number enclosed in parentheses indicates number of hours after detonation at which measurement of radiation field was made.

depend on the relative abundances of the soil constituents. Radioactivity is not observed from isotopes of some of the more abundant elements in the soil, such as silicon and oxygen, either because of their low neutron-capture ability or because neutron capture in these elements produces stable isotopes, radioactive isotopes having essentially no gamma-ray emission, or radioactive isotopes with such short half-lives that their radiations do not form part of the residual radiations.

Neutrons from nuclear weapons also produce radioactive isotopes in nearby materials other than soils. For example, an Army tank located just outside the radius of physical damage from a nuclear detonation, but within the range of a large neutron field, has been observed to become quite radioactive. A multichannel analyzer system with a thallium-activated sodium-iodide crystal mounted in a lead housing at the rear of a truck has been used as indicated in Figure 4 to observe gamma radiations emitted by this tank. The numbers near the tank indicate the level of radiation in milliroentgens per hour, as measured 12 hours after the detonation. The pulse height distribution that was observed consisted solely of radiations of manganese-56. It appears that the resultant radioactivity was produced primarily from neutron capture by the manganese in the steel of the tank. This type of radioactivity could also be induced by neutron interactions in other steel structures, such as ships, etc. Other materials placed near nuclear detonations, such as electronic equipment, were also found to be radioactive. But in those cases, the neutron-induced radioactivity came from a larger variety of types of radioactive isotopes.

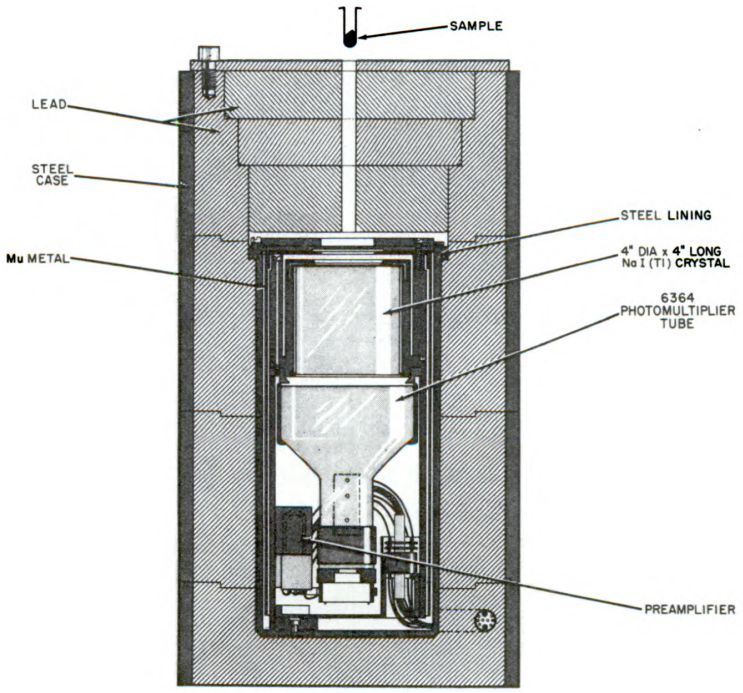

Figure 2 - Cross section of lead collimator and NaI(T1) crystal-photomultiplier system showing general location of radioactive fallout samples at time of measurement.

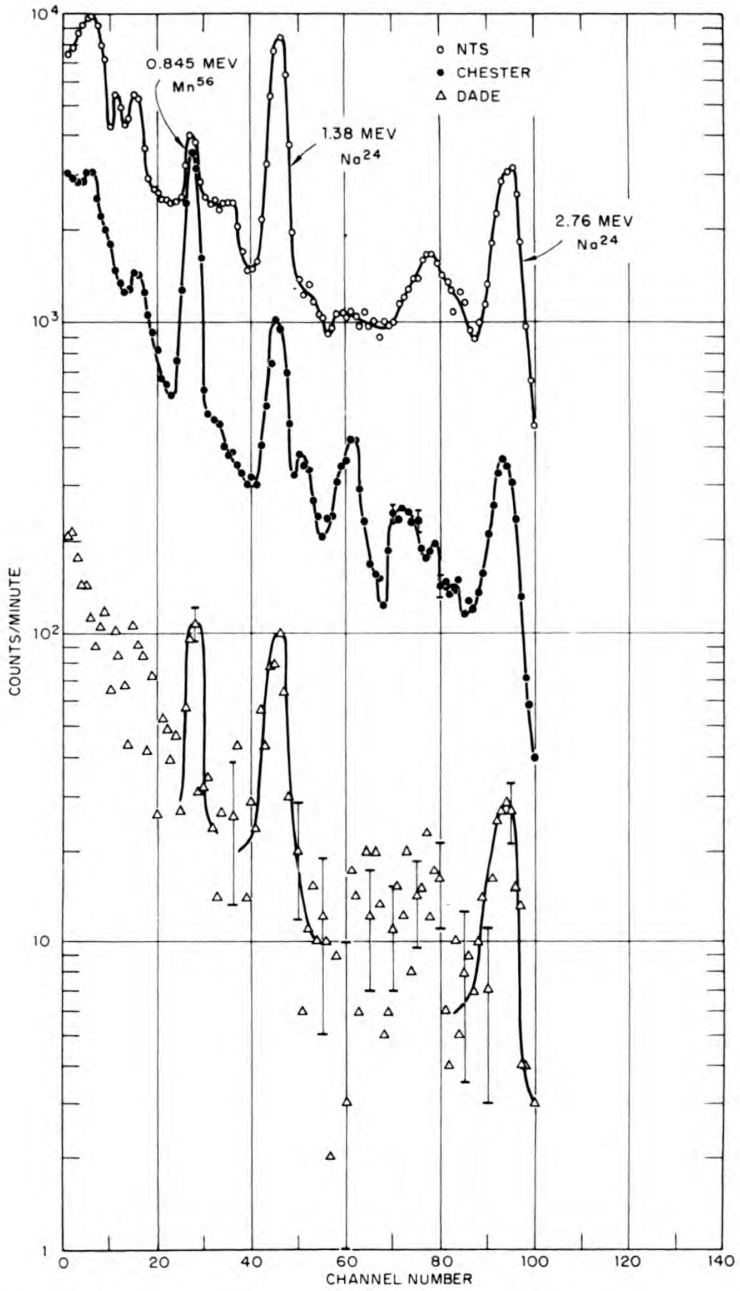

Figure 3 - Pulse height distributions recorded by a NaI(Tl) crystal for gamma rays emitted by Nevada Test Site, Chester, and Dade soil samples (page 13).

