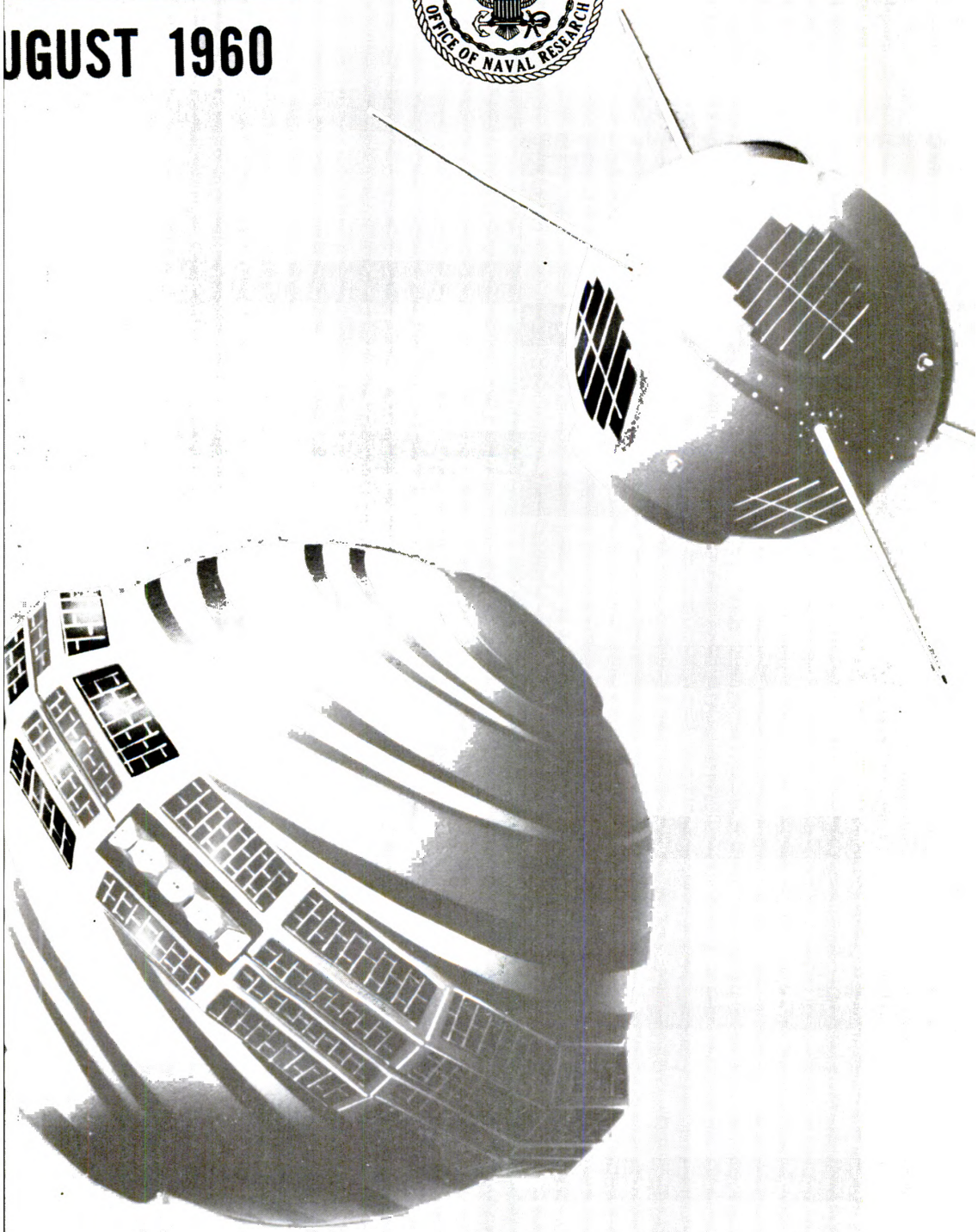
AVAL RESEARCH

EVIEWS

UGUST 1960



Project RAM's Flying Laboratory. (See pp. 4-7.)

The Navy's Solar-Radiation-Measuring Satellite

Robert W. Kreplin, Dr. Talbot A. Chubb,
and Dr. Herbert Friedman
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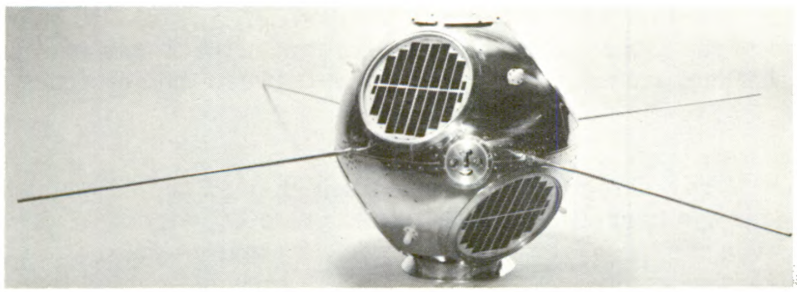
Washington, D. C.

Whirling around in outer space are two Navy satellites placed in orbit simultaneously on June 22. One is the Naval Research Laboratory's fact-finding, solar-radiation-measuring satellite, nicknamed here "Sunray" to distinguish it from its erstwhile traveling companion; the other is Transit II-A, the second experimental doppler-type navigational satellite to be launched by the Navy. The instruments in Sunray were designed especially for the Laboratory's most recent satellite solar photometry experiment and are now collecting and reporting continually on the intensity of shortwave solar radiations arriving at the top of the earth's atmosphere—above the levels at which ultraviolet and X-rays from the sun are absorbed.



A side view of the prototype of NRL's solar-radiation-measuring satellite, showing the X-ray detector and the magnet, mounted on the equator of the sphere.

The two satellites (see the cover photo) were clamped together in the nose cone of an Air Force Thor-Able-Star rocket, with Sunray riding piggyback on Transit, and launched from the Atlantic Missile Range at Cape Canaveral, Fla. About 30 minutes after the early morning (1:54 a.m. EDT) launching, the satellites were disconnected by a spring device and ejected into separate orbits around the earth. Transit-II-A, similar in appearance and function to Transit I-B, is a 223-pound, 36-inch fiberglass sphere; in addition to its navigational payload, Transit II-A carries a digital clock and an experimental receiver and antenna for obtaining measurements of radio background noises from the galaxies. NRL's Sunray is a 42-pound, 20-inch aluminum sphere that looks like a sea diver's helmet. Once each period of 101.5 minutes, Sunray completes an orbital path 382 (perigee) to 657 (apogee) miles above the earth, the path inclined about 65 degrees north from the equator.

Inside Sunray are two ionization chambers, each containing a gas and a window in front to let the radiation enter. Radiation entering either chamber ionizes (or "electrifies") the gas inside—the more ionized the

gas, the better it conducts electricity. (The chambers are made to operate in the 2 x 10^{-11} ampere range). By recording the measured changes in conductivity of the gas, one can tell how intense is the radiation entering the chambers. One of the chambers is sensitive only to extreme solar ultraviolet radiation (principally Lyman-alpha, of 1216A wavelength), and the other is sensitive to penetrating solar X-rays (2A to 8A in wavelength). The chambers are designed for an operational life of one year, and both are mounted so that the sun energizes only one at a time.

The Lyman-alpha detection chamber, which is filled with nitric oxide gas, is 3/4 inch in diameter and 7/8 inch deep. Through a window made from a plate of lithium fluoride crystal, ultraviolet light of wavelengths longer than 1050A enters the chamber and ionizes the gas. In the sensitive wavelength band 1050A to 1350A, Lyman alpha radiation is the predominant solar emission and contributes all but about 10 percent of the ion chamber response. Since sunlight slowly destroys the chamber due to decomposition of the nitric oxide gas, the incident light is limited by means of a small aperture (6.13×10^{-4} cm^2). Parallel to the Lyman-alpha detector is a photocell which is sensitive to visible light. The photocell measures the angle between the satellite spin axis and the sun; its responses permit distinguishing the sun from any other source of observed radiation. In addition, the photocell is used to correct the response of the Lyman-alpha ion chamber, and of the X-ray ion chamber, when a change occurs in the view angle between the detectors and the sun.

The X-ray detection chamber is 1 inch deep and filled with argon gas. Through a berryllium metal (0.021 gm/cm^2) window, 1.60 $inches^2$ in area, X-rays of wavelengths between 2A and 8A enter the chamber and ionize the argon gas. The chamber is mounted behind the gap of a permanent magnet, which has a field strength of about 3000 gauss. (The magnet gap is 3/8 inch in width and 1 by 1 inch in cross section.) This magnet should greatly reduce the chamber's response to low-energy electrons, both by deflecting those of energy less than 1 Mev and by sharply limiting the detector angle of view.

