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RESEARCH REVIEWS

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DEPARTMENT OF THE NAVY
WASHINGTON, D. C.

COVER PHOTO: A team of underwater photographers at the Navy Photographic Center has been working on a variety of assignments that require the use of both motion picture and still cameras. These swimmers wear protective suits when they operate in waters colder than the Caribbean Sea where this picture was taken.

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

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In This Issue

Transosonde balloon in hangar at Weeksville, N. C.

Balloons and Weather Forecasting

The Transosonde System

The state of the weather and its prediction have been subjected to widespread scientific investigations of a scope and magnitude which suggest that responsible people are weary of bad jokes on the weather, and that a much greater reliability in weather forecasting must and will be a pattern of the future. A Navy-financed research effort—concerned with the weather, meteorological data, and forecasting—introduces modern methods and techniques on the flight of free balloons. There is no novelty in the flying of balloons; the Office of Naval Research has been flying them for years. There has been a notable tendency, however, for free-flight balloons to become larger. This broadens opportunities for scientific investigation, and contributes to the feasibility of the joint effort of the Bureau of Aeronautics and the Naval Research Laboratory in developing a new system for collecting information on the weather.

This system which has come to be known as "The Transosonde System" makes use of sizable plastic balloons to go aloft and yield by modern telemetering methods, much needed meteorological data. In particular, this information is sought over ocean areas where there is little or no reporting of a meteorological nature. Thus the name "Transosonde" was devised as a contraction of "trans-ocean sounding." The use of free flying balloons in flights with a prevailing wind was demonstrated by the Japanese during World War II. They launched thousands of balloons with incendiary or anti-personnel bombs attached. As anticipated by the Japanese, the winds carried the balloons toward the North American continent. Now the Navy proposes to develop a system of data-gathering for weather forecasting purposes with newer type balloons which will hold to an altitude of about 30,000 ft (300 millibar pressure surface). At the 300 millibar surface, winds tend to be prevailing westerly in general, and launchings from most any point logical for data-gathering put balloons into winds that can be expected to carry them from west to east.

Ideas for the system that has come to be known as Transosonde began to generate in 1949 when the Chief of Naval Operations placed a requirement with the Naval Aerological Service. A concept of the system was then placed before the American meteorological Society in 1950 by CAPT H. T. Orville, then head of Naval Aerology. Later in the same year, the Bureau of Aeronautics established a problem with the Naval Research Laboratory for a feasibility evaluation of the transosonde concept. In essence, the proposal to be evaluated called for trans-ocean free flights by balloons which could be floated across inaccessible ocean areas in upper air currents with flight at constant levels. Through these balloons and attached devices, the atmosphere would be sounded, and information gained in the process would be transmitted to shore-based receiving stations. Also during the time the balloon was aloft, it was proposed that its trajectory be tracked through position fixes which would be determined by a suitable positioning technique.

After intensive study, NRL scientists reported favorably on the prospects of developing a transocean sounding system which could collect meteorological data heretofore unavailable yet greatly needed. The flight trajectory of the balloons was regarded as a primary source of information, as the course of the flights represented directly the atmospheric flow pattern. Meteorologists could derive conventional forms of information such as wind velocities from flight trajectories, and then plot on standard charts. If sensors were added to the equipment carried by the balloon, then data could be obtained on temperature, humidity, and other parameters which would be helpful to weather forecasters.

EQUIPMENT OF THE TRANSOSONDE SYSTEM

Scientists from NRL who contributed to the feasibility study were drawn from both the Atmosphere and Astrophysics and the Radio II divisions of the Laboratory. They indicated that the system be developed to consist essentially of:

- A balloon carrier that is constrained to float along a constant pressure surface (such as 300 millibars) in the atmosphere by means of suitable control equipment,
- An airborne station made up of meteorological sensors, transmitters, and power supply,
- A network of high-frequency radio direction-finding stations to position the balloon at periodic intervals, and to collect meteorological intelligence.

Experimental equipment was designed and assembled for field tests scheduled in the autumn of 1952 at Tillamook, Oregon. The balloons (Figure 1) were made of polyethylene plastic, 39 feet in diameter, and

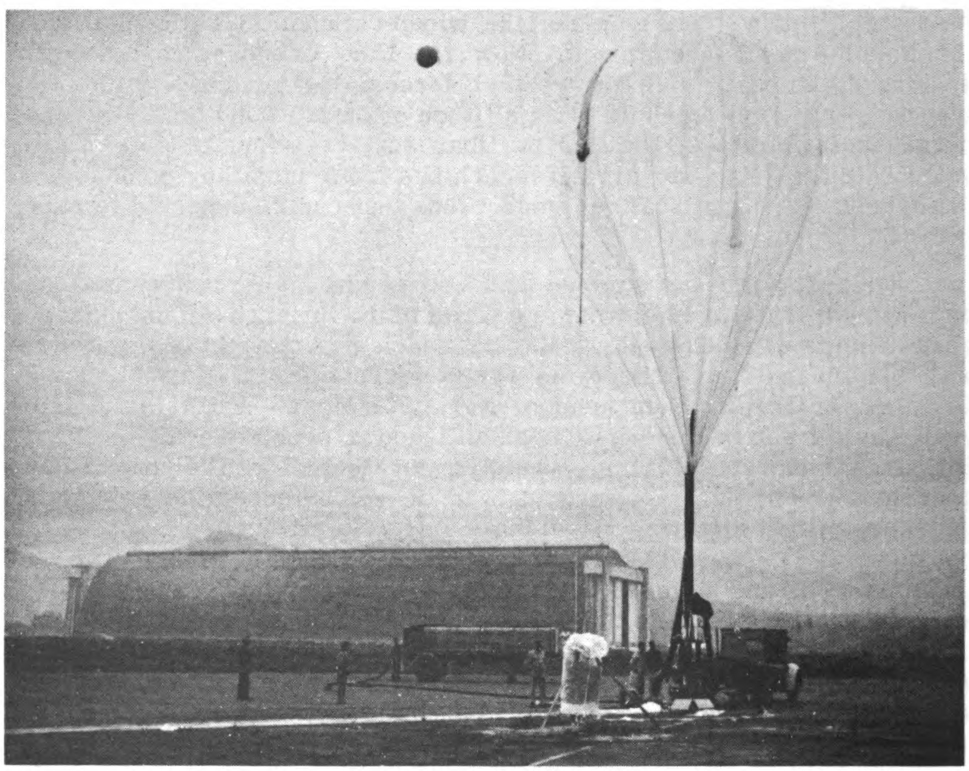

Figure 1 - Balloon-flights from Tillamook, Oregon in the autumn of 1952

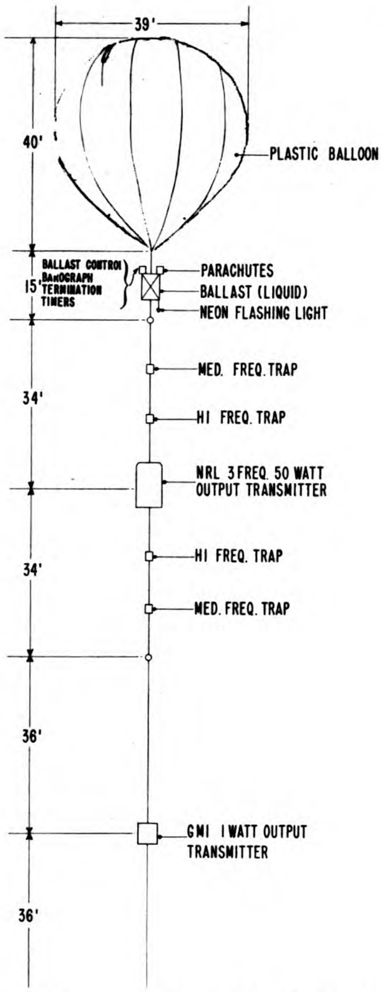

Figure 2 - Schematic of balloon and train in the transosonde system

Control of the pressure height of the balloon was achieved by means of a ceiling and ballast control system which maintained flight between two pressure height limits. The ballast control system consisted of a pressure switch which activated a ballast valve whenever the balloon descended below the selected control level and checked the descent.

The transmitter was designed for operation on three frequencies with an output of 50 watts. The rate of transmission during flight was once every two hours for a five-minute period on each of the capable of carrying up to 700 lb while floating at the 300-millibar surface. Each balloon had a quota of equipment which is suspended in a vertical flight train beneath the balloon (Figure 2). The 50-watt transmitter in the train (Figure 3) provided the means for tracking the balloon using a network of high-frequency radio direction-finder stations.

The first evaluation flights were encouraging, and enough was learned to warrant re-engineering the equipment for a second series of flights. These launchings were made from Minneapolis, Minn. in the summer of 1953. The balloons were made by heat-sealing 14 sections of polyethylene plastic to form an inverted tear-drop nearly 40 feet across. In pre-test this balloon lifted 1700 lb, nearly three times the specified load. There was no evidence of stress concentration or apparent leakage.

