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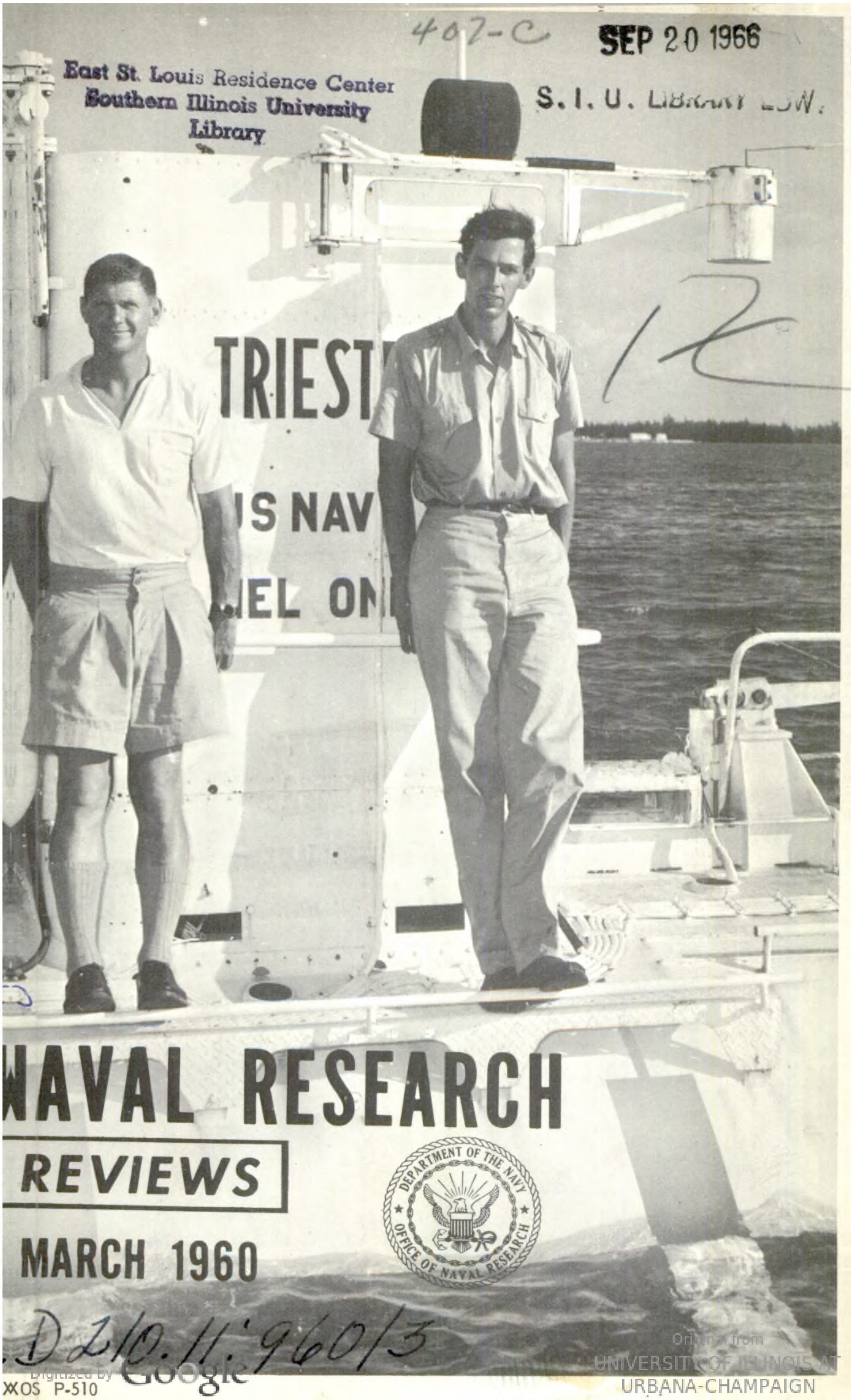

NAVAL RESEARCH

REVIEWS

MARCH 1960

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH

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Portion of a right stereophoto taken in April west of Point Barrow, Alaska, showing typical thawing and freezing action in the arctic regions. The glassy-looking areas (in contrast to the lighter relief areas) indicate refrozen sea ice, as interpreted by sea-ice forecasters. See the related story beginning on page 1.

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Aerial Photography and Sea-Ice Forecasting*

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The function of sea-ice forecasting is to provide tactical support for ice breakers, ships, and convoys navigating waters covered by ice. Ice-forecasting techniques use synoptic, meteorological, oceanographic, geophysical, and ice data. But whereas the first three groups consist of interpolated data measured by instruments, ice data are based on aerial visual reconnaissance of ice observers. The accuracy of data reported depends on the experience of the observer and his ability to judge ice conditions. Flying at different altitudes in varying weather conditions at different hours of the day, the observer is exposed to subjective sensual reactions when formulating his data and constructing his reconnaissance ice chart. It is well known that observers overestimate ice concentrations on flights at high altitudes and tend toward lowered resolution power when they become physically tired.

Utilizing aerial photographs in ice forecasting eliminates the subjectivity and inaccuracy of visual observation, thus improving the reliability of ice data for the construction of ice charts and the distributing of ice forecasts to ships. The limits for the collection of itemized ice data and for the construction of ice charts must fit into the arbitrary forecast categories presently in use: The short-range ice forecasts are for 48 hours or for 5 days; the long-range forecasts are for 30 days or for one year. The different nature of these types of forecasts require the construction of different charts, although they may use the same data.

Ice data collected during reconnaissance flights are usually topographic by nature; therefore, it seems reasonable to use aerial photographic techniques for their evaluation and charting. The objective of a sea-ice aerial photographic project is to develop methods and systematic techniques for the recognition and identification of various ice types and ice features, as well as the prediction of their distribution, formation, disintegration, and movement. Since such techniques are used to predict ice conditions for both short-range forecasts and long-range planning, it becomes necessary to develop speedy methods for converting photographic exposures into reliable practical information concerning sea-ice.

The possibility of utilizing photographs for sea-ice forecasting is based on analyzing the relations between photographic equipment, materials, or processing, on one hand, and the acquisition and utilization of processed materials to obtain practical information, on the other. The

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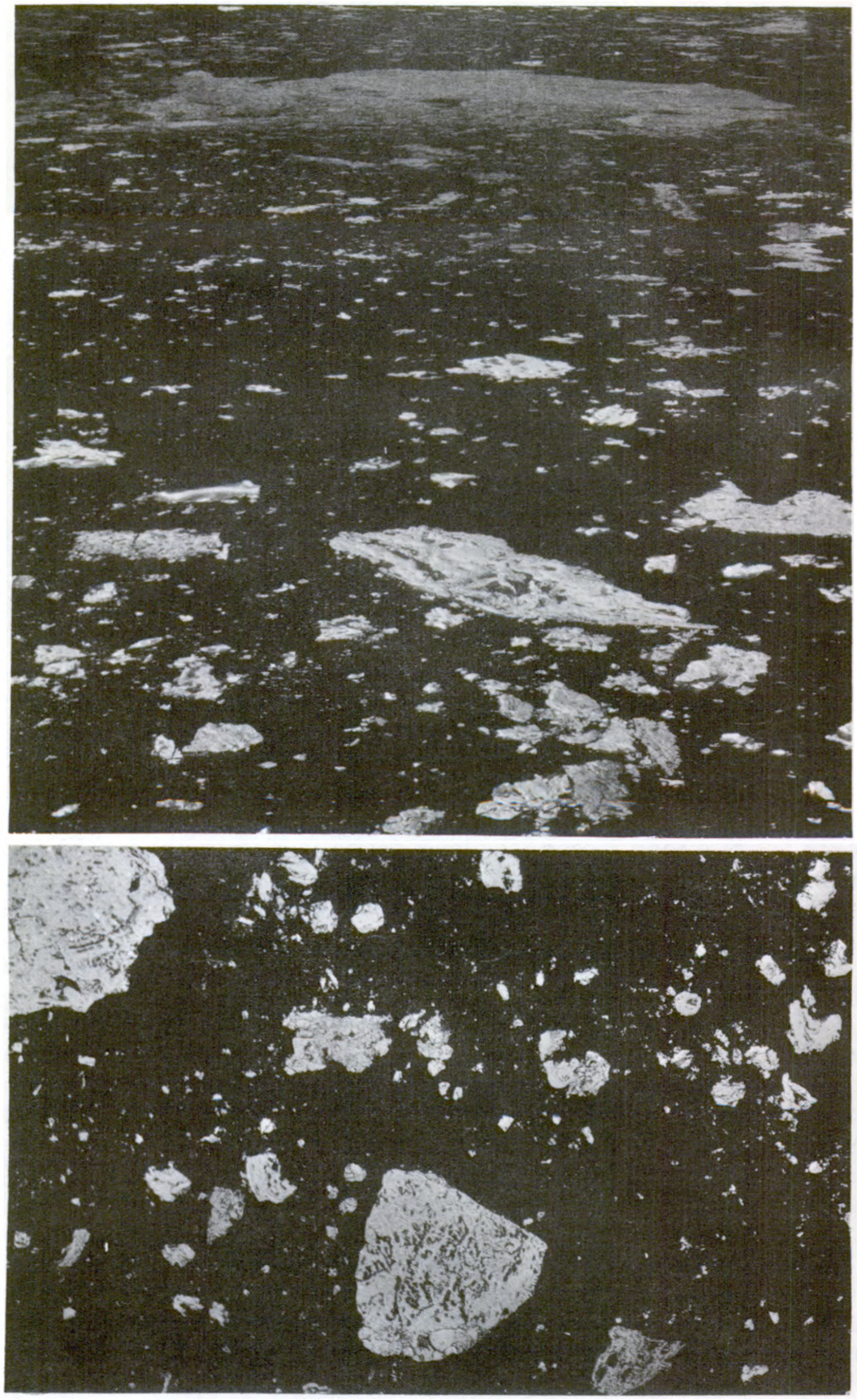

Figure 1—Two-tenths concentration of ice in the Beaufort Sea in July as exemplified by an oblique photo (top) and a vertical photo (bottom scale, 1:10,000). Note the overcast area on upper half of the top photo. Electronic scanning for measuring concentration and floe sizes is feasible in such photographs. The surface of each floe shows melting in progress.

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key factors in such analysis are the film type—panchromatic black-and-white, infrared, color—and the exposure scale of photographs. Each of the resulting photographs must contain a good image of the topical items required for the ice forecast. That is, the methodological problem of how to use efficiently aerial photographs for sea-ice forecast purposes rests on (1) the comparative analysis of sea-ice features in relation to their appearance on photographs and (2) on the measuring techniques for recording the data in a speedy way.

Comparative analysis of photo types and topical items with regard to measurable elements in photographic images resulted in the following three principal categories of topical items: First, there are topical items with area elements which require the measuring of plane (two-dimensional) elements which appear on individual spot shots or in a sequence of vertical shots taken during one single flight. Second, we can distinguish spatial (three-dimensional) elements; these we can also call relief elements requiring vertical series photographs with overlap, or oblique shots taken during one single flight. Third, there are topical items which contain time elements and, therefore, cannot be evaluated by simple measurements in individual or series photographs but require several photographs taken during various seasons along the same flight route or in the immediate vicinity of the flight so as to ensure a progression of changes. But here we have to distinguish between topical items and elements of displacement (two-dimensional changes in the ice patterns and directions of movement) and those which contain elements of ice growth and ice disintegration—changes that affect ice patterns as well as volume and relief configurations.

In each category these factors are to be considered: (1) the relations of ice to water and (2) the relation of ice surface features to one another. Thus, concentration (either absolute or relative by size) (see Figure 1), ice fragments per unit area, shape and orientation of the longer axis of ice fragments, and the area, dimensions, shape, and orientation of features related to sea-ice distribution—such as leads, cracks, and polynyas—are plane elements with two-dimensional relations of ice and water. Dimensions, orientation (see Figure 2), and distribution of ice-relief features and patterns, as well as puddling and snow cover are plane elements with two-dimensional, ice-surface relations. Ice thickness and the depth of puddles are three-dimensional, ice-to-water relations of the space element category, whereas the individual ice-relief features—pressure ridges, hummocks, warping, and also the average roughness of ice—are surface items in the spatial (three-dimensional) category (see Figure 3).

