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The STRATO-LAB system has special instrumentation for gathering scientific information while aloft and for radio communications with stations on the ground.

Navy Gets Better Acquainted with the Stratosphere

The role of the Navy in upper atmosphere research has been brought into bold relief by the recent flight of two naval observers (Mr. M. D. Ross, ONR, and LCDR M. L. Lewis, USN, BuAer) in the specially designed balloon gondola called the STRATO-LAB (see Cover Photo). This was the first of a series of manned flights scheduled for the STRATO-LAB project which has a carefully planned program of research laid out for the future.

The two observers who went aloft in the flight of 10 August 1956 were well qualified aerologists with considerable experience in meteorology. While much of the STRATO-LAB program is related to the work of the meteorologist, there are several other important lines of research that will be followed.

The beginning of some of the planned STRATO-LAB investigations go back to 1946 when the Office of Naval Research pioneered in the development of plastic balloons. At that time, it was realized that a stable platform was needed for carrying out desired scientific investigations to gather information of value in upper-atmosphere physics, nuclear energy and cosmic radiation, and in connection with future high-altitude flight. The basic problem was to find a vehicle capable of carrying a payload to sufficient altitude and remaining there long enough to make the desired observations. Inherent limitations of planes, rockets, and rubber balloons used in high-altitude studies precluded their use for carrying observers to the stratosphere.

The initial project, called HELIOS, under contract with General Mills, Inc., called for the construction of plastic balloons which would make possible a flight to the stratosphere with a manned gondola equipped with a battery of scientific instruments to obtain information of value to science and never before obtainable. It was anticipated that the balloon-borne gondola would remain at ceiling, 100,000 ft, about ten hours and would collect data during the entire flight from launch to recovery.

Dr. Jean Piccard and Mr. O. C. Winzen were among the principals in the project, working with CDR G. W. Hoover, USN, who was at that time with the Training Device Center of ONR. The concept of this system was the use of a thin plastic material which permitted a reduction in the weight of the balloon itself to only a fraction of that of rubber balloons and would therefore allow a cluster of the plastic balloons to reach a much higher altitude. Many connected with this first plastic balloon project have continued to work on the problems of launching a stable laboratory into the stratosphere.

After a year's study, plans for the manned flight were abandoned because the technology of plastic balloon flights had not been developed sufficiently to make the flight feasible. The studies definitely proved the feasibility of using plastic balloons to take scientific instruments to high altitudes for periods ranging from a few hours to a day or more. In this way some, but not all, of the desired information could be obtained.

Accordingly, the Office of Naval Research initiated Project SKYHOOK and the first flight of a SKYHOOK balloon, developed by General Mills, Inc., occurred on 25 September 1947. Launched at St. Cloud, Minn., carrying a payload of 63 lb, it soared to an altitude of more than 100,000 ft before it finally descended at Eau Claire, Wisc. Since that time more than 1000 such flights have been made from locations within the United States and Canada, and from naval vessels in the Atlantic, Pacific, Caribbean, and northern waters. Each new phase of the project has resulted in important improvements and a greater fundamental understanding of the relatively new field of plastic-balloon technology and the complex inter-relations between the balloon vehicle and the atmosphere. Development of such plastic balloons, ground-handling equipment, and launching methods by both General Mills and Winzen has reached the stage where the technical capability now exists to realize the original dream of a manned plastic-balloon flight in the stratosphere.

A new technique was developed in 1952 in which a meteorological Deacon rocket is lifted to altitudes of above 70,000 ft by a SKYHOOK-type balloon (Research Reviews, October 1952). As the balloon rises above a fixed altitude a pressure switch fires the rocket from an almost vertical position. With the aerodynamic drag of the lower altitudes thus eliminated, the rocket achieves a near-vacuum ballistic trajectory and attains altitudes greatly in excess of those which can be reached from a sea-level firing of the same rocket. These rockets have telemetered scientific information from altitudes of more than 50 mi. LCDR M. L. Lewis of BuAer proposed this technique in 1949 while conducting SKYHOOK experiments aboard the USS NORTON SOUND.

On 18 May 1954, the largest plastic balloon ever built for the Navy, the SuperSKYHOOK, was launched by General Mills from the University of Minnesota airport. It soared to an altitude of 117,000 ft. The balloon occupied more than three million cu ft in volume and carried almost 400 lb of Navy instruments to gather new information on cosmic rays.

Today's concept of a "space laboratory" is far broader than that envisioned in 1946. It is based on a need for scientific data which can only be obtained at this time by the balloon-flight method. A balloon-borne laboratory is a practical, economical method to obtain data needed for aviation in the near future and a wealth of fundamental data in the fields of astronomy, astrophysics, and physics of the upper atmosphere.

PHOTOS OF JET VAPOR TRAILS

At a pre-flight conference in Minneapolis scientists from Cornell Aeronautical Laboratory made final plans for the observers to photograph contrails or vapor trails. The purpose of this experiment was to obtain pictures of contrails during formation, growth, and decay. Two jet aircraft from the Naval Air Station, Minneapolis, created the contrails. These were photographed at three film speeds, 200 frames, 16 frames, and approximately one frame a sec. Various speeds were necessary because of the large change in diffusion constant at increasing distance behind the aircraft.

The STRATO-LAB system carried two cameras, a Traid 200 for very-high-speed photography, and a 16-mm Cine Special, mounted on standard tripod heads to provide complete angular freedom of motion. The tripod heads were mounted on 3-in. diameter aluminum tubes attached to the floor of the gondola. Each camera lens was approximately 48 in. above the floor. The Traid 200 was permanently mounted but the Cine Special was so mounted that it could be placed in either of two positions.

Heretofore contrails could be photographed only from the ground or from a fast-flying jet aircraft. Photography above much of the earth's atmosphere at both high and low speeds should enable physicists to understand more about how contrails are formed, grow, and decay.

Simple psychological tests were carried out in flight to detect any deterioration in ability of the personnel.

HIGH-ALTITUDE MEDICAL DATA

Prior to the flight the pilots went to the Naval Medical Research Institute for a complete physical examination, particularly with respect to those elements which might be affected by a flight to the stratosphere. For example, their eyes were dilated and pictures of the retina were taken in color. These will be compared with pictures taken from flights at higher altitudes. Pulse, respiration, and heart action were recorded to determine the normal rate for each observer so that changes occurring during and after flight could be noted and compared with higher flights. Chemical observations were also made of blood and urine. Just before the take-off in Minneapolis, the two fliers were given another examination (Figure 1).

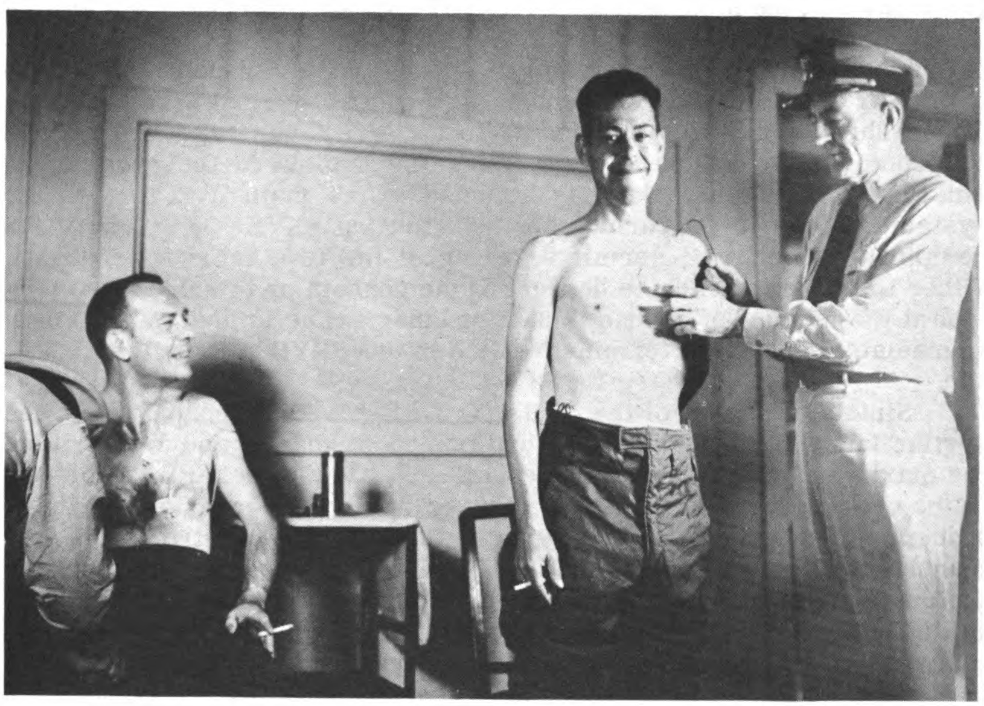

Figure 1 - The two naval observers on the initial STRATO-LAB flight are given a physical examination prior to the take-off on 10 August 1956.

The instrumented aeromedical experiments included a radio-broadcasting version of an electrocardiograph developed by CAPT N. L. Barr, (MC) USN, while at the Naval Medical Research Institute, Bethesda, Md. (Research Reviews, July 1955). The device recorded the pilots' physiological reactions and provided a continuous record of their heart reactions and respiratory conditions to the medical observers.

Flat electrode discs, a little larger than a shirt button, were glued directly on the pilots' skins with collodion and held securely in place by adhesive tape. The pilots each wore an amplifier about the size of a cigarette box, and a short-range, light-weight radio transmitter with a range of about a mile.

The laboratory equipment was carried in both a truck and a plane which tracked the balloon. In addition to a receiver and amplifier, laboratory equipment consisted of a cathode-ray oscilloscope which gave a temporary recording of the heart rate; a cardiotachometer, which showed the pulse rate; and a Brush recorder which gave a permanent electrocardiogram that was later compared with those taken in earlier tests. A high-fidelity speaker also enabled those in the laboratory to check on the pilots' respiration. The electrocardiograms will be compared with those taken on future flights to determine heart reactions in the stratosphere.

STRATO-LAB SYSTEM

Although the first STRATO-LAB flight was made with an open basket (Figure 2), parachute, plastic SKYHOOK balloon, and gaseous oxygen for breathing; the high-altitude STRATO-LAB system consists of an aluminum gondola (see Frontispiece), parachute, and SKYHOOK-type plastic balloon with a liquid oxygen supply. The gondola is suspended from the balloon by a system of nylon webbings which are attached to the gondola. These shrouds are also connected to an Air Force cargo-type nylon parachute which can be used to lower the gondola in the event of an emergency. This parachute is attached to the main load line of the system. Above the parachute is the standard SKYHOOK termination equipment which will permit severing of the load from the balloon, either to initiate parachute descent of the gondola or to release the balloon at the moment of ground impact at landing time to prevent dragging. Immediately above the termination line is the SKYHOOK balloon.

Simulated flights of the STRATO-LAB have been made to test the system launching techniques, and balloon performance, and to determine the maximum "g" forces to be encountered by the gondola and observers in the event of a flight termination by parachute. A gondola containing a dummy load and equal in weight to the equipped, instrumented and manned gondola, was used. The flights were programmed similarly to the manned flight and directed by remote radio control from the ground. Balloons for the pending high-altitude flights have been developed and tested by both General Mills and Winzen Research.