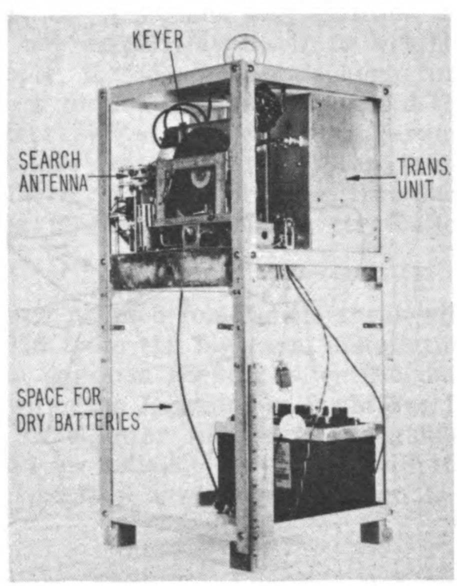

Figure 3 - Transmitter and power supply for transosonde system

three frequencies: 6420 kc, 12,855 kc, and 19,282 kc. During each transmission period Morse-code keying was provided to give the atmospheric pressure at the floating level, and the temperature inside the transmitter pack. Also during transmission, two 30-second dashes were sent out to aid the participating direction-finder stations in their job of getting bearings. The procedure on balloon positioning called for "fixes" every two hours through the use of radio direction-finder facilities of the Navy and the Federal Communication Commission.

EVALUATION - 1953 FLIGHTS

The ten flights from launchings in Minneapolis were all controlled to float at the 300-millibar surface, and were set to terminate by means of a pre-set clock mechanism. Forecast trajectories were made for each flight; these guided the scientists in charge of the launchings when decisions were made on terminations. After the test flights had been run, computations were made to determine the duration of flights. The over-all reliability was exceedingly good as there were no flight terminations due to failure of the balloon, and only one premature termination resulted from malfunction of the control equipment. The simple controls on altitude were effective in keeping the balloons within a 2000-ft layer. This is considered very good for flights along the 300 millibar pressure surface (about 30,000 ft).

During the course of tests, participating radio stations took bearings and collected meteorological data under varying conditions of transmission path-length and direction. Quality ratings for the radio-finder positions covering the various flights were from poor to good,

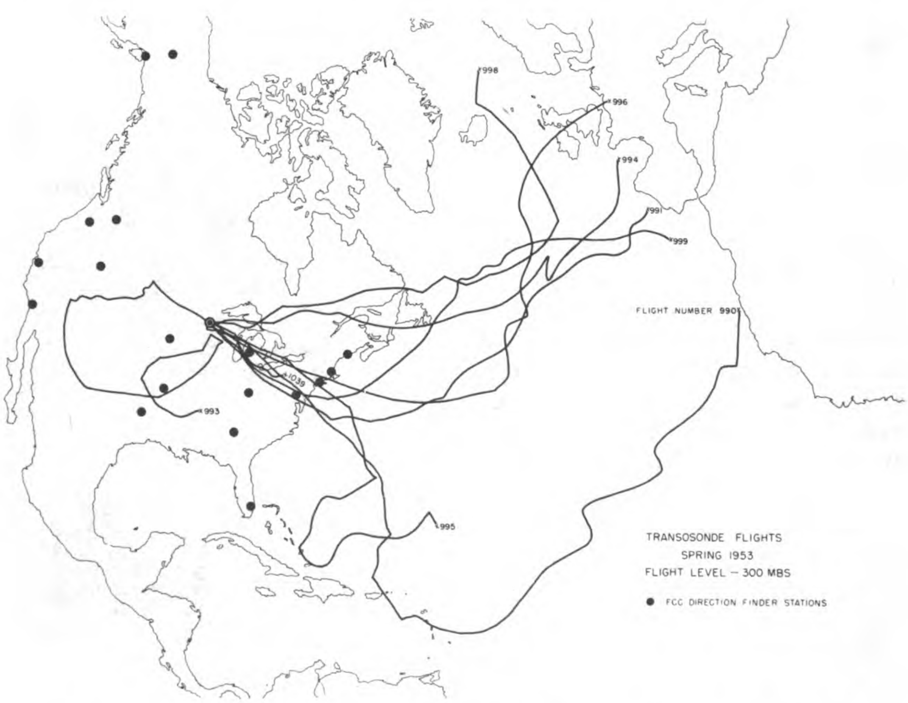

Figure 4 - Trajectory of 10 balloon flights launched from Minneapolis in 1953

but direction-finder positions of reasonable quality were obtained quite consistently out to a distance of 3000 miles from the nearest direction-finder station.

These flights provided not only information on the speed and direction of the wind, but also gave an indirect determination of contour spacing. They indicated the presence of "troughs" and "ridges" which are, respectively, elongated areas of low barometric pressure and wedgelike extensions of high-pressure areas. This is the sort of information that greatly aids weather forecasters, so plans were laid to continue with further flights which would extend information beyond that gained through the trajectory of balloon flights. Future transosonde systems will carry additional sensors to collect other valuable forms of meteorological data along the flight path. Droppable units may also be included to sound the atmospheric layers beneath the balloons.

EVALUATIONS OF THE BUREAU OF AERONAUTICS

The Bureau of Aeronautics provided the personnel for the service evaluation that took place in the spring and summer of 1955 at the Naval Air Facility, Weeksville, N. C. (Figure 4). In a series of 22 flights there were several remarkable ones. One balloon was terminated in flight about 1000 miles off Boston, and a U. S. submarine, the TUSK (SS426), sighted the kapok bag and equipment floating on the sea. The remarkable thing about it, however, was that the telemetering equipment was still working, although no measures had been taken to waterproof the transmitters. A shore station tracking a balloon near Ireland followed a descent from 30,000 ft. down to 5000 ft. where the signal was lost.

Not only with the transosonde system gather the more conventional types of meteorological data, but there are potentialities for additional telemetered information not usually available to weather forecasters. It is possible, for example, to measure atmospheric turbulence and the vertical components of motion. Measurements of the vertical wind component have long represented a much sought parameter in meteorology. Still another unique feature of the system is the continuity of information as telemetered, and the promise that such continuity may bring to light details in the atmospheric circulation hitherto unknown and undetermined.

Further field-evaluation tests are planned for Pacific areas with flights scheduled to begin early in 1956 from the big naval installation in Yokosuka, Japan. Thus American balloons seeking scientific data will follow the course of balloons flown by the Japanese in World War II. An interesting sidelight is afforded by a letter written by Tsuguhiko Kato of Camp Zama, Japan who had an indirect connection with the Japanese balloon project, and who expressed a willingness to go in a balloon on a transPacific flight.

The experienced BuAer flight team of an officer and ten men will spend some months in Japan to prepare for the tests, and to send the balloons aloft on schedule. These U. S. Navy men were not especially screened for their assignments, but all are competent Aviation

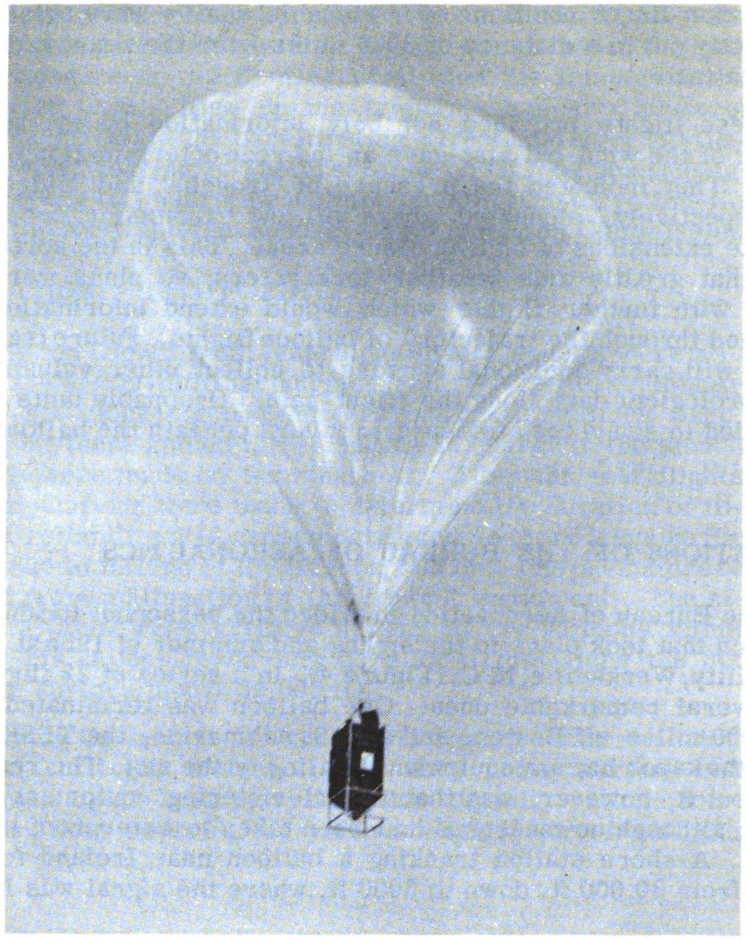

Figure 5 - Balloon and airborne transmitter aloft after launching at Weeksville, N. C.