Two-dimensional items with ice-to-water relations in the time-element category are the direction and speed of ice boundaries, such as fast-ice boundaries. The remaining items of this category are those in which changes occur because of melting or freezing—such as the kinds of ice, the age of ice, relative quantities of polar ice during different seasons or shorter time intervals, and the changes in ice surface configurations, including puddle pattern changes.

It is obvious that the entire Arctic Sea cannot be covered by aerial photography during different seasons, and even larger subregions such

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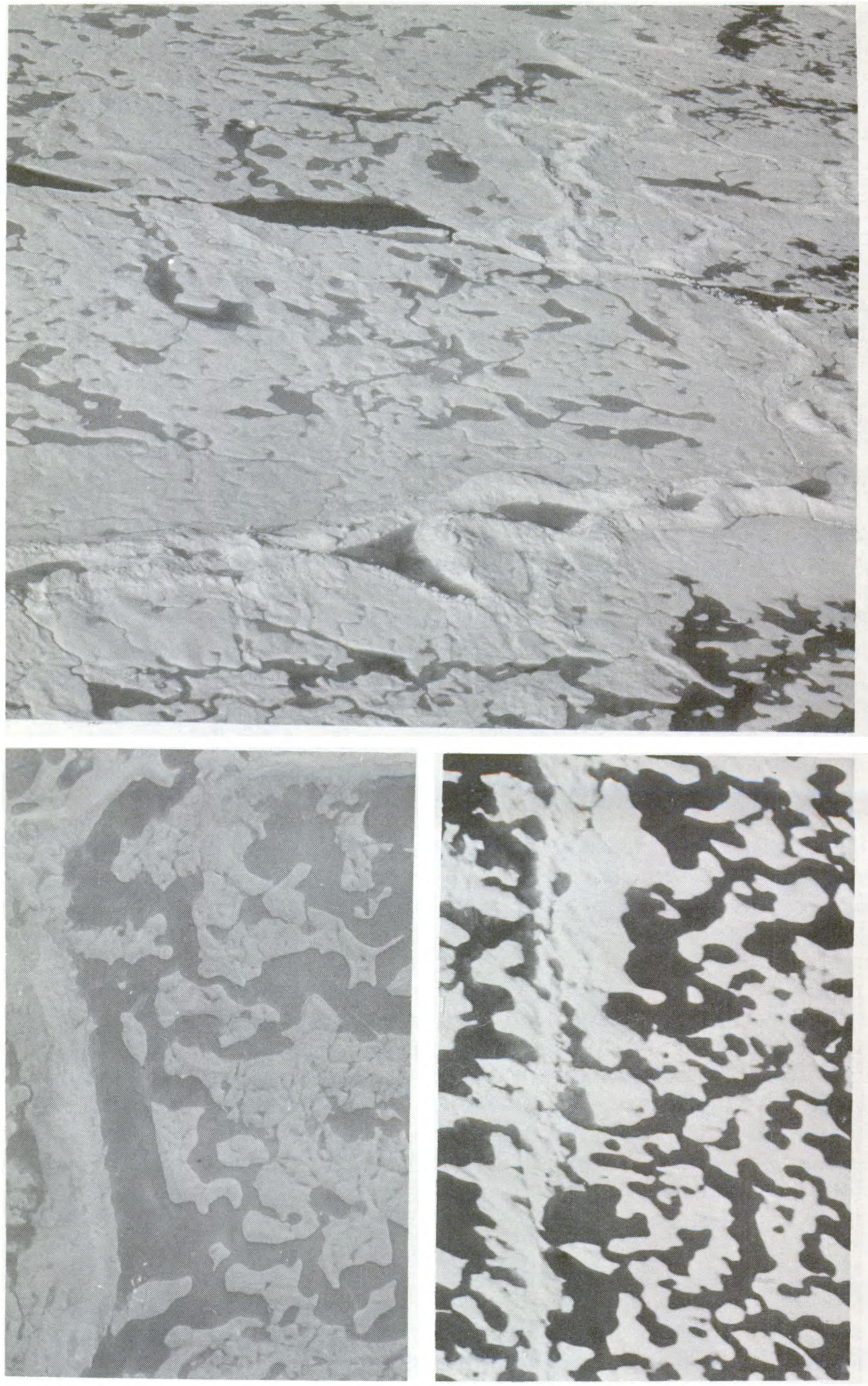

Figure 2—Melting ice floes in the Mackenzie Bay area in August. Top (low oblique): light grey puddles and burned-through ice (dark area, right bottom corner) and lower-pressure ridges. Lower left (vertical): Shallow puddling. Lower right (vertical): burned-through ice. (Scale, 1:200.)

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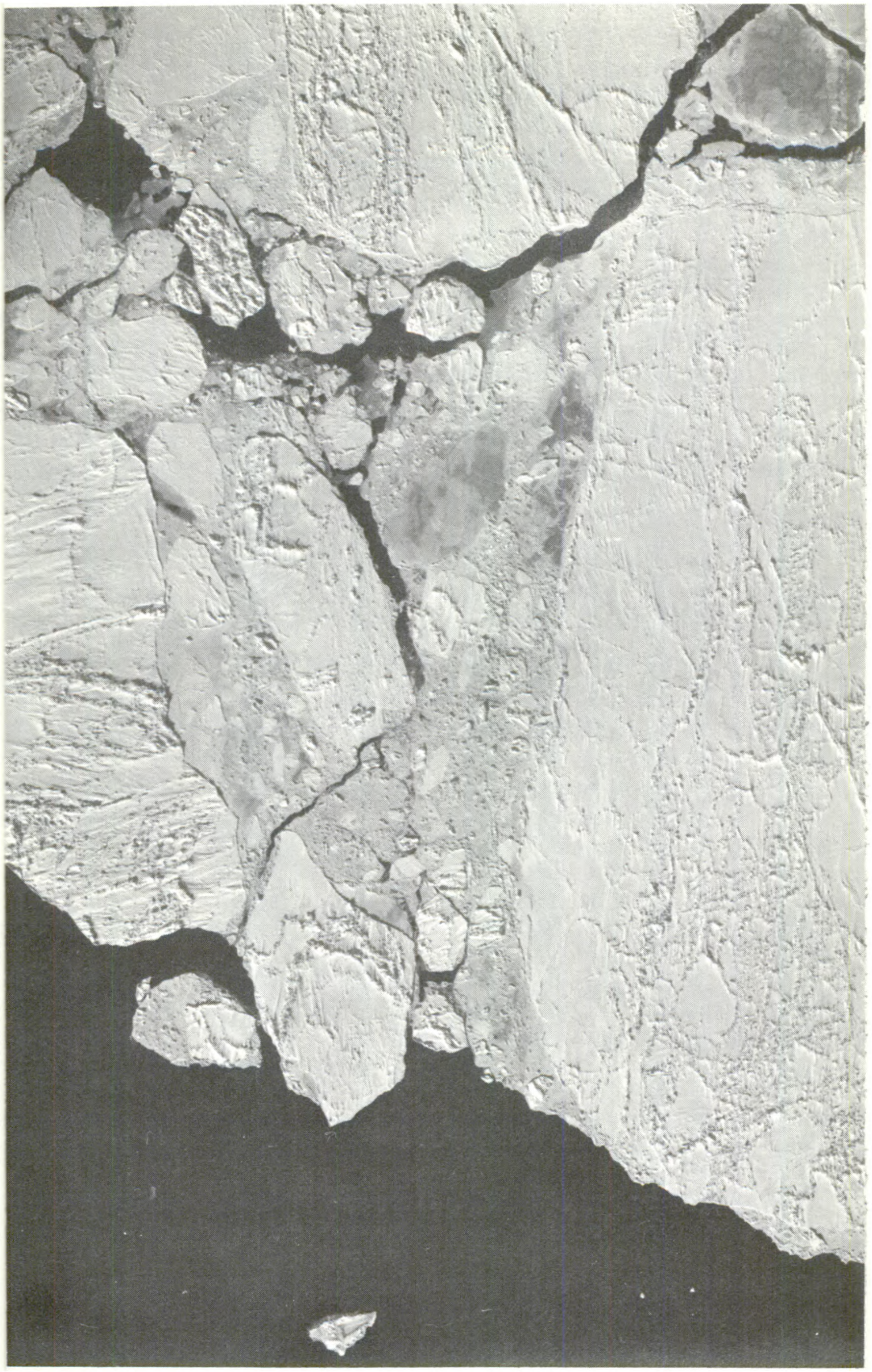

Figure 3—Polar ice breaking up in July north of Point Barrow, Alaska, seen vertically. (Scale, 1:10,000.) Large floes show high-pressure ridges (alined differently) from earlier breaking and re-freezing (dark grey ice between floes) in May and June.

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as the Beaufort Sea, could not be photographed week by week or day by day. Not only is the area too large for such coverage flights, but arctic weather conditions are frequently atrocious, imposing a major barrier to the acquisition of qualitatively good or even fair photographs. Furthermore, good mapping and forecasting requires precise location control, which is difficult at great distances off shore. Therefore, detailed programs have to be prepared which outline the year-to-year tasks of obtaining the necessary photographic coverage. The programs must take into consideration the possible weather conditions and the operational facilities. Moreover, oriented photographs are necessary because undercast conditions and land ties are not always available for series photographs or strip photographs. Oriented photographs alone will make possible the determination of the direction of leads, cracks, pressure ridges, orientation of longer axis of floes, and similar items.

Because navigational operations are confined to certain routes, it becomes imperative to have dense network coverage with decreasing time intervals as the summer navigation period approaches. In the polar pack area spot shots or short strips, spread over the entire season, will suffice.

Whereas the long-range (one-year) forecast leaves plenty of time to develop films and prints, evaluate exposures, and measure topical items, all other forecasts require speedy procedures. Considering that strip photography or series photography usually has to be analyzed, individual exposures may run as high as 300 to 400 per day on days when conditions are right for taking photographs. Vertical photographs of topical item with area elements can be evaluated with an area meter; a superficial estimate can be attained by using an overlay scale-grid series. Tests have shown that these practices are time consuming and of no real value to short-range forecasts. Yet, topical items with area elements are important to ice forecasts because they contain items such as absolute concentration per unit area, relative concentration of various flow sizes per unit area, number and sizes of ice fragments, distribution of concentrations along a navigation route, the orientation of longer axes of floes (which are related to wind directions, the orientation of leads, cracks, ridges, and puddle patterns), and various other items. In regard to area elements, electronic scanning is the technique need for speedy evaluation and recording of sea-ice data. Electronic scanning is favored because of its speed and because film exposures, either positive or negative, can be scanned better than prints. The use of this technique obviates both the lengthy and difficult procedure of developing prints of equal quality and the skilled attention of technicians to correct the loss of detail and sharpness of prints.

In general, the concept involves scanning the negative or positive film by means of a photocell attached to an electronic computer system. An intense microscopic spot of light, generated by a cathode-ray tube, is focused on the field to be counted. As the spot of light crosses the field, it passes through the film and is focused optically on a photo tube. The electrical output of the photo tube depends on the amount of light reaching the tube, which depends on the obscuring effect of tonal differences of the film. This basic device can be attached to the memory and calculating circuits of a logical computer; the resulting information is then fed through auxiliary circuits to an electric typewriter for automatic typing, or it can be fed to a computer and stored for computation. An

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attachment to the electronic device standardizes the scale of the exposure by using a simple focusing procedure. Accordingly, comparative analysis and recording of data become a reality, rendering a timely solution to a vexing problem.