What information the satellite-borne probes are obtaining about Lyman-alpha and solar X-rays is being radioed to ground stations on a ten-channel AM-FM telemetry system. Much of the most recent knowledge about these radiations has been acquired through rocket astronomy experiments, which the Naval Research Laboratory has been conducting at intervals since 1949. For example, the fact that X-rays stream from the sun and are generated primarily in the sun's corona, and the finding that the sky is covered with still unexplained blotches of ultraviolet radiation. Although very significant, the information from rocket experiments has been limited by several factors, such as the brevity of rocket observation periods (about 6 minutes per rocket flight), the relatively few rockets which can be instrumented and flown per year, and the variability in rocket and instrument behavior from one round to the next. These factors do not apply to NRL's solar satellite photometry experiment because of the comparatively long and continuous observation

period (up to a year or more) now possible with a single instrument package in orbit. Thus, the NRL experiment is expected to provide, for the first time, a reliable time history of solar radiations and to yield the kind and quantity of data long desired and needed for correlating these solar emissions with their terrestrial atmospheric effects.

Solar ultraviolet and X-ray radiations are responsible for the formation of the ionosphere of the earth. These radiations are variable and produce changes in ion density from day to day and from season to season. They also produce, at times of solar flares, sudden ionospheric disturbances which create havoc with long-range radio communication and navigation systems. When satellites have collected enough data on these radiations, we shall know much more about the why's and when's of ionospheric behavior; then we may be able to predict the range of shortwave communications and perhaps eliminate the problem of untimely radio fadeouts. This knowledge in turn would be an important step toward perfecting the Navy's Transit satellite navigation system, which transmits radio data (doppler shift) for computing position fixes in any weather, day or night, anywhere in the world.

CAPT Barr Receives Certificate

CAPT Norman L. Barr, MC, USN (Ret), was presented a Bureau of Medicine and Surgery Certificate of Exceptional Service on March 28 during ceremonies in the office of the Surgeon General of the Navy, RADM Bartholomew W. Hogan. The Certificate was presented by RADM Hogan in recognition of CAPT Barr's research work during his naval career. A former director of the Bureau's Astronautical Division, CAPT Barr retired from the Navy on September 1, 1959, following more than 21 years of active service. The citation on the Certificate states:

"For his brilliant research which has enhanced the readiness and competence of the naval services in Fleet Defense and its medical-aeronautical and astronautical operations.

"An indefatigable and purposeful worker, he succeeded, through his researches, in increasing significantly the capabilities of pilots and crews to perform their function of protecting the Fleet. He developed systems, now in use by the Navy, for simulated instrument-flying conditions in instrument-training aircraft cockpits. He was the first to determine and explain the need for artificial lights in aircraft cockpits for high-altitude daylight flight. He was also the first to measure and report the important effects of atmospheric brightness on the visibility of cockpit instruments. He designed instruments to compute visibility range and to measure physical variabilities influencing visibility. He perfected a system for reducing the hazards due to the blinding effects of glare from aircraft searchlights during night attacks. He devised systems for gathering and automatically recording physiological data from airborne pilots, and from animal and human occupants of earth-orbiting vehicles, transmitting it to the ground by radio and relaying it to a central laboratory by radio and telephone from any part of the world."

(This busy man has also been a willing contributor to Naval Research Reviews.)

Project RAM

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For the past 13 years Project RAM has broadly applied telemetry as a tool in both basic and applied research on aviation medical problems and by means of telemetry has extended aviation medical services to remote installations. The Project's objective is "to develop adequate and suitable pickups, to detect the desired physiological responses to be transmitted, and to perform tasks as desired to evaluate the stamina of men and animals in flying aircraft or missiles." The name RAM is short for Research, Aviation Medicine.

From the simple start of one officer, two hospital corpsmen, and one electronics technician, the project has grown in complement and capability and has advanced the state of the art in electronics as applied to Aviation Medicine. The main plant, located at the Naval Medical Research Institute, includes a modern electronics laboratory and a low-pressure chamber that is capable of simulating altitudes of 150,000 feet and temperatures down to -70 degrees C. Another important tool is the airborne telemetering sending-and-receiving station built into an R5D aircraft (DC4), which is under the operational control of the Air Programs Division of the Office of Naval Research. This "flying laboratory" has some unique capabilities that lend themselves readily to research problems. It is not only equipped with a single sideband radio but with facilities for airborne transmission and reception of television signals. In addition there is an intracommunication system that has both headphone outlets and loud speakers.

The cabin of the plane is divided into two sections: a laboratory forward and a 16-seat passenger compartment aft. On the forward bulkhead of the passenger space is a duplicate flight panel, containing the basic instruments and autopilot for control of the aircraft. This space could be adequately isolated for various studies in physical and psychological responses attendant to isolation, heat, reduced oxygen saturation, etc. Simple modification of the panel would allow programming of the instruments in contrast to the actual attitude, altitude and speed of the aircraft. The laboratory space itself is approximately 20 feet in length and has an electronic workbench along the starboard side of the aircraft. There are numerous outlets for various electrical loads. The equipment for telemetry includes a discriminator, tape recorder, visual auditory "read outs," and receivers. A photo of the R5D Flying Laboratory appears on the inside front cover and a detailed drawing of the laboratory is shown in Figure 1.

Project RAM's staff is divided between the Naval Medical Institute and the Naval Air Station, Anacostia (Washington, D.C.). Attached to the

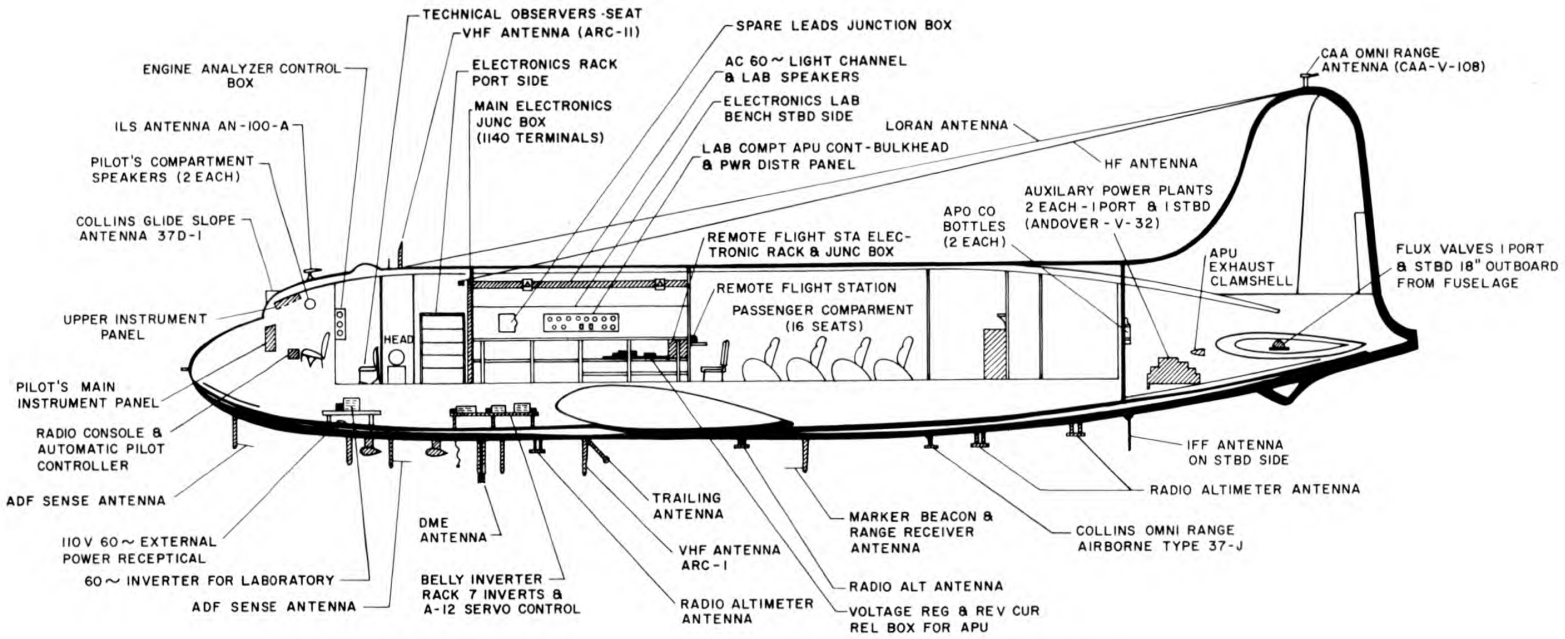

Figure 1--Detail drawing of Project RAM's R5D Flying Laboratory.

project and stationed at NAS, Anacostia, are four aviation machinists, one aviation metalsmith, and one aviation radioman. The plane commander—LCDR G. E. Baker—and four aviation electronic technicians are attached to the project but have additional duty in the NMRI Aviation Medicine Division. Also stationed at NMRI in the Aviation Medicine Division are a Naval flight surgeon, a Naval aviator, two electronic technicians, three hospital corpsmen, one training devices technician, and a draftsman. (CAPT Joseph P. Pollard, MC, USN, is the head of the Aviation Medicine Division. Within the Aviation Medicine Division is the Aviation Psychology Branch, headed by CDR W. F. Madden, MSC, USN, who also serves the Bureau of Medicine and Surgery as Head of the Aviation Psychology Division. Two additional psychologists are expected to join this branch within the next 6 months. The psychologists work closely with Project RAM's electronic group in instrumenting and training animals for various experiments; in addition, they carry on their own research programs. All of the personnel contribute to the design, development, testing, and operational performance of the various components used in Project RAM's telemetry system.)