The radiations from air-burst neutron-induced radioactivity have serious consequence only for those people who enter the radiation field after the weapon event is completed. The total energy transferred to tissue or other material by these secondary radiation sources is small compared to the total energy transferred to this same tissue or material by the original, short-lived neutron-radiation field that produced the induced radioactivity. Therefore, the gamma-ray dose accumulated by an individual exposed to a neutron-induced field is always many orders of magnitude less than the dose that would have been

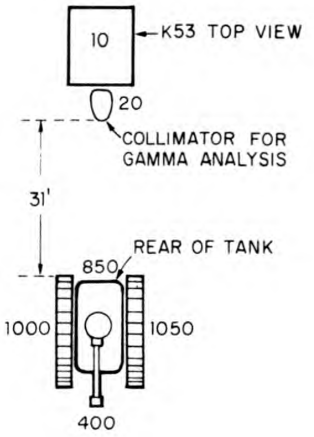

Figure 4 - Schematic view of experimental truck-mounted arrangement of measuring gamma radiation emitted from army tank.

acquired in the original neutron field that produced the induced radioactivity. On the other hand, an individual in a radiation field produced by fallout is usually outside the range of neutrons emitted by the weapon, thus the time element becomes less important. As a result fallout radiation fields are of importance both to people who were there at the time of detonation, as well as to people who enter the field at a later time.

FALLOUT RADIATION

Gamma radiation emitted by fallout samples originates from: radioactive fission products, radioactivity induced by neutrons in bomb materials, and radioactivity induced by neutrons in materials near the detonation. All of these radioactive materials are carried up by the forces of the explosion and distributed over a considerable area. A compilation of data from analyses of fallout samples that have aged for several hours indicates that the gamma radiations consist primarily of a few major monoenergetic groups plus a number of minor groups. The amount of radiation and the spectral characteristics of this radiation at any single time is not the same for all weapons nor for all detonation conditions. One important reason for the differing radiation characteristics among individual fallout samples seems to be the varying ratios of neutron-induced activities and fission-product activities. Another is the varying degrees of fractionation of the radioactive elements.

After fallout has been distributed over a land surface it forms a plane source which emits radioactivity in all directions. The characteristics of the radiation from this distributed fallout have been determined by using the same pulse-height analyzer that was used for observing the neutron-induced radiation emitted by an Army tank. The intensity of the fallout radiations were found to vary with the direction of incidence of their source. In general, the most intense radiation — consisting mostly of monoenergetic, direct gamma rays—was observed when the analyzer was aimed just below the horizontal plane. When the instrument was raised above the horizontal plane, the radiations — mainly diffuse and secondary in nature — become less intense. These facts are understood by noting that the primary source of radiation fallout consists of tiny radioactive particles lying on the surface of the

ground. These are emitting primary gamma-rays in every direction. When the analyzer is aimed at the ground, just below the horizontal plane, the analyzer is exposed to the greatest possible area of ground surface, and thus the greatest number of radioactive particles. When the analyzer is aimed above the horizon — into the air — radiations can come only from air molecules. These air molecules are not radioactive in themselves, but reflect and bounce the gamma rays emitted by the fallout particles on the ground. This radiation is called scattered or secondary radiation and individual photons are not as energetic as those emitted by the primary source.

This has been a brief description of the residual gamma radiations that have been found following a nuclear detonation and the experimental techniques that have been used to measure these radiations. A word of caution must be inserted to alert readers of this article to the fact that the exact nature of such radiations is critically dependent on the nature of the detonation and the detonation and the meteorlogical conditions at the time of detonation. The radiations actually existing following any single detonation may fluctuate quite violently from detonation to detonation and from the observations discussed here.

Ships Too Speedy

Speed is the major cause of accidents, not only for automobiles but for ships, according to a Coast Guard report covering the three fiscal years 1957, 1958 and 1959.

Out of 199 cases studied, 77 were due to excessive speed. Other causes were: wrong side of channel, 58; failure to sound signals, 45; failure to keep clear on part of overtaking vessel, 29; turning left in the meeting situation, 27; burdened vessel's failure to give way in the crossing situation, 24; and evasive maneuver too little or too late, 21. Analysis also disclosed that 111 collisions occurred at night, 80 of these where lights could be seen for over five miles. The difference between a major and minor collision was usually only a matter of chance, depending almost exclusively on the human element.

Dr. Kurie Receives Award

Dr. Franz N. D. Kurie, former Technical Director of the Navy Electronics Laboratory, San Diego, recently received the Distinguished Civilian Service Award for the technical programs he initiated and fostered at the Laboratory which have brought national renown and prestige to the Navy Department. Dr. Kurie, who retired on disability from NEL in September 1960, received the award at bedside ceremonies in his home. He was formerly Superintendent of the Nucleonics Division at NRL before transferring to NEL in July, 1953.

Bats That Fish

J. J. G. McCue
Lincoln Laboratory,* Massachusetts Institute of Technology

Mainly through the work of Prof. D.R. Griffin of Harvard University, it has been known since about 1940 that bats navigate and hunt by means of airborne sonar.† Because of evidence that bat sonars are impressively effective systems, Lincoln Laboratory has recently undertaken to evaluate some of them and to find out what principles underlie their design. The work is closely coordinated with that of Prof. Griffin. Most of it is concerned with insect-eating bats; it deals with such questions as how one family of bats tracks and intercepts mosquitoes by using pulses about 70 feet long, and just how another family of bats profits from the use of frequency-modulated pulses. However, certain other bats seemed to demand attention, because they catch fish. The potential usefulness of a sonar device for finding underwater targets from an airplane does not need arguing. The Lincoln Laboratory bat study therefore has examined two questions: Do the fishing bats use sonar to find their prey? If they do, how do they overcome the formidable difficulties that arise from the severe mismatch in the specific acoustical impedances of air and water?

