OFFICE OF NAVAL RESEARCH JANUARY 1955

RESEARCH REVIEWS

NADU's WV-2

NAVEXOS P-510

DEPARTMENT OF THE NAVY
WASHINGTON, D. C.

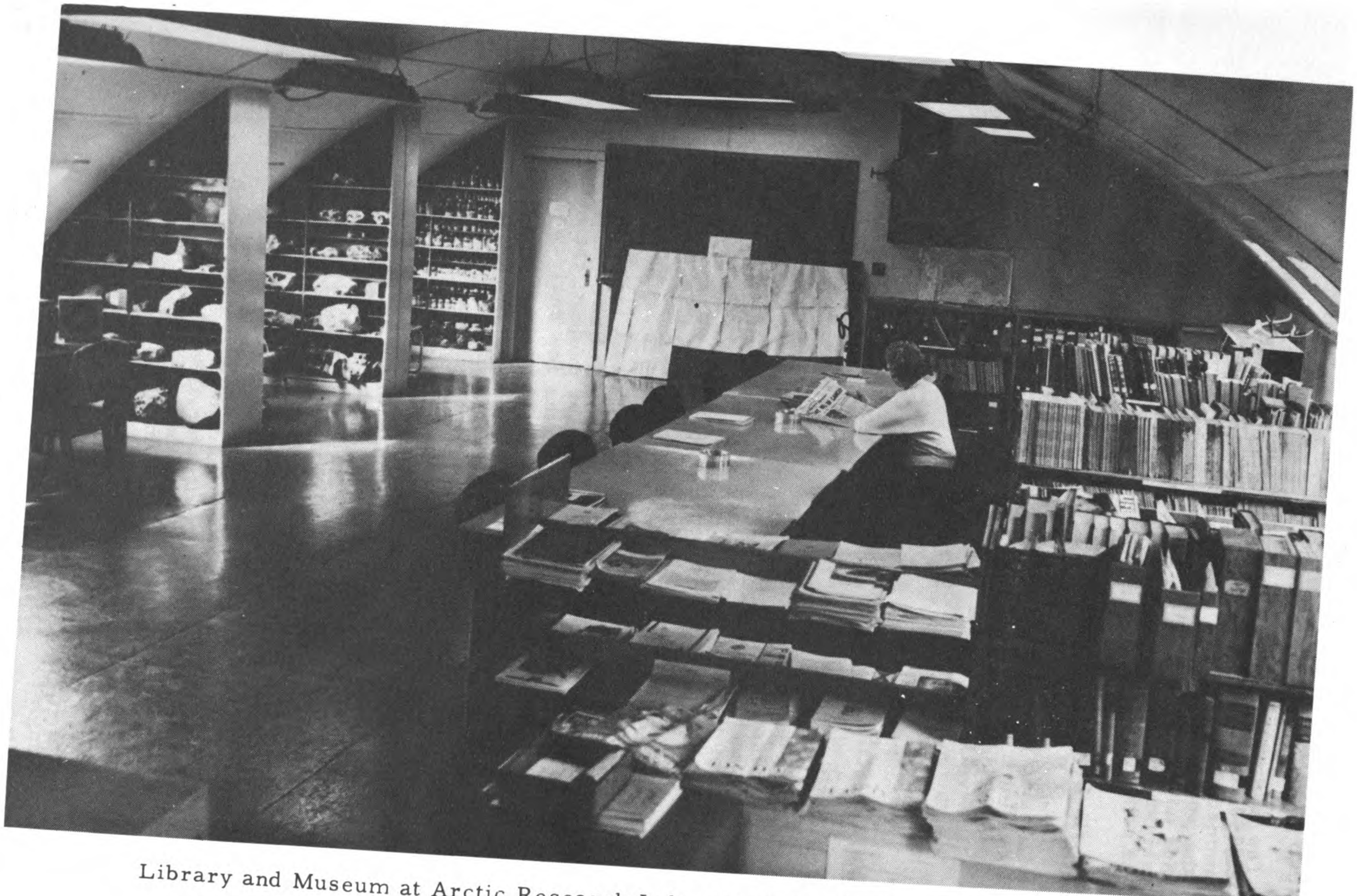
COVER PHOTO: "Big Dipper" landing at South Weymouth, Mass., where—two years ago—the Naval Air Development Unit was established. The plane, a converted Constellation, is an airborne combat information center equipped especially for radar early warning. See p. 17.

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, 14 February 1952

In This Issue



Library and Museum at Arctic Research Laboratory, Pt. Barrow, Alaska (See p. 10)

Nuclear Powered Aircraft

CDR David M. Walley, USN

Power Branch, ONR

When scientists first started to explore the possibilities of nuclear flight, it might have seemed like the answer to all our problems in aviation. The principal advantage, of course, is the low rate of fuel consumption. One pound of Uranium 235 is equivalent to 1,700,000 pounds of gasoline or 3,000,000 pounds of coal. This fact, combined with the unlimited temperatures which are available, brings us to the realization that there is no practical limit to the speed or range which can be attained provided these temperatures can be utilized.

As with most new discoveries, it was soon realized that these tremendous advantages bring with them disadvantages and problems. From that point on, the development of a nuclear aircraft power plant has consisted of describing and appraising some of the toughest problems in the history of engineering, and then trying to solve them. The handmaiden of nuclear power is radiation, deadly to men and damaging to equipment. This means cumbersome heavy shielding which complicates design and reduces efficiency. Because of this necessary shielding, the total weight of even the simplest system would be high, particularly if our vehicle is going to carry a crew.

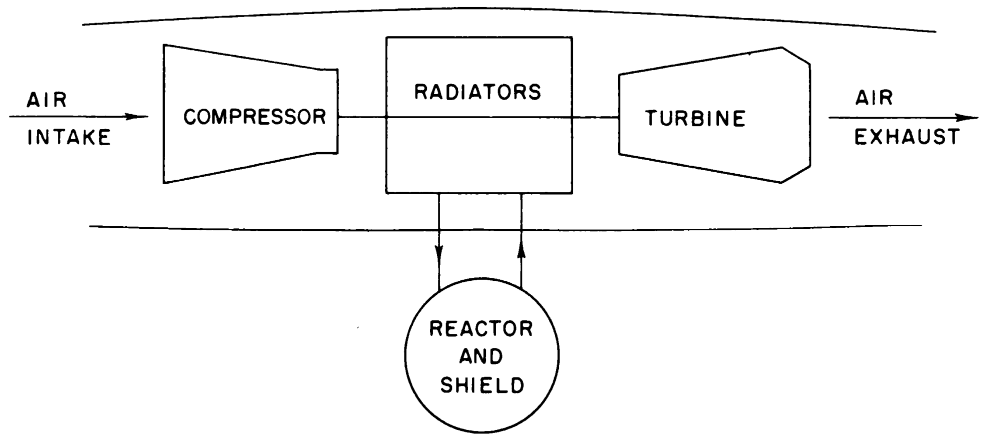
Additional weight must be carried for such considerations as crew comfort in order to use the available range. A heavier landing gear would be required than for conventional chemical powered airplanes of the same take-off weight; the low fuel consumption rate works against us here resulting in a landing weight almost as great as the take-off weight. Seaplanes have an advantage in this respect since the weight which must be added to accommodate the larger landing loads is much less for them than for land planes.

Two basic means of using nuclear power might be considered: the nuclear reactor and the atomic bomb. The latest published figures for the operating temperatures of existing piles is 212° F for the water cooled unit and 300° F for the air cooled unit. Heat delivered at such low temperatures is of limited usefulness. On the other hand, the fission fragments fly apart from an exploding bomb with velocities corresponding to temperatures of many billions of degrees. Even the most refractory materials melt or decompose at temperatures of only a few thousand degrees so the chances of taking advantage of this source seem remote.

Some highly impractical schemes have been suggested in attempts to span the gap between the low temperature of the nuclear reactor and the high temperature of the bomb.

One scheme which has been suggested is to use the recoil momentum of the fission fragments from nuclear reactors themselves to obtain a thrust. This is absurd, since the momentum of the particles would be very small even with the pile operating at a very high level. Ranges for fission fragments in air have been reported as 19 to 25 mm. Obviously a layer of solid material only a few microns thick would be effective in producing thrust.

Similar difficulties preclude the possibility of a fission emf device which proposes to have the fission fragments transfer their electrostatic



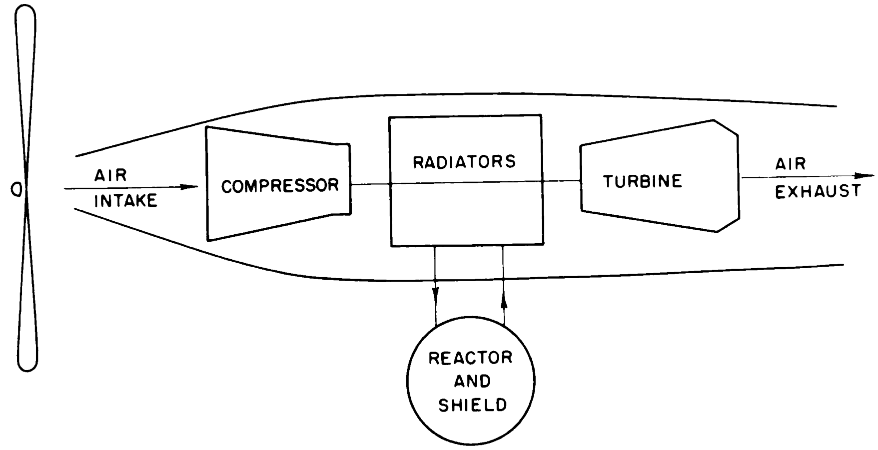
Schematic of nuclear turbojet

charge against an opposing intense electric field between an inner solid chain-reacting sphere and an outer concentric shell. Even at a difference of potential of a million volts, the power developed is negligably small compared with that required to fly an airplane.

Returning to the realm of practicality, it appears for the present that all nuclear power plants will depend on: (a) the maintenance of a neutron chain reaction in fissionable material, (b) the conversion of the fission energy to heat, (c) the removal of the heat energy by raising the temperature of a fluid and (d) the conversion of this heat energy to mechanical energy by conventional means. For aircraft, this might mean, for example, a turbo jet or a turbo prop with a nuclear reactor replacing the combustion chamber. This is shown schematically in Fig. 1.

