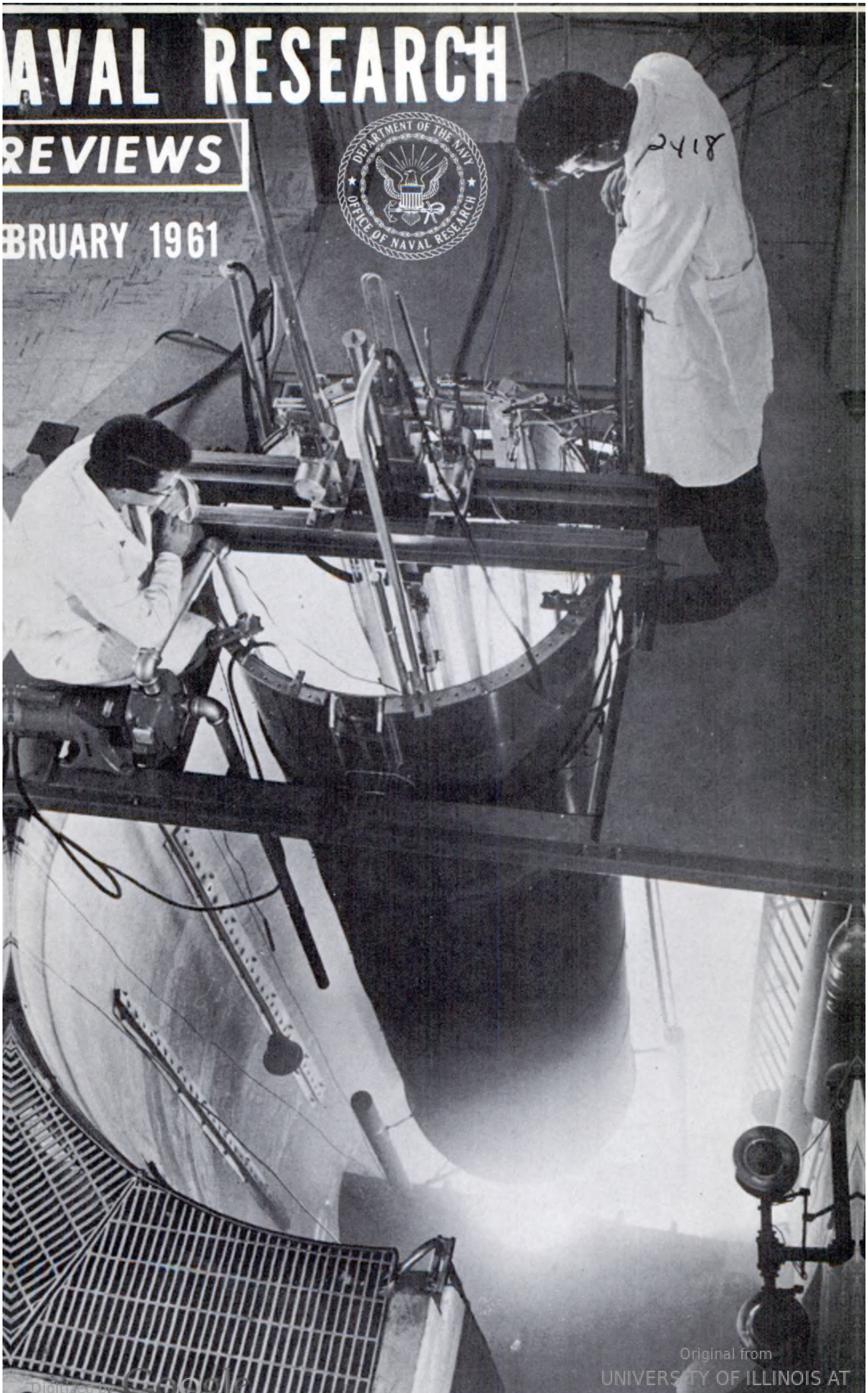
AVAL RESEARCH

REVIEWS

BRUARY 1961



New Chief of Naval Research

RADM Leonidas Dixon Coates, who relieved RADM Rawson Bennett, II, as Chief of Naval Research in February, is a career naval officer who is outstandingly qualified for top-level administration of a major scientific program. He has been closely involved in naval research and development since 1941, and is already well known to the ONR family.

The new Chief graduated from the Naval Academy in 1930. After a period of sea duty on two battleships and a carrier, he was ordered in 1933 to the Naval Air Station at Pensacola, where he completed flight training in 1934. Following two years of flight duty at sea, he studied at the Postgraduate School at Annapolis. He continued his training at California Institute of Technology and was graduated with a Master of Science degree in Aeronautical Engineering in June 1939.

After two more years of sea duty, he joined the Bureau of Aeronautics in 1941 where he served almost continuously until 1950, first in the Patrol Plane Design Section, then as the BuAer Representative with the Douglas Aircraft Company in California, and ultimately as Deputy Director of the Aircraft Division. After a course in advanced management at Harvard University in 1950, he returned to the Bureau of Aeronautics, serving first as Director of the Guided Missiles Division and then as Deputy Assistant Chief for Research & Development. In 1954 he began a two-year tour of duty as Deputy and Assistant Chief of Naval Research at ONR. When appointed as Chief of Naval Research, he was Director of Development Planning in the Office of the Chief of Naval Operations. RADM Coates is a member of the Institute of Aeronautical Sciences and the U. S. Naval Institute.

SURFACE CHEMICAL SALVAGE OF WATER-DAMAGED ELECTRICAL EQUIPMENT

A Navy-developed chemical cleaning system is demonstrating almost incredible effectiveness in salvaging electronic and electrical equipment damaged by sea water, fuel oil, and smoke. The system is currently recovering millions of dollars worth of radio, radar, and fire-control instruments removed from the fire-damaged areas of the carrier USS CONSTELLATION. Hopes are bright that 90 to 98 percent of the equipment not actually burned can be restored to fully usable condition.

In a former cafeteria building at the New York Naval Shipyard, Brooklyn, the process is in full operation on an assembly line basis. Motors, whole radar cabinets, and switchboard panels go in water-soaked and smoke-blackened at one end, and come out glistening and dry at the other. In most cases the gear is completely operable.

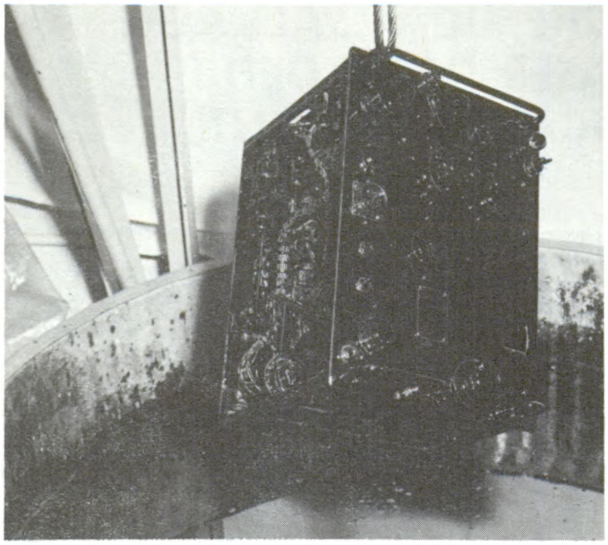
In the first step, the equipment is either lowered bodily into a tank of cleaning emulsion, or the emulsion is sprayed on. This removes gummy substances such as fuel oil or smoke residue. Although the emulsion itself does most of the cleaning, there is added scrubbing, in the spraying procedure, by the pressure of the spray jet. In the tank, the scrubbing is done ultrasonically by a high-frequency sound transducer which agitates the emulsion.

In the next step, the equipment is thoroughly flushed with fresh water to remove the cleaning emulsion and traces of salt. Again this is done either with a spray gun or by ultrasonic treatment in a tank.

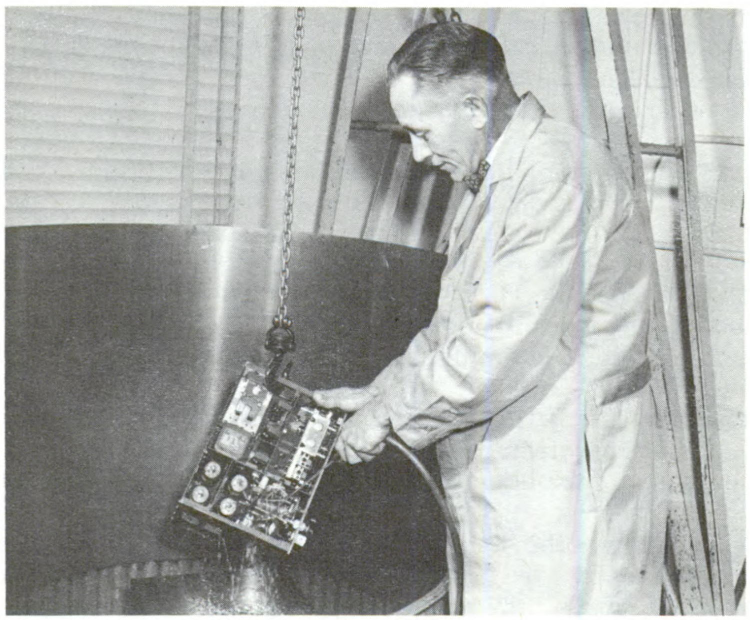
After flushing, the bulk water is blown from the equipment with oil-free compressed air. The water that cannot be blown free is then removed by a water-displacing composition. This physically pushes the water aside, or lifts it away from the wetted surface, replacing the water with a thin film of preservative. Most of the water drains off. The little that remains, in deep crevices or interstices between coil windings, combines with the water-displacing composition to form an azeotrope, ie., a fluid with a lower boiling point than water that takes the water with it when it evaporates.

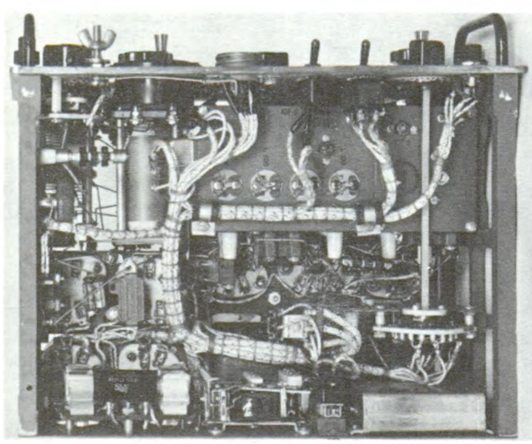
In the final step the equipment is placed in a warm oven, where it is left for several hours. The low, steady heat evaporates the azeotrope, and with it the last trace of moisture.

The two chemicals that make the process work are the emulsion, which removes the salt water and oily matter, and the water-displacing composition, which removes the water used in flushing the emulsion, and also coats the cleaned surfaces with a thin film that resists both moisture and oxidation. Both were formulated at the Naval Research



Radio transmitter as it appears after being immersed in a tank containing sea water and fuel oil.