Of the very few kinds of bats that fish for a living, the one most accessible from Massachusetts is Noctilio leporinus, which inhabits parts of the Caribbean area. In the most detailed of the reports on this bat that have appeared in the scientific literature, P. Bloedel showed in 1955 that Noctilio catches fish by gaffing them with the well-developed claws of his feet. This he does by flying low over the water, dipping his feet from time to time and dragging them for distances of a few inches to a few feet. Some fraction of the time, this dipping results in pulling out a fish. Bloedel experimented with captive bats fishing from a shallow tray. Observations of these bats led him to believe that they dip their feet at random, and catch fish simply because the fish are abundant. His experiments, however, were not entirely convincing, since they did not closely reproduce the conditions normally encountered by the fishing bat.

As a first step in finding out whether this bat located targets under water by the use of airborne sonar, Prof. Griffin and the author made a reconnaisance of this bat in Panama and Trinidad. The objectives of the trip were (1) to find where Noctilio could be observed while fishing, and in a place where electronic instruments could be used without too great difficulty; (2) to establish a source of supply for possible transportation of the bats to Cambridge, and to learn enough about them to be able to maintain them in captivity for laboratory use; (3) to choose a tropical site for study of captive Noctilio near their habitat; (4) to observe the fishing activity in order to lay plans and prepare instruments for making a field study of it in the near future.

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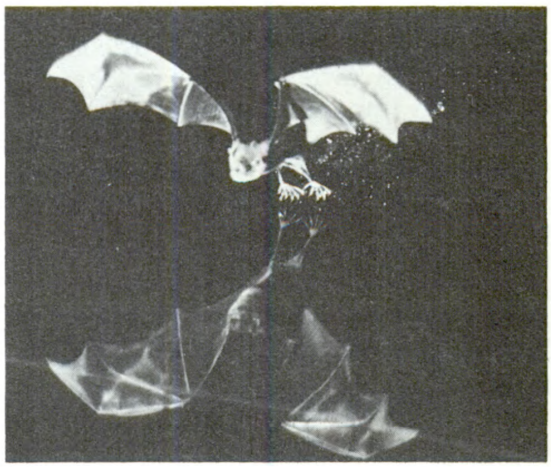
*Operated with support from the U. S. Army, Navy, and Air Force.
†For a number of years, Prof. Griffin's work on bats has received support from the Office of Naval Research.

All these objectives were accomplished. In addition, with the help of an ultrasonic detector and a small tape recorder, some records were obtained that should give information about the repetition rate of the bat's pulses while fishing, and an attempt was made to procure photographs with an electronic flash that left a synchronizing pip on the tape. Some of the photographs were successful. No analysis of the tapes has been made as yet.

The first site visited was the Canal Zone Biological Station on Barro Colorado Island, a wildlife sanctuary in the Panama Canal Zone. Three nights of observing resulted in many interesting contacts with various fauna, but in only one brief glimpse of a single Noctilio. The next site was a shallow fresh-water pool in a branch of the Upper Chagres River, above Santa Rosa in the Republic of Panama. This place, though wild, is easily reached from Juan Mina in the Canal Zone, where the Gorgas Memorial Laboratory maintains a house and dock. Here Noctilio were plentiful and were observed for several hours, on two successive moonlit nights, from a dugout canoe beached on a sand bar.



Fishing bat skimming the water with his claws. (Photo courtesy of M. I. T.)

Operations were then transferred to Trinidad, with headquarters at the field station maintained near Arima by the New York Zoological Society. Nearly all the observing was done at the U.S. Naval Air Station at Chaguaraumus. The situation here did not quite duplicate that in Panama. Here the water was salt, and it was not so sheltered as was the pool in the Chagres River. The waves had a trough-to-peak height of perhaps as much as 4 to 6 inches.

During the first few nights, no bats could be found fishing, though it was easy to find them roosting in caves; these were the nights near full moon, and some natives believe that the bats avoid fishing at this time because they may themselves be snatched at by fish much larger than they are. Be that as it may, as soon as the moon began to rise later in the evening, the bats appeared at dusk and began to fish. Though no correlation between ultrasonic-pulse repetition rate and foot-dipping had been observed in Panama, the ultrasonic detector showed that the bats in Trinidad markedly raise their repetition rate during a burst of pulses just before they dip, much as insect-catching bats do just before catching a flying insect (D.R. Griffin, "Listening

in the Dark," Yale University Press, 1958.) It is not certain that the fishing bats always increase their pulse rate before dipping, but in no case when the bat was visible did it raise the rate and then fail to dip. This correlation strongly suggests that the bat does use sonar in his fishing. There is at present no knowledge as to whether these bats detect an underwater target by sonar — they may simply detect ripples made by a fish just below the surface.

The trip showed that Bloedel's hypothesis appears very unattractive in the light of field observation, and that it is both practical and desirable to apply electronic techniques to a field study of how the bat does find the fish. Because of its technical facilities and the accessibility of the bats' daytime roosts, Trinidad is a more convenient site than Panama. Work on the fishing bat will be continued by Prof. Griffin and his students, with help from Lincoln Laboratory in the matter of instrumentation that is not available commercially. The New York Zoological Society has offered Prof. Griffin the use of its facilities near Arima, and he plans to establish two of his students there so that observations of fishing under controlled conditions can be carried out during the coming year.

New Space Terminology

The forthcoming exploration of the moon has resulted in the addition of two new words to the language to describe lunar flights, according to Dr. Lewis Larmore, chief scientist of the California Division of the Lockheed Aircraft Corp. These words are "apolune" and "perilune," describing the far and near points, respectively, of an orbit around the moon. The equivalent descriptions of earth orbits, apogee and perigee, have become household words in the space age. Aphelion and perihelion, applying to the sun, are equally established in science. Apolune and perilune round out the picture to fulfill the immediate needs of the space era. (This writer suggests that, as we reach further into space, our space vocabulary will be expanded to include similar terms, such as apovene and perivene, apomar and perimar, apojup and perijup, aposat and peristat, and apoplut and periplut). - Arthur R. Laufer, ONR Pasadena.