Project RAM's telemetry system has a 12-channel capability. Transducers are available for obtaining electrocardiograms, respiratory rates with some indications of respiratory volume, skin and body temperatures, and the recording of electroencephalograms. The transducers, amplifiers, and subcarrier oscillators used at present have all been designed, developed, tested, and operationally employed by the personnel attached to the project. Continued modification and refinement of components have enabled the project to keep abreast of the state of the art in electronics. A comparison of the original size of transducers, amplifiers, and subcarrier oscillators with the current size and design can be seen in Figure 2.

Throughout the years Project RAM has utilized its capabilities in different spheres. In 1953, electroencephlograms, electrocardiograms, respiratory rates, skin temperatures, and body temperatures were monitored from the pilot of a single-engine aircraft. In 1956, two high-altitude balloon flights were monitored. The Stratolab (high-altitude

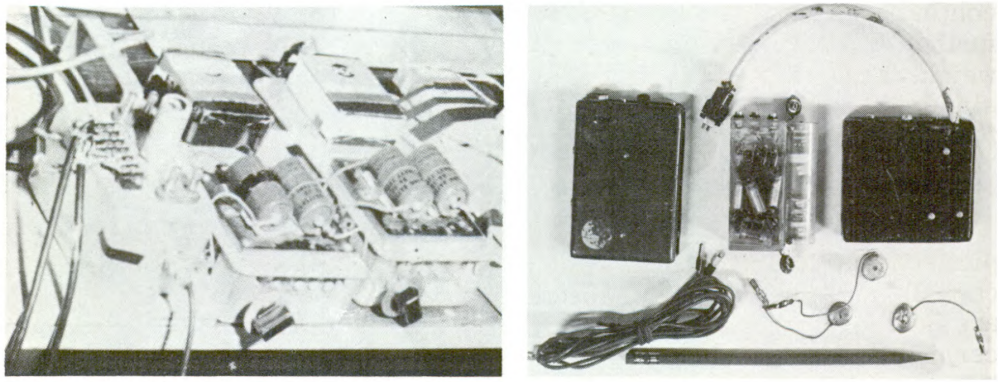

Figure 2--A comparison of the original size of transducers, amplifiers, and subcarrier oscillators (left) with the current size and design (right).

balloon) flights, sponsored by the Office of Naval Research, were monitored by the Flying Laboratory. Valuable data have been recorded on the response of individuals to a closed environmental system in various conditions of stress. In 1958, physiological data was transmitted from an open-basket gondola over Minnesota to NMRI via radio and two-way leased telephone lines. In addition, pulse and respiratory rates were transmitted from the gondola to the airborne receiving station via closed-circuit television, actually the first time TV had been so employed.

Also in 1958, electrocardiograms were transmitted from Naples, Italy, to NMRI via low-frequency radio. Consistently accurate diagnoses were made by cardiologists on the transmitted traces. In February 1959, physiological data were received by FM radio and then transmitted over a 6000-mile telephone network. Again, the data were sufficiently clear to enable accurate diagnosis.

In May 1960, Project RAM, in connection with the Atomic Energy Commission and the Martin Company, displayed at the Aero-Space Medical Convention the first employment of a nuclear power source for the transmission of an electrocardiogram. Also demonstrated was a small transmitter that has a range of one mile. This development is a most encouraging breakthrough, because—by eliminating the wire to a large transmitter—the monitored subject will have unlimited freedom of movement.

Project RAM is not confined to the work on telemetry systems. In the past, the project has made other contributions in the field of Aviation Medicine. Under the direction of CAPT Norman L. Barr, MC, USN (Ret) (see page 3), valuable data was obtained on the brightness of the atmosphere at different altitudes to 45,000 feet. A study was also conducted on the visability of aircraft runways. Both of these studies are documented in NMRI Reports.

At the present, two Project RAM items—a telemetry oxygen meter and a transducer for recording blood pressure—are being developed. In continuing a program already mentioned, Project engineers hope that further utilization of the nuclear power source will be possible so that weight and space can be reduced. Being contemplated is a study of simulated instrument flying which would involve a special pair of glasses for aviators in flight to simulate actual instrument conditions.

Project RAM is unique and affords opportunities that can be exploited in many ways, thereby contributing greatly to the over-all capability of the U. S. Navy. Both the staff and the project's equipment are available to other laboratories and installations. Problems concerning instrumentation are especially welcome, but any experiments that would be mutually beneficial would be acceptable. Contacts in regard to the project should be initiated through the author of this article, at NMRI.

Navy Machine Translation Research

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Office of Naval Research

Machine Translation Research, which seeks a system capable of translating from one language to another, can be divided roughly into three categories. These are (1) the computer input and output devices, (2) the computer itself, comprising not only the electronic circuitry capable of making decisions but auxiliary memories as well, and (3) the computer program and associated lexical, syntactic, and semantic techniques, enabling the computer to translate languages automatically. Research leading to a completely automatic capability should proceed along all three lines. Of course, research in each of the three categories would have considerable application to the solution of many scientific and engineering problems other than those in machine translation, and might well be motivated by the necessity to solve numerous varied types of problems Accordingly, investigation in these areas—although of great importance and significance to the machine translation effort—is frequently not supported specifically under this category of research.

Since the very inception of the high-speed digital computer, the Navy has been heavily involved in the support of computers, computer organization, programming techniques, computer technology, and auxiliary computer devices. For example, the Navy supported at least in part some of the earliest and most imaginative attempts to build high-speed digital computers—such as the Harvard Mark II and Mark III computers, the Institute for Advanced Study computer, the Whirlwind computer, the Naval Ordnance Research computer, and the George Washington University Logistics Research computer. These computers provided much of the technology and organization for existing and proposed high-speed computers so necessary for machine translation.

Currently, the Navy is sponsoring, at least in part, a number of the newest and most advanced high-speed computers—such as the Remington Rand LARC, the Philco TRANSAC, and computers at the University of Illinois and the University of California at Los Angeles. Also the Navy is supporting million dollar contracts at IBM, Sperry Rand, and the Radio Corporation of America to consider novel technology for the design of computers that operate in a billionth of a second.

In regard to the question of auxiliary computer components, particularly high-speed, high-density memories, ONR has always heavily sponsored and currently continues to sponsor research in these areas. For example, the large photomemory which is the heart of the IBM Machine Translation System was initially developed under a Navy contract with the International Telemeter Corporation from June 1953 to August 1954; Dr Gilbert King, now at IBM, was the principal investigator. ONR sponsored the basic research leading to the magnetic-core memory under Project Whirlwind at M.I.T., as well as the magnetic-drum memory under contract with Engineering Research Associates which subsequently merged with Remington Rand. Magnetic cores and

magnetic drums are the main memories used in present-day digital computers.

ONR is currently sponsoring a number of tasks toward the development of other types of high-speed, high-density memories which will be of great use in their application to machine translation problems. These include, among other tasks, a novel photomemory of considerably different design and potentially greater capabilities than that of IBM and Dr. King. This photomemory is being developed under contract to M.I.T. and Hydel, Inc., of Waltham, Massachusetts.

Computer input and output devices have been recognized by the Navy as an area of the greatest importance, insofar as the use of computing techniques is concerned. Both ONR and the Bureau of Supplies and Accounts have been actively concerned with research in this area. The Navy now supports a number of research projects which will lead to computer input devices that should be able to read rapidly and easily a large variety of different type fonts as well as—eventually—handwritten characters. Among these, the Navy supports projects concerning the "Perceptron" (see the research note, pp. 17-19) at Cornell Aeronautical Laboratory and Cornell University. Other projects under Navy support in this area exist at the University of Chicago and the United Research Corporation in Cambridge, Massachusetts. The Bureau of Ordnance supported from January 1954 to July 1957 fundamental research in pattern recognition at Baird-Atomic, Inc , Cambridge, Massachusetts, which led to the print reader. Much work along these lines currently is being carried on at the Research Laboratory for Electronics at M.I.T. and Lincoln Laboratory of M.I.T. in Lexington, Massachusetts. Both are three-Service contracts in which the Navy participates. The Navy carries on research on the recognition of speech, eventually as a means of computer input, at the University of Michigan and has supported related work at IBM.

With regard to computer output devices, the Navy has supported work which led to the now widely used Stromberg-Carlson high-speed printer, capable of printing 5000 lines per minute.

The computer program and associated linguistic research have been recognized by the Navy to be very adequately supported by other agencies, particularly the Air Force, the Army, the Central Intelligence Agency, and the National Science Foundation. The Navy expects to profit very considerably from these efforts. However, apart from activities in support of the needs of the Office of Naval Intelligence not met elsewhere, the Navy limits its activities in the field to small imaginative, fundamental efforts where unique and significant ideas are likely to arise rather than to the more massive development type of support.