After the transmitter has been bathed in NRL's cleaning emulsion, it is flushed with fresh water (above) to remove any residue of emulsion and traces of salt. The result is a transmitter (left) ready for immediate return to service.

Laboratory, with the support of the Navy's Bureau of Ships, in a program that extends back over seventeen years.

Toward the end of 1943 Earl Palmer, a design engineer in the Bureau wondered if something couldn't be done to prevent the total loss of the electrical equipment still being raised from the ships sunk at Pearl Harbor. Palmer took the problem to Dr. W. A. Zisman, a Naval Research Laboratory chemist who was already winning national recognition as a specialist in lubricants and surface chemistry. He brought his assistant, H. R. Baker, into the project.

Zisman and Baker started with a physical phenomenon that had been discovered at least a 100 years earlier but had been more or less forgotten: that if one drops a little alcohol, or other polar volatile fluids on a wet surface, the water will be pushed aside by the alcohol. But the water quickly flows back again. The two chemists hoped they could find an organic substance that would push water aside, like alcohol, but would then adhere to the surface of the wetted material – displacing the water entirely.

The search took several years, involving hundreds of chemicals that have molecular structures similar to that of alcohol. Ultimately Zisman and Baker succeeded in finding a chemical composition (butyl alcohol plus 3 percent basic barium dinonyl naphthalene sulfonate) that would successfully displace sea water. This was patented, under the Navy patent system, and was produced commercially under the name Spradri.

But recovery of equipment soaked by salt water was only part of the problem. Usually when a ship's hull is ruptured, say by collision or torpedoing, fuel bunkers are also pierced. As a result when the flooded compartment is drained the entire space and everything in it is covered with a thick layer of black oil that is almost as viscous and sticky as tar. Any attempt to salvage electrical or electronic gear under these circumstances was regarded as virtually hopeless.

If something could be done, however, the rewards would be incalculable – not only in dollar savings but in the speedier restoration of a ship to combat effectiveness. Accordingly, in 1956 Earl Palmer asked the Research Laboratory's surface chemists, now led by Dr. C. R. Singleterry, to revive the water-displacing problem, this time seeking an agent that would remove the oil as well. The Bureau provided the financial support – a modest sum, because this was essentially a basic research problem.

As the NRL chemists saw the task, it wasn't enough merely to find a composition that would remove heavy (Bunker-C) fuel oil; to be practical, especially for use on shipboard, the cleaning agent must have added characteristics tailored into the formula.

1. It should remove oil residues rapidly and gently with little or no need for mechanical treatment or brushing.

2. It should not cause significant damage to insulating materials, whether cloth, rubber, plastic, or varnish.

3. It should be less flammable than the fuel oil it removes.

4. It should be noncorrosive and should retard the rusting of steel surfaces to which it is applied.

5. It should be nontoxic and nonirritating to the skin.

6. The salvage equipment should be simple and available on shipboard.

Quite early in the subsequent research program it was determined that the oil-displacing composition must include in its formula a hydrocarbon similar in molecular structure to that of the contaminant oil. The development of an emulsion-type cleaner seemed the most promising approach. The dispersed hydrocarbon component of the emulsion would dilute and dissolve the fuel oil while the water portion would serve to flush away the contaminant. The continuous water phase would serve to reduce the flammability and health hazard of the cleaner formulation as well as to lower overall cost of the composition. The emulsion spray and suspended contaminant could be flushed away with sea water or fresh water depending on availability.

Some form of surfactant (surface active agent) was also needed to hold the hydrocarbon and water in a useful emulsion. After studying and testing a long list of surfactants, one – a proprietary composition – was found that would break from emulsion upon contact with an oil-fouled surface, thus releasing the solvent to penetrate and dilute the contaminating film. This composition also exhibited considerably better rust inhibition than any of the other available products.

The formula thus worked out, early in 1959, was composed of 40 to 60 percent aliphatic solvent (flashpoint 140°F), 3 to 7 percent fuel oil or jet oil or diesel fuel, 0.15 to 0.35 percent surfactant, and 40 to 60 percent water, either fresh or sea.

Baker and a new recruit to the project, Paul Leach, subjected the system to detailed tests in the laboratory. As an example, electric motors were immersed for several days in a tank of sea water on which a thick layer of Bunker-C fuel oil was floating. After removal, the motors were allowed to stand until the oil had set to a tacky, black goo. Then they were run through the cleaning process. In almost every case the motors operated perfectly. (Of course, practically all lubricating oil had been removed by the cleaning agents, so oil or grease would have to be added before the motor could be restored to service.)

In 1959, CAPT R. R. Bradley, Jr., of BuShips backed the NRL chemists in extending their research to include electronic gear. Here again, the cleaning was gratifyingly effective. In one test, a complete radio transmitter was immersed in sea water covered with fuel oil, and then was restored. That transmitter is still in use and functioning perfectly after hundreds of hours of service.

An excellent opportunity to test the system under service conditions came when a number of 100,000-dollar airborne radar installations were nearing completion by two Baltimore contractors. As is customary, one equipment was selected for environmental testing, the "salt spray" test being scheduled as the final phase because it usually ruined an equipment for further operation. In this instance the test set was indeed in apparently useless condition, so the manufacturers were glad to turn it over to Baker and Leach to see what they could to with it. They applied the NRL cleaning treatment. The electronic engineers then went over the equipment, and found they had to replace five small components, totaling about $100; after that the entire installation functioned perfectly. Also, in the course of the Baltimore experiments it was found that the cleaning treatment, because it leaves a protective monolayer on every surface, makes the equipment more resistant to high humidity, such as is characteristic of tropical environments.

Further field tests were planned during the winter of 1960-61. Then the disastrous fire aboard the CONSTELLATION offered a practical test just as challenging and far more dramatic. To be sure, there was virtually no damage from oil, but the heavy deposit of soot, followed by drenching with harbor-water, offered a convincing substitute. Those who have seen the fire-scorched cabinets, with "innards" so blackened one component is no longer recognizable from another, can scarcely believe the equipment is worth anything but junk. But, as was stated earlier, better than nine-tenths of the damaged gear apparently is restorable — needing nothing but a paint job and perhaps a tube or two to render it completely serviceable. Small wonder the Bureau of Ships has issued a directive* adopting the restorative procedure as standard for salvage of both electrical (small motors and switch gear) and electronic equipment. Programs are being implemented by the Bureau to extend the NRL investigations to include procedures for salvaging large propulsion motors and generators.

The Navy personnel in charge of repairing ships are understandably cautious about using any salvaged gear, particularly in key electrical or electronic installations where reliability is paramount. But the surface-chemical restorative technique is so convincingly effective it is now believed the damaged parts from the CONSTELLATION can be reinstalled as soon as the giant carrier is readied to receive them. Even more promising, the technique is so simple it can be used aboard ship by ordinary damage-control teams. —A.T.D.

VEMA Expedition

The research vessel VEMA operating for the Lamont Geological Observatory has been engaged in a global expedition for the past nine months. Of signal interest have been the seismological measurements carried out on board: one shot, originating south of Australia, was received at the station on Bermuda, 12,000 miles away. During her present cruise, the VEMA circumnavigated Antarctica.

*BuShips Instruction 4740.3, Ser. 634A-23, of 19 Jan. 1961.

Mark F TRIGA — Reactor for Research

The newest member of the versatile and inherently safe family of TRIGA* nuclear reactors, the Mark F DASA† TRIGA, will be installed in the forthcoming Armed Forces Radiobiology Research Institute. Ground was broken for the new facility at the National Naval Medical Center on November 29, 1960, by Dr. Frank B. Berry, Assistant Secretary of Defense for Health and Medicine.

The reactor will become the heart of the Department of Defense DASA-sponsored laboratory. Here, scientists of the military services, as well as federal and other organizations, will be able to conduct a broad research program on the effects of large neutron and gamma-ray fluxes on living organisms, electronic instruments, and other devices. The Mark F TRIGA, the first pulse-type reactor designed solely for medical research, will provide scientists with laboratory control of dose. The General Dynamics Corporation, San Diego, California, is in charge of constructing the 2.4 million-dollar reactor facility, which is expected to be completed in October 1961.

TECHNICAL HISTORY OF TRIGA

The prototype TRIGA was the result of two years (1956-1958) of research by the General Atomic Division of the General Dynamics Corporation into the development of a completely and inherently safe reactor. This prototype has been in operation at General Dynamic's John Jay Hopkins Laboratory in San Diego since May 1958.

Safety features of nuclear reactors include methods of shutting them down if the power levels become excessive for the design. This may be achieved in several ways, the most common of which is a series of electrical circuits which analyze the radiation flux and, when an excessive power level is reached, release a system of rods which have a high affinity for neutrons. The capture of large numbers of neutrons by these control rods results in a return to lower power levels or to subcriticality. A second control method is achieved by the employment of the negative temperature coefficient, a physical property of the reactor core. This negative temperature coefficient results in a decrease of reactivity as the reactor core becomes hot. In many reactors, this negative temperature coefficient provides safety only against relatively small increases in excess reactivity.

The secret of the inherent safeness of the family of TRIGA reactors lies in the physical properties of its unique fuel-moderator elements, which are composed of an alloy of uranium-zirconium hydride (U-ZrH). In effect, the new DASA-TRIGA reactor will possess a built-in "thermostat" to assure safe operation, for as the reactor power level approaches its peak, the self-regulating characteristics of the fuel elements will automatically bring the power level down to normal operating levels. The U-ZrH alloy, developed by scientists of the General Atomic

*Training, Research, Isotope Production, General Atomic.
†Defense Atomic Support Agency.

Division of the General Dynamics Corporation, is the first solid homogeneous system to achieve the goal of a large negative temperature coefficient in a reactor that can be run at useful power levels. Because of this safety feature, personnel will be able to remain in the control room and near the reactor during its operation.

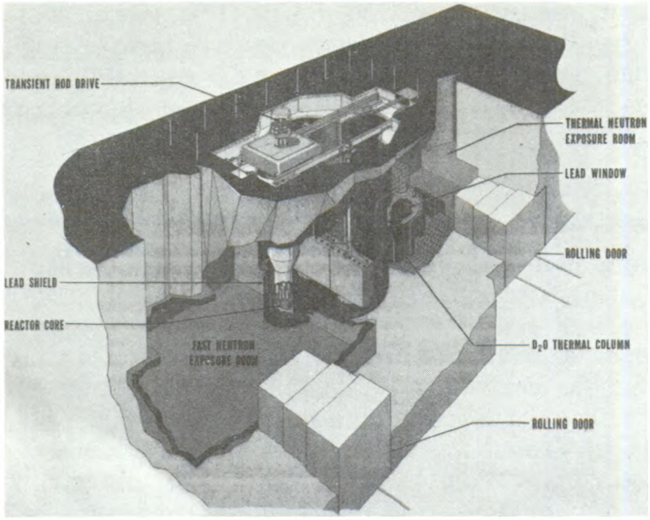
The fuel elements are formed as a solid homogeneous alloy of enriched uranium and zirconium. The alloy is then hydrided. The result of the process is a fuel element in solid form, containing the moderating material, hydrogen, in an intimate mixture. In action, there is essentially no delay between the release of energy by the fissioning of the uranium and the decrease of excess reactivity by heating of the moderator material. Any insertion of excess reactivity causes an automatic and immediate return to the normal power levels. If the fuel heats up suddenly, the moderator also heats up, resulting in an increase of the average energy of the thermal neutrons. These higher energy neutrons have a smaller chance of causing further fissioning. This physical characteristic enables the reactor power level to be promptly and effectively reduced. The large negative temperature coefficient has been verified by numerous tests of TRIGA reactors.