The STRATO-LAB balloon is constructed of polyethelene plastic .002 in. thick. The plastic film is clear with a slight milky tinge.

It comes in rolls as large as nine ft wide and several hundred ft long. The polyethylene film was first produced in thin gauge for balloon operations in 1947. Today polyethylene film and bags have become a household item, and a tremendous packaging industry has arisen as one of the results of government-sponsored research.

Lifting gas is introduced into the upper portion of the balloon by means of a separate plastic inflation tube or tubes. Other accessories serve safety, control, and launching purposes. A valve at the top is used for vertical control in flight.

Open basket platforms have been the laboratories for the low-altitude flights. The gondola for upper-atmosphere flights, originally designed for Project HELIOS, has been designed to provide adequate climate, flight sensing, flight control, and safety and communication equipment.

The flights are all planned with "vertical" inflations. In this manner the balloon is laid out on the ground and helium introduced into the top portion with a long tube. As the helium is increased, the top of the balloon erects slowly and inflation proceeds until sufficient helium has

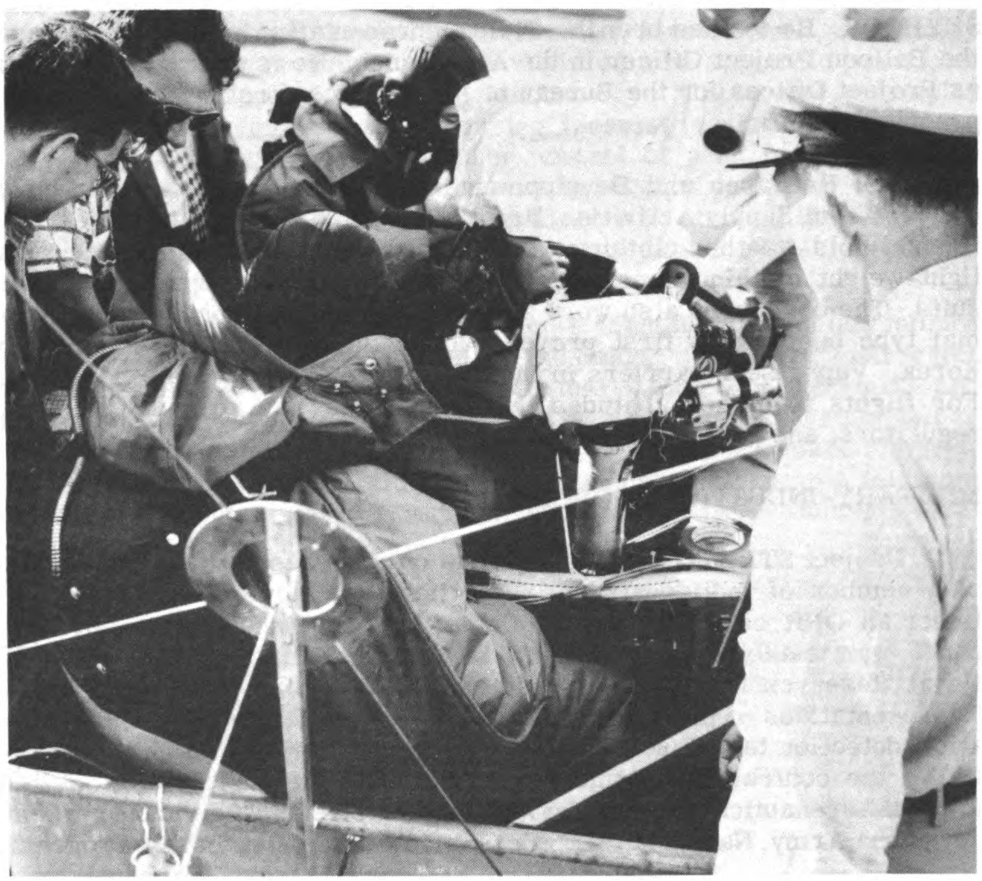

Figure 2 - Technicians, scientists, and others with an official interest in the STRATO-LAB gather at the site of launching, University of Minnesota Airport.

been introduced to lift the gondola and the balloon is released. As in every SKYHOOK flight, launching and flight procedures are in accordance with current Civil Aeronautics Administration instructions.

THE INITIAL BALLOON FLIGHT

It would be difficult to find two naval officers with a more comprehensive knowledge of and experience in balloon operations than the two observers. Mr. M. D. Ross (LCDR, USNR) the project officer for the STRATO-LAB program, was an aerological officer during World War II. Since 1951 he has been closely identified with the SKYHOOK program, first as ONR Field Representative, Navy Balloon Projects, Minneapolis, and then as Balloon Projects Officer with the Air Branch, Naval Sciences Division of ONR in Washington. He is now a meteorologist with the Air Branch.

LCDR M. L. Lewis, USN, BuAer liaison officer for the STRATO-LAB program, has spent many years in aerological work. Since World War II most of his work has been connected with balloon projects. He served as aerological officer with Project HELIOS, then worked with Project SKYHOOK at the U. S. Naval Training Device Center, Port Washington, N. Y., as the Project Engineer. As Field Liaison Officer at the ONR Branch Office in Chicago, he continued to work on Project SKYHOOK. He too has been the Field Representative in Minneapolis and the Balloon Project Officer in the Air Branch. He is currently assigned as Project Officer for the Bureau of Aeronautics constant-level balloon program.

The Research and Development Division of the Clothing Supply Office, Naval Supply Activities, Brooklyn, N. Y., supplied special experimental cold-weather clothing. Previously tested in the Antarctic, this light-weight clothing consisted of special underwear, inner and outer suits. The observers also wore a special parka-type hood. Their thermal type boots were first proved successful by the U. S. Marines in Korea. Vapor seal barriers in the boots were used to retain body heat. For flights to higher altitudes the Air Force will provide helmets, regulators, and partial-pressure suits.

MILITARY-INDUSTRY COOPERATION

Project STRATO-LAB is possible only because of the cooperation of a number of individuals and activities, both civilian and military. Under an ONR contract with the University of Minnesota, an advisory panel was established to provide technical guidance to the Office of Naval Research for overall planning in the development of the system. Representatives of the same University were in charge of gamma radiation detection techniques that will be used for future flights. Meanwhile, the contrail experiments were under the supervision of the Cornell Aeronautical Laboratory. Many agencies and individual personnel of the Army, Navy, and Air Force have participated in this program.

It was the "team effort," displayed by the contractors and all who served in an advisory capacity, that solved the numerous problems which stood in the way of successful flight.

Navy Cold Weather Clothing

When the STRATO-LAB made its initial flight from the University of Minnesota Airport, the two Navy fliers made excellent use of cold-weather garments (see Cover Photo) which were designed and developed by the Navy, and in most part, adopted officially for naval service in early 1951. The Research and Development Division of the U. S. Naval Clothing Supply Office, a field activity of the Bureau of Supplies and Accounts, went into this matter of winterized clothing and brought out a series of garments which serve to protect personnel from head to toe. The items of winterized clothing approved in 1951 have been supplemented by other useful items, and by modifications on apparel such as winterized rubber boots.

The clothing is composed of two basic outfits known as the Extreme Cold Weather Outfit (A-1) and the Intermediate Cold Weather Outfit (A-2). Both outfits are worn together, with the A-1 as the outer garment, to form an Arctic Outfit for sub-zero-temperature protection.

Work on the development of this gear, together with the required components of handwear, was initiated in 1946, as a result of deficiencies disclosed in special clothing during World War II. As a preliminary, attention was directed to new fabrics, coating formulations, and design factors. This was combined with a study of new scientific principles which could be applied to clothing technology. These new principles were used for the purpose of increasing thermal insulation by reducing body heat through clothing by better control of such factors as conduction, convection, radiation, and evaporation of moisture from the skin. This work resulted in a marked advance in clothing technology by introducing three-dimensional design features and double-moisture-barrier principles of insulation to clothing.

The application of these new concepts, together with the new fabrics and materials developed, resulted in the design of this new gear which provides a substantial increase in thermal protection, comfort, and functionability, with a decrease in weight, bulk, and in the number of clothing items required as compared with previous standard clothing. This special cold weather clothing has been used recently by the naval personnel participating in Operation DEEPFREEZE in the Antarctic.

The double-moisture-barrier principle has been used in the outer A-1 outfit and in the insulated boots and mittens. In the jacket, trousers, and mittens the insulating medium is enclosed between two layers of waterproof, neoprene-coated nylon twill fabric. The double moisture barrier is best demonstrated by the rubber insulated boots developed by the Navy Clothing Supply Office and later adopted by all the other Services and used with marked success during the Korean conflict. The white boots are experimental U. S. Army Quartermaster Corps items and are similar in principle except that the insulation was increased and an air valve added for high-altitude use.

In the garments, "three-dimensional" design was achieved by the use of heavy ridged seams on the arms and sides of the jacket and the use of side panels. Thus the garment follows the contours of the body with the weight supported by various parts of the body instead of the shoulders carrying most of the burden. This allows greater freedom of movement, less constriction, and added insulation since more air space is created. The design also reduced "clothing fatigue" felt by the wearer, and in the case of cold weather operations, this is an important factor.

The underwear used with this cold weather clothing is also new and improved. It is fabricated from all-cotton waffle-knit cloth, and as a result there is no itching or shrinkage—both shortcomings of woolen "Long Johns." In addition, the tri-dimensional waffle effect traps air and reduces fabric-skin contact in the same manner as the Brynje vest used for many years by Norwegian fishermen.

The Intermediate Cold Weather Outfit does not employ the moisture-barrier principle as it is primarily used in moderate dry-cold temperatures in which the body can generate sufficient heat to overcome any losses. This outfit is also used to supplement the outer A-1 outfit in extreme sub-zero temperatures.

NOMENCLATURE AND DESCRIPTION OF COLD WEATHER CLOTHING

Extreme Cold Weather Outfit - Jacket, Trousers and Hood, Cold Weather, A-1 (Moisture Barrier). These items have an impermeable, waterproof, outer fabric, and employ the double-moisture-barrier principle of insulation. The insulation of the jacket and of the trousers is enclosed and protected from moisture by also using a coated lining fabric. By placing the insulating materials between the two waterproof fabrics a special effect is created which is very much like an ordinary picnic jug. Increased insulation is provided by the air which is trapped between the two impermeable layers and, in addition, the insulating materials are kept dry so that their efficiency cannot be destroyed. Although some of the seams of these garments have been brush-coated with cement, the garments are not entirely waterproof. The hood is attached to the jacket by means of a slide fastener and has retractable face shields for added face protection.

Intermediate Cold Weather Outfit - Jacket, Trousers and Cap, Cold Weather, A-2 (Lightweight). These items have a permeable, water-repellent outer fabric which has good resistance to wind penetration. This outfit is primarily for use in dry, cold weather, especially for personnel engaged in active duties. The ensemble has been streamlined in design and is light in weight for maximum comfort and mobility. The jacket is designed to be worn as an outer garment or as a shirt tucked into the trousers, under the A-1 Jacket (Moisture Barrier), in very cold weather. The cap has an extension flap which will provide neck and ear protection when needed.

