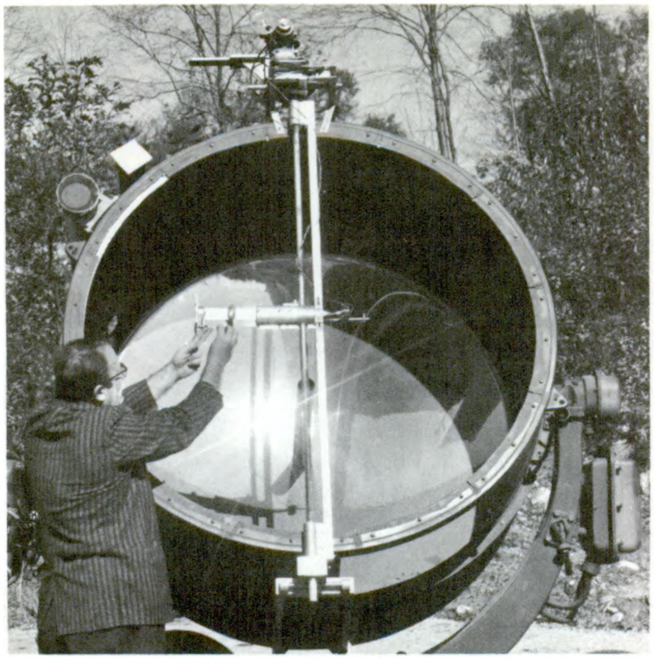
NAVAL RESEARCH REVIEWS

DECEMBER 1960

New Use for Surplus Searchlight



A surplus Army searchlight modified for use as a solar furnace in nuclear-age research may someday be largely responsible for improvements in metals used for submarine construction, nuclear reactors, missiles, and space ships. Researchers at General Dynamics Corporation's Electric Boat Division--builders of nuclear-powered submarines from the pioneering USS NAUTILUS to the Polaris-firing USS PATRICK HENRY--are using the 60-inch-diameter searchlight to test the ability of metals and other materials to withstand the effects of extreme heat.

In its role as a solar furnace, the converted searchlight is capable of reflecting the sun's rays to a focal point of more than 6500 degrees Fahrenheit. In many instances, the melting points of certain materials are unknown--the furnace may supply the answers. Soaking up solar energy in an area adjacent to the Division's Research and Development Laboratory, the furnace provides an effective and relatively inexpensive means of measuring quantitatively the properties of various materials. Information is noted by a series of electronic recorders that have been attached to the furnace in place of its searchlight accessories.

Although still retaining its basic searchlight appearance, the furnace has a long observation tube passing through its center from front to rear. Samples of materials to be tested are mounted in a movable holder attached to the tube. Test progress can be watched--with the aid of dark glasses--through the tube from behind the furnace. Furnace projects include metal-fatigue studies of welding materials used in submarines and the synthesizing of potential new materials to serve as thermoelectric cooling elements. Dynamics researchers also plan to use the furnace in studies of metal thermoconductivity and in the examination of solar radiation and its effects on photosynthesis.

The Division is currently engaged in research work with a photosynthetic gas exchanger aimed at the development of a system permitting man to rely on algae cultures for food and oxygen during travels into outer space. About the only drawback to maximum use of the furnace, say Electric Boat researchers, is the weather. When it rains, the furnace takes it easy for a while.

Setting up the ARLIS-1 campsite, with the USS BURTON ISLAND alongside the ice floe.

ARLIS-1: Seven Men On An Ice Floe

In September the Navy established a seven-man scientific research station on an 8-foot-thick ice floe in the Beaufort Sea—some 420 nautical miles northeast of Point Barrow, Alaska, at about 75 degrees north latitude and 136 degrees west longitude. Dubbed ARLIS-1 for Arctic Research Laboratory Ice Station Number 1, the floating station was established directly from the 6000-ton Navy icebreaker USS BURTON ISLAND (AGB-1). The Navy is duly proud of its accomplishment because, in establishing this scientific camp on an ice floe, the BURTON ISLAND penetrated farther into the arctic icepack than any other previous ship under her own power.

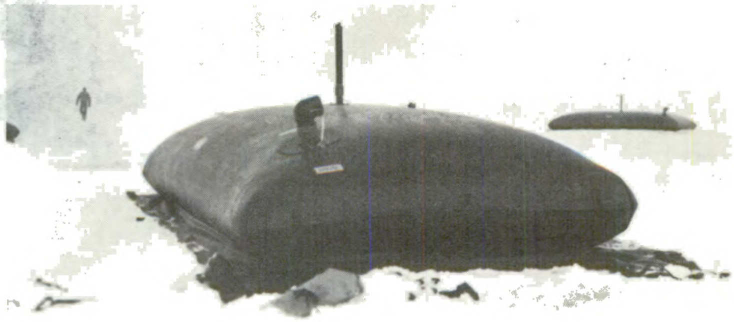
The six arctic scientists and one Alaskan native maintenance man landed on the ice floe, approximately 2.3 by 3.5 miles in size, on September 10. With the assistance of crew members from the icebreaker, which carries a complement of 204 men and 15 officers, they assembled 10 prefabricated buildings to serve both as laboratories and housing and made the campsite shipshape in just 2 days. Highly significant, too, was the fact that the scientists were doing research in 6 days after the BURTON ISLAND came alongside the ice floe.

ARLIS-1 was planned and set up by the Arctic Research Laboratory (ARL), Point Barrow, Alaska. ARL, directed by Mr. Max C. Brewer, is operated for the Office of Naval Research (ONR) by the University of Alaska. The latest word from ONR, concerning ARLIS-1, is to the effect that the civilian scientists will remain on the ice floe "as long as it proves to be scientifically productive." Five of the six scientists are from the University of Washington. They are Dr. Kenneth Bennington, ice physicist and station leader; Dr. Charles Knight, ice physicist and assistant station leader; Mr. George E. Brayton, oceanographer; Mr.

Key men in establishing ARLIS-1: CDR Griffith C. Evans, Jr., Commanding Officer, USS BURTON ISLAND (on the left); LCDR William Deacon, III, Executive Officer, USS BURTON ISLAND; Mr. Max Brewer, Director, Arctic Research Laboratory; Mr. Don Stevens, Scripps Institution of Oceanography Representative at Point Barrow; Dr. Kenneth Bennington, University of Washington, ice physicicist and station leader, ARLIS-1.

Arnold M. Hanson, micrometeorologist; and Mr. Robert W. Ditzler, micrometeorologist and radio operator. The sixth scientist is from the University of Southern California; he is Mr. John Tibbs, marine biologist. Serving as ARLIS-1's maintenance man is Mr. Frank Akpik, of Barrow, Alaska. An eighth man, a cook, was scheduled to be a member of the party, but he lost his enthusiasm at the last moment. A cook will be added as soon as aircraft landings are possible. Other scientists aboard the BURTON ISLAND, commanded by CDR Griffith C. Evans, Jr., conducted related research programs as the ice breaker moved about in the Arctic Basin.

Supplies being stored in a prefabricated building on the floating station.



They brought their own fuel supply and stored it in three plastic tanks.

The scientists are on the ice floe to conduct research programs in physical oceanography, micrometeorology, sea-ice physics and crystal orientation, marine biology, and some marine geology and geophysics.

Previous to establishing the station, ski-equipped aircraft were flown to the icepack by ARL for short-term investigations. ARLIS-1, therefore, demonstrates a new and important method for establishing research stations on ice floes. Commenting in regard to the operation, RADM Rawson Bennett, III, Chief of Naval Research, said: "ARLIS-1 is part of the continuing Navy effort to understand the rigorous arctic environment. The valuable information that will be obtained will add to the fund of knowledge the Navy must have to carry on operations in this vital, militarily strategic area." In the role of ice forecaster and task-unit coordinator aboard the BURTON ISLAND, ARL Director Brewer said: "Establishment of the station has far-reaching significance, both from a scientific and an operational standpoint."

Intensive planning went into the selection of a suitable ice floe for ARLIS-1. ARL scientists, familiar with the icepack, flew over possible areas in Navy P2V reconnaissance planes from Kodiak, Alaska, and made tentative selections. On the basis of information gathered from these flights, a final selection was made by Mr. Brewer, Dr. Bennington, and LCDR William Deacon, III, Executive Officer of the ice breaker, flying in one of the two choppers carried aboard the BURTON ISLAND.

Flag-raising ceremony, ARLIS-1--the first ice-floe station ever established by ship. Note one saluter in the foreground is coffee-cup equipped.

They selected the smaller of two suitable ic
thin floe and, according to Mr. Brewer, only

Plenty of hustle was a must in sett ..., and all hands—men ranging from the executive offic ...an and civilians—heaved around such equipment as electric generators, weighing 3400 pounds, and hauled them around potholes that the weasel could not negotiate because of soft ice. All told, 65 tons of prefabricated buildings and supplies were hauled the quarter mile from the ship to the campsite. CDR Evans described the operation "the finest display of teamwork I've seen during six commands in the Navy." The largest single piece of equipment on the ice floe is the weasel, which is also the only motorized vehicle available. The bulkiest items on the ice floe, of course, are the prefabricated buildings—each measures 12 by 16 feet with a 7-foot ceiling. The station is supplied with more than 10,000 gallons of bulk fuel from the BURTON ISLAND stored in three plastic storage tanks. Necessary supply items needed by the seven men are being airdropped by ARL aircraft.

Some statistics pertaining to the movement of ARLIS-1 might be interesting. The ice floe, which has been steadily drifting in a westerly direction since the station was established, traveled 215 nautical miles during October. Its position on October 1 was 75° 00.0' N and 140° 35' W. Its position on October 31 was 74°36.6' N and 148°53' W. Its latest position (as of November 27): 74°18' N and 153°6' W.

CDR Evans adequately sums up the worth of ARLIS-1: "The most significant single factor of the entire operation was that the BURTON ISLAND could operate inside the polar pack with complete facility."—BHR.

Awards Presented for Development of SPASUR System

Two Naval Research Laboratory Scientists, Mr. Roger L. Easton and Mr. James J. Fleming, received Distinguished Civilian Service Awards and CAPT Winfred E. Berg, USN, received the U. S. Navy Legion of Merit Award during a Pentagon ceremony November 17 in the office of the Honorable James H. Wakelin, Assistant Secretary of the Navy (Research and Development). The awards were presented in recognition of leadership and major contributions of the three men to the successful and timely completion of the Navy's Space Surveillance (SPASUR) System in less than one year.