In testing TRIGA to determine its safety characteristics, step increases in reactivity were made by rapidly withdrawing a control rod. Because of the damping effect of the large negative temperature coefficient associated with the zirconium-uranium hydride fuel-moderator elements used in TRIGA, the reactor power rises in a very short period to a maximum value and then quickly reverts down to a much lower steady power level by itself. Several hundred insertions of excess reactivity (2.2% k/k) have been made in the prototype TRIGA. With such an insertion the reactor power reaches a peak of 1000 megawatts in a pulse 16 milliseconds wide at the half-maximum point. The energy release in such a burst is 17 megawatt seconds. The proven pulsing capabilities of TRIGA make it an attractive tool for doing research on the effects of large radiation doses during short time exposures. It was the need for such a tool with safe operating characteristics that prompted the Defense Atomic Support Agency to select the TRIGA for the new institute.

FEATURES OF MARK F DASA TRIGA

The DASA-TRIGA reactor will be simple in concept and operation, yet it will have sufficient versatility, power, and neutron flux for full scale and valuable research in many fields. Complete physical and visual access to the moveable core of the DASA-TRIGA will be possible at all times through the 16 feet of water shielding above the core of the reactor. This will enable the personnel engaged in an experiment to observe the "heart" of the reactor, the nuclear core, without shutting down operations.

A prototype of the DASA-TRIGA has been constructed at General Atomic to investigate the characteristics of the TRIGA core which is radially reflected through 180° by the water. This prototype, known as the TRIGA Mark-F, has been in operation since July 2, 1960. The performance of this reactor has exceeded expectations. It has been pulsed



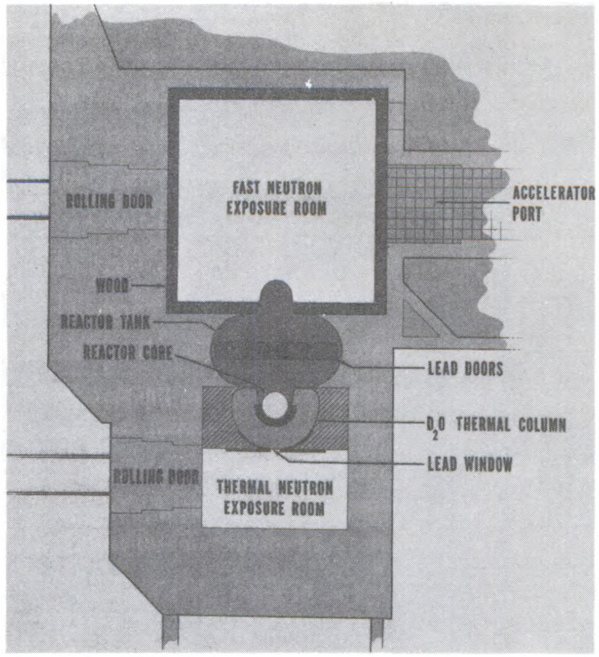
Cutaway view of the TRIGA Mark F reactor system. (Official U. S. Army photo.)

over one hundred times to peak power levels with complete safety. In the tests, the Mark F increased its power output from one watt to more than 2,000,000 kilowatts in less than 1/20th of a second and then returned automatically to its normal power level without the use of any external control devices. These pulsing characteristics indicate an improvement over the built-in safety of the original TRIGA.

The DASA-TRIGA will operate at a steady-state power level of 100 kilowatts and at 1000 kilowatts for periods up to ten minutes at a time. It can be pulsed for split-second periods to a peak power level in the range of 1500 megawatts, providing intense but self-limiting pulses of neutron and gamma radiation. The fuel-moderator elements of the reactor (uranium-zirconium hydride in a solid homogeneous alloy) make possible a relatively small core and fuel inventory. The critical mass of fissionable material contained in the approximately 90 individual fuel-moderator elements will be only about three kilograms of uranium-235. The fuel elements will be 28.4 inches in overall length and 1.5 inches in diameter. They will be encased in aluminum to contain the fission products of the controlled chain reaction. It is estimated that the fuel elements will last several years before replacement is necessary.

The DASA-TRIGA will be located in a water-filled tank approximately 14 feet in diameter and 19.5 feet deep. Extending the full depth of the tank will be two diametrically opposed cylindrical projections. The core may be moved into either of these projections so that one-half of the core surface is exposed to either of the two exposure rooms. A tank filled with heavy water will be placed between one of the reactor tank projections and an adjacent irradiation area to moderate neutrons, so that this exposure room can be used for thermal neutron irradiation. On the opposite side of the tank, the other projection will extend directly into another room that will be used for irradiation by unmoderated or fast neutrons.

The purpose of the exposure rooms will be the accommodation of specimens too large to be handled by the pneumatic tubes and open area



Plan view of the TRIGA Mark F reactor showing its relationship to the two exposure rooms. The accelerator port leads from still another room: the LINAC electron-exposure room. (Official U. S. Army photo).

around the core in the reactor tank. The fast-neutron exposure room adjoining the tank will be 20 by 20 by 8 feet high and will be shielded by 12 feet of concrete. Access to this room will be through the rolling "plug" doors which cannot be opened when the core is in position near the room. In order to gain access to the room, the core of the reactor must be moved to the opposite side of the tank. The thermal-neutron exposure room will be 14 by 15 feet and 10 feet high. This room will be shielded by 9 feet of concrete and will have the same system of safety locks as the fast-neutron exposure room. A tank filled with heavy water (D_2O) will lie between the thermal-neutron exposure room and the reactor tank for the thermalization (moderation or slowing down) of neutrons from the reactor. A lead slab six inches in thickness can be positioned to separate the heavy water tank from the reactor.

The DASA-TRIGA will utilize a radial reflector of either water or water and lead around the core rather than the graphite type previously used in reactors of the TRIGA family. This will make available for irradiation studies large numbers of fast neutrons. Vertical reflection and shielding will also be provided by this same medium. In the fast-neutron exposure room, neutron doses at the reflector surface of 6×10^4 rads per pulse and gamma doses of 10^5 rads per pulse may be achieved (1 rad = 100 ergs per gram).

The DASA-TRIGA will enable the scientists to duplicate, in a safe controlled operation, a great many of the types of radiation exposure necessary for biomedical experiments. Activation analysis will be used to determine traces of elements in body tissues and fluids, to detect small chemical changes within cancerous cells and to assist in the study of bone growth and diseases. Studies of the radioactive nuclides and chemistry of very low concentration solutions will be carried out.

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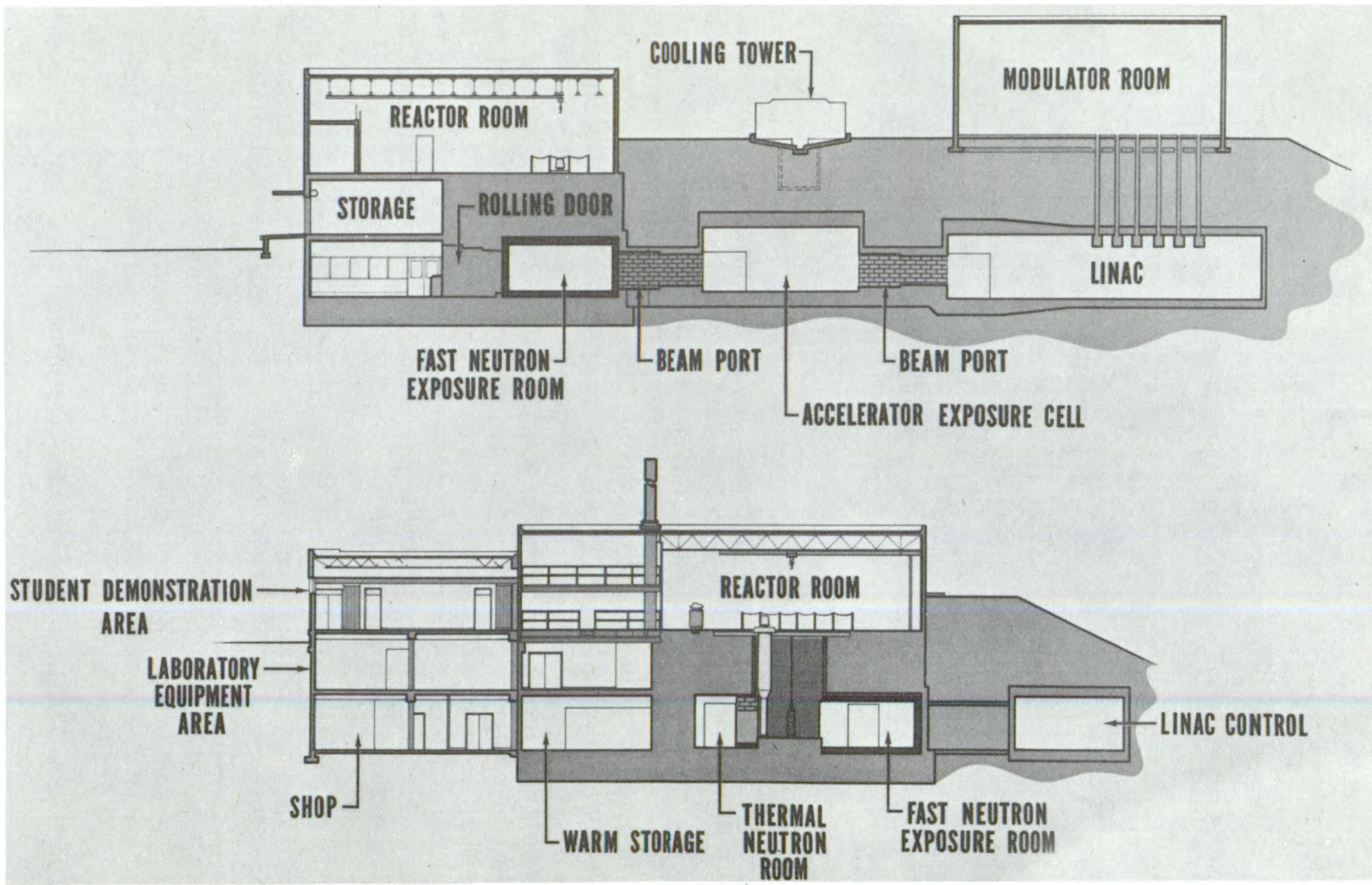

Sectional views of the future Armed Forces Radiobiology Research Institute containing the DASA Mark F TRIGA reactor. (Official U. S. Army photo).