The reactor may be thought of as a more or less spherical body throughout which fissionable material such as Uranium 235 is distributed. It also contains passages for the flow of coolant through it for the removal of the heat generated and, of course, structural material. The reaction starts with the capture of a neutron by the nucleus of an atom of uranium. The U-235 nucleus disintegrates into two or more fragments plus two to three neutrons. These fission fragments are the nuclei of other atoms lower in the atomic table such as barium and molybdenum. The weight of these fragments plus the weight of the neutrons produced is less than the weight of the original uranium atom. What happened to the weight that was lost? There can be only one explanation. It was converted into energy; tremendous amounts of energy since by the relationship, $e = mc^2$ (where c is the velocity of light), the effect of even a very small mass is magnified many times when converted into energy. This energy appears first as kinetic energy in the motion of the fission fragments and neutrons and, when these fragments are stopped, (within a few microns as stated previously) the kinetic energy appears as heat which gives us the means for utilizing the energy produced.

The two to three neutrons produced are ejected into the body of the reactor and may suffer one of three different fates: (1) They may escape from the reactor entirely and be captured in the surrounding shield or structure, (2) they may be captured by some of the nonfissionable material within the reactor itself. (3) they may be captured



Schematic of nuclear turboprop

by another U-235 nucleus following which two or three more neutrons will be given off. Our problem, then, is to design our reactor so that about 40 percent of the neutrons given off in fission are captured by other U-235 nuclei to produce more fissions.

Gamma rays and beta rays are also given off in the fission process and in the nonfission capture of the excess neutrons. These are the deadly rays which must be screened from men and equipment by the heavy shield.

In principle, control of a chain reaction is exceedingly simple. In order to reduce the fission process, we need only to insert a nonfissionable material, usually as "control rods," into the reactor to increase the percent of neutrons lost to nonfission capture. To increase the reaction, we withdraw the material. One of our first problems in designing a reactor is to keep the investment of fissionable material at a minimum since this material is very expensive. This may be accomplished by minimizing the two nonproductive neutron losses. We therefore must keep to the smallest practical value the mass of nonfissionable material within the reactor to reduce the nonfission capture. Since the coolant and structural material are both contaminants they must be chosen to be as weak contaminants as possible and a careful balance must be maintained to insure there is sufficient material present to fulfill the primary function and no excess.

Neutron leakage may be counteracted to some extent by surrounding the reactor with a material that scatters and reflects the neutrons but does not capture many of them. Use of a reflector also gives us another method of control: if part of the reflector is removed, neutron loss by escape is increased, reducing the reactivity in the same manner as control-rod insertion.

If allowed to escape, the neutrons and gamma rays would make it necessary for human beings to stay at a distance of more than a mile from a high powered reactor while it was in operation. Furthermore, since the fission products themselves are radioactive and continue to emit gamma rays even after the chain reaction has been stopped, it is not possible to approach a reactor much closer than this even after it has been shut down. Clearly a protective shield from this radiation is required. This shield must provide protection from both neutrons and gamma rays; other radiation is present but is of little concern here.

Neutrons are most effectively slowed down and captured by the nuclei of light atoms such as hydrogen or beryllium, so an effective shield must contain light atoms. Gamma rays are produced by the absorption of neutrons in most materials and these, as well as the gamma rays from the fission reaction, are best stopped by heavy elements. Hence, the shield normally will also contain heavy elements. The details of the arrangement of the light and heavy elements are not particularly important for a large stationary reactor but for a mobile reactor, particularly one intended to fly, this arrangement is critical. The detailed solution of this problem is extremely complicated. It must be remembered that the shield is by far the heaviest single object aboard the aircraft, therefore very close attention must be paid toward keeping its weight at a minimum.

One of the ways in which this may be accomplished is to reduce the reactor size. This reduces the area for coolant flow and increases the coolant pressure drop, both of which increases the power required to pump the coolant. In general the smaller size also increases the investment of fissionable material. The trick, then, is to find the best balance between shield weight, on one hand and coolant pressure drop and fuel investment on the other.

It should be clear by now that one of the biggest problems in aircraft nuclear power is that of heat transfer. The reactor coolant must be a low neutron absorber to keep the fuel investment low and there must be a minimum amount present in the reactor for the same reason and to keep the reactor small, since a smaller reactor means a smaller, lighter shield. Yet there must be sufficient coolant present to remove the heat. Obviously, the heat-transfer characteristics should be, as far as possible, compatible with the above, and the characteristics should be such that activation of the coolant is minimized since the coolant leaves the protection of the shield.

All of these requirements may or may not be compatible with the requirement that ultimately the heat absorbed by the coolant must somehow supply the heat which replaces that previously supplied by chemical fuels in the combustion can of the engine. Security prevents elaboration of the problems and possible methods of solution, so in this paper recognition of some of the problems will have to suffice. Whatever coolant is chosen, maintenance of its flow is imperative since heat is generated under normal operation whether it is removed or not. The quantity of heat with which we are dealing is such that if coolant flow is interrupted even for a very short time, the reactor will be damaged.

Almost every type of aircraft propulsion machinery ever conceived has been suggested for incorporation in a nuclear power plant for aircraft. The ones discussed previously in this paper were chosen only for convenience. In this scheme the reactor coolant might be the air itself which is the working fluid of the turbojet/prop or an intermediate coolant might pick up the heat from the reactor and transfer it to air radiators which physically replace the combustion chambers. Another obvious proposal is that propellers be driven by turbines which are in turn driven by expanding our coolant through them. The reactor might also take the place of the combustion apparatus in a ram-jet propulsion system.

In making a choice among the various types of propulsion machinery which have been suggested, the designer must perform detailed and careful analysis of many possible combinations. Cognizance must be taken of coolant containment problems and the length of lines containing fluids which may be both thermally and radioactively hot.

A most important associated problem in reactor technology is that of finding useful materials. This includes structural material within the reactor, shielding materials, coolants, materials for retaining fluids both radioactively and thermally hot, etc. Structural materials within the core must fulfill their normal load-carrying requirement under conditions never before encountered. They are at temperatures unusually high for structural materials and in addition are in the extremely high radiation field. The shield must perform its function under conditions only slightly less stringent. Problems associated with other materials throughout the system come closer to normal engineering practice except that the requirements are usually higher.

The finding of materials adequate to withstand these conditions is a challenge worthy of the best metallurgist, ceramist, or chemist.

As with all aspects of this paper, statements regarding future prospects are closely involved with national security and therefore any discussion of them is not easy. Furthermore, any predictions must necessarily be opinions of the author. There is with this the danger that we may be credited with having answers to many questions to which we do not have answers. With this in mind there are, nevertheless, some statements which can and should be made.

In many respects, the propulsion of aircraft is an ideal use for nuclear energy. Here, to a greater extent than in any other application, the highly concentrated source of heat can be used to good result. Here alone the low rate of fuel consumption is more than important—it is an absolutely vital consideration. The goal of producing a nuclear powered aircraft is admittedly an ambitious one. In spite of the difficulties involved and the problems not yet solved, nuclear flight is believed to be in the forseeable future. The nuclear powered airplane will be large and heavy but probably not excessively greater than that of chemically powered airplanes which might exist in the same period. Prospects of appreciable reductions in shield weight are remote. It is no breach of security to observe that intense radiation is produced by nuclear reactions and this radiation must be shielded from men and equipment. To stop the radiation something must be put in its way and this requires heavy shields.

The airplane when it flies will be capable of a range limited only by crew endurance. It will completely destroy the distance barrier. There appears to be no fundamental physical limitation which will prevent the ultimate achievement of speeds now anticipated for large chemically powered aircraft. Chemically powered airplanes attain high speed only at the expense of range, and long range at the expense of reduced pay load or complications such as air-to-air refueling, and even then the range is limited.

The Navy has a vital need for such an airplane in fulfilling its historic role in the control of the seas. The availability of airplanes whose mission can be established by military necessity rather than the limitations of range must not be overlooked.

Cathodic Protection Progress Report

Two and one-half years ago, Research Reviews (May '52) described the Navy's program for protecting its ships against electrolytic corrosion. Since then, "cathodic protection" has become standard treatment for mothball ships, and is now being applied, experimentally, to active ships as well.

In simplest terms the problem is this: When an iron or steel ship floats in sea water, the steel hull and rudder act as the anode and the bronze propellers as the cathode of a huge electrolytic cell. An appreciable current flows between the electrodes, eventually destroying the anode—the steel hull, struts, and rudder assembly.

There are two long-standing ways of combatting this insidious form of corrosion. One is paint to insulate the steel from the water. But a dielectric paint that will stand up under the friction and cavitating wear of sea water is hard to find. The current usually leaks through somewhere, and the paint flakes off with the corroded metal. The second way is to fit the hull with "sacrificial anodes"—zinc plates which are supposed to corrode instead of the ship. Though theoretically these should work, they haven't been very successful, partially because there has been insufficient electrical contact with the hull and partially because oxidation deposits have insulated the anodes from the water. Newer methods, postdating World War II, have included the use of other materials for galvanic anodes—magnesium, a zinc of greatly improved quality, or aluminum—and the employment of impressed-current anodes. The latter are plates or rods charged with a voltage that is regulated to counterbalance the electrical field set up by the bronze-cathodes. This requires more or less constantly measuring the electrical potential of the hull and regulating the current to the anodes accordingly.

As was reported earlier, the Bureau of Ships, with technical assistance from NRL, tried out the various cathodic-protection systems on 26 Reserve Fleet ships laid up in various ports on the Gulf, Atlantic and Pacific coasts. The impressed-current method proved to be outstandingly successful. By giving the ships positive protection, it keeps the hulls ready for sea and greatly lengthens the period between dockings—thereby saving the Government millions of dollars a year. It has since been applied to over 200 mothballed ships and others are being fitted as fast as they come due for periodic haul-out.