Mr. Easton, who came to work at NRL in 1943, is presently responsible for the detection portion of the Navy's nonradiating satellite tracking program. Mr. Fleming has been at NRL since 1941, and Head of the Operational Research Branch since 1945. CAPT Berg who was Senior Program Officer for the SPASUR System was cited for exceptionally meritorious conduct in the performance of outstanding service to both Project Vanguard and the SPASUR System while at NRL.

...ical Warfare*

[... ...ot to be construed as indicating that the Off... ...Research or the Department of the Navy is prep... to use BW agents as military weapons, or is recommending their use. The Navy does recognize, however, that biological warfare has immense capabilities in the hands of an unscrupulous enemy, and the best deterrent to its employment is an equally powerful capability of retaliation. It was just such a retaliatory capability that prevented the use, by either friend or enemy, of poison gas in World War II--Ed.]

Since biological warfare (BW) has never been used on a significant scale, a definite evaluation of its effectiveness is difficult. Different standards must be used for the three major types of biological warfare: antipersonnel, antianimal, and antiplant BW. Experimental results with antianimal and anticrop BW agents have indicated that these agents would be highly effective in reducing or destroying the food supplies of a nation—provided a suitable means for delivery of the BW agents on target were employed. So far as antipersonnel BW agents are concerned, evaluation is hindered by limitations on the amount and kind of experimentation that can be done and by the questionable validity of interpolating to human beings data obtained from animals. One unique property of antipersonnel BW agents is that they can be "tailored" to cause varying degrees of incapacitation, ranging from minor, temporary illness to death. The choice of agents and consequent effects will depend upon the objectives of the user.

A number of unfounded, often sensational claims have been made for and against BW. It is not logical to assume, nor is there any evidence to support claims that BW could wipe out entire populations or all forms of life on large and extensive targets. Likewise, the concept that BW is more horrible than other weapons systems is completely unjustified. In fact, if comparisons are to be made, it can be shown that military objectives can be attained with BW with fewer permanent-type casualties than with other known weapons systems. However, paucity of information concerning the actual value of BW in modern warfare should not lead to underestimating its potential. It is known that mass production of BW agents is possible and the cost of production is low compared with other munitions. Effective methods for artificial dissemination are certainly within the realm of engineering possibility.

By definition, biological warfare is the intentional military use of living microorganisms or toxic products to produce disability or death in man and other animals, or to injure or destroy food crops, or other economically important plants. It includes the use of insects and other pests because of their potential direct effect on target organisms and also because they may act as vectors of disease-producing organisms.

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*Based on an unpublished paper prepared by Dr. Roger D. Reid, Director, Biological Sciences Division, Office of Naval Research.

For convenience, plant-growth-regulating substances are included in the area of BW agents.

The primary target of biological warfare is man, but the means of attack may be direct or indirect. Direct attacks would employ infectious or toxic agents to cause incapacitation or death in humans. This is antipersonnel BW. Indirect application of BW would utilize agents which have the capacity to reduce or destroy agricultural crops and domestic animals. This is conveniently referred to as antifood BW. BW is always directed toward living things and does not have any destructive effect on materiel, buildings, churches, architectural and art treasures, factories, railroads, and the like, which may have postwar value and importance in reconstruction and rehabilitation.

Probably only a few of the known pathogenic microorganisms would be suitable for use as biological warfare agents, because of unusual factors which may be encountered. These include stability of agents under adverse meteorological conditions, the production of aerosols of suitable particle size to cause infection, and inherent natural immunity or resistance of target host.

Although the military effectiveness of biological warfare has never been established by actual use in war, there is evidence that limited, improvised attempts have been made to spread disease to gain military objectives. Among these were attempts during the Middle Ages to spread plague by contaminating certain areas and water supplies with diseased corpses. During the French and Indian Wars, smallpox was transmitted to the Indians on blankets intentionally infected with exudates of the disease. Also during World War I, the Germans infected horses with glanders in order to spread the disease in animals used by the AEF. It has been claimed by the Chinese that in 1940 Japanese aircraft dropped plague-infested fleas and grain as a means of initiating epidemics. The importance of naturally occurring epidemic disease in influencing the outcome of war emphasizes the need for giving serious consideration to the possibility that human diseases, spread artificially and introduced in high concentrations through an unnatural portal of entry, may be decisive factors. Shortages of food, medicinal, and other products obtained from plants or animals may also have a profound effect upon a nation's ability, or will, to wage war.

PROPERTIES OF BW AGENTS

Many BW agents, especially the pathogenic microorganisms, have characteristics not generally possessed by other types of munitions. These are:

- Their action is not immediate and may be delayed for several days or longer.

- BW agents are difficult to detect and identify.

- They may reproduce and multiply in the host.

- Some may spread from the initial target to secondary hosts, thereby establishing epidemics.

- Their activity may be much greater than for the same weight or volume of other weapons, but this activity is limited by their ability to survive and maintain virulence when exposed to air, light, heat, cold, desiccation and unnatural methods of dissemination.

- Their ability to overcome resistance of the target host.

- BW agents are highly selective in their action on host targets.

CLASSIFICATIONS OF BW AGENTS

Classifications are not based on hard and fast rules and are subject to such considerations as host susceptibility and resistance, environmental factors, and operational considerations. However, differentiations are useful: type and kind of agent; nature of the host target; severity of results desired; persistance of agents; virulence of agents, their communicability or epidemic-producing potential; and their use in tactical or strategic situations.

BW agents are classified biologically as microorganisms (bacteria, viruses, rickettsiae, fungi, or protozoa) and according to the toxic products produced by living organisms (microbial toxins, phytotoxins, or zootoxins). Pests harmful to animals and plants are also included and are further classified as to whether their effect is direct or if they are merely vectors of pathogenic microorganisms. Finally, there are compounds that inhibit or prevent the growth of crops. A type of biological warfare frequently overlooked is that which makes food and material unusable by infestation, deterioration, or contamination.

BW agents are highly selective in their ability to attack host targets. Many antipersonnel agents are highly specific and would produce disease only in humans whereas some antianimal agents will not infect man. There is some overlapping between these two types; for example, the agents of anthrax (carbunclelike) and brucellosis (undulant fever) infect man and certain species of domestic animals. Anticrop BW agents are highly specific and may cause disease in a single species, even a strain or race, of plants and never cause infection in man or other animals.

BW agents may be further classified according to their lethal effects on susceptible hosts. As mentioned earlier, BW may cause death of target host organisms, or illness of varying degrees of severity. No firm line can be drawn between strictly lethal and strictly nonlethal agents used against man and animals, because of variability of virulence, dosage, portals of entry of the agent, and resistance or susceptibility factors of the host.

BW agents vary widely in their ability to survive and remain infectious or toxic after dissemination. In general, the vegetative form of microorganisms and their toxins are highly susceptible to heat, light, moisture, and desiccation, while those capable of forming spores—such as clostridia and fungi—are comparatively resistant.

The relative infectiousness of a disease-producing organism is its virulence. Since highly virulent strains would be the most effective BW agents, attempts to increase virulence may be anticipated. Efforts will also probably be made to develop strains of microorganisms that are unusually resistant to treatment by drugs. Two or more kinds of organisms may be used together to enhance the coordinated production of disease. Other techniques may also be devised to increase the effect of normally nonvirulent or slightly virulent agents. An important consideration in this respect is the possibility of enhanced virulence or increased severity of host response by introducing the agents into the host by an unnatural portal of entry—such as an intestinal organism inhaled into the respiratory tract.

If biological warfare were used, it would be expected that the results would depend upon an initial infection of large numbers of people, animals, or plants. An initial outbreak of the disease would depend upon large-scale dissemination of the agents upon a susceptible population. Biological warfare is thus primarily a strategic weapon because it rarely has an immediate or "quick-kill" effect. This is because infectious agents require an incubation period before the symptoms are apparent. For this reason, they are better suited to attacks on large population centers or concentrations of animals or food crops than for hand-to-hand or tactical use.

REQUIREMENTS OF BW AGENTS

Effective biological warfare agents must possess certain characteristics that enable them to produce desired effects on host targets and to survive and operate under a wide range of environmental conditions. Probably no single agent will meet all the desired requirements; therefore, some compromise must be made between optimum and minimum limits that would be acceptable. The following requirements are probably the most important and essential properties in a BW agent.

- The agent should consistently produce disability, damage, or death in susceptible targets.

- It should be stable under conditions likely to be found in storage and transportation.

- It should lend itself to effective dissemination by known methods, equipment, or munitions.

- It should be resistant to "decay" after dissemination from a munition.

- Economical production of the agent in large quantities should be possible.

The following requirements are desirable but not essential characteristics of a BW agent.

- It should be possible to protect the user from the agent during preparation, storage, and use.

- It should be difficult for the enemy to detect or protect against it.

- The incubation period should be predictable and short.
- After dissemination, the persistence of the agent should be predictable.
- The agent should be capable of producing results when introduced into the host target by various portals of entry.
- It should be able to withstand dissemination by various methods.
- It should complement or supplement tactical weapons.
- It should produce desirable psychological effects.

Much of the present information on the production and behavior of BW agents is based on results obtained by the use of simulant agents—microorganisms or toxic compounds resembling true BW agents in all respects other than causing disease or being poisonous.

DETECTION AND IDENTIFICATION

BW agents cannot be detected by any of man's five senses. The first hint of BW attack may be by observing smoke, mists, unusual munitions, or unusual carriers of microorganisms. The first knowledge of an attack might be the appearance of an unusually high occurrence of disease in host targets. The molecular filter technique is the most promising method for the rapid detection of potential BW agents. This method may be used for relatively rapid identification of some bacterial agents. Identification of BW agents may be complicated by the use of unusual disease agents, administration through unusual portals of entry, the use of exceptionally high infective doses, and mixtures of various agents. Absolute identification of BW attack may depend upon prolonged and intricate laboratory studies of material obtained in the target areas, requiring the specialized techniques of highly trained technicians. Appearance of characteristic symptoms in the host and its reaction to treatment may be helpful in establishing the identity of the agent used.

