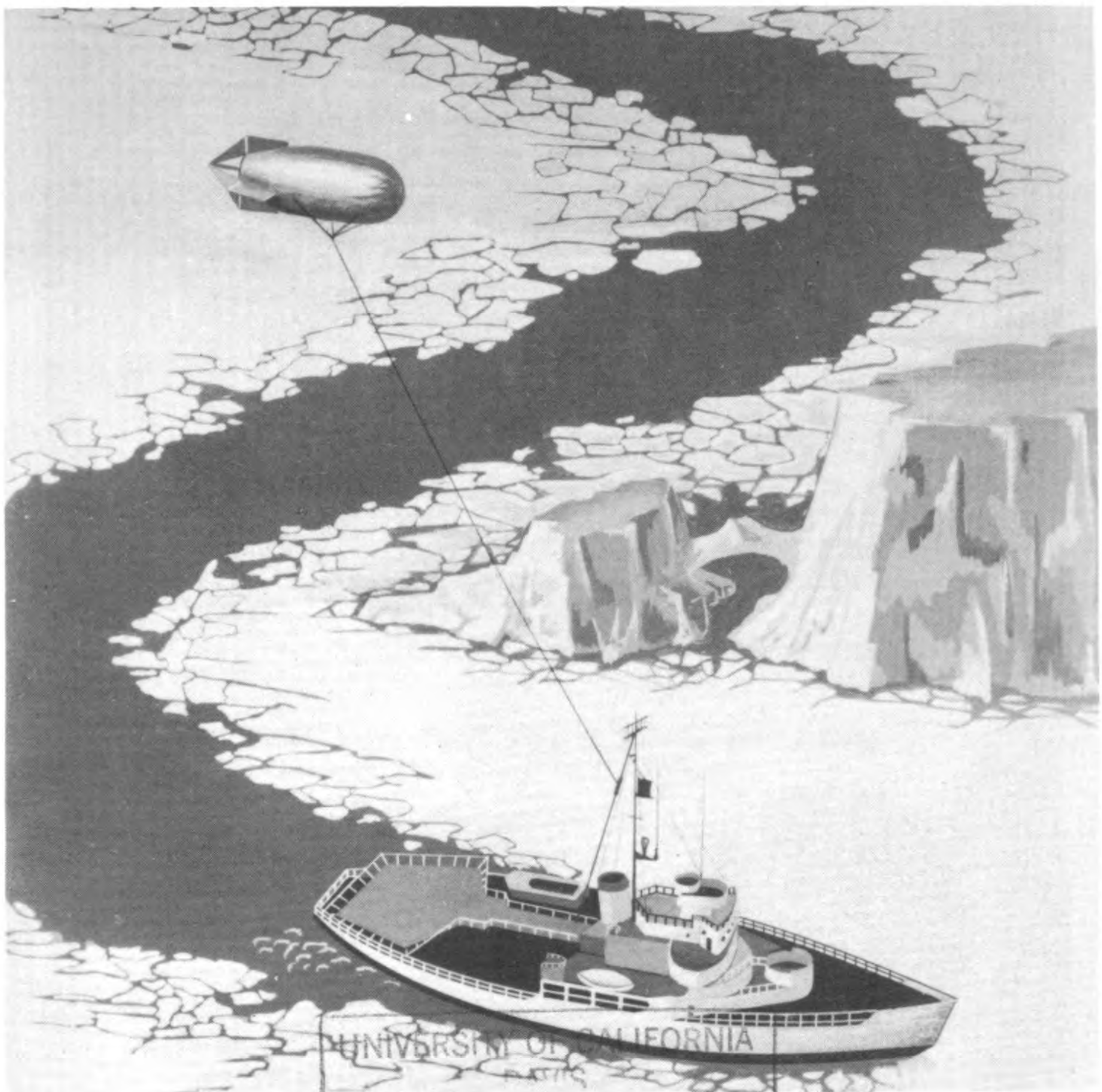
OFFICE OF NAVAL RESEARCH OCTOBER 1956

RESEARCH REVIEWS



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DECENNIAL
DEPARTMENT OF THE NAVY
1946 1956
OFFICE OF NAVAL RESEARCH
YEAR

DEPARTMENT OF THE NAVY
WASHINGTON, D. C.

No 2428678

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

Whereas CARL L. NORDEN and THEODORE H. BARTH, of New York, N. Y., assignors to UNITED STATES OF AMERICA, as REPRESENTED BY THE SECRETARY OF THE NAVY,

PRESENTED TO THE **Commissioner of Patents** A PETITION PRAYING FOR THE GRANT OF LETTERS PATENT FOR AN ALLEGED NEW AND USEFUL IMPROVEMENT IN

BOMB SIGHTS,

A DESCRIPTION OF WHICH INVENTION IS CONTAINED IN THE SPECIFICATION OF WHICH A COPY IS HEREUNTO ANNEXED AND MADE A PART HEREOF, AND COMPLIED WITH THE VARIOUS REQUIREMENTS OF LAW IN SUCH CASES MADE AND PROVIDED, AND

Whereas UPON DUE EXAMINATION MADE THE SAID CLAIMANTS are ADJUDGED TO BE JUSTLY ENTITLED TO A PATENT UNDER THE LAW.

NOW THEREFORE THESE **Letters Patent** ARE TO GRANT UNTO THE SAID

United States of America, as represented by the Secretary of the Navy OR ASSIGNS

FOR THE TERM OF SEVENTEEN YEARS FROM THE DATE OF THIS GRANT

THE EXCLUSIVE RIGHT TO MAKE, USE AND VEND THE SAID INVENTION THROUGHOUT THE UNITED STATES AND THE TERRITORIES THEREOF.

In testimony whereof *I have hereunto set my hand and caused the seal of the* Patent Office *to be affixed at the City of Washington this* seventh *day of* October, *in the year of our Lord one thousand nine hundred and* forty-seven, *and of the Independence of the United States of America the one hundred and* seventy-second.

Attest:

J. E. Schimmel
Law Examiner.

Lawrence C. Kingsland
Commissioner of Patents

Patent granted for the Norden Bomb Sight prepared by the Navy Department and granted 7 October 1947.

The Navy Patent Organization

CAPT George N. Robillard

The Navy's far-flung research and development program delves into virtually every field of science and branch of engineering. New equipment, machines, manufactures, compositions, processes and other inventions are constantly being developed in numerous large industrial-type establishments operated by the Navy and in private industrial plants and laboratories performing research and development work under Navy contracts. The scientific and technical personnel engaged in research constitute the main dynamic force contributing to progress of the arts and sciences. Many of the steps in their research involve inventive concepts. Inventions are property of an intangible nature and the law provides certain specific procedures for their protection.

The Government stands in no different position from that of any of its citizens with respect to the right to use inventions and patents. Therefore, in a Government agency such as the Navy Department, patent problems are inevitable and require a patent organization to:

- Give professional advice to engineering and scientific personnel on patent matters,
- Determine when invention and patent rights should be acquired from Navy contractors and employees,
- Secure such rights as may be appropriate in order to protect the Navy Department and the Government against future claims for infringement and the unnecessary payment of royalties with respect to such inventions.
- Prepare and prosecute patent applications covering those inventions in which the Government's interests should be protected under the patent statutes.

Other functions of such a patent organization are to give professional advice on procurement matters involving patents, inventions, copyrights, and technical data of a proprietary nature such as to investigate the appropriateness of royalties and to negotiate for the voluntary reduction of royalties involved in government procurement when such payments are believed to be excessive. It also administers the patent provisions of Navy contracts.

In the year 1947 the Office of Naval Research took definite steps to consolidate the patent functions under the "Assistant Chief for Patents and Patent Counsel for the Navy." CAPT George N. Robillard served in this position until 1951. Successive incumbents of that office were CDR Donald H. Dickey and CAPT William G. H. Finch.

Shortly following the retirement of CAPT Finch in 1955, CAPT Robillard was again appointed the Assistant Chief for Patents and Patent Counsel for the Navy, after successive tours of duty in the Department of Defense. He had been abroad as United States Representative on the Technical Property Committee and Patent Advisor to the United States Ambassador to the North Atlantic Treaty Organization (NATO), and as Chairman of a Board of Review in the Office of the Judge Advocate General of the Navy. CAPT Robillard is also a member of the law faculty of the George Washington University and conducts courses in patent law.

The Navy Patent Organization as presently established consists of: Assistant Chief of Naval Research for Patents and Patent Counsel for the Navy, Civilian Patent Counsel, Patent Administrator, and a Patents Legal Division.

The Organization also includes four Patents Divisions which serve ONR, the Bureau of Aeronautics, the Bureau of Ordnance, and the Bureau of Ships, respectively. The organization is under the management and technical control of the Assistant Chief for Patents who, among other things, is responsible for prescribing the necessary policy and procedures in professional matters.

In the Navy-wide administration of the patent program, the Navy Patent Organization coordinates all activities within or on behalf of the Department of the Navy relating to patents, inventions, trademarks, copyrights, royalty payments and matters connected therewith of concern to the research, development and procurement activities of the Navy, obtains and analyzes invention disclosures, makes patentability searches, prepares and prosecutes patent applications and obtains patents on inventions of importance to the Navy.

These operations are conducted for the protection of the Navy, because failure to file applications on such inventions would either lose for the Navy an opportunity to establish priority rights through patent interference proceedings or result generally in the grant of patent rights to others and require the payment of royalties. The Patent Organization also makes patent-validity investigations, investigates and negotiates the settlement of infringement claims, investigates and negotiates for voluntary reduction of royalties, and negotiates patent and copyright licenses.

In addition to administering the patent provisions of Navy contracts and recommending deviations from the standard contract patent clauses where appropriate, the Navy Patent Organization through its membership on the Patents Subcommittee of the Armed Services Procurement Regulation Committee actively participates in the preparation of standard clauses pertaining to patents, copyrights, and technical data for use in Navy contracts and in all other matters relating to the drafting of those parts and sections of the Armed Services Procurement Regulation dealing with patents, copyrights, and technical data.

The Navy Patent Organization administers the secrecy provisions of the patent statutes and provides the Navy representatives on the Armed Services Patent Advisory Board. This is a joint agency of the three Military Departments established to facilitate the inspection of patent applications for the purpose of determining the military security, etc, under the Inventions Secrecy Act (35 U.S.C. 181, 184). The Patent Organization also makes recommendations on the use, release, and export of technical information and assists in matters relating to the protection of proprietary rights in technical information proposed for release pursuant to intergovernmental agreements.