Electronic scanners are now being produced commercially which can count sizes of items in the field as small as two tenths of a millimeter on a screen of approximately 4 by 4 inches. Better resolution is realized if the screen is smaller. No item—such as a floe—is counted twice or more, even if the scanning lines pass over the same item more than once. Recently developed scanners—with 3000 scanning lines per field, synchronized by the time-base generator of the commuter—give a theoretical maximum commuting rate of 9 million particles per second. These scanners are capable of discriminating approximately 20 different grey tones as well as a wide range of colors. Color photographs are of great value to sea-ice forecasting because polar ice and winter ice have different colors. However, the spectrophotometric characteristics of the colors reproduced on color film depend upon the spectrophotometric characteristics of the quantities of three or more dyes used to duplicate a particular color. Therefore, there is no direct relationship between the spectrophotometric characteristics of the object photographed and those of the colors on a color film. Because of this, color photographs can only be used as an aid to panchromatic grey-tone exposures, unless new color photointerpretation methods are developed.

The two-dimensional items of the time-element category are easier to record because speedy scanning makes possible the recording and computing of data on a statistical basis. But, like all items with a time element, dense photo coverage with small time intervals are an essential prerequisite for recording and evaluating ice changes in any arctic area. Scanning may not be applied as readily to three-dimensional topical items where relief is involved and heights or height differences have to be measured and recorded. Stereometric methods on parallax measuring—as used at present—are not only slow and cumbersome but on ice surfaces (where spot height differences rarely exceed 16 feet and the average is about 5 feet), they are almost impossible to apply because, by increasing the scale necessary to achieve accurate measuring, the field of exposure decreases below the adequate size needed for the evaluation of items. Thus only a part of a floe may be shown in the exposure, barring the finding of the average base level to which the heights should be compared.

There are a great number of constantly occurring hurdles in the application of electronic scanning: These include: Haze and fog which affect the quality of the exposures, or prevent photographs altogether; the albedo influences on infrared film; the effect of weather conditions and light reflections from ice surfaces which distort the results on film; and the time lapse between exposing and developing color films. Therefore, the right type and quality photographs are difficult to acquire; also obtaining the minimum necessary coverage of a given area poses a difficult problem. To utilize aerial photographs for sea-ice forecasting will require:

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● A good or at least fair areal seasonal coverage of the navigation region.

● A precise coordination of cameras, films, film processing, and electronic scanning, and other methods, including the standardization of various quality photographs with Log-E-Tronics.

● Training ice observers and indoctrinating them into sea-ice photointerpretation.

Now, if aerial photographic evaluations are applicable and precise and if measuring and recording ice data utilizing electronic scanning prove statistically sound, then it is mainly a technical problem to develop and construct radar screens or a combined instrument, including camera, automatic photoprocessing, and electronic scanning for aircraft or missiles, which can instantly transmit the computed data to forecast stations or vessels. Radar screens would go a long way toward solving problems caused by weather conditions which stand in the way of good areal and seasonal coverage of a selected sea region. They also would eliminate the difficulties caused by lapses and inadequacies associated with cameras, films, and film development. Moreover, the entire acquisition and transmission of data will become speedy enough to meet even the shortest range ice-forecasting requirement.

More About ANIP, SUBIC and SURIC

In reporting on SUBIC (Submarine Integrated Control) in August 1959 and on ANIP (Army-Navy Instrument Program for aircraft) in January 1960, this magazine inadvertantly gave the impression that SUBIC was the pioneer project, and that ANIP came along later. The opposite is true. ANIP was established in April 1953; the program was so productive that SUBIC was implemented along the same lines in December 1956, and SURIC—a similar program for surface ships—was established in 1959. The three are frequently considered together under the title: Man-Machine Integrated Control Research Program.

New-Type Dosimeter

A new-type dosimeter, known as a "thermoluminescent dosimeter," is 20 times more sensitive than the standard film-badge type, familiar to monitoring personnel exposed to radiation. It is reusable, less expensive, and easier to read then its predecessor. The new device, developed by NRL scientists, consists of a special calcium fluoride powder on a supporting plate, which is enclosed in a protective envelope with a glass window. The powder absorbs energy from the impinging radiation. To read the radiation dose, the device is gently heated electrically causing the powder to emit the stored energy in the form of visible light. The brightness of the luminescent "glow" is a measure of the radiation dose—the larger the exposure, the greater the brightness.

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Nutritional Aspects of Infectious Disease*

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The 19th century's most spectacular contribution to medical science was the discovery of the causes of infectious disease; an equally spectacular contribution in the first half of this century was the control of these diseases by public health measures and by sulfonamides and antibiotics. Baffling, though, is the fact that these contributions were made with only glimmerings of the nature of pathogenicity, the ability of certain microbes to cause a disease.

Disease-inciting microbes are given a special name, pathogens, and the animal or plant expressing the disease is termed the host. Microbes include bacteria, fungi, protozoa, and viruses. It has been possible to ask questions but it has been very difficult to get the answers concerning pathogenicity. How does the microbe produce the disease in a host? Why do certain microbes prefer particular hosts or even specific sites in the host? Finally, why should one type of microbe be unable to attack and another closely related type be able to cause a disease? Numerous factors in both pathogen and host appear to be involved in answering these questions. When we consider the great mass of data at our disposal and apply the concepts of biochemistry and genetics, it is possible to formulate an approach—a formula or scheme—to understand better the factors related to both pathogen and host. The following graphic view of the problem may make the arguments easier to understand:

Step 1	Step 2	Step 3	Step 4	Step 5
Entry	Multiplication and metabolism (growth)	Micro-environmental changes	Production of host-damaging factors	Disease

According to this scheme of things, the host may be resistant if it can block the flow of events anywhere along the line prior to reaching the end of the line. The pathogen may not be able to incite disease if it cannot accomplish all the steps. Model systems are being sought to determine the effect of a block at each step by manipulating either the host or the parasite. Both animal and plant pathogens have been used for this purpose.

The successful invasion (step 1) and subsequent growth in the host (step 2) with its characteristic attendant reactions—the disease—are the bases for considering a parasite to be a pathogen and, simultaneously, the host to be susceptible to attack. If the parasite fails to multiply or to metabolize extensively after invasion, this may reflect either

*The work described in this article developed as the result of a contract between ONR and the Univ. of Chicago.

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the absence or loss of pathogenicity for the parasite or the resistance of the host or both. Consequently, pathogenicity must always be defined as an expression of a dynamic two-component system: the host-parasite relationship. Such a definition emphasizes the host as the environment for the pathogen.

Potential hosts continue to live and to function in a world teeming with pathogens because numerous devices have been developed by the host to keep the pathogens from entering into the host. It is possible for a host to harbor pathogens on its exterior and interior surfaces without contracting a disease. A host may survive exposure to an aerosol of pathogens provided that the diameter of the pathogen-bearing droplets exceeds a critical value. Unfortunately, it is impossible to prevent breaks in the surfaces or breakdowns of the filtering systems. Some pathogens have joined forces with such living syringes as the mosquito (yellow fever) and the flea (plague).

Once entry into the host has been effected, the invading microbes meet two environments: a nutritional and an inhibitory environment. To be a pathogen, the microbe must be capable of using the host environment as a growth medium (nutritional environment) and of overcoming the total defense mechanisms of the host (inhibitory environment). The host may prove to be resistant if it does not provide a suitable growth medium or if it presents defense mechanisms that prevent or restrict the potential growth of the parasite.

The great contribution of medical bacteriologists and immunologists concerns the development of techniques for creating an effective inhibitory environment in a normally susceptible host by vaccines and antitoxins. A host becomes immunized if the vaccine proves to be effective in provoking the production of antibodies by the host. If the pathogen produces a toxin, which would be a host-damaging factor in the scheme (step 4), the immunologist devises methods for getting an antitoxin or for getting the host to produce an antitoxin. Unfortunately, vaccines and antitoxins are highly specific and usually require information on the species of pathogen or even strains of a species already present in the host which is under attack. The most successful application of vaccines and antitoxins involves such common diseases as diphtheria, typhoid, and polio, to mention a few.

If we consider vaccines and antitoxins as rifles, drugs and antibiotics are shotguns. Accordingly, the most effective drugs and antibiotics have the broadest spectrum, hitting many species of pathogens and usually all the strains of a species. The pathogens, however, may strike back by producing drug-fast or antibiotic-resistant mutants. Since a mutant is a new type which occurs spontaneously in a population of microbes, their occurrence is almost a certainty. For this reason, it is a constant tug of war between the pathogens and the producers of drugs and antibiotics. The perfecting of a new antibiotic is usually a matter of trial and error; the relatively few successes make all the expenditure of time, energy, and money worthwhile. However, determining the effects of a drug or antibiotic on the metabolism of pathogens would provide a valuable insight in the search for new or more effective drugs and antibiotics.

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Part of the problem of understanding pathogenicity is the question of the high degree of specificity of certain pathogens for specific hosts or specific tissues of a host. Why is it difficult or even impossible to produce a disease in some mammalian species but not in others with a particular pathogen? Why do different strains of one host species differ in their resistance to a given pathogen? Attempts to answer these questions in terms of known sources of resistance have not often been successful. It is conceivable that the answer to some of these questions may involve biochemical differences among tissues of one host, strains of a host species, or among species of host. The nutritional aspects of pathogenicity offer a possible approach to solving one or more of these problems. The role of nutrition in the host-parasite relation refers to the nutritional requirements of the pathogen as they may or may not be satisfied by the host environment, either at the site of inoculation or of localization.

If the parasite cannot satisfy all its nutritional needs, it will neither multiply nor metabolize and the chain of events leading to disease will have been blocked at step 2. It is possible that the host may be resistant by virtue of its failure to feed the parasite. Although it is well known that dietary stress may alter a host's resistance or susceptibility, the relationship between the biochemical constitution of the host and its response to a pathogen has been intensely studied during the last decade.

Rather than determining the biochemical constitution of the host, pathogens with known nutritional needs were used. After exposing bacterial pathogens to ultraviolet light, it was possible to isolate cells which would not grown in a medium containing certain salts and a carbon source (glucose). These cells are termed biochemical mutants. They will grow in the original medium only if a specific organic compound is added. The compound may be an amino acid, vitamin, growth factor, purine, or pyrimidines. The last two classes of compounds are important components in cellular metabolism.

Biochemical mutants with known, specific requirements were inoculated into the host and their ability to incite the disease was determined. If the mutant was no longer a pathogen, it was assumed that the nutritional requirement was not satisfied in the host environment; if the mutant was still pathogenic, it was assumed that the required compound was present in the host in adequate concentration to support the multiplication and metabolism of the mutant.

Biochemical mutants of such pathogens as those causing a type of pneumonia in children, human typhoid, mouse typhoid, the plague, and glanders in horses have been studied. Mutants of these pathogens were injected into mice. Although mutants that needed amino acids, vitamins, growth factors, or pyrimidines were still pathogenic, all mutants requiring purines could not cause the death of the mice. Fluids from the mice did not support the growth of these nonpathogenic mutants. If the mutant lost its need for purine as a consequence of a second mutation, its pathogenicity was restored. Finally, if the purine-requiring mutant was inoculated and then a solution of purine was also injected into the mouse, the mutant multiplied, completed the chain of events already described, and the mice died of the disease. In these experiments, the

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mouse was handled as a living test tube with the mutant being fed by the injected purine rather than the animal itself.

The defense mechanisms of animals are often so complex that they may obscure the role of nutrition in the host-parasite relationship. Therefore, it was decided to conduct a series of experiments in the vegetable kingdom, using bacterial and fungal plant pathogens. It was found that biochemical mutants of plant pathogens displayed a pattern of pathogenicity — that is, certain mutants were able to cause a disease and other mutants could not, depending on the species or varieties of the host species. For example, a mutant of the soft-rot bacterium requiring a specific amino acid, arginine, was not pathogenic for nine varities of radish and three varieties of turnip but was pathogenic for 21 varieties of potato. If crystals of this amino acid were added to the surface of turnip slices previously inoculated with the mutant requiring arginine, areas of soft rot occurred only at the site of the crystals. This observation is complete if analogous to the animal experiments using the purine-requiring mutant and inoculating purine solution.