The Navy currently supports research in machine translation of a general, critical nature at Hebrew University in Israel and at Wayne State University, where a small group is considering the translation of mathematical literature from Russian to English. The latter group cooperates very closely with groups at Georgetown University under CIA sponsorship and at Ramo-Wooldridge under Air Force sponsorship. From 1952 through 1956, the Navy supported a basic study of Russian

linguistics also at Wayne State University. This resulted in a most important book by Professor Harry Josselson, The Russian Word Count.

The Navy encourages and relies heavily on the dissemination of information among various groups concerned with machine translation. Accordingly, ONR assisted in the sponsorship of a conference on machine translation at the University of California at Los Angeles in February 1960 and is jointly sponsoring with the National Science Foundation a machine translation working conference of the various groups in the field at Princeton in July 1960. The Navy also assisted, through its Project FOCUS, in the sponsorship of a Symposium on the Structure of Languages and Its Mathematical Aspects at the American Mathematical Society Meeting in New York City in April 1960.

The Navy is involved in a number of coordination activities in machine translation through its membership on various governmental committees Some of these are the Subcommittee for Mechanical Translation of the Committee on Documentation of the Intelligence Board, the National Science Foundation Interagency Committee on Mechanical Translation and Information Retrieval, and the Interagency Group for Research on Information Systems. In addition the Navy supports a number of peripheral activities which are closely connected with, although not specifically directed toward, machine translation. Those activities supported include research in computer programming at Princeton and Carnegie Institute of Technology, and research in information retrieval at Hebrew University in Israel, at Benson Lehner Corporation in Los Angeles, and at the University of Pennsylvania.

The Navy feels that machine translation is one facet in the communication sciences consisting of artificial intelligence, communication biophysics, communication systems, experimental psychology, linguistics, neurophysiology, processing and transmission of information, sensory aids for the handicapped, social science, and speech communication. Research in all of these fields is currently supported by the Navy at M.I.T. and elsewhere, and advances are expected to have a strong bearing on progress in machine translation.

The reasons for Navy support of machine translation and auxiliary projects are:

- First, good machine translation would be of great and immediate value to ONR. Much of the information used by the Office of Naval Intelligence arrives in one foreign language or another Acceptable automatic translation not only would increase manyfold the amount of raw data which could be ingested, but also could improve the accuracy and consistency of available English translations. Perhaps most important, competent analysts would be freed from the necessity of personally translating documents which they need quickly, thus leaving additional time available for the more abstract aspects of intelligence analysis. An added quasi-intelligence benefit to the Navy resulting from the availability of good mechanical translation equipment would be the case of translating information from English to the language of the various foreign personnel encountered by Naval forces in various parts of the world.

- Second, the Navy has a very great interest in the translation to English of foreign scientific and engineering literature. The Navy spends many millions of dollars annually in discovering and developing new devices and methods. Wide availability of pertinent foreign information could easily shorten the development periods required and reduce the money spent on work already accomplished elsewhere. American scientists would accordingly be considerably more aware of foreign projects and would have a broader base of scientific research upon which to draw in attacking specific Navy problems.
- Third, machine translation is a most exciting application of high-speed computer technology. As has been mentioned, many of the problems involved in machine translation are common to a number of fields of information processing, so that progress in one field results in progress in the others, as well as giving additional insights into the solution of problems in other fields. Thus, for example, advances in machine translation will yield simultaneous improvements to document storage and retrieval, high-speed data processing, and automatic programming. All of these subjects are of vital interest to the Navy and contribution to them will in many cases have immediate and widespread application.

CAPT Pollard Relieves CAPT Gell (Retired)

CAPT Joseph P. Pollard, MC, USN, reported for duty at the Office of Naval Research on May 16 as Special Assistant for Medical and Allied Sciences. He succeeds CAPT Charles F. Gell, who voluntarily transferred to the retired list on May 1. A native of Virginia, CAPT Pollard took his premedical training at the College of William and Mary, graduating with a B. S. degree in 1935. He obtained his M. D. degree at the University of Virginia in 1938. After serving his intership and residency, he was commissioned a LTJG in April 1941. He spent 8 years with the Pacific Fleet as flight surgeon on the USS HORNET, the USS YORKTOWN (Battle of Midway), and with the Naval Air Transport Service Squadrons which included duties in connection with air transportation of patients in the Pacific and Aleutian areas. For the latter, he was awarded the Navy Commendation Medal and Ribbon.

His subsequent assignments included duty at the Pentagon with DOD's Research and Development Board as the Navy member on the Committee on Medical Sciences (1949-53); Senior Medical Officer on the USS CORAL SEA; Assistant Medical Officer at the U. S. Naval Air Station, Norfolk (1955); and Executive Officer at the Naval Research Institute, Bethesda (1956-58). During the past 2 years, CAPT Pollard served as Head, Aviation Medicine Training Branch; Head, Aviation Medicine Branch, BuMed; and Head, Aviation Medicine Research Division, Naval Medical Research Institute. CAPT Pollard is a Fellow of the Aerospace Medicine Association, a Diplomate of the American Board of Preventive Medicine in Aviation Medicine, a Fellow of the American College of Preventive Medicine, and a member of other professional societies.

Natural Mammalian Hibernation

Albert R. Dawe
Chief Scientist
Chicago Branch Office
Office of Naval Research

Until last year, no organized attempt had been made on an international basis to pool the thoughts and efforts of scientists engaged in unraveling the mystery of the phenomenon of natural mammalian hibernation. In May, 1959, a Symposium sponsored by the Physiology Branch, Office of Naval Research, brought together 34 scientists who have devoted most of their research lives to discovering the bodily mechanisms for hibernation. Original endorsement of the Symposium was provided by the late Capt. T. K. Ruebush and by Dr. Roger D. Reid of ONR. Dr. Charles P. Lyman of Harvard University Medical School, who probably knows as much about the deep sleep of hibernators as anyone in the world, was Chairman of the Symposium. Scientists from the United States, Canada, Finland, Switzerland, Germany, Sweden, France and Yugoslavia were in attendance. Two Russian scientists were invited but could not attend; however, N. Kalabuchov sent a paper to be included in the published proceedings of the Symposium. All sessions were held at the Massacusetts Institute of Technology's Endicott House at Dedham, Massachusetts.

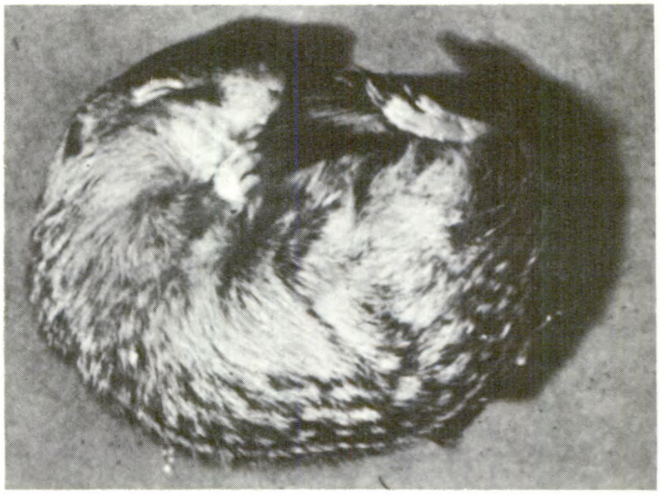
An increasingly large number of scientists anticipate that the study of hibernation physiology will open new vistas of information about the mechanisms of the living body. Hibernation is one of the few methods natural to mammals whereby every measurable process in the animal is profoundly slowed down. To illustrate how great this metabolic reduction can be, consider for a moment that a ground squirrel's heart beats 360 times a minute (6 beats per second) in normal activity, yet it will slow down to 3 beats per minute (1 beat every 20 seconds) during hibernation. This animal has depressed its heartrate by 120:1. In a mamal's nonhibernating life bodily processes can seldom be retarded, even under the most extreme conditions, by more than a factor of 10:1.

Nature has provided physiological minima in hibernation, making possible a selected number of mammalian species which can function in harsh, otherwise intolerable Northern environments. A ground squirrel hibernating in its underground burrow through the winter has solved the problem of food gathering--it does not gather food; it has resolved the problem of maintaining body temperature by dropping its temperature almost to that of the surrounding air; it has mastered the problem of predation, for it remains hidden away from most of its enemies. Living functions continue during hibernation but at such feeble operating rates that this state has often been mistaken for death.

Scientists are studying mammalian hibernation partly because of its possible applications in medicine and surgery. The human body can often be best repaired when its active parts are functioning slowly. Human heart repair surgery recently achieved almost miraculous results when the patient was greatly cooled and anesthetized by means of

"artificial hibernation." In this case, the heart beat was slowed to enable the surgeon to repair a quiet heart muscle. In contrast, an operation on an actively beating heart would place undue burdens on the patient and the surgeon. Such hypothermia is, however, a lethargy less profound than that of true or natural hibernation.