DEFENSE AGAINST BW

If it were possible to give each individual complete and solid immunity to all possible BW agents, even with an extremely high dosage and an unusual portal of entry, there would be no danger from BW used against man or animals. Antiplant BW could be complicated or simplified by the development of plants resistant to all infectious agents and pests. Since this is impossible, other resources must be considered. The best defense against BW may well be a strong retaliatory capability, closely associated with reliable information concerning an enemy's capability in the field and his intention of using BW. Probably the only defense against anticrop BW depends upon (1) preventing the introduction of plant pests or viruses into the country or (2) if introduced, detection early enough to allow for decontamination or disinfestation of fields.

Regarding antipersonnel BW agents, defense depends upon detection, physical protection, decontamination, immunization, and therapy. It is

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apparent that the present defense against BW is far from adequate. Developments in the control of naturally occurring infections will be useful in BW. Likewise, developments in BW defense will lead to advances in preventive medicine and epidemiology. Research in the field of BW has already contributed much to our knowledge of the control of disease and pests. Future developments in this field will unquestionably be of great value to personal and public health, agriculture, industry, and science in general.

Whether BW will ever be used in war is unanswerable, but knowledge of its capabilities and limitations is essential in developing adequate defenses and deterrents. Such information will also be useful in developing better controls, treatment, and understanding of infectious processes under peaceful natural conditions.

Burn Research Conference at NNMC

The First International Congress on Research in Burns, held recently at the National Naval Medical Center (NNMC), Bethesda, Md., was attended by more than 200 international leaders in the field. The Navy, through the Office of Naval Research, was host for the Congress--which was organized by the American Institute of Biological Sciences and financially supported by the Public Health Service, Department of Health, Education, and Welfare. The program was televised in its entirety by the NNMC closed-circuit TV system to military hospitals in the Washington area.

Honorary Chairman of the Congress, the Honorable Frank Berry, Assistant Secretary of Defense (Health and Medical), was joined by the Surgeons General of each of the Armed Forces and the Public Health Service, a representative of the American Institute of Biological Sciences, and the Commanding Officer of NNMC, in welcoming delegates from more than 17 countries, including Russia, Japan, Peru, and Yugoslavia.

The Congress, although the first of international scope, was the fourth such meeting on a national level which resulted from problems encountered during World War II. The last conference was held in 1955 at Brooke Army Medical Center, Fort Sam Houston, Texas, where considerable significant development in research in burns has been made.

Dr. Howard T. Karsner, Research Advisor to the Surgeon General of the Navy, was Chairman of the Planning Committee which invited reports from international authorities on important developments in research and clinical treatment of burns during the past 5 years. Dr. Curtis P. Artz, currently Associate Professor of Surgery, University of Mississippi Medical Center, and formerly an Army Medical Officer who contributed much to burn research at Brooke Army Medical Center, was Coordinator for the varied group of contributors to the Congress. Several reports came from civilian institutions working on this research problem through grants from the Office of Naval Research. A Naval Medical Department facility working in this field has been the Naval Medical Field Research Center, Camp Lejeune, N. C., where much investigation of the physiopathology of burns and burn shock has been conducted.--U. S. Navy Medical News Letter.

Ten Years of Navy Logistics Research*

William Marlow, Ph.D.
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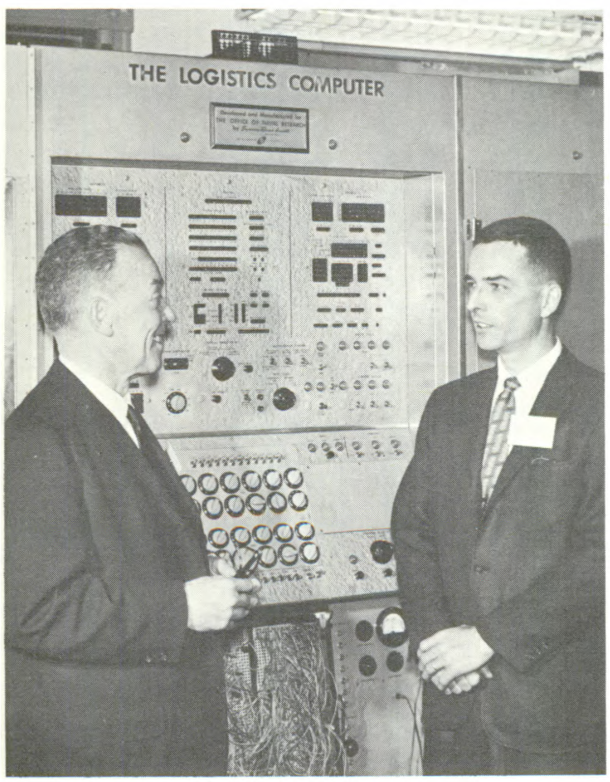
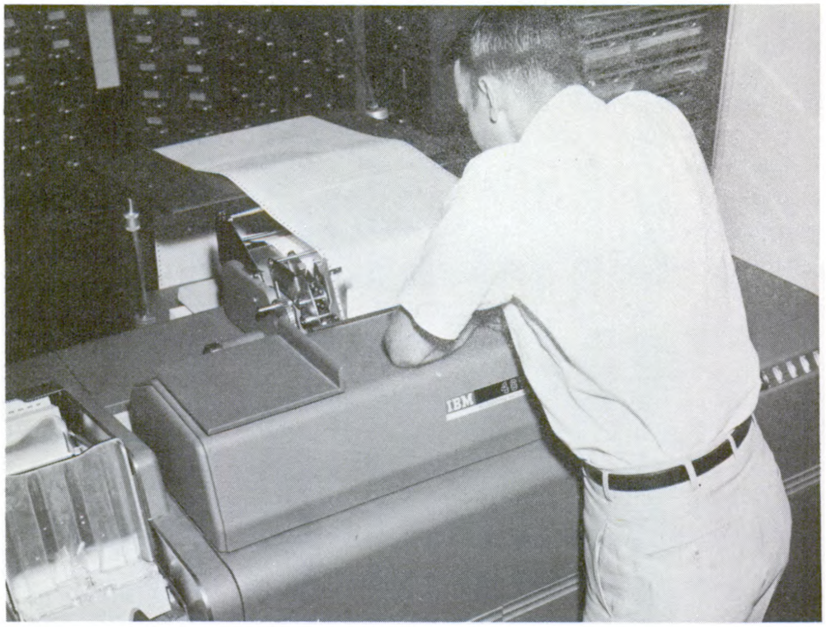
Washington, D. C.

One of the classic definitions of logistics is indicated by the following quotation: "Strategy and tactics provide the scheme for the conduct of military operations; logistics provides the means therefor." As military operations have become more complex so have their logistics become more demanding and more critical. The idea for conducting basic research in logistics had its origin during World War II when many persons engaged in logistics endeavors were dissatisfied with the working of the systems and methods then current. They concluded that it would be profitable to explore the application of scientific methods and automatic computing machinery so that not only could waste be reduced but solutions might be obtained for problems which hitherto had not been quantitatively studied. Principal examples of such problems were concerned with analysis of logistics plans in order to determine, during early stages in the planning process, detailed requirements and other consequences.



Acting University President Oswald S. Colclough is greeted by Dr. Marlow at a celebration of the tenth anniversary of the Navy Logistics Research Project. Behind them is the Logistics Computer developed and manufactured for the Office of Naval Research.

*From the Fall, 1960, Federalist, The George Washington University, and used by permission of the author.



The tabulating machine prints for Gordon J. Morgan, Research Associate, the results of questions asked the computer.

The foregoing briefly describes the background of the U. S. Navy Logistics Research Project which is now in its eleventh year of operation at The George Washington University, Washington, D. C. This project, which occupies Staughton Hall on the GWU campus, functions under the leadership of a Principal Investigator and under the general supervision of the Dean for Sponsored Research. It operates under contracts between the University and the Office of Naval Research, where its scientific administration is functionally directed by the Head, Logistics and Mathematical Statistics Branch. Project staff members are drawn from the fields of mathematics, statistics, economics, and engineering; in addition, there are included retired naval officers with long and varied experience in logistics matters.

The Project was founded in November 1949 in a University atmosphere in order to take advantage of well-established traditions and techniques of successful University research. Furthermore, it was realized that to contribute effectively to the improvements of logistics practices, particularly on a long-range basis, the Project should be free from routine administrative duties. While the project has been set up in this way somewhat outside of "operating logistics structure" of the Navy, it has avoided working in a vacuum by means of maintaining close liaison with the naval activities which it serves. Indeed, many of the Project studies have been carried out jointly with military personnel.

From its beginning, the Project has been engaged in research on logistics data processing. Some of the earliest efforts led to the construction of an electronic computer which was an early application of the concept of tailoring a computer to a specific end use. Certain problems of logistics were analyzed, notably inventory record keeping and scheduling of detailed requirements to support programs of military construction, and these were used to fix the computer specifications. Since its delivery in early 1953, the Logistics Computer has been modified and extended in capability to reflect accumulated experience in logistics calculations and the rapidly evolving computer technology. The Logistics Computer as it exists today with its transistorized input-output devices bears little resemblance to the original machine. For a large segment of logistics problems, it remains unparalleled in the power of its application.

One of the areas in which the Project has had its greatest success and one in which it has contributed most significantly to problems of serious concern to the military is the area of line item logistics planning. The general problem here consists of devising means for setting "best" stock levels of individual items, "nuts and bolts," to

Daily maintenance work is done on the input-output section of the computer by Erwin J. Sobel, engineer in charge of the computer, and William E. Caves, senior technician. This section of the computer translates punch-card data into a form usable by the computer and transmits the converted data to the computer, and vice versa.

provide for uncertainly known future usages. For example, the "Allowance List Problem" consists of determining the actual list of repair parts to be carried on board ship for use by the crew in direct support of installed components. In the case of a conventional submarine, there are about 65,000 "pieces" to choose from and there is so little space available for stowage that only a few thousand can be carried. Another difficulty follows from the fact that it is not yet known how to predict future usage sufficiently accurately on the basis of past usage experience alone. That is, the Project has performed extensive analysis of historical usage data which it collected over several years and found that conventional predictive techniques were inapplicable. The only alternative consisted of providing means for introducing military worth measures: relative measures of importance of having available one item rather than another. Studies by the Project based on problems of a conventional submarine have demonstrated that it is possible to distinguish several categories of Military Worth. When these are augmented by data on past usages, it is possible to devise a "best" allowance list in the sense that the available space for stowage is most advantageously utilized by giving priority to "high worth" parts in order to provide maximum independence from any outside support. The results obtained during this research are being used to study more difficult problems of supply support and they are also being translated into operating practice by the Navy on a broad scale.