By coincidence, that same May of 1952 a 2200-ton destroyer, the USS SUMNER, put into Boston Naval Shipyard for refit. Her bottom plating, especially near the propellers and rudder, was so pitted and corroded that whole sections had to be replaced. The zinc sacrificial anodes had disintegrated entirely. BuShips asked NRL engineers to go to Boston and fit the SUMNER with an impressed-current system. The installation was completed in September. In December '53, after 15 months of operational service with her squadron, the DD was again docked, this time at Norfolk. The anodes had largely disintegrated and some of the bottom paint had worn away, but where metal showed through it was as bright and unpitted as if it had just come from the rolling mill. As far as SUMNER's hull was concerned, all it needed was a few slaps with a paint brush.

---

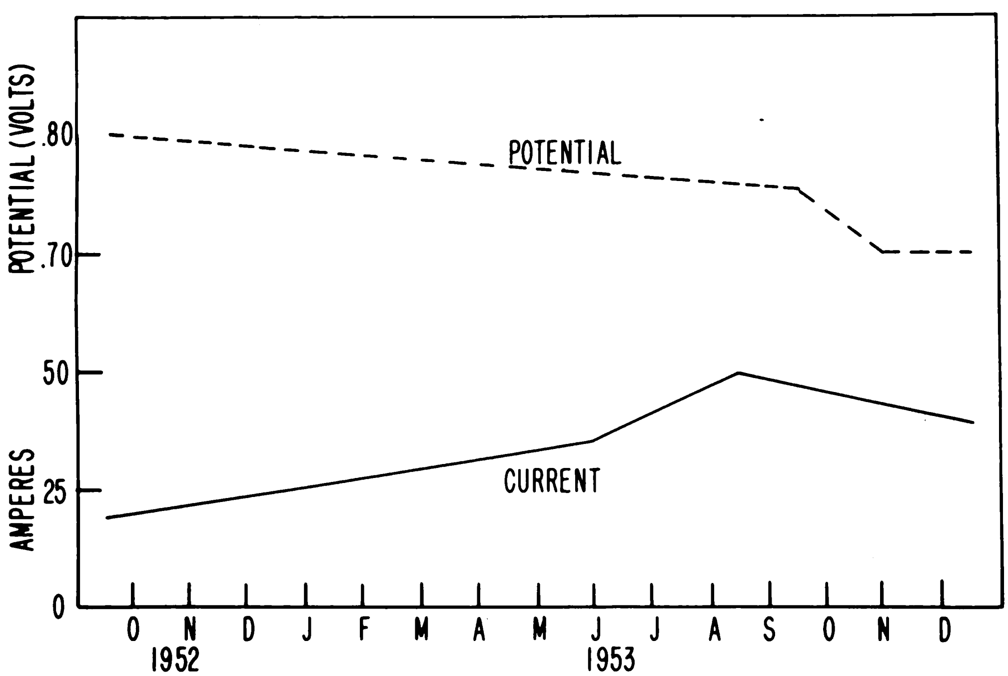
*A digest of several memorandum reports prepared by the Metallurgy Division, Naval Research Laboratory.

The protection system consisted principally of eight (later sixteen) steel-reinforced magnesium blocks, 16 inches long by 8 inches wide, fixed to the upper side of the bilge keels near their after end. The blocks and hold-down bolts were insulated from the hull by rubber gaskets. They were connected together electrically by a steel bus, and thence to the control unit by cables led through the hull. The control consisted of an ammeter for measuring and an adjustable rheostat for controlling the current. A supplementary impressed-current system, a single graphite anode 3 inches in diameter and 5 feet long, was installed right above the propellers. It was attached by insulated brackets, and the current was supplied by a rectifier.

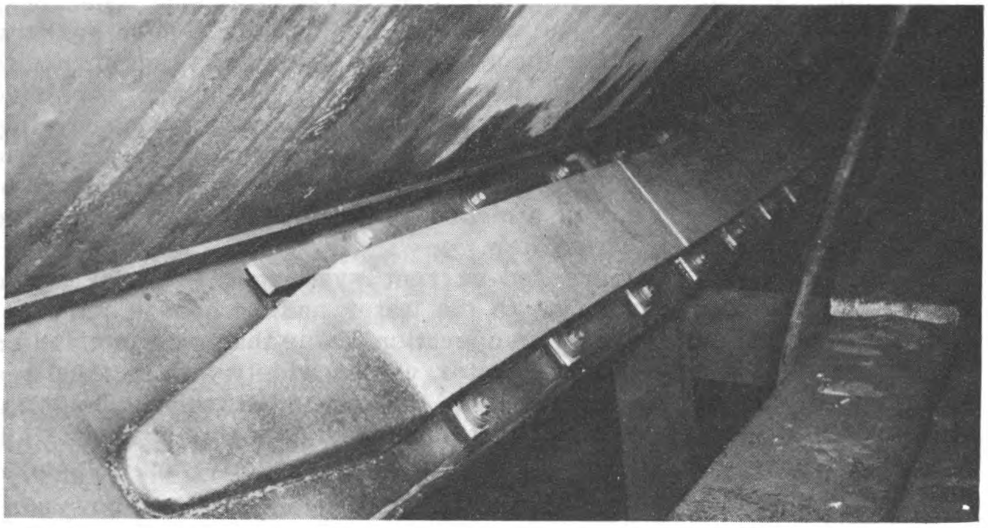
The trick in any impressed-current system is to maintain the proper hull potential in relation to the water and the bronze cathodes. This is much more difficult on an operational ship than on a mothballed one, because the conductivity of water varies widely with location and salinity, and because there is a marked difference between the potential measured in a moving ship and that measured in a ship at rest. This means that hull-potentials must be checked frequently, and the anode current controlled accordingly.

On the SUMNER this monitoring was done by silver-silver chloride reference electrodes attached to the hull at widely separated locations, connected through a common selector switch to a potentiometer-voltmeter. The switch and meter were located in the crew's mess where they could be easily read and daily recordings made.

During the 15-month observational period the recorded hull-potential averaged between .70 and .80 volts—somewhat lower than the .85 volts originally envisioned for control. The current delivered to the anodes to effect protection averaged about 20 amperes, increasing



General relationship between potential, current and time under all conditions of operation; USS SUMNER, 15 Sept. 1952 to 15 Dec. 1953



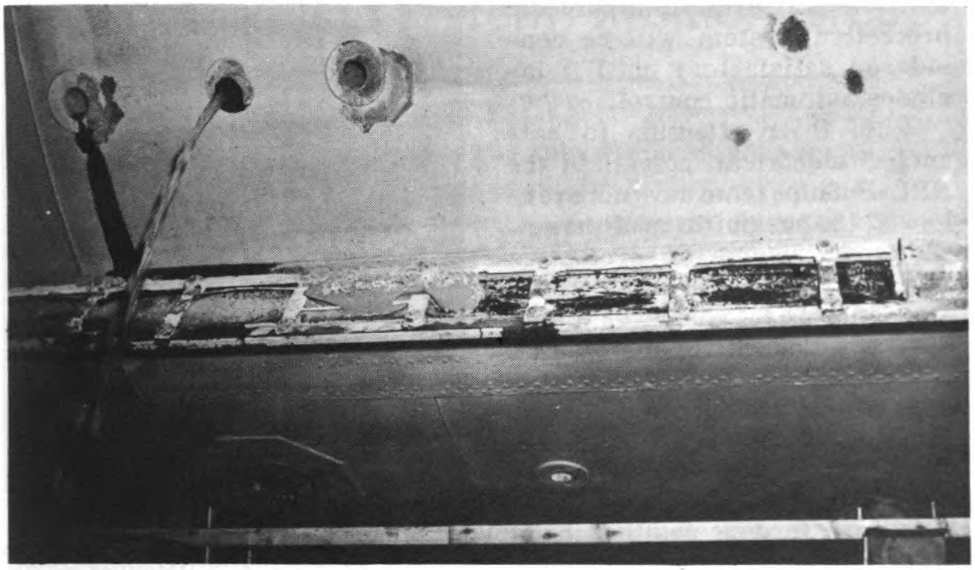
Magnesium anodes and fairwater on bilge keel, USS INGRAHAM

somewhat toward the end of the period—presumably because current flowed to bare-metal areas exposed by paint wear. A very interesting fact was noted from the plotted data: approximately twice as much current was required to maintain a given potential when the ship was moving as when it was stationary; but, apparently, varying rates of speed made little difference once the ship was underway.

Concurrently with the SUMNER tests, a similar cathodic-protection system was tried out on a sister ship, the USS INGRAHAM. The anodes installed on INGRAHAM's bilge keels were considerably larger and 20 instead of 16 were used. Other variations: The experimental anodes (two of them) installed over the propellers were small copper bars coated with platinum, the ship had several patches deliberately left bare of paint on her underhull, and for a few weeks she had a reference electrode trailing astern from a 150-foot cable.

The INGRAHAM's time between dockings was only 12 months, from January to December, 1953, but her goings and comings included two extensive cruises at sea. At the close of the test, inspection—in which particular attention was paid to the bared spots—indicated that the protection afforded was 95 to 100 percent effective. The magnesium anodes were from 70 to 100 percent deteriorated, however, indicating that their life expectancy was considerably less than the two years hoped for. A calculation of the weight lost by the anodes, balanced against the 23.4 amp-years of current delivered, indicated that only about 20 percent of the current was being used in actual protection—maybe even less. The other 80 percent represents wasted current due to short-circuiting.

By "short-circuit," here, is meant that the protective current literally takes the shortest route from the anode through the water to the steel hull. On an operational ship (as opposed to a mothballed one) the anode must perforce be only a few inches from the bottom plating. Let us suppose the anode is given an impressed current of 10 amperes. A small area of the plating nearest the anode may receive 8 of those amperes while the large surrounding area has to share the remaining 2 amps. A few spots, immediately around the anodes, get too much



Anode corrosion after 12 months, USS INGRAHAM

protection and the rest of the ship not enough. Or, as happened on the SUMNER and INGRAHAM, the anodes were wasted away before their time.

What can be done about it? One stab at an answer is to shield the ship under the anodes with a large patch of some dielectric material. For instance, 8 by 12 foot sheets of neoprene rubber have been cemented to the hull of the submarine AMBERJACK under platinum anodes. Theoretically the insulation will diffuse the current so that surrounding areas will get a larger share of the amperage. The chief drawbacks are that neoprene rubber is very expensive and difficult to apply to an underwater hull. So far it has stayed put on a relatively slow-moving submarine but might not on a high-speed destroyer.