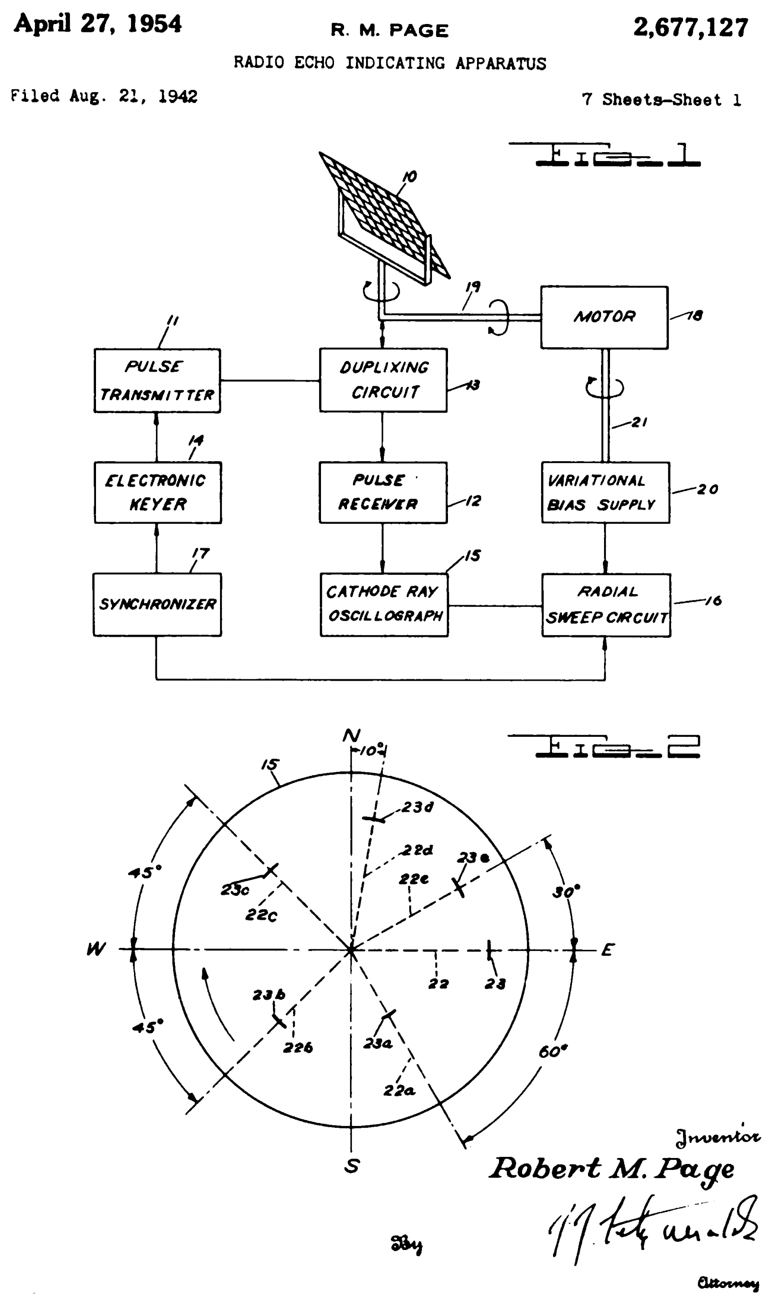
When Navy Department employees are involved in an invention, the Patent Organization makes determinations of rights with due regard to the basic Government policy established by the President under Executive Order 10096 wherein certain cases are subject to approval of the Chairman of the Government Patents Board established under this Order. The Board advises and confers with the Chairman concerning the application and operation of the policies set out in the Order.

The Navy Patent Organization assists the Department of Justice in patent-interference proceedings and patent litigation involving the Department of the Navy. It also answers Calls of Courts when patent and related matters are involved. The Organization also makes recommendations with respect to initiating, supporting, or approving legislation concerning patents and disseminates information relative to the Navy's patent program.

Another important function of the Navy Patent Organization is the processing of suggestions and inventions submitted by persons outside of the Naval Establishment for evaluation to determine whether they warrant adoption, bureau project tests, demonstrations, or further study. The Organization also provides representatives on the ONR Inventions Evaluations Board.

Although patent personnel are thought of by many primarily as lawyers, they are also technicians. The basic qualifications for both patent adivsers and patent attorneys rendering professional patent services in the Navy require that they be professionally trained in either engineering or the sciences, and that they be able to interpret and apply the patent statutes and court and Patent Office precendents to the particular scientific or engineering facts as developed either in the preparation and prosecution of patent applications or in the handling of infringement claims. Thus, with rare exceptions, Navy patent personnel hold degrees in engineering or science in all principal fields, as electrical, mechanical, civil and aeronautical engineering and chemical, physical and mathematical sciences. In addition the patent attorney must have professional legal training and bar membership and be registered to practice before the U. S. Patent Office in order to properly qualify for the work which he is required to handle. When registered to practice before the Patent Office, patent attorneys are one of the two categories of specialists in the law field who may designate their specialty on their letterheads under the Canons of Ethics of the American Bar Association.

To date, the Navy Patent Organization has received more than 16,000 invention disclosures for patent investigation; conducted approximately 9000 patentability searches; prepared and filed in the Patent Office about 5500 applications for patent; prepared about 18,000



First page of one of the key radar patents, granted to R. M. Page of NRL amendments to applications for the purpose of obtaining final action on such applications; and obtained the issuance of about 4500 patents.

The Office of Naval Research budgets for the Navy Patent Program on a performance basis. Funds appropriated by the Congress for the Navy Patent Program provide salaries for all Navy patent personnel, departmental and field, as well as funds for other expenses such as travel, drafting services, and Patent Office fees. Salaries and travel funds for patent personnel in the field activities of the Bureaus are furnished by the Office of Naval Research by allotment. The annual budget for the Navy Patent Organization is about $1,000,000.

Substantial dollar savings to the United States Government annually result from the administration of the Navy Patent Program by the Office of Naval Research. Such savings are realized principally from the filing of patent applications, the investigation and adjustment of royalties, and the settlement of infringement claims. Known dollar savings annually average approximately $3,000,000 as compared to an annual budget for the Patent Organization of, as above noted, about $1,000,000. These savings, which represent only a part of the total savings realized annually, more than offset the cost of supporting the patent program.

The statistics which follow indicate the size and scope of the patent soliciting program and are restricted to data on invention disclosures, patentability searches, applications, amendments, interferences and patents which constitute the principal phases of this program. The annual average rates are averaged over the three fiscal years 1954-1956.

Statistics

Invention disclosures	
Annual average rate of receipt	2042
Received in fiscal year 1956	1969
Percentage of disclosures patentable	58.4%
Patentability searches	
Annual average rate of searches	1265
Searches in fiscal year 1956	969
Applications	
Annual average rate of preparation	716
Prepared in fiscal year 1956	630
Amendments	
Annual average rate of preparation	1789
Prepared in fiscal year 1956	1733
Interferences	
Annual average rate of declaration	14
Declared in fiscal year 1956	19
Patents	
Annual average rate of issuance	468
Issued in fiscal year 1956	626
Patents assigned to Government in fiscal year 1956	290
Patents licensed to Government in fiscal year 1956	336

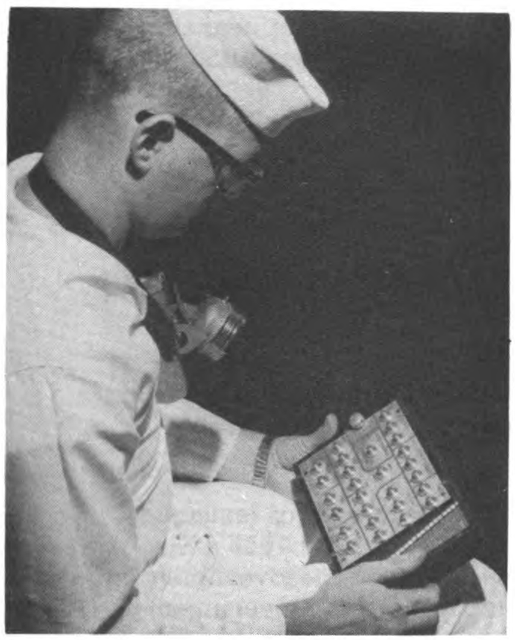
Memory Box for Sonar Operators

How does a sonarman tell whether the signals he receives are echoes bounced back from whales, from a surface ship, or from a school of fish, or whether they indicate a genuine "contact" with a submarine? And if the latter, is the sub approaching, presenting its broadside, or heading away? There are clues—too many of them.

The clues, of course, lie in the characteristics of the echo, both as heard aurally and as seen on the Plan Position Indicator. The echo may be sharp, or mushy; it may have high, or low, doppler; or a half-dozen other distinctive characteristics. As the sonar operator lines-up and analyzes these characteristics, much as a doctor lines up symptoms, he can determine which of 25 or more underwater objects the target really is. But the "deciding" requires a high level of training and an excellent memory—qualities hard come by in these days of short enlistments and frequent transfers.

Underwater-sound engineers at the Naval Research Laboratory and at the Navy Electronics Laboratory have worked together to develop a simple computer that does the memorizing for the operator. Working on the principle of a punched-card sorter, the computer automatically eliminates the kinds of targets—a wreck, reef, pinnacle, fish-school—that the target is not. If the operator properly analyzes the signal, and moves a few knobs accordingly, the machine cancels out 24 items of a 25-item index, leaving the one that the target is—say, "sub, bow."

The Sonar Classification Logical Computer is no larger than a cigar box and is as mechanically simple as an auto-bridge player. It does not do an operator's thinking for him, but he no longer has to be a second-order genius to do his job well.