LINAC

Next to the fast-neutron exposure room, there is yet another exposure room in which may be placed the target for a beam of 30 Mev electrons from a linear accelerator (LINAC). This target can also be placed in the fast-neutron exposure room. The LINAC will produce a dose rate from forward gammas at a distance of 3 inches from the target of about 6×10^9 rads per hr. It is possible to use this source of gamma irradiation independent of, or in conjunction with, irradiation with the DASA-TRIGA.

The advent of the Armed Forces Radiobiology Research Institute and the DASA-TRIGA opens up important new fields of research on the effects of high-level radiation. Mankind will benefit in many ways as a result of data obtained with this installation. In peace or war, knowledge of radiation effects on biological systems, with particular emphasis on man, is essential to the well-being of mankind.

Sponsler Joins BuShips as Chief Scientist

Dr. George C. Sponsler recently joined the Research and Development Division at the Bureau of Ships as Chief Scientist for Research and Development on the Technical and Analysis and Operations Research Staff. Before coming to the Bureau, Dr. Sponsler was Senior Scientist at the Hoffman Science Center, Santa Barbara, Calif. (1959-1960), Head of Special Projects at ONR (1958-1959), Science Liaison Officer for Electronics at ONR, London, England (1956-1958), and Senior Staff Member at the Lincoln Laboratory of M.I.T. (1952-1956).

Dr. Polachek Receives Award

Dr. Harry Polachek, Technical Director of the Applied Mathematics Laboratory at the David Taylor Model Basin received the Distinguished Civilian Service Award on November 23, 1960. This award, the highest that the Secretary of the Navy may confer on a civilian employee of the Navy, was given in recognition of Dr. Polachek's achievements in organizing and directing the Applied Mathematics Laboratory; in demonstrating the potential of high speed computers; and in his contributions to scientific, technical and management fields, such as nuclear reactor design, advance programming systems, and analysis of acoustic signals. His work has opened additional lines of research, such as the automatic computation of ship lines, and speeded the solution of a variety of problems and data reduction.

Missile Range Technology Challenges Military Medicine

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and

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Not long ago a medical magazine, commonly found in the waiting room of many doctors, carried a short article describing the electronic aids which would be used in the operation of a huge new ultra-modern hospital. The most notable of these aids were:

- A central, electronically operated transcription system for recording patient reports.
- An electronic memory machine, that responds to individual code signals and gives the physician any messages that have come in during his absence.
- For the patient, bedside control panels permitting direct communication with the nursing station, finger-tip control of radio and television, and direct-dial telephone service.
- Closed-circuit television guarding the entrances and exits.
- For key medical and nursing personnel a radio call system utilizing individual transistorized receivers.
- An electronically guided pneumatic-tube system to speed messages and small supply items throughout the hospital.
- An electrically controlled, fully automatic X-ray film processing system.

It is interesting and yet a little disturbing to note that no mention is made in this article of any electronic aid that would record, transmit, or present the actual physiological and psychological state of a patient. Is this omission due to lack of information or interest on the part of the author, or does it reflect a serious lag in medical technology and its application? The electronic aids mentioned are primarily administrative devices useful to the hospital system but remotely related to the health of the individual.

The primary purpose of the hospital system is to improve the health of the patient under care. It is contended here that electronics could contribute fast, reliable, and effective communication channels from the individual patient directly to the ward-supervising nurse and to the physician. A system is visualized wherein a patient, who is quietly dying and unable to sound an alarm would, without self-initiated action, audibly and visibly call the attention of the supervisor to his critical condition. This could be accomplished through modern electronic sensing, communicating data storage and data monitoring devices capable of automatic and continuous comparison of critical physiological conditions such as body temperature, respiration rate and heart beat. This system would operate with pre-established limit norms.

Picture in your mind a present-day hospital: A ward of patients requiring close nursing supervision in which therapy is based on daily ward rounds by the physician. Are the nursing notes the most reliable information obtainable on the patients' daily status during some twenty-three hours that the physician is not at the bedside? Is the physician's daily (or as required) ward visit to the bedside the ultimate in medical practice? Can we afford the risk of human error inherent in the system of having the patient's vitality periodically determined in person by nurses and attendants? Must we rely upon the tolerance limit of the individual patient to provide for us the danger signal when he calls in alarm or pain? Furthermore, must time be squandered at the bedside in taking pulse rate, respiration, and temperature to assess the patient's critical condition, when this information could have been continuously available at the nurses' station? Advancing technology requires that the medical profession become cognizant of modern telemetering and display techniques. The medical profession must recognize the utility of these modern developments in the area of medical supervision. In order to illustrate the possibilities in this field of development and to stimulate the medical profession's interest, let us examine the problem in the light of the technology required to support the development, testing, and evaluation of present day missile systems in the operational environment of the missile range.

TECHNICAL SUPPORT APPLICATIONS

As a missile is tested and evaluated, it must be closely monitored. This may be accomplished by using optical, radar, radio, or television instrumentation. In addition many finite measurements of humidity, temperature, acceleration, vibration, noise, radiation, strain and stress must be recorded. Sometimes this information must be telemetered back to the control center for recording. Sometimes it is recorded on magnetic tape in the vehicle and recovered afterward. Then the collected data must be compiled, reduced, analyzed, and presented in an interpretable form. The immensity and complexity of the range instrumentation system required to accurately conduct the monitoring of vehicles in flight, and the laboratory facilities required to conduct ground testing, is almost beyond the imagination of those not directly associated with this technology.

In order to provide technical support to range and missile systems a wide scope of scientific and engineering capability must be maintained in the support unit. At the Pacific Missile Range, the mission of the

Technical Support Directorate is to render service pertaining to the engineering, production, installation, maintenance, calibration, and custody of technical equipment. These services include:

- Engineering development, design, and specification in aeronautics, mechanics, materials, and electronics.
- The development and maintenance of physical standards.
- The engineering direction and control of equipment calibration and maintenance.
- The manufacture, modification, repair, and installation of equipment and systems.

This technical support capability allows rapid response to operational

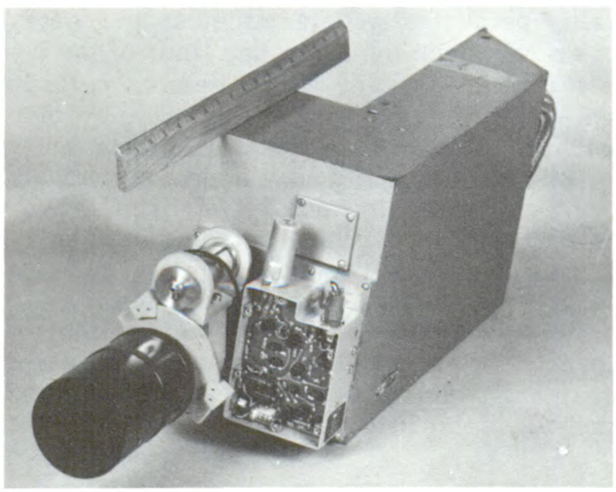


Figure 1 — Automatic exposure control mounted on an airborne camera. This unit has proved to be particularly rugged and reliable and has required no maintenance during a nine-month period of day-to-day operation.

problems and, as a dividend, provides the most advanced techniques needed to supply the "man with an idea" the necessary technical assistance needed to translate an idea into hardware.

The effectiveness of this capability is demonstrated in our recent development of an automatic iris control for airborne instrumentation cameras (Fig. 1) in response to a need for better exposure control when using narrow-latitude color film. Previous film losses as high as 80 percent because of poor exposure have been cut to practically nothing by use of this new device.

BIO-MEDICAL APPLICATIONS

It is widely recognized that continued development of instrumentation technology for biological systems is absolutely necessary if we are to solve many problems, not only of aerospace medicine, but of medicine in general. A tremendous advance in biological instrumenta-

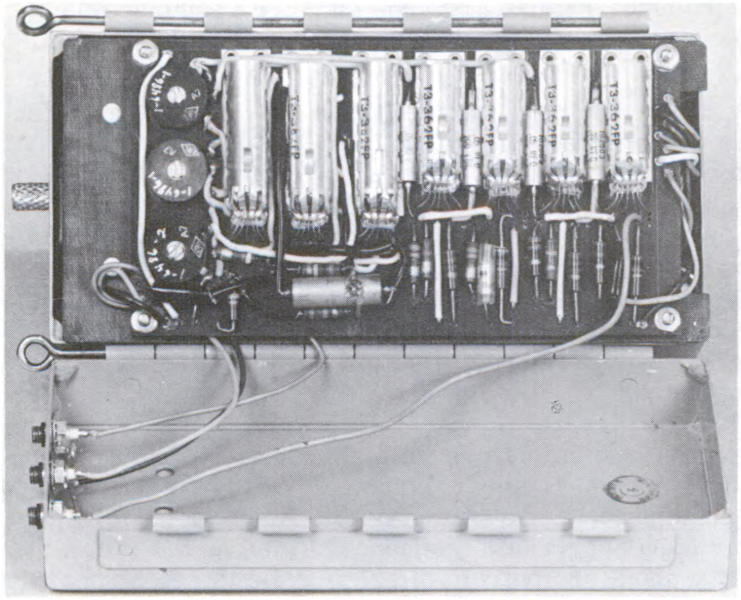


Figure 2 — A miniature portable high-gain, low-frequency amplifier suitable for use in amplifying electrocardiograph signals.

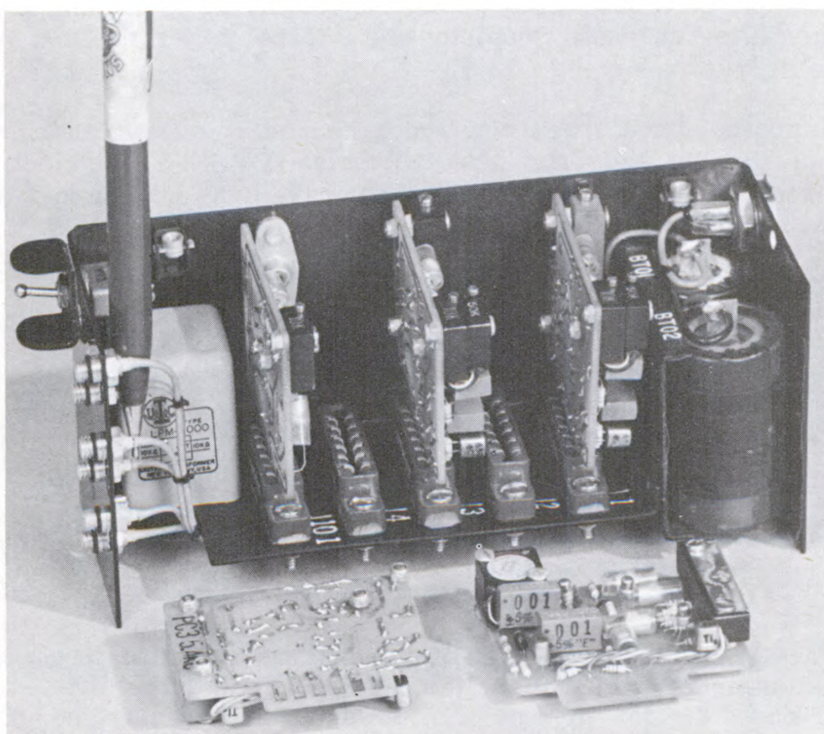


Figure 3 — A sub-miniature multiplexing unit with the voltage-controlled oscillators and audio amplifier shown in detail. (Pencil inserted at left to indicate scale.)

tion will be made when we apply the technology of the missile range directly to the biological problem under the guidance of life-sciences personnel.