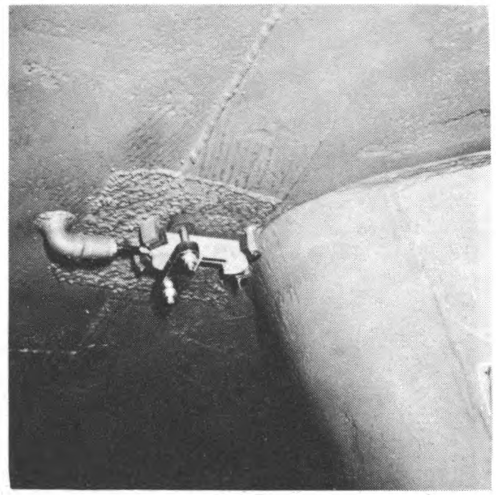
Another approach from the same direction is to use large steel plates as shielding. These are attached to the hull by insulated bolts, and are connected to the hull electrically through resistors. Thus the amount of current flowing from the plate directly to the hull can be regulated to say 100 milliamperes per square foot, and the rest of the current is dissipated away from the spot directly beneath the anode.* This is one of a number of experiments being tried out by NRL scientists on the 125-ft Coast Guard Cutter CUYAHOGA, which operates out of Curtis Bay, Maryland.

All in all, a dozen or more operational ships are now equipped with some type of experimental cathodic protection. Some have graphite anodes, others zinc, magnesium, or aluminum. Also being tried out are different methods of current control. In regard to the latter, both electronic and mechanical schemes have been tested. In general they haven't worked as satisfactorily as manual control, but NRL's corrosion engineers now have high hopes for a system that incorporates magnetic

*Trailing anodes, attached to a cable to be streamed astern of the ship, have been suggested. In this regard it is interesting to note that a patent for trailing anodes was granted to Thomas Edison in 1898.

amplifiers. Certainly no cathodic protection system will be considered satisfactory until it includes automatic control.

In their attention to balancing electrical potentials the NRL-BuShips team have not overlooked the possibilities of the new and vastly superior protective coatings that have been developed since the war. Whenever a ship has been docked for installation of anodes its underbody has also been painted with one of the vinyl or similar synthetic paints. There is no doubt of their efficiency; probably they are too efficient. Affording positive insulation and protection for 99 percent of the hull, spots that are scratched or marred form points of concentration for galvanic corrosion.



Platinum anode installed at root of port rudder, USS INGRAHAM

Fortunately, good paint and good cathodic protection supplement each other, and the corrosion men feel they are on the right track for the latter. It is now a question of further experimentation until the most efficient system is found.

The SUMNER and the INGRAHAM will be docked again at Philadelphia this January after 28 and 25 months respectively of service with magnesium anodes. If their bottoms are as clean as the corrosion men hope and honestly expect, it will be the best evidence to date that cathodic protection is as practical for operational ships as it has been in the Reserve Fleet.

Even the most expensive cathodic-protection system costs only a few thousand dollars to install, and upkeep is negligible. In contrast, it costs from $75,000 to $100,000 to dock an unprotected destroyer and repair the corrosion damage. If the time between dockings for all the ships in the active fleet can be extended from two to four years, and if at the end of that time the parts below the waterline need only a coat of paint, the savings will be enormous.

Arctic Research Lab Has a New Landlord

From 1948 to 1953 the Arctic Research Laboratory, ONR's facility in Alaska, was an adjunct of the naval station set up at Pt. Barrow to exploit the oil resources of Petroleum Reserve No. 4. With the closing of Pet 4 in September 1953 the laboratory established its own homekeeping facilities and operated as the major military activity in this Arctic setting. Recently the station was transferred to the Air Force which will now have a sizable operation in Arctic Alaska. ARL will, however, continue and the Air Force will provide the logistical support in much the same way as Pet 4 formerly did.

The Geography Branch of ONR will shortly have available a brochure describing the Laboratory, its facilities, the type of work that can be done there, and how it may be used by scientific organizations interested in establishing projects there.

Communication Patterns in Small Groups

Marvin E. Shaw

Department of Psychology, The Johns Hopkins University

The military services have long been concerned with the relationship between morale, leadership, and group efficiency; the assumption has been made that higher morale means higher efficiency and that a "good leader" can produce both. But the terms must be carefully used since under different definitions of these three variables, the relations between them may change. Morale and efficiency may, for example, be unequally affected by the same leadership. Group-research attempts to break down these blanket words and analyze relationships between the variables more precisely than has been done heretofore.

For most purposes, a number of individuals working together can be considered a group only if they must interact with one another in order to accomplish a specific task. The efficiency of a group and the satisfaction of its members are largely dependent upon the free-flow of information among them. Therefore, those factors which influence the pattern of intra-group communication should also influence group performance and morale.

One method of studying communication in groups is to observe units or teams as they actually function in the work situation. This technique must consider such factors as the quality of interpersonal relations, the amount of communication required, types of communication favored by the group leader, situational stresses, etc. To understand the effects of these variables, it is necessary to select and study carefully many types of naturally occurring groups. Much effort can be saved, therefore, by a preliminary laboratory study of various types of groups in which the communication situation is simplified and systematically varied to magnify influences otherwise too complex to analyze. The present research starts with one of the simplest possible communication situations. Ideas developed in these laboratory groups should later be adapted to field conditions.

To utilize very simple communication situations, small problem-solving groups are used and various communication patterns are created. The basic conditions common to all situations here reported are:

(a) Every individual in the group must be able to communicate, either directly or through another, with every other individual in the group;

(b) if A can communicate directly with B, then B can communicate directly with A; i.e., all communication channels are two-way channels;

(c) two patterns are the same if they can be rearranged to correspond to one another; i.e., to have the same shape.

With these limitations in mind, it is evident that for any given number of individuals the number of possible arrangements of communication channels is limited. For three-person groups only two communication patterns are possible; for four-person groups only six, for five-person groups twenty-one, and so on. The possible patterns for three- and four-person groups are shown in Figure 1. In this diagram, the filled-in circles represent individuals and the lines represent two-way communication channels. The patterns are labeled "wheel," "circle," etc. for convenience in making reference to them.

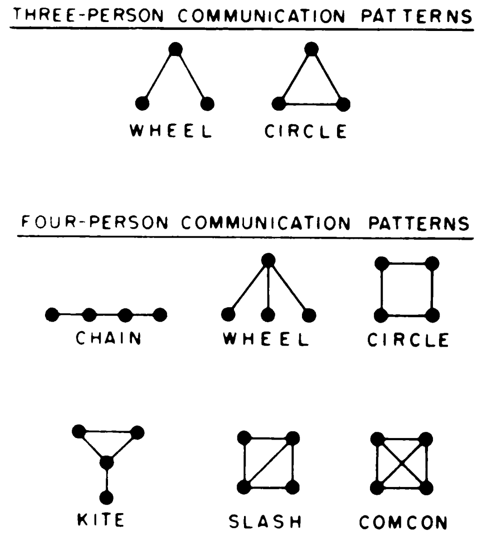


Figure 1 - Possible arrangements of small groups. The connecting lines represent two-way communication channels.

The equipment for research of this type consists of cubicles separated by partitions and connected to each other by slots through which written messages can be passed. These slots can be closed to establish any desired arrangement of channels. Groups of subjects are then placed in these cubicles and required to solve problems. The information needed to reach a solution is distributed among the subjects so that they can solve the problems only by writing messages to each other and passing them through the slots (Figure 2). Information must be passed from member to member until at least one person arrives at a solution and communicates it to the rest. A leader may be designated by the experimenter. In all of the investigations here reported, groups were limited to one problem-solving session of about an hour. The subjects were male college students of about equal intelligence, and strangers to each other.

An earlier investigation which involved the solution of extremely simple problems (the identification of a symbol held in common by all group members) revealed some differences between communication patterns with respect to group performance and satisfaction. A pattern that places one person in a central position (such as the wheel pattern in Figure 1) was found to be more efficient but less satisfying to group members than one that places them in equal positions (such as the circle in Figure 1). This result differs from "common-sense" expectations, since it is commonly believed that task satisfaction and efficiency are positively correlated. In the long run, this might prove to be the case here.

Using more complex problems (arithmetic problems requiring addition and multiplication), this writer found the wheel pattern both less efficient and less satisfying than the circle pattern which suggested that problem complexity was important in group performance.

Since the two experiments reported were performed by different experimenters and hence not entirely comparable, a further study was made to compare the effects of the wheel and circle communication patterns on tasks of varying complexity. Groups of three men each were studied. The simple problems required identification of a common symbol; the complex ones were arithmetic problems like those described above.

The outcome of this investigation supported the previous findings: For the wheel pattern more time was required to solve complex problems but less time to solve simple problems than for the circle pattern. For both simple and complex problems, participants expressed more satisfaction with the circle than with the wheel arrangement. Thus restrictiveness of a communication pattern was not found to be invariably a drawback. At least for a short period of time, it aided the solution of simple problems despite the fact that participants preferred the greater freedom of a more loosely constructed pattern. For complex problems, however, the less restrictive pattern supplied greater flexibility and efficiency as well as higher satisfaction.

The results of investigations of the sort described led to the formulation of two general concepts of group interaction: independence and saturation. The concept of independence refers to the degree of freedom with which an individual may operate in the group, the extent to which he is unrestricted by such things as the communication pattern or the actions of other group members. For example, an individual who can communicate directly with only one other is restricted more than the individual who can communicate with two or more others.