For several years the Project has been active in the area of scheduling ocean transportation. Basic relationships in transportation have been developed which have a profound influence on minimizing the number of ships that are required to meet specified future delivery schedules. The scheduling techniques devised by the Project yield schedules which satisfy the underlying "war plans" with the smallest possible number of ships. Indeed, attention is given to all phases of the transportation scheduling problem in the sense that at a given point in time, the total number of ships throughout the system are considered—whether loading in transit to delivery point, unloading, or in transit from delivery. In this work, the Project has worked in close connection with military planners with the result that not only have specific logistics plans been translated into numbers of ships required but also considerable information of a supporting nature has been produced. This supporting information enables better use to be made of available resources and also to bolster confidence in the underlying "war plans" themselves.

The first 10 years of the Project, which pretty well coincided with the first 10 years of logistics research, were marked by a Decennial Logistics Research Conference at the University in January 1960. This conference was attended by more than 100 representatives of universities, industrial organizations, and the military agencies concerned with logistics research. The central theme of this conference was empirical methods in logistics research. Such methods are characterized by the gathering of pertinent information and data on the logistics problems followed by searches for patterns, which are then exploited through numerical models. The Navy Logistics Research Project was able to report many instances of success from use of such techniques as typified by the military worth and transportation studies, described herein, which have served to reinforce the wisdom of having a University undertake a long-range program of sponsored basic research.

The modern aircraft carrier powered by eight nuclear reactors has the ability to run at top speed for 5 years without refueling.

POLARIS, the Navy's long-distance ballistic missile, represents the coordinated labor and thinking of 3000 firms, large and small.

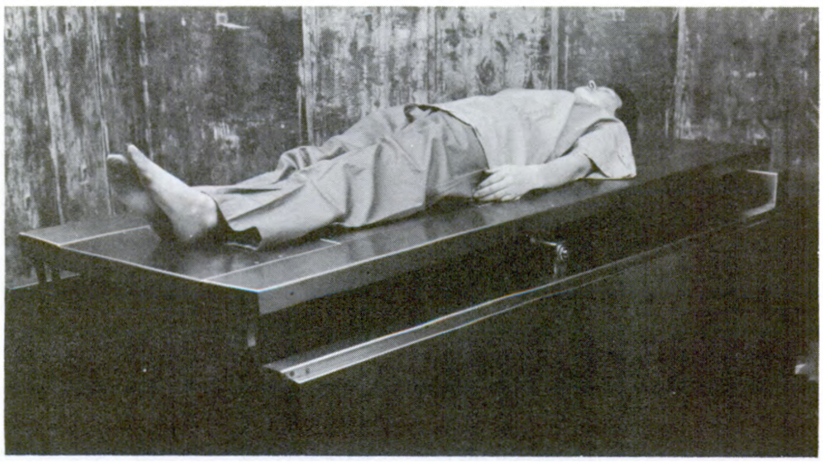
Radiation Exposure Evaluation Laboratory Established at National Naval Medical Center

The National Naval Medical Center in Bethesda, Md., now has the most complete and self-contained laboratory for the evaluation and treatment of victims of accidental exposure to radiation. The Navy, recognizing in 1957 that the increasing use of radioactive substances would cause a corresponding rise in the probability of accidental exposure to their harmful rays, instituted a crash program for such a laboratory, and on October 14, 1960, a $750,000, two-story facility was formally dedicated.

The four rooms of the whole-body, radiation-counting facility, encased in 16-ton, steel armorplate partitions, are located in the basement of the REEL building.

The Radiation Exposure Evaluation Laboratory (REEL), as it is called, is administered by the Department of Radiology of the U. S. Naval Hospital, National Naval Medical Center, and is under the direction of CAPT J. S. Burkle, MC, USN. The laboratory has facilities for an evaluation program of four phases. Two aspects of this program, hematology and chemical analysis, are concerned with the detection of changes in the nature and chemistry of blood and other body fluids, respectively. Another phase, pathology, has to do with the detection of changes in tissues, and includes autoradiographic studies. The "whole-body" counting aspect concerns the determination of the amount and source of radiation emitted by a person's body as a whole. In addition, the laboratory has three private hospital rooms and a small operating room for the treatment of victims of radiation exposure.

A unique feature of the whole-body radiation detection facility is the presence of four 8-foot cubicles, each encased in 8 inches of pre-1945 steel armor plate. This construction was necessary to exclude as much natural radiation from outside sources as possible, thus insuring an environment of low background-radioactivity. Pre-1945 steel (obtained from the Naval Ordnance Plant, South Charleston, W. Va.) was used because post-1945 steel is believed to be contaminated with minute quantities of cesium-137, a product of atomic-blast fallout. In addition, cobalt-60 is being used as a radioactive time-tag element in the firebricks of some blast furnaces, thus irradiating some new steel. The resultant radioactivity of post-1945 steel, however, is of extremely minute proportions, and is only of concern when extremely sensitive radiation-detection devices are to be used. By excluding as much outside radiation as possible (from cosmic rays, earth, air, walls, etc.), the doctors will know that the majority of the radiation detected has originated in the patient's body. To further this goal, each patient is required to undergo a very thorough scrubbing before being admitted into the steel cubicles. Communications between the steel rooms and the central control room consist of intercom and television systems.

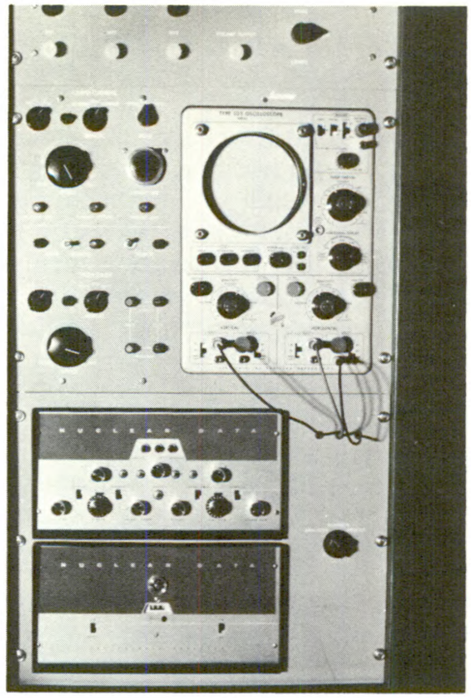


Patient in position on the plastic-crystal, whole-body radiation counter in the "quick and dirty" room.

Two of the steel rooms are equipped with sensitive radiation detectors. One cubicle is known as the "quick and dirty room" because in it a patient can receive a rapid quantitative evaluation. This room has a table containing three radiation-sensitive scintillating plastic crystals, each measuring 18 by 18 by 6 inches. These crystals are made of polyvinyltoluene. They are housed in stainless steel for durability, but this steel also effectively stops all but gamma rays, the most penetrating of the nuclear rays. This means that these crystals can detect the presence of gamma-ray-emitting natural potassium-40, found wherever natural potasium is found, and cesium-137, an atomic-fallout product found in all living things. However, they cannot detect the presence of beta-ray-emitting strontium-90 and carbon-14, two other radioactive constituents of living things.

A further evaluation of the patient can be made in the other room, which is equipped to determine and locate the source of the abnormal radioactivity detected in the quick and dirty room. This other room

Control panel for the 256-channel analyzer and display oscilloscope used in conjunction with the sodium-iodide crystal.



contains a sodium-iodide scintillating crystal that measures 8 by 8 by 4 inches. This crystal is mounted in a movable apparatus that permits it to be used for scanning purposes. This crystal also is sensitive only to gamma rays, but it, together with analyzing equipment, permits a qualitative, as well as a quantitative evaluation. The count rate in this crystal is slower than that of the plastic crystals, because the plastic crystals have a much greater volume and surface-area of sensitivity to radiation.

The information coming from the sodium-iodide crystal can be utilized in several different ways. A total-body count of the patient can be made by placing him in a horizontal arc-like position with the crystal fixed centrally over his body. The total-body count data is then put into the memory device of a 256-channel analyzer. Here the information can be translated into: (1) total counts per unit-time for each channel, or (2) energy values for each channel, as seen on an oscilloscope, from which gamma-emitting elements can be determined. Furthermore, these oscilloscope tracings can be recorded by the machine on graph paper.

The location of the source of any abnormal radiation detected by this method can then be narrowed by placing a slot collimator in front of the sodium iodide crystal to narrow down the field of detection. The crystal is then moved slowly along the length of the patient, who is now in a straightened position. This information is collected in a single-channel analyzer, where the counts per unit-time are shown on a rate-counter. If a permanent record is desired, the machine will plot these counts in profile form on graph paper. To pin point the source of radiation, a honeycomb collimator may be placed in front of the crystal to narrow the field of detection still further. Then the crystal is moved slowly across the patient's body (scanned) and the data is collected in the single-channel analyzer, where the counts per unit-time are again

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shown on a rate-counter and may be plotted by the machine as a series of dots on graph paper. This final evaluation can pin point the location to a small circumscribed area or even to one organ.

However, calibration of the detection instruments with known standard sources of radiation must be undertaken before any evaluations of patients can be made. Some of this calibration is being done by using a mannekin to simulate an actual patient. Following this, a continuing study to establish norms of radiation levels for a cross section of the population will be initiated. Meanwhile, the doctors at the laboratory are interested in evaluating any victims of accidental radiation exposure.

In addition, several special projects are planned or under way. These include: studies of patients undergoing cobalt-60, total-body radiation therapy, observations of changes in human chromosomes, studies of the changes following total-body irradiation both in the fibrinolytic system of the body and in the urinary excretion of certain amino acids, and bone-marrow preservation and transplantation research.

Furthermore, it is estimated that, by using the highly sensitive equipment in the shielded rooms, the diagnostic dosage of radioactive tracer-elements, such as iodine-131, can be reduced to one-tenth that normally required when the usual 2-inch, sodium-iodide crystal is used for radiation detection in a room less impervious to nuclear rays.—CEF.