Underwear, Cold Weather, A-1 - The underwear, consisting of an undershirt and drawers, is to be worn with both outfits to obtain maximum efficiency from the clothing. This underwear is manufactured from a new cotton waffle-knit cloth which creates a multitude of air pockets on both sides. This enables the fabric to entrap warm, dead air and reduces surface contact, thus increasing warmth. The new cloth also eliminates the itch sensation which occurs with woolen underwear, and reduces shrinkage problems.

How to Ferret Out Information Electronically

In any information storage and search system, there are two things that we deal with:

An item that we put away,
An idea which characterizes the item.

Regardless of the complexity of the information system—be it a mammoth machine with a vast electronic memory, a card index at a library, a series of stock records, price sheets, or a directory of names, addresses and telephone numbers—the two elements are the same. There is the item; then there is the idea. In a search for a piece of stored information—such as in a listing or a directory—the item is usually the starting point. But the idea can also be an effective starting point, and the electronic system EDIAC does just this. Such a system has been the subject of research conducted by Documentation, Inc. under the sponsorship of the Office of Naval Research.

For some time, people confronted with complex information problems have felt that some sort of a machine or mechanical system is the best solution. A number have been brought forward; still others are in planning and development stages. None of the machines which ferret out information can be tabbed as creative in the sense that they can be expected to function like a brain. But on the other hand, machines have a better memory than human beings. The mind tends to forget; it also suppresses things that are unpleasant, and goes so far as to add new things that go beyond the specifics of a particular memory.

Any device created to meet information problems on storage and search must be able, first, to store information, and second, it must make a selected response to queries. Moreover, the response must be of a type that is useful. It is well to analyze the type of questions to which the device must respond. These are: (1) the index question, (2) the content or abstract question, and (3) the association or coincidence question.

<u>The Index Question</u>. This is the simplest and most direct type of query with which we approach any storage and search system. Given a subject-heading, an index term, a code, a Uniterm, a classification, a descriptor, or any type of subject designation, we ask the machine what information it has on this subject.

The device may respond to such a question by printing the <u>Encyclopedia Britannica</u>, or any part of it, but its minimum response must be the number, the address, or any other identification of a document, book, page, microfilm frame, etc., where the required information can be found; that is to say, it is always possible to select the appropriate item from storage if we know where it is stored, but the machine must respond minimally with an address when any subject question is put to it.

The Content Question. An information system such as a standard library catalog or a printed system like Chemical Abstracts and its Index not only answers the question, "What does the system have on this subject?" by giving the address of an item, but it gives information about the items which may range from a simple title to the type of informative abstracts provided by Chemical Abstracts. This creates a similar requirement in a mechanized storage and retrieval system. Ideally, such a system should tell us the subjects covered by any document when we ask not "What documents do you have on this subject?" but the complementary question, "What are the subjects covered in this document?"

The Association Question. In searching a card file or a printed index, a false start, i.e., a search under the wrong set of terms or subject headings, can lead to an adjustment in the search as it progresses. Similarly, a vague approach can be sharpened by noting, as we search, the "association" of terms supplied by the index. But a machine system into which too vague a question or the wrong question has been put grinds out its wrong answer, or no answer at all, and it is only when the machine finishes its work that we know or suspect that the error or the negative answer is the result of the wrong question put to the machine.

In manual systems we proceed by the method of trial and error and successive approximations. Something analogous to this process should characterize the steps in a machine search; but if we had to wait until the machine finished its search, and delivered its answers only to discover we had asked the wrong question, the prospect would be intolerable and the more complete an answer delivered by the machine, the more intolerable the situation would be. If we ask the wrong question and use the wrong set of needles in a hand-sorted deck of cards, the prospect of another search is not too bad; but if we ask a large data-processing machine the wrong question and sit by expectantly while it sorts, selects, and prints the wrong set of answers, we would soon find it preferable to resort to the tedious conventional methods.

It is largely the realization of this situation, by those groups who have envisioned machines which require "blind entry," which has also led them to search for words of "association" or artificial languages which will program the machine to ask the right question even though the searcher asks the wrong question. There are those who hope that codes can be constructed whereby vague and indefinite as well as fixed ones can be coded to a system which will exhibit precise answers.

Actually, there are more promising avenues of avoiding "blind entry" than the possibility of devising artificial languages, and one of these avenues we have called "the association of ideas." Just as the manual search of a card file or printed index displays to the searcher other terms which define and refine the subject of his search, so a storage and retrieval machine should display to the searcher those associations in the system which will permit him to make an increasingly more specific search for the information he wants.

LOGIC CIRCUITS

In addition to the three types of questions which we have described, the most effective storage and retrieval device must possess circuits capable of providing logical products, logical sums, and logical complements. The index question, when it is clearly in the mind of the searcher and needs no refinement or redefinition, is delivered as a logical product. But for the content question and the association question, we require logical sums and complements. The machine must tell us not only the class which is "A and B," but the class which is "A or B" and the class which is "A and not B."

There are those who seem to require more of machines than logical circuits. They envision machines which will tell us that A loves B but B doesn't love A; that C is the father of D and not vice versa; that flowers attract bees in a different sense than they attract girls. Here again we will not say that such machines are impossible. Given enough dollars we can store in a machine every word, every combination of words and every nuance of meaning in all the printed material in existence. We can build a machine able to distinguish not only "biting dogs" from "bitten dogs" but "Tweedle Dum" from "Tweedle Dee."

We can do all this not by building in proper circuits but by increasing the number and complexity of the descriptors, terms, or codes stored in the machines.

Our studies of the logic of information storage and retrieval have demonstrated that we require for storage and retrieval systems not data processing or rapid addition, subtraction, and multiplication, but random access, instantaneous recognition, and direct display of any item permanently stored in a static memory. The crucial fact is that we input not binary digits to be computed but terms and logical relations which are appropriate to the storage and retrieval problem.

Suppose in an information center or library we were concerned with the rapid recovery of any item in the library or any fact recorded in any item. Suppose further that costs were not a consideration. The most effective storage and retrieval device for a collection of 1,000,000 reports, documents or other items might then have the following components:

- One million people each holding and studying a single item.
- A system of communication connecting the million "storage" points with a central reference bureau of input microphone.
- A system of facsimile transmission connecting the "storage" points with a central output.

A question sent over the central microphone would start all "storage mechanisms" studying their items and the one holding the desired document could send a copy by facsimile to the central output station located adjacent to the input microphone.

This fanciful supposition has a serious purpose. It enables us to see exactly what we have done when we substitute a million abstract cards in a catalog for our live storage elements and ask the searcher to walk through the catalog system to find the card which suits his purposes; or when we bring the cards to the searcher by means of sorting machines, tapes, or drums. Certainly the shift from live storage elements to cards or magnetic dots is only significant as a saving in input costs.

Steam shovels and automobiles may have many parts in common—motors, gears, batteries, wheels, etc. But no one would suppose that the way to get better automobiles is to concentrate on designing and building bigger and better steam shovels or vice versa. And the fact that the development of more efficient storage batteries for steam shovels may be, at the same time, the development of more efficient batteries for automobiles is still no argument for the identity of steam shovels and automobiles. Even though steam shovels may be self-propelled and could be used, if efficiency were no object, to carry people from place to place, they are not primarily vehicles for transportation. It is nevertheless, as reasonable to use a steam shovel for locomotion rather than digging as it is to use a computer as a storage and retrieval device rather than for computation. It can be done but we would certainly look askance at someone driving from Washington to New York in a steam shovel, and we must be similarly less than enthusiastic about the ingenuity of using a good computer as a poor storage and retrieval device.

The one factor most responsible for the confusion between the entirely distinct functions of computers and storage and search systems is the common interest in devising ever-larger storage devices which will store more information at a lower bit cost.

A computer system processes data which may be fed into the system directly by an operator or indirectly from a memory in order to arrive at certain mathematical quantities. As is manifest from its name, a computer performs an arithmetical computation or a series of them in order to arrive at an arithmetical value. A storage and search system does not perform any arithmetical operations or even logical operations. It searches a memory or storage device to select or identify data in accordance with specific questions put to the system.

The form of the question may involve a logical operation, e.g., one can ask for the logical product PQ. That is, we do not ask a storage and search machine to calculate, compute, or derive logical products, but only to find anything stored in the system which can be identified in terms of a logical product. In making identifications for selection, a storage and retrieval machine may use the type of components used by a computer to make computations, that is, reading heads, switches, relays, diodes, holes, magnetic dots, etc. But this similarity of components again should not obscure the essential difference between the two types of systems. Advances in the computer art may certainly be significant for information systems and vice versa.

In short, the similarity of components and subassemblies, the similarity of problems of storage costs, random access times, etc., should not obscure the basically different purposes and functions of computer systems and storage and search systems. The consideration which determines that we are here faced with an essential difference with superficial resemblances, rather than with essential similarity and superficial differences, is that a highly efficient computer may be a very poor storage and search machine, and a highly efficient storage and search machine may be completely useless as a computer.

FEATURES OF EDIAC MACHINE

On the basis of decisions concerning the type of questions and the required logical relations, we found it possible to design and build an electronic machine (Figure 1) which can physically demonstrate the operations of an effective storage and search system. And it seemed appropriate in designing such a model to concern ourselves not with storage and input problems, but with the output. This is because the output, or what the machine will do, defines the basic task of the system. The type of input and storage then becomes a matter of determining the most economical and efficient method of securing the desired output.

The model we have built contains a vocabulary of 250 terms (see Table I for examples) which, in various combinations, were used to index 100 reports. The machine is called EDIAC, an Electronics Device for Indexing, Association, and Content. In its development stages, Alexander

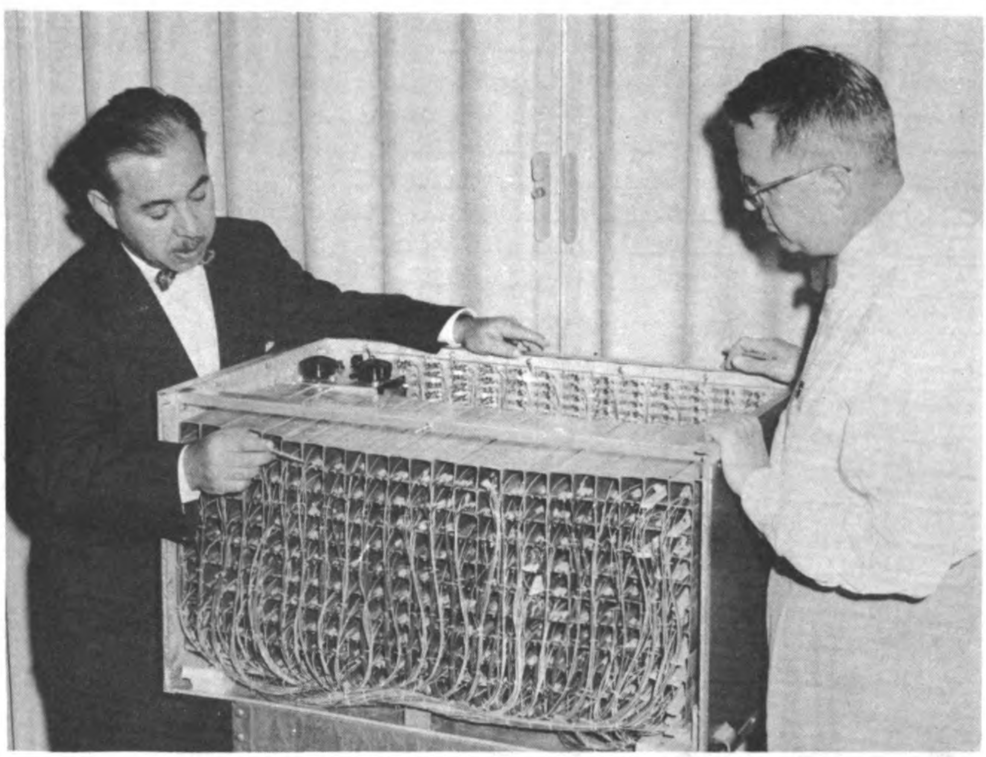

Figure 1 - The EDIAC machine with Dr. M. Taube who developed the logic, and E. E. Miller of the Documentation, Inc. staff.