Hydrogen Peroxide as a Source of Energy

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Massachusetts Institute of Technology

The usual oxidant for the combustion of a fuel is, of course, air. However, there are two circumstances under which it is desirable to use an oxidant other than air: first, when a very rapid rate of energy release is required, as in an artillery round or an aircraft assist take-off unit and, secondly, when propulsion is desired in a sphere where air is not readily available, as high above the earth's dense atmosphere or under the surface of the sea. For both types of applications a primary goal is to obtain the maximum amount of available energy per unit of weight or volume. It is impractical today to use compressed air or any other gaseous oxidant, because of the high ratio of the weight of storage container to that of the gas. Instead some more compact oxidant, either a liquid or a solid, must be used. This is the primary role played by concentrated hydrogen peroxide in military applications today.

The development of the self-propelled, underwater torpedo provides an excellent illustration of the continuous increase over the years in the power developed per unit weight of the propulsive package in a particular military weapon. It is also the story of the early development of the military use of hydrogen peroxide in the United States, for it was the U. S. Navy's search for new methods of torpedo propulsion which led to the first application in the U. S. of hydrogen peroxide as a source of energy.

Early torpedoes used compressed air alone for propulsion; in later developments the air was preheated by burning alcohol, but soon alcohol was accepted as a main ingredient, and attention was primarily directed towards more compact ways of carrying the oxygen for its combustion. The low boiling point of liquid oxygen presents severe handling and storage difficulties, and compressed oxygen-enriched air or gaseous oxygen must still carry the penalty of a large ratio of container weight to oxidant weight.

In 1934 the Naval Research Laboratory, after studying several oxidants, decided that hydrogen peroxide was the most promising, and initiated work on methods of controlling its decomposition. As studies proceeded to the development stage, the work was transferred to the then-named Newport Naval Torpedo Station. In 1938 the duPont Co. installed at the station a concentration unit to provide 48.5 weight percent hydrogen peroxide from the lower concentrations then marketed commercially. By 1939 torpedoes incorporating hydrogen peroxide of this concentration were being ranged. With the onset of World War II, development activity was greatly increased, and in late 1943 the Massachusetts Institute of Technology was asked to assist. Several groups under the direction of T. K. Sherwood, H. C. Hottel, and G. C. Williams were formed to tackle immediate problems in torpedo development and on hydrogen peroxide.

It soon became apparent, however, that real success in the use of hydrogen peroxide for propulsion would require much more fundamental knowledge about this chemical. For example:

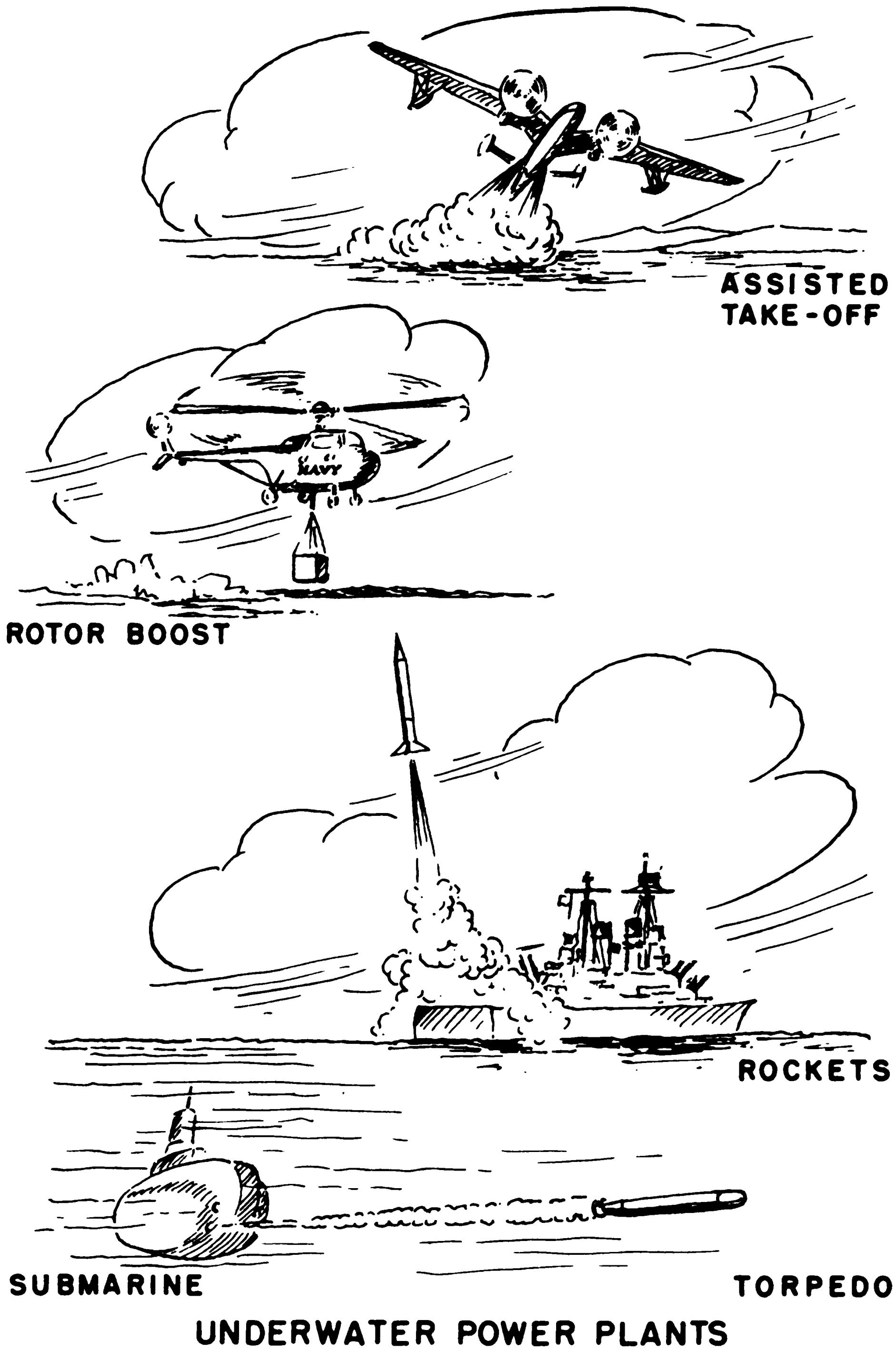

Figure 1 - Actual and potential applications of hydrogen peroxide as a versatile propellant for the Navy.

- How safe would it be to handle the concentrated solutions proposed for propulsive use?
- What were the factors involved in keeping such solutions stable on storage?
- What were the mechanisms involved in decomposing hydrogen peroxide?

Further stimulus derived from reports just then coming from Germany, where the use of concentrated hydrogen peroxide had been pushed to a high degree, indicating that its utility for various other military applications was far greater than had been suspected.

With these incentives M.I.T. set up a program to increase our fund of basic knowledge about hydrogen peroxide. This was sponsored at its beginning in 1944 by the Navy Bureau of Ordnance, and has continued from 1948 to the present time under the Office of Naval Research.

The first projects undertaken were fairly developmental in nature but, with the growth in interest in hydrogen peroxide by industry and other military groups, we have felt that our own role would best be restricted to studies of the fundamental, and generally unclassified, kind which are more consonant with an academic environment. However, we keep in close touch with the classified practical applications and problems.

Our aim has been two-fold, first to try to foresee and help provide the kinds of information and increased understanding that will be needed over the long run, independent of any specific application in a military device. We concerned ourselves with such investigations as the precise determination of physical properties, factors affecting stability on storage, and certain aspects of safety. Secondly, we have tried to break down the enormously complex phenomena that occur in power-producing systems into simpler models more amenable to study and analysis.

For example, at the entrance to a decomposition chamber packed with solid catalyst, one is dealing with a liquid-phase decomposition reaction of concentrated hydrogen peroxide occurring at ambient temperature. As one moves downstream, the temperature increases, a gas phase forms, and the liquid becomes more dilute and diminishes in amount. Towards the exit of the chamber all decomposition is in the gas phase at a high temperature. Thus, the overall performance of the decomposer is the result of a variety of different processes, interacting with one another in a complicated fashion. In early work at M.I.T. such decomposers were studied as a whole, and some empirical design equations were developed. More recently, attention has been directed to the separate individual steps. For example, we have shown that decomposition of hydrogen peroxide vapor on an active catalyst is limited not by the activity of the catalyst but rather by the rate of transport of the peroxide to the catalyst surface. Thus the observed decomposition rate can be directly calculated from general mass transfer correlations, for flow in a system of simple geometry. Very recent studies have provided quantitative data on vapor-phase homogeneous decomposition rates, which help delineate the operating regions in which this mechanism might become important. Work is presently under way on studies of flame propagation in hydrogen peroxide vapor which may help ultimately to dispense with the catalyst chamber entirely.

The aid in the understanding of the processes occurring at the entrance of a decomposition chamber, the chemical mechanism of decomposition of dilute hydrogen peroxide solutions has been studied with catalytic materials such as compounds of mangenese, cobalt, lead, and silver. A number of techniques, including radioactive-tracer procedures, were developed to characterize the individual chemical steps which make up the overall catalytic decomposition process with these materials. This work offers the suggestion that there are striking similarities in the mechanisms encountered. For example, in all these cases solution of the catalyst to a certain degree seems to be necessary before appreciable catalysis begins, and the amount of solution follows a solubility-product type relationship. Establishment of these facts poses an intriguing invitation to further profitable research in this field.

The catalytic decomposition studies deal with enormously high reaction rates. Hydrogen peroxide also poses problems in the range of reaction rates difficult to measure because of their slowness, namely the problems encountered in measuring decomposition while in storage. The high purity material of the present day commonly exhibits a decomposition rate of less than 0.5 percent per year. Such acceptable stability has not always been the case. For example at the turn of the century 10 percent per year was regarded as acceptable. The acceptance formerly of such high rates of decomposition had given the erroneous impression that hydrogen peroxide is an inherently unstable material, and this notion has yielded only slowly.