The concept of saturation refers to the condition in which the input and output communication requirements imposed upon a group member become so great as to interfere with the smooth operation of the group. In other words, for a given situation there is a saturation point at which an individual in a certain communication position is required to receive and/or send more messages than he can handle efficiently. His position

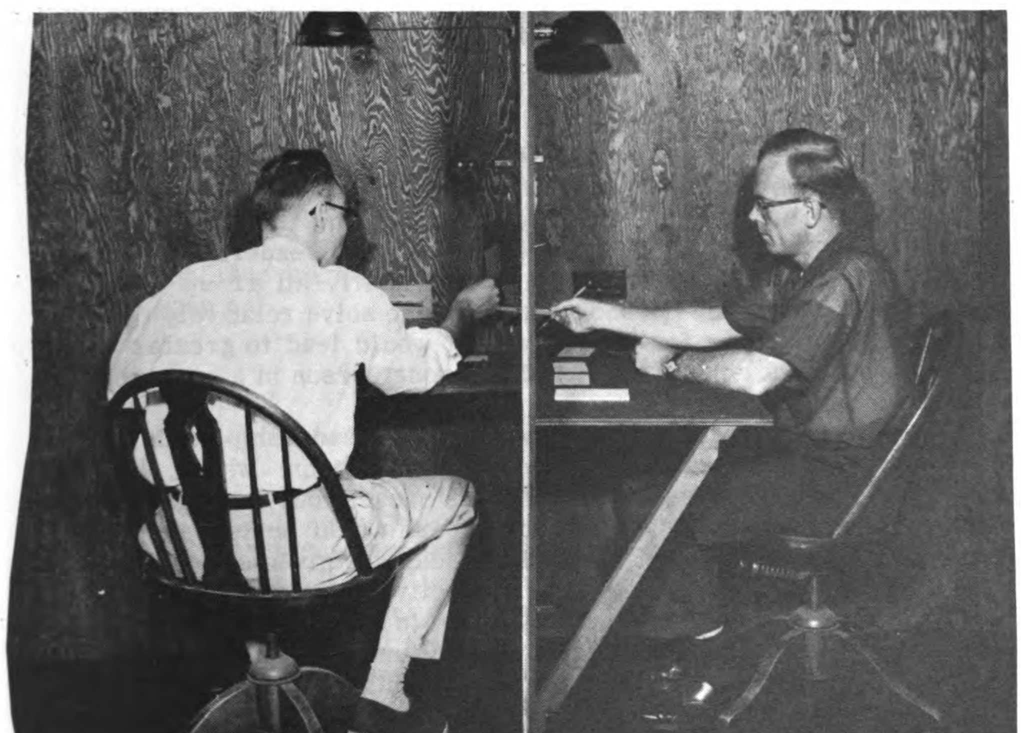


Figure 2 - These two members of a four-person group are communicating with other group members by passing written messages through slots in the walls separating the cubicles. The units of information needed to solve the problem upon which they are working have been distributed among members of the group.

is said to be saturated and, of course, the communication net is also saturated. Saturation and independence interact in that too high independence may produce saturation.

Many aspects of the group situation might be expected to have an effect upon independence and saturation, such as the number of problems which must be solved simultaneously, the kind of leadership operating in the group, the past experiences of group members, the behavior of persons in central positions, and so on. It was decided that a study of the effects of different types of leadership in various communication patterns would give some indication of how useful our concepts are for the understanding of group behavior.

The types of leadership chosen for study were: (1) Directive leadership in which the leader gives orders rather than suggestions, makes decisions without consulting other group members, and arranges the situation in accordance with his own desires and views; (2) nondirective leadership in which the leader gives suggestions rather than orders, makes decisions with the help of other group members, and develops the situation in accordance with the views and desires of the group as a whole.

Directive leadership should increase the independence of the leader himself but decrease that of the followers. Nondirective leadership should increase independence for all group members, since it permits each group member to have a part in deciding the method of operation.

Saturation should be less likely under directive leadership, since the leader may be expected to demand a minimum of participation on the part of followers and can control the communication demands upon his own position. Nondirective leadership should increase the possibility of saturation effects, since agreement in a "democratic" manner will necessarily involve more communication demands upon all group members, including the leader.

With these expected effects in mind, it was predicted that: (a) Directive leadership should result in better group performance and lower job satisfaction than nondirective leadership in the same communication pattern, and (b) regardless of type of leadership, communication patterns allowing participation by nearly all group members would require less time but more messages to solve relatively complex problems, would cause fewer errors, and would lead to greater satisfaction with the job, than patterns placing one person in a central communication position.

To test these expectations, two types of leadership as described above and three communication patterns (four-person: wheel, kite, and comcon) were investigated. The members of each four-man group were informed that a certain specified individual would be leader and they should follow his directions. This individual was given secret instructions to behave in a directive or nondirective manner. In the case of the wheel and kite, the leader was assigned to the most central position in the pattern. After the problem solving, followers or directive leaders rated their leaders significantly more authoritarian than did followers of nondirective leaders, thus indicating that the assigned roles were played satisfactorily. At the conclusion of the experiment the members were all informed of the contrived nature of the leadership, since the directive role ran counter to their social norms.

These experimental groups were required to solve four arithmetic problems involving simple addition, division, and multiplication. Directive leadership resulted in shorter time scores, fewer errors, fewer messages, and less satisfaction with the job than did nondirective leadership. On all measures except errors, the differences produced by the communication patterns were as expected; that is, the comcon tended to be most efficient; the wheel least.

An interesting finding was that the most messages were sent in groups completing the tasks in the least time. It has been suggested that perhaps more messages are required to save time. However, this relationship is not found between authority conditions, i.e., directive-led groups required fewer messages and also less time than did non-directive groups. Hence, more messages do not necessarily save time. It is probably safe to say that more simultaneous, goal-directed messages save time, while more random, non-goal-directed messages waste time. According to this view, directive leadership increases the relative number of goal-directed messages. In terms of independence and saturation, this means that directive leadership limits the kinds of messages which may be sent (thus decreasing the independence of the followers), and the reduction in number of messages automatically decreases the susceptibility to saturation.

These simple experiments indicate the complexity of the problems involved in morale, efficiency, and leadership. It is apparent that no sweeping statements can be made about the relationship between the three variables. Job satisfaction and efficiency may under certain conditions be negatively related. Leadership or communication patterns which restrict individual freedom are not necessarily less efficient. What stands out in the results is that the requirements of the situation and of the leader in themselves generate certain patterns of group function leading to the achievement of the goal. These patterns of functions are characterized by different degrees of job efficiency and satisfaction. One line of future research would therefore be to find out the kinds of communication patterns and leadership styles which are appropriate to the solution of various types of problems. Another important extension of this type of research would be to apply it to groups meeting several times. It is possible that, due to the lower satisfaction generated, the more restrictive leadership loses efficiency as time goes on.

Writing School for Engineers

A 15-session course in writing and editing technical reports was recently completed at the U. S. Naval Engineering Experiment Station, Annapolis, Md. Supervisors and upper-grade engineers from USNEES's laboratories attended. The aim of the course was to show how writing is produced effectively and efficiently; it was conducted by a well-known Washington science and industry writer.

Results of an anonymous poll of the students who completed the course showed its worth. All agreed that they learned how to write better reports. Writing techniques improved. Students learned what to look for in writing and in what order. They came to realize that when an engineer or scientist starts to write a report he becomes a writer and must use professional writing techniques to obtain good results.

Naval Air Development Unit and WV-2

During World War II, one of the largest eastern bases for the lighter-than-air craft that patrolled our ship convoys was the Naval Air Station at South Weymouth, Massachusetts. This base was subsequently deactivated, but in September, 1953, it was recommissioned as the Naval Air Development Unit (NADU) under the management of BuAer and the technical direction of the Chief of Naval Research.

The mission of NADU is the operation and servicing of various aircraft in support of Naval research and development activities. Its current responsibilities include that of providing aircraft services to Project LINCOLN and assisting that project in the development and testing of detection, tracking, and interception systems. How well this mission is being accomplished can be seen in warm letters from Lincoln Laboratory scientists attesting the high degree of cooperation and support received from NADU.

In pursuance of its important mission, NADU maintains a complement of aircraft of diverse types, including jets, long-range reconnaissance planes, and two of the Navy's new ZPG-2's. The most recent addition, however, is a well-known airplane with a new and very special purpose: airborne early warning radar.

One of the fundamental characteristics of electromagnetic waves in the upper frequency bands (including the radar bands) is their inability to bend around obstacles—and the earth's curved surface is an inescapable obstacle. This single problem has perhaps resulted in the expenditure of more nervous energy in high circles than any other of late. Its significance is immediately apparent: in an age of near-sonic and supersonic speeds, an enemy plane is upon you almost as soon as you have detected its approach. If the approaching vehicle is a 4000-mph rocket or guided missile, the best warning by surface radar may be a scant few minutes.

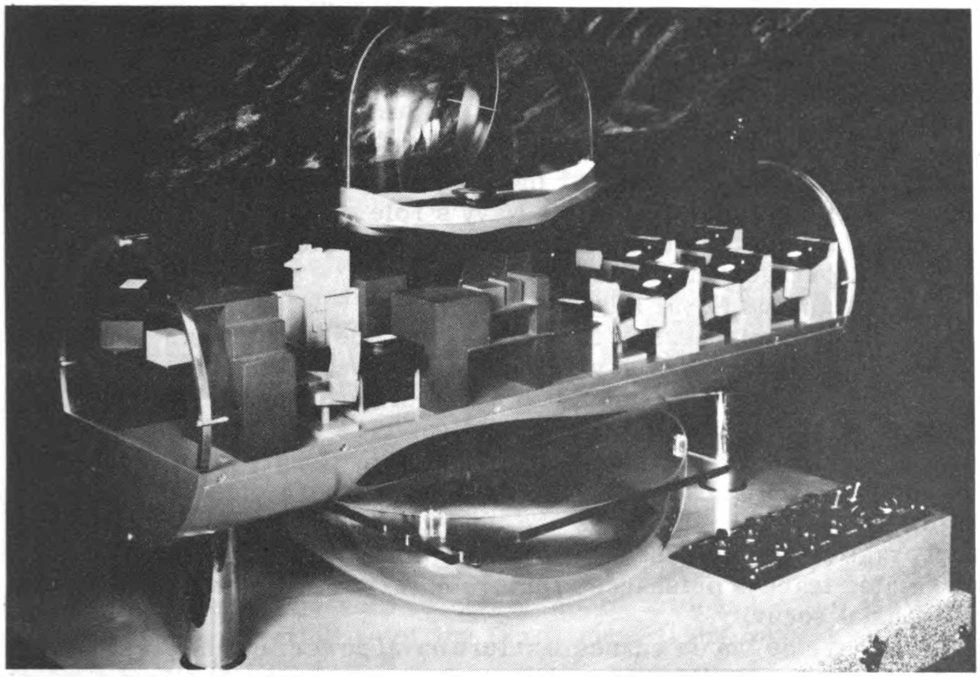
But, formidable as it is, the problem is not wholly without solution. The welcome recent acquisition of NADU mentioned above is the WV-2, a Lockheed Super Constellation with bulging "radomes" (wave-translucent domes enclosing radar antennas) in its top and belly, and special wingtip tanks for extra fuel. This giant high-flying radar eye carries 6 tons of electronic equipment—more than any other aircraft—and cruises at speeds exceeding 300 mph. With the extended range made possible by its tip tanks, it can sweep a wide protective circle around the unit it serves. Operating with the fleet from a land base, the far-seeing giant with its 31-man crew can pinpoint approaching enemy craft long before they enter the horizon-limited detection ranges of surface radars.