The first attempt to accomplish this integrated effort at Point Mugu was initiated several years ago on a "Research Aviation Medicine" project during a study of stress in aviators flying high-performance aircraft and firing air-to-air missiles. Miniature portable amplifiers suitable for amplifying electrocardiographic signals to recording level were developed (Fig. 2). These amplifiers have a gain of 2500, a low-frequency response compatible with electrocardiac work and are small and rugged enough to be carried by the subject under study. The self-contained, self-powered units are 1 1/4 by 3 by 6 inches and weigh only a few ounces.

Recently, sub-miniature voltage controlled oscillators have been developed to multiplex several channels of instrumentation data onto a single recording magnetic tape (Fig. 3). Each oscillator operates at its own center frequency. This frequency is then varied as the input voltage varies. This input or control voltage may be the electrocardiac voltage by using the amplifiers shown in Fig. 2.

Similarly, these units can be driven by appropriate transducers and amplifiers, to record pulse rate, breathing rate, temperature, or other physical function, as well as the relative humidity of the air. An oscillator package now being used consists of four oscillators plus an audio amplifier channel, complete with internal power supplied by re-chargeable batteries.

Improved cardiograph electrodes consisting of gold plated grids with superflexible leads have been fabricated (Fig. 4). These electrodes make excellent contact with the skin. They are light and comfortable to wear, and allow arbitrary location for optimum cardiac signals.

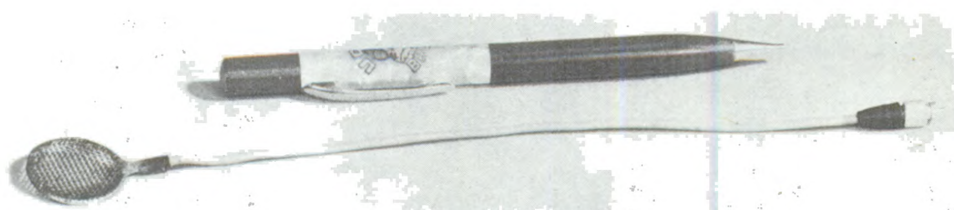


Figure 4 — Improved cardiograph electrode with gold-plated grid and superflexible lead. (Pencil included for scale.)

Variations of these electrodes are being evaluated in gathering information from pilots flight testing the Navy's latest all-weather, carrier-based fighter aircraft: the F4H Phantom carrying the Sparrow III air-to-air missile. Advanced instrumentation will most surely be applicable to the measurement of physiological and psychological changes in the diseased as well as a healthy subject under stress.

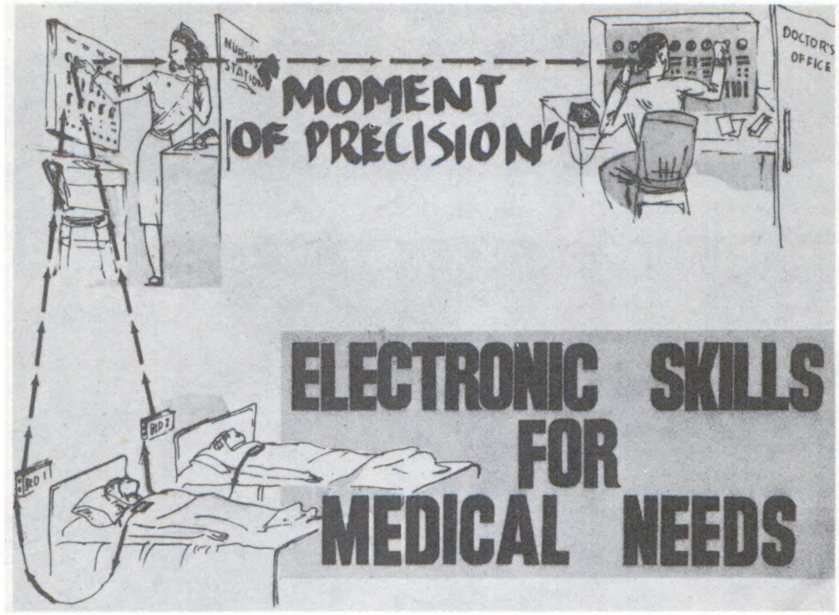


Figure 5 — Sketch of tomorrow's hospital ward.

Now visualize, if you will, your hospital ward of seriously ill patients equipped with advanced instrumentation capable of continuously recording their temperature, blood pressure, heartbeat (electrocardiograph), and brain "waves" (electroencephalograph) simply and painlessly at the bedside (Fig. 5). Note the miniaturized data system transmitting this information to the nurses' station where it is automatically recorded and the advanced presentation console which provides the busy physician with meaningful information.

Is this too much to hope for? We think not. The challenge of assimilating missile age technology in medical research and practice is here now and must be accepted.

Navy AwardsContract To Add JULIE-JEZEBEL on Neptunes

The Navy has awarded a $4,941,573 contract for installing JULIE-JEZEBEL detection equipment on 69 NEPTUNE antisubmarine aircraft to Lockheed Aircraft Co., Burbank, California.

The new equipment permits underwater detection at greater ranges. The JULIE system uses floating buoys that employ an explosive sound source for echo ranging, while the JEZEBEL buoys locate the submarine by triangulating on the noises it produces. The two systems are linked together in the plane's electronic equipment. Both are being put on new planes in production. The new contract completes a program begun in 1958 to modify some 300 earlier-model NEPTUNES already in service.

Figure 1 — Aluminum gondola after a test run from Rapid City, S. D., on Nov. 8, 1956. The late LCDR M. L. Lewis, USN, and LCDR M. D. Ross, USNR, (from left to right) are aboard.

Research with High-Altitude Balloons*

HISTORICAL BACKGROUND

The first plans of the Office of Naval Research for a manned balloon flight into the upper atmosphere were made in 1946. At that time, it was realized that a stable platform from which scientific observations could be made was needed to gather information of value in connection with future high-altitude flight. The basic problem was to find a vehicle capable of carrying a payload to sufficient altitude and remaining there long enough to make the desired observations. Inherent limitations of planes, rockets, and rubber balloons used in high-altitude studies precluded their use in maintaining observers in the stratosphere for extended periods.

The initial project, HELIOS, under contract with General Mills, Inc., required the construction of plastic balloons that would make possible flight to the stratosphere with a manned gondola equipped with scientific instruments. It was anticipated that the balloon-borne gondola would remain at a ceiling of 100,000 feet for about 10 hours and would collect data during the entire flight from launch to recovery. Among the principals working on the project were Dr. Jean Piccard who is now Professor Emeritus of Aeronautical Engineering, University of Minnesota; Mr. O. C. Winzen, President of Winzen Research, Inc.; and CDR

*Condensed from Navy Medical Newsletter; articles on phases of this research have appeared in previous issues of NavResRev.

G. W. Hoover USN, then with the Naval Training Device Center. The concept of this system was the use of a thin plastic material which would permit a reduction in the weight of the balloon itself to only a fraction of the weight of rubberized balloons. It was planned to use a cluster of plastic balloons in order to reach a very high altitude.

Plans for manned balloon flights were postponed because the technology of plastic balloon manufacture was not sufficiently developed at that time. The studies, however, definitely proved the feasibility of using plastic balloons to take scientific instruments to high altitudes and maintain them there for periods ranging from a few hours to a day or more. Accordingly, the Office of Naval Research initiated project SKYHOOK and the first flight of a SKYHOOK balloon developed by General Mills, Inc., occurred on September 25, 1947. Lauched at St. Cloud, Minn., and carrying a payload of 63 pounds, it soared to an altitude of more than 100,000 feet before descending at Eau Claire, Wis. Since that time more than 1,000 such flights have been made from locations within the United States and Canada, and from naval vessels in the Atlantic, Pacific, Caribbean, and northern waters.

Once the feasibility of using plastic balloons for high-altitude research was demonstrated, many and varied projects developed. Throughout the development of the art of plastic-ballooning techniques, General Mills, Winzen Research, and the University of Minnesota, all under ONR contract, have held leadership in this field. Among the SKYHOOK flights and projects which have taken place, the following have particular significance: In 1948, the first shipboard SKYHOOK launch took place from the USS NORTON SOUND. Nearly 300 shipboard launchings have occurred since that time. Project ROCKOON, which featured small Deacon rockets lifted to about 70,000 feet and released from a SKYHOOK balloon, was held in Arctic waters during 1952.

On May 18, 1954, the largest plastic balloon ever built, the super SKYHOOK, was launched for the U. S. Navy by General Mills, Inc., from the University of Minnesota airport. It soared to an altitude of 117,000 feet. The volume of the balloon was more than three million cubic feet and it lifted about 400 pounds of scientific instruments useful in gathering information on cosmic rays.

On September 7, 1956, the University of Minnesota launched a giant Mylar plastic balloon developed by the G. T. Schjeldahl Company to set an unofficial balloon altitude record of 145,000 feet for unmanned balloons.

In 1957, the U. S. Navy began an operational system known as TRANSOSONDE (trans-ocean sounding) which consisted of almost daily balloon flights across the Pacific Ocean from Japan. On September 25, 1957, the tenth anniversary of the first SKYHOOK flight, project STRATOSCOPE used an unmanned SKYHOOK balloon to carry a special solar telescope aloft to 81,000 feet which obtained the sharpest photographs ever taken of the sun. Recent U. S. Air Force projects, such as MANHIGH and FARSIDE have also utilized the balloon techniques developed for SKYHOOK and other ONR balloon projects. The purpose of SKYHOOK flights has been to obtain cosmic-ray, meteorological, and other geophysical data.

SKYHOOK 60 was conducted from the USS VALLEY FORGE (CVS-45) between January 18 to 31, 1960 in Caribbean waters. Two balloons of 10,000,000 cubic feet each were launched from the carrier deck, as were several tracer balloons varying in size from 750,000 to 2,000,000 cubic feet. From this series of unmanned balloon launchings, the feasibility and desirability of the aircraft carrier as a launching platform for manned balloons was proved.

THE STRATOLAB PHASE

The STRATOLAB program was initiated in 1954 when the gondola shell, originally designed by Jean Piccard and built for Project HELIOS, arrived at Minneapolis to be fitted out and tested. The first flights under Project STRATOLAB were conducted in 1955. These were low-level flights made to collect atmospheric data. The following year, intermediate-altitude flights were conducted as was the first high STRATOLAB ascent.