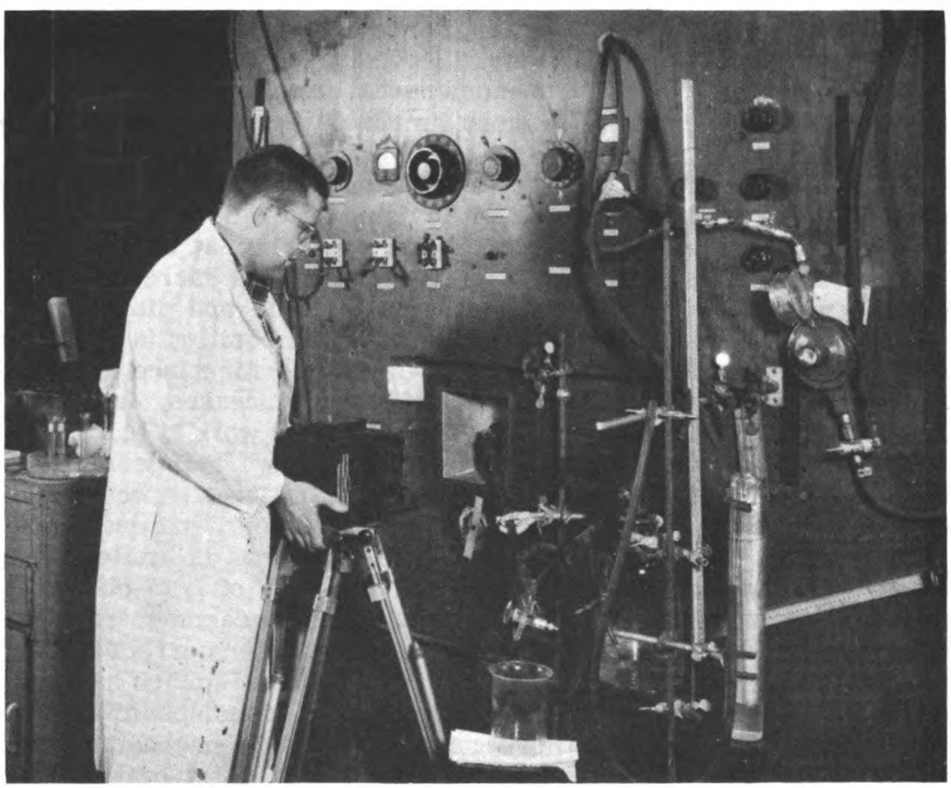

Figure 2--Photographing a hydrogen peroxide flame.

Continuing studies in the M.I.T. hydrogen peroxide laboratories on the stability problem have shed more light on the processes responsible for decomposition in storage.. This research has established among other things that the decomposition rate may be almost immeasurably low under suitable conditions. The temperature coefficient of the decomposition while in storage, the effects of pH (the acidity or basicity), and the contribution of surface-to-volume ratio to decomposition have all received attention. Many systems of stabilizing substances, some of them rather exotic, others quite promising, have been examined for their general utility.

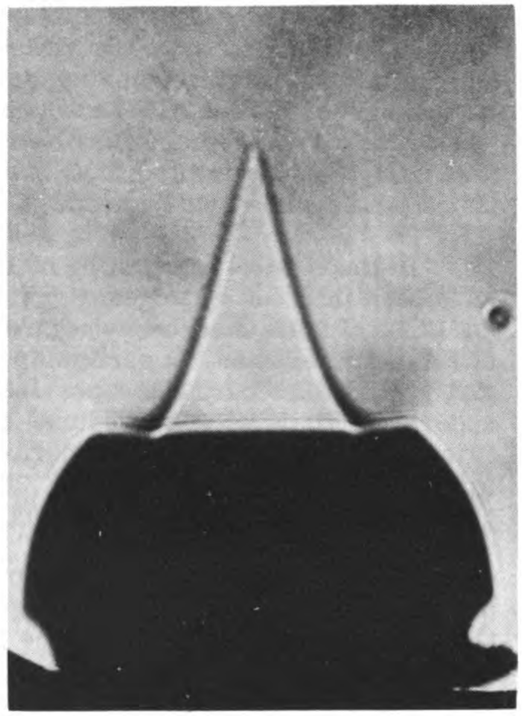

Figure 3 - Shadow photograph of a hydrogen peroxied flame. Hydrogen peroxide vapor by itself can "burn" just as a mixture of inflammable gas and air.

A number of physical properties of hydrogen peroxide also have been examined, both to confirm previous investigations and to establish other properties for the first time. This work has included such subjects as:

- Liquid density,
- Diffusion coefficient of the vapor in air,
- Electrical conductivity,
- Vapor-liquid equilibrium,
- Viscosity of the vapor.

There has also been an opportunity to improve our knowledge of analytical procedures involving hydrogen peroxide. A very precise investigation was carried out to establish the absolute accuracy of the commonly-used permanganate titration. Other studies have examined the well-known titanium method and analytical procedures to be applied to mixtures.

One of the special reasons for the interest of chemists in hydrogen peroxide is its unique position as an intermediate between oxygen and water in the oxidation-reduction scale of the all-important element oxygen. A result of this position of hydrogen peroxide in this relationship is that in a great many of the processes in which oxygen goes to water in oxidizing some other substance, hydrogen peroxide is formed as an intermediate.

Combustion is a good example. Both scientifically and practically, then, there are compelling reasons for studying the role of hydrogen peroxide in such processes. For example if the hydrogen peroxide could be withdrawn from a combustion process before it went in turn to water, this might make a cheap manufacturing method. Studies at M.I.T. in this vein have been devoted to the oxidation of propane. The effects of concentration, temperature, mixing, and methods of collection of the products of partial combustion have been examined in considerable detail. The chemical mechanisms involved are extremely interesting and present many further problems. Other potential manufacturing processes based on alkaline earth peroxides have also been examined.

Perhaps most interesting of all the studies undertaken at M.I.T. have been those of hydrogen peroxide vapor. Until very recently there had existed much uncertainty regarding the possible explosive properties of hydrogen peroxide. In particular it was uncertain what part the liquid played and what part the vapor in explosions. Accordingly work was undertaken to develop procedures for generation of substantial quantities of concentrated hydrogen peroxide vapor at atmospheric pressure—a result never successful before. The achievement of this goal made it possible to establish the minimum concentration of hydrogen peroxide vapor in mixture with water vapor and other inert gases which could be exploded on initiation by thermal or electric discharge. The effects of pressure and surface on these explosion limits have also been investigated. This knowledge has gone far toward outlining the conditions under which hydrogen peroxide can be handled with safety. Studies presently being initiated will extend this work to superatmospheric pressures.

In addition to the various studies outlined above there has also been undertaken the preparation of a monograph on hydrogen peroxide, in collaboration with Prof. W. C. Schumb of the M.I.T. Chemistry Department, who has directed the stability studies on hydrogen peroxide since their initiation. This recently appeared in print as No. 128 of the American Chemical Society Monograph Series. We hope that it will help increase understanding of this fascinating and useful substance—one which is becoming increasingly important to the U. S. Navy.

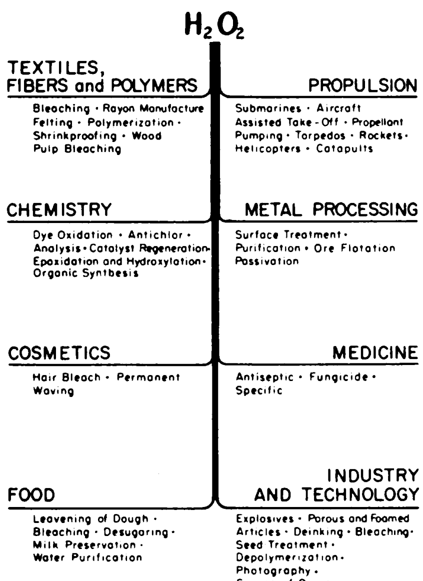

Figure 4 - The many uses of hydrogen peroxide

A Radio Antenna 1200 Feet High

Radio operators frequently have considerable difficulty in maintaining two-way communication when they are operating in polar areas or extreme latitudes. On most of the frequencies normally used for transmitting radio messages, peculiar propagation phenomena occur in the areas near the two magnetic poles of the earth. Radio blackouts cause difficulties ranging from serious attenuation to complete loss of signal. The Navy has been investigating these problems for years, and continues to prosecute research for the purpose of improving radio communication in these regions. Specifically, a method has been sought to provide a reliable system which will cover emergencies and maintain reliable communications for extended periods.

Previous experimentation and investigation indicated that more reliable radio communication could be expected in the lower frequency ranges. Unfortunately it is difficult to install an efficient antenna arrangement on shipboard which would provide effective radio communication at these low frequencies. The Naval Research Laboratory accepted the problem of designing and developing equipment for an efficient low-frequency radio transmitting system to be installed on the USS GLACIER (AGB-4) upon request of the Bureau of Ships through its Antenna Design and Installation Sections.

The phase of antenna development first undertaken at NRL was associated with raising the antenna into the air. It had been determined that in order to provide maximum effectiveness for low-frequency operation, the antenna required a physical length of approximately 1200 feet. Also the diameter of the wire or cable had to be no less than 1/8-inch to prevent corona. Such an antenna would weigh 24 lb and require special equipment and rigging aboard ship to meet the unique operational requirements of ships of the icebreaker class.

During the course of study and consideration of lifting devices for the proposed antenna, NRL scientists considered the use of small helicopters. It was felt that "helicopters" of the small drone type in their present state of development presented too many operating problems under hazardous arctic weather conditions. Balloons, on the other hand, were fairly easy to get up in the air, were cheaper, and more reliable. Also they fitted well into the idea of general emergency communication requirements for extended periods. It was obvious that spherical balloons would not have the required flight characteristics for the intended operational conditions. Consequently, an investigation of the commercially available zeppelin-type balloons was initiated. After a series of performance tests the Jalbert JX-7 balloon was selected as having the required flight characteristics, exclusive of static lift. NRL scientists collaborated with the manufacturer in designing two larger balloons, the JX-8 and JX-9 which would have the required minimum static lift in addition to the other desirable characteristics.

After determining the probable maximum tension in the balloon cable and the desirable rates of launching and retrieving, the design of a power-operated winch was started. A 2-hp three-speed winch was constructed using standard stock components, and a spooling device was added by the NRL shops.

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Phonoelectric bronze, which has high tensile strength and good conductivity, was selected as the material for the wire rope which serves as a tethering cable for the balloon and also as an antenna. The 6 x 6 x 7 wire rope has a nominal diameter of 0.125 inch and fibres of nylon are used for strand cores because of its non-hygroscopic properties. This wire rope is extremely flexible, has a breaking strength of 335 pounds, weighs 20 pounds per 1000 feet and resists corona up to 25 kilowatts (RMS). Three 1200-foot lengths were provided, one rolled onto the winch and two for spares.