New Appointment

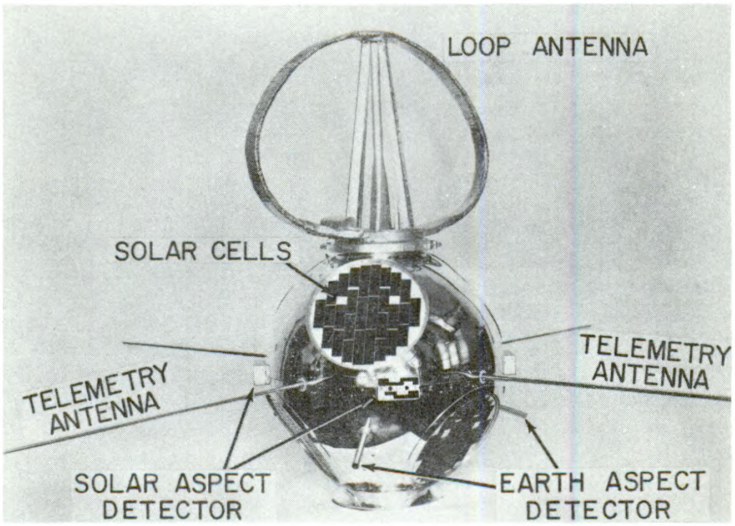
Dr. Norman H. Jasper was recently appointed Superintending Scientist of the Navy Mine Defense Laboratory, Panama City, Florida. Dr. Jasper, former Head of the Ship's Dynamic Division at David Taylor Model Basin, Carderock, Md., will direct the technical work of the Mine Defense Laboratory, whose mission is to provide defense against mines and torpedoes and to conduct applied research in related physical sciences.

Research Notes

The Success of LOFTI-1

Before burning up in the atmosphere after a short life of some six weeks, the U.S. Naval Research Laboratory's LOFTI (Low Frequency TransIonospheric) satellite opened a whole new field of scientific investigation that may lead to remarkable advances in military communications and space vehicle navigation.

By receiving VLF (Very Low Frequency) radio signals from a ground station, the Navy satellite provided science with its first data on the degree of VLF penetration into and through the ionosphere. From the data telemetered back to earth from the satellite, Naval Research Laboratory scientists have been able to confirm their belief that the ionosphere is not nearly as opaque at these frequencies as generally assumed and that VLF radio waves do pass through the ionosphere into the exosphere with relatively little attenuation. It has thus been definitely demonstrated that while the ionosphere reflects VLF radio waves back to earth to a large degree, it also permits very substantial penetration of VLF waves to outer space. The information derived from the NRL "sphere" points, among other uses, to the possible use of trans-ionospheric VLF radio waves emanating from ground stations as navigational aids to manned or unmanned space vehicles, and, conversely, to the possibility of communicating with submerged submarines by means of communication satellites.

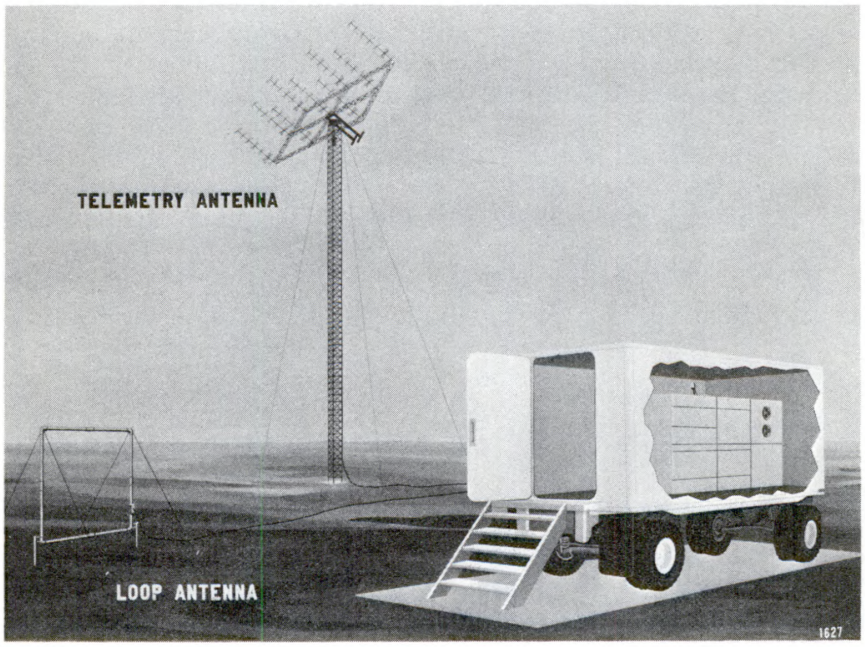


LOFTI-I satellite

The data from the satellite also indicates that, unlike higher frequency radio waves — which travel through the ionosphere at essentially

the speed of light in free space — the velocity of the VLF waves is dependent on the geometry of the signal path and local ionospheric conditions and is a fraction of the speed of light. In addition, under certain conditions, weaker pulses that seem to be delayed replicas of the preceding signal pulses appeared in the output of the satellite VLF receiver. These secondary pulses are delayed as much as 2/3 second; they may be echoes that result from the VLF waves emitted by the ground transmitter being guided along the configuration of the earth's magnetic field, starting from the northern hemisphere and travelling to the southern hemisphere, then being reflected back. The long time-delay of the echo is an indication, in part, that the guided waves traverse the ionosphere and exosphere with comparatively low velocity.

The Naval Research Laboratory's LOFTI sphere was launched on February 21 jointly with the TRANSIT III-B navigation satellite. The satellites and the second stage of the launching rocket failed to separate and the assembly assumed an unintended elongated orbit which, from the point of view of the TRANSIT project, was most undesirable.



LOFTI mobile telemetry ground station

However, the eccentric orbit—varying in altitude between about 100 and about 600 miles—enabled the Navy LOFTI satellite to give a very much better picture of the effects of the ionosphere on low frequency radio waves than the intended orbit would have given because it permitted a sampling of the ionosphere in depth during each revolution in orbit.

In the LOFTI experiment, the VLF radio signals from the Navy Station NBA in the Panama Canal Zone were picked up by a receiver in the satellite and retransmitted from the sphere over VHF telemetry channels to special NRL mobile and NASA ground observation stations.

