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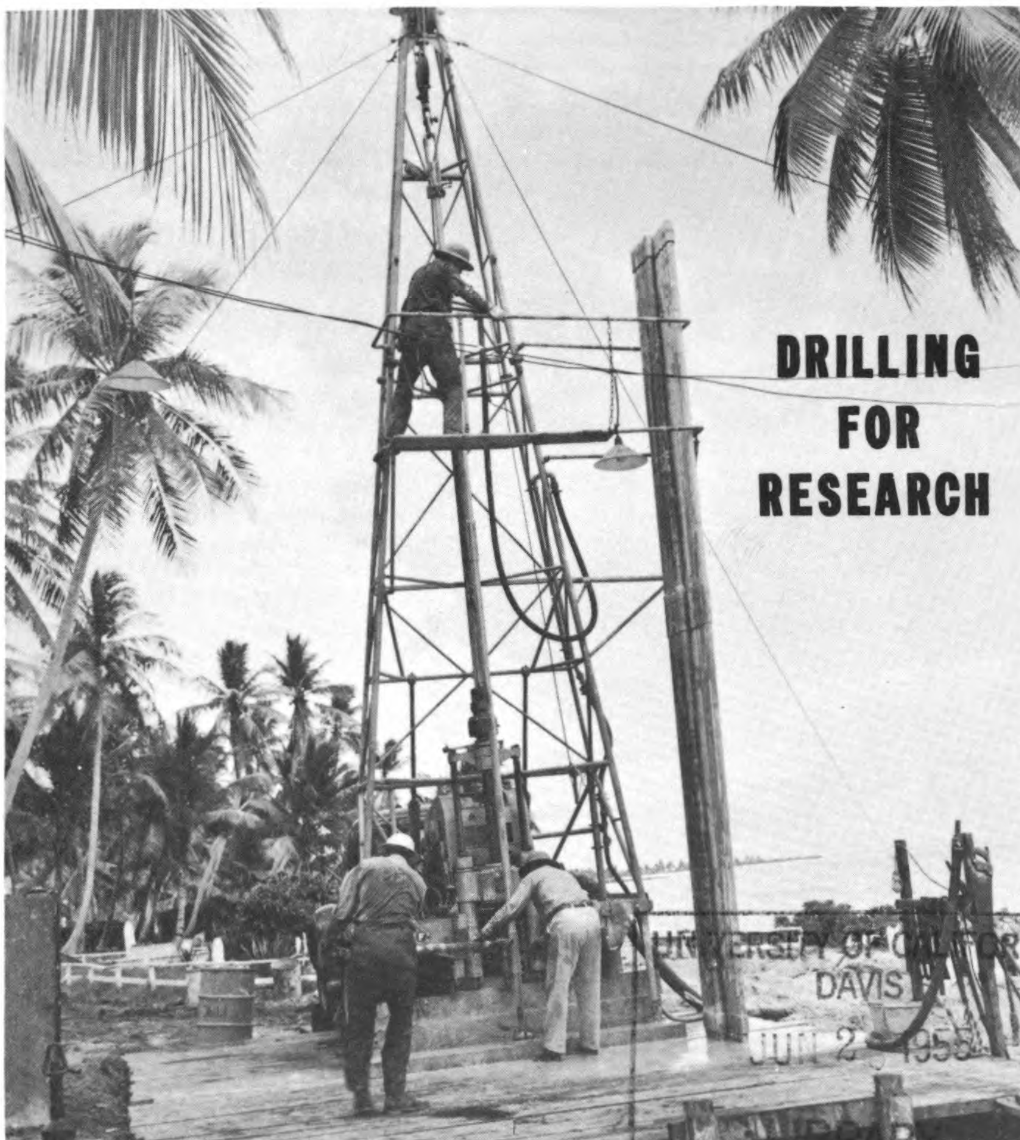
RESEARCH REVIEWS



NAVEXOS P-510

DEPARTMENT OF THE NAVY
WASHINGTON, D. C.

COVER PHOTO: Core drill in operation on Bikini Atoll where one hole was carried to 2500 feet. This rig was also used on Eniwetok, but heavier equipment was needed for the holes drilled to the basement. See p. 13.

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.

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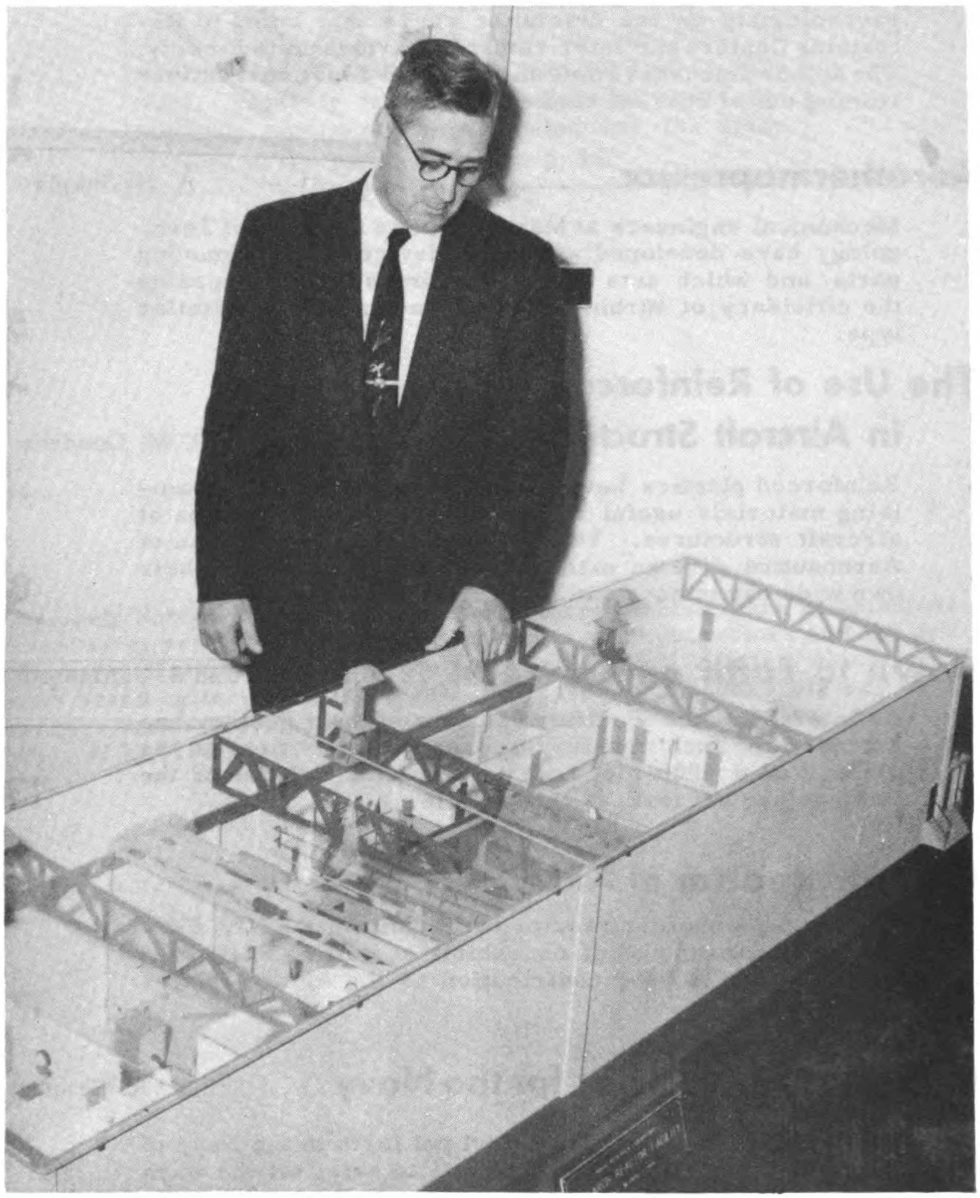
In This Issue



Model of low-power nuclear reactor under construction at the Naval Research Laboratory. (See p. 17)

The Navy's Attack on Problems of Delinquency

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Recently a high-ranking officer, who plays an important policy role in the Navy's disciplinary program, commented that he is not trained to know what goes on in the heart of a man who commits a theft, but that he is trained to determine whether a man is a thief or not by knowing whether or not he has committed an offense. Can a man's future behavior be better predicted by making inferences regarding what goes on inside the man himself or by looking for relationships only between his behaviors? This is a basic psychological research problem; its applied aspect—whether to look into an offender's heart or into the nature of his crime to determine the probability of his continuing to offend—is of primary interest to our naval officer.

With the turn of the century, research psychology was eager to free itself from the intangible, often thought of as mystical, problems concerning the nature of man's mind. Behaviorism was held to be a science concerned only with events which could be seen and measured. "Laws of behavior" were advanced, such as: acts which are rewarded will tend to be repeated; or, practice makes perfect; or, if a certain act occurs once in a given situation, the act will tend to be repeated whenever a man is in a similar situation. The latter is very close to the concept: "Once a thief, always a thief."

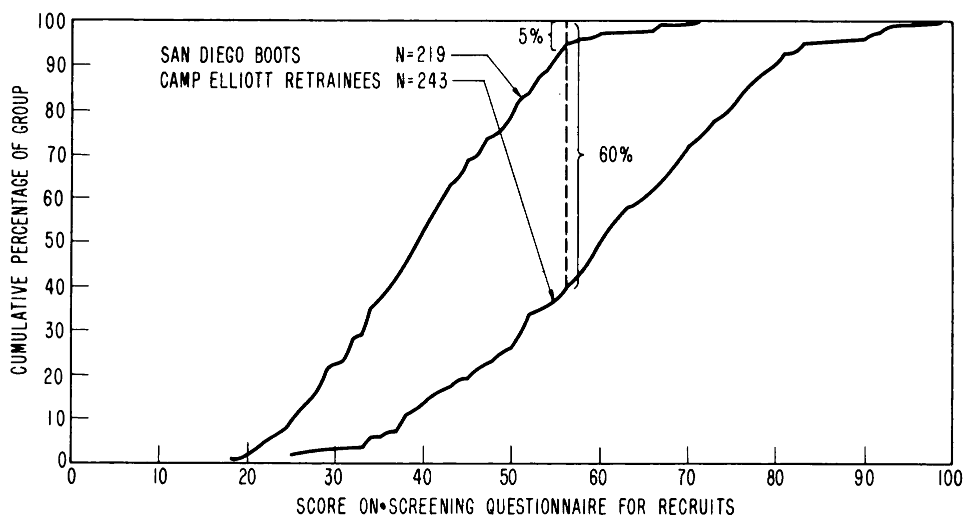
Behaviorism as a science did not get very far with its efforts to by-pass some form of organized understanding of man's inner feelings and motivations. Edward Tolman, with his "purposive behavior," has led a group in showing that there are many behavioral relationships in animals and men which demand some "intervening variables" for adequate understanding. The "behavioral laws," concerned only with acts, and attempting to by-pass the nature of the actor, have been made to look very foolish in the scientific struggle for adequate explanations.