Continued R&D of BUMBLEBEE Missiles

The Applied Physics Laboratory (APL) of the Johns Hopkins University Silver Spring, Maryland, has been awarded a Navy contract for continued research and development of guided missiles--which encompasses a continuation of the BUMBLEBEE program and the performance of some work related to the POLARIS fleet ballistic missile. The BUMBLEBEE project was assigned to APL in 1944, when the Pacific Fleet was being attacked by the Japanese kamikaze aircraft, to develop better air defense systems for U. S. ships. The surface-to-air guided missiles--TERRIER, TARTAR, TALOS, and TYPHON--are results of this program.

In 1956 TERRIER became the first of the BUMBLEBEE group to join the Fleet. On May 28, 1958, with the commissioning of the USS GALVESTON (CIG-3), TALOS, too, was operational. TARTAR, designed for use aboard destroyer-type ships, has been installed in the USS CHARLES F. ADAMS, commissioned last September and scheduled to become operational in the Fleet by the end of 1960.

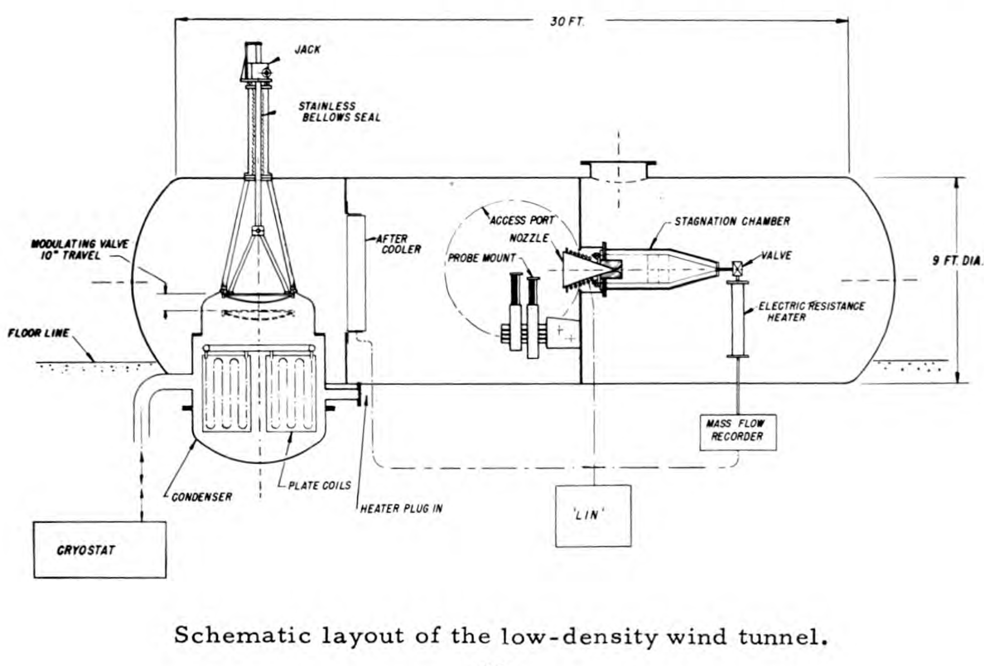
TYPHON is the new designation for advanced versions of TALOS and TARTAR missile systems which are still in the design and development phase. Super-TALOS has been renamed Long-Range TYPHON. Super-TARTAR is now Medium-Range TYPHON.

Dr. Chuan's Wind Tunnel

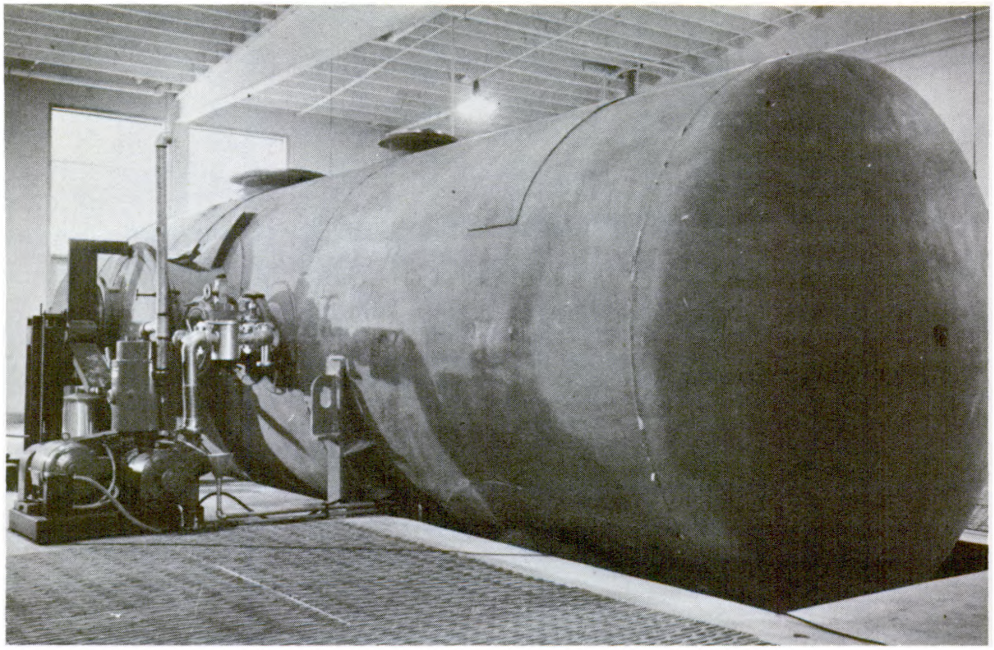
Professor Raymond L. Chuan, Director of the Engineering Center at the University of Southern California, has developed a wind tunnel capable of producing near-flight conditions at 50- to 60-mile altitude. A nozzle with a one-meter-diameter exit produces air velocities of 450,000 centimeters per second at one micron of pressure with a total-energy temperature near 4000 degrees Kelvin. This facility, now administered under an Air Force contract, was originated and developed under Office of Naval Research support. Its history began in a CalTech thesis by Dr. Chuan in 1953—in which Dr. Chuan demonstrated the principle of producing high vacuum by means of a condensation process.

In his experimental work, Dr. Chuan operated a small low-density tunnel by a steam condensation process. The need for a wind tunnel of sufficiently low density to clearly demonstrate rarefaction effects led Dr. Chuan to propose a feasibility study program which ONR supported. This study led to the design of a hypersonic low-density wind tunnel with air or nitrogen as the working medium. The enormous pumping rate required of such a facility is achieved by condensing the air into plates kept at 20 degrees Kelvin by a helium refrigerator. This process of admitting nitrogen gas to the wind tunnel and collecting it by freezing netted Dr. Chuan the friendly title of the "ice man" among wind-tunnel researchers. In principle, the frozen solid nitrogen could be shoveled back into the supply for re-use, but low-cost supplies made it unnecessary. A byproduct of the systems, however, is nitrogen in a degree of purity unobtainable commercially.

The helium refrigerator is a modified Collins Machine, originally produced by Arthur D. Little, Inc., for recondensing hydrogen. The machine has a capacity of 350 watts at 20 degree Kelvin. Helium is

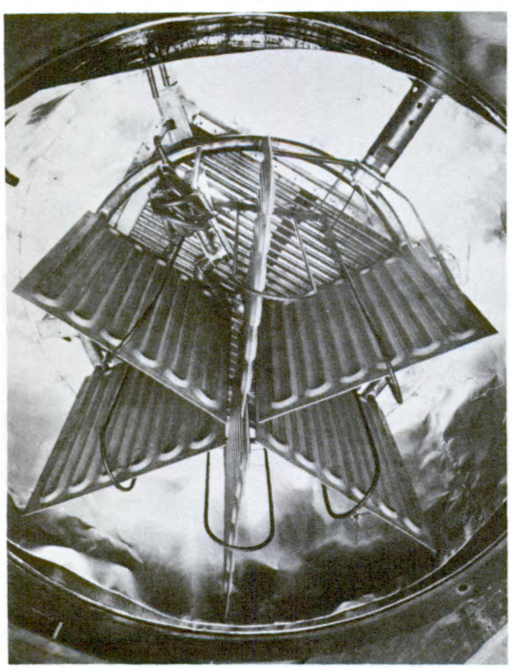


Schematic layout of the low-density wind tunnel.

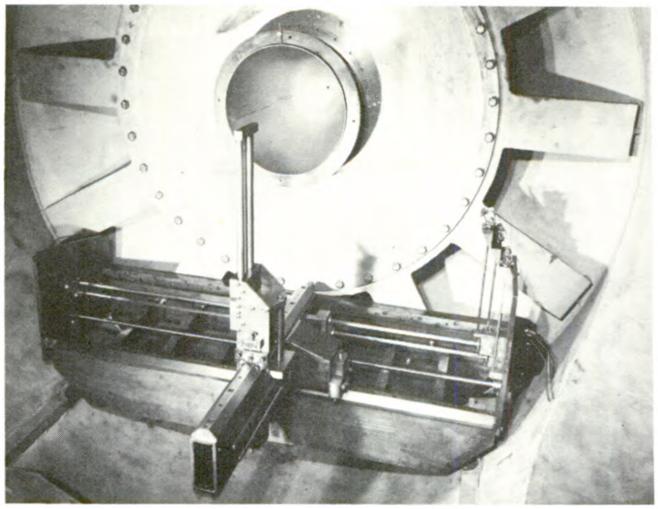


The wind tunnel, inside the laboratory building.

pumped through collection plates in the wind tunnel. The surface conversion temperature is near 20 degrees Kelvin, so that the nitrogen goes directly from the gaseous to the solid state on contact. The surface area is sufficient for 10 hours of operation. To increase efficiency in the system, liquid-nitrogen-cooled baffles cool the nitrogen below 200 degrees Kelvin just before it solidifies in the condenser.



The condenser of the wind tunnel.



Test section.

The term "cryogenic" pump or "cryopump" has been coined for this evacuation process. The principle makes large-capacity pumping possible, which might otherwise require many diffusion pumps. The potential of the system is illustrated by the fact that nitrogen has a vapor pressure of 10^{-13} atmosphere at 20 degrees Kelvin. Cryogenic pumps are now in the design or construction phase at several wind-tunnel research centers, such as the Air Force Arnold Engineering Development Center.