Many of the anatomical and physiological characteristics of hibernating mammals were detailed during the Symposium (1) to demonstrate



A 13-lined ground squirrel in deep hibernation when its body temperature was at 5 degrees C.

distinctions between hibernating and nonhibernating species and (2) to show the differences between the body of an animal in hibernation and during its active life. There appears to be no fundamental internal anatomical differences between nonhibernating mammals and hibernators. A possible single exception is the large amount of brown fat found, especially in the neck regions, in hibernating species. Thus, the nonhibernating rat has very little brown fat; the hibernating ground squirrel has a large amount. Physiological differences between species are very great, however, when the hibernation "syndrome" (signs and symptoms of hibernation) is present. Comparisons of nervous activity, heart and blood vessel functioning and hormonal activities show remarkable differences. These variations are most evident when comparing a hibernator, such as a ground squirrel, during hibernation with a nonhibernator, as the rat. Even more striking is the fact that many of these physiological differences exist within the same animal depending on whether it is hibernating or active. Thus, the state of hibernation seems to be a self-contained phase of living which can be turned on and off in hibernating species. The "off phase" resembles the normal state of a non-hibernator in almost all respects; whereas the "on phase" is unique, resembling but not identical to anesthesia, sleep, hypnotism or "facultative hypothermia" (a new term introduced at the Symposium). Another, more curious aspect of hibernation is that it can be turned on and off throughout a hibernation season. It is never a long sleep.

A number of popular misconceptions were dealt with summarily during the Symposium. Perhaps they will soon disappear from the scientific literature in the light of the following:

Hibernation induction and arousal are disassociated from temperature effects. Cold does not cause hibernation, nor do animals arouse from hibernation in the spring because of increasing warmth. However, cold applied to an animal about to hibernate increases the profundity of the torpor into which it will sink.

Hibernation is not restricted to season. It can occur at any time of the year.

Hibernation is not a simple sleep. It is so all-inclusive that body tissues actually undergo changes which can be seen and measured, and can be shown to function in new ways. For example, the mouth is sealed in hibernation.

Hibernation is probably closely linked to both hormonal and nervous influences. Changes in functions of almost all endocrine glands and nervous systems can be shown to occur before the animal hibernates, while it is hibernating and as it arouses from hibernation.

Many states have been called hibernation but are not. "Hibernation" in bears, for example, is not true hibernation.

A hibernating animal survives on about 1/100th of his normal supply of food and oxygen. Within limits an animal in hibernation is relatively uninfluenced by radiation, sound, light, and temperature, but is highly sensitive to tactile stimuli.

The animal in hibernation acts in many respects like an animal with a "thermostatic control" and a "built-in clock."

Hibernation in mammals raises the question of whether true hibernation may be induced in man. The possibility of such a feat is suggested graphically in science fiction. The usefulness of hibernation in man in space flight has been alluded to in recent years. Dr E. F. Adolph, one of the truly great physiologists of our time and one of the "philosophers" who participated in the Symposium, advised the group that the less said about the science-fiction aspect the better--and for good reasons. It is always dangerous, logically and physiologically, to extrapolate from one species of animal to another and to formulate opinions when they are warranted by only the most meager facts. But, as a dim future possibility, such a notion is extremely intriguing for the following reasons:

If hibernation could be attained for man, then the space capsule in which he would fly (or the submarine in which he would ride or "fly") could be kept at a low temperature, perhaps zero degree Centigrade.

If the traveler hibernated, his food and oxygen requirements might be only 1/100th that of an active man.

In hibernation, man's "arrest of time" might be such that he could possibly exist for about 20 normal lifetimes of 1400 years, since, as pointed out by Dr. Donald R. Griffin, some hibernating bats apparently may live 20 times longer than nonhibernating mamals of the same body weight.

During hibernation, such a man would not suffer from radiation. Dr. Douglas E. Smith explained to the Symposium that hibernating mammals endure tremendous dosages of radiation without effect while hibernating; however, upon returning to activity, they showed most of the usual signs of radiation injury. (If body repair from radiation injury could be effected in hibernation, survival could be attained.)

Aside from space travel, a method may be developed for holding man in suspended animation for future activity, for medical treatment, or for other reasons.

After the Symposium disbanded, Dr. Frank E. South, University of Illinois Medical School, and the writer (stimulated by CAPT Bruce L. Carr's suggestion that Symposium attendees should maintain effective liaison) set up a Hibernation Information Exchange within the ONR Chicago Branch Office. This followed the nearly 100 percent favorable response of Symposium participants to the idea of an Exchange. Serving a group who essentially represent the western world in mammalian hibernation, the Exchange acts as a central point for circulating new ideas, technical papers, and news items among members. By this technique, publications and ideas reach the scientists almost instantaneously. Long literature searches are often eliminated since most of the definitive work in this fairly narrow field reaches a member almost as soon as it is produced.

During the Exchange's first 3 months, more than 50 different reprints were received. That the Exchange helps its members is borne out by the circulation of a 2500-reference bibliography on hibernation, collected by Dr. R. J. Hock over many years. The response to a request for supplemental references was so great that the Exchange now probably has access to the world's most complete bibliography on hibernation. Thus, the Office of Naval Research has taken a significant lead in the field of natural mammalian hibernation, through sponsoring the First International Symposium on Natural Mammalian Hibernation and by its continuing effort to promote the exchange of information in this field.

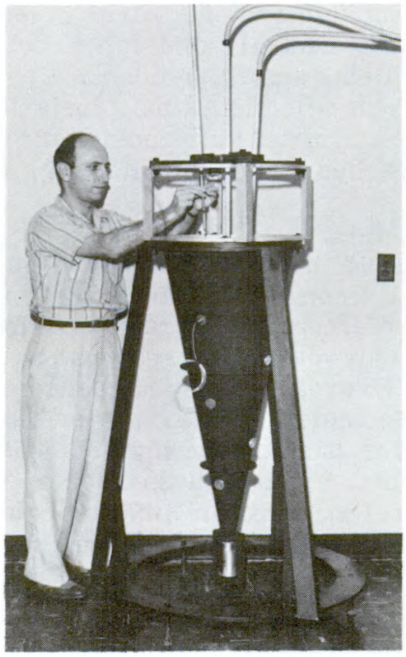
Transfers to Washington

Robert J. Mindak, has transferred to the Office of Naval Research where he is an Assistant Research Coordinator for the fields of (hydromechanics and thermodynamics). Prior to his Washington transfer, Mr. Mindak served as a Physical Science Coordinator in the ONR Chicago Branch Office. For the past two years he participated on a part-time basis as a staff member of the ONR Hydrodynamics Contract Research Program. In recognition of his service in this assignment, he was presented with a Sustained Superior Accomplishment Award in the spring of 1959.--ONR, Chicago.

Research Notes

NOL Simulates High-Explosive Blasts For Shock-Wave Tests

High-explosive blasts as powerful as those generated by the Hiroshima atomic bomb may be simulated with relatively small charges as a result of a series of tests with conical shock tubes developed by the Naval Ordnance Laboratory, White Oak, Silver Spring, Maryland. The cone test method for explosives was developed by William S. Filler as part of basic research in blast-wave phenomena by the Air-Ground Explosion Division of NOL's Explosion Research Department.



William S. Filler of NOL's Ground Explosion Division adjusts one of the pencil-type, piezoelectric gages fitted into a 22-degree conical shock tube to measure the powerful blast pressure generated in the cone by a relatively small charge. The cone is also fitted with a flush-wall piezoelectric gage.

When a small charge is fired in the apex of a cone, its blast wave represents a sector of a spherical shock wave generated by a much larger charge fired in the open. In effect, the small-charge shock wave expands within the confines of the cone in the same manner as it would

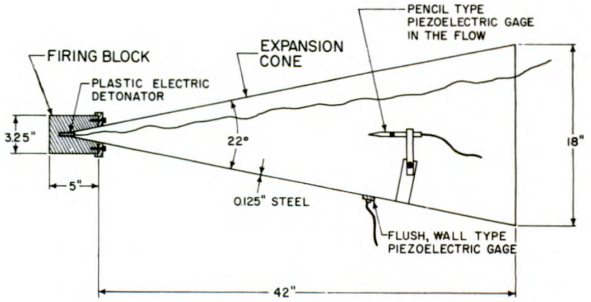


Diagram of the 22-degree cone used at NOL to produce a blast wave equal to that from a 33-only 1/2 gram of explosive.

if it were part of the full sphere. To determine the size of the charge required to simulate an open-air blast, an "amplification factor" is used. This factor is the ratio between the solid angle of a sphere to that of the solid angle of the cone and theoretically can be increased to a 16,000-to-one factor by using a cone of 1/2 degree.

In his work at NOL, Mr. Filler first tested a cone of 22 degrees which has a theoretical amplification factor of 110. In this cone, he fired a 1/2-gram charge in an attempt to generate a blast wave equal to that of 55 grams of explosive. Because of heat loss through the firing block and other factors, this cone proved to be 60-percent efficient and produced a blast wave equal to that of a 33-gram charge, giving an actual amplification of 66.