The satellite was designed for reliability by a combination of simplicity and redundancy. Of the two VLF antenna systems — one a 20-inch loop atop the sphere, the other consisting of two 15-foot long whips extending from the top and bottom of the satellite — the latter depended on extendable antennas. When the two satellites and the rocket second stage failed to separate, the whip antennas could neither extend nor function. However, the experiment was a brilliant success since the loop antenna and its associated receiver system functioned perfectly. The thermal operation and the power supply system of the satellite were unaffected by the lack of separation. Instead of the intended LOFTI spin rate of one revolution per second, the unseparated bodies rotated very slowly, about 20 minutes per revolution. This resulted in periods when the rest of the assembly was in the sunlight while LOFTI was in the dark, being shaded by the vehicle. However, the loss in solar power during this portion of the rotation was more than offset by the energy reflected from the Transit shell, and battery charging currents were higher than anticipated. The high charging rates resulted in abnormally high battery voltages, but did not produce any harmful effects.

The nominal design package temperature was 60 degrees F. The actual package temperatures measured in orbit were from 50 to 70 degrees. Thus the average temperature was unaffected by the lack of separation. The eccentric orbit resulted in excellent altitude sampling by LOFTI. As the recorder data is processed, it will be possible to ascertain in detail the variations in VLF signal strength as a function of altitude. At the time of reentry, the satellite had completed over 500 revolutions around the earth. Many months of data analysis will be required to reduce the information obtained.

TRIESTE to be Fitted With Movable Arm

The Navy's deep-diving bathyscaph TRIESTE is to be fitted with a movable arm that can reach out and pick up materials from the ocean floor during its exploratory dives. The mechanical arm manipulator, being manufactured by General Mills' Nuclear Equipment Department, Minneapolis, Minnesota, is designed to withstand pressures up to nine tons per square inch. (The TRIESTE was subjected to a pressure of 7.9 tons per square inch during its record-breaking dive to 35,800 feet at the bottom of the Marianas Trench off Guam in the Pacific in January 1960.)

The manipulator will be equipped with oil-filled units to equalize pressures on motors and other critical parts. Mounted directly ahead of the steel sphere suspended below the TRIESTE, it will provide six motions: grip; wrist, elbow and shoulder bending; and rotation of wrist and shoulder. Men inside the sphere will control the arm by individual switches that provide directional and variable speed control for each motion. The TRIESTE program is sponsored jointly by the Office of Naval Research and the Navy's Bureau of Ships. The next exploratory dive by the bathyscaph will be made in the Atlantic this summer.

Translator of Computerese

The EECO 100 Computer-Language Translator now in operation in the Greater Washington D. C. area is becoming a real workhorse in the field of data processing both for its lessee, the U. S. Navy David Taylor Model Basin, and for many other bureaus and agencies. Installed at the Applied Mathematics Laboratory of the David Taylor Model Basin early in 1960, the CLT is known there as the Computer Data Format Translator (See inside back cover). It is the largest such system delivered to date and will perform 12 translations of computer data.

In addition to its use at the Applied Mathematics Laboratory, the CLT is employed by the Hydromechanics Laboratory and the Structural Mechanics Laboratory, of the Model Basin. This Navy facility is the largest research laboratory devoted to the development and improvement of ships, aircraft, and missiles by means of model testing. While its primary concern is with ship-aircraft-missile types for the U. S. Navy, it also tests models of new designs for private industry. The Applied Mathematics Laboratory is the principal computer facility for the Bureau of Ships and its field activities. The Laboratory has pioneered in the application of computers and auxiliary equipment to the solution of naval engineering and management problems since the date of its inception in 1952. The fastest and most powerful computers available to the Department of Defense, including the ultra-high-speed LARC and the IBM 7090 plus a Univac 1, are teamed with the EECO CLT, creating an extremely flexible, versatile, and intergrated scientific facility. Research projects at the laboratory making use of the translator include Polaris submarine tests, underwater explosion studies, full-scale ship trials, model trials, submarine radiated noise studies, and various statistical and data conversion studies.

When open translator time is available, nearly a dozen government agencies and other organizations concerned with defense activities have had data processed through the Applied Mathematics Laboratory. Conversion functions of the translator can be divided into two major segments: (1) Conversion of analog data onto magnetic tape acceptable to IBM Univac computers, and (2) conversion of Univac or LARC tapes into IBM binary coded decimal formats, or vice versa. Analog data may be digitized at rates up to 15 kc into binary information for conversion to IBM or Univac tapes.

New Escape Device Tested

A new device designed to be used in submarine escapes has been developed and tested by LT. Harris E. Steinke, Director of the Escape and Rescue Department, USN Submarine School, New London, Conn. Named the "Steinke Hood," the one-piece unit was first developed and constructed in the home of LT. Steinke and later tested at the Submarine

Escape Training Tank in New London. In early March LT. Steinke and CDR Walter F. Mazzone, Director of the SubMedTec School, used the "Steinke Hood" in their record escape from the USS BALAO off the Florida coast. The ascent, from a depth of 318 feet, took 55 seconds.

The "Steinke Hood" consists of a standard Navy submarine inflatable life jacket with a nylon fabric hood. The hood has a transparent plastic face piece that allows the escapee to see where he is going. The relief valves, normally found on the lower front section of the life jacket, have been relocated on the upper section behind the head. This area is completely covered by the hood. As the escapee rises to a shallower depth, air in the jacket expands and forces its way through the relief valves, entering the hood area and providing a constant supply of fresh air. As pressure builds up in the hood area, it forces its way out past the neck (see photo on inside back cover).

The hood is also equipped with a snorkel device that is used whenever outside air is available. It has a mouthpiece on the inside section and a cylindrical sliding valve on the outside. The mouthpiece is only used while breathing outside air and is withdrawn from the mouth prior to making an ascent. It is used again while on the surface. The snorkel shut-off valve, located on the outer end of the mouthpiece, is closed by pulling it away from the body and may be reopened by pushing it in towards the body.—New London Submarine Base, Dolphin.

SEA QUEST Commissioned

RV SEA QUEST, Lockheed's new oceanographic vessel, was commissioned recently. She is expected to be ready soon to start measurements on internal waves for ONR under the direction of A. J. Carsole and W. V. Kielhorn. Taking part in the ceremony at San Diego were officials of Lockheed and James S. Bercaw, master, who read his first orders. About 50 persons attended the ceremony. The Navy was represented by guests from the Destroyer Development Group, Long Beach, the Operations Evaluation Force, San Diego, and ONR.