Experiments with plants have disclosed several different mechanisms whereby a nutritionally deficient pathogen may become nonpathogenic for certain hosts. These experiemnts have indicated that plant pathogens may furnish valid model systems for understanding the possible origins of resistance or susceptibility of animal hosts to nutritionally deficient pathogens. Viruses are characteristically unable to multiply outside of the cells of their hosts. It is interesting to note that the first experimental evidence for the origin of infectious diseases came from studies in plant pathology.

Recent advances in virology are based on using tissue cultures rather than intact hosts. These advances stem from studies on the viruses that attack certain bacteria. These investigations provided the model system for virologists studying viruses that attack animals and humans. It is now almost pointless to add that basic research often yields information of a vital and practical application. Yet, the continuous growth in the direction of greater specialization in the sciences often leads investigators to overlook the ideas and stimulation that may be derived from distant but related fields. With very few exceptions, all living things are subject to disease. It is possible that to be alive is to become an environment for another organism. A study of the factors of pathogenicity should include information from plant diseases as well as animal diseases. It is best to cover all bets in the gamble to stay healthy and free of infectious diseases.

Navy researchers have found that intermittent or pulsed combustion can increase gas-turbine efficiency 10 percent or more. NRL's Mechanics Division, after testing a valveless pressure-gain combuster, reports fuel savings as great as 17.3 percent with an improved design at the maximum bleed flow (0.762 pounds per second). Even greater savings for the pulse-jet burners as compared with the conventional type were recorded at lower operating levels. The researchers also say that the pressure-gain design is "not yet optimized," and further improvement can be expected.

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The Allowance List Test Program

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A logistics problem of great importance to the Navy is the determination of spare parts to be stocked aboard ship; this is commonly referred to as the Allowance List problem. Its significance follows from the strategic requirements for maximum mobility and independence of combatant ships. The less that ships have to rely on shore and afloat sources for supply and repair support, the greater will be the ships' effectiveness and potential for meeting future and uncertain strategic situations. These conditions of mobility and independence are of consequence for all ships and are receiving greater emphasis for weapon systems such as the Polaris.

The George Washington University Logistics Research Project (a contract group sponsored by the Logistics and Statistics Branch of ONR), and the Research and Development Division of the Bureau of Supplies and Accounts, have been engaged in a joint study on the Allowance List problem. This study has been termed the Allowance List Test Program (ALTP).

The usual definition of an Allowance List is that it represents the range (number of different items) and depth (quantity of each item) of specific line items to be stocked on an individual ship. This covers the ''initial stocking'' aspect of the shipboard inventory problem. In ALTP it has been extended to include shipboard ordering and resupply policies. The Allowance List problem is considered by ALTP to be an inventory problem including such concepts as safety levels, recorder levels, etc., with certain modifications necessary to account for features peculiar to shipboard problems. One feature particularly worth noting is that the amount of spare parts to be stocked is subject to a space constraint. Also there may be other limitations such as a budget constraint.

To study the problem, attention was focused upon submarines. This choice was due to their importance and severe space limitation for spare parts. Another important factor was that the various kinds of required data were most readily available for submarine-type vessels. Since the problem concerns stocking parts for some future time, a principal consideration is that of estimating future usage. Attention must then be given to the nature of usage behavior. To this end, a first extensive analysis of usage data was conducted. This included data pertaining to 12 submarines over a 4-year period. The data was available through the Korean Data Collection Program which was a large-scale usage data collection by the Logistics Research Project. The data included the use of all types of items (for example, electronics, ordnance, mechanical, and electrical items) and represented usage incurred by or on account of each of the ships—that is, data represented

Bracketed information is used in this article in lieu of footnotes — in the interest of easier reading. (This information does not constitute editorial comment.)

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usage by the ship itself as well as usage from support sources (for example, shipyards and tenders) on account of each of the ships.

One significant finding as a result of this analysis concerns the usage of individual spare parts by (or on account of) a ship is extermely low and sporadic. For example, in observing the usage of parts by (or on account of) 12 submarines, most items (75 percent) which were expected to be expandable (deemed wearable) showed no usage over a 4-year period for each and all of the 12 vessels. This problem is further complicated by the fact that approximately 70 percent of the items which were used demanded only once in the 4-year period. The situation observed is of such a nature as to disallow the adequacy of utilizing conventional approaches to inventory problems, even the most modern ones. Briefly, the problem is that the demand characteristics cannot be represented by any of the standard probability distributions. [Since this first analysis other studies have been conducted. These included additional years for the same ships as well as data for other type ships. The conclusions have been the same.] How to treat those items which have not shown usage in the past but may in the future (almost all items used in one year are not used the following year) is of paramount importance.

A principal conclusion related to shipboard stocking policies is that greater emphasis should be given to determining the range of items to be carried than to depth. Given the situation where usage is so highly unpredictable, one question then raised is: How does one select the range of items to be stocked? This gives rise to an explicit consideration of the military worth of spare parts. Although there is a general need for consideration of military worth, the need became acute in the light of how the items were used.

To measure the "worth" of spare parts, one submarine—the USS TIRU, including its entire population of installed parts—was selected for an experiment. The concept adopted was to consider the military worth of a part to be a function of its relative importance to the component in which it is installed and the relative importance of the component to the ship's mission. For the experiment an assumption was stated which included a description of a typical 60-day wartime patrol with no supply replinishment or repair support available from afloat or shore activities. Two questionnaires were utilized, one of which was directed at gaining information on the importance of each component. A component was assigned one of four possible codes, as follows, representing the result of failure of the component.

- Code 1 Termination of patrol.
- Code 2 High risk—restriction on tactical capability.
- Code 3 Moderate risk—no necessary restriction on tactical capability but resulting in decrease in efficiency.
- Code 4 Negligible effect.

Each of 1335 component applications was independently rated by three experienced submarine officers. The three sets of answers were almost perfectly consistent. About 15 percent of the components were assigned high worth (codes 1 or 2) and 85 percent assigned low worth (codes 3 or 4).

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The other questionnaire, answered by experienced CPO's and civilian technicians, was directed at the relative importance of a part to its parent component. For each of about 32,000 part applications, questions of the following kind were answered. Can ship's force replace the part? Can the part be manufactured on board? If the part failed, are there standard jury-rig procedures? If the part failed, can the component operate satisfactorily with no compensation for loss of the part? Based on the results of these questionnaires, one means of classifying the parts was to assign one of the following codes to each part.

- Code A There is no possibility of compensation for lack of the spare.
- Code B Compensation for lack of the spare is possible via manufacturing or jury-rigging.
- Code C The part is not necessary for component.
- Code D The part cannot be replaced by ship's force.

By combining results from both questionnaires and employing the codes just listed, a part application may be assigned to one of 12 categories. (1A, 1B, ----4C). [Parts which cannot be replaced of the ship's force (code D) may automatically be excluded from the Allowance List.] If parts assigned codes 1A, 1B, 2A, 2B are considered "high worth" and the parts assigned other categories are considered "low worth" about 28 percent of the part applications installed were judged "high worth" and about 72 percent judged "low worth." These findings are extremely important in their marked contrast to the implicit and sometimes explicit operating assumption that all parts are equal and highest "worth."

Various models of the Allowance List problem have been formulated. Most of these are variants of a basic formulation which may be described in a general manner. There are essentially two "rounds" of stocking. For the first round only high-military-worth items are candidates for stocking. The complete range of high-worth parts, space permitting, is placed aboard ship; items with smallest cube are stocked first. The depth of these items to be stocked in this round is a function of their population — that is, the number of times the part is installed. [One procedure is to stock the square root of the population. Thus far, this has produced the best results.] For this round, past usage is ignored. Parts which were not used in the past of "high worth" are included while parts which were used in the past of "low worth" are not included in this round. The second round is based on military worth and usage. Items are stocked in order of military worth and the depth of each item is based on past usage. For items with "high worth," the expected usage is added to those stocked in the first round. If expected usage is zero, no additional quantity is stocked. Items with "low worth" are stocked in this round if their expected usage is justified.

The ALTP formulations have been tested and are being tested by machine simulation. Utilized data, pertain to the USS TIRU, and include usage, military worth, population, and item cube data. The sample then may be considered to be one submarine and its entire population of installed parts. The nature of the large-scale simulation is to stock the ship for a future (interoverhaul) period using various stocking policies and usage data, military worth data, etc. For the "present" periods as well as the "future" periods, actual usage data are employed. The

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effectiveness of a particular policy are evaluated by comparing the "sample" Allowance List with the actual usage which actually occurred in the subsequent period. [At the present time there are available usage data for 9 years.] Shortage counts are then evaluated to provide a basis for measuring how well each of the policies performs in terms of its objectives. The ALTP Allowance Lists are also compared with the ships actual list.

Through the use of these simulations, it has been clearly demonstrated that ALTP formulations yield significant improvements in the effectiveness of Allowance Lists with no increase in costs. With proper use of a military-worth concept, historical demands, and other information, as well as data processing techniques, the gains over existing procedures are extremely significant.

The ALTP formulations result in:

- Feasible endurance loading of spare parts.
- Minimum high-military-worth range shortages.
- Significant reduction of depth shortages for all (high or low worth) items.
- Effective purging from Allowance Lists of the many items having both low worth and zero usage.
- Capability for tailoring Allowance Lists to meet specific operational objectives.

An operational test of ALTP procedures will be initiated for the USS TIRU in the near future. It is expected that this will clear the way for Navy-wide implementation. During the operational test, various problems associated with Allowance Lists—such as information and communication problems—will be further examined.

The past 30 years have probably been the driest period in southern California in at least 50,000 years since before the last Ice Age, says Carl L. Hubbs, Professor of Biology at the University of California's Scripps Institution of Oceanography. The situation may continue he warns: "We ought to be prepared, on the existing incidence, to meet the very strong possibility—if not the probability—of even increased aridity in the southwestern regions, including southern California and Baja California. It would be most unwise to plan otherwise." Hubbs has found that as the ample lakes and running streams that characterized the West in the Ice Age shrunk to isolated pools and trickles, distinctive fish populations were developed. During the past 30 years he has seen several of these populations die out after having survived perhaps 12,000 years of increasing drought.

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U. S. Navy Communications Moon Relay (CMR) System

On January 28, the Navy gave to representatives of the press, radio, and television a demonstration of the Communications Moon Relay (CMR) System at the U. S. Naval Radio Station, Cheltenham, Md. Highlight of the show was the reception of a telephoto of the carrier HANCOCK, transmitted via moon relay from Hawaii. Admiral Virden's introductory remarks for this occasion appropriately described the communications system, and provided a brief history of its development. These remarks are therefore quoted in full.

Introductory Remarks

RADM Frank Virden

Assistant Chief of Naval Operations (Communications)

"This occasion marks the Navy's first public demonstration of a new mode of communications, which uses the moon as a passive reflector for relaying radio signals. The capabilities of this system include facsimile and the multichannel teletypewriter mode of operations. Picture transmission of Navy facsimile via the moon is a milestone in the development of communications. The demonstration today will utilize four multiplex teletypewriter channels, three of which will carry two-way operational traffic simultaneously with one channel carrying press exchanges between Cheltenham and Hawaii.

"Although the electromagnetic frequency spectrum is very wide, certain natural phenomena have required the majority of the world's long-distance radio communications both military and civilian, to concentrate in the medium and high frequency portions of the spectrum. The moon relay mode of communications opens up a new portion of the spectrum for high-capacity, long-range communications.

"The Moon Relay Communication system or CMR demonstrated today uses ultra-high frequencies which are useful only for direct line of sight transmissions and they are not affected by ionospheric disturbances. These ultra-high frequency waves are directed to the moon by a high-powered transmitter using a highly directional, narrow beam antenna. The radio waves are reflected by the moon and are collected by a high-gain directive antenna at the remote receiving terminal. The transmitting and receiving antennas must both be electronically visible from the moon. Intentional jamming of this communication system requires the use of very high power and can only be accomplished by another station also in the line of sight of the moon. Any new frequencies that can be used are valuable contributions to assist in meeting the rapidly increasing requirements of the world for rapid long-range communication. This Navy system of communication by Moon Relay uses ultra-high frequencies which can provide many communication channels over this 480,000-mile path.