Science has been forced to look again within the man, using such concepts as "needs," attitudes," and "frames of reference" rather than mind, soul, and heart as were fashionable in the previous century. We hope the re-look will prove more fruitful, but certainly scientists are now convinced that we cannot study just acts themselves but must understand the nature of the beast performing the act in order to explain behavior.

Military and civilian efforts to handle delinquency are applied problems paralleling the basic-science struggle. We have done very poorly attempting to predict and control antisocial behavior by studying only the offenses themselves, and attempts to look within the offender have been few. Administrators, forced to make decisions concerning an offender's future, have sometimes used the only readily available "intervening variable," the man's intelligence.

The General Classification Test, as a measure of intelligence, has not proven itself an adequate predictor of military adjustment. Although there is a slightly higher percentage of low-GCT personnel in confinement than in the general service population, the average GCT of the confined man is only two points lower than the average recruit. Further, the confinee who is later successfully restored to duty actually averages somewhat lower in intelligence than the unseccessful restoree. It appears that intelligence is not an appropriate "intervening variable" for delinquency prediction.

In an attempt to answer this practical question of prediction and control, as well as to clarify the basic science issues, the Navy is now conducting a research program which approaches the problems of delinquency through studying the nature of the offender, his capacities and attitudes. The research is focused on three major questions: (1) What are the personality characteristics of the recruit who will prove himself a military offender? (2) Of military men who demonstrate extreme nonconformity and require rehabilitation, what are the characteristics of those who will be able to modify their behavior sufficiently to adjust eventually to military group life? (3) What is the nature of the process that brings about attitudinal and behavioral change within the nonconformist so that he is able to meet the demands of military group life?



Comparison of the scores made by representative recruits (San Diego "boots") and offender groups (Camp Elliott retrainees) on the questionnaire for prediction of delinquency. The larger the score, the greater the potential for delinquency--especially above some critical score. Should a critical score of 56 be selected for separating men from the Navy (see vertical broken line above) then only five percent of the recruits would be eliminated, but 60 percent of the Navy delinquents (Camp Elliott retrainees) would be eliminated.

Concerning the personality characteristics of the recruit who will prove himself a military offender, a test has been developed which sharply differentiates between confined and non-confined service personnel (See Chart). The test taps attitudes such as insensitivity to the effects of one's own behavior on others, resentment against the family, lack of confidence in self and others, rebelliousness, rejection of civil and military responsibilities, and the denial of long-term friends or relationships. This test is in the form of a series of statements which the individual marks according to whether each is a "true" or "false" description of his own behavior. The first step in setting up the test was to try out a large number of statements on a group of recruits and on a group of military offenders, determine the test items which were answered "true" or "false" significantly more often by offenders than by non-offenders. Examples of two test items to which offenders answer "false" significantly more often than non-offenders are:

1. I hate to walk in late and have everyone look at me.
2. I find it hard to "drop" or "break with" a friend.

The next step in the development of the test is to see how well it will predict which recruits will have delinquency difficulties within the service. A large sample (N = 20,000) of naval recruits has been tested. Their careers are now being followed to check the ability of the test to predict which will become offenders and which will not.

In an attempt to study offenders who later make an adjustment to military life, a continuous investigation of all Naval and Marine personnel restored to duty following confinement at the Navy's Retraining Command, Camp Elliott, San Diego, California, is in progress. Current findings, based upon confines already restored to duty, have produced a questionnaire which predicts the restorees who will succeed on probation. It includes statements of attitudes concerning authority, self-respect, responsibility, status, socially accepted behavior, trust, conformity, and guilt. Examples of two test items from the Probation-Success Questionnaire are:

1. I usually work things out for myself rather than get someone to show me how.
2. I can't really enjoy a rest or vacation unless I have earned it by some hard work.

The first is answered "false" and the second "true" significantly more often by the successful probationer.

At the present time the Navy is restoring approximately one hundred men per month from its three Retraining Commands with approximately sixty per cent of the men successfully completing six months duty following restoration. By the use of the Probation-Success Questionnaire in its present form it should be possible to restore approximately one hundred fifty men per month to duty with ninety per cent of them successfully completing six months of satisfactory duty upon restoration.

In addition to the questionnaire approach, restorees are being studied by recorded interview to determine further personality characteristics related to probation success. An example of a personality area related to probation success is the nature of one's plans for the future. While a stated desire for a military career is in no way related to probation success, the ability to plan specifically and realistically for the future is highly related to probation success.

The final phase of the problem is to determine and aid the process by which men change their attitudes toward military life and develop more socially cooperative behavior. This two-year research project, known as the Living Group study, is a new departure in the area of group psychotherapy in that trainees are given the opportunity for therapeutic contacts in the course of their daily living as well as during formal therapy sessions. Small companies of men, with their military supervisors, live, work, study, and play as a closed unit having only restricted contact with personnel outside their own living-group. Part of their program consists of a daily group-therapy session with a professional consultant. Every effort is made in these sessions to bring into the open the actual day-to-day involvements of the men with each other and with their supervisors, who are participating members of the therapy group.

It is characteristic of these confined men to have moved from school to school, job to job, parent to parent, wife to wife, and friend to friend, always complaining of the behavior of others but never being forced to look at themselves. In other words, these men have handled their problems by running away; the majority of confined military personnel are AWOL offenders. The research design forces the subjects to stay with their group relationships and encourages them to face their problems of relating with others.

Basic in the approach to all three of the questions being studied is a theory of delinquency. The theory postulates that each offender can be characterized as having reached a certain stage of social or interpersonal maturity. The individual is seen as starting out in babyhood with no very clear perception of differences between himself and others. He is "omnipotent," feels that he can do what he pleases. Later he learns that he must allow for the behavior of other people but sees them merely as means to his own ends; he "manipulates" them. If he reaches a really mature stage of development he respects the rights of others and sees them and himself as stably functioning human beings. A total of seven stages of self-development have been differentiated. The theory at present being tested holds that an individual remaining at an immature level of development is not necessarily delinquent but is more likely to become so than a more mature individual. Those individuals at very early developmental levels may be the ones who are unlikely to benefit from rehabilitation and be able to return to duty.

The theory holds that the higher an individual is on the scale of maturity, the more capacity he has for responsible group participation. The nature of the change which the living-group experiences are attempting to foster, therefore, is upward movement on this social-maturity scale. "Social maturity" is thus one of those essential "intervening variables" within the offender which are necessary for prediction, understanding, and control of offenses as well as offenders.

Aerothermopressor

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Can cooling raise the pressure of a gas? Can a machine from which energy is withdrawn act as a compressor, and increase the pressure of the gas flowing through it? Many suspect that these results would somehow involve perpetual motion. Yet they do occur in the Aerothermopressor, and indeed they follow from the fundamental laws of gas dynamics.

Basically, the Aerothermopressor is a duct within which atomized water evaporates into a high-speed stream of high-temperature gas. The net result is a rise in total pressure (static pressure plus dynamic pressure) of the gas stream. Thus the Aerothermopressor performs the same function as a reciprocating or rotary compressor, but requires only a simple structure having no moving parts. One of the most attractive applications is for improving the performance of a gas-turbine power plant (Figure 1) where the conventional compressor would be retained, but additional power gained through the use of an Aerothermopressor.

We know from the history of inventions that the theory of a device nearly always comes after the conception of its mechanical arrangement. The Aerothermopressor seems to be one of those rare instances in which the theory revealed the practical possibilities. In fact, the mode of operation of the Aerothermopressor is far removed from that intuitive sense which usually underlies invention. Hence one could hardly imagine its having been conceived rationally without the theoretical advances in gas dynamics of the past decade and a half.

When a gas is contained in a tank of fixed volume, it is well known that its pressure will fall if the tank is cooled. The startling fact revealed by theoretical gas dynamics is that the cooling of a gas stream flowing in a duct at high speed produces a rise in total pressure (the static pressure may either increase or decrease, depending on whether the gas speed is respectively subsonic or supersonic).

Beginning in 1946, attention was directed at M.I.T. towards putting this novel phenomenon to practical use. Cooling the duct from the outside was discovered to be futile, for the amount of cooling which can occur in this way is never large enough to offset the losses in total pressure due to pipe friction. Theoretical investigation of evaporative cooling of the gas stream by means of an atomized water spray traveling with the gas itself was next undertaken. It was found that this method is indeed feasible if the amount of gas flow is sufficiently large so that the pipe friction does not cancel the beneficial effects of the evaporative cooling.

Of the various applications which have thus far been considered, the use of the Aerothermopressor for improving both the performance

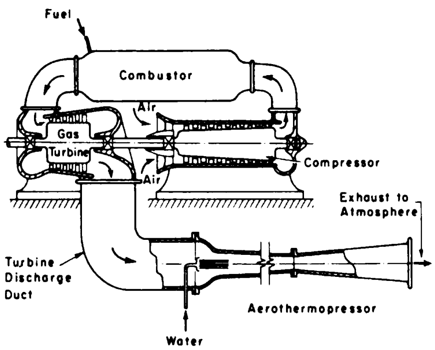

Figure 1 - Application of Aerothermopressor as auxiliary to gas turbine plant

and the characteristics of a gas-turbine plant is one of the most promising. For example, when placed at the exhaust of the power turbine in the simple gas-turbine cycle, the Aerothermopressor is supplied (at no expense, as it were) with a stream of air so hot that appreciable evaporative cooling, and hence an appreciable increase in total pressure, can occur (Figures 1 and 2). If the Aerothermopressor increases the total pressure and also discharges to the atmosphere, it follows that the total pressure at the turbine exhaust must be reduced below atmospheric pressure. Thus the Aerothermopressor is somewhat analogous to the condenser of a conventional steam power plant. Without any change in the fuel flow, air flow, or machinery size, the net power is increased.

Another cycle arrangement is shown in Figure 3. Here the fuel flow must be increased. On the other hand, the steam generated augments the gas flow through the power turbine. This, together with the increased pressure drop available for the turbine, may yield a net gain in performance.

Simple as it may seem in outward appearance, the events transpiring within the Aerothermopressor are complex and tightly interwoven. The hot air coming from the turbine is accelerated by a converging nozzle (Figure 2) into the evaporation section at a Mach Number (ratio of gas speed to sound speed) of about 0.7. There the water is injected at low velocity into the gas by multiple jets, and is disrupted into an atomized spray by the shearing action of the gas stream. After the droplet cloud is formed, it experiences simultaneously three types of interaction with the gas flow.

First, it is rapidly accelerated by the aerodynamic drag forces exerted by the air on the droplets.

Second, it receives heat from the high-temperature gas, and thus its temperature tends to rise.

Third, it evaporates into the gas, and the latent heat supplied tends to keep the droplets cool.

These three phenomena, namely, drag, heat transfer,

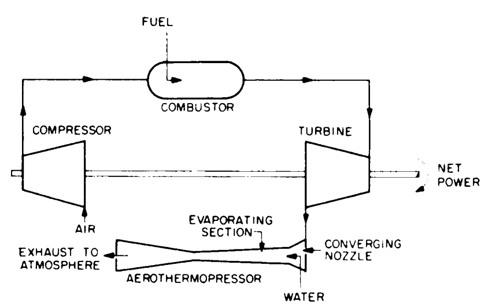

Figure 2 - Gas turbine cycle with Aerothermopressor at turbine exhaust

and steam generation, in turn produce effects on the high-speed gas stream. The latter are too complex to describe here. Suffice to say that the aerodynamic drag and steam generation tend to reduce the total pressure of the gas, while the heat transfer tends to increase it. After the gas stream is nearly saturated with water vapor, it enters a diffuser, where ti is decelerated and where dynamic pressure is exchanged for static pressure. The stream is discharged from the diffuser exit to the atmosphere.