Attempting to produce a blast wave equal to that of 150 pounds of explosive, he fired a 7.5-gram charge in a 2-degree cone which has an amplification factor of 10,000. Owing to increased heat loss, this cone proved only 30-percent efficient and produced a blast equal to that of a 45-pound charge, giving an amplification of 3000. However, it should be noted in comparing the results of the 22- and 2-degree angle cones that an increase of two orders of magnitude in amplification factor was realized with the smaller angle cone while the efficiency was only halved.

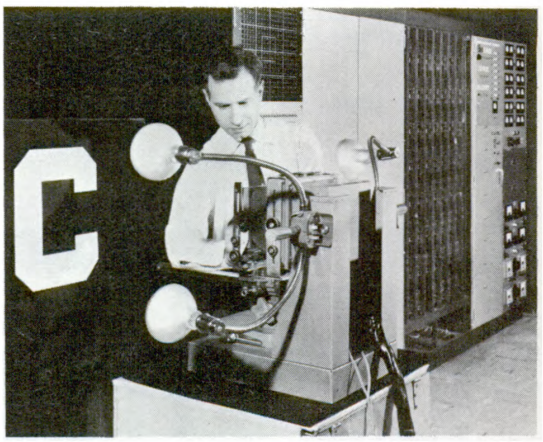
Based on the experimental results, generating blast waves equivalent in magnitude to those from atomic weapons is considered possible. Specifically, it is feasible to construct a cone that will simulate a 20-kiloton TNT blast similar to the one generated by the atomic bomb dropped on Hiroshima during World War II. Such a cone would be 2000-feet long and have an angle of about 1/2 degree. Since a cone of this design could not be expected to function more than 25-percent efficient, a 1000-pound charge of TNT would be required to generate the blast.

The new cone method of studying high-explosive shock waves provides numerous advantages over the field method. For one, the noise factor is reduced considerably because of the reduced size of the charge used. Another advantage is that cone explosive blasts can be studied under laboratory conditions much easier than in the field. Probably the most important advantage in using the blast cones, according to Mr. Filler, is the fact that "the experimental problems of studying large high-explosive blasts in a variety of fluid media is expected to be drastically simplified in future studies with the use of the cones." —Report, U. S. Naval Ordnance Laboratory, Silver Spring, Maryland.

Research Device Identifies Objects or Patterns

An experimental machine which can be "trained" to automatically identify objects or patterns such as letters of the alphabet has been developed by the Cornell Aeronautical Laboratory, Buffalo, New York, under the Perceptron research program—sponsored by the Office of Naval Research with assistance from the Rome Air Development Center, Rome, New York, of the Air Research and Development Command. The

Mark I "Perceptron," as it is known, was built to demonstrate the feasibility of the basic perceptron concept which previously had been simulated on a high-speed digital computer. The Perceptron research device is not designed for practical applications but is rather a limited-capacity version of what may become a family of efficient pattern-recognizing machines.



The Mark I Perceptron. This experimental machine can be trained to automatically identify objects and patterns – such as letters of the alphabet. The Cornell Laboratory Engineer shown here adjusts the machine's photocell "eye" during a letter-recognition training sequence. The cabinets to the right rear contain the machine's "memory" and "response" units.

The man who originated the Preceptron theory is Dr. Frank Rosenblatt. The 31-year-old research psychologist has been in charge of the perceptron program since it began in 1956 at the Cornell Aeronautical Laboratory. (See NavResRev, Oct. '58, pp. 5-13.) The Mark I is an electromechanical device consisting basically of a "sensory unit" of photo cells which views the pattern shown to the machine, "association units" which contain the machines's memory, and response units which visually display the machine's pattern recognition response.

The machine is generally trained by placing test patterns, which could be letters of the alphabet of a single type face, in the view field of the perceptron's photoelectric cell "eye." When the machine incorrectly identifies a pattern or letter, the trainer forces it to respond correctly by means of an electrical control. When the training is completed, the letters of the particular type face can then be shown to the machine's eye, and it will correctly identify the letters without error. When the recognition problem has been complicated by adding letters of a different type face, the machine has been correct 85 percent of the time.

"Unlike some pattern-recognition machines," Dr. Rosenblatt explains, "the Perceptron does not recognize forms by matching them against an inventory of stored images or by performing a mathematical analysis of characteristics." He further explained that the perceptron's recognition is direct and almost instantaneous since its memory is in the form of altered "pathways" through the system rather than a coded representation of the unique stimuli.

The Perceptron has particular potential use in the processing of non-numerical information for the solution of scientific, engineering, and military problems, according to Dr. Marshall Yovits, director of the project for the Office of Naval Research. Although human beings can normally handle such problems readily, machines would have obvious advantages and would supplement existing types of digital computers which fundamentally handle numerical data.

Scientists engaged in the Perceptron program foresee machines much larger than the Mark I and with much greater capacity. They would have a variety of sensory outputs and would be able to receive audio as well as visual inputs. Such future machines could be used to read print of various type faces and to recognize spoken words. They could extract salient features from photographic information.

There are a number of scientific approaches to the research involved. This research is currently being pursued at a number of academic, industrial, and government organizations. Much of it is supported by the Services because of its potential value to the military. The Perceptron is one of the earliest to develop potentially useful hardware.

Hybrid Propulsion System

The Navy has awarded a contract to explore a revolutionary approach to rocket power plants. The "end product' would be a "hybrid rocket" with the best features of present liquid and solid-propellant rocket power plants. The contractor, Aerojet General Corporation, a subsidiary of the General Tire and Rubber Company, will be attempting to make advances on work already accomplished on hybrid propulsion systems by the Navy.

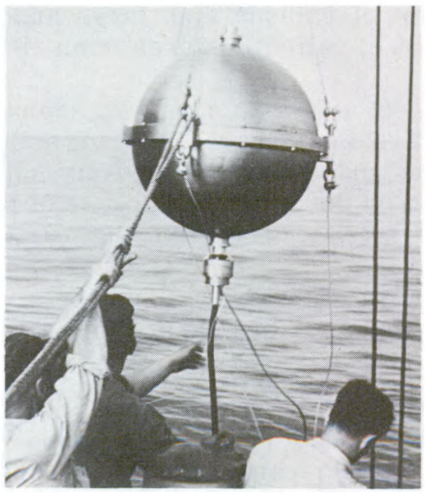
A successful hybrid propulsion system would offer advantages of significantly greater ranges for conventional weapons, provide the start-stop and variable thrust capability needed for space missions, and give propulsion scientists much greater latitude in selecting the best possible fuels and oxidizers for optimum propulsion systems.

The Aerojet contract represents the first large-scale attempt of a government agency to combine the high-performance capability of liquid propellants with the simplicity and compactness of solid fuels. Essentially, the hybrid rocket would employ a liquid oxidizer which would be sprayed into a core of solid fuel. This method would give the vital start-stop and variable thrust capabilities needed for advanced weapon systems and space missions.

Current liquid-propellant rocket engines burn a combination of liquid oxidizers and liquid fuels that require separate tanks, valves and pumps for the two liquids The hybrid rocket would be much simpler since it would eliminate one complete system. Current solid-propellant rockets use fuels and oxidizers in a solid state which are cast into a composite grain and burned inside a rocket chamber. The hybrid rocket would provide significantly greater range since this type of design provides greater total impulse in the same volume.

NOL Develops Deep-Sea Sphere

An unmanned, deep-diving sphere named DEEP DIP has been developed by the U. S. Naval Ordnance Laboratory at White Oak, Silver Spring, Maryland, to carry recording instruments into the deepest ocean voids and return them to the surface after hours, days, or weeks on the bottom. Initial tests of individual DEEP DIP components and full-scale test of the entire device were conducted off Nassau in the Bahamas when NOL scientists and technicians dropped the DEEP DIP 1 1/2 miles into the Tongue of the Ocean and successfully retrieved it. NOL will begin using the device to make electromagnetic radiation measurements on the ocean bottom later this year.



DEEP DIP is lowered into the Tongue of the Ocean off Nassau by crewmen of the USS STALLION (ATA 193), during a recent test of components.

Designed primarily to make magnetic, electromagnetic, radioactive and acoustic measurements, DEEP DIP can also be used for underwater photography, bottom sampling, and deep ocean current measurements. DEEP DIP has the advantage of eliminating the human element from its deep dives. It can stay on the bottom for an extended period, limited only by the capacity of its recording equipment. Weight is no problem either. Almost any heavy equipment can be lowered and raised by the same technique.

The nerve center of DEEP DIP is a 30-inch diameter sphere made of one-inch thick tool steel, built by the Baldwin, Lima, Hamilton Company of Philadelphia. This holds the sensing devices, recorders, and batteries. Attached to the sphere are antennas and under them an anchor-release mechanism and a concrete anchor. Above the sphere is a rubber, gasoline-filled flotation bag, equipped with a small radio transmitter.

When the complete system is dropped over the side from the launching vessel, the anchor carries it to the bottom. At a preset time, a clock mechanism in the anchor-release fires an explosive coupling, severing the anchor from the rest of the system and allowing the flotation bag to pull it to the surface. Once free of the water, the radio on top of the bag begins sending out a signal to monitoring stations. Recovery vessels can home on the signal and retrieve the device.