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"The Navy CMR system is still classed as experimental, but it is a working experiment. It is being used to pass operational messages when other systems are not operable because of ionospheric storms. The importance of this new system is that it offers reliable, high-capacity, long-distance communications limited only by the availability of the moon. This limitation will be eliminated some day by the use of man-made satellites hovering in fixed orbits about the earth. Satellite relay systems based on principles similar to the Navy's CMR system might eventually be used to provide simultaneous world-wide television telephone service to the people of all nations.

"In 1946, the Army discovered that radar echoes could be received from the moon. The Naval Research Laboratory proved the feasibility of using moon reflection techniques in 1951. In 1954, the Naval Research Laboratory successfully transmitted both continuous wave or "CW" and voice radio signals between the East and West Coasts of the United States via the moon. A few months later the Navy conducted the first one-way single channel radio teletypewriter communications between Washington, D. C., and Pearl Harbor, using the moon as a passive reflector. These initial tests proved that the moon reflection technique was practicable. The late Mr. Quarles, then Assistant Secretary of Defense for Research and Development, witnessed tests, saw the implications of this new technique and became a strong supporter for developing this new mode of communication. The impetus he was able to impart through use of Department of Defense special funds is an important factor in the creation of the system you are witnessing today.

"The Chief of Naval Operations directed the Bureau of Ships to develop a reliable, long-range, high-speed communication system using the new technique and making it adaptable to either natural or artificial earth satellites. In May 1956, the Bureau of Ships concentrated with the Developmental Engineering Corporation in Washington to develop the system. The system in operation today is far more than a space-age experiment. It is system with operational application now. It is providing valuable information that can be used for the design of more sophisticated systems.

"The moon may not be as sophisticated in its satellite role as the bards and poets would say it is in other ways. As a satellite, however, it is 100 percent reliable; it is always in orbit, and like some of the other best things in life, it's free."

Looking at the via-the-moon facimile recording at Cheltenham, Md., are (left to right): Robert W. Moss, Assistant Project Engineer; Warrant Officer R. P. Grimes, Navy Project Officer; and Robert L. Hensell, Chief Project Engineer.

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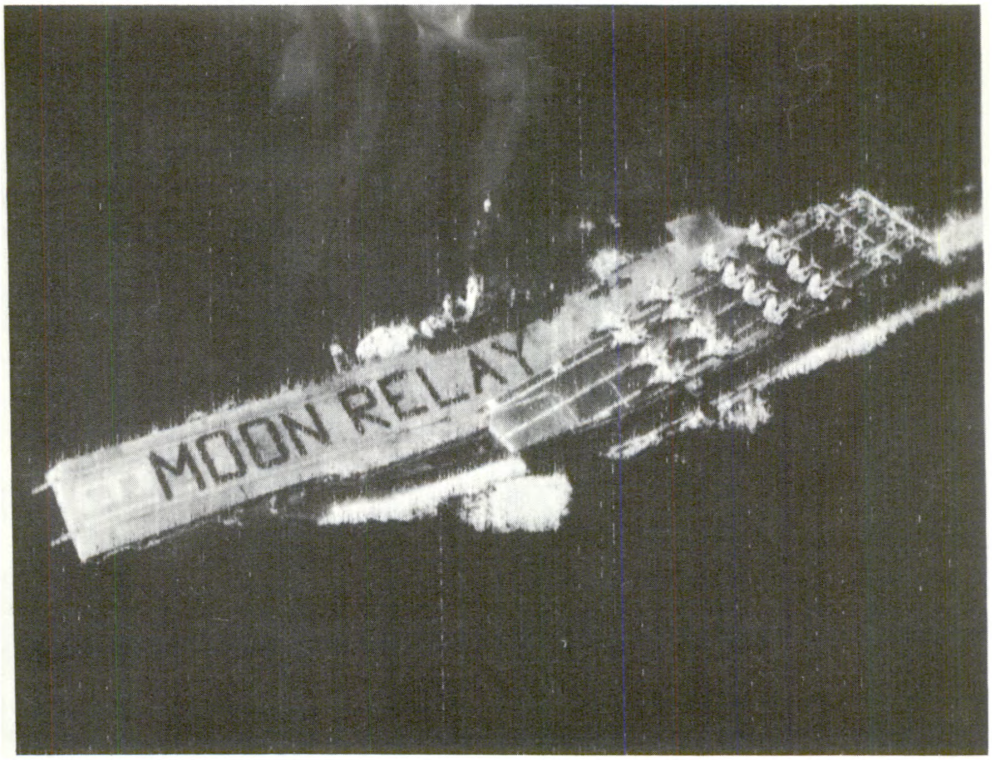
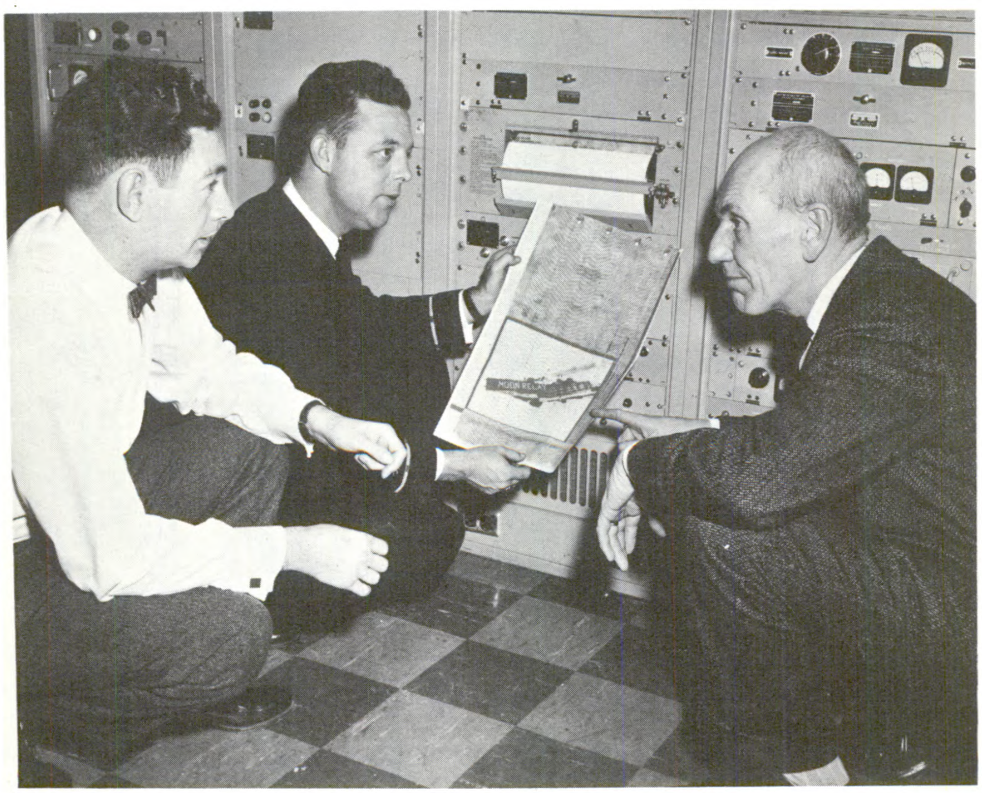


First official photograph transmitted by Moon Relay from Hawaii to the Continental United States. Officers and men of the HANCOCK (CVA-19) spell out "MOON RELAY" as the ship operates in Pacific waters.



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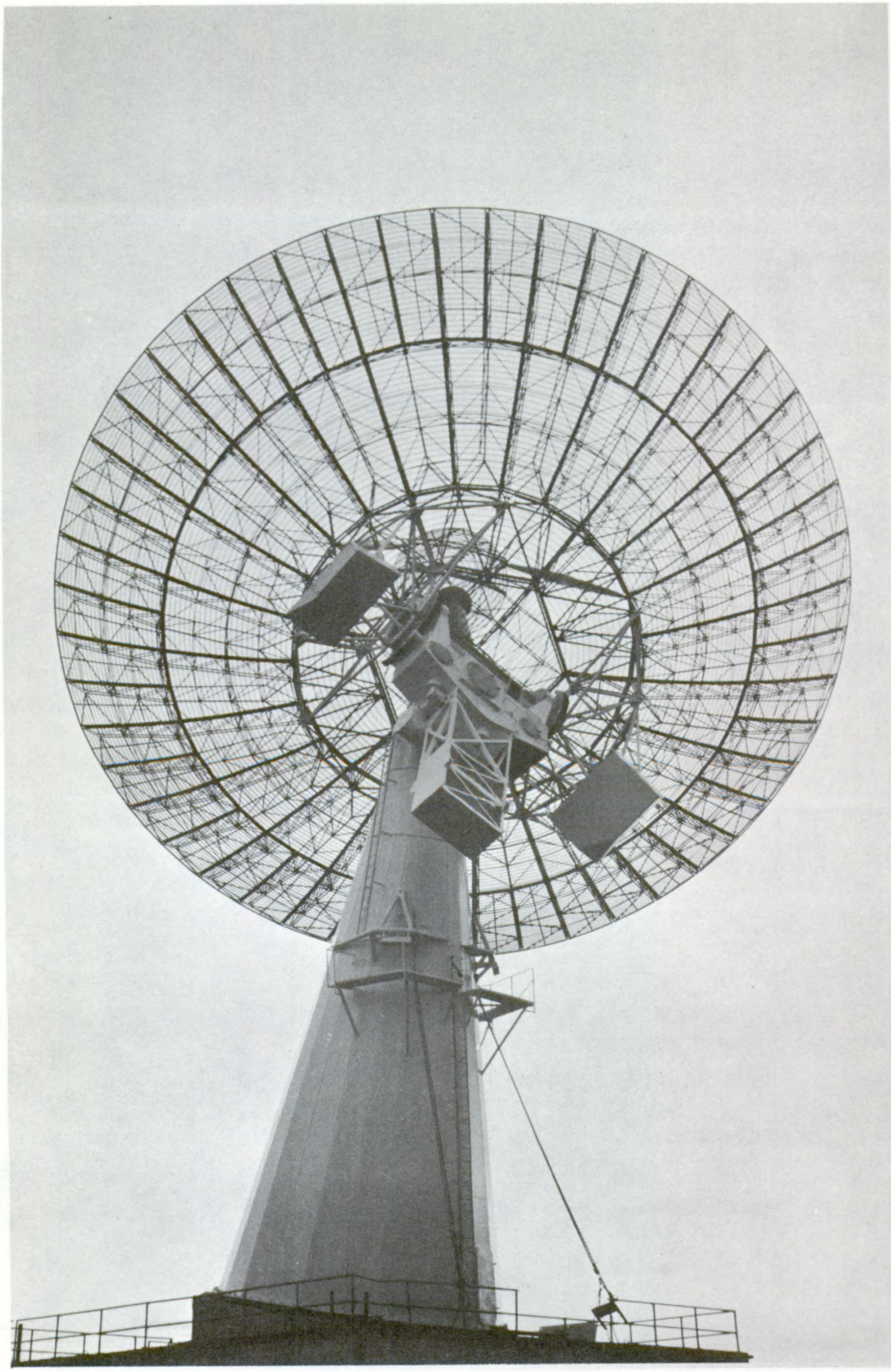

Dawn silhouettes the 84-foot transmitter of the Navy's Moon Relay Station at Opana, Oahu, Hawaii — with the moon, object of the dish's affection, seen overhead. The unit and its twin (the receiver station at Wahiana, Oahu) comprises one of four Navy CMR sites.

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TRIESTE Goes Down to 35,800 Feet—Officially

The exploits of the bathyscaphe* TRIESTE offer excellent testimony of ONR's policy of supporting research wherever it promises to produce results, and whatever the nationality of those doing it. Thus 2 years ago the U. S. Navy purchased the TRIESTE—a device built in Italy by two Swiss engineers, Auguste and Jacques Piccard—for research to be carried out in European waters. The early experiments, done in cooperation with the IGY program in oceanography (Naval Research Reviews, April 1957), proved so successful that ONR decided to continue the work in much deeper waters. The submersible was subsequently shipped to San Diego, where it joined the research flotilla of the U.S. Navy Electronics Laboratory.