SEA QUEST is a steel-hulled craft originally designed as a fisherman. Lockheed acquired her from R. Sabin, who invented and had installed on her his "Cathanodic" system of corrosion protection. Lockheed also acquired the manufacturing rights for this system, which is beginning to be widely used. The hull of SEA QUEST is, in fact, in excellent condition. With a length of 50 feet, a beam of 12.5 feet, 50 tons displacement, and a high forecastle, the craft appears seaworthy. She is powered with 140-horsepower diesels and has a very large cruising range. The engine controls are on the bridge, so that for single-day trips she can be handled by a crew of one. Laboratory space is in the deckhouse with the bridge, and occupies about 9 by 18 feet, ample for the radar, sonar, and other electronic equipment which will be installed. - M. C. Sargent, ONR, Pasadena.

Major Accomplishments in Naval Aviation Medicine-1960

Several new developments were made at the U. S. Navy Air Crew Equipment Laboratory, Philadelphia, Pa. The Navy Mark-IV full-pressure suit became fully operational and was issued to fleet aircraft squadrons on the east and west coasts. This suit provides omni-environmental protection: It is air-cooled for hot weather, insulated for cold weather, supplies oxygen for high altitudes, and provides the necessary pressure envelope for cabin-decompression emergencies above 35,000 feet. The Mark-IV was selected, in competition with others, as the one to be worn by the Mercury astronauts. Certain modifications were made to fit their requirements and they were trained in its use. Also, development and testing of the newer Mark-V exposure suit was completed, and procurement and distribution to operational units was begun.

New facilities installed at the Navy Air Crew Equipment Laboratory include a complete mockup of the Project Mercury Capsule within the large low-pressure chamber and a bioastronautical facility to permit the study of closed ecologic systems. The Project Mercury Capsule mockup will be used for training astronauts. Within the capsule, the astronaut—in a full-pressure suit—will endure programmed, static, space-flight simulation consisting of simulated emergency conditions as evidenced by instruments and actual automatic activation of emergency life-support systems. Programmed simulated flights will require navigation, orientation, timing, and other normal piloting functions of the astronaut, during which simulated emergencies must be met and countered in order to prevent a simulated catastrophe.

The bioastronautical facility is composed of a chamber within a chamber so outboard leakage can be obtained. The versatility of the device was demonstrated by putting six men through an eight-day test. The oxygen was supplied by a solid oxygen source that also acted as a partial carbon-dioxide scrubber. It is recognized that the solid oxygen source plays a major role in removing body odors from the atmosphere—whereas bottled oxygen does not—as well as removing a large percentage of carbon dioxide from the atmosphere.

Two new devices of major importance were installed at the U. S. Navy School of Aviation Medicine, Pensacola, Fla. One of these is the unique Human Disorientation Device, which has since been improved upon by the addition of advanced instrumentation and added computer capacity (see photo on p. 30). The other new device is the Slow Rotation Room, a 15-foot square room constructed over the hub of the human centrifuge, which will aid in studies of the effects of slow rotation on human subjects for long periods of time.

A miniaturized biopack for the support of mammals on a seven-day orbital space flight is being developed by the U. S. N. Aviation Medical Acceleration Laboratory, Johnsville, Pa. These flights, utilizing the instrumented biopack, will aid in the study of the effects of ionizing radiation, weightlessness, etc. on the response-performance ability of animal subjects.

Three 100,000-foot (altitude) low-pressure chambers were being installed at three air stations: the Marine Corps Air Stations at El Toro, Calif., and Beaufort, S. C., and the Naval Air Station at Cecil Field, Fla.

At the Aviation Medical Acceleration Laboratory in Johnsville, the astronauts were trained on the dynamic flight simulator. This gave them a realistic idea of the acceleration stresses they will encounter during flight. They were also trained with display panels and controls which enabled them to "fly" replicas of their orbital mission. In non-Mercury projects, efforts were made at the Laboratory to develop advanced means of protection against very high g forces, one means being a water-filled "iron-maiden" which permits protection against as much as 31 g's of acceleration force over comparatively long (5-sec.) periods of time.

Six medical officers were selected to conduct medical monitoring and surveillance of the Mercury capsules in flight. They, along with other Department of Defense medical personnel, will man the world-wide net of tracking and monitoring stations when the Mercury flights take place. These officers were intensively trained in medical aspects of orbital flight and are expected to provide a pool of knowhow for future space-flight operations.

In order to participate fully in the development of military space technologies—particularly in the development of a capability for this nation's projected manned-space-flight program—a naval flight surgeon was selected for assignment to full-time duty with the Flight Systems Division, Manned Satellites, Goddard Space Flight Center, Langley Field, Va. On this Project Mercury assignment, the flight surgeon and a psychologist will work with the seven astronauts—four of whom are naval aviators—in human-factor studies. - U. S. Navy Medical News Letter.

STRANGER Completes Asian Study Cruise

The oceanographic survey ship, STRANGER, as reported by the "TIMES OF VIET NAM" (a weekly magazine) is no longer a stranger to the Vietnamese fisherman, oceanographers, and educators. This 138-foot, 300-ton, yellow and white research vessel from Scripps Institution of Oceanography, has just completed one and a half years of scientific work in the South China Sea and the Gulf of Thailand. This cooperative oceanographic expedition was sponsored jointly by South Viet Nam, Thailand, Scripps Institution of Oceanography and the American Aid Mission. The scientists aboard the vessel were working under contract to the International Cooperation Administration on a joint marine research program.

The cruises, covering the entire coast of Viet Nam in all seasons, completed a descriptive survey of the coastal waters and collected thousands of hydrographic measurements and biological specimens. A thorough study was made of the monsoons and their influence on marine life; also a study was conducted on the relationships of water temperature, currents, tidal flow, and other factors affecting the migration and behavior of marine life. Measurements of ocean depths made by the STRANGER will help to make navigation safer in the much-travelled South China Sea. Knowledge gained on this expedition relating to the

patterns of upwelling could greatly benefit the peoples of South East Asia, according to Boon Indranbarya, Chief of the Thai Fisheries Department. The plentiful supply of sea food that such knowledge could insure, he said, would supplement diets with much-needed protein.