If operating efficiency during protracted flights is to be maintained at a high level, careful consideration must be given to personnel comfort. Accordingly, many features of the commercial Constellation have been retained and adapted for this purpose. Inside the soundproof cabin, pressure control maintains 10,600-foot conditions at altitudes up to 25,000 feet, and the temperature can be kept near 75° F despite a frigid -60° outside. Bunks are provided that may easily be converted into couches, and all seats are scientifically designed to reduce fatigue. The galley, complete with refrigerator, grills, and running water is the last word in convenience for a military aircraft.

These planes are now rolling off Lockheed's production lines at Burbank, California. The Air Force is using them too, under the designation RC-121C, nicknamed "Pregnant Goose."

The early-warning radar carried by the planes was originally developed during World War II as project CADILLAC by the National Defense Research Council's Radiation Laboratory at MIT. The project was continued after the war by ONR-NRL. The instrumentation for WV-2 was done by the Philco and General Electric Corporations under contract with BuAer.

Although WV-2's are in operation, the NADU is engaged in continuing research for further improvement of early-warning radar.



Display model of "Big Dipper's" C.I.C. compartment showing radomes above and below. (General Electric Co. photo)

Editor's Note: News has just reached us that a WV-2 crashed at NAS, Johnsville, Pennsylvania, on 9 December after a low-visibility landing approach. Although the ensuing fire destroyed the plane, all 20 airmen aboard escaped with only minor injuries.

Split Second Hearing

A dog's ears can distinguish time intervals of .0000045 second. If the Greenwich chronometer lost this much time per hour, it would lose only 1 second in 25 years! Under the right conditions, a man's ears can do very nearly as well. (From ONR conference on "Orientation In Animals")

ONR & the Navy's Public Information Policy

Research Reviews has not been a medium for the promulgation of Navy Regulations or directives, nor do we propose to change this editorial policy now. We do, however, want to call our readers' attention to SECNAV INSTRUCTION 5720.10, because we think it will be of interest to them.

This instruction set forth the public information objectives of the Navy. It points out that only with the support of the American people can the Navy perform its functions effectively. To maintain that essential support, it continues, the Navy is obligated to inform the public and the naval service concerning:

"The Navy as an instrument of national policy and security,

The activities of the Navy, as compatible with military security, and

The responsibilities and participation of naval personnel as United States citizens under the American concept of government and society."

In view of this, then, the Navy's public information objectives are:

"Public understanding of the continuing importance of seapower.

Public appreciation of the Navy's role today.

Public appreciation of the Navy's future role.

Encouragement for career service.

A vigorous Naval Reserve.

Public awareness of the need for a modernized fleet.

Public awareness of growing Soviet naval strength."

It is, of course, a truism that we must have research and development if we are to have a modernized fleet. The importance of this need was recognized by the members of the 79th Congress in 1946, in the passage of Public Law 588. The primary purpose of establishing the Office of Naval Research, as the act states, was "to plan, foster, and encourage scientific research in recognition of its paramount importance as related to the maintenance of future naval power, and the preservation of national security."

Today, the "maintenance of future naval power, and the preservation of national security" is made imperative by the growing Soviet naval strength. The following information, digested from public addresses and statements by the Chief of Naval Operations in recent weeks, gives sobering statistics on this strength.

Submarines – Russia has about 350, 35 to 40 percent of which are long-range types capable of attacking merchant shipping or mine laying. This is more than double that of U. S. strength and is currently the world's most powerful submarine fleet. It represents more than seven times the number of German U-boats at start of WW II, quantitatively speaking at least.

Cruisers – Thirteen large light cruisers have been built since WW II; these are equipped, first-class ships comparable to opposite numbers in Western navies. This is more than the U. S. has in active operation. They are suitable for long-range raiding cruisers in the Atlantic or Pacific. The building program is larger than all of the NATO nations combined.

Destroyers – Russia has 125 compared to 175 for U. S., however, Russia has built more than 50 large fleet DDs since

WW II, including well armed destroyer leaders. New DDs are big, fast and capable of long-range operations. Again, the building program is larger than that of combined Western navies.

Carriers — None so far known but Russia has seven or eight shipyards capable of building largest type carriers or battleships. Land-based naval air arm numbers some 3500 planes including jet fighters and jet light bombers—almost as many as Germany had all told at start of WW II.

Manpower — Excluding marines, Russia is ahead.

Location of Major Units and Access to Open Sea — Four main fleets—Northern Fleet, Baltic Fleet (largest), Black Sea Fleet and Pacific Fleet. Canal and river system makes it possible to shift smaller naval units from Baltic to Black Sea. Northern ports have direct access to Barents Sea. Ice-free ports available on the Pacific with direct access to open sea.

Miscellaneous — Russia preparing an over-all program aimed at over, on, and under the sea units. In 10 years Russians will be ahead of U. S., numerically speaking. Most U. S. combat and merchant ships are of WW II vintage. Russians have extensive current merchant ship acquisition program. Ships currently being built in satellite countries and purchased or constructed in Western countries. This leaves Russia's yards free for combat ship construction. Russian Navy is numerically second in size in the World. (Compared to 7th only ten years ago). Historically, Russians first to employ contact mines in planned defensive system. (Crimea). . .First to use shell fire in ships against ships. (1854). . .First to carry out successful attack by Torpedo Flotilla (1877).

Research Reviews was established in 1948 in partial fulfillment of another requirement of the Office of Naval Research, that of providing "within the Department of the Navy a single office, which, by contract and otherwise, shall be able to obtain, coordinate, and make available to all bureaus and activities of the Department of the Navy, world-wide scientific information . . . ."

Specifically, Research Reviews is designed to report to the Navy at large the activities of naval research and its accomplishments. By so reporting we are in fact furthering the public information objectives of the Navy. Review of the over-all program reveals that every area covered by the public information objectives is one in which the Office of Naval Research is coordinating, sponsoring or conducting research.

The importance of sea power and the Navy's role now and for the future demand a continuing analysis of the elements, requirements and operations in the employment of naval power. Such analysis is a continuing part of the activity of ONR. The attractiveness of a naval career is a synthesis of individual personal elements and the social, vocational and mechanical aspects of the Navy. A better understanding of these can lead only to improvement. Also, the Office of Naval Research sponsors a vigorous Research Reserve Program. Through research, the fundamental knowledge necessary for a modernized Fleet is garnered from all the areas of science and brought to the service of the Navy. Out of this knowledge applied to the analysis of naval problems and the evolution of weapons and weapons systems, the power to counter growing Soviet naval strength will come.

In reporting to the Navy on the progress of research, first attention goes beyond the immediate concern of ONR and focuses on Navy-wide problems. The biggest of these is manpower—how to get naval officers and enlisted ratings and keep them in the service so that the planes, ships and shore installations will be adequately manned with competent personnel. On the research level this problem resolves into questions of leadership, motivation, morale, group behavior, personnel utilization, and training methods. Second only to manpower is the problem of economic efficiency—getting the most navy for the defense dollar. New materials which reduce our dependance on imports or critical materials; new methods which reduce manpower, machinery, or training-time and skill requirements; simplification of equipment and systems; methods or materials which offer promise of expanding functions or utilization without increased costs; new concepts of solutions to typical naval problem or functions, are pertinent here.

Research Reviews also discusses programs which are not generally understood by the Navy. For instance, human engineering in all its applications is directly related to the problems mentioned above, yet is frequently misunderstood or not sufficiently utilized. Nor does the Navy, as a whole, realize the part played by fundamental research in aviation. Pilot safety, physiology, equipment and training; materials, fuels, devices necessary to the solutions of problems involved in high speed, high-altitude flight; flight-deck, air-strip, aircraft-handling problems and their solutions, such as the high-intensity noise problem are the concern of ONR's science divisions. In general, it is the policy of Research Reviews to publish articles which will give its readers:

A greater appreciation of the role of science and research in the Navy.

A better understanding of how research contributes to a better Navy for the man who is in the Navy.

A desire to utilize the results of ONR research in his work, area of interest, or the Navy as a whole.

In this way, we hope to continue to serve the purpose of the SECNAV Instruction and to keep the public and the Service informed of what the Navy is doing, in cooperation with its contractors, through research and development to maintain future naval power and the preservation of national security.

Report on "Orientation in Animals"

In February 1953 ONR sponsored a two-day conference on orientation in animals, held in Washington, D. C. Sixteen papers were presented, some by such distinguished authorities as T. C. Schneirla of the American Museum of Natural History, A. D. Hasler of the University of Wisconsin, and Donald Griffin of Cornell. The subject matter ranged from the migrating instinct of birds to the schooling of fishes, the discussions centering around the question: "How?".

The conference has attracted so much interest that the Biology Branch decided to print a book-length report of the proceedings. This document—just published—is a verbatim presentation of the papers, discussions and summaries.

Research Notes

Research and Development

Contracts for One-Man Helicopter Let by Navy

Two helicopter manufacturers have been awarded contracts as a result of a Navy design competition for a rotorcycle (one-man portable helicopter). The Gyrodyne Company of America, Inc., St. James, Long Island, N. Y., and Hiller Helicopters, Palo Alto, California, submitted the selected designs. Research and Development contracts amounting to approximately $200,000 have been placed with each company. Each will complete flight articles within one year.