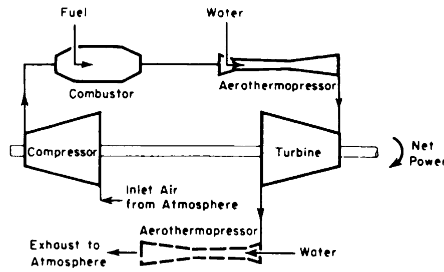

Figure 3 - Gas turbine cycle with Aerothermopressor between combustor and turbine. Dotted lines show that a second Aerothermopressor may also be placed at turbine exhaust

From what has been said before, it is evident that, to get a useful result from the Aerothermopressor, the beneficial effects produced by the loss of heat from the gas to the droplet cloud must be made to outweigh the combined harmful effects of pipe friction, aerodynamic drag of the droplet cloud, and steam generation. In the first place, this requires that the scale of airflow be sufficiently large—corresponding to a gas-turbine plant of about 200 hp at the break-even point. In the second place, the speed of the gas flow, the amount of water injected, the length of the evaporation section, the method of atomization, and the shape of the evaporation duct must all be established with great care.

In large gas-turbine units it appears likely that the Aerothermopressor will be able to produce a total pressure increase of about 20 percent. This means that the pressure at turbine exhaust will be about 17 percent less than atmospheric. For power plants with compressor and turbine efficiencies of 85 percent, this will produce about a 20 percent increase in power for the same fuel consumption and machinery size. For plants with component efficiencies of only 75 percent, the increase in power will be nearer 50 percent.

Like the airplane and the gas turbine itself, the Aerothermopressor almost fails to work. Only by an understanding of the important physical phenomena and a rational design based on theory and experiment can a successful result be achieved.

RADM Albert G. Mumma New Chief of BuShips

In a recent ceremony at the Pentagon, RADM Albert G. Mumma became the new Chief of the Bureau of Ships to succeed RADM W. D. Leggett, Jr. who has retired. When original Navy studies were made on the use of nuclear power for ship propulsion, beginning in 1947, RADM Mumma was assigned a key post as Deputy Coordinator for Nuclear Matters in the Bureau of Ships.

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The Use of Reinforced Plastics in Aircraft Structures

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The use of reinforced plastics in aircraft had modest beginnings, but with widespread industrial use and constant improvement, more and more places have been found where the material has advantages. And it is only by the use of appropriate reinforced plastics that certain desirable features can be built into our modern airplanes which are designed so carefully to conserve and save weight wherever possible. In general, the kinds of reinforced plastics found most attractive to the aircraft industry, and which will be discussed here, are those which employ glass fiber as the reinforcing material.

In most cases glass-fiber reinforced plastics are highly desirable for building aircraft components because of their certain well-established properties. For example, the excellent dielectric properties of reinforced plastics makes the material suitable for the construction of radomes, for antenna housings, and for use in panels where electric power is involved. One of the Navy's airplanes, the "Pegasus" (WV2), has several radomes of special configuration (Figure 1) which enables the crew to get maximum results from six tons of electronic gear in the plane. Another Navy plane, the "Neptune" (P2V-4) carries its radome, also of glass-fiber reinforced plastic, below the main body structure of the aircraft (Figure 2).

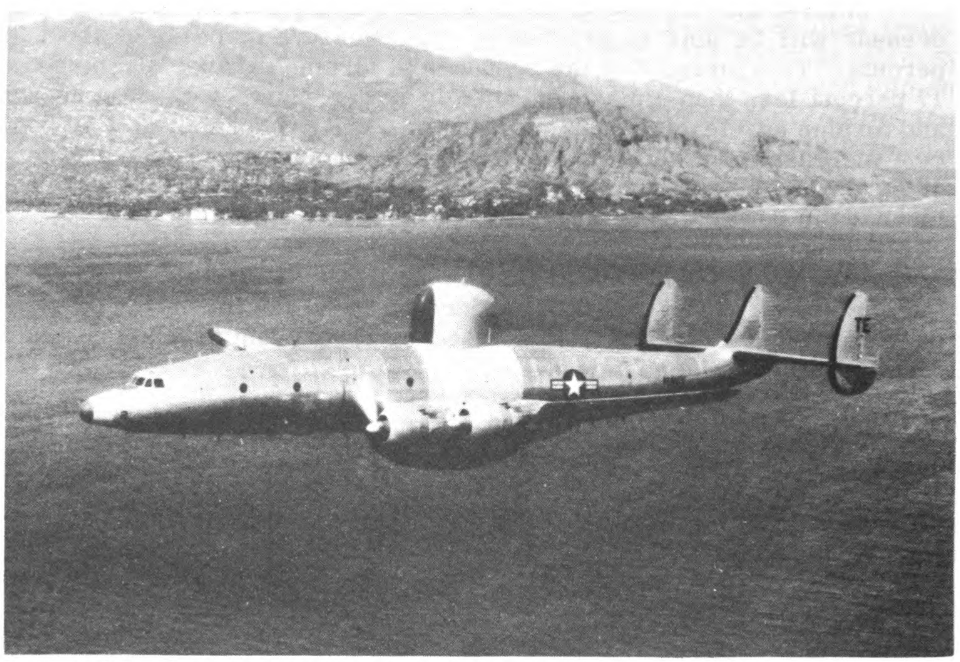

Figure 1 - Reinforced plastic radomes on the "Pegasus," the first WV2 type aircraft put into Navy operation

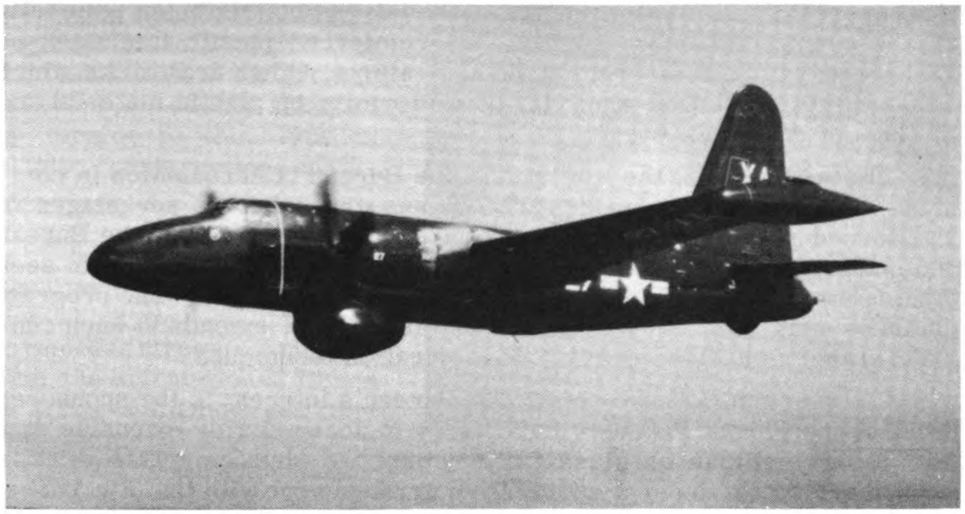

Figure 2 - The "Neptune," a Navy P2V-4 aircraft, has a radome of reinforced plastic

Still other properties of the plastic material under discussion afford an advantage that is ballistic in nature. It is the best light-weight material for use in self-sealing tank installations as backing board. Complete freedom from corrosion makes this plastic material suitable for prolonged exposure to salt water, as in wing-tip floats on seaplanes (Figure 3). Furthermore the material is easy to fabricate in complex shapes. Thus they are frequently preferred for making items such as fairings, junction boxes, various air ducts, and other odd-shaped parts.

Reinforced plastics have been found most suitable for aircraft structures where structural considerations are not predominately

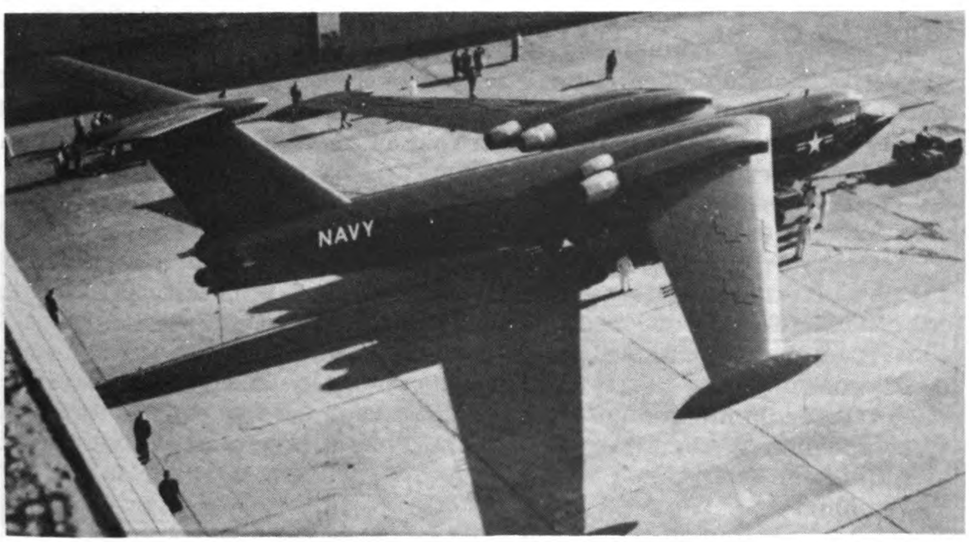

Figure 3 - Reinforced plastic wing-tip floats of the "Seamaster," a Navy seaplane (XP6M) do not corrode and require only simple maintenance (Photo courtesy of The Glenn L. Martin Co., Baltimore, Md.)

decisive. This limitation on the material can be attributed primarily to the comparative low stiffness of reinforced plastic laminates as compared with the aircraft structural alloys. Other drawbacks which impose this limitation are: (1) nonuniformity of plastic material and (2) lack of ductility.

Notwithstanding the limitations, the Bureau of Aeronautics in common with the other services recognizes the inherent advantages of reinforced plastics for structural purposes. Consequently the Bureau has supported for a number of years a comprehensive program to seek further improvements and get the most out of the material. The program includes work on glass fibers, fiber finishes, and extends to such considerations as design criteria and fabrication techniques.

An outstanding example of the Bureau's interest is the sponsored work of the Forest Products Laboratory in accumulating extensive data and design criteria on glass-fiber reinforced plastics. This work is being carried out under a cooperative arrangement with the Air Force, the Bureau of Aeronautics, and the Civil Aeronautics Administration.

Laboratory tests have brought information on such characteristics as flexural, tensile, shear, and compressive strengths (both wet and dry); bearing strength, fatigue strength, strength after repeated loadings; and elastic moduli. While these data are essential and provide some help to the designer, they are not sufficiently comprehensive to meet all design combinations. There may be size effects that are difficult to analyze and a consequent need to reduce design allowables when large assemblies are involved.