Electronics Mates, and Aerographers Mates. It has been shown that the transosonde system can be successfully operated by Navy personnel without elaborate training of a specialized nature. The meteorological data gathered in the balloon flights over the Atlantic are being further processed and evaluated by the Bureau of Aeronautics in Norfolk, Virginia, under Project AROWA (Applied Research Operational Weather Analysis). Projected some time in the future are service evaluation tests in the tropics.

The transosonde system represents a visionary and bold approach to the problem of collecting weather data over inaccessible ocean areas. Forecasters faced with the difficult problem of determining weather patterns where little or no data are available, will find the advent of the transosonde system a valuable aid in preparing better forecasts. There are possibilities also that as quantities of telemetered data are processed in research projects like AROWA, a new insight may be gained on the dynamics of atmospheric motion, and that such additional basic information may be useful to scientists in fields other than weather forecasting.

Teflon - the Miracle Lubricant

Imagine a lubricant that will not absorb water, that will stay slick at temperatures 70 below zero or at heats up to 500 degrees, that will not collect sand or dust, that can be sprayed on like paint and then heat fused into a surface-coating that sticks like enamel and does not rub off. You might say that such a material is a Serviceman's pipedream. Yet all those qualities have been combined in a single miracle coating a few ten-thousandths of an inch thick. Its name is Teflon.

Before going any further, the material itself is neither new nor Navy discovered. "Teflon" is short for tetrafluoroethylene resin, and is a trade mark of the E. I. DuPont de Nemours Co. They developed it as a plastic coating, and it is commercially available in an extensive series of water-dispersed primers, finishes, and enamels. It has superior qualities as a coating because it wears well, has relatively high heat stability, is very durable, and provides excellent corrosion resistance—not only against moisture but against many chemical exposures as well. Being nonconducting, the material is also a good insulator.

What the Navy did was to uncover, through intensive research, Teflon's possibilities as a dry lubricant, to ferret out military applications for the stuff (both as a lubricant and as a protective coating) and then test it in operational use. The Marines, who have tried it, are convinced that Teflon is a miracle indeed.

The Navy's special interest in dry lubricants goes back to the Korean War. At that time aircraft automatic cannon were freezing up in the frigid cold over North Korea, and the Bureau of Ordnance urgently asked the Naval Research Laboratory to find a lubricant that would keep the guns firing. Borrowing on prior research, NRL's chemists came up with a stop-gap answer in 90 days: a series of synthetic oils and greases that remained effective from minus 70° to plus 160° F.

Both BuOrd and NRL realized, however, that there were continuing problems with aviation ordnance lubricated in a conventional manner with oils, greases, or waxes. Such lubricants pick up and retain dust, dirt, debris and water. This contamination of the lubricant causes it to thicken and also invites ice adhesion at high altitudes.

The major lubrication problem in the automatic aircraft cannon was associated with the need for a cartridge-case lubricant which would stay on over long periods of time and yet would not become contaminated. Also, it was necessary that the cartridge lubricant should not affect the gun-mechanism lubricant.

Faced with these problems, chemists at NRL began investigating dry-film lubricants as a replacement for conventional fluid lubricants. First, a detailed outline was prepared of the desirable characteristics for an ammunition lubricant. A satisfactory lubricant for this purpose should have:

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- A coefficient of friction of 0.1 or less over a temperature range of minus 75° to plus 500° F.,
- Good adhesion to brass and steel over the same temperature range,
- No softening or melting point over this temperature range,
- Repellence to both water and dirt,
- Negligible solubility in any oil or solvent which would be likely to contact it,
- Ease of application without affecting the cartridge metal,
- Ability to prevent atmospheric corrosion of brass and steel,
- Economy in terms of cost of application and adequate availability in time of war.

Out of the 14 most promising dry-film lubricants investigated, only thin films of Teflon could meet these requirements.

Scientists at NRL in cooperation with the Fabrics and Finishes Department of the DuPont Co. worked out practical methods (Figure 1) for applying single and multiple coatings of Teflon to both brass and steel cartridge cases and prepared several thousand rounds for test firing at the Laboratory and at the Naval Proving Ground at Dahlgren, Virginia. The gun-firing tests, using Teflon-coated cartridges, indicated a degree of freedom from cartridge malfunction not previously obtained either with conventional lubricants or with uncoated cartridges.

The Bureau of Ordnance then ordered a large quantity of Teflon-coated ammunition from a contractor. (The coating, which looks like a dull green paint, has a distinctly slippery feel to it; rub two cartridges together and they slide like a runner on hard ice.) Tests at Dahlgren with this ammunition substantiated the conclusions of the NRL scientists. There was unheard of freedom from cartridge-jamming; the guns and feed mechanisms were cleaner; and the Teflon lubricating films performed much better over the temperature range of minus 75° to plus 500° F.

Figure 1 - Experimental apparatus used at NRL for coating 20-mm shell casings

The success obtained in lubricating ammunition with Teflon films led the NRL scientists to study other similar military lubrication problems. In a comparatively short time, hundreds of lubrication problems were being solved, in the Laboratory, with Teflon films.

Following laboratory tests of automatic pistols, rifles, ammunition and similar ordnance equipment, the Marine Coprs completed extensive field tests of coated infantry weapons. According to the Marine Corps, these tests, which lasted approximately eight months, have established that "The original coating of Teflon provides satisfactory lubrication for an almost indefinite period following issue." In addition, the dry lubricating film also proved to be "a suitable preservative for long-term storage of weapons under those conditions which might exist in a storage site," and is "much superior" to the conventional preservative both in corrosion prevention properties and in maintaining combat readiness of weapons. (If you have ever had the messy, laborious job of breaking out and cleaning a crate of rifles packed in cosmoline, you will know what they mean by "combat readiness.")

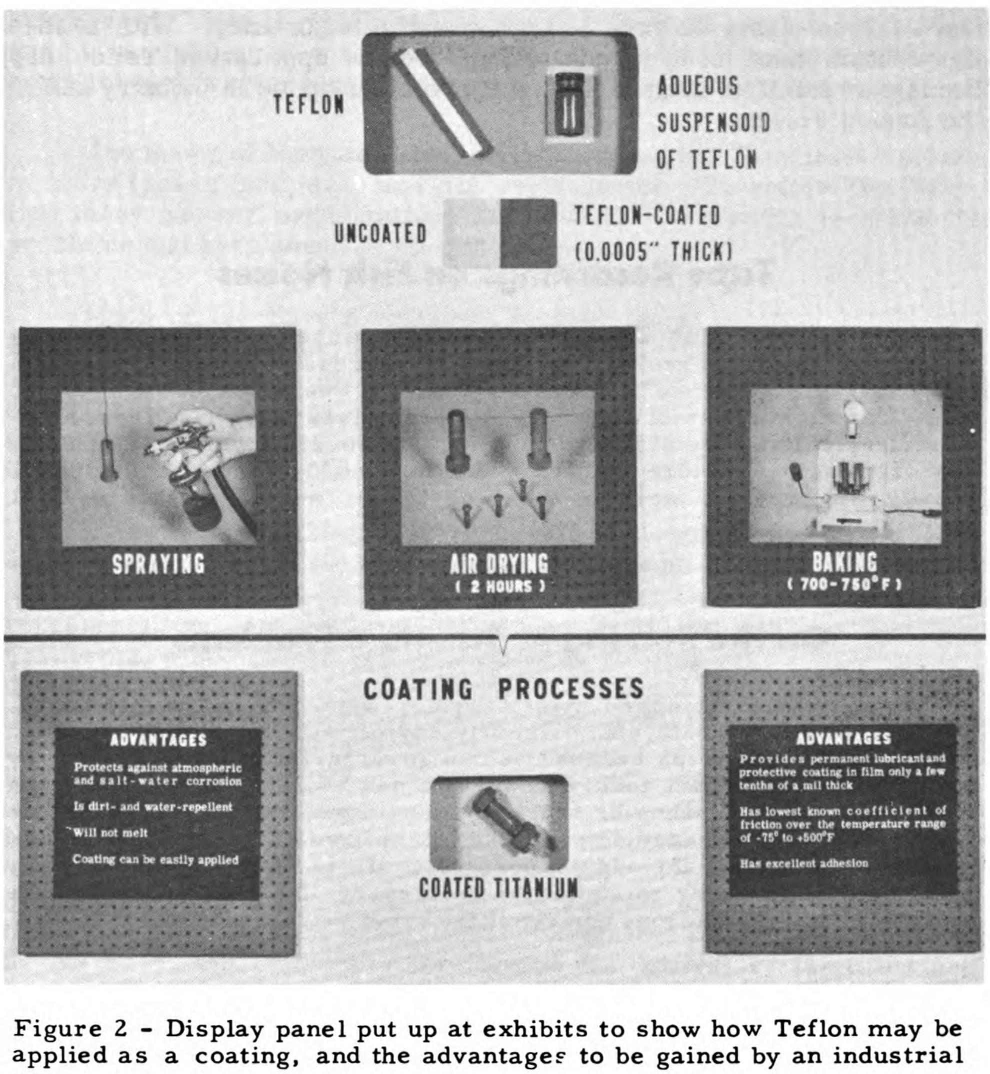


Figure 2 - Display panel put up at exhibits to show how Teflon may be applied as a coating, and the advantages to be gained by an industrial user

Teflon has so many possible uses that its potentialities—like cellophane thirty years ago—have only been sampled. The Navy is not overlooking any possibilities. We can expect the olive-drab coating to appear in more and more places aboard ship, not only in ammunition boxes, but in gear trains, elevating quadrants, universal joints, etc.—in place of the heavy greases now used for anticorrosion protection and in-use lubrication. At exhibits on Navy research and development (Figure 2) Teflon has been put on display as a product which not only has important defense applications, but also has widespread industrial use.