Studies have indicated that future aircraft may not be able to operate in sustained level flight between the altitudes of 100,000 and 400,000 feet. Although the extreme boundary between our atmosphere and space occurs at about 600 miles, flights at altitudes below 100,000 feet (about 20 miles or less) present many of the important operational and physiological space-barrier problems. STRATOLAB provides a research platform through the zone to 100,000 feet which will continue to be useful altitudes for operational-type military aircraft in the future. As a space laboratory it will provide continued opportunities for the study of various techniques and experimental equipment for manned flights into space.

The STRATOLAB system consists of three categories—low, intermediate, and stratosphere flights. The open-basket system is used for scientific observations in low- and intermediate-altitude flights. The basket is not pressurized; therefore, the maximum altitude is limited to about 42,000 feet. The gondola used for stratospheric flights is a true "space" cabin and is adequate for flights to any altitude. Originally designed for Project HELIOS, the gondola was completed and fitted out by Winzen Research, Inc., and General Mills, Inc. It is designed to provide adequate climate, sensing, flight control, safety, and communication equipment. The octagonal floor, 52 inches in diameter, has a total area of approximately 15 square feet and has two escape hatches. Cabin altitude pressure equivalent to near sea level is maintained in the gondola during flight.

The gondola is suspended from the balloon by a system of nylon webbings which are attached to the gondola. These webbings are also connected to an Air Force cargo-type nylon parachute which can be used to lower the gondola in the event of an emergency. This parachute is attached to the main load line of the system. Above the parachute and just below the balloon, is a standard SKYHOOK-termination device which will permit severing of the load from the balloon either to initiate parachute descent of the gondola or to release the balloon at the moment of ground impact at landing time to reduce dragging.

Balloon sizes can be varied according to the upper limit of the altitude desired, the number of personnel to be accommodated, the weight of the scientific instruments, and the planned duration of the flight. The largest balloon used with the open-basket system was about 80 feet in diameter. Such an open-basket flight was made August 10, 1956 to photograph vapor trails made by jet aircraft and to obtain aeromedical data. Observations were made of cirrus cloud particles and aeromedical measurements were taken.

A STRATOLAB HIGH #1 flight, launched by General Mills, Inc., on November 8, 1956, reached an altitude of 76,000 feet. (see Fig. 1). On this flight, the 21-year old record of Explorer II was broken and an era of almost routine very high-altitude, manned plastic-balloon flights became a reality. An analogy could well be made to the long-standing barrier of the four-minute mile. In both cases, once the old barrier was shattered, new records have become commonplace.

Since then, valuable astronomical and medical data have been obtained from several succeeding STRATOLAB HIGH flights, (see Fig. 2). Chief pilot on these flights was CDR Malcolm D. Ross USNR, of the Office of Naval Research. Copilot for the first three flights was the late LCDR M. Lee Lewis USN (Ret), head of the balloon flight operations for Winzen Research, Inc., and developer of the gondola and the plastic SKYHOOK balloon that now carry the men aloft. The scientific observer for the STRATOLAB HIGH 4 was Charles B. Moore, Jr. on the staff of Arthur D. Little, Inc., Cambridge, Mass.

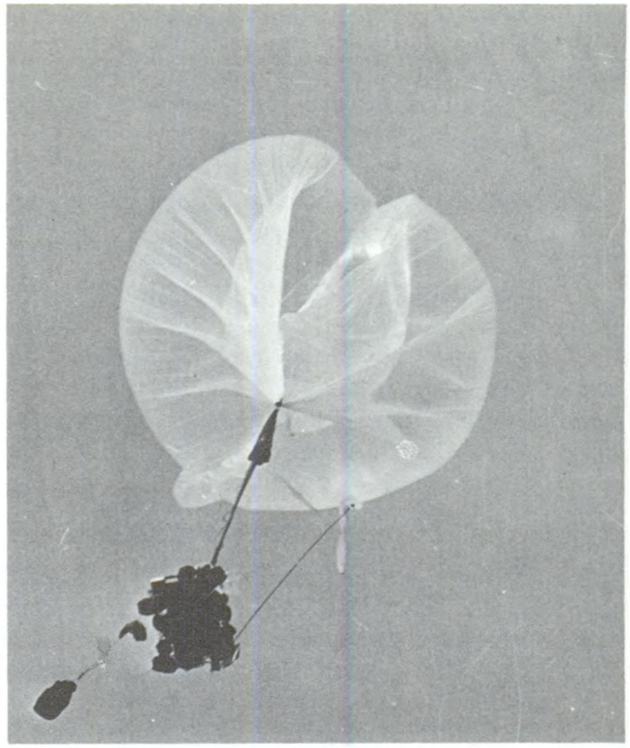
MEDICAL MONITORING

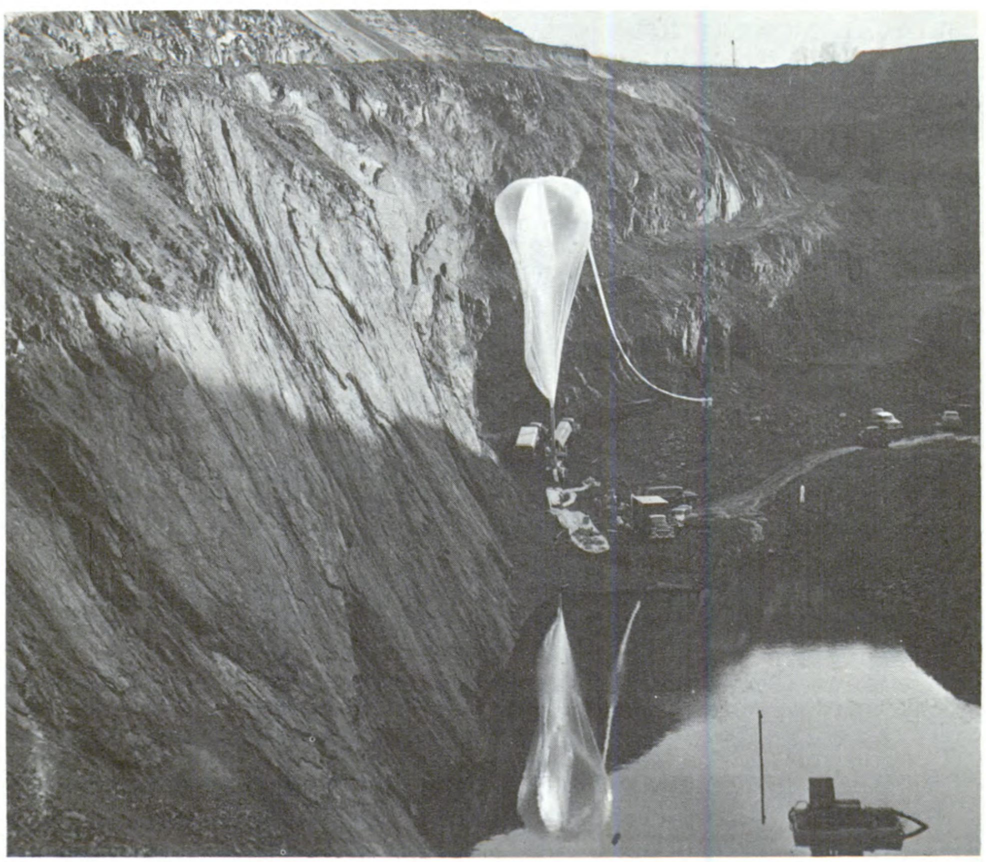
The recording of the valuable medical data obtained on STRATOLAB flights has been possible through the use of telemetering equipment developed at the Naval Medical Research Institute, Bethesda, Md. Monitoring of the balloonist's heart and respiratory rates are begun several hours prior to the flight. Records of the balloonist's physiological reactions, including a continuous record of heart reactions and respiratory conditions, are transmitted to medical observers located on the ground and in an accompanying aircraft.

For recording heart beats, flat electrode pick-up discs slightly larger than a shirt button are held in place on the balloonists by black plastic electric insulating tape. Small amplifiers about the size of a cigarette box are used in connection with these electrodes. A thermistor connected to a respiratory voltage-measuring device is fastened to each microphone. The electrocardiograph amplifiers and respiratory-voltage devices are fed into an FM subcarrier oscillator and to an FM transmitter with a range of about 100 miles. The telemetering system in the gondola weighs approximately 5 pounds, not including the batteries. Monitoring equipment is carried in a specially configured R5D-type aircraft, an ambulance, and a carryall. These vehicles also track and follow the course of the balloon.

The equipment in the aircraft includes a Clark receiver, an AN/UKR-2 telemetry set, and a Brush recorder. The composite signals are recorded on magnetic tape for future study. The signals are fed in

Figure 2 — STRATO-LAB flight launched May 6, 1958, with civilian astronomer and Navy pilot aboard: Below: inflating balloon at bottom of iron mine in Minnesota. Right: open-basket gondola rising upward to about 40,000 feet.





parallel to the Brush recorder for instantaneous observation during the flight. Constant voice communication is maintained between the balloonists and the medical observers and the communications are also recorded for correlative post-flight study. Continuous monitoring of the physiological condition of the balloonists permits monitors to provide early warning of possible impending danger to the safety of the flight and permits termination of the flight if necessary.

The indoctrination and training in aviation physiology of the balloonist and the accompanying scientific investigator are routinely accomplished. In addition, research studies on the effects of flights into the stratosphere upon man's physiological system are conducted. Direct assessments of adrenal cortical activity have been obtained as well as indirect measurements through studies of protein metabolism, electrolyte metabolism, and white blood counts. Results of these studies are published by the Naval Medical Research Institute.

Basic biological experiments preliminary to manned space flight are also conducted. Fruit flies, house flies and fleas have remained at altitudes of from 78,000 to 82,000 feet for 16 hours in balloon gondolas, where they were exposed to cosmic-ray attack 60 times more intense than at sea level. These experiments have been performed in cooperation with the U. S. Department of Agriculture, whose scientists examine the genetic makeup of the insects and their progeny to determine the chromosome damage resulting from cosmic-ray bombardment.

TDC's Simulated Periscope View

The USN Training Device Center has developed an unusually life-like simulator for training neophyte submariners in the use of a periscope. By employing TV techniques, target images are projected in full color, varying aspect, and changing size on a 360° sky-seascape.

Correction

On page 27 of Naval Research Reviews for December there appeared a sketch demonstrating the geometry of Naval Ordnance Laboratory's hole-sizer, or "Wobbler." The accompanying formula was lettered: $D = b + \frac{aW}{L}$. A "2" should have been added: $D = b + \frac{aW}{2L}$.

Space 'Bearing' Up

Lack of warehouse space for inventory is no problem for an instrument—jewel bearing plant in Rolla, North Dakota. A year's production of some 2,000,000 bearings—destined for precision defense items and the government strategic stockpile—would not fill a milk bottle. The plant is operated for the government by Bulova Watch Company, Inc. on a dollar-per-year contract.