The original tunnel was limited to a Mach number of 12 by the necessity of avoiding condensed nitrogen in the test section. The supply was heated to 800 degrees Kelvin before entering the nozzle. Expansion resulted in center-of-mass (static) temperature of 40 degrees Kelvin at the nozzle exit. In order to raise the Mach number and the static temperature, a method was devised to obtain a total temperature of approximately 4000 degrees Kelvin. Other wind tunnels attempting to achieve this temperature level suffer from high heat transfer and ablation in the narrow throat section. To avoid this problem, Dr. Chuan has developed a nozzle in which the air is heated downstream from the throat. A high-frequency electric field is established through the flow from outside electrodes just below the throat. Ionization of the nitrogen results in the absorption of 15.5 electron volts of energy per molecule. Recombination then takes place further down the nozzle, resulting in the release of 9.7 electron volts of kinetic energy, plus radiation, which gives a total temperature of approximately 4000 degrees Kelvin. Nozzle expansion and length must be greater to produce uniform flow from this heating process because the flow is not adiabatic during the decay. (A similar energy process occurs from the ionization in arc-fed plasma tunnels.) A static temperature of near 300 degrees Kelvin is achieved in the test section, which corresponds to the air temperature at 300,000-foot altitude. The speed realm of glider-type re-entry vehicles is achieved by the Mach number of 14.

Development of this higher-Mach-number heated nozzle began in 1958. A small pilot nozzle has been operated, using these principles, for more than a year and serves other research needs. The final one-meter-diameter nozzle is now installed and operating.

The mean free path under these flow conditions is of the order of a centimeter. Thus, aerodynamic experiments impractical at higher densities become feasible. One is the investigation of flow at the start of a boundary layer. A centimeter of length provides sufficient room for instrumentation. Shock-wave structure is also amenable to observation by the same scale of advantage.

As an example of practical problems arising in the development of a new technology, the achievement of extremely low pressures created the need for measuring those pressures. Standard gages, such as Pirani and McLeod, became unstable or impractical at this general level of 10^{-6} centimeter of mercury. Accordingly, Dr. Chuan devised an ionization method for quantitative density measurement. The device uses radio-frequency energy between concentric electrodes. The amplitude is increased from zero and the point of breakdown is noted. Calibration leads to a direct reading of density.

The Engineering Center also operates the Naval wind-tunnel facilities at the Naval Air Missile Test Center, Point Magu, California, where permanent personnel are stationed. The on-campus work occupies the time of 50 people. Of these, seven are part-time faculty, eight are full-time technical, usually 12 are part-time students, and the remainder are nontechnical. The Center does most of its own administration.

Professor Chuan teaches rarefied gas dynamics and advises Ph.D. candidates at the University of Southern California. Requirements for a Ph.D. in aeronautics include minors in physics, electronics, and chemistry. This broad capability possibly arose from the secondary problems and instrumentation accompanying the development of this new facility. Professor Chuan's work demonstrates the rare and extremely valuable ability to assimilate and exploit several fields of science for a new breakthrough in knowledge.—ONR, Pasadena.

Weatherill Medal Awarded Dr. Vacquier

The Franklin Institute of Philadelphia has awarded the Weatherill Medal to Dr. Victor Vacquier of The University of California's Scripps Institution of Oceanography for his invention of a new magnetometer for locating mineral and oil deposits. The magnetometer, developed by Dr. Vacquier in 1940, was used by the Navy during World War II to locate submerged submarines in European waters. Currently, Dr. Vacquier is conducting marine magnetic investigations, supported in part by the Office of Naval Research. The Weatherill Medal is awarded annually for new discoveries or inventions in the physical sciences.

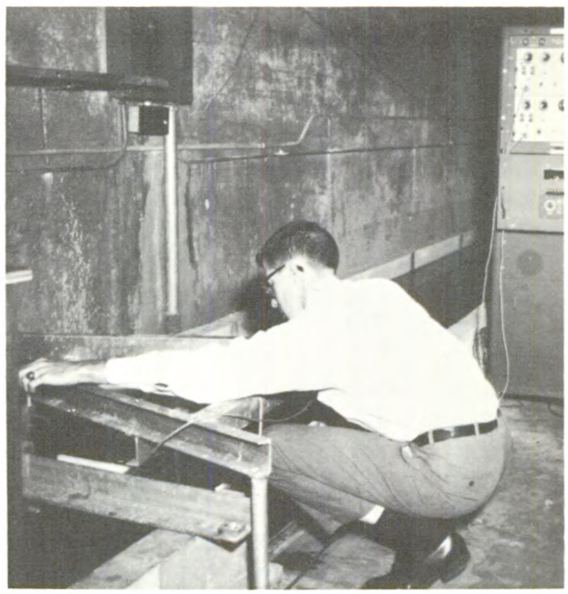
Measurement of Sound in Steam

Dr. James Woodburn of the North Carolina State College, Raleigh, has constructed an apparatus to measure the velocity and attenuation of sound in steam. Dr. Woodburn's work is part of ONR's basic program on Physical Acoustics, which is largely concerned with acoustic propagation in gases, liquids, and solids. Measurements are currently being carried out on steam at pressures at 1000 per square inch and temperatures as high as 750 degrees Fahrenheit, using a variable-path interometer, and work at higher pressures and temperatures is planned.

Research Notes

Davidson Laboratory's Wave Channel

Davidson Laboratory's Wave Channel has been proving its worth since December 1959, when it was completed at Stevens Institute of Technology, Hoboken, N. J. The Wave Channel—constructed under a Bureau of Ships contract for the purpose of studying the propagation of shallow water waves—is currently being used to study the mechanisms which lead to energy dissipation and the resultant attenuation of such waves. Hydrodynamic information about shallow waves is important for the geologist, the civil engineer, and anyone interested in determining the forces acting on off-shore structures and other types of civil construction.



Chester Grosch, a researcher at Stevens Institute of Technology, makes an adjustment on Davidson Laboratory's Wave Channel which was constructed under a Bureau of Ships contract.

The fundamental type of research being conducted with the Wave Channel is necessary in gaining an understanding of the action of waves near the shoreline of rivers, harbors, and exposed beaches. The Wave Channel enables researchers to study the excitation of standing waves in close regions and the energy dissipating mechanisms acting on these waves. Other possible areas of work, involving the Wave Channel, are wave propagation studies over sloping and irregular bottoms.

The Wave Channel is 240 feet long, 3 feet wide, and 9-1/4 inches deep. Its concrete bottom supports precast-concrete-slab sides (4 feet long, 4 inches thick, and 9 inches high). Waterproof plastic completely seals the inside of the installation. Two measuring stations are located at points one-fourth and one-half the length of the channel. Each measuring station is fitted with a full-length window (2 feet long) and an external instrument well. Waves are generated by means of a portable paddle-type device which can be located at any desired point in the channel. The period of the wave-generating device can be varied between

2 seconds and several minutes; stroke amplitude can be varied between zero and 3 inches.

The dimensions of the Wave Channel, particularly its length and the depth of the water, determine the type of work that can be accomplished. For shallow waves, the wave velocity is proportional to the square root of the water depth. Since it is desirable to generate several wave lengths to establish steady-flow conditions, and since each experiment must be stopped when reflections from the far end of the channel arrive back at the measuring station, Davidson Laboratory's Wave Channel with its great length comes into its own as an exceedingly valuable tool to researchers. The long channel is also invaluable because it enables viscous boundary-layer effects having large Reynolds numbers to be investigated. Finally, the long wave channel afforded by Davidson Laboratory's Wave Channel provides adequate room to investigate problems peculiar to wave-absorbing beaches.

New Laboratory in Honor of Dr. Fish

The Charles J. Fish Oceanographic Laboratory was dedicated recently at the University of Rhode Island, Kingston, R. I. Dr. Fish has long been associated with the Office of Naval Research through the Narragansett Marine Laboratory where research has been, and is continuing to be, supported by the various scientific branches at ONR, Washington. The construction and equipage of the Laboratory was partially supported by ONR. For the first time in the history of the University, a building was named for a living person who was, or had been, associated with the institution.

The new Laboratory was built on a slope near now-abandoned Fort Kearney, overlooking Narragansett Bay. It contains 7242 square feet of space, and has eight suites of laboratories with individual offices, a conference room, three business offices, a library, and a photographic darkroom. The Laboratory replaces the one destroyed by fire in January 1959.

Honorary Doctor of Science Degrees were conferred upon Dr. Henry B. Bigelow (see NavResRev, Oct/60, p. 6), the father of modern oceanography in the United States and the first director of the Woods Hole Oceanographic Institution, and Dr. W. Maurice Ewing (see NavResRev, Apr/60, p. 10), Director of the Lamont Geological Observatory of Columbia University, who gave the keynote address.—ONR, Boston.

Whiskers Grown on Concrete

The U. S. Naval Civil Engineering Laboratory at Port Hueneme, California, may not be able to grow hair on billiard balls, but it has done something almost as difficult, it has grown whiskers on concrete. This has been the unexpected and incidental result of studies of water-vapor transmission through concrete. The whiskers are a salt growth, and when seen under powerful magnification they present the appearance of a tropical jungle.

Salt-growth whiskers. Inset: powerful magnification of whiskers.

Research Vessel CHAIN Returns to Woods Hole

The research vessel CHAIN of the Woods Hole Oceanographic Institution returned to her home port at Woods Hole, Massachusetts, November 12, after a 5-month cruise which took her north of the Arctic Circle and into five European seaports. The expedition had a strong international flavor, with scientists from several European nations aboard. In addition, during various portion of the cruise the American scientists worked with the Norwegian research vessels HELLAND-HANSEN and H. U. SVERDRUP, the British DISCOVERY II and the Scottish EXPLORER.

Most of the work was in the North Sea, the Norwegian Sea and the North Atlantic between Iceland and the British Isles. A variety of old and new techniques was used to examine the ocean waters, the bottom sediments and the underlying crust. Many seismic observations were made at locations suggested by the foreign scientists to help with their own research projects. Almost continuous use was made of the thermistor chain, a 600-foot, instrument-carrying chain which is towed astern to get continuous temperature recordings from the upper water layers. It was towed nearly 20,000 miles, including both Atlantic crossings. About 3 dozen scientists took part in the expedition for varying lengths of time. Among them were 10 students doing summer work at the oceanographic institution.