As a case in point, commercial bakers have found the new coating so highly useful and money-saving that there has been a wholesale departure from time-worn methods. Whereas the big baking companies formerly used tons of loose flour every day to prevent dough from sticking to pans, baking sheets, and dough chutes, they now use Teflon instead. The heat-applied coating lasts for years, and loaves and pies can be turned out without leaving a crumb. Multiply this particular application by hundreds of others which can be expected in a few years, and a fair idea may be gained of its growing importance. With a little more "know-how" as to its use and methods of application, Teflon may become as familiar in the home as it promises to be in industry and in the Armed Forces.

Tape Recordings on Fish Noises

Dr. Charles J. Fish, Director of the Narragansett Marine Laboratory at Kingston, R. I., has recently completed a successful research program at the Institute of Marine Biology, La Panguera, Puerto Rico. He obtained more than eight miles of tape recording of noises eminating from identified tropical species of fish. These include sounds from some 165 fish representing 65 or more species. This new collection will enhance greatly the previous work in this line by Dr. and Mrs. Fish on ONR projects.

On the Solving of Scientific Problems

"I am fain to compare myself with a wanderer on the mountains, who, not knowing the path, climbs slowly and painfully upwards, and often has to retrace his steps because he can go no farther--then, whether by taking thought or from luck, discovers a new track which leads him on a little, til at length when he reaches the summit, he finds to his shame that there is a royal road, by which he might have ascended, had he only had the wits to find the right approach to it. In my works, I naturally said nothing about my mistakes to the reader, but only described the made track by which he may now reach the same heights without difficulty."

---Hermann Helmholtz

Navy Research in Southern California

CAPT D. P. Tucker, USN
Commanding Officer, Pasadena Branch Office
Office of Naval Research

The importance of the research effort to national strength has been well recognized in this country, but perhaps our appraisal is less keen on the character of this research. Because the work of scientists in the United States is unregimented, because we are committed to a policy of free research, our total effort has produced scientific progress that can well be regarded as the true product of a free society working in harmony. In contrast with free research, there is the kind practiced by those who operate on a regimented basis. Scientists are questioned each month on their work and what they expect to accomplish. There is a story that one of the more canny of these foreign scientists never told the commissars about future work other than what he had already accomplished. Thus at month-end he was able to make good on his quotas, and he was held up as a notable example of a scientist who was able to come through with accomplishments he had predicted in advance.

The scope of Navy research is large, since the Navy must operate in every type of land, sea, and air environment. Therefore the Navy, like many another organization, has turned to research to solve its problems and keep ahead of its competitors.

Much of the Navy's research is done on a contract basis with educational institutions, research foundations, private laboratories, and business organizations. This work is directly sponsored by many different Naval organizations, but large responsibilities of coordination on the over-all Navy research and development program have fallen on the Office of Naval Research.

In the Southern California area, the Navy has research contracts with more than 25 organizations. Some of these are engaged in classified work, but of the unclassified projects several can be singled out as representative. Among these contractors is the University of Southern California, which has 20 separate projects ranging over a wide variety of subjects. In the field of chemistry, a typical sponsored research program is going forward in boron compounds (Figure 1) under the guidance of a professor who was interested in their possibilities long before he secured an ONR contract. Originally, the best known boron compound was Borax taken from Death Valley. In his proposal to the Navy for extended work on boron compounds, the objective was to investigate them for their possibilities as rocket fuels. This fitted in with broad Navy plans in the development of rockets and rocket fuels—and much progress has been made in both. When the project was approved by the Navy, the University contributed its laboratory facilities and some of the time of its regular staff. Navy funds covered the salaries of student assistants and procured for the University equipment it did not have.

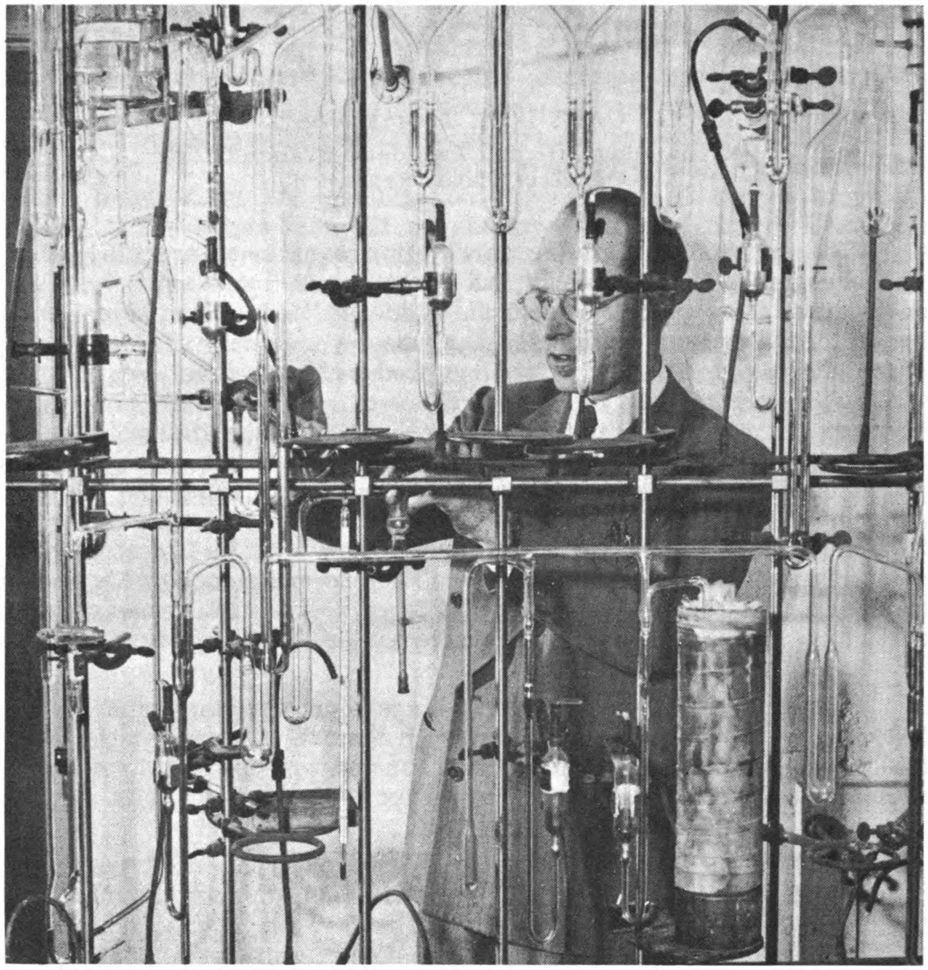


Figure 1 - A boron research facility at USC

As a result, the properties of boron hydrides, which used to be a laboratory curiosity, are well known throughout the country. The original investigation led into other developments of outstanding immediate industrial use. The boron hydrides are an accepted reducing agent in many industrial processes; one in particular has become associated with the manufacture of the famous new drug, Cortisone. Thus the benefits of the research on boron hydrides by the Navy and by the pharmaceutical companies, have been carried far afield to sufferers who have been helped by the new product now so easily manufactured.

In connection with the research on boron hydrides at the University of Southern California, some ten students who participated in the work were awarded Ph.D's for the originality they displayed in their investigations. Thus another group of young scientists joins the many others who have gained their experience in Navy-sponsored research.

At the University of California at Los Angeles, among the many Navy projects there, is one which makes use of a large electronic computer to solve problems of interest to national defense. The team on the project is also determining the capabilities (Figure 2) of such computers in general, and how the research mathematician may use them. A natural problem for the computers, from the Navy viewpoint, is inventory control. Also, some good work has been done in getting down to cases on the multiplicity of stock items in the control system.