The Bureau of Ships engineers collaborated with NRL scientists in determining the operational procedures and the necessary provisions for safety of both personnel and equipment, which would be required in an emergency low-frequency radio transmitting system for the USS GLACIER.

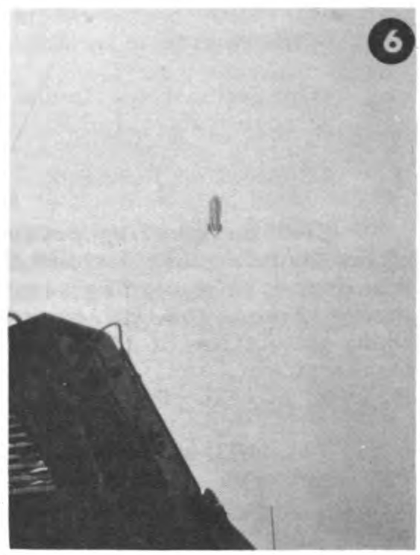
To facilitate launching of the balloons under shipboard conditions, an antenna trolley and masthead sheave were designed and constructed at NRL. This arrangement minimized the danger of antenna entanglement in the ship's rigging by permitting the lowest uncontrolled point of the antenna cable to be maintained at a clear open space above the deck during launching or retrieving operations but at the masthead at all other times. With the lowest uncontrolled point on the cable at masthead it is possible for the ship to maneuver without danger of entangling the balloon cable in the ship's rigging.

Special insulators were required to electrically isolate the balloon from the antenna cable, and for insulating the antenna trolley from the handling lines. The insulators were designed and constructed at NRL. Laminated glass cloth impregnated with polyester resin was used as the dielectric. The insulators have withstood potentials in excess of 25 kv (RMS) of radio frequency.

Various steps in launchi

In order to isolate the ship's power system from the antenna potentials, both radio-frequency and static, it was necessary to design a special switch to be mounted adjacent to the winch. It is a combination three-phase power circuit and RF switch. When the operating lever is in one of two positions, power is supplied to the winch, the antenna is grounded and the transmitter is made inoperative. In the other position, the ship power circuit is opened, the antenna circuit is closed and both winch and antenna are insulated from the ship by 20-kv insulators.

Preliminary investigations to determine the practicability of such an antenna system were made by NRL scientists aboard the USS EDISTO (AGB-2) during an annual northern provisioning and hydrographic cruise. It was found that a Jalbert JX-7 balloon could be inflated on open deck and launched in relative wind velocities of up to 30 knots. Then, in 1955, extensive tests were made of the entire system aboard the GLACIER. These provided an opportunity of checking operating procedures under actual shipboard conditions. Later in the year this ship joined those on Operation DEEPFREEZE in the Antarctic. This cruise provided additional evaluation of the balloon antenna system under actual operating conditions. It was found that a meter was needed on the winch-cable mechanism to indicate length of the antenna cable in order to simplify determination of the resonant lengths for various frequencies used. An improved type JX-9 balloon incorporating a new type of tail-fin assembly with superior aerodynamic characteristics has been procured for future operations. The improved tail-fin was designed by an NRL scientist.



While installed aboard the GLACIER the emergency "Skyhook" Antenna successfully maintained reliable communication with the "fly-in" planes all the way from their New Zealand base to the Antarctic. This feat is considered exceptional in that it was the only available method of homing these planes, and it demonstrated clearly the effectiveness of the system.

ɪg the Jalbert JX-7 balloon

When the USS GLACIER returned from its duty with Task Force 43 in Antarctica, it again embarked on the annual resupply mission to the Arctic. In the meantime, the Antenna Section of BuShips advanced plans for service use of the new equipment by procuring six of the improved "JX-9" and six of the "JX-7a" Jalbert balloons. In the time lapse between service in the Arctic and the Antarctic with DEEPFREEZE II later this year, the balloon system will be repaired to eliminate minor installation deficiencies resulting from the severity of Antarctic operations. Subsequent tests and evaluations on shipboard during future expeditions should add much to the ultimate solution of complex problems associated with Arctic and Antarctic communications.

Symposium on Preservation for Mobilization Requirements

A three-day sumposium, from 23 through 25 October, will be held at the Case Institute of Technology, Cleveland, on "Preservation for Mobilization Requirements." The American Statistical Association and the American Association of Civil Engineers are co-sponsoring the six-session meeting, which will be concerned with the use of statistics in the civil engineering field.

Major topics to be discussed over four half-day sessions are:

- Operating Experience
- Preservative and Fluorocarbon Research
- Metals and Metal Coatings Research
- Controlled Humidity Research

Civil engineering presentations will be given during the session of the morning of 23 October by the Marine Corps, Army, Navy, and Air Force. The closing session will be featured by a panel type of summary. Among the five experts on the panel will be E. Bryan Williams from the Office of the Assistant Secretary of Defense, Research and Development, and CAPT B. F. Bennett, Chief, Materials Development Branch, Bureau of Ships.

Two NRL scientists will participate in the session given over to "Preservative and Fluorocarbon Research." Chairman for the session will be H. R. Baker, Head, Rust Inhibition and Grease Research Branch at NRL, and V. G. FitzSimmons of the Surface Chemistry Branch will read a paper on "Fluorocarbon Research."

The Open Mind, 1861

In the first year of the War Between the States, inventor John Ericsson submitted a model of a small raft-like vessel to the U. S. Navy's Ironclad Board. When the chairman of the Board, a salty line-officer, had scrutinized the model he said to an assistant: "Tell him (Ericsson) to take that little thing home and worship it. It will not be idolatry because it is the likeness of nothing on the Earth, nor upon the seas, nor in the waters under the earth." Yet in spite of their own distrust, even contempt, the Board went ahead and had the "Monitor" built anyway--thereby saving the fleet at Hampton Roads and altering the character of naval construction forever.

The Ducted Propeller for Vertical Take-off

James A. O'Malley, Jr.
Project Aerodynamicist
Bell Aircraft Corp.

Ever since the time of the Wright Brothers, man has refined and developed his flying machines. The emphasis, more frequently than not, has been on speed. Designers have accordingly worked to minimize drag, and in so doing, landing and take-off conditions have been increasingly compromised. This has led to the use of longer and longer runways—especially for taking care of planes that fly at high subsonic and transonic speeds.

It became evident that the building of ever longer runways was only a palliative, and other ways would have to be found to meet problems of take-off and landing. Calling upon its experience with a variety of planes and helicopters, the Bell Aircraft Corp. in 1953 pushed into a new area to develop a fixed-wing, jet-propelled VTOL (vertical take-off and landing) airplane. When completed, the Bell VTOL Test Vehicle was able to hover; it could fly vertically and it could fly horizontally.

This article will concentrate on some of the future design thinking which is possible due to the success of the VTOL Air Test Vehicle, and will propose the application of some of the principles resulting from those tests to a vertical take-off and landing transport. The value of vertical take-off had been demonstrated many times in the company's long experience with helicopters; and during the Korean War, this value was emphasized again and again. Often the only launching area from which a helicopter could operate in Korea was a small site hacked out of the side of a mountain. On the other hand, the use of a short running take-off permitted a sizeable increase in load and extension of radius. Translating this vertical take-off requirement to a Navy situation, there would be a decided advantage in the case of crowded transports if a plane could be launched vertically, whereas the short running take-off could provide extended radius where flight decks or short runways were available.

With these requirements as starting points, the answer was almost obvious. Design the airplane so that it had the VTOL capability, but such that it could also take advantage of the existence of short take-off strips for overloaded take-off. The practical exploitation of this scheme dictated the use of a horizontal fuselage attitude on the airplane with a conventional-type landing gear which could be used for a running STOL (S for "short"). Furthermore, the horizontal fuselage attitude is more sensible than the fixed-thrust tail-sitter for many other reasons.

Although it is necessary to rotate the thrust to provide VTOL, we preferred this more complex design problem to the operational problems which appeared in the fixed-thrust concepts. A design problem needs solving only once; an operational problem is always with you. Of no

*Published under slightly different title in the August 1956 issue of "Aeronautical Engineering Review."

small importance was the desirability of having a pilot sit upright in a conventional cabin. Further, the hovering condition was improved by a design which reduced the area affected by surface winds, and the horizontal attitude provided by the design made it easy for the airplane to leave its hovering position and go into horizontal flight.

Servicing was easily accomplished since the airplane preserves a conventional ground attitude. As a final attribute, no complicated ground handling equipment was necessary.

Considering the general field, it appeared that a requirement might be developed for a VTOL airplane with characteristics lying somewhere between the helicopter and the jet VTOL. In order to examine such a requirement, we sought a configuration which would have a vertical take-off and landing capability, a much better subsonic cruise speed than the helicopter, and better hovering efficiency than the jet-powered VTOL.

Examining various methods of designing such a vehicle, we were attracted by the ducted propeller because of its high static thrust and low fuel consumption. If a spectrum of VTOL airplanes is visualized the value of such a configuration becomes apparent as shown in Figure 1. If hovering efficiency is regarded as a simple relationship of the thrust of the engine divided by fuel consumption, a comparison of hovering efficiency and speed capabilities would lead to a variety of VTOL types.

The helicopter has been selected to represent a 100-percent hovering efficiency. In general, it is speed-limited to about 150 mph. Slightly below the helicopter, at about 90-percent hovering efficiency, a rotor-type convertiplane may be visualized showing a speed capability of 250 to 300 mph. At the bottom of the spectrum, since they must support the airplane on pure jet thrust, the jet-propelled VTOL airplanes show a hovering efficiency ranging from 5 percent down to 2-1/2 percent. They are the best airplanes in terms of speed, however, the nonafterburning jet showing a speed capability of from 500 to 700 mph. The afterburning jet VTOL shows a speed capability extending well into the supersonic flight where it becomes closely competitive with the newer fighter airplanes.