According to Captain James Faughn, skipper of the STRANGER, the year and a half descriptive cruise will be followed by a detailed analysis of the collected data at the Scripps Institution, the Oceanographic Institute of Nha Trang, South Viet Nam, and the Chulalong Korn University in Bangkok. A two-volume report on the expedition is expected to be published by Scripps in November 1961.

Peacetime Use for a Midget Sub

The Navy has several projects underway for which it is desirable to have a birds-eye view of a submarine operating on and below the surface. The (NRL) research involves the origin and structure of waves, light penetration through water, underwater visibility, and similar phenomena. The availability of an experimental midget submarine, the X-1 mothballed at Portsmouth, answered the problem of the underwater vehicle. And the Chesapeake Bay Bridge, near Annapolis, provides an ideal support for a combination observation-eyrie and instrument shack. The three-man submarine was checked out operationally, and last month the 50-foot enclosed platform was hoisted to the underside of the Bay Bridge at a point 70 feet above the eastern channel (see photos on inside front cover).

Hydraulic Ring Tensile Tester

Lightweight fiberglass rocket-motor chambers, reinforced with nonwoven glass fibers (roving), are destined soon to become standard equipment for space vehicles. Chambers of this description may cost only a fourth as much and be up to three times as strong on a weight basis as metal chambers presently in use. This prediction comes from chemists at the Naval Ordnance Laboratory, Silver Spring, Maryland, who have developed a test device for studying fiberglass. It is part of an NOL program to evaluate parallel glass fibers as reinforcement for plastic pressure vessels, of which rocket motor chambers are a prime example.

Called the "NOL Hydraulic Ring Tensile Tester", the new test device is being used to develop a body of quality control data needed to define more precisely the strength and environmental resistance properties of parallel glass filament for reinforcing plastics. These data will ultimately be used in the preparation of specifications for glass roving for reinforcing plastics. The tensile tester is a pressure-tight housing in which fiberglass test hoops are hydraulically ruptured. Data collected with the tester in this manner are used to determine the hoops' tensile strength and modulus of elasticity. In many cases, these data are directly applicable to the design of large rocket-motor chambers, since the test hoops and chambers are similar in shape.

On the Naval Research Reserve

Aerospace Medicine Seminar

The Fifth Annual Research Reserve Seminar at the U. S. Naval School of Aviation Medicine, Pensacola, Florida, adopted a new concept for this year: a seminar on Aerospace Medicine. A record number of 92 reserve officers of all services participated: 67 Navy, 20 Air Force and 5 from the Army. The seminar was designed for nonmedical officers as well as for staff corps medical officers and those qualified in sciences allied to medicine. Accordingly, many scientific disciplines were represented, including psychology, biochemistry, biology, medicine, engineering, physics, bacteriology, chemistry, physiology and opthalmology.

This two-week seminar, which convened 13 March, 1961, was sponsored by the Office of Naval Research in conjunction with the Naval Air Training Command and the U. S. Naval School of Aviation Medicine. CDR Henry A. Imus, MC, USNR, planned and organized this timely seminar as well as initiating its predecessor, the Aviation Medicine Seminar, in 1956. In a civilian capacity Dr. Imus serves as Assistant Director of Research at the School of Aviation Medicine. Assisting him in the course of the seminar was CDR Richard Trumbull, USNR, Head of the Physiological Psychology Branch in the Office of Naval Research.

The seminar was opened by RADM J. L. Holland, MC, USN, Commanding Officer of the U. S. Naval Aviation Medical Center. He welcomed the conferees and extended greetings on behalf of VADM Robert Goldthwaite, USN, Chief of Naval Air Training. An excellent description of the Training Command was made by CAPT W. E. Fly, USN, Plans Officer. In the afternoon, CAPT C. P. Phoebus, MC, USN, Commanding Officer, U. S. Naval School of Aviation Medicine, outlined the role of the Navy in bioastronautics. The first day's program concluded with a talk by RADM L. D. Coates, USN, Chief of Naval Research, on "Research and the Future Navy."

Tour of the human disorientation device at the Aerospace Medicine Seminar.

The following nine days of the seminar were devoted to the latest developments in aerospace medicine related to space travel by primates and human beings. Excellent presentations were made by scientists from the Naval Air Training Command and the School of Aviation Medicine on basic satellite physics, biological factors in space flights, exotic environments, radiation hazards in the Van Allen Belts and in outer space, early experimentation with ballistic missiles, physiological, psychological and psychiatric factors in space flight, and future developments in bioastronautics. Visits to research laboratories gave conferees a first-hand view of activities described in presentations.

Representatives from industry presented problems and developments related to space travel from the psychological and engineering viewpoints. Dr. James D. Hardy, a recent selectee for RADM, USNR, (Research Reviews, March 1961), presented a thought-provoking discussion of military pilot training of the future. From the Office of Naval Research were CAPT Joseph Pollard, MC, USN, "Basic Research in Support of Bioastronautics" and CAPT Julius Jockusch, Jr., USNR, "The Research Reserve Program."

Excellent tours were made to nearby air fields: Saufley Field, Whiting Field, Ellyson Field, and Eglin Air Force Base. Tours of these fields consisted of presentations on training programs, visits to research laboratories and observation of operations. One full day was spent aboard the aircraft carrier, USS ANTIETAM. Presentations were made by staff members and observations of landings and take-offs were viewed.

On the social side, a "happy hour" was held at the conclusion of the first day of the seminar, a fish-fry later in the week at the Barrancas Beach Club, and a dinner meeting in the second week at Mustin Beach Club. The address of the dinner meeting was made by Dr. Ernst Stuhlinger, Director, Research Projects Division, Geroge C. Marshall Space Flight Center, Huntsville, Alabama.

Oceanography Seminar

One hundred sixty-four reserve officers in the THIRD Naval District attended an outstanding two-day Research Reserve seminar on Oceanography on 7-8 April on the campus of Columbia University. The seminar was planned and conducted by Naval Reserve Research Company 3-8, New York, under the command of CAPT Edgar O'Neil, USNR. The excellent presentation of this seminar was due largely to the efforts of the general chairman, CDR Dewitt D. Wise, USNR, a member of NRRC 3-8.