The improvement in fibers is an approach to better and more acceptable reinforced plastics in aircraft structures. Perhaps equally as important is the compatibility that can be attained between the fibrous and the resinous components of the plastic. The Bureau's current reinforced plastics program places emphasis on both of these considerations.

MODULUS OF ELASTICITY

It is readily evident from a review of the values shown in Table I that the modulus of elasticity (stiffness) of a typical glass-fiber reinforced plastic laminate is much less than that of metals commonly used in aircraft construction:

TABLE I

Material	Specific Gravity	Modulus of Elasticity ($x10^{-6}$) Actual	Specific
Plywood	0.8	1.1	1.4
Polyester laminate	1.8	2.8	1.6
Magnesium	1.8	6.5	3.6
Aluminum	2.8	10.5	3.7
Titanium	4.5	16.5	3.7
Steel	7.9	30.0	3.7

The lack of stiffness has made it practicable to use the material successfully in a highly stressed primary structure only if the part is relatively small or the design engineer is in a position to take advantage of the greater freedom of design afforded by turning to this type of plastic construction material.

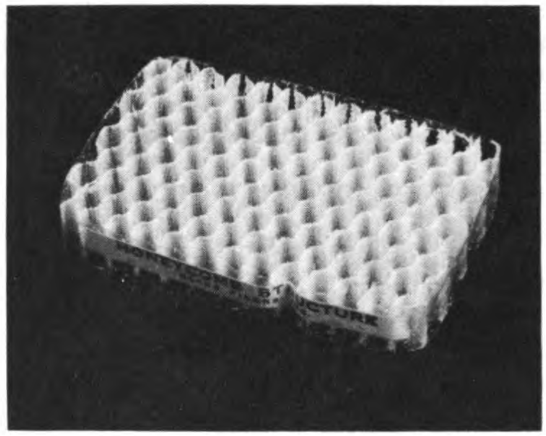

Figure 4 - Honeycomb structure made of reinforced plastic material

Some of the techniques peculiar to plastics fabrication which may be employed to improve structural rigidity are: the orientation of fibers in areas of high-stress concentration, the use of curved sections, and the use of sandwich construction. In the case of sandwich construction the glass-fiber reinforced faces are separated and stabilized by a low-density core (Figure 4). The lower density of the laminates compared with the structural alloys permits the use of greater relative thicknesses, a circumstance which helps but does not fully obviate the stiffness problem.

These techniques, when fully exploited in specific instances enable a plastics fabricator to manufacture a highly efficient plastic aircraft structure at a minimum of weight. Such a structure can be presumed to have a more uniform stress distribution and a lower unit stress than an equivalent assembly of many pieces of metal joined by riveting or spotwelding.

However, there have been cases where an apparently adequately designed reinforced-plastic assembly has exhibited excessive deflection in static test or instability under flight conditions with the result that the part is considered unacceptable for operational use. When this occurs, the part is either redesigned in metal or, if dielectric considerations are paramount, in "beefed-up" plastic with a weight penalty.

It is obvious that any progress made in raising the moduli of reinforced plastics would not only improve their usefulness from the standpoint of aerodynamic considerations, but would also facilitate the problem of attachment. For some time to come, at any rate, it can be expected that the use of reinforced plastic structural parts will require some sort of a joint or attachment to metal structures. This calls for compatibility of the moduli of the two materials with the most importance centering in the control of stress concentrations in the joint regions. The fiber component is regarded as the real contributor to stiffness in the composite material. Only minor improvements in stiffness, the Bureau feels, can be expected through resin or resin-glass modification.

A contract with the Imperial Glass Corp. seeks to develop reliable glass fiber with a Young's modulus of elasticity approximately twice that of present commercially available textile-grade fibers. The new higher modulus fiber will afford advantages in easing the problem of multiple cracks (crazing) on the surface of reinforced plastics as well as other problems identified with fiber-resin relationships. A better material is produced because the extension of the fiber at rupture (assuming no comparable increase in fiber strength) is in closer agreement with the extensions of the resins commonly employed, notably polyesters.

MECHANISM OF REINFORCEMENT

Since fibers and resins present similar problems and can readily be studied together, the Bureau has placed a contract with the National Bureau of Standards to investigate the bond between fiber and resin. In particular, information will be sought on the properties of the components as well as those of the composite material.

Such a fundamental study should not only provide useful guides for subsequent research and development effort in the reinforced plastic field, but also indicate ways in which existing design data can be applied to construction problems. In the past, the evolution of design data has rested primarily on the empirical process of making and testing reinforced panels. There are many variables to be considered, and it is unlikely that completely adequate data can be produced in this way. Limited material studies, as a rule, are projected as a logical preliminary to the design and construction of a particular reinforced plastic part for an aircraft.

The approach being taken by the National Bureau of Standards in carrying out this scientific work is as follows:

- To estimate the comparative degree of adhesion between glass fibers with various treatments and several types of resins,

- To determine the strength properties of the glass fibers and the resins,

- To measure the properties of rods made with these fibers and resins.

Reinforced plastic rods were chosen for the initial phases of this work to eliminate the additional variables associated with the use of fabric. As the work progresses, attention will be directed to glass-fabric laminates.

CONCLUSIONS

Although glass-fiber, reinforced, low-pressure plastic laminates offer numerous advantages for specific structural applications in aircraft, they must be improved, particularly in stiffness and in wet strength, if they are to compete successfully on a strength and weight basis with the aircraft alloys. It is hoped that the fundamental work currently underway on the materials and the material combinations best suited to plastic construction will bring about improvements sought by the Bureau, and contribute to performance goals set for these materials in aircraft structures.

Down to Earth on Eniwetok

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In 1952 a crew of Texas drillers under contract with the Office of Naval Research and supervised by government geologists, drilled two deep holes on Eniwetok Atoll for the Atomic Energy Commission. Both holes went beyond 4,000 feet to reach the black basaltic core of the atoll, and samples of this basement rock were brought up from one of the holes. These holes, the deepest yet drilled on a coral atoll, demonstrated that Eniwetok is a thick cap of shallow-water limestone resting on the summit of an eroded volcano that rises two miles above the floor of the ocean. The primary justification for this expensive operation was the need, on the part of AEC scientists, for factual data to support their geophysical interpretations. Necessary facts about the hardness, the porosity, the lithology, and the thickness of the foundations of Eniwetok were obtained by drilling and were transmitted to the AEC before the drilling party left the atoll.

As is often true, the accomplishment of the primary objective opened the way to a whole series of what might be called secondary objectives. Some of these were anticipated, but others developed after the holes were completed. The results of research are notably unpredictable and—if drilling a hole in the ground can be called research—it may be worthwhile to refer briefly to some of the results obtained from the holes on Eniwetok.

The first hole was drilled on Elugelab Island on the north side of Eniwetok. That drilling site is now beneath the sea, but before it was blasted away a geophysical party made seismic measurements at various levels in the hole while setting off small charges of explosives nearby. After these vertical velocity measurements were made, a thermal cable was let down into the hole to record the temperature gradient. Seismic and thermal measurements were also made in the second hole, drilled on Parry Island, nearly 20 miles to the southeast. The rise and fall of the tide were measured in both holes indicating, incidentally, that the thick limestone cap of the atoll is as permeable as a sponge. The measurement of the temperature beneath the atoll as a function of depth was of interest for several reasons; it demonstrated the permeability of the atoll, it aided in computing sound velocity in the atoll materials, and it aided in estimating the heat flow from the earth's interior. Attempts have been made by others to measure the heat flow through the deep-sea floor in other parts of the Pacific, and the authors hope that the Eniwetok gradient will lend independent confirmatory data. Such measurements are vital for an understanding of the thermodynamics of the earth's interior.

For a variety of reasons geophysicists are interested in the physical properties of the rocks making up this hitherto unknown geologic section. The Geological Survey and the Bureau of Mines carried out a series of tests on the cores to determine their specific gravity, porosity, permeability, hardness, compressive strength, tensile strength, modulus of rupture, impact toughness, elasticity, modulus of rigidity, and specific damping capacity.

Geologists, of course, are interested in the geologic history of the atoll. The basalt of the foundation was a volcanic flow, and detailed petrographic studies of the rock and its alteration should reveal some things about the conditions under which it was formed. Helium analyses indicated that the mound was built up at least 40 million years ago. Tests for other trace elements such as cobalt and nickel are also being made.

Many of the limestones that make up the 4000-foot section are richly fossiliferous, containing reef corals, algae, Foraminifera, and the shells of a variety of mollusks. Studies of these fossils enabled the paleontologists to date the cores and cuttings. We already know that a nearly complete sequence of rocks going back to the Eocene epoch lies under Eniwetok.

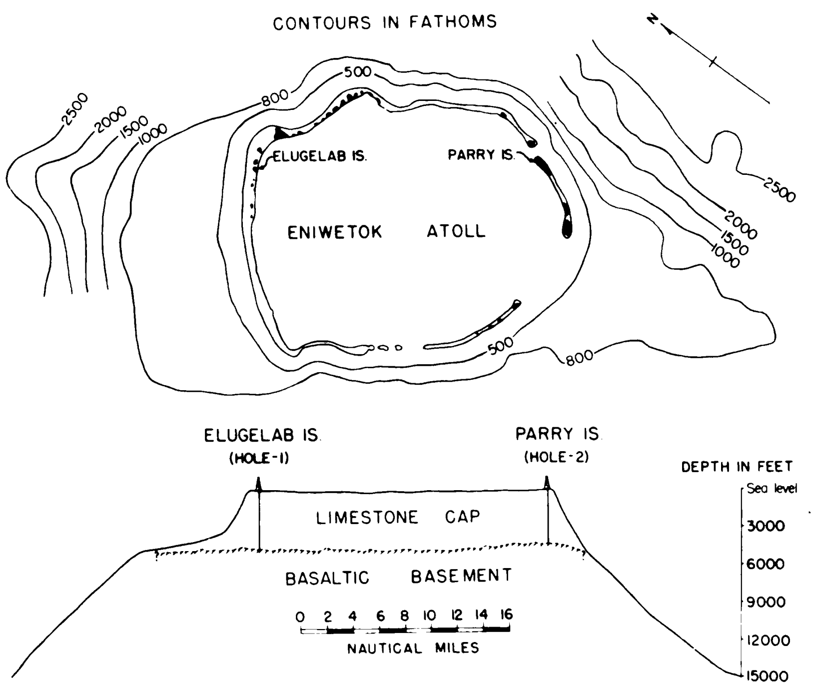


Figure 1 - Generalized chart of Eniwetok Atoll and section through Elugelab and Parry Islands.