LT Don Walsh who accompanied Dr. Jacques Piccard on TRIESTE's 35,800—foot dive to Davey Jones' locker in the Marianas Trench, off Guam.

Last fall the operating theater was shifted to the Marianas Trench, southwest of Guam. There Dr. Andrew Rechnitzer of NEL and Dr. Jacques Piccard broke the world's deep-diving record by going

*Compounded from the Greek: bathy (sea depths) plus skaphe (boat).

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down to 18,000 feet (Naval Research Reviews, December 1959). (See the photo of Dr. Rechnitzer and Dr. Piccard on the cover of this issue.)

The record was more than doubled on January 23, when Piccard and Navy LT Don Walsh took the TRIESTE down to an official 35,800 feet, reaching the ocean floor in the deepest chasm of the earth's crust. (This depth was previously announced in the press as 37,000 feet, the official calculation at that time.)

Going down took 4 hours, 48 minutes; 20 teeth-chattering minutes were spent on the bottom, and the return trip to the surface took another 3 hours and 17 minutes. The time on the bottom was spent recording data on temperature, pressure, and so forth, and in making observations through the Plexiglas ports of the spherical gondola. Lights fixed to the exterior showed living and moving objects, proving that life does exist even in the stygian blackness 7 miles below the ocean surface.

The depth program, far from being a stunt, was established to provide scientific knowledge of sunlight penetration, underwater visibility, transmission of man-made sounds, and marine geological studies.

SPASUR Stations Pick Up UNK 60-1

The Space Surveillance Stations, three in the deep south (Georgia-Alabama-Mississippi) and three in the southwest (Arizona-New Mexico-California), have established an electronic satellite-detection fence across the southern United States (Naval Research Reviews, March 1959). On February 11 it was announced that the fence had proved its effectiveness by picking up an hitherto unidentified satellite or a piece of space junk: an orbitting stage of a launching vehicle, or somebody's space missile that accidentally got into an orbit. The Navy promptly named it UNK 60-1, for the first unknown detected this year.

The SPASUR system was developed by NRL for the Advanced Research Projects Agency. The center station in each of the complexes is a transmitter, and the flanking stations—some 250 miles east and west—are receivers. The triple array thus establishes a long-base "radio interfermeter," erecting a high fan-shaped beam through which a satellite will eventually pass—unless it is too high or in an equatorial orbit. Data from the complexes are fed into a tracking and prediction computer center (NORC) at Dahlgren, Va. The computer output is fed automatically to a display (SPASCORE) which shows, with impressive accuracy the present position and past and future paths of all identified orbiting objects.

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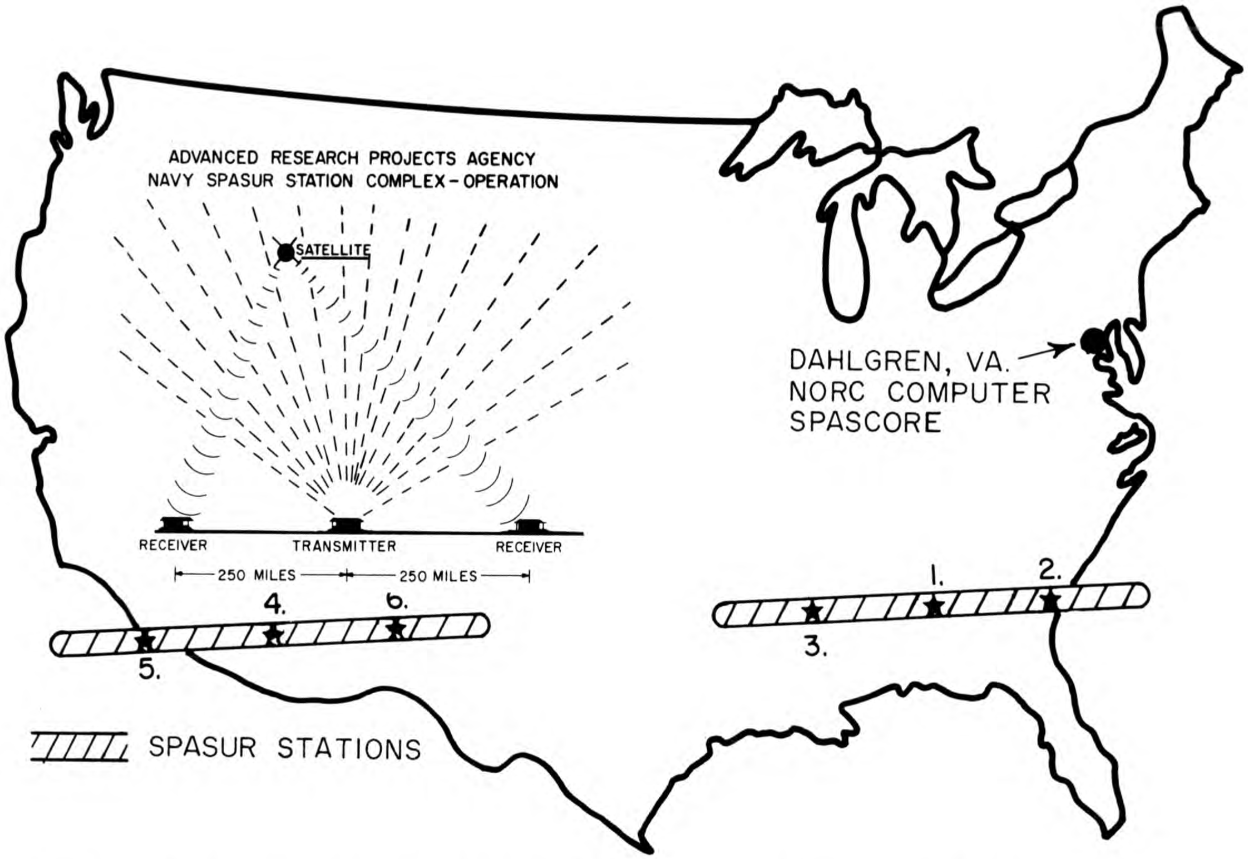

The SPASUR complexes. Three are in the deep south (1—Jordan Lake, Ala., 2—Ft. Stewart, Ga., 3—Silver Lake, Miss.) and three are in the southwest (4—Gila River, Ariz., 5—Brown Field, Calif., 6—Elephant Butte, N.M.); 1 and 4 are transmitters, and 2, 3, 5, and 6 are receiving stations.

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Skyhook Balloon Launched from VALLEY FORGE

Disappointment mixed with a measure of success sums up the story of two flights by the world's largest balloons, both cut short of their hoped-for flights, and a mishap on the third and final launching attempt.

The first of the two successful flights was launched from the aircraft carrier on January 26. It achieved an altitude of 116,000 feet, but remained aloft only 8 hours, instead of the 48 recommended for maximum return of scientific data. The gondola was jettisoned after the balloon was blown off course and headed for the jungles of South America. The gondola was recovered at sea and repaired for reuse in the second flight.

On January 30, the second of the 411-foot balloons was inflated with 10 million cubic feet of helium and left the flight deck of the support carrier VALLEY FORGE. The ship was then about 100 miles south of the Virgin Islands. After rising to a height of 113,000 feet, the balloon began to descend slowly to near 60,000 feet as the cool night air contracted the helium. Following a flight of 26 1/2 hours, the gondola was released 240 miles southwest of San Juan, Puerto Rico, when once again the balloon appeared to be heading for South America. The destroyer COMPTON recovered the instrument package after being directed to the scene by a Navy hurricane-hunter aircraft. She then steamed for San Juan to transfer the gondola to a special MATS plane for its flight to Norfolk, Virginia, then on to Chicago.

Of its entire flight, the gondola remained above 100,000 feet for only about 5 1/2 hours. Professor Marcel Schein, who heads the scientific group from the University of Chicago, expressed hope that some scientific data had been recorded on the nuclear emulsion carried in the gondola.

Meanwhile back aboard the VALLEY FORGE everything was going perfectly in preparation for the launch of the third and last balloon when the tapes holding the balloon to the deck gave way, letting the giant drift aimlessly upward—a shapeless blob of polyethelene. Fortunately the gondola and its scientific cargo was left on the flight deck.

The purpose of the flights was to measure cosmic-ray activity at altitudes up to 120,000 feet. The balloons carried sheets of emulsion sensitive to cosmic-ray activity, much in the same way as photographic film is sensitive to light. After recovery, the emulsion was to be returned to the University of Chicago to be processed by scientists who are working in cosmic-ray research under the direction of Professor Schein. The huge stack of processed emulsion sheets will be divided among scientists in 14 countries for analysis.

Cosmic-ray research with balloons is not new. In this experiment, however, each balloon took aloft the unprecedented weight of 2500 pounds, including 800 pounds of emulsion, a gondola, ballast, and control equipment, above most of the earth's atmosphere.

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The ten-million-cubic-foot balloons needed to lift this weight are by far the world's largest. They were built by Winzen Research, Incorporated, of Minneapolis, Minnesota, for the Office of Naval Research and are almost twice as big as the previous record holder, a six-million-cubic-foot Navy balloon used in a cosmic-ray flight in September 1959 to carry a 94-pound load to an altitude of 149,000 feet.

Launching operations were termed highly successful by the balloon crew. The hard core of the launch team is a 7-man civilian group from Winzen Research, Incorporated, manufacturers of the giant balloon, the world's largest. Edwin F. Lewis, chief of flight operations for Winzen, praised 12 Navy men working closely with the launch crew. ''Captain E. M. Stever, Commanding Officer of the VALLEY FORGE did some superb ship-handling in an unusual situation,'' Lewis said. The ship must maneuver to counteract changing wind conditions and create an absolute calm on the flight deck so the 500-foot-high balloon will not be adversely affected. Donald Foster, Winzen chief project engineer, added that the launch proved that there are no insurmountable problems in launching big balloons off ships.

After launch at 6:37 a.m. EST (on 26 January), the balloon climbed satisfactorily, heading westward along the trajectory predicted by previous test balloons. At about 11:30 the balloon reached the desired altitude. At this point it was caught by winds from the northeast.

It was tracked continuously by aircraft from Airborne Early Warning Squadron 4, based at Jacksonville and flying for this operation from the Naval Air Station, Roosevelt Roads, Puerto Rico, and by ASW aircraft from the carrier. LTJG Howard C. Curran, pilot of one carrier-based AD5W Guppy aircraft, tracked the balloon for about 40 minutes. ''From our altitude, about 10,000 feet, the balloon appeared a brilliant silverwhite, about the size of a dime. We could see it 25 or 30 miles away. Crews in our planes used bubble sextants and relayed information to the ship for plotting or flew below the balloon giving 'mark underneath.' From this data, the ship was able to compute the balloon's course and speed.''

Dr. Schein had hoped for a longer flight because the purpose was to capture more ultrahigh-energy, cosmic-ray particles caused by collision of primary particles and subsequent showers or ''jets'' of secondary particles. These ''jets'' are caused by collision of the primary particles with nuclei in the emulsion. This makes possible a greater number of individual ''events'' for study and a greater possibility of statistical comparison of the events. Dr. Charles Braden, National Science Foundation physicist aboard the VALLEY FORGE, says ''If interesting high-energy cosmic ray events are recorded on the emulsions, our purpose will have been achieved. The Navy has made every effort to ensure a successful scientific operation.''

Editor's note: While this research note was being readied for the printer (GPO), Professor Schein died in Chicago of a heart attack while ice skating.

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M.I.T. Lincoln Laboratory's Magnetic-Film Memory Unit and High-Speed TX-2 Digital Computer

A magnetic-film memory unit, installed in a high-speed TX-2 digital computer, continues to give an entirely satisfactory performance after more than 6 months' routine operation at the M.I.T. Lincoln Laboratory, Lexington, Mass. This is believed to be the first successful operation of a practical memory-computer application. The memory unit has a capacity of 32 ten-bit words, suitable for evaluation testing, and serves as an experimental prototype for larger units. Its read-and-write cycle of 0.8 microseconds is consistent with the speed of the computer, although bench tests have demonstrated successful operation at a cycle as short as 0.4 microseconds.