In 1950 the Office of Naval Research initiated a research program for a portable, strap-on, minimum-weight helicopter. A contract was made with Rotor-craft Corporation which resulted in the development of the RH-1 (Research Reviews, August 1954). At the same time work on rocket motors was sponsored with the Reaction Motors, Inc. and on rotors with the Prewitt Helicopter Co. Having demonstrated the feasibility of principles involved, the project was turned over to the Bureau of Aeronautics for development.

Invitations to bid in the competition for a rotorcycle-type helicopter for future use by the Marine Corps were sent to helicopter manufacturers a year ago. Marines will use this type helicopter for observation, liaison, escape and evasion, and small-unit tactical maneuvers. Both designs selected by the Navy are for a machine which can be collapsed into a small package for easy transportation, and quickly assembled. Eighteen manufacturers entered the competition and submitted over 30 separate designs for consideration by the Bureau of Aeronautics.

Propulsion for both rotorcycle designs is a Nelson, four-cylinder opposed, two-cycle air cooled gasoline engine manufactured by Barmotive Products, Inc., San Leandro, California. The Hiller rotorcycle is a single two-bladed rotor with a small tail rotor. The Gyrodyne design calls for a coaxial, contra-rotating two-bladed rotor arrangement with a fixed tail stabilizer.

Device for Drawing Arcs of Very Large Radius

Everyone knows how to draw an arc, or a circle, using a compass—an arc of relatively small radius, that is. But how would you go about drawing an arc of radius somewhere between 20 and 250 feet? That is a problem faced by people who use SHORAN. Navigation by SHORAN involves the drawing of large-radius arcs (called "iso-time arcs") with extreme precision, and this onerous business has proved a bottleneck on more than one occasion.

However, an easy means of drawing these arcs does exist. It was brought to the Navy's attention recently by LCDR N. H. Prade of the Bureau of Ordnance. Interestingly, it was originally developed by a Frenchman, M. Peaucellier, to draw a straight line, but by a simple modification it can be made to draw arcs of any desired radius.

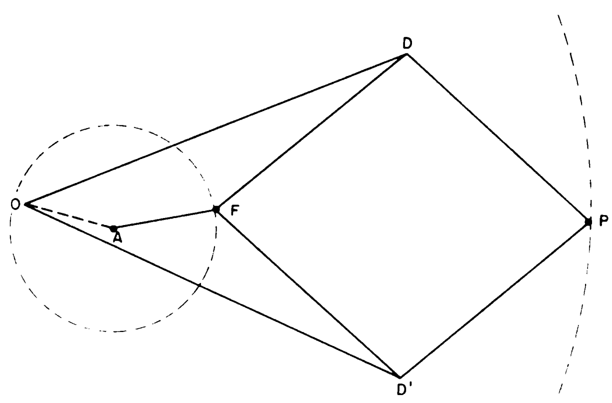
The device consists of four pivot-linked rods of equal length, $\overline{FD}$, $\overline{DP}$, $\overline{PD'}$, and $\overline{D'F}$, which form a rhombus, FDPD'. Two opposite vertices of the rhombus, viz. D and D', are linked by pivoted rods of equal length, $\overline{OD}$ and $\overline{OD'}$, to the fixed point O. A third vertex, F, is linked by a pivoted rod $\overline{AF}$ to the fixed point A which is distant $\overline{OA}$ from point O. Thus point F can describe a circle of fixed radius $\overline{AF}$ about A, and the entire machine can swing on the fixed pivot at O.

Let the direction $\overline{OA}$ be aligned along a radial of the desired arc. It can be shown by mathematical analysis that when F is turned in a circle about A, the point P describes an arc whose radius of curvature, ρ, is given by the expression

$$\rho = -\overline{AF}\,\frac{\overline{OD}^2 - \overline{DP}^2}{\overline{OA}^2 - \overline{AF}^2} = -\overline{AF}\,\frac{\dfrac{\overline{OD}^2 - \overline{DP}^2}{\overline{OA}^2}}{1 - \dfrac{\overline{AF}^2}{\overline{OA}^2}}$$

It is readily seen that the curve opens toward or away from the machine according as AF $\gtrless$ OA. If AF = OA, the curve is a straight line, i.e., the radius is infinite.

A prototype instrument of this kind can be seen at the Instrument Shop, Room B-802, Department of Commerce.



ONR-NRL Represented at Meeting of American Rocket Society

The Office of Naval Research and the Naval Research Laboratory were well represented at the Ninth Annual Convention of the American Rocket Society in New York City November 30--December 2.

Mr. A. G. Lundquist of ONR's Power Branch was vice-chairman of the Tuesday afternoon session. Chemical Components was the session subject. The Space Flight Symposium Thursday afternoon was chaired by Mr. Milton Rosen of NRL. The vice-chairman was also from NRL—Mr. Richard B. Snodgrass.

Among the speakers at the Space Flight Symposium was LCDR George W. Hoover, USN, of ONR's Air Branch, who discussed "Instrumentation for Space Vehicles." A recent contributor to Research

Reviews, Dr. S. Fred Singer told of Orbits and Lifetimes of Minimum Satellites. Two ONR contractors, Mr. N. S. Davis, Jr., and Mr. R. Bloom, presented a paper, "Newer Techniques in High Pressure H_2O_2 Transfer," at the Chemical Components Session."

An ONR contractor, Mr. A. M. O. Smith of Douglas Aircraft Company, received the Robert H. Goddard Memorial Award for his work on liquid rockets. Winner of the James H. Wyld Memorial Award, established this year, was Mr. Rosen of NRL. His work on the Viking research rocket brought this award to Mr. Rosen.

Institute of Mathematical Sciences Opened

The Institute of Mathematical Sciences at New York University was dedicated on 29 November in the auditorium of the University's Vanderbilt Hall in New York City. Dr. Niels Bohr, one of the leading atomic scientists in the world today, gave the principal address. His subject was, "Mathematics and Natural Philosophy." The occasion was, in a way, a milestone for the Office of Naval Research as well as for the Institute.

The Institute of Mathematical Sciences evolved from a small but closely knit group of mathematical scientists who in 1936 organized a team at the University to engage in basic mathematical research. During World War II this group made significant contributions to defense by solving intricate mathematical problems for the Army and Navy. At the same time the group, mindful of its original purpose, continued to engage in basic research.

Without outside assistance this group would have disintegrated after the second World War. Support provided by ONR after its organization in 1946 enabled the group to continue.

Today the Institute is working on many contracts for the Department of Defense—ample justification of ONR's backing through the years. The following projects are typical of current research in applied mathematics: numerical analysis with a view to the use of high-speed electronic computing machines (IMS has a UNIVAC); application of numerical analysis to problems of river control and flood prediction; fluid dynamics and gas dynamics, including shock propagation, transonic flow, air-foil theory, propulsion theory; statistical mechanics and kinetic theory of gases; wave propagation, including a continuing study of water waves and various extensive studies of electro-magnetic wave problems with special reference to scattering and reflection problems and problems of the ionosphere.

The Institute operates as both a graduate school and a research laboratory, thus combining training and research. For it, New York University has purchased a nine-story office building on Waverly Place in downtown New York City.

On the Naval Research Reserve

ONR Reserve Curriculum

A recurring thought at recent seminars, commanding officer conferences, and other Research Reserve gatherings has been that the Research Reserve program inherently requires of its participants a certain degree of common understanding of ONR, its branches, services, and functions.

Recently, impetus was given to the establishment of an actual training curriculum to provide a basis for this common understanding; Research Reserve Company 9-2 submitted to ONR a proposal for the preparation of such a curriculum as a company project.

It has been established that while a fixed curriculum is necessary to accomplish the desired end, such a curriculum must consume only a portion of the time scheduled for company drills, in order to encourage the originality of individual companies in establishing their training program. Present plans call for the preparation of 36-lesson outlines to be incorporated in the training schedule of each company over a period of three years.

It has further been established that the curriculum should include a fairly comprehensive coverage of ONR and its organization, as well as its relationship to other Research and Development agencies, the Navy, the other services and the Department of Defense. It should also include a general coverage of fleet operations, Naval administration, and the broad field of logistics.

Research Reserve Company 9-2's current project is directed toward a review of ONR, its organization, administration, and relationship to other agencies of the government. The end result of the project will be detailed lesson-outlines under each heading, complete with training aids and bibliography. ONR will acquire and furnish reference material whenever it is necessary and available, and will assist in providing training aids. It is anticipated that a minimum of twelve two-hour lessons will be developed in this particular field.

The general military part of the proposed curriculum will be broken down by the headings "Operations," "Administration," and "Logistics." There will be a minimum of eight lessons prepared under each heading. The breakdown of the lessons will be a company project, and the participation of companies in addition to 9-2 is desired.

As it did in the case of the lesson outline being prepared by Company 9-2, ONR will furnish initial guidance and assistance in locating and providing appropriate training aids. Companies interested in assisting in the preparation of this curriculum on a project bases are encouraged to indicate their field of interest to ONR - Code 120.

Sixth Annual Nuclear Sciences Seminar

The sixth annual ONR-sponsored Nuclear Sciences Seminar convened at Oak Ridge, Tennessee, on 28 November 1954, with fifty Naval Research Reserve Officers and forty officers from the Army Research and Development Reserve Corps in attendance. While its major emphasis was on nuclear reactors, the seminar was also designed to refresh the participants' knowledge of the fundamentals of nuclear science in general. Owing to the present rapid pace of research and development directed toward nuclear propulsion for ships and planes, the Navy is vitally interested in keeping its scientific personnel in intimate touch with the very latest achievements and activities in this field. The Oak Ridge Seminar fulfilled all expectations in this respect.

Among the highlights of the seminar were addresses by the following distinguished civilians: Dr. N. H. Woodruff, AEC Assistant Manager for Operations, Oak Ridge Operations Office; Dr. C. E. Larson, Director, Oak Ridge National Laboratory; Dr. W. G. Pollard, Executive Director, Oak Ridge Institute of Nuclear Studies; Dr. R. T. Overman, Chairman, Special Training Division, ORINS; and Dr. F. C. Moesel, Office of CNO.