Studies are being made to determine the percentages of the various fossil groups present and to determine the texture and other lithologic features of the rocks penetrated by the drill. These studies will make it possible to interpret some of the conditions that prevailed at the time of deposition. The texture of the rock indicates the amount of fragmentation and transport the shells and other skeletal parts underwent prior to burial. Preliminary studies of the cores show wide ranges in texture and fossil content that reflect varying conditions of deposition. In several levels of the holes the shells of mollusks are essentially

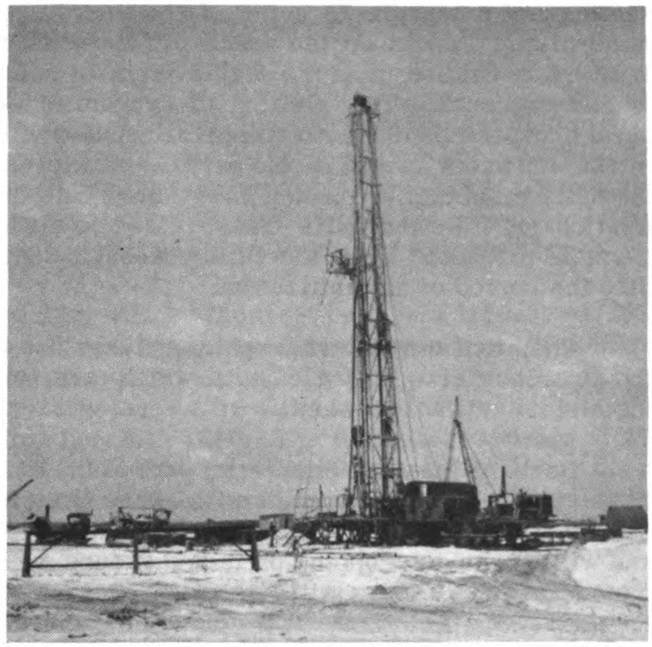


Figure 2 - Core drill used in operation at Eniwetok that carried hole 4000 feet deep. (Photo by courtesy of Los Alamos Photographic Laboratory).

unaltered, and measurements of the isotope rations O^{16} / O^{18} may give an indication of the temperatures that prevailed in the sea when these animals lived.

The mineralogy of the cores is being determined by microscope studies, staining tests, x-ray diffraction patterns, and insoluble residues. The microscope and staining studies show the aragonite-calcite-dolomite relationships in the core; x-ray diffraction patterns show the mineralogy of the submicroscopic material; and insoluble residues show the presence of non-calcareous material such as volcanic ash. Staining tests made thus far show the presence of dolomite in the Eocene part of the

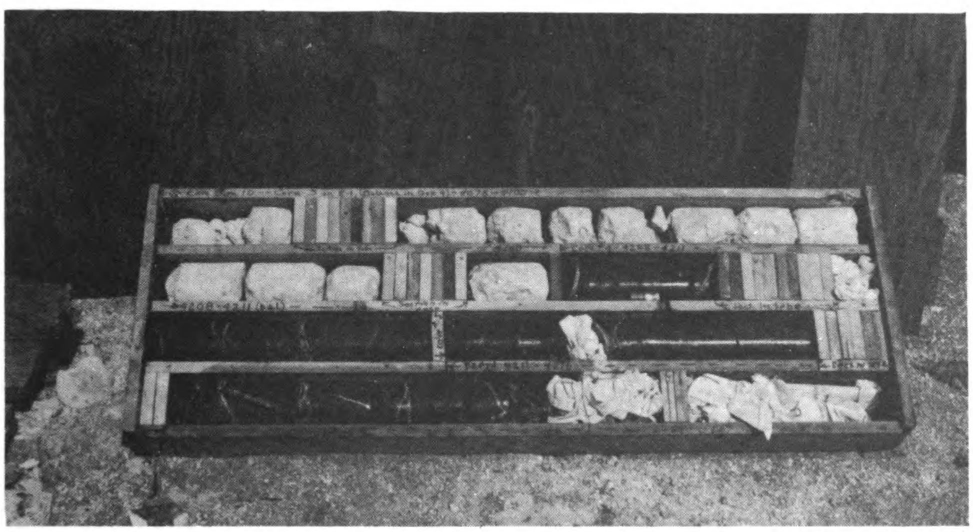


Figure 3 - Light-colored limestone cores (above) and dark basalt cores (below) obtained from depths of more than 4000 feet under Parry Island.

section and aragonite in some of the younger rocks. Aragonite is the mineral that makes up the shells of many living corals and mollusks. It alters to calcite, a more stable form of calcium carbonate, on prolonged exposure. The plotting of aragonitic zones in the cores may show that periods of relative uplift alternated with periods of subsidence in the Eniwetok area. Alpha-particle counts and thermoluminescence intensity tests that are being made may date the periods of recrystallization that followed uplift. These tests are also being made on dolomite crystals extracted from the limestones of Eocene age in an attempt to date the period of dolomitization.

Chemical and spectrographic analyses are being made to determine the presence of minor elements which are important in interpreting the history of the limestone.

Perhaps the most significant part of the Eniwetok core studies will be the comparison to be made with cores from nearby Bikini Atoll, from Funafuti Atoll in the Ellice Islands, from Kita-Daito-Jima in the Ryukyus, and with rocks outcropping on island groups such as the Marianas. The plotting of fossil zones with respect to present sea level in these several localities will show relative uplift and subsidence over wide areas.

Thus the Eniwetok section will serve as a sort of "geologic anchor" to which can be moored the numerous less complete limestone sections previously studied in the Western Pacific.

Nuclear Reactor at NRL

A preview of the new research reactor under construction at the Naval Research Laboratory was afforded by the exhibit of a model at the Bolling Air Force Base on Armed Forces Day. The model is about eight feet long and shows in miniature the features of the research reactor facility which will be completed early in 1956 (see Frontispiece).

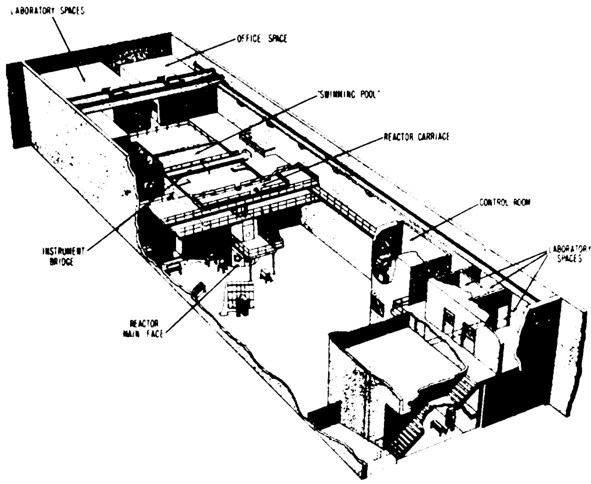
This nuclear reactor will be the first built in a laboratory of the Department of Defense. It will be operated at a power level of 100 kilowatts and will provide large quantities, or fluxes, of neutrons–uncharged nuclear particles–for use in the Laboratory's program in nuclear physics, an activity that began in 1939. The Radiation Division at NRL has designed the reactor, and will supervise its construction and operation. At least five of the other divisions of the Laboratory also will make use of the new research facility.

The nuclear reactor, which is being constructed in an existing building at the Laboratory, is known as the "swimming pool" type, since the main feature of the installation will be a water pool 40 ft long, 26 ft wide, and 20 ft deep.

The reactor core, detector, and control-rod system are to be suspended in the water at a fixed depth by means of an aluminum framework from a track mounted carriage spanning the 26-ft dimension of the pool. This will permit movement of the core along the center line of the pool. The water of the pool will cool the reactor by natural convection and also provide part of the radiation shield required. Large-scale experiments such as bulk shielding studies, and high-level irradiation of any experimental arrangement that can be waterproofed can be carried out by immersing the necessary equipment in the pool. The pool will be divided into two sections and provided with an aluminum gate which can be installed across the middle. This gate will be arranged so that either section may be sealed independently of the other, permitting the drainage of one-half of the pool for work on installations while the reactor core is stored or operated in the other section.

At one end of the pool will be a seven-sided main shield, or face, which will provide facilities for neutron beam studies and for irradiation of material samples. Lead, and a dense barytes-containing concrete will be used as the shielding materials in this portion of the installation.

Penetrating this shield will be seven horizontal beam parts extending radially from the core, and one horizontal "through" hole tangential to the core. A vertical graphite thermal column 9 feet in height and 4 feet x 3-1/2 feet cross section will be incorporated within the solid shield. The lower two feet of the column will be adjacent to a vertical face of the core.



Model of nuclear reactor under construction at NRL

The fissionable material to be used in the reactor (uranium 235) will be contained in specially prepared fuel element assemblies. A compact square or rectangular array of these assemblies, held together by a loading plate or grid, will constitute the active lattice. Two basic core configurations will be used: one for bulk-shielding work and one for neutron-beam experimentation. For shielding experiments, the core will normally be completely water reflected. When the core is positioned in the main shield for beam experimentation, it will usually be carbon reflected on three vertical faces and water reflected on the fourth vertical face and the top and bottom faces. To avoid the necessity of having two separate reactor structures, a single loading grid which allows a 7 by 7 array of loading holes will be used. This choice, besides providing space for typical critical assemblies, allows the use of small canned reflectors in the extra holes and permits some flexibility in the geometric configurations and location of the reactor assembly proper. The configuration of the carbon reflector and loading grid will restrict the number of elements in one direction to five for this position.

The area adjacent to the reactor proper will be divided into several laboratory spaces, administrative offices, and working areas. A control room will be provided, from which the reactor operator can maintain manual or automatic control of the power level, and can observe all the experimentation being carried out in the neighborhood of the reactor.

Knowledge once gained casts a faint light beyond its own immediate boundaries. There is no discovery so limited as not to illuminate something beyond itself.

---J. Tyndall

Improved Small Boats for the Navy

William R. Graner
Materials Development Division
Bureau of Ships

In these days of multi-million dollar expenditures for Navy carriers, the importance of small boats and their cost may not attract much attention in any general considerations of naval preparedness. But there are engineers and technicians within the Navy who seek improvements and better performance from the smaller boats with as much zeal and tenacity as "big-ship" designers and engineers who struggle with Navy problems. This article will trace developments in the "small boat" field to give the reader a picture of where it now stands and may go in the future.

The progress that has been made in constructing better small boats for the Navy is a combination of effort which involves operating people in the fleet, engineers in the Bureau of Ships, and the skills of personnel at shipyards. Business and industrial organizations also have a hand in developments, either through Navy contracts for design or fabrication services or by independent development of improved materials or methods.

Since World War II attention has been directed at the Bureau of Ships to the possibilities of structural plastics in the construction of small boats. During this period the plastic industry reached a point where satisfactory results could be obtained in bonding and laminating such materials as glass fibers (see Research Reviews, August 1953) to produce materials having high specific strength and toughness. The advantages of a glass-reinforced plastic in constructing small boats were obvious—the material was light in weight, it was durable, the manufacturing process was simple, and maintenance costs would be low.

Enough progress had been made by 1946 in building small boats with glass-reinforced plastic that several 28 footers were ordered for Navy use. In making the hulls of these boats, use was made of the so-called bag molding technique and an aluminum female mold. Anyone interested in details on this and other methods of building plastic boats will find them in an article by J. B. Alfers of the Bureau of Ships, "4 Ways to Build a Plastic Boat," which appeared in the Oct. 1951 issue of Modern Plastics. As the program was still in the experimental stage, two of the 28 footers were framed with a combination of wood covered by laminate. This was unsatisfactory as the wood absorbed moisture and swelled, and in so doing cracked the laminate. The later boats were framed with aluminum, but this also was not satisfactory because of salt water corrosion.