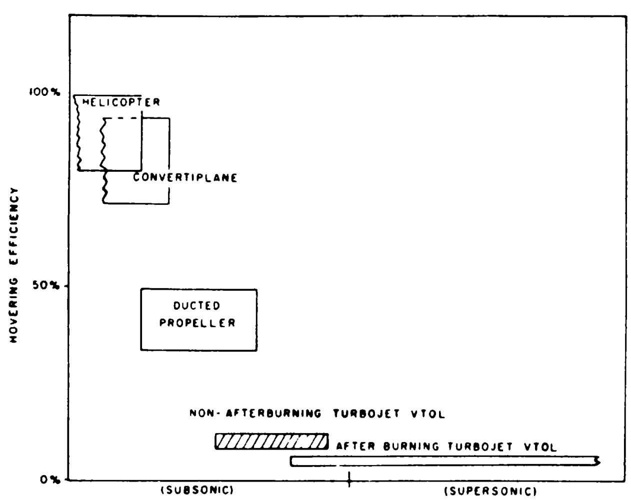
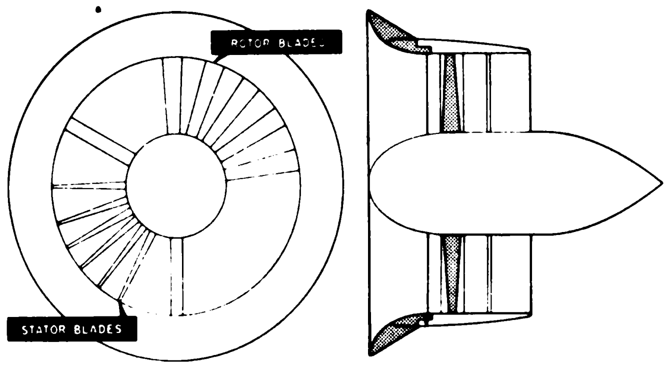


Figure 1 - Bell Aircraft VTOL Spectrum

Figure 2 - Ducted Propeller Concept



In between, we have plotted the characteristics of a hypothetical ducted propeller which was selected for its high-static-thrust potential. Since the ducted propeller converts shaft horsepower into thrust, and the turboprop engine has a lower specific fuel consumption than the jet engine, it is possible to obtain about 40 percent of the hovering efficiency of the helicopter. The ducted propeller extends the speed range of a plane easily up to 500 mph. This satisfactorily fills the need for aircraft which can hover efficiently and operate satisfactorily at speeds ranging from 300 to 500 mph.

A schematic arrangement of a ducted propeller with extended take-off flaps is shown in Figure 2. The design was selected because of the increased thrust resulting from the use of the duct. In addition, the hovering stability is improved by the duct since the use of a shroud around the propeller approaches the aerodynamic cleanliness typified by a jet source. The shrouds also are advantageous in still another field of interest—noise level. NACA experiments on shrouded propellers have indicated that the noise resulting from a propeller may be reduced by nearly 50 percent through the use of a shroud on the propeller. This is a factor which will become extremely important if a commercial transport application is considered.

The advantages of a good structural arrangement for rotating the propeller, and the safety features embodied in wrapping a shield around the rotating propellers, are also worthy of note. Although it may appear that a shroud would add weight to the installation it must be remembered that a bare propeller used on a horizontal-attitude VTOL usually requires long landing gear, extensive flap arrangements, or tiltable wings which also tend to increase the weight and complexity.

In adapting a ducted propeller type to a transport plane, a typical concept is shown in Figure 3. The airplane is arranged to mount two shrouded propellers at the wing tips. The shrouds enclose multi-bladed propellers about 11 ft in diameter. Retractable take-off flaps, provided for high-static thrust are shown in the closed portion used for high speeds. Each shroud is rotatable through about 100° from horizontal. The engines are inter-connected to all of the propellers and can be visualized as using mechanical shafting.

The airplane is designed to weigh 35,000 lb, has a wing span of 83 ft and an overall length of 55 ft. It is capable of lifting a payload of 4000

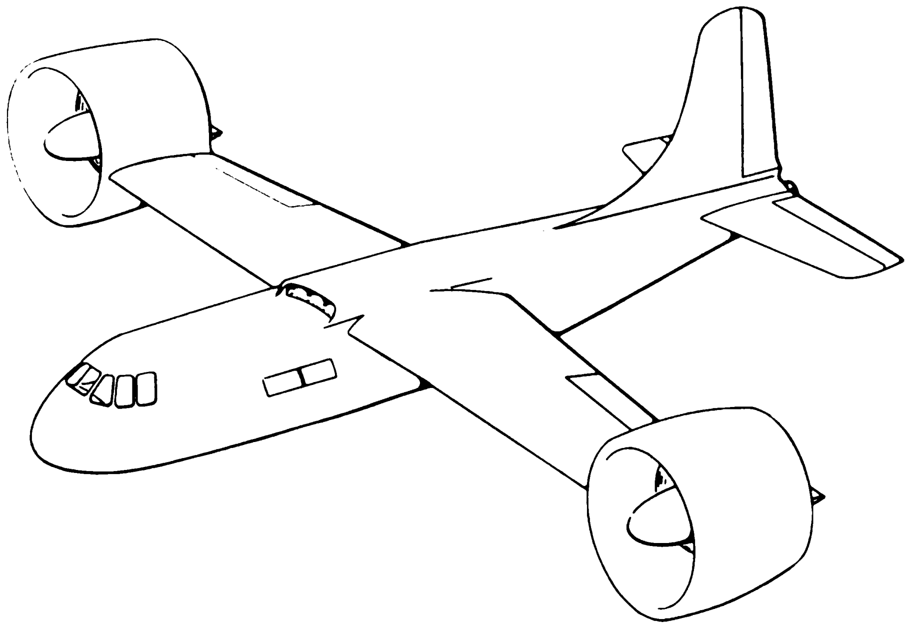


Figure 3 - Ducted Propeller Transport

lb in a vertical take-off and transitioning to level flight, or it can use an STOL to carry an overload in a running take-off.

It can be powered with a choice of currently available turboprop engines providing a total of 12,000 horsepower. In the vertical take-off condition, the flaps on the shroud are extended and the engines are rotated to the vertical or 90° condition. A thrust of 42,000 lbs was considered available for take-off. This would permit a transition to level flight in about 35 seconds.

From the performance standpoint, we felt that the airplane could follow a flight path made up of a vertical rise to a nominal altitude, followed by a translation from this position to the horizontal flight condition. The general type of flight path is similar to that already used on our Test Vehicle. A schematic representation is shown in Figure 4. The translation can be accomplished by either pitching the airplane nose down slightly or by rotating the engines. In both cases the wing is maintained at an angle of attack less than stall angle as speed is increased.

Let us suppose that a ducted-propeller transport airplane was designed that would have a maximum speed capability of 430 mph. A sample cruise calculation, based on the airplane's range plus a 60-min hovering time, indicates that it would carry a payload of 4000 lb a distance of 581 mi at 250 mph and at an altitude of 3000 ft. Should it be desirable to operate the airplane at higher altitudes the range would be increased to 810 mi at 20,000 ft. The hovering capability of this airplane would be moderately good. A capability of 108 min hovering time is available with standard payload and zero range. At the range of 810 mi, 60 min of hovering would be available.

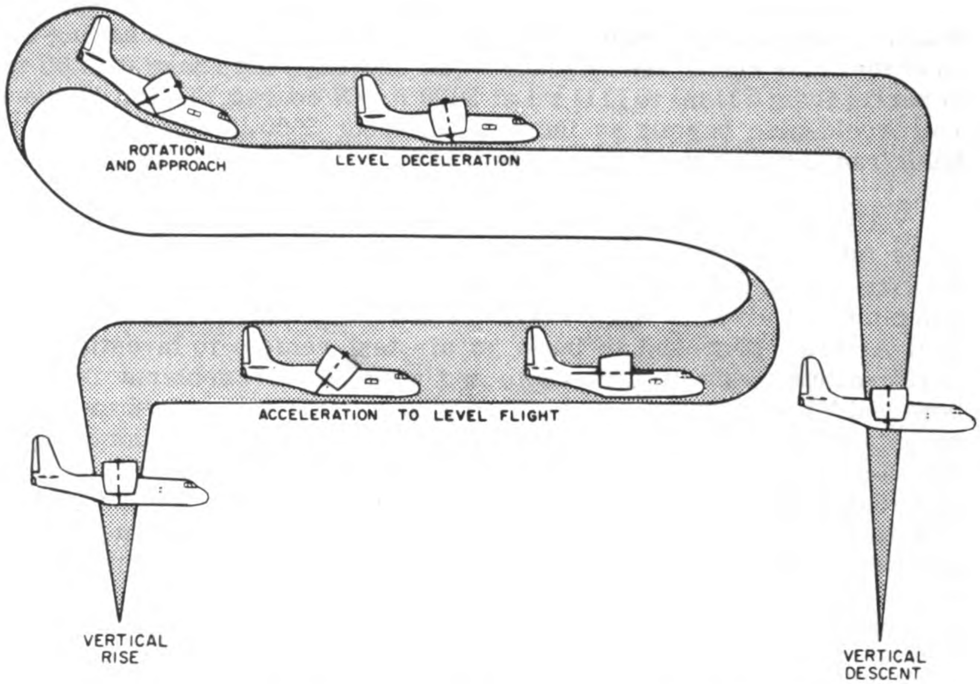


Figure 4 - Vertical Take-off and Landing (Rotating Ducted Propellers)

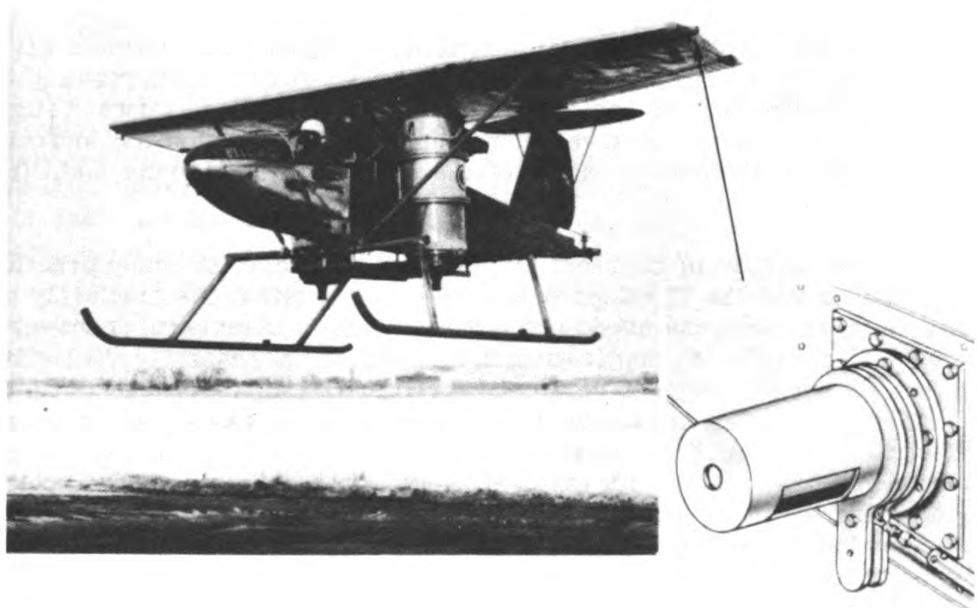


Figure 5 - Air Test Vehicle

Operation of the transport as an STOL airplane is considered an available secondary mission. Using a 400-ft ground run and adding 3500 lb of fuel to overload the airplane would increase the range with 60 min hovering from 581 mi to 1111 mi at 3000 ft. Of course, the 400-ft ground roll would also permit an increase of about 3500 lb in payload if the basic range figure were maintained.