TABLE I

VOCABULARY* USED TO INDEX REPORTS

acceleration
aircraft carrier controlled approach
all weather
analysis
anti-clutter
autonavigator
bearing
camera
celestial
coherent
constant glide path
counter
dead reckoning
digital
doppler
equipment
fighters
gating
gyro
high speed
identification (I. F. F.)
inductors
interference
landing
lock-in
magnetic amplifier
meteorology
motion
navaglobe
oscillator
plotting
pursuit
printed circuits
radar scope interpretation
rain
reaction time
reduction
return
scanning
signal
soldering
straight-line indicator
supersonic
synchronization
telegraphy
time sharing
transistorization
U.H.F.
very high frequency (V. H. F.)
visual

*The 50 here are examples of 250 making up complete vocabulary.

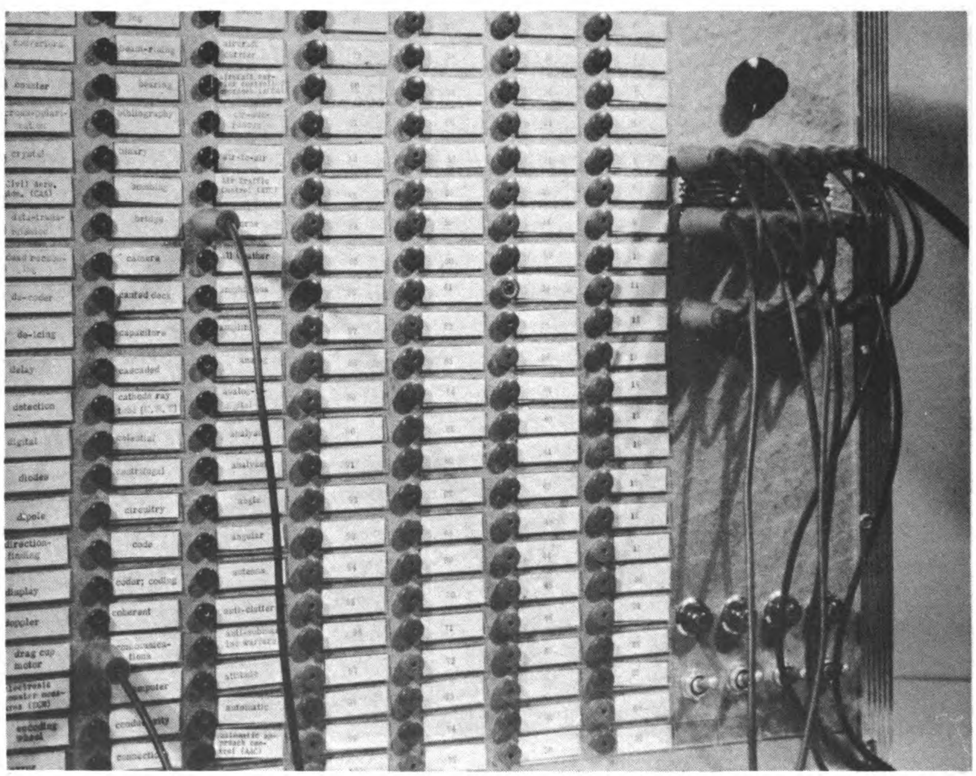

Figure 2 - Display panel of EDIAC machine.

Kreithen and Dr. Frederick Jonker of Documentation, Inc. were responsible for the electronic circuitry and the engineering design. Easily visible to the operator, the machine displays on a panel the total vocabulary and the numbers of each report in sequence. Each vocabulary term and each report has associated with it a light and jack (Figure 2). The reports are entered and the associations are made by establishing the appropriate electrical paths, with isolation of paths to prevent false answers.

In this model the number of Uniterms is two and one-half times the number of reports. In practical application this ratio would probably increase in the early stages. For example, the first 300 reports might require four times the number of Uniterms, or perhaps even more if they were in widely diversified subject fields. However, the necessity of adding new indexing terms would soon begin to level off and the ratio decrease. Thus one might expect that by the time 5000 reports are in the system there would be something on the order of 3000 terms and that each new report then indexed would rarely require the addition of a new term.

The operation of the device is extremely simple. For the index question the searcher selects any term in which he is interested and applies a voltage. He is told instantly the numbers of the reports dealing with that subject. Putting voltage in at any term also lights all other terms associated with the first term. This enables the searcher to

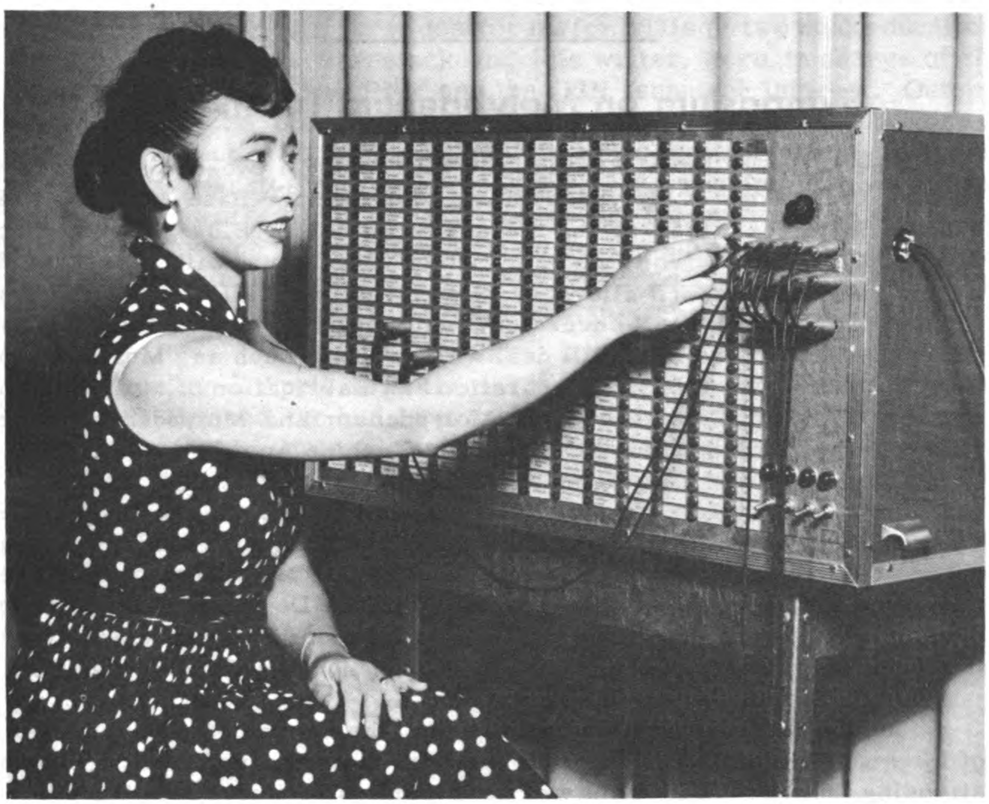

Figure 3 - Operator of EDIAC machine gets answers with electronic speed when systematically searching for information.

answer the association question, that is, to program his search in terms of the information in the system.

For the content question, the searcher (Figure 3) can input at any report number and instantly have displayed to him a telegraphic abstract of the content of the report. Appropriate logical circuits also permit the searcher to narrow or increase his field of search as he chooses.

We have chosen an instantaneous electrical display as a query and output representation rather than the more usual typewriter or printing equipment because it is more effective for the purpose of demonstrating physically the logic of the operations involved. This choice implies no decision concerning the query mechanism or the output of a complete storage and retrieval system.

Similarly, the memory elements we have used represent a fabrication from off-the-shelf items without regard for input costs, storage space, etc. Behind our display we could have used tapes, drums, punched cards, radio transmitters, printed circuits, etc.: we could have used coils, resistors, capacitors, toroids, diodes, etc. What we did use was dictated by availability, immediate cost, and expediency. What should be used in an operating system will be determined by storage and retrieval theory in accordance with the requirements of a particular set of operating conditions. The complete development of such a theory in qualitative and quantitative terms will be our next objective.

Symposium on Molybdenum Technology

The Office of Naval Research is sponsoring a two-day symposium on the "Technology of Molybdenum and Molybdenum-Base Alloys" on 18 and 19 September 1956 at the Rackham Memorial Bldg., Engineering Society of Detroit, Detroit, Mich. An up-to-date picture will be presented on molybdenum and its alloys as structural materials by a group of invited speakers who will cover some fifteen subjects over the two-day session. The papers read will deal with subjects such as "Molybdenum as a Structural Material," "Preparation and Fabrication of Molybdenum and Its Alloys," "Metallurgy of Molybdenum and Molybdenum-Base Alloys," and "Molybdenum Alloys in Gas Turbine Applications."

This is the first major symposium held in this country on the subject of research, development, and applications of molybdenum as a structural material. All aspects of the research and technology will be covered and the roster of speakers will include Department of Defense contractors, experts from industrial organizations, and representatives from Europe to discuss the status of molybdenum developments abroad.

On the day following the symposium, the Climax Molybdenum Co. of Michigan will hold an "Open House" for the scientists and engineers attending the meetings. This will be of particular interest to the members of the group interested in arc-melting and the working of molybdenum alloys.

RNN-USN Seakeeping Trials

Dr. V. G. Szebehely
Head, Ship Dynamics Branch,
David Taylor Model Basin

Little did this writer know that his peaceful laboratory work would lead him to two weeks on board destroyers furiously fighting heavy seas.

A search of the literature, a little mathematics, and quite a bit of model testing in 1954 resulted in a paper written for and presented at the International Conference on Ship Hydrodynamics* on slamming and on some aspects of motion of ships in rough seas. One reader of the paper, Lt. W. H. Warnsinck of the Royal Netherlands Navy asked this writer if he would like to find out personally how actual ships behaved in actual seas and challenged this writer by suggesting an extensive program of destroyer trials. A short account of the wonderful experiences, useful education, change of viewpoint, disappointments in some theoretical results, and of the history of the removal of the "desk-man" from the ivory tower of his laboratory and books, forcing him to face reality, are given in the following few lines.

According to an agreement between the Netherlands Navy and our own, we were to furnish the instrumentation and the Dutch Navy contributed the services of three destroyers for trials of two weeks duration. The originators, Lt. Warnsinck and this writer, were in charge of the trials, representing the RNN and the USN technical interest. Our job was to convince our superiors that drilling holes in the bottom of destroyers, cluttering up the ships with wires and instruments, shipping measuring apparatus and technicians over seas, running into heavy seas at 25 knots, were all in the interest of the two nations' navies. The understanding and cooperation displayed and, as a consequence, the successful execution of the trials, were the valuable awards received by my partner and me for our enthusiastic efforts.