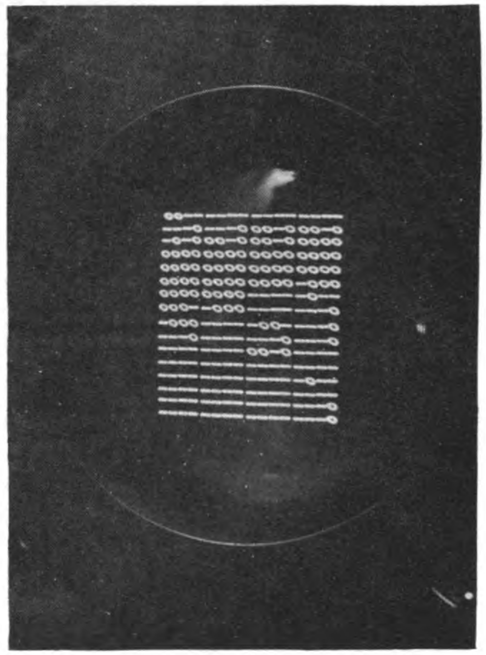


Figure 2 - A monitor cathode tube shows binary numbers storage of the automatic computer at UCLA

As an example, the Navy stocks many thousand different kinds of gaskets for the various engines in ships and planes all over the world. Thousands of other items, large and small, must be carried on inventories that are continually being depleted at different rates, depending on the location of the warehouses and supply points where stocks are kept. As computers prove their capabilities in handling complicated problems of inventory control, the Navy can probably cut down on present stocks, and save money for the taxpayer.

In the aviation field, the Navy has the Douglas Aircraft Co. coordinating a big, complex investigation started by a naval aviator for the purpose of simplifying the cockpit installation (Figure 3) of an airplane. The idea is to reduce the dozens of indicators, switches, and levers to about six functional controls. These controls in turn would have built-in automation that would carry out each routine operation in flying the plane, and in addition, would check the instruments. Among the new items being developed in cockpit instrument simplification is a large, flat television tube only three inches thick (Research Reviews, February 1955). It is possible to see completely through this tube. Thus it can be used as the windshield of a plane, and the pilot when flying blind sees the same kind of a picture he would actually see under conditions of good visibility. Such a tube would be invaluable in blind landings.

The California Institute of Technology also has a share of the Navy's research in the Los Angeles area. Both of the Nobel Prize winners now at the Institute are working on Navy-sponsored projects. Famous as an engineering school, Cal Tech also has done some outstanding work in biology, particularly in genetics. A fundamental research project in the Division of Biology is concerned with the problems of skin grafting. Skin burns are one of the occupational hazards of the Navy because of the large amounts of gasoline and explosives on many ships and shore stations. At present when a skin graft is needed, only the skin of the patient or of his identical twin may be used. In solving this problem, we need to know more about cell growth, antibodies,

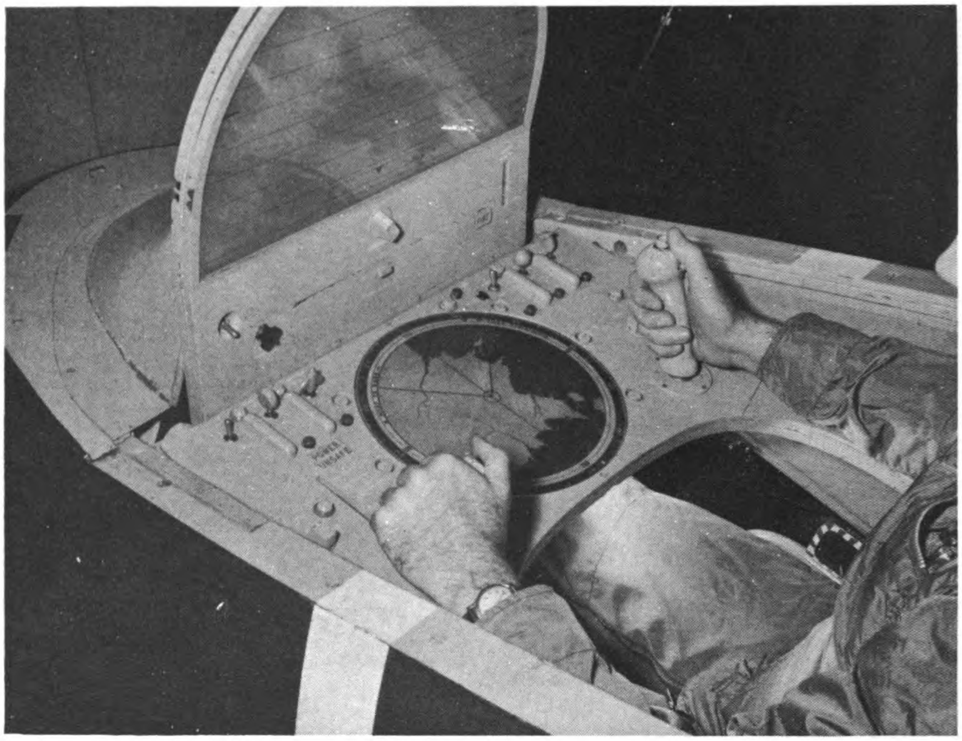


Figure 3 - Mockup of instrument panel and controls of a plane. A system with such innovations is expected to be ready for testing within three years

and genetics. Therefore, a powerful research effort in this direction is going forward at Cal Tech.

Navy research, in the four cases detailed and in other projects, contributes not only to the solution of problems important to national defense, but also has far-reaching effects on our economy in general. The taxpayer is footing the bill, but he gets extra dividends in the form of a higher standard of living based on discoveries which can also be used by industry and medicine. In addition, the national level of education has been raised by the government's drive for a better technology and a broad advance in many fields of science. This program of the government has aided competent young men by the thousands in getting a higher education, and in becoming scientists. They gain a lot of personal satisfaction by becoming expert in their field; the nation as a whole benefits by having so many highly competent people in technology and science.

All this has been gained economically, as the Navy research projects in the Los Angeles area are financed at an annual cost of about two large airplanes. The bulwark of national defense is becoming ever stronger, and the benefits to our peacetime economy are piling up at the same time. Some of the best scientific brains of the country are at work to improve and extend the research effort, and we can expect even more far-reaching benefits in the future.

A Library Panel Speeds the Flow of Information

Wm. E. Jorgensen
Chief Librarian, U. S. Navy Electronics Laboratory
San Diego, California

A technical library battles constantly with its ever-increasing flood of published information. The routines of receiving, cataloging, finding additional space, etc., are only a part of the job faced by a librarian. More important he must see that the proper scientists and other people served get this material that comes in.

A system has been developed at the library of the U. S. Navy Electronics Laboratory in San Diego, Calif., which reviews and evaluates incoming scientific and technical reports, and in the process lines up names on a priority list for each item. Books and periodicals are not included in this system as the information about them is already accessible through book reviews, abstract journals, indexes, etc.

Some 10,000 to 15,000 technical reports are received annually by the library. To help the scientists sift out what is important to them in this mass of material, a Literature Review Panel (Figure 1) was started.

The members of the panel are selected from the civilian scientists, engineers, and technicians in the scientific and technical divisions. To provide opportunity to the most people for participation and training, panel members are appointed by their division heads to serve for only

Figure 1 - Members of the Literature Review Panel are drawn from scientific, engineering, and technical divisions of the Laboratory

three months. The time involved is negligible, for the weekly sessions of the panel last only about an hour or an hour and a half. Enthusiasm has remained high since the panel started a year and a half ago. This is due largely to the fact that the members feel they benefit personally by having such convenient access to the whole range of report literature hot off the press.

The functions of the panel are to:

- Provide a continuing program for evaluating the current technical literature in terms of its pertinence to Laboratory work and for ensuring the prompt delivery of new publications to those persons directly concerned.

- Establish a mechanism for two-way communication between the library and scientific and technical groups concerning their requirements for published technical information.

- Afford panel members an opportunity to keep abreast of the literature in their fields and to report back to their several groups on the new developments and concepts appearing in the current literature.

The responsibilities of the individual members of the panel are threefold:

- To review the new technical literature for the purpose of evaluating its pertinence to laboratory work.

- To indicate, if applicable, the persons to receive certain publications.

- To report back to their own groups new developments and concepts appearing in the publications reviewed.

The final step in the procedure is accomplished when the library staff records the reserve lists for each publication, and starts them all on their circle of short-term loans to those persons indicated by the panel. In the meantime all the scientific and technical personnel in the laboratory are notified of the week's new library accessions by means of a mimeographed "Acquisitions List." Others who wish to see these publications are added to the reserve lists so they will receive them in turn. The added impetus given by the panel's suggestions for routing have served to increase considerably the use of library materials.