The CHAIN left Woods Hole in late June and made a run toward the Bahamas to check equipment, then touched at Bermuda and headed across the Atlantic and into the Baltic Sea to Helsinki, Finland. On the way she paused over the Mid-Atlantic Ridge, where bottom samples and photos were obtained and measurements were made of the heat flow from the Earth's interior.

At Helsinki many of the scientists attended a series of international scientific meetings, then the CHAIN sailed for Bergen, Norway. Bergen was headquarters while the ship made two long cruises into northern waters, one of which took her to the latitude of 74 North--five degrees above the Arctic Circle--in the vicinity of remote Jan Mayen Island. At another point both CHAIN and SVERDRUP were forced by a gale into a fjord north of Bergen, where they used the time to good advantage by taking bottom cores as far as 60 miles inland. During this period most of the summer students worked on short cruises on the HELLAND-HANSEN, examining bottom structure in the fjords.

Leaving Bergen in mid-September, CHAIN worked down to the English Channel and made seismic studies southwest of England in company with DISCOVERY. After a brief stop of Plymouth, she headed for Aberdeen, Scotland. With scientists from the Marine Laboratory there, CHAIN and EXPLORER made hydrographic studies of the water structure and currents south of Iceland. The CHAIN stopped at Belfast, Northern Ireland, then headed for home via Bermuda, making continuous temperature and acoustical studies enroute.

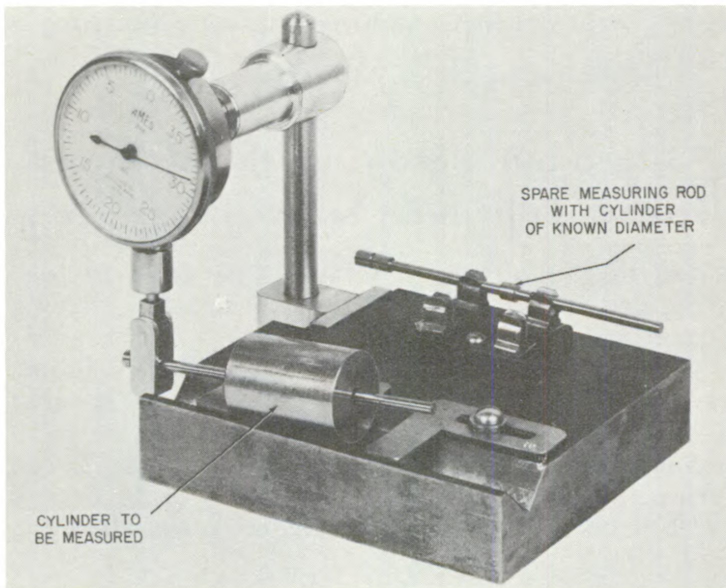
The chief scientists for different portions of the cruise were Dr. Earl E. Hays, Dr. J. B. Hersey, L. Valentine Worthington and Dr. Richard H. Backus. The CHAIN, largest of the five ships in the oceanographic institution fleet, is a 214-foot former Navy salvage ship which was converted for scientific work in 1958. She carries 28 scientists and a crew of 35.

A piece of partially petrified wood dated as being at least 30,000 years old has been dredged from the floor of the Pacific Ocean by scientists of the University of California's Scripps Institution of Oceanography. It lay half-buried off the coast of Mexico in water a quarter of a mile deep. The top half of the wood, which was exposed to the sea water, had become fossilized by the intrusion of calcium phosphate. The bottom half, which rested in the clay sediments of the sea floor, is in a state of nearly perfect preservation, virtually untouched by time.

Chemical studies of the specimen have been conducted by Edward D. Goldberg, Associate Professor of Chemistry. The log was dredged by Robert H. Parker, Junior Research Ecologist on a Scripps expedition to the Gulf of Tehuantepec. The log is about a yard long and a foot thick. Several smaller sticks, leaves, pine cones, and fish bones were taken in the same dredge haul. Identified only as a dicotyledon, like most trees of the temperate zones and those that forest the upper slopes of the nearby mountains of Mexico, the specimen is the first find of a phosphate fossil wood from the sea floor. Normally, petrified wood is mineralized with silicon dioxide, commonly called opal.

NOL-Developed Instrument Measures The Inside Diameter of Small Holes

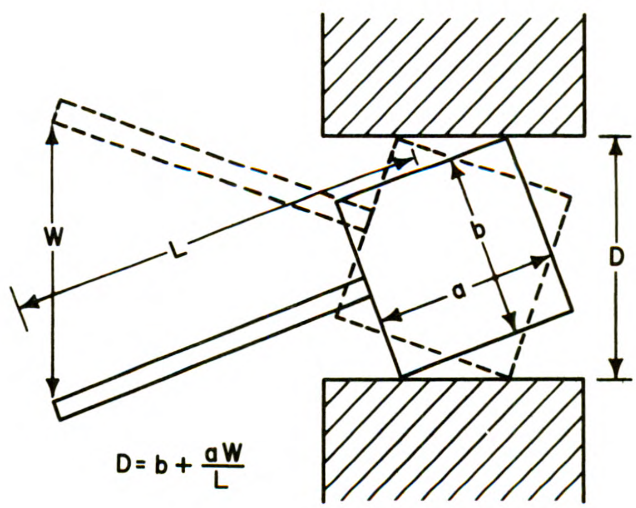
A relatively inexpensive device for measuring the internal diameter of small holes (in the order of 0.2 inches diameter) to an accuracy of 0.0002 of an inch has been developed by the Navy. Called the ''Wobbler,'' the instrument was designed at the Naval Ordnance Laboratory White Oak, Silver Spring, Maryland, to determine within one-half percent, the amount of explosive contained in small diameter test fixtures.



NOL's Wobbler.

Simple in design, the ''wobbler'' is basically a cylinder attached to a rod which, in turn, is connected to a dial. The cylinder, whose diameter is slightly less than the hole to be measured, is inserted in the hole

Principle of the Wobbler.



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of the test fixture and the rod is rocked or wobbled by hand. As a function of the size of the hole, the movement of the rod is measured by the dial which indicates the diameter of the hole to within two-tenths of a mil.

The "wobbler" is presently used by the Explosion Dynamics Division of NOL's Explosions Research Department to determine hole sizes in explosive test fixtures used to measure the sensitivity of various explosives as a function of their density, composition, physical size, and environment. Because available gages did not meet the required accuracy, the "wobbler" was especially designed for these tests by Richard Stresau, a former NOL employee and now a part-time consultant.

Postgraduate Program in Advanced Science Education for Naval Officers

LCDR Burton I. Edelson, USN, and LCDR Dean Taylor, Jr., USN, recently received their Ph.D. Degrees under the Navy's Advance Science Program. Both officers are 1947 graduates of the Naval Academy. LCDR Edelson, of the Bureau of Ships, completed the requirements for his Ph.D. in Metallurgy from Yale University; he received his Master's Degree under the Program from Yale in 1954. LCDR Taylor, commanding officer of the USS CONGER (SS 477), completed his requirements for his Ph.D. in Chemistry from Case Institute of Technology. He received his Master's Degree under the Program from Case in 1958.

The Postgraduate Program in Advance Science Education for Naval Officers was proposed in February 1946 and was established the following November. From the beginning, the training of selected officers was to be "fundamental" rather than "engineering" in character. The circicula was set up to deal with the problems of fundamental research in general physics, nuclear physics, chemistry, and applied mathematics. Metallurgy was added at a later date.

The Superintendent of the Postgraduate School was directed by the Chief of Naval Personnel to select eight officers from among volunteers of the class who had entered the curricula in 1946 and to arrange for their transfer to civilian universities for an additional 2-year course of instruction, beginning with the academic year 1947-48. In 1949 arrangements were made for student officers to have an additional year of instruction at their universities, allowing them to complete a Ph.D. program. This policy of granting a 12-month extension beyond the basic 3 years to exceptionally qualified officers has remained in force. Some students who have earned Master's Degrees in a scientific field during a previous tour of instruction are allowed to receive a Ph.D.

The objectives of the Program, are quoted from the November 24, 1958, letter of the Chief of Naval Operations to the Chief of Naval personnel. "The Chief of Naval Operations re-affirms the requirements for postgraduate education of officers as follows: (a) Education in technical fields for long-term unrestricted line officers in order that Fleet operational capability may keep pace with weapon and weapon system advances, and (b) Education in technical fields for both long-term unrestricted line officers and officers who may become engineering duty officers to meet the requirements of the Bureaus and the Office of Naval Research for officers to discharge technical supervisory duties."

Although ONR sponsors and supervises the Advanced Science Curricula, the Program provides education and training not only for officer billets in ONR, but for billets throughout the Navy—both in the Fleet and the Shore Establishment. Participation in the Program is voluntary, and the number of officers participating in the Program has increased from eight in 1946 to 25 in 1958. Officers chosen to pursue the science curricula are selected either from first-year students of the Postgraduate School and transferred into the Program, or are assigned directly from sea duty to civilian universities on the basis of their records. Those officers chosen usually have a summer familiarization course at the Office of Naval Research and the Naval Research Laboratory.

Students who worked last summer at ONR and NRL are LT Daniel C. Dennison, LT Willis S. Rich, and LT John F. Wellings. LT Dennison, a 1956 graduate of the Naval Academy, attends New York University where he is studying in the field of Applied Mathematics. LT Wellings, a 1953 graduate of the Naval Academy, is now studying in the field of Metallurgy at the University of Pennsylvania. He entered the University after completing the Aeronautical Engineering Course at the Postgraduate School.

LT Herman D. Winfree worked last summer at ONR, San Francisco. He is now attending the University of California and continuing his postgraduate work in the field of General Physics. LCDR Harley D. Wilbur, who completed his instruction at the Postgraduate School in August, is now studying Applied Mathematics at the University of Michigan.

The Navy Vetoes Artificial Reef

An Associated Press report from Miami states that the U. S. Navy has vetoed a Dade County Plan to sink 1000 scrap automobiles off Miami Beach to create an artificial reef. The Navy isn't opposed to good fishing, such as a reef would provide, but says submarines--and it doesn't mean ours--could hide alongside the reef. All that underwater detection devices would report is that "something" is down there.

On the Naval Reseach Reserve

Research Reserve Introduces a New Seminar on Electronic Computers

Seventy reserve officers from the Navy, Air Force, Army, and Coast Guard, representing 25 states and the District of Columbia, attended the Research Reserve Seminar on "Electronic Computers and Their Military Applications," sponsored by ONR, at Stewart Air Force Base, Newburgh, New York, 16-30 October 1960. This seminar was the initial presentation by the Research Reserve on the vital subject area of computers for the training of reserve officers.