A gasoline-filled flotation bag, part of DEEP DIP's assembly, is readied for a test dive. In the background (upper lefthand corner) can be seen part of DEEP DIP's large electromagnetic antenna.

DEEP DIP was designed to withstand pressures at depths of 8 miles, greater than any known ocean depths. It thus provides a new tool for the study of one of the world's last remaining unknown areas.

Project MERCURY

Project Mercury is the official United States project designed to result in manned orbital flight. Descriptions of the nature of the project have become well known to the American public through numerous articles in the press. Not so well known, however, is the extent and nature of Navy Medical Department participation in Project MERCURY.

This participation has included support in selection of the Mercury astronauts, selection of the full pressure suit developed by the Air Crew Equipment Laboratory (ACEL) as the suit which the astronauts will wear in flight, an extensive program of training of the astronauts on the dynamic flight simulator of the Aviation Medical Acceleration Laboratory centrifuge, additional training of the astronauts at ACEL in a specially modified low-pressure chamber which permits environmental studies on the astronauts occupying a full-scale MERCURY capsule within the chamber, training of the astronauts in various aspects of survival, and many other tasks which have been carried out by several of the research and development laboratories of the Navy Medical Department.

Project MERCURY, being conducted by the National Aeronautics and Space Administration, is a combined effort involving NASA, Depart-

ment of Defense, and industry. CAPT Clifford P. Pheobus MC USN, Director of the Astronautical Division of the Bureau of Medicine and Surgery, has been designated as the Naval Medical Assistant for all of the bioastronautics aspects of Department of Defense support for Project MERCURY. There are similarly designated representatives of the Army and Air Force.

Military medical officers will man the world-wide tracking and monitoring stations which will exercise surveillance over the Mercury astronauts in their orbital flights. Army, Navy, and Air Force medical officers, carefully selected for assignment to these stations, began training for their vital medical surveillance roles in May 1960. The six Navy Medical officers selected for this assignment were: CAPT Carl E. Pruett and LT Glenn F. Kelly, Pacific Missile Range, U. S. Naval Missile Center, Point Mugu, Calif.; CAPT Edward L. Beckman and LCDR John J. Gordon, Aviation Medical Acceleration Laboratory, Naval Air Development Center, Johnsville, Pa.; CAPT Walton L. Jones, Bureau of Medicine and Surgery; and LCDR Frank H. Austin, Jr., Carrier Air Group Four, U. S. Naval Air Station, Cecil Field, Fla.

While attention and publicity has been focused on the preparations for the Mercury flights, the Navy has primary responsibility for all aspects of the recovery phase of Project Mercury–this on a world-wide basis. CAPT Ashton Graybiel MC USN, Director of Research at the Naval School of Aviation Medicine, Pensacola, Fla., has been designated director of the medical aspects of the recovery operation. As such, he is charged with preparation of the necessary medical support and debriefing plans and the organization and direction of the activities of the Medical Support and Debriefing Team for both animal and man flights. His major task will be to insure the adequacy of medical support to the astronauts after they have completed their flight and have been located and recovered by Navy units dispersed for that purpose. In order to gain maximum benefits from this national man-space project, it will be necessary for CAPT Graybiel to prepare a debriefing plan which insures that every possible item of useful information may be obtained.–U. S. Navy Medical News Letter.

"SPLAT COOLING" OF METALS

"Splat cooling," a Navy-developed process to create new metallic alloys for use in the electronics and other fields, has been successfully tested at the California Institute of Technology, Pasadena.

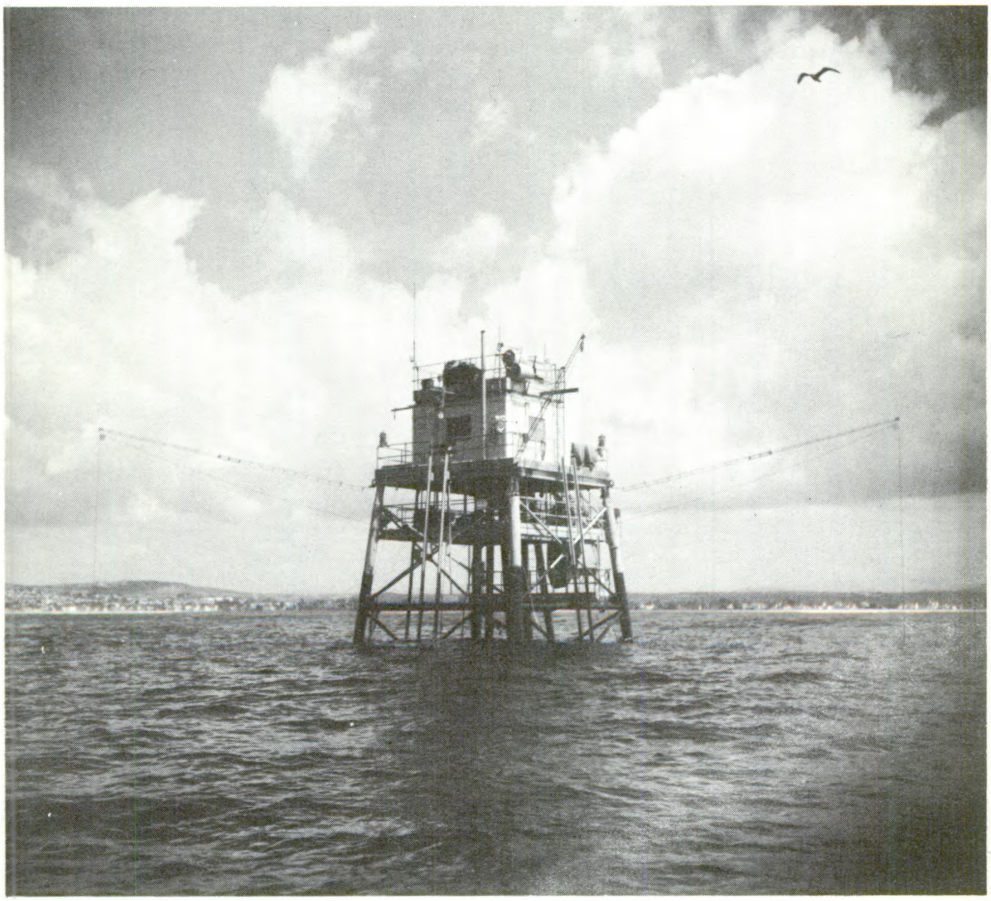
Developed by Dr. Pol Duwez, Cal Tech professor of mechanical engineering, the process involves blasting a molten droplet of a pure metal, or an alloy, against the rim of a refrigerated metal wheel spinning at high speed. This quick freezes the metal before the atoms have time to realign themselves.

The new process may lead to the discovery of alloys with new electrical and magnetic properties for use in computers and other devices that require very small amounts of energy.

NEL's Oceanographic Tower

A new kind of "Texas tower" has been erected about one mile offshore from the Mission Beach jetty near San Diego, California. It is the Navy Electronics Laboratory's unique 90-foot oceanographic research tower—designed especially for shallow-water investigations. NEL scientists are finding the facility extremely useful for meteorological, sea surface, water temperature, biological, chemical, optical, and acoustical studies. Knowledge gained from these studies is being applied to devising better ways of detecting and neutralizing enemy mines, sneak craft, and submarines, and the development of improved communications and navigation systems for the Navy.

The tower consists of a platform containing an instrument house, supported by a steel-pipe structure—similar to that of an oil-well derrick. It is fastened to the sea floor by pins driven 63 feet into the bottom through each of its four hollow pipe legs. The mean low-tide mark on the tower is 56 feet from the sea floor, and the main deck is 27 feet from this level. The main deck—actually a 22-foot-square slab of concrete—supports a 13- by 15-foot instrument house. The flat roof of the instrument house forms an upper deck on which are installed



The unique 90-foot research tower.

electrical transformers, an emergency generator, meterological instruments, and the motor for the hydraulic winches. Just below the main deck there is a catwalk around all four sides of the tower for handling equipment; a second catwalk or boat landing, is located on the shore side of the tower at a still lower level.

The instrument house is equipped with recorders, instrument racks, benches, space heaters and fresh water supply. Instruments are lowered through a trap door in the center of the house floor to permit the collection of water samples at any depth to the bottom. Two guide cables extend up from the sea floor through this trap door to the house ceiling. A diving bell also operates from this central location inside the tower framework.

On three sides of the tower, instrument elevators can be lowered to the bottom on vertical railway tracks (30-inch-gage thickness) by means of a hydraulic winch system mounted on overhead beams. Various sensing instruments are attached to the elevators, with electrical leads extending from the instruments to recorders in the deck house.

The tower was erected at Long Beach, California, prior to its installation and then transported to the San Diego site via a barge. Among the recent uses made of the tower have been measurements of "internal" waves and photographic studes of turbulence. Plans are being made to enlarge the instrument shelters and to provide quarters for technicians.