It was found in the operation of the panel that the Program Aides, the Naval engineering officers, and the Commanding Officer and Director's staff were reviewing for somewhat different purposes than the rest of the panel, and could get better results by meeting separately. The Aides are responsible for rather broad functions such as sonar, radar, radio, etc., and are more concerned with general, over-all programs than with the specific details. By meeting separately, the Aides are also able to discuss the new literature among themselves, in relation to their mutual

Figure 2 - Program Aides review current literature under the guidance of the Chief Librarian and the Head of the Document Analysis Section

interests and programs. Figure 2 shows the Program Aides reviewing the current literature. Assisting them are (left) Wm. E. Jorgensen, Chief Librarian and (right) I. G. Carlson, Head, Document Analysis Section.

The Literature Review Panel has served very well during its first year and a half of operation. There has been a considerable decrease in the time-lag usually involved in disseminating current technical information pertinent to the work of personnel in all echelons. Even more important, though, a better method has been provided for ensuring that new scientific and technical developments as reported in the literature will not go unnoticed by those who most need to be aware of them and their implications for the mission of the Laboratory.

Navy's Highest Civilian Award to NRL Scientist

Another scientist at the Naval Research Laboratory, John C. Link, has been given the Distinguished Civilian Service Award, the highest for a non-military man, for his research and development work leading to the production of improved electronic equipment for the protection of military personnel.

The text of the citation begins: "The Secretary of the Navy takes pleasure in presenting the Distinguished Civilian Service Award to Mr. John C. Link for exceptionally outstanding service to the United States Navy in the field of countermeasures research and development."

How Navy Swimmers Take Underwater Pictures

With the development of practical cameras for use under water, the Navy has sought out new photographic possibilities through the work of a team of swimmer-photographers attached to the Naval Photographic Center, Washington, D. C. For some months an officer, LCDR Charles A. Hooper who is an expert swimmer, and a group of three enlisted men carried out a number of experiments in the waters off the Virgin Islands and later from favorable locations near Key West, Florida. Thus far the team has concentrated in testing and evaluating underwater equipment and has recorded the movements of such undersea objects as the hull of a ship or a submarine. In addition, training films have been made on Explosive Ordnance Disposal and Mine Disposal and on underwater swimming and photography. Most of the underwater scenes for the first "Navy Log" television program, featuring the work of an Underwater Demolition Team, were taken by this group.

By the activities and research of this team, the Navy is now able to analyze the previously unobtainable or obscure data to be gathered from beneath the surface of the sea. New interest has been aroused in this vital field since the Underwater Photographic Team has begun to record underwater situations that formerly could only be reported through human vision and memory.

The team is a unit that needs little more than logistic support to carry out a photographic task. Requests for the services of the Team have been received from naval activities such as the Bureau of Ships, Bureau of Ordnance, Bureau of Aeronautics, and the David Taylor Model Basin. When assigned to a task the Team takes its own equipment and sets up shop aboard a ship or station especially assigned to support the operation. Since all the Team's equipment except the bulky aqualungs can be transported in half a dozen 50-lb boxes, transport to a working site is a fairly simple matter; Navy units encounter but few problems when they avail themselves of the capabilities of the Team.

Each member of the Team is carefully chosen with emphasis on physical fitness. They must be a rugged group, because the rigors of underwater work demand exceptional stamina, mental as well as physical. The men are well-qualified photographers, and are attracted by the opportunity to increase their skill in a new medium. The men who have served at one time or another on the Team tend to become dedicated to their work, which is reflected by a tremendous enthusiasm and love for their job under the water. Once beneath the surface they become scientists, exploring and discovering a world new to photographers; they become artists when the color and beauty of this underwater world unfolds as a lure to their cameras. But they are also technicians, well trained to obtain the important data they are called upon to record. The objective may be to show the influence of the tides and moving water on anchors and buoys or to film aspects of the performance of submarines.

When these men work together, the Team is foremost, for they rely on one another to insure their safety and their efficiency. Ever on the alert for danger, they seem to sense the imminence of any peril, natural or mechanical, and each man protects the others. Using the "buddy-system," no man is ever completely alone. Needless to say, camaraderie runs high on a team such as this and the men display much of the same close-knit interdependence when "topside" during their periods of recreation. With these men, when they are on location, recreation frequently means skin-diving or spear fishing—always sharpening their technique and improving their breathing.

Assignment to the Team is sought after, as the men get interesting duty and have a chance to round out their photographic skills in an activity that is just beginning to attract popular attention. There are over two dozen applicants for the next opening. This is all the more remarkable as the job does not bring extra pay for hazardous duty.

The members of the team when doing a picture assignment under water work mostly in the area between 30 and 70 feet below the surface. (At times the swimmers have gone as far as 100 feet down). Most of the work has been done in tropical water so protection from cold has not been a problem. The swimmers have adopted the practice of wearing a blue woolen jersey, diving underwear, and a pair of swim trunks. A hatchet, it was learned, is a most useful tool to have under water. Of course, the photographers are burdened with a standard 70-lb aqualung (Figure 1), and propel themselves with giant duck feet. The face masks worn by members of the team are of the Champion type, that allow the swimmer to equalize pressure and protect such sensitive parts of the head

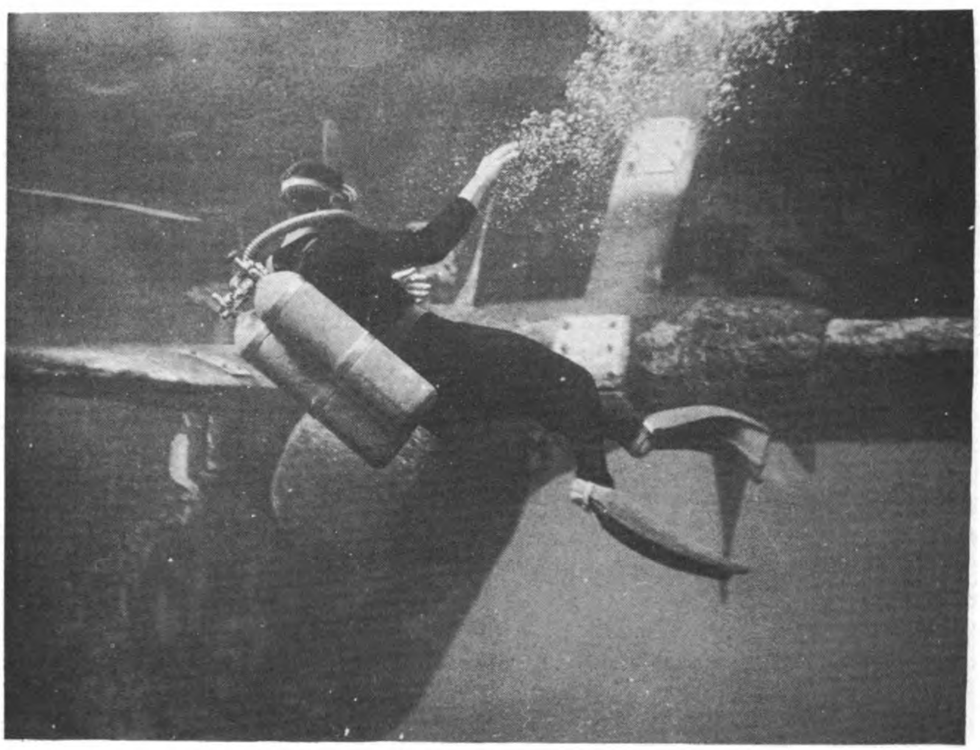


Figure 1 - The aqualung has two oxygen bottles to account for 70 pounds carried by the underwater swimmer