One-millivolt output signals are obtained from each memory element—actually a circular spot of thin Permalloy film (82 percent nickel and 18 percent iron), 750 Angstroms thick, 1.6 millimeters in diameter, and centered 2.5 millimeters apart—of each memory array. The spots are deposited by evaporation on a flat glass substrate (0.1 millimeter thick), and they are arranged as a 16-by-16 "spot square" (256 spots to each array). The memory unit, as installed in the TX-2, is shown in Figure 1. An experimental memory array is shown in Figure 2. The transistor drive and sensor circuits, surrounding the two memory arrays, can be seen in Figure 1.

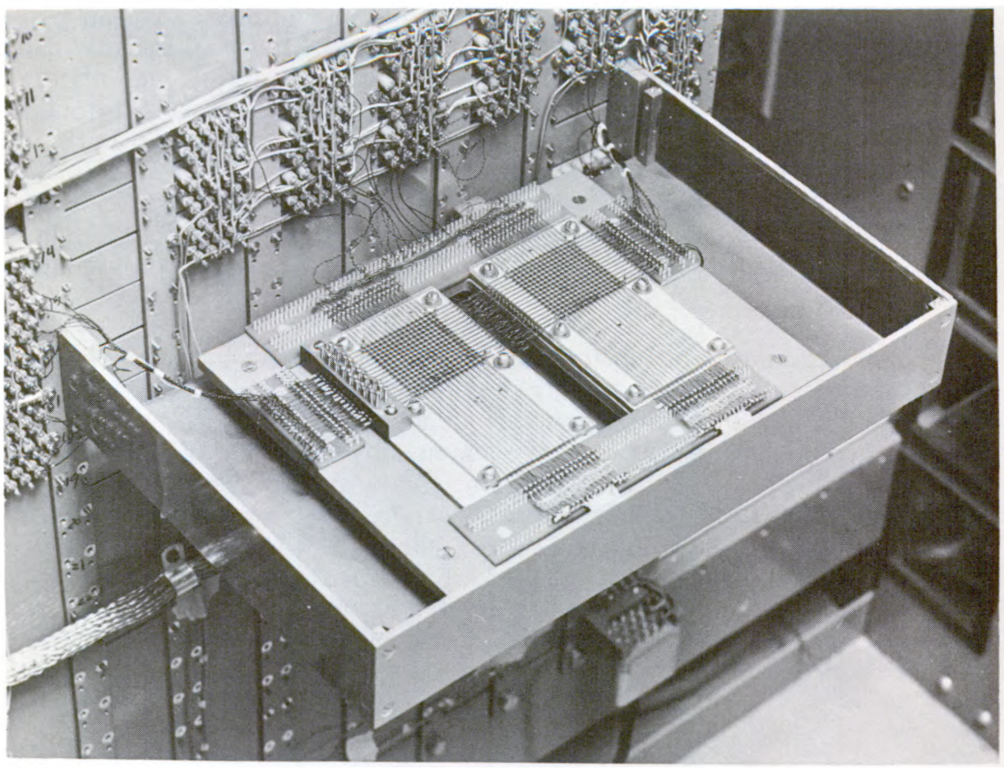

Figure 1—A magnetic-film memory unit installed in high-speed TX-2 digital computer at the M. I. T. Lincoln Laboratory. The two memory arrays (center) are surrounded by the transistor drive and sensor units.

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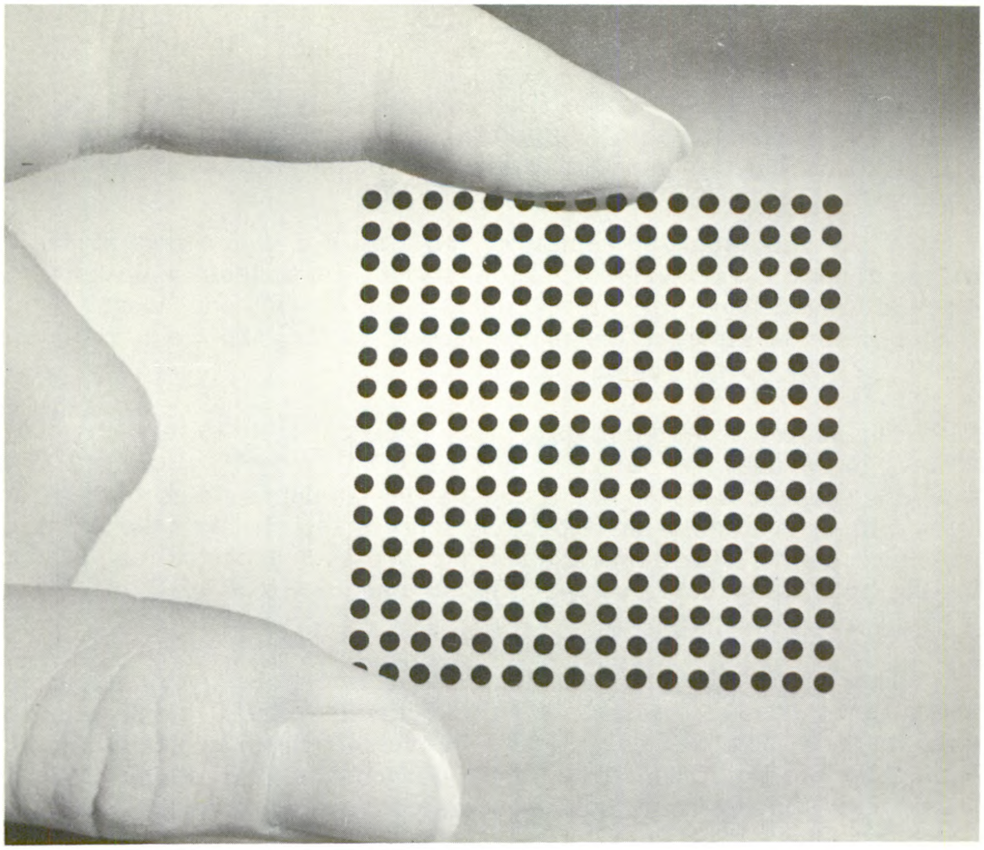

Figure 2 — No, this is not a section of a pegboard — far from that! This is an experimental memory array similar to the two arrays of the magnetic-film memory unit installed in the high-speed TX-2 digital computer.

A thin-film memory has several potential advantages over the more familiar ferrite toroidal core memory: faster cycle time, lower power dissipation, greater compactness, and simpler fabrication. The Laboratory's memory unit now in operation confirms these advantages, although none of them have been fully exploited in this first developmental application. Both the magnetic-film memory unit and the high-speed TX-2 digital computer were developed by the Lincoln Laboratory and supported by ONR and others.

SEA GULLS AND PLASTIC OWLS

The Navy Electronics Laboratory at San Diego recently did some research on the problem of sea gulls roosting on the NEL oceanographic tower—via the biweekly activity report of the Scientific Department, ONR, Pasadena. In response to NEL's query for advice, an ONR, Boston, researcher suggested the use of plastic owls. NEL followed the suggestion and plastic owls were placed on the tower. The last word on the subject was to the effect that the beautiful put pesky seal gulls haven't returned in over 5 weeks, since placing the plastic owls on the tower.

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Project Talent

"Project Talent" is the first scientifically planned national inventory of human talents: the aptitudes and abilities of a people. It will be conducted this month in order to coincide with the 1960 population census.

A carefully selected sample of half a million high school students will be given a 2-day series of examinations. These tests will measure many different kinds of things, and will be carried out through local school systems all over the nation—in the country and the city, and in public, private, and parochial schools.

The scores from the tests will be made available to the individual school, to be used as the school wishes, but "Project Talent" will not evaluate specific schools nor compare one student with another. The tests will be available only to those schools selected as a part of this scientific study. The tests are not intended as substitutes for present testing programs; they are special instruments scientifically designed for this particular purpose.

This project covers more than school activities; followup studies are planned. The project will seek to determine what these people are doing in their jobs or in higher education one year after graduation from high school. The first survey and later questionnaires also will ask about their interests or hobbies. A young person may have a hobby which involves a special talent in photography or music, for example, but that interest may not be revealed in ordinary school work. These examinations will be designed to measure potential aptitudes and abilities of a more general sort in addition to measuring what the student knows.

New electronic scoring machines, coupled with high-speed electronic computers, make it possible to process thousands of test items in a small fraction of the time required in the past. Each of the 500,000 sets of student's answer sheets will contain about 2000 items. These one-billion bits of information will require 1250 machine-hours for initial scoring, reporting to schools, and recording on magnetic tape for analysis and future followup studies. The analyses of these data on high-speed computers are expected to take less than 100 hours. This data processing would have required millions of man-hours of work as recently as 5 years ago.

The principal factor in the initiation of this project, however, is that the nation has begun to appreciate the importance of assuring an educational system designed to offer proper training and opportunities to students having diverse aptitudes and developmental needs. It is financed for the most part by funds from the United States Office of Education, with funds provided by the Cooperative Research Program. Support for the project is provided also by the National Institute of Mental Health and the Office of Naval Research, with aid in the planning stages from the National Science Foundation. Dr. John C. Flanagan, Professor at the University of Pittsburgh and Director of the American Institute for Research, prepared the initial proposals for the study and is the responsible investigator.

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On the Naval Research Reserve

Reserves Selected for Promotion

Eight hundred and forty-two Naval Reserve line officers have been selected for promotion to Captain and 951 to Commander by the FY 1960 Reserve Selection Boards. Of this number, 99 are Research Reservists; 55 were selected for Captain and 44 for Commander. Fifteen of the Research Reservists selected are Commanding Officers of their companies. Congratulations are extended to these officers.

FOR CAPTAIN

	NRRC		NRRC
W.J. Alfriend	6-1	A.H. Lagrone	8-5
S.E. Atherton	1-7	K.J. Latimer	13-6
G.H. Ayres	8-5	W.E. Liljestrand	8-4
R.O. Blau	5-8	A.V. Logan	13-5
E.O. Box	8-8 (C.O.)	J.R. Lyman	5-8
T.S. Brown	6-13	A.W. McReynolds	11-5
W.B. Brown	9-15	J.K. Mitchell	1-1
C.B. Cannon	13-6	W.B. Mitchell	11-8
L.A. Clousing	12-3	G.L. Neely	12-5
C.M. Cox	5-1 (C.O.)	E. O'Neil	3-8 (C.O.)
L.R. Dailey	5-10	N. Pace	12-5
G.Z. Dimitroff	1-7 (C.O.)	L.T. Palmer	6-13 (C.O.)
C.H. Donovan	6-4	E.F. Peters	9-13
J.J. Edgerly	6-16	F.E. Ridley	12-3
J.D. Fahey	12-5	J. Rockwell	13-1
P.H. Flint	1-1 (C.O.)	W.F. Seedlock	12-3
D.W. Fraser	11-7	J.W. Smith	5-8 (C.O.)
M.A. Gabrielsen	3-2	W.P. Smith	9-20
A.E. Hamilton	11-7 (C.O.)	G. Sprugel	5-10
D.T. Hawley	6-8	W.H. Thames	8-3
C.A. Hering	12-8	G.E. Thelen	13-1
J.K. Hicks	13-1	C.S. Tilton	1-1
G.W. Hyde	3-1	T.J. Wadsworth	13-6 (C.O.)
A.S. Jensen	5-4	R.W. Wagner	1-1
A.P. Kelso	11-2	B.A. Wambsganss	12-3
C.A. Keyser	1-3	R.L. Woodcock	12-3
O.C. Kreider	9-5	M.S. Worley	13-1
F.E. Kulman	3-1 (C.O.)		