Undersea Liquid Storage System

Testing has begun off the coast of Louisiana of an undersea liquid storage system that may be the forerunner of many undersea fueling stations throughout the world. The prototype unit, a 50,000 gallon—or 1200 barrel—rubber container was submerged in about 52 feet of water on the Gulf's seabed. While this container is the largest ever built, it will be only a segment of the eventual system of interconnected containers that would be in the range of 25,000 barrels rather than the 1200 barrel unit now being tested. These future underwater warehouses would hold more than a million gallons of fuel, enough to supply several destroyers and smaller vessels. The present unit, when filled, is 20 feet in width and 68 feet long. It is held to the ocean floor by a tubular steel frame and nylon harness. It could also be used for the storage of gasoline, lubricating oil, crude oil at offshore oil operations and possibly fresh water and other liquids.

Staff Appointments at ONR, Pasadena

The Office of Naval Research, Pasadena, Calif., Branch Office, has announced two appointments in its Scientific Department–Dr. James E. Garvey, a native of Cleveland, O., and Dr. Van O. Nicolai, a native of Illinois.

Dr. Garvey served in the U. S. Army Air Force in England and Africa during World War II as a fighter pilot (Spitfires). He obtained the Ph. D. degree in theoretical physics at Ohio State University in 1951. His dissertation was entitled "The Liquid Drop Model of the Nucleus and the Fine Structure of Alpha Spectra." Dr. Garvey was then employed by North American Aviation (now Atomics International), where he was engaged in criticality calculations and studies in reactor theory, reactor kinetics, and inherent safety. He was later employed by the Rheem Manufacturing Company, where he undertook warhead studies and problems in explosion phenomena and fracture theory. Most recently, he was employed at the Western Regional Office of the Office of Ordnance Research, in which position his duties were similar to those he will have at ONR Pasadena. Dr. Garvey's special interests now lie in operations research, including the military doctrine aspects of military operations research, and scientific methodology. Dr. Garvey has served as the Army representative on the Steering Committee of the West Coast Military Operations Symposia (WCMORS), sponsored by ONR, and he will continue and intensify his activities in this connection.

Dr. Nicolai served in the Navy for 2-1/2 years during World II as an electronics technician. His undergraduate and graduate training were received at the University of Illinois. In 1954 he was awarded the Ph. D. degree in physics, after completing a thesis on the high-energy photodisintegration of helium. He spent an additional postdoctoral year at Illinois on studies of liquid-hydrogen targets. Dr. Nicolai spent two years teaching at the University of North Dakota, and then two years teaching at Southern Illinois University. During this period his research interests were in low-energy X-rays and in the fundamental theory of electrodynamics. One summer was spent as a consultant at NOTS, China Lake, California. Dr. Nicolai was most recently employed at the Armour Research Foundation in Chicago, where he was engaged in studies in upper-atmosphere physics, magneto-hydrodynamics, and exploding wire techniques.

Marine Corps Launches Bullpup from Helicopter

A heavier punch may now be added to Marine Corps and Army assault troops as a result of the successful launchings at Patuxent River, Md., of the Bullpup air-to-surface missile from a Marine Corps helicopter. The Bullpup, used by both the Navy and Air Force, is a radio-controlled missile. The pilot guides it to the target by a switch on his control stick. Flares in the after section of the missile help the pilot to keep it in sight as it streaks toward the target. It had previously been fired only from such fast planes as the Navy's Douglas A4D and the North American FJ-4B. In recent tests the Bullpup was fired while the Marine helicopter hovered at 1500 feet. Seconds after the missile left the craft's side, it splashed within inches of a target disk 10,000 yards out in Chesapeake Bay.

On the Naval Research Reserve

Research Reservists Participate in Armed Forces Day

Members of Naval Reserve Research Company 9-13, Des Moines, Iowa, assisted in the preparation of an ONR float and took part in that city's Armed Forces Day parade on 21 May 1960. Through the efforts of LCDR John V. Gebuhr, USNR, Commanding Officer of NRRC 9-13 and company members, the Strat-O-Lab display float was organized and entered in the parade and later moved to the Naval Training Center for further viewing by visitors.

ONR float at Des Moines, Iowa. From left to right: CDR E. F. Peters; LCDR J. Everett Payne; LT Merle F. Sherbring; CDR John R. Maloney; CDR Harris M. Golden, and LCDR John V. Gebuhr, Commanding Officer of NRRC 9-13.

ONR Boston Conducts Research Reserve Seminar

CAPT G. K. Williams, USN, Commanding Officer of the Office of Naval Research, Boston, was host to 22 Research Reserve officers for 14 days of active duty for training from 12 to 25 June 1960. The officers who participated in the seminar were members of the Research Reserve and came predominantly from the First Naval District. Officers were present from other Naval Districts, including one officer from Gainesville, Florida.

This active duty, which was handled by the staff of ONR Boston, gave the members of the Research Reserve an opportunity to learn the functions of a Branch Office, as well as an insight into the various research projects that the Navy supports in this area.

Visits were made to the Laboratory of Nuclear Science, the Naval Supersonic Laboratory, the Research Laboratory for Electronics and the Nuclear Reactor at M.I.T. In addition, visits were made to the Electronics Department at Harvard University, A. D. Little, Incorporated, and Woods Hole Oceanographic Institution. Two days were spent at

Lincoln Laboratory and the MITRE Corporation. These visits allowed the group to view the large radar at Millstone as well as the operation of the air defense system SAGE. The group also spent a half day on the USS BOSTON and a full day with the Naval Air Development Unit at South Weymouth, Massachusetts. The members of the seminar also spent a half day discussing Reserve problems and the group was honored by a visit from CAPT J. W. Jockusch, Jr., USNR, Special Assistant to the Chief of Naval Research for Research Reserve, and CDR H. V. R. Palmer of the Commandant, First Naval District's staff.

A banquet was held for the group at which CAPT Jockusch, CAPT Williams and CDR Palmer were honored guests.

CDR A. H. Healy, USNR, Executive Officer of Naval Reserve Research Company 1-1 and also Head of the Contract Department, ONR Boston, handled the administrative details for the 2-week seminar. The program for the seminar was arranged by CDR T. B. Dowd, USNR, also of Research Company 1-1 and a member of the Scientific Department, ONR Boston.

Participants at ONR Boston Seminar. CAPT G. K. Williams, USN, and CAPT J. W. Jockusch, Jr., USNR, are seated in the middle of the first row.

Inspection of NRRC 8-13

On 2 May, CDR L. P. Hoskins, USNR, Research Reserve Assistant, ONR Chicago and CDR R. W. Sims, Jr., USN, Specialist Programs Officer, Eighth Naval District conducted the Annual Reserve Inspection of Naval Reserve Research Company 8-13, Stillwater, Oklahoma, NRRC 8-13 won the first place award for excellence among specialist companies, in the District for FY 59 (Naval Research Reviews, January 1960). As a result of the 2 May inspection the Company was assigned a grade of 95.3, which may well earn the first place award for FY 60. One of the elements which contributed to the excellence of the company was the fine appearance of the officers at the inspection of personnel.

CDR R. W. Jones, USNR, commanding officer of NRRC 8-13, presents the company for inspection to CDR L. P. Hoskins and CDR R. W. Sims, Jr. The speaker at the drill program, COL M. T. Edmison, USAR, Director of the Research Foundation, Oklahoma State University, can be seen at the far left. A partial group of members of the company are on the right.

ADM Bennett Addresses NRRC 1-1

RADM Rawson Bennett, USN, Chief of Naval Research attended the annual banquet of Naval Reserve Research Company 1-1, Boston, Massachusetts, on 6 June 1960. Admiral Bennett addressed the 75 members of the company on ONR's basic research program. Another honored guest of the evening was RADM Carl F. Espe, USN, Commandant, FIRST Naval District.

The above picture was taken by Mr. M. R. Lipman, ONR Resident Representative, Lawrence, Kansas, on the occasion of the annual inspection of NRRC 9-20. Although not a Reserve Officer, Mr. Lipman attends regularly the drills of the Lawrence unit. Several Army Reserve Officers attend the company drills and contribute to the training program.

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ASROC (antisubmarine rocket), the Navy's newest and deadliest antisubmarine weapon, stands poised and ready for loading into a launcher aboard the USS NORFOLK during the recent 2-month evaluation program conducted by the Bureau of Naval Weapons off Key West, Florida. In announcing the development of the ASROC missile system, RADM P. D. Stroop, Chief of BuWeps, described the missile as "a significant advance in the Navy's antisubmarine warfare program." The front half of the missile is a deadly homing torpedo that is boosted by a solid-propellant rocket to the target area. The rocket booster separates in flight and a parachute opens to slow the torpedo's entry into the water where it seeks out its submarine target. ASROC was developed by the U. S. Naval Ordnance Test Station, China Lake and Pasadena, California; prime contractor was the Minneapolis-Honeywell Regulator Co.

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.

Drawing of the Naval Research Laboratory's Solar-Radiation-Measuring Satellite (nicknamed "Sunray" at NRL) shortly after its separation from TRANSIT II-A—the second experimental doppler-type navigational satellite to be launched by the Navy—and after being placed simultaneously in orbit with and atop the navigational satellite.