When, on 7 April 1956 the three destroyers participating in the trials left Holland, we had 16 pressure gauges installed in the bottoms, 6 gyroscopes, 15 accelerometers, 12 strain gauges, 4 cameras, 5 oscillographs, 41 amplifiers, and some 30 people distributed on the ships. When, on 21 April we returned, we had some 6 miles of motion, pressure, and stress records, 5600 photographs, and 30 happy people who felt that their hard work was not in vain.

The purpose of the trials was to obtain useful design information on three different type destroyers steaming parallel in the same sea. Figures 1 and 2 show HNMS FRIESLAND in peace and in war with the elements. She is a new destroyer; her partners in the trials were the destroyers ZEELAND (of the same class) and the EVERTSON (older British).

*"On Slamming" by V. G. Szebehely et al., TMB No. 995, 1956

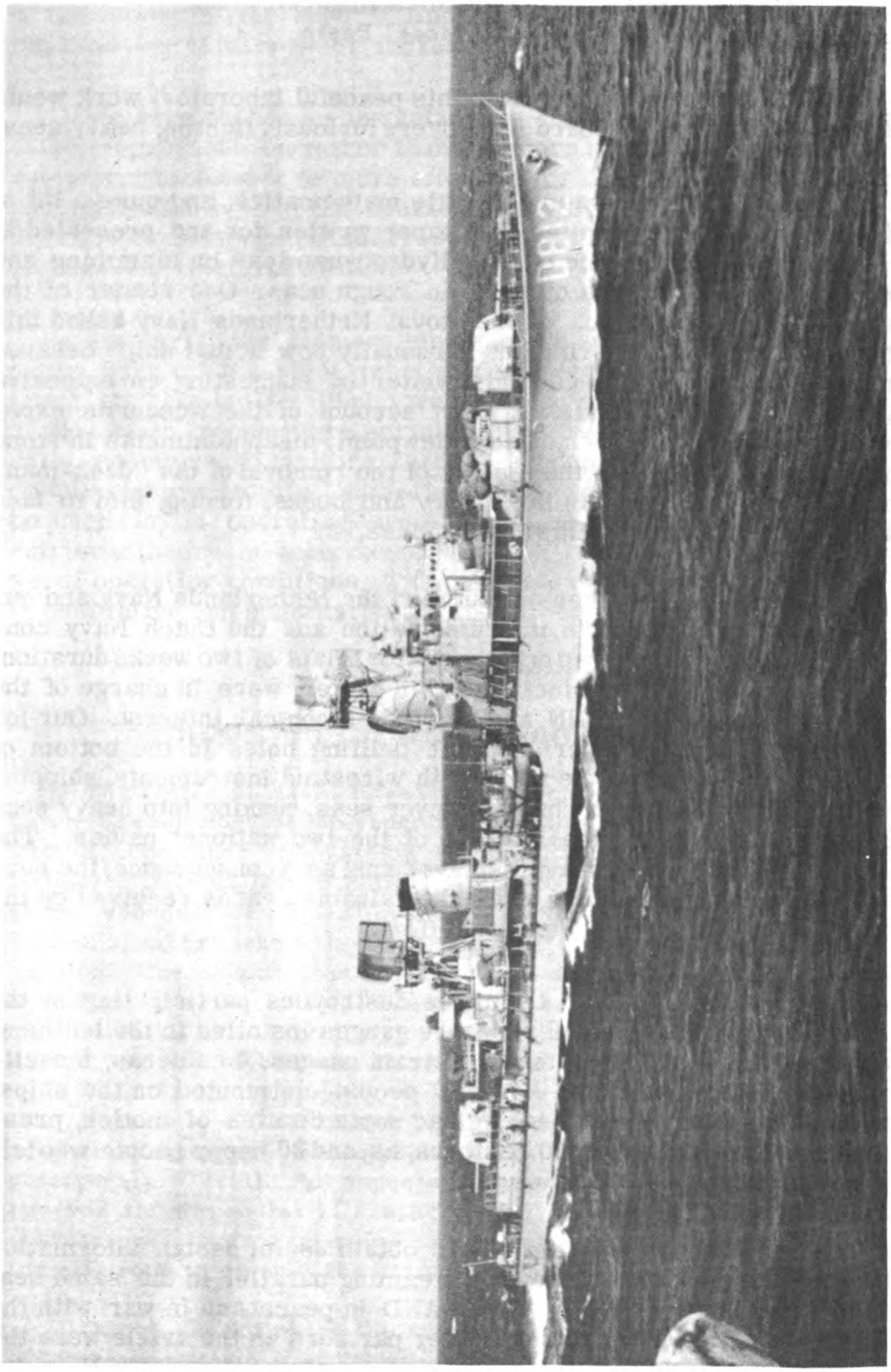

Figure 1 - HNMS FRIESLAND in calm waters.

Figure 2 - Impact of heavy seas on HNMS FRIESLAND.

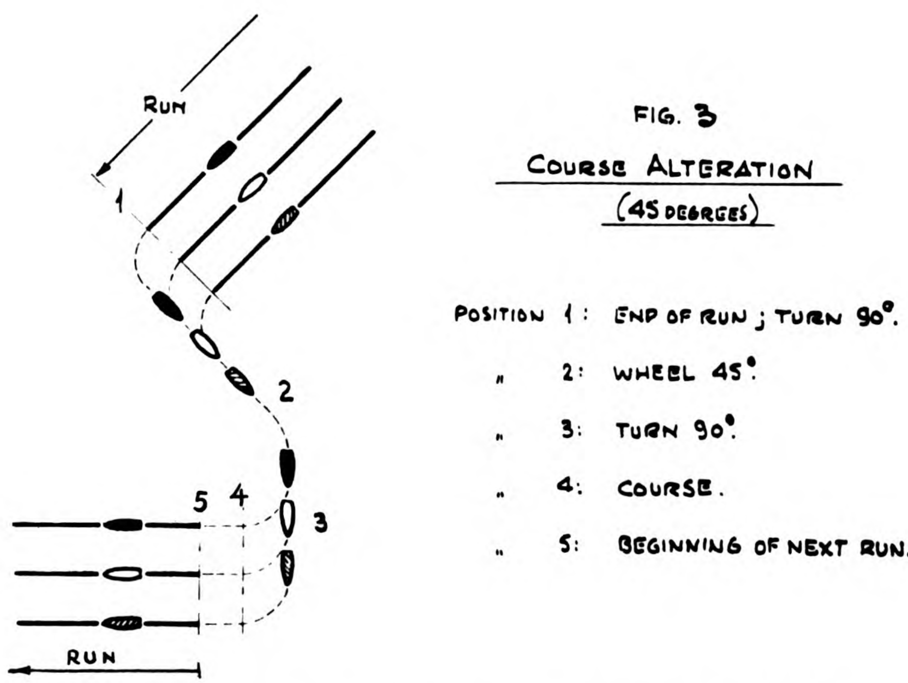

Figure 3 - Course alteration of ships in tests conducted off British Isles.

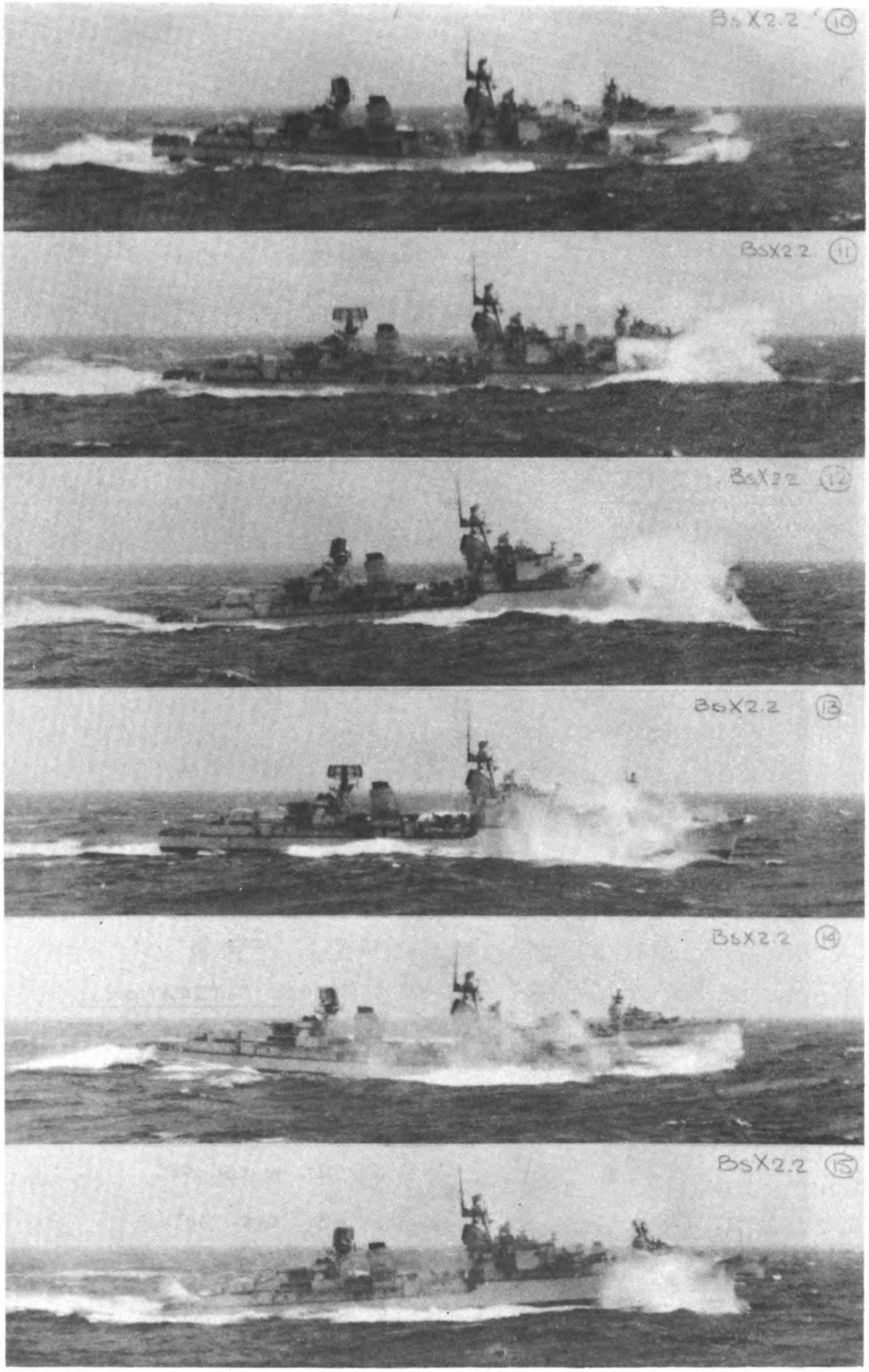

Figure 4 - In trial runs, ships steamed at 17 knots, with waves coming in 45 degrees from the bow.