RESEARCH NOTES

New Sloan Laboratory and Tandem Van de Graaff Generator to Speed Research

The new five-story Alfred P. Sloan Laboratory of Mathematics and Physics and the ONR 12-Mev tandem Van de Graaff generator were dedicated recently at the California Institute of Technology. Mr. Alfred P. Sloan, Jr., former chairman of the board and now honorary board chairman of the General Motors Corporation and president of the Alfred P. Sloan Foundation of New York was present, as was Dr. James R. Killian, chairman of the Corporation of the Massachusetts Institute of Technology and formerly President Eisenhower's scientific advisor, who is also a member of the board of the Sloan Foundation. ONR representatives present included RADM Rawson Bennett, Capt. William G. Jackson, Jr., Dr. Shirleigh Silverman, and Dr. William E. Wright.

The Office of Naval Research made available to CalTech about 1.6 million dollars to procure the tandem Van de Graaff and associated equipment. The accelerator was constructed and assembled by the High Voltage Engineering Corporation (HVEC) at Burlington, Massachusetts, and has operated there in excess of its specifications. It was then completely disassembled, shipped to California, and then put together again by representatives of HVEC and the CalTech staff. Dr. Dennis Robinson, president of HVEC, attended this dedication of the fourth tandem accelerator built by his company. Although the generator is nominally described as a 10-Mev machine, it is capable of producing particles with an energy of 12 Mev. The accelerating tube is enclosed in a tank, 35 feet long by 8 feet in diameter, which contains nitrogen under pressure. The accelerator is housed in the sub-basement of the Sloan Laboratory in a large concrete vault which provides shielding against the radiation developed.

RESEARCH PLANS

During the dedication ceremony, Dr. William Fowler discussed the research planned for the new accelerator: ". . . We plan to carry on much along the same lines of research as those started here by Professor Lauritsen some 30 years ago, . . . on the study of the structure and properties of the light elements. . . .Our first projects will have to do with the study of the structure of the light isotope of lithium, namely lithium 6. We know a great deal about lithium 6, but we hope to learn even more to complete our studies of its properties, using the machine available to us. . ." Light elements have properties with some very interesting implications in things other then just the nuclei themselves. "These are the applications to astronomy. With the three Van de Graaffs that we have used in the past, we have studied the reactions by which hydrogen is burned in stars like our sun. And I can say without too much exaggeration that, give or take a few little details, we understand now, from work done here and in many other laboratories, the processes by which hydrogen is converted into helium. Hydrogen is the fuel and helium is the ash in our sun, and we know with only some small uncertainties exactly the rate at which hydrogen is burned in the sun, and can give astronomers like Professor Hoyle and Professor Greenstein the information they need to understand in detail the properties of the sun and other stars.

"One of our programs with the new accelerator will be the study of the reaction by which helium is consumed. Eventually, five billion years from now, our sun, like many other stars, will have consumed its hydrogen and will start to burn helium. We don't know any of the details of the reactions involved in the burning of helium, although we have hints as to how it goes on. With this machine, we will be able to study the reactions of helium with nuclei such as carbon, nitrogen, oxygen and neon, and when we finish that, we will have some understanding of just how our sun will begin to evolve once it has consumed all of its hydrogen and starts to heat up its helium ash and in turn burn that. . . . By that time, astronomers tell us, the sun will be enormous and its hot gases will have encompassed the earth. . . ."

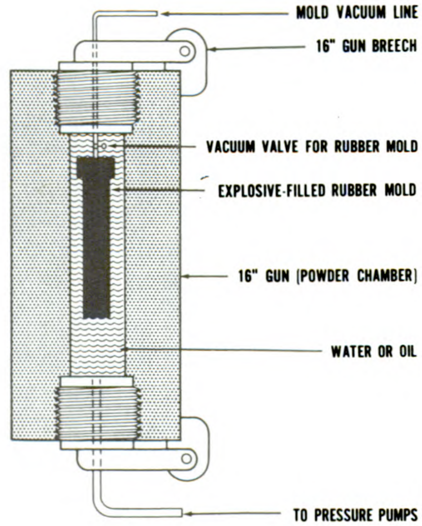
Admiral Bennett presented the accelerator to CalTech on behalf of the Navy. His presentation speech included the following significant remarks: ". . . One could say that this complex is representative of one of the best combinations that is possible, and possible really only in this country of ours. The Sloan Laboratory, its equipment, and the use of that equipment, represent a happy combination of philanthropy; the interest of the government; the Navy Department specifically, in basic research; and a great school. It is only the intermingling of these three that makes this complex possible. . . . The Office of Naval Research was the first agency of the federal government with a broad charter for research; as the law reads, we can do anything as long as it at some time may have some application to the Navy."

In his concluding remarks, President Lee DuBridge of CalTech made the following statements, which the ONR community will be happy to read: ". . . There are too few people who understand that the objective of the Office of Naval Research is the support of the search for new knowledge for its own sake. . . . I saw a little of the organization of the Office of Naval Research immediately after the war, and I was also in on the organization of the National Science Foundation which. . . stole ONR's scientific director to get the Foundation underway on a somewhat similar pattern. So, to ONR the scientific world owes an enormous debt of gratitude for pioneering the way in which the government could assist the universities in the prosecution of the search for basic knowledge and in the training of graduate students in scientific and engineering pursuits. These techniques have been widely copied in other agencies of government today. . . . For your participation in this and many other CalTech projects over the past many years, we repeat again our gratitude. And as a symbol of the fact that we will not forget that this tandem accelerator laboratory was made possible by the Office of Naval Research, we will place on the control panel in a conspicuous place this plaque, reading 'Office of Naval Research Tandem Accelerator' which is the official name of the installation, so that we will forever know that this facility was made possible by the Office of Naval Research and will be our method of letting everyone know our indebtedness to ONR."

ONR — Pasadena

New Press from Old Gun

The Navy has found a new and unique use for its 16-inch naval guns, which have become all but obsolete since the development of the long-range nuclear-warhead missile. The breech end of one of these guns has been converted into a press for safely and cheaply compressing ultrasensitive powdered explosives into high-density molded charges for research.



NOL Isostatic Press

Developed at the U. S. Naval Ordnance Laboratory at White Oak, Silver Spring, Maryland, the press gives the Navy a valuable tool in its present applied research program aimed at determining the explosive patterns of variously shaped charges. Called the NOL Isostatic Press, the new explosives compressor is a fluid-filled chamber in which the sensitive powdered explosives, contained in custom-shaped rubber molds, are subjected to equal pressures from all sides. When 30,000 pounds per square inch of pressure is applied to the chamber by means of four hydraulic pumps, charges of uniform density are produced without cracks or cavities. Such charges can be machined much more easily, and their performance is subject to more accurate predictions.

Since there are no moving parts to the mold, the only friction involved is that between the explosive particles. Thus, more highly sensitive explosive materials can be compressed than is possible with standard hydraulic presses, where piston rams squeeze the powdered explosive into a compressed solid charge. The new press can mold several small charges at the same time or mold a single charge measuring six feet long. The use of soft rubber molds to contain the powdered explosives makes possible the compressing of a variety of irregular shapes, ranging from that of an hourglass to a cylinder.

On the Naval Research Reserve

Twelfth Nuclear Science Seminar at Oak Ridge

The Twelfth Annual ONR Nuclear Science Seminar at Oak Ridge, Tennessee, was held from 27 November to 10 December 1960, with Naval Reserve Research Company 6-3 serving as host. The seminar was sponsored by the Office of Naval Research in conjunction with the Atomic Energy Commission, the Oak Ridge National Laboratory, and the Oak Ridge Institute of Nuclear Science. Sixty-two participants attended, including eight Army and four Air Force officers from twenty-six states and the District of Columbia. LCDR Peter P. Holz, USNR, served as Seminar Chairman, with LCDR Bletner, LCDR Cory, LT Hobbs, LT Redford, LT Wilson, LT Scates, and Yeoman Wallace assisting.

During the two-week seminar, discussions were devoted to most of the many fields of the overall nuclear research program, including some basic theory and application in the fields of the life sciences, isotope production and use, health physics, and nuclear reactors. A total of forty such presentations were made by scientists and engineers associated with the Oak Ridge National Laboratory, Oak Ridge Institute of Nuclear Science, the Oak Ridge University of Tennessee Agricultural Research Laboratory, and the Atomic Energy Commission of Oak Ridge staff. Dr. W. G. Pollard, Executive Director, ORINS, gave the opening and closing talks on "Nuclear Structure" and on the "Origin of the Universe." Other noteworthy speakers included Dr. R. A. Charpie, Assistant Director, ORNL, "The Gas-Cooled Reactor Program"; Dr. J. A. Lane, Directors Division, ORNL, "Power Reactor Economics"; Dr. Elda E. Anderson, ORNL, "Health Physics"; and Mr. S. R. Sapirie, Manager, Oak Ridge Operations, AEC, "Operations at Oak Ridge." Dr. J. A. Swartout, Deputy Director, ORNL, addressed the group on "The Role of Oak Ridge National Laboratory in the Nuclear Energy Program."

Tour of ORNL facilities during Oak Ridge Seminar

In addition, speakers on topics of specific military interest were: CAPT R. L. Karl, USN, Production Superintendent, Charleston Naval Shipyard, "Moral Rededication"; CAPT J. C. Myers, USN, Deputy and Assistant Chief of Naval Research, "Research and the Future Navy"; CAPT J. W. Jockusch, Jr., USNR, Special Assistant to the Chief of Naval Research, "The Research Reserve Program"; LCDR E. F. Kehoe, USNR, Educational Specialist, Office of Naval Research, "Training Opportunities in the Research Reserve"; CDR Gordon Facer, USN, Chief of Weapons Division of Defense Atomic Support Agency, "Nuclear Weapons"; CAPT E. E. Conrad, USN, "The Navy's Program for Nuclear Propulsion of Ships"; Lt Col J. B. Robinson, III, USAF, "Aero Space Applications of Nuclear Energy"; LCDR C. W. Mallory, USN, "The Army Nuclear Power Program"; and CAPT R. R. Green, USN, "Fleet Anti-Air Warfare, Present and Future."

Field trips included tours of the American Museum of Atomic Energy, Fort Loudoun Dam (TVA), Kingston Steam Plant (TVA), Abbott Laboratories, the facilities at Oak Ridge Institute of Nuclear Studies, the University of Tennessee-Atomic Energy Commission Agricultural Research Laboratory, the Atomic Energy Commission Technical Information Center, and the Oak Ridge National Laboratory.

Seminars Given by NRRC 11-3

During the last quarter of the calendar year 1960, NRRC 11-3, Los Angeles, arranged an important series of Seminars on Nuclear Weapons, which included the following topics:

- The description and tactical use of nuclear weapons, by Major L. Kletzker, USMC, Nuclear Weapons Training Center, Pacific;
- The physical effects of the close-in environment of large-yield explosions, by Dr. Harold L. Brode, theoretical physicist, Physics Division, RAND Corporation, Santa Monica;
- Data on radioactive fallout, by Dr. Willard F. Libby, former AEC Commissioner and now Professor of Chemistry, UCLA (Dr. Libby had been notified of his Nobel Prize award just a few days earlier);
- The bases for popular resistance to the development and use of nuclear weapons and technical aspects relating to public health, by Dr. Lowell D. Wayne, Research Division, LA Air Pollution Control District;
- The problem of negotiating a nuclear test ban with the Soviet Union, by Dr. Frank Press, Director, Seismological Laboratory, California Institute of Technology, Pasadena, and head of the U. S. Scientific Mission to the Geneva Conference;
- The problems of inspection and the techniques for determining evidence of nuclear explosions, by Dr. Richard M. Foose, Chairman, Department Earth Sciences, Stanford Research Institute.