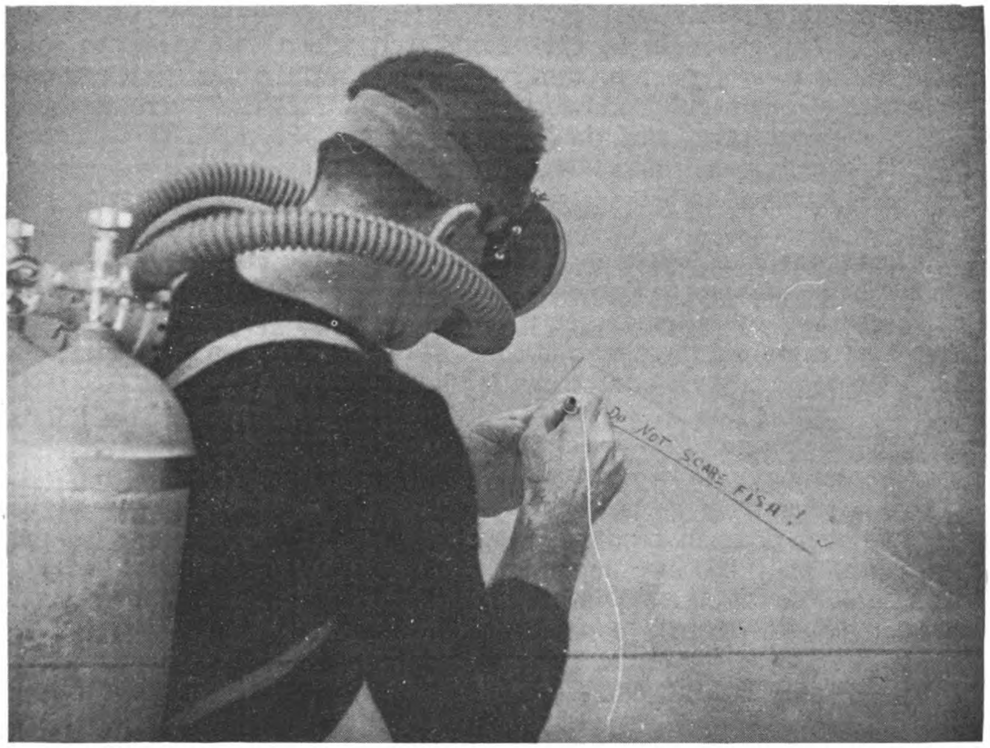


Figure 2 - Leader of the Team writes instructions underwater

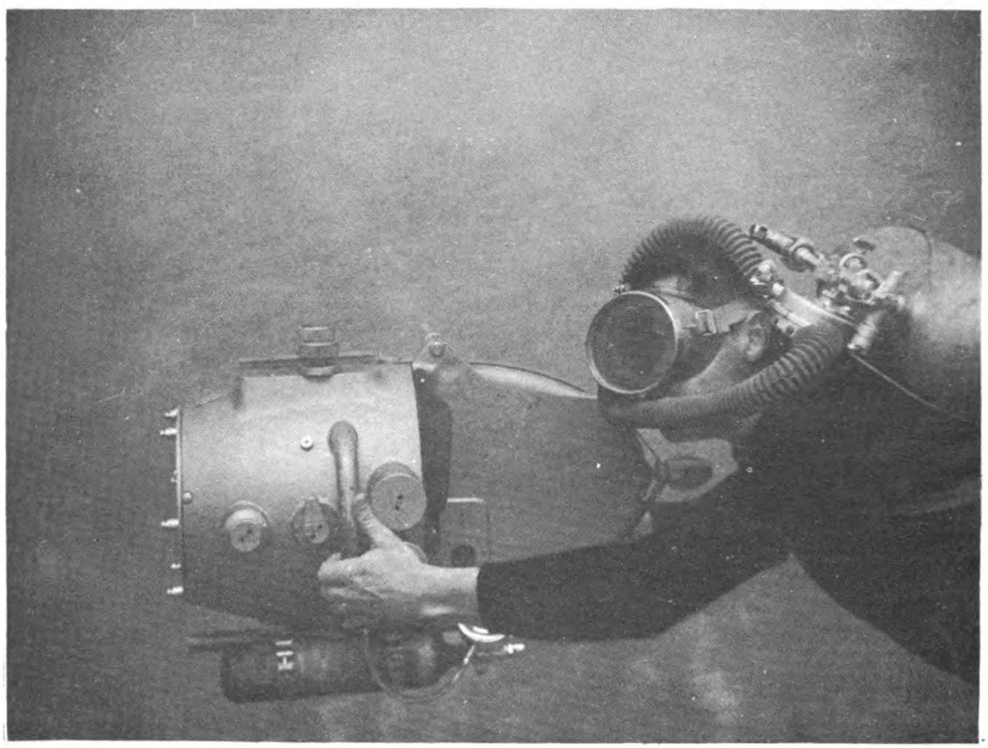


Figure 3 - Swimmer with Aquaflex camera

Figure 4 - The Fenjohn "Goggler" camera is versatile
for underwater work

Figure 5 - The Leica camera has a special waterproof case

as the eardrums and the eyes. Although there is no microphone in the mask, the swimmers can hear a team-mate yell up to a distance of about 20 ft, and tapping on the air bottle is an effective way to gain immediate attention. On special occasions, the leader of the Team may write messages on a board while underwater (Figure 2).

One particularly popular aspect of the Team's work is taking pictures with the remarkable Aquaflex camera (Figure 3), for there are relatively few of these so far in use. The Frenchman, Commandant Jacques-Yves Cousteau, who pioneered underwater photography, designed the case for the Aquaflex, which is a conventional but unusually compact motion-picture camera. A wide-angle lens is used in the undersea world as the environment tends to reduce the view down to that of a standard lens under normal shooting conditions. The Aquaflex uses either 35mm black and white or color movie film. Some color motion pictures have also been made on 16-mm Kodachrome of the Daylight type. The Fenjohn "Bantam" used is a gun camera fitted with a water-tight case.

No less important are the still pictures which are taken with several kinds of cameras. The Fenjohn "Goggler" (Figure 4) camera takes black and white or color pictures of both 70mm and 120mm sizes. A Leica (Figure 5) or a Robot are used for 35mm color stills, here again using Daylight Kodachrome. Color film can be used to advantage in cases when the water is turbid as black-and-white film does not register

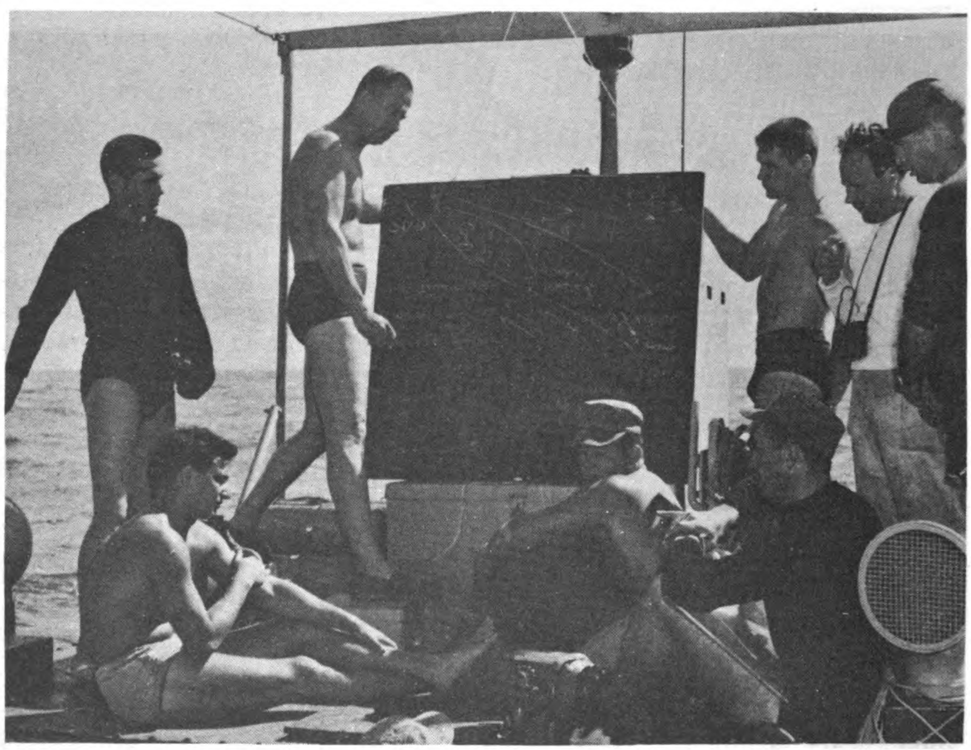


Figure 6 - Preliminary briefing for pictures to be taken on the next session under water

well. It has also been found that if objects to be photographed are painted yellow, the clarity and sharpness of the image are greatly enhanced.

The work of the Team calls for preliminary conferences (Figure 6) in which the leader explains carefully and in detail what each man will do while he is carrying forward the job at hand. Then the matter is thoroughly discussed from all angles by the swimmers with each contributing what he can to insure success of the operation. This kind of preparation is considered of the greatest importance in building confidence and paving the way for effective work by underwater photography.

To become an effective working member of the Team, the new swimmer needs to become accustomed to the strange environment in which he will become as much at home as on the surface. In a short time, swimming with their equipment becomes second nature to these underwater men and seems as natural as walking. Soon after jumping into the water, the masses of bubbles (caused by the air the man brings in with him) clear away, their eyes become accustomed to the half-light and they find themselves in a strange and beautiful world. The men often liken this undersea creation to the "other world" descriptions. Everything has a blue-toned luminescence in which the reds of the coral formations, and the browns and greens and yellows of the underwater foliage are accentuated. It is an easy matter to become distracted from work and wander away from your group in this magic world, no matter how often you enter it. The men, however, seldom wander far, for they are acutely aware of the dangers that do exist. Also a buddy by hammering on his air bottle with the ever-ready hatchet may bring his enraptured team-mate to his senses.

At any appreciable depth, not only the body but the mind operate with reduced speed and facility. A problem solved by reflex action on the surface becomes a matter of thought, because of the underwater environment, when speed is essential. Barracuda are an ever-present menace in warm waters of the Caribbean; sharks are not taken too seriously on most occasions, as any movement toward them sends them off in a tizzy like skittish, timid horses. The worst enemies underwater are the pests such as sea urchins which sting and poison anybody who happens to step on them. Then there is the so-called fire-coral which can seriously burn a man who touches it.