Excellent talks were also given by various naval personnel, notably the following: CAPT L. D. Coates, USN, Deputy and Assistant Chief of Naval Research; CAPT T. Blanchard, USNR, Special Assistant to Chief of Naval Research; CAPT F. C. Wiesner, USNR, Head, Power Branch, ONR, and Commanding Officer of Research Battalion W-1; CAPT W. B. Moore, USN, Atomic Energy Division, Office of CNO; LT D. T. Leighton, Nuclear Power Division, BuShips, and CDR G. B. Cattermole, USN, Executive Officer, Development Division, Armed Forces Special Weapons Project.

Seminars During the Remainder of Fiscal 1955

Three ONR-sponsored seminars—on Special Devices, Nuclear Sciences, and Metallurgy, respectively—remain on the schedule for the present fiscal year.

The Special Devices Research Reserve Seminar will convene at Sands Point Special Devices Center, Fort Washington, New York on 17 April, 1955. It will be devoted to lectures, tours, and demonstrations covering the development and procurement of special devices. The course will be highlighted by the appearance of prominent military and civilian guest speakers and by field trips to selected military and commercial facilities in the Fort Washington Area.

This year the Nuclear Sciences Seminar at Brookhaven National Laboratory, formerly sponsored by the Third Naval District, will be sponsored by ONR. This seminar will convene on 29 May 1955. Qualifications for attendance have been established as follows:

> Satisfactory completion of Navy Correspondence Course "Nucleonics for the Navy," or evidence of employment in some phase of nuclear energy, including administration.

The Research Reserve Metallurgical Seminar will convene at Columbus, Ohio, on 13 June 1955. It will feature current developments in selected research activities pertaining to metallurgy.

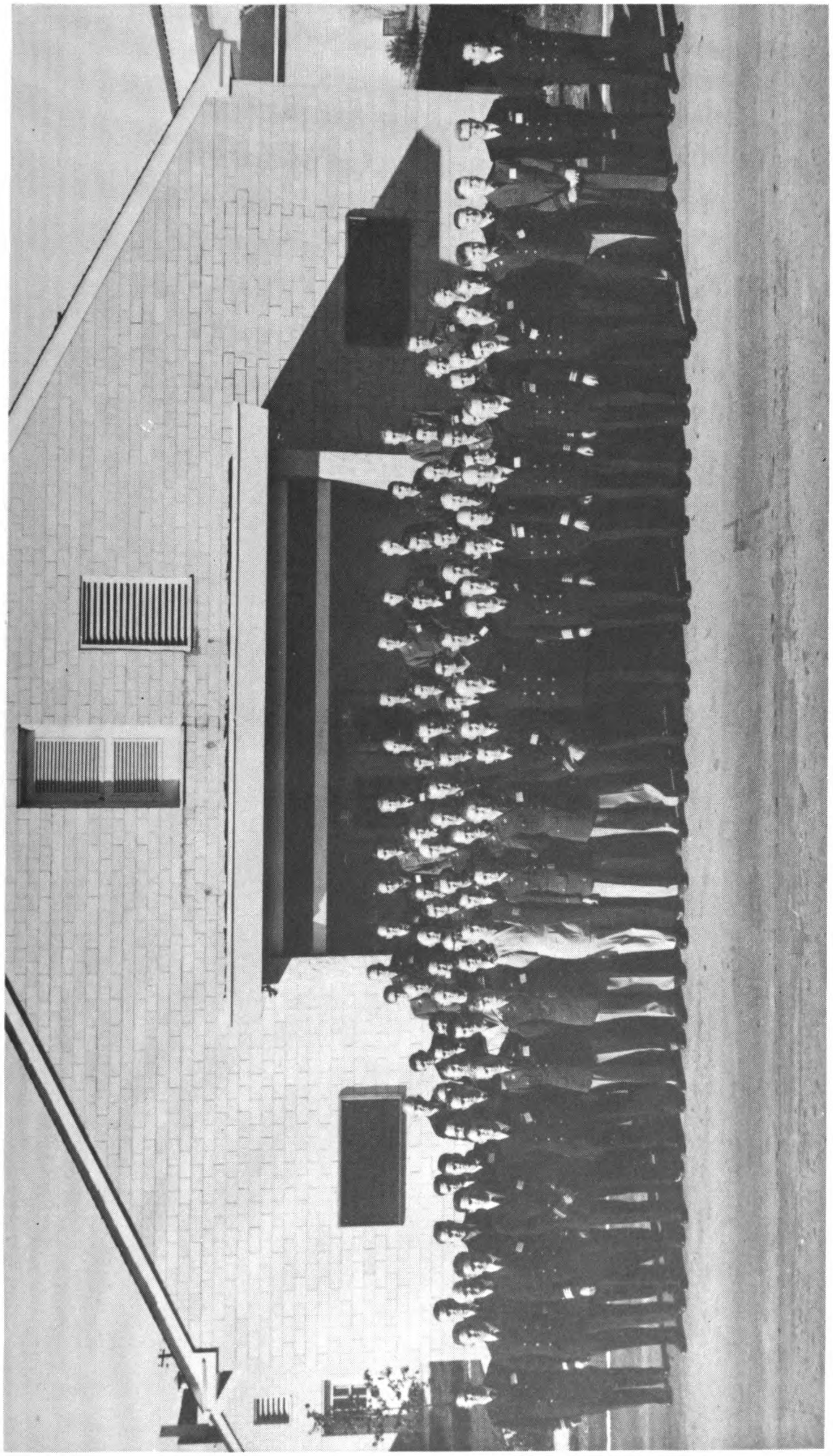
All of the above mentioned seminars will require secret clearance.

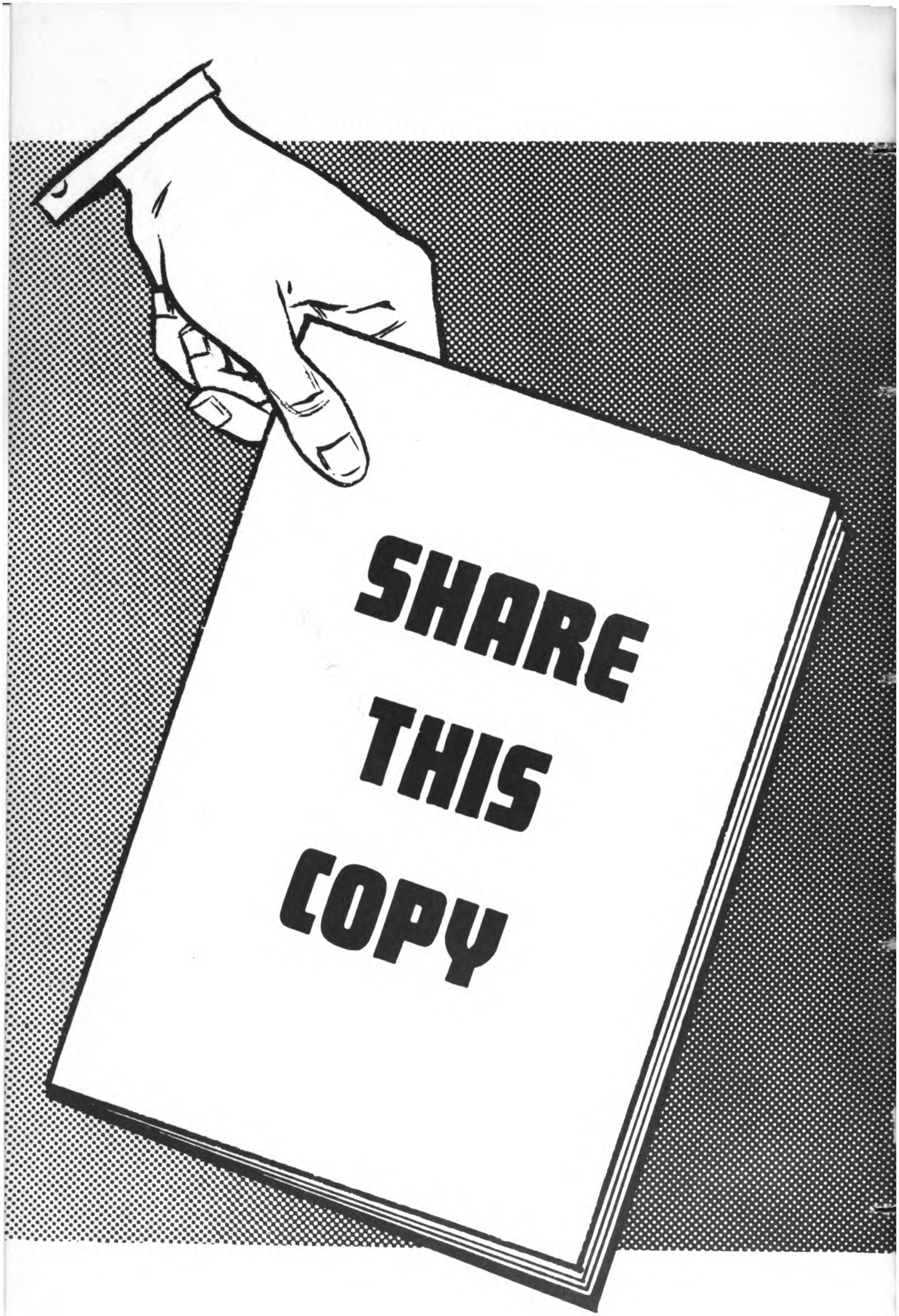
12-9 at NRDL

In our last issue we announced the organization of a new Research Reserve Company (12-9) at the Naval Radiological Defense Laboratory, San Francisco. Since then, we have received the above photograph of the initial meeting. Among the officers seated in the front row are (second from left) CAPT R. A. Hinners, Director of NRDL and Sponsor of the company, (third from left) CDR H. B. Joslin, Reserve Program Officer, and (second from right) CDR W. B. Plum, Commanding Officer.

Reservists attending 6th Annual Seminar grouped in front of Oak Ridge Institute of Nuclear Studies. ➝

U. S. GOVERNMENT PRINTING OFFICE : 1955 O - 326685




SHARE
THIS
COPY