During the first quarter of 1961 the series will be in the field of the biological sciences, with programs on cell structure, muscle physiology, engineering applications in brain research, and space perception and conceptualization. These discussions will be presented by nationally known anatomists, physiologists, and research physicians. As in all of the programs of NRRC 11-3, the topics and discussions are considered in their basic and applied relationships to the naval service, its research needs, and methodologies.

Technical Study Completed by NRRC 4-2

Members of Naval Reserve Research Company 4-2, Phiadelphia, Pennsylvania, completed and submitted the final report on a research study entitled "Ship Concealment." This study was conducted under the direction of CDR Edmund Thelen, USNR, former Commanding Officer, NRRC 4-2. The research study was of interest to the Undersea Programs Branch, Naval Applications Group, ONR and copies were also sent to the Bureau of Ships as a subject matter of interest to that bureau.

Members of the company were commended "for their interest in the problems of ship concealment and their enumeration of the capabilities and limitations of existing and projected techniques within unclassified security limitations." It was concluded that the study had served an excellent educational and familiarization purpose for participants in the study.

Research Reserve Companies Commended

Two new seminars were introduced to the training program of the Research Reserve in fiscal year 1960. The companies responsible for the presentation of these seminars have been commended by RADM R. Bennett, USN, Chief of Naval Research.

The first of these seminars was presented by Naval Reserve Research Company 4-1, Princeton, New Jersey. This seminar on "Research Planning and Management" was presented for the two-week period commencing 22 August 1960 and was publicized in the November issue of Naval Research Reviews. The seminar was under the chairmanship of CDR Raymond R. Goldberg, USNR, former Commanding Officer and presently a member of NRRC 4-1.

In mid October 1960 Naval Reserve Research Company 3-14, Kingston, New York, presented a seminar on "Electronic Computers and Their Military Applications." This seminar was presented at Steward Air Force Base, Newburgh, New York, under the chairmanship of CDR James D. Quale, USNR, Commanding Officer of the company. An account of the seminar was published in the December issue of Naval Research Reviews.

These two new seminars provided an excellent opportunity for Research Reservists to enhance their mobilization potential in these new vital subject areas. Attendance at each of the seminars was approximately 70 officers from all services. The two Research Reserve Companies were commended for "the initiation, organization and follow through" required in the introduction and presentation of these outstanding seminars.

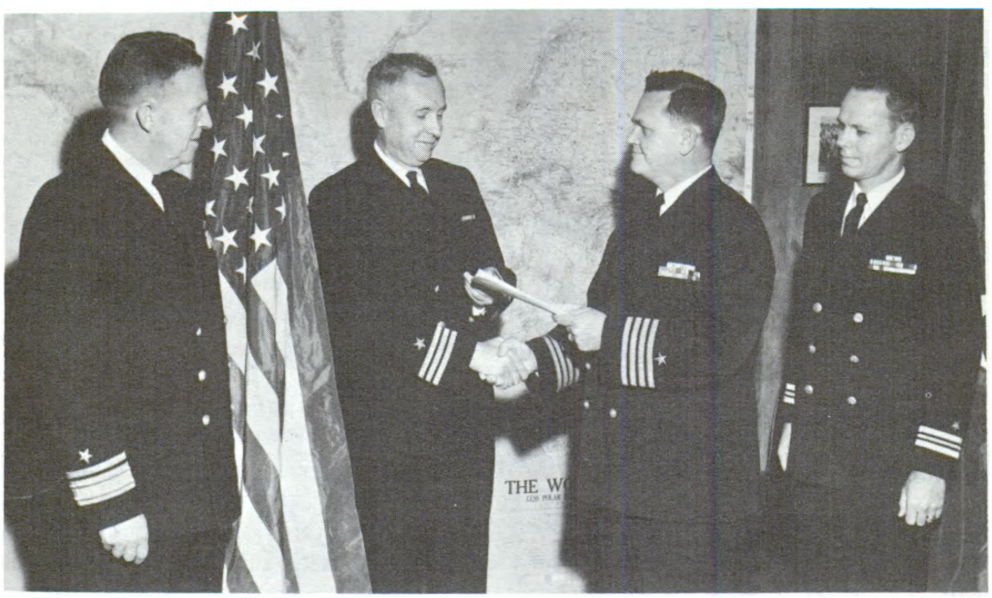
Outstanding Companies Selected

The Commander, Naval Reserve Training Command, has sent Letters of Commendation to Commanding Officers of Naval Reserve Research Companies which were evaluated as OUTSTANDING by the Commandants of Naval Districts for fiscal year 1960. These letters read in part:

> "This noteworthy achievement could result only from outstanding leadership on your part combined with excellent performance of duty by the officers and enlisted personnel under your command."

Letters of Commendation were received by the following Commanding Officers who served during fiscal year 1959:

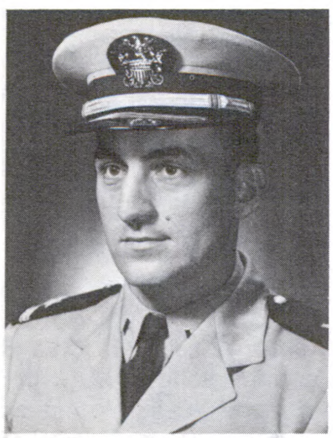
CDR Sidney F. Wexler, USNR	NRRC 1-3
LCDR Daniel Howland, USNR	NRRC 4-7
CDR Loren T. Palmer, USNR	NRRC 6-13
CDR Roy W. Jones, USNR	NRRC 8-13
CDR Marshall W. Keith, USNR	NRRC 9-14
CDR Arthur J. Imm, USNR	NRRC 11-2
CDR Gilbert F. Kinney, USNR	NRRC 12-8



CAPT R. B. McLaughlin, USN, C.O., ONR Branch Office San Francisco, presents letter of commendation to CAPT G. F. Kinney, USNR, C.O. of NRRC 12-8. Looking on are RADM E. E. Yeomans, USN (Superintendent of the Naval Postgraduate School where the reserve unit meets), and LCDR H. A. Wellemeyer, USN, Reserve Assistant, ONR San Francisco.

CDR R. W. JONES (MSC), USNR, Commanding Officer of NRRC 8-13, Stillwater, receiving from CDR L. P. HOSKINS, Reserve Assistant, ONR-Chicago, a Letter of Commendation from the Commander, Naval Reserve Training, and the Commandant, Eighth Naval District. Looking on are the members of the Company.

Assistant Training & Liaison Officer (Research Reserve) Reports to ONR, Chicago



LTJG H. D. Sims

LTJG H. D. Sims, USN, from Aurora, Illinois, reported for duty at the Office of Naval Research Branch Office, Chicago, on 7 November 1960. LTJG Sims is a graduate of the University of Missouri with a B. S. degree in Secondary Education. He has also completed advance work in Educational Administration.

LTJG Sims completed pre-flight school at Pensacola, Florida, before going to sea to serve as Operations Officer in a destroyer picket, the USS MILLS (DER-383). He served in that capacity for two years prior to reporting to ONR-Chicago.

Selected for Admiral

RADM T. J. Killian

Dr. T. J. Killian, ONR's Deputy Chief and Chief Scientist, was selected by a recent board for Rear Admiral, USNR, capping a naval career that began two months before Pearl Harbor.

Dr. Killian graduated from M. I. T. in 1926, obtaining a B. S. and M. S. in Electrical Engineering. He obtained a fellowship at Princeton and in 1927 received an M. A. and, in 1929, a PhD in Physics. After a three-year period as an instructor at M. I. T., he became an executive of the Barkon Tube Lighting Corporation. Later, in 1939, he was appointed Director of Research jointly for the Frink Corporation and the Sterling Bronze Corporation, a position he was holding when he volunteered for active service in the Navy in 1941.

Dr. Killian's first duty, then as a Lieutenant, USNR, was Head of the Physics section at the Naval Postgraduate School, Annapolis. By 1944, he had advanced to Commander and was serving as Project Cadillac Coordinator under the Chief of Naval Operations. At the close of the war he was Coordinator for Electronics and Guided Missiles. He returned to civilian life in 1946, and was promoted to Captain, USNR, in January 1954.

Upon his return to the inactive reserves, Dr. Killian joined the staff of ONR, first as Head of the Scientific Branch and later as Scientific Director of the Research Division. After five years in that capacity he was appointed Chief Scientist of the Army's Office of Ordnance Research, and was for a while Dean of the School of Engineering and Architecture of Catholic University. He returned to ONR in 1955, becoming Deputy Chief and Chief Scientist—the position he now holds.

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New Oceanographic Data Center

The National Oceanographic Data Center was dedicated January 16, 1961, by Hon. James H. Wakelin, Jr., Assistant Secretary of the Navy for Research and Development and Chairman of the Interagency Committee on Oceanography.

The new Center, located in the Naval Weapons Plant, Washington, D. C., is under the joint sponsorship of the Navy Department, the U. S. Coast and Geodetic Survey, the Bureau of Commercial Fisheries, the National Science Foundation, the Atomic Energy Commission, and the Weather Bureau. Starting with a basic nucleus of data provided by the Navy Hydrographic Office, the Center will collect, process, preserve, and disseminate oceanographic data. Among the services offered by the new agency will be:

- The preparation of summaries and tabulations of data on annual and seasonal oceanographic conditions.
- The preparation of indexes of its holdings, to be made available on request.
- The exchange or sale, in accordance with existing law, of summaries and tabulations to the general public.
- The promotion and encouragement of the routine collecting of time series and ocean-wide survey data.

Several types of reports will be available on photo cards, in data logs, and in other forms. They may be studied free of charge in the reference library or they may be procured in the form of listings, summaries, tabulations, or microfilm at standard costs. The Center will include various data storage facilities, standard automatic devices as well as a high-speed computer for processing, and photographic and machine card reproduction equipment.

The present International Indian Ocean Expedition will be the first large-scale oceanographic expedition to furnish data to the new Center for processing. The type of information that will be available at the Center will be useful in extending our knowledge in areas such as:

- In the development and improvement of oceanographic prediction techniques, such as fish-population forecasts and forecasts to aid in the routing of ships.
- To extend Gulf Stream and hurricane studies and research into fish-mortality problems.
- In the preparation of new oceanographic atlases.
- In the planning of new oceanographic surveys.

The Center will be administered by the Navy Hydrographic Office; personnel will include oceanographers, marine biologists, geologists, mathematicians, physicists, chemists, and physical science technicians.

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. Use of funds for printing this publication was approved by the Director of the Bureau of the Budget, February 12, 1958.

Scientists peer into the heart of the prototype of the new Armed Forces Mark F TRIGA nuclear reactor. See the story on pp. 6-11. (Official U. S. Army photo).