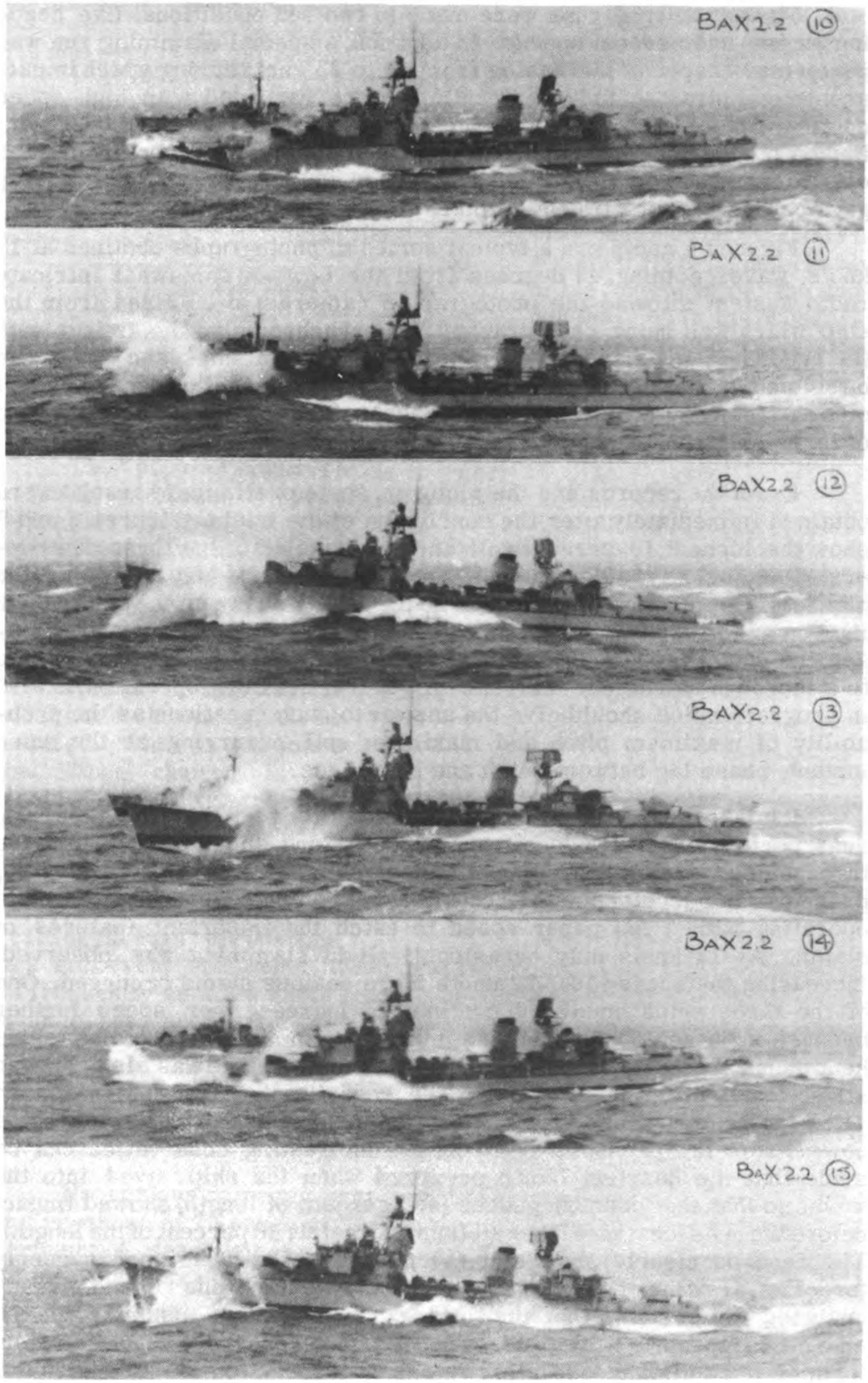

Figure 5 - Photos were taken by using radio to trigger cameras.

The actual trial runs were made in two sea conditions, five heading angles, and several speeds. In addition, a special slamming run was performed at speeds increasing from 18 to 25 knots during which impact pressures, strains, and accelerations were recorded with high-speed oscillographs. The ships changed course (Figure 3) every 10 min. Having no previous experience in maneuvering together, performing the operations shown in 10 min in rough water 400 yd apart, the Dutch Navy gave once again a testimony of their famous seamanship.

Figures 4 and 5 are a typical series of photographs obtained at 17 knots, waves coming 45 degrees from the bow. A somewhat intricate radio system allowed the photographic cameras to be fired from the ship which was being photographed. By synchronizing the firings with the recording instruments the relative position of ships and waves can be studied at the instant of slamming or at the moment of occurrence of other phenomena of interest. The Flagship was in the middle of the line of three ships and was photographed from two sides.

From the records and the pictures, some preliminary results were obtained immediately after the conclusion of the trials. Figures 6 and 7 show the highest 10-percent roll and pitch angles of the three destroyers. Reading, say, 100 cycles of the motion record and averaging the highest 10 amplitudes, one arrives at the values shown on the plots. Such figures are presently in preparation regarding accelerations and stresses, the photographs are being assembled and the records are subjected to a thorough statistical analysis. A general scanning operation is also in progress which should give the answer to such questions as the probability of maximum pitch and maximum roll occurring at the same instant, phase lag between pitch and heave, etc.

It might be of interest to give some details regarding the slamming runs performed. In waves of some 200 ft long and 9 to 16 ft high the three ships were first heading into head seas at 18 knots. The strain, pressure, and accelerometer recording instruments were intermittently operating with 1 fps paper speed to catch the important features of slams. At 18 knots only occasional, slight slamming was observed. Increasing the speed to 20-22 knots more serious slams occurred. One of the three ships could not continue to increase her speed further because of the seriousness of slamming at 22 knots. The two other ships kept on, until 25 knots was reached. The heading angle was also changed slightly and it was observed that the severity of the slams increased when the heading angle was changed from head sea to one point to the bow. From the pressure records, the interesting observation can be made that the heaviest blows occurred when the ship dived into the waves so that the foremost gauges (at 5 percent of length) showed impact before the ones located farther aft (approximately 20 percent of the length). The records clearly show that the pressures build up very suddenly (order of a few hundredths of a second) and we have one record already analyzed which shows that the impact occurred at an instant when the amount of spray is negligible. The strain records show slamming in form of an additional oscillating stress, superposed on the wave-induced hogging and sagging stresses. The magnitudes of these additional slamming stresses on some records are 50 percent of the basic sagging stress. The most interesting feature of these slams to this writer was the often-observed, associated, violent longitudinal acceleration.

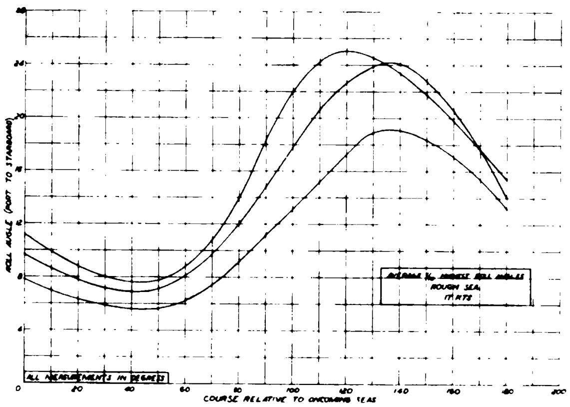

Figure 6 - Roll angles in rough sea.

The few records analyzed show that slamming occurred at the instant when the ship was approximately at even heel and the bow velocity was maximum. The similarity of slamming records obtained in the laboratory and those obtained on the trials is striking. The sudden change of the acceleration, the sudden build up of the pressure, the lengthy vibration after slam, the continuous record of pitch, etc. are all expected from the tank work.

The popular idea of avoiding slamming by speed reduction or by changing course seems to be in need of some modifications. So do some recent theories suggesting that at high speeds the ship might cut through the waves and in this way its motion and slamming will be reduced. While it was found that large changes in the heading angle (45 degrees or more) in combination with speed reduction will reduce the probability of slamming, it was also clear that the "cutting through" proposition is a somewhat risky one. When making 25 knots the ship did not slam as frequently as at 20 knots and it was cutting some of the waves but in random seas sooner or later some longer and higher waves are met which the ship will not be able to cut and which might have serious consequences. This writer had difficulty in keeping his footing during the few slammings at 25 knots. While the slams were experienced more frequently at 20 knots, they were much milder.

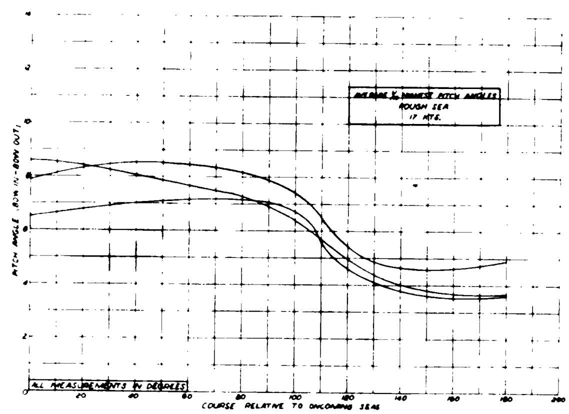

Figure 7 - Pitch angles in rough sea.

No serious damages occurred to the ships except the dislocation and breakage of 25 cases of beer during slamming. No record was lost because of seasickness, no language difficulty was encountered, the international cooperation was on a high level, and perfect understanding was established. We feel that the competency and cooperation of our friends in the Dutch Navy will contribute to a harmonious and efficient evaluation of the records.

It is hoped that a somewhat detailed, but still preliminary report will be published in the summer of 1956 and a series of final reports will come out in 1957.

The Defense Research Program and Our Economic Future*

C. C. Furnas
Assistant Secretary of Defense
(Research and Development)

Although it has been said many times that "scientific knowledge and technology know no geographical boundaries" another repetition does not come amiss. Any nation that develops first-rate scientists and is willing to devote an adequate proportion of its resources to research and development may readily acquire a high degree of technical knowledge and skills. Modern Russia has demonstrated that this is true.

Indications are that the quality of their trained personnel in most scientific fields approaches that of the United States. Although ideological interference seems to have caused a lag of some of the biological sciences behind the physical sciences, Russian progress in military-related fields has been rapid. The quality of their jet fighters in Korea, the jet bombers paraded in their May Day air shows, the transport version recently flown to London are eloquent testimony in the aircraft field.

Now this brings us to the inevitable question of who's ahead. There has been much discussion on both the qualitative and quantitative aspects of this question in the public press and it is not possible to give a truly factual answer. The reasons are very simple. In the first place, there is an Iron Curtain. It and the Russian governmental concepts that support it make it exceedingly unlikely that we shall learn very much in detail of the things the Soviets want to keep to themselves. Secondly, from our side, as Secretary Wilson has pointed out: "There have been many times when loose handling of critical military information would have served an enemy far more than an extra division or an extra wing of aircraft." He goes on to say that while the Defense Department must make information available that is necessary for Congress to carry out its responsibilities, extreme care must be taken by everyone concerned to avoid disclosing to all the world such critical military information as production rates of weapons and present and planned force strengths which, once released, seriously jeopardize our security.

One aspect of the "Who's ahead" question that should be remembered is the fallacy of the numbers racket, as we call it. There are some who have advocated that the United States alone should match potential enemies plane for plane, radar for radar, and so on, through the various categories of weapons, regardless of the impact on the total security effort or the civilian economy. This can easily lead into error.