Still another technique of fabricating glass reinforced plastics was employed by the Norfolk Naval Shipyard in making a 26-foot whaleboat. This was the so-called vacuum-injection method. A feature of the boat construction was stiffeners or mountings made of precast laminates rather than wood or metal. These were inserted into the glass layup before impregnation by the vacuum-injection process. More recently, Norfolk has made use of a vacuum-pressure impregnation process in which the resin is injected into the bottom of the mold by means of slight positive pressure while a vacuum is drawn at the top. By this means, impregnation was improved and porosity minimized. Also, the shipyard has redesigned the boat to make it almost 100 percent reinforced plastic. In the original boats much of the outfitting was done in wood, including bulkheads, walking flats, seats, gunwhales and other trim. To-day, the only "foreign" hull materials are the wooden rub-rails and steel channels for mounting the engine. Even the latter may soon be eliminated. Some of these changes were made possible by the use of sandwich-type honeycomb panels to achieve greater stiffness without the sacrifice of increased weight. This type of construction will be discussed in more detail later.

THE 12-FOOT WHERRY

With increased interest in reinforced plastic construction, the Bureau of Ships selected the 12-foot wherry (Figure 1) as the next plastic

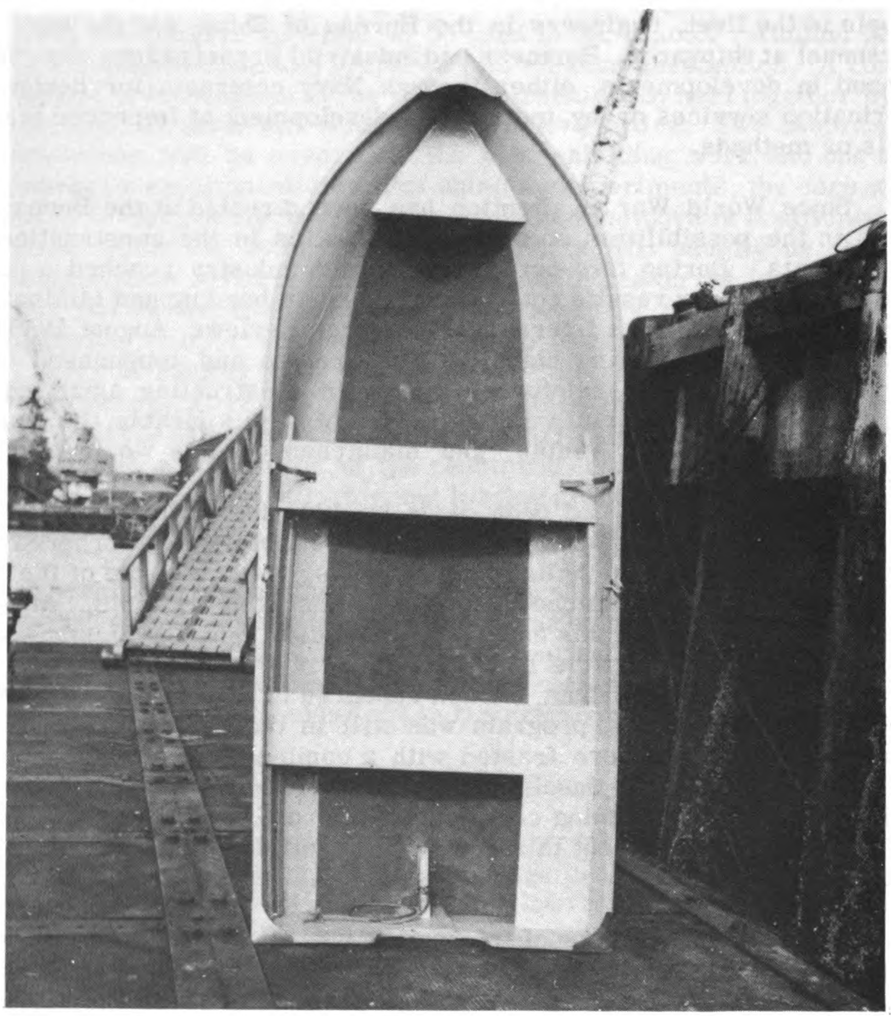


Figure 1 - 12-foot wherry of plastic materials
built at Puget Sound Naval Shipyard

craft to undergo Navy service and prove its worth. The Puget Sound Naval Shipyard was assigned this building task and between 1951 and 1953 turned out some 200 of the plastic boats. Service performance soon indicated a need for general strengthening of the hull. This was accomplished by use of glass cloth in addition to mat as reinforcement, and the addition of thwart brackets and breasthooks.

Construction of 12-foot plastic wherries is still continuing at Puget Sound. The boat, however, has been completely redesigned, based on service experience, to improve its seaworthiness and make it more suitable for use with an outboard motor.

A new development in the glass reinforcement field also made it possible for the shipyard to change completely its production technique, and greatly improve hull strength while achieving greater production economy. A new material known as "woven roving," which was independently developed by the industry, indicates the benefit of closely coordinating the material requirements of the Navy with the representatives of glass cloth weavers. Woven roving, which may be quickly described as a coarse, plain weave similar in appearance to the hand-woven hot plate pads which are so popular today with the kids, provides a reinforcement which is cheaper than the conventional woven cloth (competitive with mat). With it, laminates can be made by the so-called hand-layup technique which have a higher glass content and, hence, greater strength than mat-reinforced laminates. Because of its thickness per ply, faster buildup (i.e., fewer plies per given laminate thickness) can be accomplished, thus reducing production time and cost.

A reinforced plastic mold is used to make the new 12-foot wherry. For the purpose of making the mold, a wooden boat was obtained without spray rails and unpainted. The wooden hull was sanded smooth and coated with a layer of glass cloth and resin—this surface was then sanded and polished. The hull was then used as the pattern or plug on which the female reinforced plastic mold was constructed.

In laminating the boat the reinforcement is uniformly impregnated with resin by passing it through a dip-tank and scraper rolls. The impregnated reinforcement is then placed in a refrigerator overnight to permit the resin to "soak in" and better wet the fibers. The resin-glass ratio is approximately 50 percent by weight. A thixotropic formulation of polyester resin, again a recent industry development, is used to minimize drainage of the resin. Thixotropic characteristics are obtained by the addition to the resin of a small amount, usually less than five percent, of finely divided silica. Hand-layup techniques are employed.

A 5-hp outboard motor was used to put the first boat through its trial runs. On some of the runs only one person was in the boat; other runs carried varying numbers up to four. There were also tests with a 14-hp motor and with a varying number of people up to four in the boat.

The history of the 12-foot plastic wherry from a comparative cost and weight standpoint presents an interesting and most promising picture so far as the future of plastic boats is concerned. From Table I, it can be seen that the plastic construction has progressed from a highly unfavorable position compared to wood to the point where it is now lighter and cheaper. When one throws in the added factors of greater durability and lower maintenance it can readily be seen why the days of the small wooden craft are numbered. As further evidence of this, the Navy has in the last two years, designed and bought a number of other plastic craft ranging in size to 36 feet long. In all likelihood future boats, with possible exception of a few special types up to 26 feet, will be of reinforced plastic construction.

TABLE I
Construction Data for the 12-foot Wherry
(Prepared by the Puget Sound Naval Shipyard)

	Man Days	Approx. Weight	Labor	Overhead	Material	Total
Model 1 (1st injection) (1951) plastic gunwales, wooden seats	14	260	$230	$210	$322.50	$762.50
Model 2 (pressure vacuum) (1952) wooden gunwales and seats	13	255	235	220	265	720
Hand layup, outboard type, wooden gunwales and seats (1953)	10	250	210	130	160	500
Hand layup, outboard type, all plastic (1955)	8-1/2	190	175	105	155	435
Old type, all wood	12	240	260	150	100	510

It must be noted that while the cost and weight of the series of boats has been reduced progressively, present boats reflect gains in size, freeboard, stability, reserve buoyancy, and flotation as compared with the conventional wooden wherry and with the first plastic wherries. In the case of current-model plastic boats, there is no wood or ferrous metal to deteriorate.

Through the efforts of Bureau of Ships engineers and design agents for the Bureau, the size limits of plastic boats are rapidly being raised. At the present time designs are being completed for 40- and 50-foot craft. A 57-foot hull using honeycomb sandwich material has been under construction for some time and a preliminary design study to determine possibilities in the 80- to 100-foot size range is getting underway.

What the size limitation will be for plastic boats in the Navy will greatly depend on the results of these projects. Today, the ship designer is hampered greatly by lack of design information and the backlog of experience so necessary to successful drafting room design. In addition to design, there are materials, construction, and economic factors which must be resolved as this program moves along.

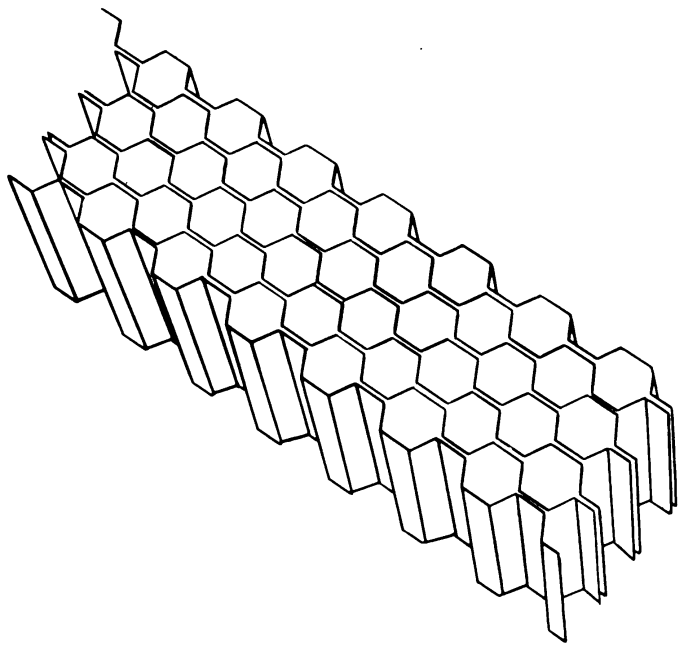


Figure 2 - Honeycomb Construction

One of the more recent designs which offers great promise in the building of large plastic boats is the honeycomb sandwich construction. Honeycomb, such as shown in Figure 2, may be made of such materials as cotton duck, glass cloth, aluminum or paper. In boat work, paper honeycomb, impregnated with a phenolic resin, is presently considered to be of greatest interest because of its low cost. By its nature, however, paper honeycomb does present wet strength and water migration problems. A Bureau of Ships sponsored research program at the Forest Products Laboratory is directed toward improvement of this shortcoming.

Figure 3 indicates a cross-section of the present 36-foot LCVP design. The hull consists of paper honeycomb faced on both sides with 3/16-inch glass reinforced laminate. Fifty of these boats will be built within the next year and their serviceability will undoubtedly affect the time table of developments in the large boat field.