Although the characteristics of such a VTOL Airplane may appear to be futuristic, they have already been demonstrated as sound engineering approaches. In 1953, stimulated by their two-fold interest in combining jet airplane speeds with the advantages of a vertical take-off, Bell Aircraft proposed to build an air test vehicle to investigate the performance, stability, control, and operational problems of a jet-powered VTOL airplane. The airplane was conceived as a cheap, lightweight, easily constructed airplane which would be built as a piloted model for flight-test investigations. These investigations were aimed at demonstrating that the state-of-the-art was ready for jet-powered VTOL. Bell Aircraft provided company funds for the design and construction of the airplane and the Air Force provided engines to support this company expenditure. Figure 5 shows the airplane. It is certainly not noted for beauty.

Two Fairchild J-44 missile engines, which had never before been flown in a piloted aircraft, were selected as the turbojet powerplants. The airplane weighed about 2000 lb. Since it was desired to obtain thrust in the vertical direction for hovering and horizontally for forward flight, the engines were mounted on a rotating hub.

The airplane was designed and built in about seven months. In April of 1953 engine manufacturers were approached to determine availability. By October of the same year the airplane was completed and preliminary ground testing was started.

In view of information obtained on hovering and translational flight, it was considered logical to conclude that a jet-propelled airplane of the horizontal attitude type could hover, could transition into forward flight, could use a rotating thrust vector to accomplish the transition, and could be built from the present state-of-the-art without requiring additional basic research.

The success of this test airplane set the stage for many practical applications of the VTOL principle. The jet applications are fairly obvious. In studying the needs and requirements of short-haul transports, the ducted propeller application has appeared increasingly attractive. A useful speed range, a vertical take-off, and a moderately efficient hovering capability are the basic ingredients which make this configuration attractive. With vertical take-off capability and a moderate hovering efficiency established, the usefulness of the vehicle is directly proportional to the speed with which it can travel. From this standpoint the ducted propeller VTOL airplanes are worthy contenders for that area of the spectrum which lies between the helicopter and the jet VTOL.

Research Notes

NRL Nuclear Reactor Goes Critical

The Naval Research Laboratory received its license to operate its recently completed nuclear reactor, from the Atomic Energy Commission, on 14 September. Three days later, on 17 September, the scientists started it going, or—as the nuclear physicists term it—"brought it critical."

The reactor is of the "pool" type, so-called because the nuclear core is suspended in a pool of water which acts as a coolant, as a moderator, and as a radiation shield. The installation, which has been over three years in design and construction, includes a large hot cell for remote handling of highly radioactive materials as well as several other special-purpose laboratories. It has absorbed a million-dollar appropriation from Congress in its building. The reactor will initially be operated at 100-kw. Higher power levels may be authorized at a later date depending upon the requirements of research.

This newest of NRL's nuclear-research facilities may be used by any of the Laboratory's 14 scientific divisions, and by other organizations in the Washington, D. C. area. It will be a tool for investigations in physics, chemistry, metallurgy, and other scientific fields, including problems in reactor technology. It will also be a unique study aid in the Laboratory's science-education course in "Nuclear Reactor Engineering."

Nonstrategic Core Material, Flakenol I, Developed for Use in Communications

The U. S. Naval Ordnance Laboratory, at Silver Spring, Md., has developed a new nonstrategic magnetic core material for use at most communications frequencies, the Navy announced today. Called Flakenol I, the core material is a flake form of the alloy developed some 20 years ago by the Japanese under the name of Sendust. It is composed of iron, silicon, and aluminum.

In addition to its nonstrategic composition, Flakenol has the advantages of higher permeability, lower eddy-current losses, and lower density than the high-nickel-content alloys making up the magnetic powder cores for electronic filter networks, resonant circuits, and transformer components now used in communications and ordnance systems. Its adoption in these uses alone would save several hundred tons of nickel each year. It would also offer the possibility of extending the frequency range of magnetic powder cores to the hypersonic and low radio frequencies, where they are not used now because of high eddy-current losses at these higher frequencies.

Flakenol I cores are made by compacting the flakes obtained by warm-rolling Sendust powder. While this would introduce an additional step in one stage of the manufacture of cores from this material, it is more than offset by the fact that the time-consuming and expensive step of insulation required in the present powder cores is not necessary with Flakenol. Because of the low cost of the raw materials, and the elimination of the insulation stage in the manufacture, Flakenol is expected to be competitive in cost to the high-nickel alloys and in many cases to surpass them in performance.

TDC Has a New Office at NAS Corpus Christi

The Commanding Officer and Director of the U. S. Naval Training Device Center has announced the establishment of a new Area Office representing the Center at the Naval Air Station, Corpus Christi, Texas. The new office, under an Area Representative, covers the states of Texas and Oklahoma, and its training specialists and engineers are available to training activities within the area in all matters relative to training device programs including installation, utilization and maintenance.

Other already established field offices of the Training Device Center are located at San Francisco, San Diego, Pensacola, Great Lakes and Norfolk. Area offices, similar in function to the field offices, are located at Seattle and NAS Jacksonville.

Land-based Submarine Engine Runs 66 Days at Full Power

A reactor power plant in Arco, Idaho—the land-based prototype of the atomic-powered submarine NAUTILUS—met the most demanding requirements that could be placed upon it during a demonstration that lasted 66 days and 66 nights.

Using only a part of a single charge of uranium fuel, this reactor test was designed to prove the reliability and stamina of pressurized water reactors for ship propulsion.

At the end of the test the reactor still had many hundreds of hours of full operation available. Operations have been resumed to obtain engineering test data and to train the Navy's atomic sailors who will man future atomic power ships of the fleet.

The test demonstrated the feasibility of nuclear power ships cruising at high speeds and without refueling for long periods of time. It also provided essential information on reactor performance during extended high-power runs. These data will be used in designing improved nuclear propulsion plants for both naval vessels and civilian nuclear power plants.

In addition to the fuel-oil factor—a train of tank cars "over a mile long" would have been required to fuel a submarine making a run equivalent to that of this prototype plant. The ruggedness of the shipboard nuclear plant demonstrated by the history-making test was commented upon by Navy observers. This is believed to have been the longest full-power run ever completed by any type of propulsion plant; land, sea, or air.

Earth Satellite Instruments Displayed in New York

Some of the instruments which may be used in the scientific earth satellite, to be launched during the International Geophysical Year 1957-1958, were on display during the eleventh annual convention of the Instrument Society of America at New York City, 17-21 September 1956.

The 10 milliwatt MINITRACK transmitter was designed by NRL scientists for use in radio tracking of the satellite. The circuit is a single-stage, crystal-controlled transistorized oscillator. The transmitter uses either Western Electric or Philco transistors which were especially designed for the tiny oscillator. The battery pack consists of seven 1.2-volt mercury cells, Mallory-type RM-12, which will power the transmitter for a period of two weeks. The thin aluminum container which houses the oscillator is gold-plated to improve its properties as a heat shield. Total weight of the unit is 13 ounces. The transmitter on display operates on a fixed frequency of 108 megacycles and has a range of more than 4,000 miles.

The pressure gauge is a bellows-actuated potentiometer. This gauge will determine if a meteorite punctures the satellite skin. The gauge has a plus and minus range of 15 lbs per square inch. The tiny metal instrument is cylindrical in shape, is one inch long and one inch in diameter. It weighs only 1-1/2 ounces.

The erosion gauge is manufactured from a semitransparent Nichrome ribbon evaporated on glass. It is designed for mounting on the outside of the satellite skin and will measure the surface erosion caused by the impact of the meteorites.

The temperature gauges designed for the satellite are semiconductor thermistors that can evaluate temperature changes from plus 150 degrees centigrade to minus 140 degrees centigrade. Information gained from pressure, erosion, and temperature gauges is telemetered to radio tracking stations on the ground.

Another piece of equipment designed for satellite experiments is a subminiature meteoritic collision microphone. This sensitive little microphone detects the collisions of meteorites with the satellite by sensing vibrations sent up in the satellite's outer surface. The information is stored in a memory device and is transmitted at given intervals to the radio tracking stations on the ground.

The Lyman-Alpha equipment will be used for measuring the ionization produced by far ultra violet solar-flare radiations through the use of a peak memory unit. The Lyman-Alpha storage equipment can collect and store information while the satellite is on the opposite side of the earth from the radio tracking stations set up on the North and South American continents. When the satellite returns to the side of the earth where the tracking stations are located, the information can be telemetered down to earth.

On the Naval Research Reserve

Nuclear Science Seminar at Idaho Falls

The Office of Naval Research, the Atomic Energy Commission and the operating contractors at the National Reactor Testing Station combined to present the Third Annual Seminar at Idaho Falls, Idaho, commencing 22 July. Arranged and conducted by Naval Reserve Research Company 13-6, with LT G. V. Wheeler, USNR, former commanding officer, as chairman, the seminar reviewed the whole field of reactor development and testing. Thirty-one Navy, eight Marine Corps and one Army reserve officer and two active duty naval officers from Sandia Base heard presentations by the Chief of Naval Research and by representatives of the Idaho Operations Office, AEC, and the Phillips Petroleum Company, General Electric Corporation and Westinghouse Electric Corporation, contractors to AEC at the Arco Site.