FOR COMMANDER

	NRRC		NRRC
D.C. Alexander	1-5	R.L. Chambliss	5-2
A.C. Alter	4-2	C.H. Chrisman	5-9
W.E. Baker	5-4	H.E. Conzett	12-5
J.A. Bassham	12-5	R.A. Drews	9-16
A.E. Bell	9-7	R.C. Epps	12-2
R.E. Borup	4-1	V.R. Evans	5-4

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	NRRC		NRRC
B.F. Gillette	12-8	G.L. Nelson	8-13
O.R. Gilliam	3-5	C.F. Pautzke	13-1 (C.O.)
M.J. Gorham	12-5	R. Puricelli	9-23 (C.O.)
J.H. Hickey	3-2	EH. Rayermann	11-9
R.M. Hodges	6-5	R.R. Rickard	6-3
J.T. Holloway	5-10	R.W. Schubert	3-1
P.M. Howell	11-10	R.B. Skelton	6-2
B.J. Jaskoski	9-1 (C.O.)	A.S. Skopetz	1-1
B.E. Jones	11-1	A.S. Soltes	1-1
E.H. Kinelski	4-1	J.C. Stallings	8-4
J.E. Land	6-2	J.B. Thaler	3-2
R.C. Mackeown	3-7	H.E. Troxell	9-12
W.E. McConnaughey	5-8	E.J. Warchol	13-4 (C.O.)
K.C. McLaughlin	9-7	J.W. Wicks	3-2
P.F. Merenda	1-2 (C.O.)	E.C. Winslow	1-2
M.M. Miller	3-1	R.B. Woolley	11-5

Statistics based on the records of the Research Reservists selected for promotion are as follows:

Officers selected for Captain

Date of Rank	Designator	Year of Birth
Earliest 7-1-45	1105 - 27	Earliest 1901
Latest 8-1-53	1405 - 13	Latest 1919
Median 7-1-51	1355 - 8	Median 1912
	1455 - 4	
	1315 - 3	

Officers Selected for Commander

Date of Rank	Designator	Year of Birth
Earliest 7-1-44	1105 - 37	Earliest 1907
Latest 7-1-55	1405 - 3	Latest 1924
Median 7-15-51	1455 - 2	Median 1919
	1665 - 1	
	1355 - 1	

Research Reserve Company Activated

NRRC 9-10 on the campus of Northwestern University, Evanston, Illinois, was activated on 9 February 1960 with 10 charter members. CAPT Alban Weber, USN, University Attorney, is the new Commanding Officer. CAPT L.P. Hoskins, USNR, Assistant for Research Reserve of the Office of Naval Research branch office, Chicago, opened the activation ceremony; CAPT Weber then read his orders and assumed command of NRRC 9-10.

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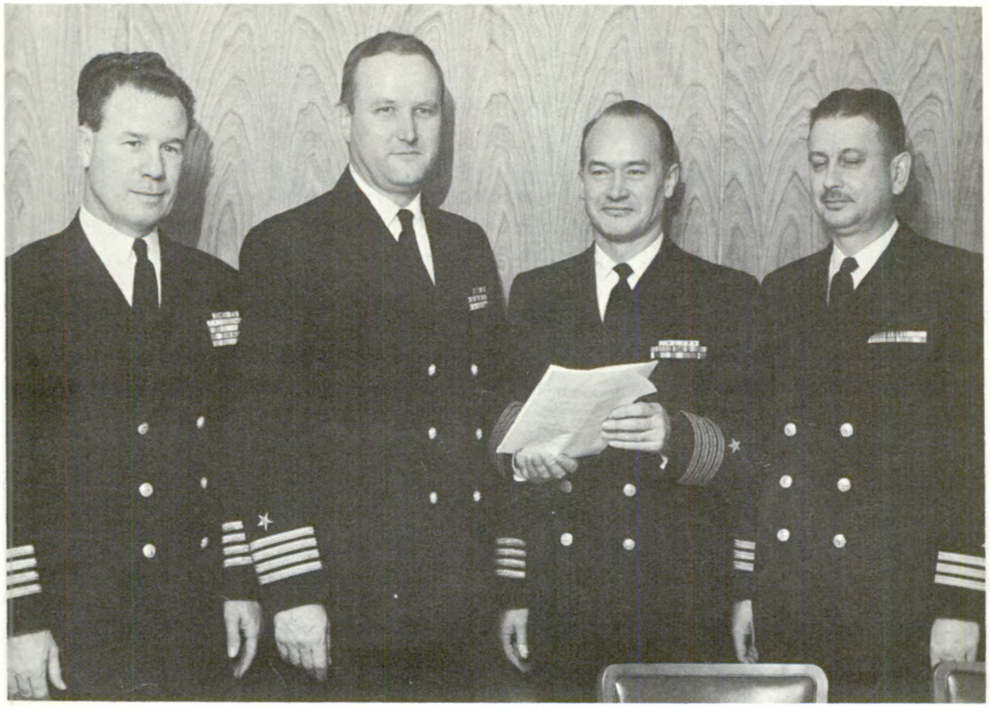

Present at NRRC 9-10 activation (left to right): CAPT R. J. Toner, USN: CAPT Alban Weber. USNR; CAPT J. P. Aymond, USN; and CDR L. P. Hoskins.

Among the guests who attended the ceremony were the following: William S. Kerr, Vice-President of Northwestern University; CAPT Aymond, USN, Special Assistant to the Chief of Naval Research (Research Reserve); CAPT R. J. Toner, USN, Commanding Officer, U.S. Naval Reserve Officers Training Corps Unit at Northwestern University; and LTJG L. A. Witucki, USNR; and Miss Gwendolyn Thyren, of the ONR branch office, Chicago.

The Charter members of NRRC 9-10 are:

CAPT Alban WEBER
CAPT William A. HUNT
CDR Richard W. EVANS
LT James J. CAREY
LT Robert A. CHALMERS
LT Thomas R. HARWOOD
LT Karl G. HENIZE, JR.
LT James P. MARTIN
LT Robert T. WOODWORTH
LTJG Russell CHANDLER, JR.

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ONR Plans Research Reserve Seminar

The last Research Reserve Seminar for FY 1960 will convene in Washington, D. C., for 2 weeks beginning 6 June 1960. About 100 officers are expected to attend the meeting, which is open to all services. The ONR seminar is under the general direction of CAPT J. P. Aymond, USN, Special Assistant to the Chief of Naval Research (Research Reserve). Technical direction will be supervised by the Research Director, Dr. F. J. Weyl.

Again this year the conferees will meet as a complete group and later will form into smaller groups to study particular fields of research and development. The four fields of study will be as follows: Frontiers of Navy Physics; Control Systems Research; Environments of Naval Operations; and Naval Problems in the Life Sciences. Insofar as possible, officers will be allowed to select the area in which they have primary interest.

Complete List of Research Reserve Seminars

Since publication of the January Naval Research Reviews, a revised list of Research Reserve Seminars for FY 1961 shows that 1 August 1960 is the convening date for the Guided Missile (West Coast) Seminar at Pasadena, Calif. Also subsequent to publishing the list, a new seminar on Electronic Computers has been scheduled. The convening date for this new seminar is 17 October 1960 at Stewart Air Force Field, Newburgh, N. Y.

The complete list of Research Reserve Seminars planned for FY 1961 is as follows:

Research Methods, Columbus, O.	10 July 1960
Training Device Center, Port Washington, N. Y.	17 July 1960
Nuclear Science, Idaho Falls, Idaho	24 July 1960
Naval Research Laboratory, Washington, D. C.	14 August 1960
Guided Missile (West Coast), Pasadena, Calif.	1 August 1960
Research Planning & Management, Princeton, N. J.	21 August 1960
Life Sciences, Brookhaven National Laboratory, Upton, L. I., N. Y.	11 September 1960
Electronic Computers, Newburg, N. Y.	16 October 1960
Nuclear Science, Oak Ridge, Tenn.	27 November 1960
Aviation Medicine, Pensacola, Fla.	19 March 1961
Research Reserve Seminar, ONR, Washington, D. C.	4 June 1961
Great Lakes Seminar, Great Lakes, Ill.	11 June 1961

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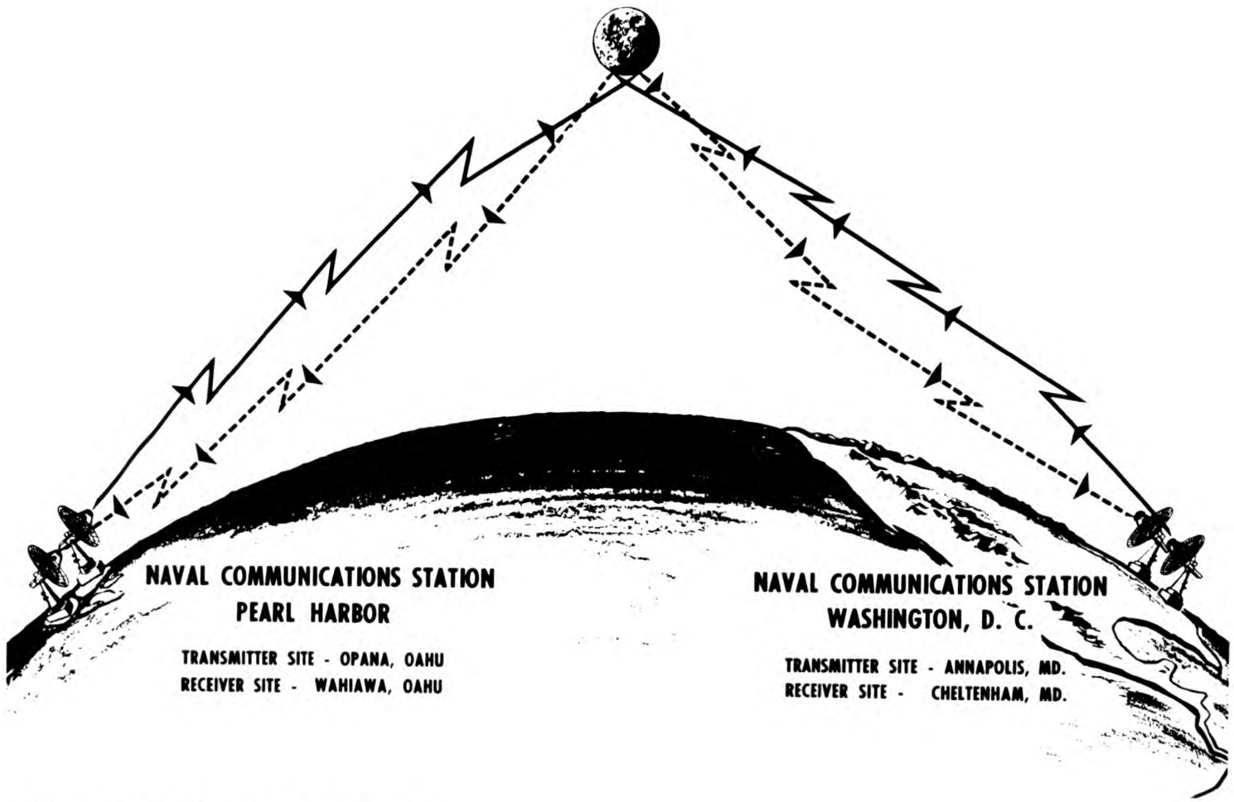
COMMUNICATION MOON RELAY SYSTEM



See the related story on page 17.

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IN THIS ISSUE

NAVAL RESEARCH reports highlights of technical progress in research by Navy laboratories and contractors and the development of important naval research facilities. The magazine is listed for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. Subscription price: $1.50 per year in U. S. and Canada; $2.00 per year, foreign; $0.15 per individual copy. Changes of address should be sent to Code 740, Office of Naval Research, Washington, D. C. Use of funds for printing this publication was approved by the Director of the Bureau of the Budget, February 12, 1958.

Dr. Andreas B. Rechnitzer (a LCDR in the Research Reserve), of NEL, and Dr. Jacques Piccard, Swiss scientist, standing on the deck of the bathyscaphe TRIESTE. Dr. Piccard and his father, Auguste, jointly designed and built the craft in Italy. See the story on page 21 and a photo of LT Don Walsh who accompanied Dr. Piccard on the 35,800-foot dive (2000 less than at first calculated).

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