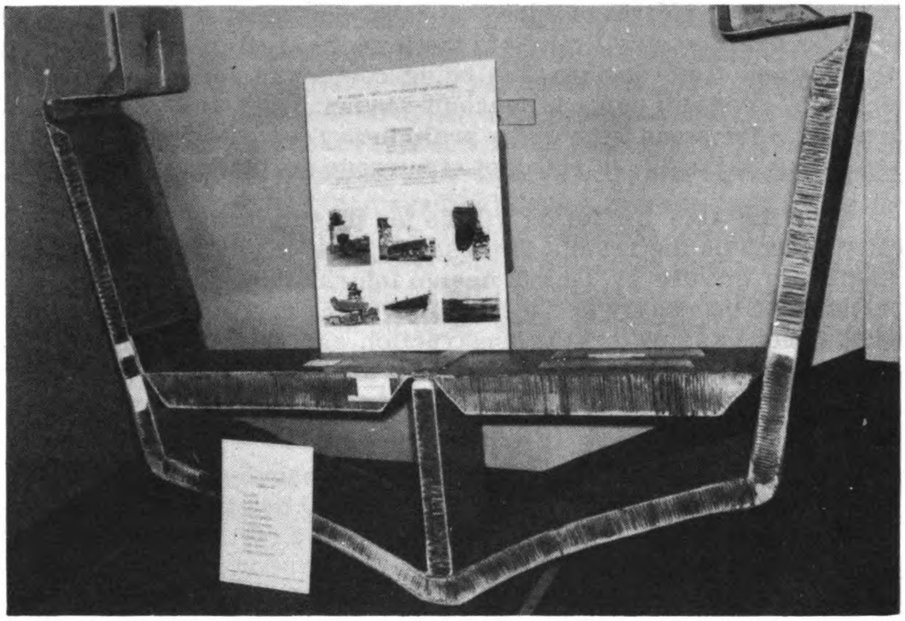


Figure 3 - Cross-section of 36-foot LCVP (Photo by courtesy of W. R. Chance & Associates)

FUTURE TRENDS

What does the future hold for plastic boats? Recent trends indicate they are rapidly replacing wooden boats as the standard for naval use in sizes below 26 feet. We can expect the use of plastic construction in large sized boats slowly to expand upward in the size ranges. This will not, however be accomplished without extensive research and development, both industry and government sponsored, in various related fields.

In materials, for example, it is likely that those in use ten or fifteen years from now will bear little resemblance to those of today. Emphasis in the resin field will be placed on the development of resins having better adhesion to the reinforcement, greater toughness and strength, and better resistance to water and weather. In the immediate future, we can expect the epoxies to take over many of the tasks now being served by the polyesters because of their superior adhesive qualities and toughness. With the extensive work now going on in phenolic and furfural chemistry offering as they do possible economic advantages, these resins may ultimately become the resins of choice.

In the field of reinforcements, looking far to the future, perhaps someday we may overcome our reliance on glass fibers with their surface flaws, extreme variability and poor wettability. In short range view, we can see the use of improved surface treatments such as that recently developed by the Naval Ordnance Laboratory or metallized glassfibers resulting from Navy Bureau of Ordnance sponsored research, now tend to make possible laminated materials of tremendously improved strength. Newly developed forms of asbestos and asbestos-glass combinations may provide much needed improvement in interlaminar bond. New glass formulations, now under development, may result in higher modulus laminates. Improved adhesives having higher peel strength and greater dependability will be developed and accordingly contribute to much lighter, simplified, and improved construction. Such a development will, for example, make it possible to mold the hull shell and framing separately and to assemble them without through fastenings.

With regard to future improvements in fabrication techniques, we can foresee greater mechanization with resultant improvement in quality control. The Navy is hampered in this regard by its generally small production requirements, which makes it necessary to rely on low-cost tooling. Industry, however, is already on the move with plans to mold in match metal dies in large presses, boats up to 15 feet in length. The knowledge thus gained will contribute much to reduce cost of molds and the "break even" point, and enable the Navy to make use of this improved techniques.

Present design knowledge must be collected and put into useable form so all engineers may use it as they make use of the wood manuals and metal handbooks. This knowledge must be expanded to provide better design criteria and information concerning optimum construction details. The engineer's increased confidence in his ability to define, on the drawing board, his final design requirements will do much to extend the use of reinforced plastics. Sectionalization (i.e., making the boat out of several parts rather than monocoque construction) will be one result of this design knowledge and will result in improved production and lower costs.

New Book by NRL Scientist

On May 25, Harper & Brothers published a book, "The Viking Rocket Story" written by Milton W. Rosen, Head of the Rocket Development Branch at the Naval Research Laboratory. In the years that Mr. Rosen has been in charge of the work at NRL on the Viking rocket, which was developed at the Laboratory, he has written a number of papers and delivered talks before scientific groups on the subject of rocketry, and the role of the Viking in upper atmosphere research. Mr. Rosen is so completely familiar with the historical development of the rocket, the launchings, telemetering, and other details that he writes with ease and intimacy that makes the "The Viking Rocket Story" one of the most readable of books authored by a working scientist.

Dr. E. R. Piore Leaves ONR

After 12 years with ONR and the Bureau of Ships, Dr. E. R. Piore, Chief Scientist and Deputy Chief of the Office of Naval Research, left government service on May 16 to take over duties as vice president of Avco Manufacturing Corp. in New York City.

Dr. Piore has served on various committees within the government to include the Science Advisory Committee in the Office of Defense Mobilization and the Interdepartmental Committee on Scientific Research and Development. He is widely known in the scientific world, and well chosen by the Avco organization to coordinate the activities of a team of leading scientists in the fields of nuclear energy, advanced electronics, guided missiles, and other areas.

On the Naval Research Reserve

Fifth Annual Special Devices Research Reserve Seminar

On 17 April 1955 forty members of Naval Reserve Research companies reported to the Special Devices Center in Port Washington, N.Y. to attend the Fifth Annual Special Devices Seminar. The officers in attendance represented Research companies from all over the United States (see Figure).

CAPT C. H. S. Murphy, USN, Commanding Officer and Director of the Special Devices Center, welcomed the group aboard and gave them an introduction to the Center's missions and function. RADM R. N. Hillenkoetter, USN, Commandant of the Third Naval District, also welcomed the group to the district area.

RADM F. R. Furth, USN, Chief of Naval Research, in discussing the mission of the Office of Naval Research, made this thought-provoking comment:

"The rate at which these (scientific) advances are being made is constantly accelerating. The time elapsing between the birth of a scientific concept and the critical experiment is no longer a matter of years—it may be as little as a week."

The concluding presentation of the afternoon was made by the Navy's pioneer in synthetic training devices, RADM Luis deFlorez, USNR (ret.), who observed that in the face of the tremendous progress being made in the development of complicated weapons, it is often forgotten that young men must be trained in a very short time to operate them.

Members of Naval Research Reserve companies in session at Fifth Annual Special Devices Seminar, Port Washington, N. Y.

The program included presentations in the form of lectures, tours, and demonstrations by key Special Devices Center personnel covering the development and procurement of special devices. It was stressed that much of the development and production is handled by contract with both profit and non-profit organizations; however, certain projects because of their nature are carried forward at SDC.

In addition to those appearing on opening day there were many other prominent guest speakers, both military and civilian, later in the program. An unusual presentation was made by Lt. Col. G. E. Hartel, USA. Col. Hartel appeared with four enlisted men, all of whom in the fairly recent past had served behind the Iron Curtain but who have since renounced Communism as a social cancer and have joined in the fight against it. The psychology of the Russian soldier was discussed in dramatic detail, and examples of his infantry weapons and clothing were displayed before the seminar group. Interest in the presentation was so high that the program had to be re-arranged to provide more time for Col. Hartel and his men to answer the many questions asked of them.

J. B. Macauley, the Deputy Assistant Secretary of Defense for Research and Development, described the need for continuing and increasing research as an integral part of the country's defense program. Dr. J. W. Joyce, now of the National Science Foundation, and formerly the Assistant Director of Electronics and Guided Missiles for the Secretary of Defense, discussed applications engineering in the Department of Defense.

From the field of education came several prominent speakers who contributed to the seminar. Dr. M. A. Gabrielsen, Professor of Educational Supervision and Administration at New York University, and a Commander in the Naval Reserve, spoke on an evaluation of shipboard living conditions which he conducted while on active duty during the Korean emergency. Dr. J. D. Hardy, Professor of Physiology at the University of Pennsylvania, and Director of the Aero-Medical Acceleration Laboratory at Johnsville, Pa., described the experiments being conducted at the laboratory on human tolerance to acceleration stress.

Appropriately, the closing address was made by CAPT Theodore Blanchard, USNR, Special Assistant to the Chief of Naval Research for the Naval Reserve. CAPT Blanchard, who directs the Reserve Research program, discussed some current and future plans for the program, noting that the outlook was very bright.

Two field trips were made by the group to nearby military installations. The first trip was made to the 26th Air Defense Division of the Air Force in Roslyn, New York. There the group was able to see first hand how it is planned to detect and repel invading enemy aircraft using central control points such as the Roslyn Air Force base. The second trip made by the group was to the Material Laboratory at the New York Naval Shipyard in Brooklyn. A complete tour of the laboratory featured this trip, and although time did not permit anything in detail, the key members of the laboratory staff gave brief talks and demonstrations on current projects.

Research Reserve Program Officers' Conference

Prior to the Commanding Officers Conference on 7-8 May 1955, the Reserve Program Officers met on the 5th and again on the 6th of May. CAPT Theodore Blanchard, Special Assistant to the Chief of Naval Research (Research Reserve) and CDR H. F. Burr, Training Officer, presided over these meetings. Officers attending were: CAPT Dundas P. Tucker, C. O. ONR, Pasadena; LCDR H. T. Wordell, RPO, ONR, Chicago; LCDR W. T. Spellman, Executive Officer, ONR, Boston; LCDR Carroll Downes, RPO, ONR, Boston; CDR H. B. Joslin, RPO, ONR, San Francisco; LT William Remick, RPO, ONR, New York; CDR J. E. O'Handley, RPO, Com 13; CDR J. M. Alexander, Com 6; LT N. E. Grigsby, RPO, Com 11; and LCDR J. T. Bedsole, RPO, Southeastern Area.

Discussions on the program of the Research Reserves led to a decision to prepare recommendations on major issues. One of these concerns the Standby Reserve, promotion and active duty for training with pay. Other recommendations are being prepared on Curriculum, Research Designator, and Recruitment.

Commanding Officers' Weekend Conference

On the 7th and 8th of May 1955, a conference of Research Reserve Commanding Officers was held in the Conference Room of ONR Headquarters in Washington, D. C. CAPT Theodore Blanchard, Special Assistant to the Chief of Naval Research (Research Reserve) welcomed the officers to begin the first day, and RADM F. R. Furth, Chief of Naval Research, then introduced VADM R. P. Briscoe of Fleet Operations and Readiness who delivered the opening address. The program then proceeded on a schedule which covered many of the more pressing problems of the Research Reserves.