The Soviet force requirements are not the same as ours. Their requirements are affected by the Soviet's geographical location, internal security requirements, and the like. General Twining has pointed out,

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*This article is based on a speech delivered by Dr. Furnas at the 20th Anniversary Celebration at the Armour Research Foundation in April 1956.

for instance, that the Soviet air-defense problem is inherently a more difficult one than ours because of their geography.

A comparison of numbers ignores differences in requirements between the two countries, and it ignores differences in capabilities. It ignores the collective security of the United States and our Allies of the free world, NATO, the advanced bases, and our combined strength. As Mr. Wilson has stated: "The real fundamental is this: the tremendous deterrent power in military forces today. We have today, and we will have for the foreseeable future, the capability of inflicting vast destruction upon any aggressor anywhere in the world. Retaliatory forces of vast proportions can be applied regardless of a massive surprise attack on our country and regardless of defensive maneuvers of the aggressor. This fact is the key deterrent to war."

In general, we are ahead, but that's no basis for complacency. We're in a research and development race—a tough one.

DEPARTMENT OF DEFENSE RESEARCH AND DEVELOPMENT

Under current world conditions, then, our course of action in research and development becomes quite clear. In addition to the effort required to maintain our forces in being in a continual state of readiness, we must expend substantial research and development effort to insure that our fighting forces in future years will have the best possible weapons and weapons systems that our nation's technological resources can devise. Thus, through a vigorous research and development effort, we hope to continue to deter other nations from taking hostile military actions against us.

An extremely difficult problem which faces the management of the Defense Department is the determination of how much money should be expended on research and development each year. Last year industrial organizations spent, on the average, amounts equal to almost two percent of their sales for research and development. It was higher in some industries, such as the chemical industry, and it was lower in others because of complex factors. In the Defense Department the identifiable research and development appropriations requested for next year are about four percent of the Defense budget—probably a reasonable ratio.

We want to support a program that will maintain a technological margin over our potential enemies and will allow the exploitation of scientific advances for weaponry. At the same time we do not want to spend more than can be used effectively, since this might well inflate costs and produce no greater results. We must remember we are in a marathon race, not a sprint.

On the other side of the coin is the necessity for maintaining an expanding civilian economy. Our struggle is economic and sociological as well as military. This brings into consideration the nation's total capacity for research and development. On the defense side, other government agencies besides the Defense Department are doing research and development work. A considerable portion of the Atomic Energy Commission research and development program of some $400 million and of the National Advisory Committee for Aeronautics program of some $70 million pays for projects which must be classified as defense research and development.

Private industry in the United States, according to a survey prepared by the National Science Foundation, is spending its own money at the rate of some 2-1/2 billion dollars a year for research and development. Thus, at approximately the current levels, the military-related research and development effort accounts for 30 to 40 percent of the nation's expenditures identifiable as research and development and for 40 percent of the professional research and development manpower.

Certain other points come into the determination of the level of the military program. Most important of these is that the military research and development appropriations do not cover all the funds which support our research and development effort. We have military personnel working on the program who are paid from a separate appropriation; we receive money from the construction appropriation for the capital expenditures for our laboratories and test facilities; and we receive substantial support from the procurement and production appropriation for buying prototypes, for engineering and service tests, and for the construction of facilities at contractors' plants. The support from the other appropriations has increased considerably in the past years.

Then, just as in industry during recent years, our costs have increased. According to the Bureau of Labor Statistics, research and development costs per scientist or engineer have increased approximately five percent per year simply because of increases in salaries, wages of supporting personnel, and costs of facilities, equipment, and materials.

In addition to the increases in costs of labor and materials, our weapons and weapons systems are becoming more and more complex. The number of engineering man-hours that now go into the development of a jet engine is close to double the number that went into the last piston engine. The development cost of the B-52 has been more than 2-1/2 times that of the B-36, and the development cost of the F-102 was more than twice that of the F-86.

After full consideration of all of these points and the examination of current and projected projects, the 1957 fiscal year budgetary level was set at about 1-1/2 billion dollars, which will provide for an expenditure rate just slightly greater than that in the present fiscal year.

INDUSTRIAL CONTRACTS

Basic to our philosophy of conducting the military research and development program is the concept that we must make certain that we integrate our efforts in utilizing the best that the science and technology of the country as a whole can produce. Outside contracting provides the primary means of doing this. Most of the contracts are on equipments to meet military needs as determined by the services, but some contracts utilize the independent, creative thinking of civilian scientists in exploratory studies and in the planning and review of our programs.

Only about 40 percent of the research and development appropriation is expended for government employees and for materials and supplies used in our own laboratories and test facilities. The remaining 60 percent is spent on contracts. About 50 percent of the total is expended on contracts with industrial laboratories and 10 percent with educational and nonprofit research institutes.

PROBLEMS

Mr. Quarles, in his recent testimony to one of the committees of the Congress, talked about hindsight. He said that in looking back over the operations of any large enterprise, and research and development is such, there will be many situations which we will all agree could have been handled better. Research and development, by its very nature of being on the frontiers of knowledge and experience, is particularly susceptible to errors in human judgment in complex situations—and to hindsight. It is a challenge to all of us to choose the proper courses of action when we are probing the unknown—to chose the right route from among the many unmapped roads.

One problem that we have not solved nationally is that of basic research. There is general agreement that a national climate, favorable to federal scientific work, should be nurtured. President Eisenhower has pointed out that "only a small fraction of federal funds is being used to stimulate and support the vital basic research which makes possible our practical scientific progress. I believe strongly that this nation must extend its support of research in basic science." The National Science Foundation was created in 1950 with the expressed intent that it formulate federal policy toward science and research and that it support general-purpose research. The Defense Department, which assumed a considerable part of the burden of research during the gap from 1945 to 1950, has also continued to sponsor basic research, although at a level which has received considerable criticism as being too low. The recent report of the Hoover Commission urges that Defense expenditures in this field be increased.

In the research field the task cannot be done by the Federal Government alone or by the Defense Department. The great responsibility must be shared by all of the technical and industrial capacity of the United States. At the present time some major industries do not appear to plow as much of their earnings into basic research as would seem desirable. I am happy to see that some companies of these industries are now increasing their basic research and development programs. It is a commendable trend and I hope that we see more of it. Research institutes and the universities have an excellent opportunity to promote this trend through their many contacts with industry.

The tremendous military research and development program will continue, as far as I can see, for a long time in the future. It furnishes the background and a large part of the stimulus for this rapidly rising, truly scientific age. If properly oriented and utilized, it will not only enable us to maintain the peace now, but eventually to win the permanent peace which we fervently hope will be the heritage of our children and grandchildren.

On the Naval Research Reserve

Seminar on Basic Research in Navy Problems

The first Research and Naval Science Seminar at the U. S. Naval Training Center, Great Lakes, Illinois, sponsored by the Office of Naval Research Branch Office, Chicago, is scheduled to be held from 15-27 October 1956. A quota of fifty Naval Reserve Research officers has been set for this seminar. Accommodations are available for more than this number if orders can be obtained from your Commandant.

Having as its theme, "Implications of Basic Research to Naval Problems," the Great Lakes Seminar agenda will include a variety of subjects: The Geophysical Year 1957-1958, Undersea Warfare, Human Engineering, Operational Aspects of Nuclear Propulsion, Cosmic Rays, Radio Astronomy, Solar Energy, Biology and Medicine, Electronics, Guided Missiles, Radiation Sterilization of Foods, and others.

RADM E. P. Forrestel, USN, Commandant, Ninth Naval District, and RADM Rawson Bennett, USN, Chief of Naval Research, head an impressive list of approximately 60 speakers, naval officers and civilians, including Dr. T. J. Killian, Deputy and Chief Scientist, ONR, Dr. M. J. Zucrow (Purdue University), Dr. J. A. Van Allen (University of Iowa), Dr. E. P. Ney (University of Minnesota), Professor Fred T. Haddock (University of Minnesota), Dr. Marcel Schein (University of Chicago), Professor J A. Reyniers (University of Notre Dame), and Dr. S. K. Allison (University of Chicago).

The Naval Training Center, Great Lakes, is a realistic setting for this seminar. Located on the shores of Lake Michigan, about 40 miles north of Chicago, the Great Lakes Training Center is the largest naval activity in the midwest. Contained in some of its 1000 buildings are several key activities of the Navy: Naval Examining Center, Electronic Supply Center, and Fleet Hometown News Center, as well as Navy schools and recruit training activities, which furnish large portions of the personnel needed to maintain and operate the Navy of today.

Commanding Officers' Conference Held at Minneapolis

Commanding Officers or designated alternates from 108 Naval Reserve Research Companies representing approximately 2400 Naval Reserve Officers throughout the United States gathered at the Naval Air Station, Minneapolis, Minn. for an annual conference on the weekend of 11-12 August 1956.

The appearance of the Chief of Naval Research, RADM Bennett and his inspiring and informative talk was the highlight of the conference. CAPT J. E. Cohn, USN, Commanding Officer, ONR Branch Office, Chicago, introduced RADM Bennett.

CDR H. F. Burr, Special Assistant to the Chief of Naval Research (Research Reserve) assisted by CDR John K. Hicks, USNR, Research

Reserve Training Officer, conducted the conference, the purpose of which was to acquaint the members of the Research Reserve with current plans, policies, and administrative procedures affecting the Naval Reserve Officer.

Speakers on the agenda included CAPT F. F. Gill; USN, Commanding Officer, NAS, Minneapolis; CDR A. O. Hoistad, USNR, Commanding Officer, NRRC 9-6, Minneapolis; LCDR W. C. Remick, USNR, Assistant for Research Reserve, ONR Branch Office, New York; CDR G. H. Ayres, USNR, Mobilization Liaison Officer, Eighth Naval District; CDRs J. W. Sheehan, USNR; R. S. Harlan, USN; A. S. Cleaves, USNR; and D. N. Morey, Jr., USNR, from the Bureau of Naval Personnel; CDR D. H. Green, USN, Office of ACNO (Naval Reserve); and CAPT H. G. Stevens, USNR, Commanding Officer, NRRC 3-1, New York.

New Assistant for Research Reserve in ONR Branch Office, Pasadena

CDR Donald A. Nienstedt, USN, received orders in July 1956 for duty in the Office of Naval Research Branch Office, Pasadena as Assistant to the Commanding Officer for Research Reserve. His most recent duty was as Commanding Officer of USS ROWE (DD 564).

CDR Nienstedt was graduated from the U. S. Naval Academy in 1934 and commissioned as Ensign USNR. Until 1940, when the Reserve Division to which he was attached was put on active duty, he was employed in the real estate mortgage business in Los Angeles. His first sea duty was in the Western Sea Frontier, fitting out PLOVER (AMc 3) and then as Executive Officer of USS AMETHYST (PYc 3), of which he was Commanding Officer until February 1943.

After a course at SCTC, Miami he fitted out USS ENGSTROM (DE 50) in June 1953 for Northern Pacific duty and USS STRAUS (DE 408) which he commanded in Central Pacific campaigns until V-J day 1945. He was acting Commander of Escort Division 65 when detached in February 1946 for duty as Assistant Director of Naval Reserve, Third Naval District.