Practical aspects of the Electronic Computer Seminar.

The Seminar was planned and coordinated through the Naval Reserve Research Company 3-14, Kingston, New York, commanded by CDR J. D. Quale, USNR. COL Robert N. Fackler, USAF, Commander of the Base, and his staff lent the necessary technical and logistic assistance required for a seminar of this size and scope.

Because of the increasing use of computer systems by the military services during the past 10 years, the seminar was held in an effort to familarize reserve personnel with the military uses of electronic computers. ADM Arleigh Burke, USN, Chief of Naval Operations, took cognizance of this fact when he commented as follows on the seminar: "Unquestionably, electronic computers are assuming a role of increasing importance in the solution of problems facing our Navy. I deem it vital that military officers have a basic understanding of the fundamentals of computers and their usefulness in military applications. It is gratifying to know that our Naval Reserve officers are keeping abreast of developments in this rapidly expanding field."

The keynote address was given by RADM R. Bennett, USN, Chief of Naval Research. In the course of the seminar representatives of the following activities participated: IBM Corporation; Remington-Rand Univac

Division of Sperry-Rand Corporation; Philco Corporation; Lincoln Laboratories; Radio Corporation of America; Electronic Associates, Inc.; Dunlap Associates; Auerbach Electronics Corporation; Navy Bureau of Ships; Air Force and Central Development Division, Air Research and Development Command; U.S. Military Academy; Navy Bureau of Supplies and Accounts; Federal Aviation Agency; AMC Electronic Center, Hanscom Field; and David Taylor Model Basin.

The first week of the seminar gave the attendees a thorough grounding in digital computer organization and components, as well as the economic and engineering considerations of importance. The week concluded with a discussion of analog computing systems and digital computing systems. Man's relation to the computer system and the future of computers were also discussed. BGEN William E. Elder, USAF, Commander of the Boston Air Defense Sector, gave a briefing of SAGE and BOADS on 19 October. The briefing was followed by a tour of the SAGE building at Stewart AFB. On 20 October, members of the seminar visited the IBM Corporation facilities in Poughkeepsie, New York. Highlight of the trip was a tour through the IBM manufacturing plant, which included observations of computer final testing operations and component manufacturing operations.

The second and final week of the seminar covered specific military systems which utilize computers as their nerve center. Speakers for the final day of the seminar were Dr. J. W. Wrench, Jr., David Taylor Model Basin; Mr. Ragnar Anderson, SPAN Data Processing Center; Mr. E. Shapiro, IBM Research Laboratory, and CAPT J. W. Jockusch, Jr., USNR, Special Assistant to the Chief of Naval Research (Research Reserve).

Reserve Research Seminar in Aerospace Medicine

The fifth annual Reserve Research Seminar, to be held at the U. S. Naval School of Aviation Medicine, Pensacola, Florida, 12-25 March 1961, will feature the latest developments in aerospace medicine related to space travel by primates and human beings. Previous seminars have dealt primarily with human factors in the operation of high performance aircraft, and with the physical, physiological and psychological support of the naval aviator in fleet operations.

The program arranged for the Fifth Seminar, in addition to the basic problems of selection and training for atmospheric and space flights, will include discussions of basic satellite physics, biological factors in space flight; exotic environments, radiation hazards in the Van Allen Belts and in outer space, physiological, psychological and psychiatric factors in space flight, and future developments in bioastronautics.

This Seminar was initiated and designed especially for nonmedical officers of the Armed Forces, including line officers as well as staff corps officers in the sciences allied to medicine. Medical officers, however, will find the program interesting and instructive.

Special events have been arranged, including trips to outlying fields to observe ground school and basic flight training, helicopter training, and operational training are planned. A one-day trip to the Air Proving Ground Command of the USAF at Eglin Field has always proved to be interesting. The highlight of the program is the observation of flight operations from the bridge of the aircraft carrier, the USS ANTIETAM, for one day in the Gulf of Mexico. Social events include a "fish fry" at Barancas Beach and a dinner at the Mustin Beach Club. For the latter, an outstanding speaker from NASA Headquarters at Huntsville, Alabama, will describe recent and future developments in missile and orbital vehicles.

Health Physics Seminar

The Eighth Annual Naval Reserve Nuclear Sciences Seminar at Brookhaven National Laboratory, Upton, Long Island, New York, got underway on 12 September to the accompaniment of drum rolls from Hurricane Donna that threatened at times to drown out the voices of the first day's speakers. Thirty-seven Reserve Officers, of the Navy, Army, and Air Force, participated in the Seminar, which was sponsored by the Office of Naval Research, Brookhaven National Laboratory, and the U. S. Atomic Energy Commission. The Seminar was conducted by a committee of NRRC 3-9 members under the direction of CDR L. A. Baker, Jr., USNR.

After a turbulent beginning, the Seminar—organized as "A Workshop in Health Physics"—proceeded undisturbed on its 2 weeks' course. Talks were given by representatives of the Atomic Energy Commission and Brookhaven National Laboratory. Subjects covered (1) basic atomic physics and the medical problems involved and (2) the means by which population and occupational exposure to radiation may be prevented. Some of the speakers were from among the membership of NRRC 3-9.

The Navy's interest in Health Physics were highlighted by two talks. CAPT J. Burkle, MC, USN, Director of the Radiation Exposure Evaluation Laboratory at the National Naval Medical Center, Bethesda, Maryland, spoke on "The Navy's Radiation Disaster Teams." CDR R. L. Gade, USN, of the U. S. Naval Medical Research Laboratory, New London, Connecticut, spoke on "Health Physics in a Nuclear Submarine."

Following the morning lectures, the Reserve Officers spent most afternoons visiting research and health physics activities at Brookhaven National Laboratory, including the reactor and accelerators, health physics instrumentation, and the meteorology facility. Two afternoons were spent practicing the safe handling of radioactive objects in the waste disposal and decontamination facilities. CAPT J. W. Jockusch, Jr., USNR, Special Assistant to the Chief of Naval Research (Research Reserve), spoke to the Seminar on the recent developments affecting promotion and retirement in the Research Reserve. CAPT R. Freitag, USN, addressed a joint meeting of the Seminar and the Suffolk County Navy League. In his talk, "The Navy in the Space Age," he described the present and potential values to the Navy of space vehicles for research, communication, and weather forecasting.

NRRC 13-4 Breakfast Meeting and Conference

RADM R. Bennett, USN, Chief of Naval Research, was the principal speaker on 12 October at a breakfast meeting of NRRC 13-4, Portland, Oregon. Present at the meeting, in addition to members of NRRC 13-4, were CAPT R. B. McLaughlin, USN, Commanding Officer of ONR, San Francisco, and CAPT H. M. Bashinski, USNR, Commanding Officer of USN and MCRTC, Portland.

NRRC 13-4 Breakfast Meeting. . .guests and members.

Following the breakfast meeting, the group reassembled at the Benson Hotel for a special conference in which RADM Bennett participated. Other speakers, at the conference, were BGEN William J. Ely, USA, Director of Army Research, and COL. H. F. Bunze, USAF, Director of the Advanced Research Air Force Ballistic Missile Division. The morning conference was followed by a luncheon with an address by Governor Hatfield of Oregon. The main speaker for this occasion was Dr. T. Keith Glennan, Administrator of the National Aeronautics and Space Administration.

Nuclear Weapons Training by NRRC 11-3

Several important aspects of nuclear weapons are the subject of a series of lectures scheduled by Naval Reserve Research Company 11-3, Los Angeles, California, for regular drill mettings in the second quarter. This program, under the direction of the Commanding Officer, LCDR Eric L. Nelson, USNR, offered four discussion the following topics: Description and Use of Nuclear Weapons, Nuclear Weapons Phenomenology, Radioactive Fallout, The Basis for Popular Resistance to the Development and Use of Nuclear Weapons, The Problem of Negotiating Nuclear Test Ban with the Soviet Union and The Problem of Inspection of Nuclear Explosions.

RADM E. N. Blackwood, USNR, Joins Research Reserve

A reserve admiral has been added to the rolls of The Research Reserve—RADM Edwin N. Blackwood, CEC, USNR. Not only has RADM Blackwood affiliated with the Research Reserve but he has also assumed command of Naval Reserve Research Company 5-6, Charleston, West Viriginia. He relieved LCDR Irving H. Bowman, USNR, who has served as Commanding Officer for the past 2 years.

RADM Edwin N. Blackwood, CEC, USNR.

RADM Blackwood was first commissioned in the Naval Reserve in 1935, and has had continuous Reserve service since that time. While on active duty in World War II, he worked in airfield design and construction and served as Commanding Officer of the 48th Naval Construction Regiment on Okinawa. He has recently been on temporary active duty at the site of the Navy's giant radio telescope at Sugar Grove, West Virginia.

A native of Mason County, West Virginia, and a 1925 graduate of West Virginia University, RADM Blackwood has served the state in a number of positions. He has been a highway and bridge engineer with the West Virginia State Road Commission, County Road Engineer for Kanawha County, and was Chief of Construction for the State Road Commission. Since World War II, he has been affiliated with Armco Drainage and Metal Products, Inc.

Three New Flag Officers

The Naval Research Reserve is proud to announce the selection of three of its members for promotion to the grade of Rear Admiral in the Naval Reserve. The announcement of the names of 13 Captains so selected was made by the Bureau of Naval Personnel on 21 November 1960. The three Research Reserve Officers selected and the Research Reserve Company with which they are associated are as follows: James D. Hardy, USNR, NRRC 4-2, Philadelphia, Pa.; Harry H. Hess, USNR, NRRC 4-1, Princeton, N. J.; and Thomas J. Killian, USNR, NRRC 5-8, Washington, D. C. Hearty congratulations are extended by the Naval Research Reserve.

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*Articles are arranged chronologically under the ONR division or laboratory having cognizance of the research described.

† Written by the editorial staff of Naval Research Reviews or adapted from anonymous sources.

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A weasel is loaded aboard the USS BURTON ISLAND for the establishment of ARLIS-1, a seven-man scientific research station on an 8-foot-thick ice floe. See the story—pp. 1-4.