RADM L. D. Coates, USN, Chief of Naval Research particpated in the welcoming ceremonies along with other representatives from the Navy and Columbia University. The two-day seminar was divided into four sessions which were chaired by authorities in the area:

The Geology of the North and South Atlantic, the Arctic and Antarctic Oceans	Chairman:	Dr. Maurice Ewing
Sediments of the North and South Atlantic, the Arctic and Antarctic Oceans	Chairman:	Dr. Bruce C. Heezen
Biological Oceanography	Chairman:	Dr. Charles J. Fish
Physical and Chemical Oceanography	Chairman:	Dr. Columbus Iselin

Group Training at Redstone Arsenal

Reserve officers who visited Redstone Arsenal are: (Left to right) LT R. W. Cloyd, LCDR P. P. Holz, LCDR W. J. Leonard, LT A. C. Morris, LCDR H. C. Francke, LCDR D. S. Zachry, Jr., LT C. G. Westendorff, CDR C. O. Smith, LTJG L. B. Mackin, Jr., and LT H. E. Cochran.

Ten officers of Naval Reserve Research Company 6-3 of Oak Ridge, Tennessee, spent a group active duty tour at the U. S. Army Ordnance Missile Command, Redstone Arsenal, Hunstsville, Alabama, on 23-25 February 1961.

The tour was well planned by CDR C. A. Buist, Jr., USNR, Commanding Officer NRRC 6-17 of Huntsville in conjunction with the protocol officer of the base. Included in the program were briefings by the Army Ballistic Missile Agency and the Army Rocket and Guided Missile Agency. A visit to the fabrication, assembly, and static-engine test tower areas (including witnessing a test firing of an engine) of the National Aeronautics and Space Agency's SATURN project gave an informative insight into the latest state of the space-age art. A closing session at the Ordnance Guided Missile School gave an excellent look at the training methods in use and provided answers to questions on items seen earlier in the day.

Selections for Promotion in Staff Corps

The March issue of Naval Research Reviews listed line officers of the Research Reserve who were selected for promotion to the grades of Captain and Commander. The Chief of Naval Personnel subsequently released the named of officers selected for Captain and Commander in the various staff corps. Congratulations are extended to the following two Research Reserve officers who were selected for Commander in the Staff Corps:

Mark K. Baum	NRRC 13-6 (Medical Corps)
Russell C. Mills	NRRC 9-20 (Medical Service Corps)

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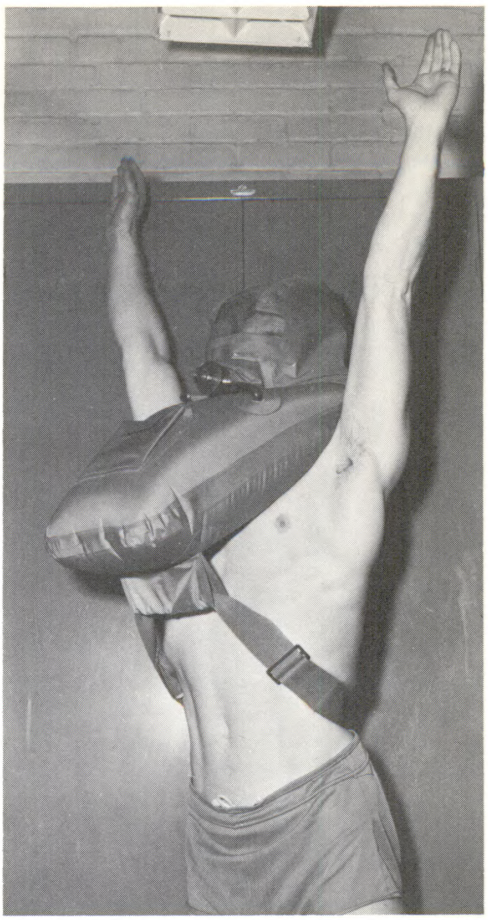
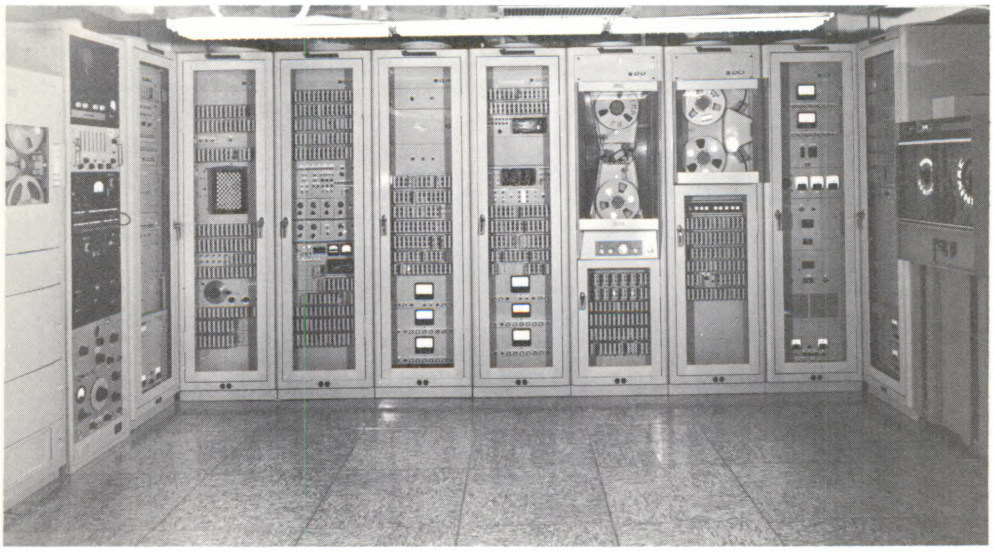


The new Steinke Hood that was used recently to establish a new record escape ascent (see story on pages 25 and 26).



The Computer Data Format Translator, recently installed at the David Taylor Model Basin, is capable of translating analog data to digital data (see story on page 24).

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.

Accumulation of ice aboard the USCGC YAKUTAT after a January storm in the North Atlantic, see pp. 1-7. (Photo courtesy U. S. Coast Guard).