On completing instruction at the General Line School, Newport, he had a tour as department head in USS TARAWA (CV 40) and one as Executive Officer at NROTC Unit, Villanova College, meanwhile having been transferred to USN status. The Korean episode greeted him with orders to command USS CASA GRANDE (LSD 13), which he left in 1953 for instruction at Armed Forces Staff College, Norfolk. This was followed by duty on the staff of Commander Amphibious Force Atlantic and in the Office of the Chief of Naval Operations, Surface Operations Division.

Suggested Research Reserve Projects

As indicated in ONR Instruction 3920.2 suggestions for appropriate duty projects will be given publicity in Research Reviews from time to time. The following is a partial list of problems which in scope and character are believed appropriate for Research Reserve companies. These and others were developed by LCDR Frank Hansing, USNR, NRRC 5-10, Bethesda, Md. during a tour of active duty for training in the Office of the Special Assistant to the Chief of Naval Research (Research Reserve):

1. Survey of marine fouling and deterioration problems confronting the Navy. What are the organisms involved and what are the physical and chemical characteristics which need to be studied to control these organisms? What research has been done in this area, particularly from the standpoint of chemical and physical properties of the surfaces that encourage or discourage the attachment of marine biological pests? There is need for a list of references describing ability of special materials such as neoprene rubber or various plastics to stand up under field conditions against marine biological deterioration.

2. Emergency survival techniques for persons isolated at sea. Increased knowledge of protection against and subsistence on local marine life is needed. A collection and review of literature on this subject, as well as advice on the type of manual to be developed for practical use, would make a suitable Research Reserve project.

3. A study of learning principles to be used by the Navy and industry. If desired, this study would be directed specifically to a study of the principles involved in making operation, maintenance, and utilization materials more readable to Navy enlisted personnel with technical ratings.

4. A study of the Naval Reserve Program, including enlistments, re-enlistments, and discharges. This would include attitudes and decisions toward each.

5. War Gaming - Such a study would include:

   (a) Game theoretical skeleton of actual military operations in the past and the decision processes which shaped them.

   (b) Examination of war gaming know-how accumulated by staff schools from the viewpoint of utilizing war gaming as a tool for quantitative analysis of military tactics and strategy.

Research Reserve Seminar on Research Methodology

The second annual seminar on Research Methodology took place at Columbus, Ohio during the period 17 June to 30 June 1956. This was conducted by Naval Reserve Research Company 4-7, under the auspices of the Office of Naval Research. CAPT Oram C. Woolpert, USNR, Commanding Officer of the local company, was Seminar Chairman, assisted by various members of the unit. Fifty-nine officers were in attendance. Most of the sessions were held in the air-conditioned Ohio Union building on the Ohio State University campus. Officers were housed in a nearby dormitory.

At the opening session, the Chief of Naval Research was represented by his Special Assistant for Research Reserve, CDR Horace F. Burr, USNR, accompanied by CDR John K. Hicks, USNR, Research Reserve Training Officer. LCDR William C. Remick, USNR, was present in his capacity as Program Officer, Third and Fourth Naval Districts. CDR Daniel Bontecou, USN, Commander Navy Reserve Area 4-5, officially represented the Commandant, Fourth Naval District. CAPT James A. Jordan, USN, Professor of Naval Science at the University, was also present.

Following a pattern established last year, the seminar presented a broad view of problems and approaches in various representative fields of research. Emphasis was placed on methods rather than solutions. Examples were drawn from the physical, biological, and social sciences, including applications of interest to the Navy. Speakers were principally from the University faculty and the staff of Battelle Memorial Institute. Audience participation was lively throughout the seminar. On several occasions hypothetical problems were assigned the attendees to be worked out in smaller groups and later discussed in plenary session.

The first afternoon was devoted to a panel presentation by a philosopher, an astronomer, and a biologist, giving the broadest possible bracketing of material to follow.

The program for the second day was planned around the problems of "space travel" in the belief that this had advanced beyond the state of mere fantasy, yet is surely beset with many difficulties, calling for the mobilization of a wide variety of specialties and challenging man's resourcefulness to the utmost. Two aeronautical engineers, a physiologist, and a psychologist had the responsibility of getting ship and crew safely into outer space and back again on this occasion.

Reactor development with its related activities provided the framework for the next day's sessions. Again it was clear that there are countless problems and vast horizons ahead. The point was made that "reactor engineering" is not a specialty as such, but rather a complex to which many fields must contribute.

In a somewhat different vein, the fourth day was devoted to currently pressing problems in training and education for research, research management, and the effective utilization of technical manpower.

Two days dealing with the biological sciences followed. These included discussions and demonstrations in the fields of genetics, endocrine disorders, pathology, physiology, nutrition, infectious diseases, and dental caries. The complexity of research in this broad field, and the interdependence of biological and physical sciences in respect to instrumentation and techniques were well illustrated.

One half-day was given over to a tour of Battelle Memorial Institute. Various research laboratories were visited, affording opportunity for discussions and demonstrations of current research activities by the respective staff supervisors.

A full day was devoted to operations research, covering both industrial and military applications. Dr. McCloskey, associated until recently with ORO, Johns Hopkins University, and now carrying on similar studies at Case Institute of Technology, was one of the principal speakers.

The Laboratory of Aviation Psychology, O.S.U., was responsible for a one-day session dealing with system research. Discussions and demonstrations of studies related to instrumentation and traffic control of aircraft were given, with numerous applications of direct interest to the Navy.

On the final day various officers in attendance gave examples of problems and methods arising in their own experience, in keeping with the spirit of the seminar, thus complementing significantly the more formally planned program.

The seminar is scheduled to be given again in June 1957.

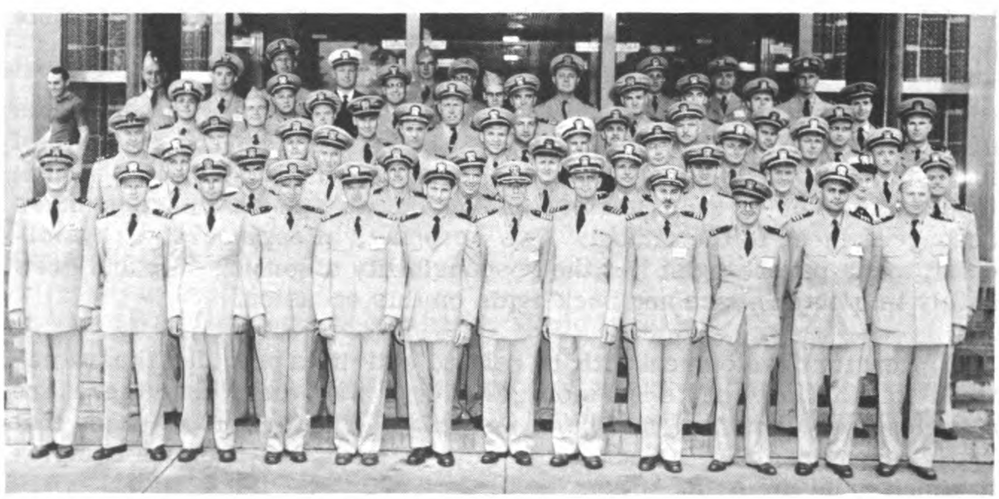

Figure 1 - Reserve Officers at Seminar in Columbus, Ohio.

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WHAT OTHERS ARE SAYING ABOUT ONR

SECRETARY OF THE NAVY DESIGNATES

ONR DECENNIAL YEAR

A Notice of the Secretary of the Navy dated 24 July 1956 designated the period from 1 August 1956 to 31 July 1957 as the Decennial Year of the Office of Naval Research. The text of the notice points up ONR activities and the service it is performing for the Navy in national defense:

"During the last decade, the Office of Naval Research has been singularly successful in bringing the scientists of this country, particularly those in universities and research institutions, into contact with the Navy's many scientific and technical problems.

"I consider it especially appropriate to designate the period from 1 August 1956 through 31 July 1957 as the Decennial Year of the Office of Naval Research. This period will provide a fitting occasion for the Office of Naval Research to evaluate its past contributions to our national defense and to make definitive plans for the coming years.

"The Decennial Year of the Office of Naval Research is of special concern to the forces afloat as well as to the bureaus, offices, and other agencies of the Department of the Navy. The increased responsibilities of the Office with regard to over-all Navy research and development coordination, operations research, foreign liaison, Navy scientific representation with other government agencies and special projects such as LAMPLIGHT, VANGUARD, and others, combined with growing technological demands and innovations have enhanced the Office's role in the research and development program of the Navy.

"The various intra and inter Navy symposia, conferences, publications, and other activities traditionally sponsored by the Office of Naval Research will, during this Year, further emphasize the Navy's awareness of the importance of basic and applied research and development.

"Thus, this Decennial Year of the Office of Naval Research will furnish an opportunity to study critically the significance of present and future science in the rapidly expanding role of the Navy in the national defense."

GARRISON NORTON
Assistant Secretary of the Navy (Air)

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10 YEARS OF NAVAL RESEARCH

Many ONR advances in items ranging from one-man helicopters to electronic computers ultimately have a "spillover" into fields of civilian usefulness that may someday overshadow immediate military applications. Perhaps the most important contribution of ONR for the long run has been its successful demonstration of how the Government may lead, encourage, and even direct pure research without submerging it in a stultifying bureaucratic maze. Only to the extent that the entire Government recognizes, as ONR seemingly does, that this is the way in which science can best make the contributions that will maintain American military and industrial superiority, will the forced marriage of science and Government succeed.

Excerpt from editorial
Washington Post and Times Herald
August 4, 1956

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Navy Gets Better Acquainted with the Stratosphere 1

For years the Navy has been probing the stratosphere with instruments borne by huge SKYHOOK balloons. The STRATO-LAB uses the SKYHOOK to take human observers aloft, ultimately—it is hoped—to 100,000 feet.

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How to Ferret Out Information Electronically 9

The need for getting information in a hurry is of considerable concern to the Navy, the Department of Defense, and others in our modern world of precision and speed. The EDIAC machine demonstrates how effectively an electronic search can be made for information stored in a library card index, a directory, or other types of information storage systems.

RNN-USN Seakeeping Trials. . . V. G. Szebehely 17

A combination of expert seamanship, synchronized photography, and up-to-date instrumentation enabled the Netherlands Navy, together with our Model Basin, to amass new data on the behavior of slender ships in heavy seas.

The Defense Research Program and Our Economic Future. . . . C. C. Furnas 24

What is the role of research in the defense of our country; why is continued progress vital to the economic strength so all-important in our world of today? Here are the views of a national leader with large responsibilities for research and development.

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COVER PHOTO: Crew and STRATO-LAB of the flight made on 10 August 1956. This was an initial flight using an open basket, parachute, and a plastic SKYHOOK balloon. Other flights are planned with an aluminum gondola, parachute, and SKYHOOK balloon.

RESEARCH REVIEWS endeavors to report briefly highlights of technical progress in research by Navy laboratories and contractors and the development of important naval research facilities. Articles which meet these broad criteria and possess a good degree of readability are welcomed. Manuscripts and changes of address should be sent to Code 740, Office of Naval Research, Washington, D. C. . . . Research Reviews is listed for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. Subscription price: $1.50 per year in U. S. and Canada; $2.00 per year, foreign; $.15 per individual copy.

Approved by Bureau of the Budget, 28 February 1955