The group received a good send-off on opening day with greetings from the Commandant, THIRTEENTH Naval District, RADM A. N. Bledsoe; from the Hon. John B. Rodgers, Mayor of Idaho Falls; from CAPT R. R. Sampson, USN, Commanding Officer of Naval Ordnance Plant, Pocatello; from Mr. A. C. Johnson, Manager, Idaho Operations Office, AEC, and from Dr. R. L. Doan, Manager, Atomic Energy Division, Phillips Petroleum Company. The subsequent sessions provided the group with authoritative lectures in reactor theory, instrumentation, shielding, metallurgical and medical aspects and reactor potential, military and industrial, for the future.

During the course of the seminar, tours were made to the Arco Site of the National Reactor Testing Station which gave the officers an opportunity to see the materials testing reactor, the submarine reactor, the experimental breeder and borax-III reactors and the progress being made on the surface ship reactor.

Logistic and administrative support, without which no seminar could operate, were provided by ComTHIRTEEN through the Commanding Officer, Naval Ordnance Plant, Pocatello and by the Hon. Mr. Rodgers who provided the meeting place for most of the sessions. The reaction of those attending was most favorable and plans are already going forward for next year.

Fifth Annual West Coast Seminar

The Fifth Annual West Coast Research Reserve Seminar, cosponsored by the Office of Naval Research and the Commandant, Twelfth Naval District, was conducted during the two week period 19 August - 1 September 1956 by the Commanding Officer, CAPT J. H. Rodgers, USN, Office of Naval Research Branch Office, San Francisco, with CDR H. B. Joslin, USNR, ONR San Francisco as Seminar Chairman.

RADM John R. Redman, USN, Commander, Western Sea Frontier and Commandant, Twelfth Naval District, made the welcoming address followed by RADM Martin J. Lawrence, USN, Commander, Mare Island Naval Shipyard, the principal speaker. RADM Lawrence was the first Deputy Chief of Naval Research in 1946.

RADM Lawrence at
Idaho Falls

Representing various branches of the service were 49 reservists from 18 states in the five Western naval districts. Included were 2 Marine and 5 Air Force reservists.

During the two week period of training field trips included visits to the U. S. Naval Radiological Defense Laboratory, Cutter Laboratories, U. S. Naval Hospital, Oakland, Western Regional Research Laboratory, USDA, Ames Laboratory NACA, Stanford Research Institute, Naval P. G. School, Monterey, NAS, Alameda, Mare Island Naval Shipyard, University of California Radiation Laboratory, Naval Biological Laboratory, Shell Development Co. Laboratory, Quality Control Laboratory at U. S. Naval Magazine, Port Chicago and Model Study, U. S. Army Engineers. Informative and interesting lectures, by outstanding speakers in scientific and technological fields, were interspersed between the tours of the various facilities.

Concluding the Seminar was the annual banquet at the Officers' Club, NAS, Alameda, hosted by Naval Reserve Research Company 12-5, LCDR Charles D. Newnan, Jr., Commanding Officer.

NRL Seminar

The fourth annual Naval Research Laboratory Training Seminar was held at Washington, D.C., during the period 19 August to 1 September 1956. Forty-six Research Reserve officers were given a comprehensive survey of the program of the laboratory.

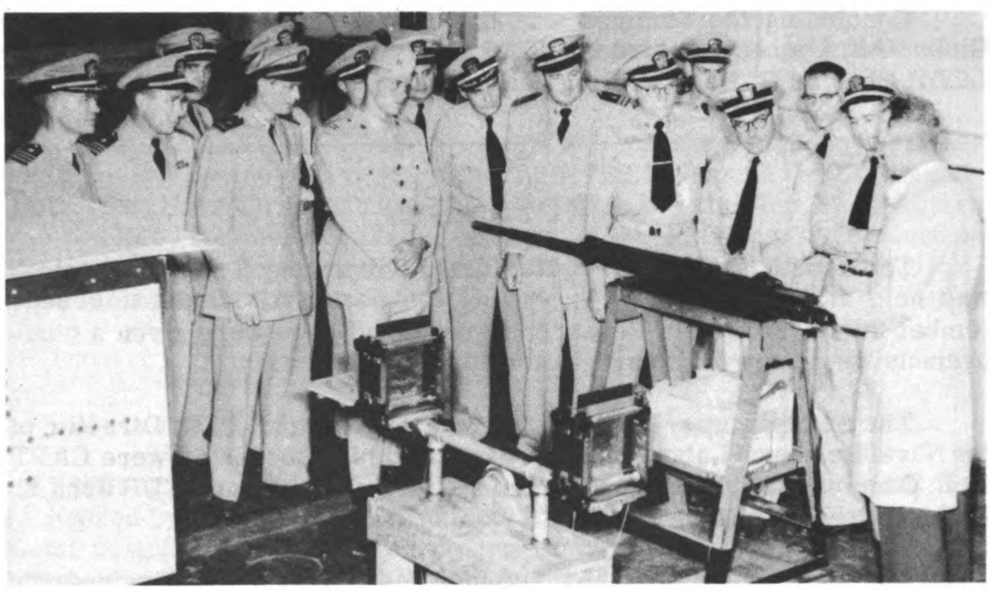
The seminar was opened by CAPT P. H. Horn, USN, Director of the Naval Research Laboratory. Present at this first session were CAPT R. E. Odening, USN, Director of Administration at NRL and CDR John K. Hicks, USNR, Research Reserve Training Officer.

The first session on Monday included tours of the Engineering Services and Technical Information Divisions of the laboratory. In the following two weeks the program was presented by the fourteen scientific divisions of the laboratory. The reserve officers were given an opportunity to learn something of the general program of the laboratory and to become familiar with the research facilities. More than 100 lectures and demonstrations were presented by some of the country's leading scientists. The leading role assigned to NRL in the International Geophysical Year Program has generated problems for many divisions of the laboratory and a number of these topics were covered. Of particular interest was Project Vanguard, the earth satellite program. The reservists were given much information which has not yet been made available to the general public.

Although Project Vanguard has become one of NRL's biggest projects, it was not allowed to overshadow the importance of other programs. For example, the NRL Reactor facility was visited and some of the problems associated with it were discussed. Problems arising from the application of nuclear power to naval vessels were discussed. We reservists were impressed by the wealth of fine equipment available to NRL scientists working in this and other fields. Among these is the NRL computer NAREC. A sample problem was run through it to demonstrate its operation.

On Thursday of the first week the group visited the Chesapeake Bay Annex which is located about 40 miles from Washington on Chesapeake Bay. Here, some of the practical applications of NRL research were demonstrated. On Friday of both weeks time was allowed for individuals to revisit the various divisions at will.

Social occasions for the period featured a lunch on opening day with Naval Research Reserve Co. 5-9 acting as host. A smoker was held on Monday evening of the second week. Coach Tommy Mont of the University of Maryland talked about the Maryland football team and showed pictures of the 1956 Orange Bowl game with Oklahoma.



Reservists at NRL viewing a high-velocity rifle used for fracture-mechanics research.

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NAVY SPOKESMEN ARE SAYING THIS ---

"Our atomic-age Navy's offensive punch is built primarily around fast carrier task forces, with high-performance carrier-based aircraft as weapons delivery agents. These task forces can be moved rapidly to changing positions around the globe, from which they can attack enemy ships, coastal or nearby coastal targets with atomic or conventional weapons from distances hundreds of miles away. Submarines carrying guided missiles, which can be equipped with atomic warheads, supplement this capability.

"Defensively, ships of our Navy today and the ships we are building are tough targets for atomic attack by the enemy. In the first place, they are always on the move—at speeds up to about 35 knots—and hence, unlike fixed targets, are difficult to locate. The enemy cannot pre-set or pre-aim a long-range missile against a ship or task force at sea. Even if located, a modern, well-balanced naval task force does not present a very inviting target, even for atomic warfare."

RADM H. C. Bruton, USN
Director, Naval Communications

"Lessons learned at atomic tests in the Pacific proving ground are being incorporated into our ships in order to better withstand blast and heat effects. Insofar as radiation effects are concerned, the ocean itself upon which the ships float provides an unlimited decontaminant supply. Properly equipped ships can withstand atomic radioactivity far in excess of shore installations or aircraft.

"This was forcibly illustrated at Bikini in 1954 when a number of ships of the joint task force were subjected to heavy, visible supercharged and continuous radioactive fallout following the detonation of one of the test shots. This situation was quickly detected and washdown systems and other measures utilized with the result that our ships were able to continue their assigned tasks without harmful effect on personnel or material. Radioactive fallout of this character and intensity ashore would have rendered the area uninhabitable for an indefinite period."

RADM H. C. Bruton, USN
Director, Naval Communications

In This Issue

The Navy Patent Organization 1

Headed by the Chief of Naval Research, an active, Navy-wide patent organization is protecting the discovery rights of naval scientists and engineers, and is saving the Government millions of dollars every year.

Memory Box for Sonar Operators 6

A simple and inexpensive logical computer eases the task of underwater-target identification.

Hydrogen Peroxide As a Source of Energy 7

The use of hydrogen peroxide in propellants has been under investigation by the Navy since 1934. Basic research at MIT is finding increasingly greater potentialities for the versatile compound.

A Radio Antenna 1200 Feet High 13

To meet a long-standing problem of difficult radio communications in polar regions, scientists at the Naval Research Laboratory in collaboration with the Antenna Design and Installation Sections of the Bureau of Ships have developed equipment that shows promise for the future.

Ducted Propeller for VTOL 17

An aircraft equipped with ducted propellers, which can thrust vertically or horizontally, offers a compromise between the pokey helicopter and the fast but awkward jet VTOL. Also, the Bell Transport plane can make use of short runways for added range or greater loads.

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Cover Photo: The Icebreaker GLACIER, wearing the unique rig that allows her to broadcast low-frequency radio signals from a 1200-foot, balloon-borne antenna.

RESEARCH REVIEWS endeavors to report briefly highlights of technical progress in research by Navy laboratories and contractors and the development of important naval research facilities. Articles which meet these broad criteria and possess a good degree of readability are welcomed. Manuscripts and changes of address should be sent to Code 740, Office of Naval Research, Washington, D. C. . . . Research Reviews 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; $.15 per individual copy.

Approved by Bureau of the Budget, 28 February 1955