RADM K. M. McMannes, ACNO (Naval Reserve) spoke on "Reserve Plans and Policies." RADM W. K. Romoser, Ass't Chief of Naval Personnel for Naval Reserve addressed the group on "Naval Reserve Training."

CAPT H. B. Stevens, USNR, C. O., NRRC 3-1, and CDR J. H. Carter, USNR, C. O., NRRC 9-8 made presentations on "How Can the Research Reserve Office and the Reserve Program Officer Assist Me in the Performance of my Duties as Commanding Officer?" LCDR H. T. Wordell, USNR, RPO, ONR Chicago presented the viewpoint of "The Research Reserve Program Officer."

CDR H. F. Burr, USNR, Training Officer, led a discussion on "Mobilization Objectives and Procedures" which included a presentation by LT J. E. Land, USNR, C. O., NRRC 6-2.

In connection with the discussion of the proposed curriculum, CDR C. H. Bowman, USNR, C. O., NRRC 9-2 presented a sample lesson plan on the subject, "ONR Contracts in Organization and Procedures." CDR J. H. Graham, USNR, NRRC 12-1 also presented a sample lesson plan at the close of the conference on the second day. CAPT D. P. Tucker, USN, C. O., ONR Pasadena summarized the conference and made the concluding address to the group.

Lt. William H. Cooke
Talks on Photogrammerty to NRRC 11-4

A familiarity with the application of improved scientific methods to the solution of old problems is, of course, one of the principal responsibilities of the members of a Research Reserve Company. It was quite in order, therefore, when it was learned that a prospective member of Company 11-4, LT William H. Cooke, had recently returned from nearly a year's study at the International Training Center for Aerial Survey at Delft Holland, that he be invited to address the company.

In his talk, LT Cooke brought out the usefulness of a technique such as photogrammetry in a number of situations including one of more than passing local interest.

The problem of subsidence is a serious one in the vicinity of the Long Beach Naval Base, and on the base itself. Buildings have been stretched or compressed to the failure point, drawbridges have been distorted to such an extent as to be made inoperative, and gas and oil lines have been ruptured. In solving the problem of subsidence, as in all others, the first step is to get all the facts, even if they turn out to be somewhat different from popular theories.

While it is true that there is a lowering of the ground level where subsidence exists, if it is uniform over the area covered by a building, little damage results. It is the differential lateral movement of the ground on which the foundations of a structure rests that is responsible for most subsidence damage. When, as has been the case, the ends of a rigid, reinforced concrete warehouse move several feet closer together something has to give. In this case the walls crumpled and cracked.

In order to properly design a structure to be erected in a subsidence area, it is necessary to know in what direction, and how far, the land areas will move. Inasmuch as the land movement may amount to several inches in the course of one year, the usual methods of field surveying parties using plane tables and chains is much too slow. Also the number of reference points practical is insufficient for the precision and accuracy needed to make the necessary allowances for lateral movement in the structure to be erected. By using the standard methods of triangulation and a relatively small number of bench marks or other reference points, a survey might be completed and interpreted in approximately eighteen months.

By the method of aerial survey known as Photogrammetry, the field work could be completed in a single afternoon, and a report could be forthcoming in much less time than that required for a ground survey alone. With the use of photogrammetry every street corner and building may be used as reference points. The cameras and other optical equipment now available have made possible the measurement of lateral position with a mean square error of only plus or minus two inches; the photography can be accomplished from an altitude of 3000 feet.

LT Cooke also discussed some of the many other applications of photogrammetry. Highway route surveys are very quickly and economically compiled by the photogrammetric process. The use of selective filters permits of an accurate estimate of crop damage or stage of development. The height and number of trees in an area may be determined more quickly and economically by photogrammetry than by the traditional cruising methods. Much time may be saved in determining by photointerpretation the locations where soil samples should be taken in making soil surveys. Photogrammetry has proved especially valuable in soil-survey projects as the soil scientist does not have to spend so much time in the field. Most of his decisions may be made in the office, and less skilled technicians can do the actual field work involved in lifting the soil samples.

The Quarterly Journal of Photogrammetric Engineering is suggested as a reference for further reading on this important scientific development.

LT Cooke is the first American to receive the degree of International Training Center Photogrammetric Engineer. He is a full partner in one of the few offices in this country specializing in precision photogrammetric techniques.

Eighth Annual Research Reserve Seminar

The Eighth Annual Research Reserve Seminar will convene at the Office of Naval Research, Washington, D. C. on Monday, 11 July 1955. Officers ordered to the Seminar will report at the BOQ, Naval Receiving Station, Anacostia, D. C. prior to 1600 on Sunday, 10 July. An over-all quota of one hundred research reservists has been established and a full attendance is expected.

In view of the time which has elapsed since the beginning of the seminar program, officers who attended any of the first four seminars will be eligible to attend the seminar this July. Officers who have attended a seminar subsequent to the calendar year 1951 will not be considered eligible.

Specific instructions regarding method of applying for orders to the seminar have been sent to the Naval Districts, ONR Branch Offices, and to the Commanding Officers of all Naval Reserve Research companies.

The seminar program being developed is designed to bring Naval Research Reservists up-to-date on research and development activities in the Navy and in the Department of Defense. It will include field trips to selected research and development activities in the Washington Area. Emphasis will also be placed on Naval Reserve planning, with particular respect to its effect on the Research Reserve program. The program features addresses by a number of outstanding speakers, military and civilian, in the fields of research and development. A brochure is being prepared, including the seminar schedule, for providing officers attending with advanced information. This brochure will be mailed to officers selected when their applications have been approved by the Reserve Program Officers in the Branch Offices.

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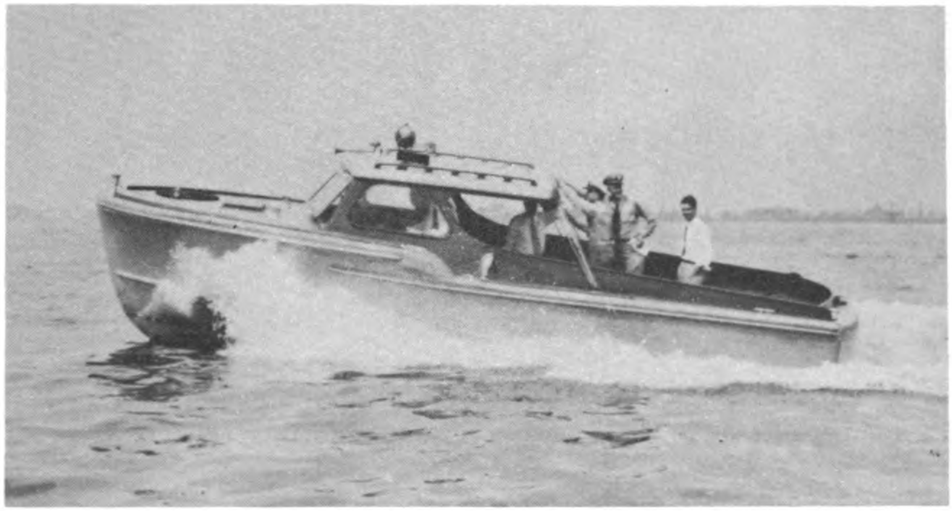
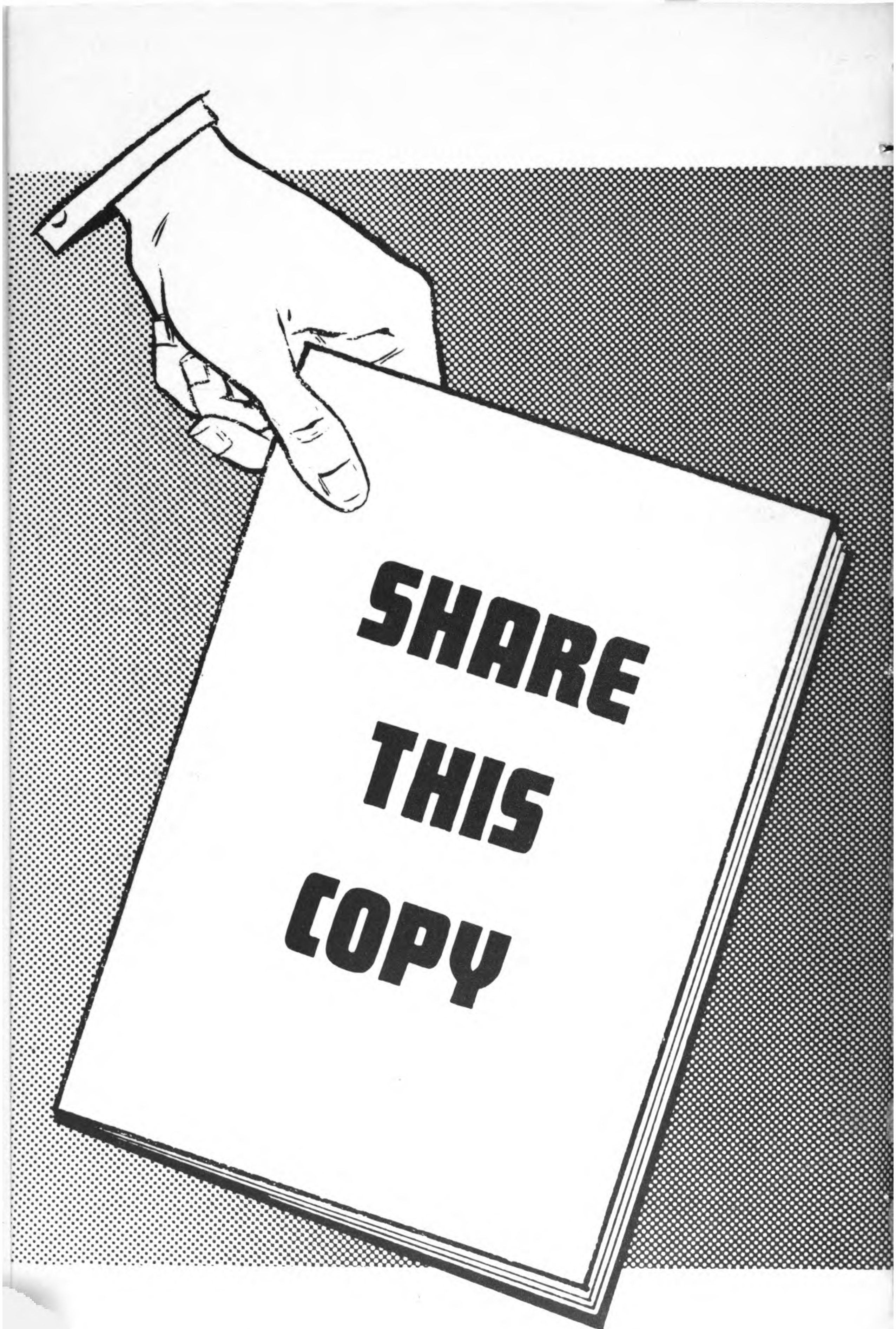


This 28-foot plastic boat has been in Navy use eight years

Test of 12-foot plastic wherry built at Puget Sound Naval Shipyard (see "Improved Small Boats for the Navy" p. 19)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