Among the well-known physiological hazards to men who work underwater are embolism, "bends," and the like. Nitrogen narcosis can be serious as it produces the light or uncaring feeling of an intoxicated man, and may strike at depths of less than 180 ft which has been cited at the critical depth at which this condition may arise.

Alertness is so important in the business of underwater photography, that the men drill at it all the time. Each new assignment is a challenge, and the variety of jobs to be done keeps interest and enthusiasm at a high pitch. Members of the Team have been pulled underwater harnessed to a submarine; they have explored a 30-year-old wreck of a sunken freighter; they have literally had to push their way through swarms of large fish living in the hold of this freighter. Whereas a great deal of the work of the Team is classified, the men make it a practice to get in a certain amount of footage, as well as still pictures, for library and reference purposes.

There are several long-range projects underway at this time. One is concerned with the turbidity of sea water, its cause, its effect, and possible alleviation. If the studies bring out ways and means to deal with turbidity, then the photography of the Team will benefit and be of better quality. Other work is being done on underwater illumination. When satisfactory lighting can be managed underwater, completely new vistas will be opened to the cameramen. Attention is being given to the use of filters with members of the team constantly experimenting and striving for better color balance underwater. One of the major current problems of the Navy in underwater photography is the development of truly corrosion-proof underwater cameras and equipment. Research is also being done to adapt film better to the strange color and light conditions found below the surface of the sea.

In the short time since the Underwater Photographic Team has been organized, useful and worth-while services have been performed for the Bureaus. In addition, much has been learned by methodical experimentation on the best way to get desired results with camera and film underwater. As the work of the Team continues, the Navy will gain new knowledge on a vast and enormously important part of the Earth—the upper 100-ft layer of the ocean.

New Television Series Based on Navy Incidents

The first of a series of half-hour television programs came on the airlines at 2000 Tuesday evening, 20 September. This CBS series is titled "Navy Log" and is a dramatic show based on true incidents in the service lives of Navy people. Though all the backgrounds and materials used in the production of this series are authentic, the programs are not merely documentary. Each one tells the moving human story of some incident of trial or triumph, courage, or camaraderie in the life of a Navy man or woman.

Full approval and cooperation has been extended "Navy Log" by the Department of Defense and the Department of the Navy. The Chief of Information has been designated to coordinate all phases of Navy cooperation. Alternate week sponsors will be the Schaeffer Pen Company and the Maytag Company.

Programs shown and set into the schedule are on such themes as a difficult underwater assignment and how it was carried out by a team of frog-men, (see the article immediately preceding); an incident aboard a dependents' train in which the Navy took care of its own; and the humanitarian role played by Navy men in the mass evacuation of Viet Namese refugees.

As the series will continue for some time, Navy personnel are invited by the Navy Chief of Information to submit new ideas for scripts. There are probably dozens of success stories in recent naval research that could be dramatized for the Log. Should there be documentary film on the subject, details should be sent in with the story outline.

Navy Leaders Stress Importance of Men and Science

At the change of command ceremony at the U. S. Naval Academy, Annapolis, on August 17, 1955, when Admiral Arleigh A. Burke relieved Admiral Robert B. Carney as Chief of Naval Operations, their remarks were of interest to all persons engaged in naval research.

In his opening statement, the Honorable Charles S. Thomas, Secretary of the Navy, pointed out the importance of a more potent, more versatile Navy at sea. "This ceremony was originally scheduled to take place aboard an aircraft carrier for a very important reason. The carrier is currently the symbol of the offensive striking power of our Navy. In this atomic age, as the Navy moves ever closer and ever more rapidly toward nuclear propulsion for all ships, to still greater use of atomic weapons, missiles and jet aircraft, it must continue to emphasize, as it has for 157 years, the importance of the offensive, of keeping any war away from our shores and of carrying the battle overseas if that, unfortunately, ever becomes necessary again."

Speaking of the impact of science and the need for men of the Navy who possess innate skills and intelligence, Admiral Carney, the retiring CNO, stated, "Obviously we cannot be unmindful of science and invention in this era—but what are they except the products of human brains and the skilled hands of people? Even in this scientifically enlightened age we cannot yet trust the fate of battle to electronics; human skill, determination, and discipline are still the principal ingredients of victory.

"The fleet of tomorrow will differ greatly from the fleet I knew. I witnessed the conversion from coal to oil and the beginnings of another conversion from oil to atoms. I once was a cog in the machinery controlling the fire of the MISSISSIPPI's guns; not long ago, I watched guided missiles soar out from that same ship. Startling new devices and new skills have appeared, and stranger innovations are in the offing, but there still is one familiar note: the demand for people of intelligence and character.

"The country must help us to find, train, and hold men of that stamp. But we, ourselves, by precept and guidance, must inspire and create a devotion to service that will weather the hard problems that confront the Navy. Each individual must endeavor to create within himself the devotion and enthusiasm which alone can give the ring of conviction to the words of leadership."

As he took over the Navy's highest position, Admiral Arleigh A. Burke opened his remarks by saying, "The strength of any military organization is the sum of its combat power. Its combat power, in turn, is the sum of two basic elements—its equipment and its people. The great men-of-war now in our fleets have a long and glorious lineage. Today's ships of the line are worthy successors to those proud old frigates who preserved our country's freedom during many tough wars and in distant waters. It has been ships such as these, and their ancestors, that have maintained firm control of the seas, that have made it possible for our Navy to be a true and invincible champion of freedom's cause. In all the campaigns of America's history, our ships have demonstrated a superior fighting quality against all challengers, sometimes, it should be noted, when the odds seemed almost insurmountable.

"Our future men-of-war face even greater challenges. Things will continue to move swiftly around this steadily shrinking globe now that we have moved into an age of jet and atomic propulsion. Guided missiles, rockets, and mines have become increasingly complex instruments of naval warfare as have the mobile air and surface platforms that mount these miraculous armaments.

"Ships have changed greatly throughout the generations that our Navy has guarded United States interests on the world's oceans, and their qualitative superiority will always remain a prime requisite to maritime supremacy. But it is the spirit and skill of the seagoing men themselves which will remain the key to success in battle.

"It is men who must plan the strategy and make the decisions; it is men who must build the weapons—and the countermeasures for those weapons; it is men who must remain sensitive to the scientific touch, respond to the newest creations, differentiate between the good and the bad, and exploit the good; it is men who must issue orders and take action; but above all, it is men—men of the fleet—who will win our future battle by working together with skill and enthusiasm toward a common goal."

The Navy's New Chief

Admiral Arleigh A. Burke is no stranger to research and development. While a Lieutenant junior grade, he received his master's degree in chemical (explosive) engineering from the University of Michigan. In 1945, Admiral Burke (then a Captain) was ordered to the Bureau of Ordnance to head the Division of Research and Development, and this was followed by work with the General Board on a treatise on the areas of potential progression in the science of warfare. Admiral Burke became Navy Secretary of the Department of Defense Research and Development Board on January 18, 1950 where he remained until September of that year, when he left for the Korean war area.

Research Notes

Speedy Work Sponsored by ONR

To Professor Zoltan Bay of George Washington University, the duration of a single radar pulse (about one-millionth of a second) must seem like a geologic age. He and his associates working under ONR sponsorship have succeeded in measuring, electronically, time intervals of one hundred-billionth of a second. One can better comprehend the precision of Professor Bay's method if one notes that is is being used to measure quantitatively time intervals of the order of those required for light to travel one-tenth of an inch.

Professor Bay is using his "stop watch" to measure the lifetimes of excited states of atomic nuclei. These are nuclei which have been created with an excess of energy, hold it for a very short time, then give it up by emitting gamma rays. Knowledge of these lifetimes is important to nuclear physicists in their continuing effort to understand the mysterious forces which bind nuclei together, or on occasion, cause them to fly apart violently in fission.

Of course the technique itself is likely to find other applications before very long.

ONR Assists European Science Organization

In a letter from CERN, a European organization for nuclear research, the Office of Naval Research has been given credit for welcome assistance. Cosmic ray research was cited as a case in point which resulted in ". . . a significant contribution to scientific cooperation at the international level." The letter was signed by eleven top European scientists, each representing a university or research organization.

Credit Given to ONR for Expanded Research in Physics

A report recently submitted by Yale University on an ONR physics project concluded with these remarks:

"We believe it is fair to say that ONR by its wise and generous support of physics in this country is chiefly to be credited with the excellent position this important subject finds itself in today in this country. . . Every physicist of my acquaintance, with negligible exception, who has worked under the auspices of ONR feels that the Department of the Navy deserves high praise for their pioneering efforts with the Office of Naval Research."

Dr. Charles W. Shilling Goes to a Medical Post With AEC

Captain Charles W. Shilling, USN (MC), (ret), has been appointed to the staff of the Atomic Energy Commission. After twenty-eight years of service with the Navy, Dr. Shilling temporarily assumed the position of Special Assistant to the Director of the Division of Biology and Medicine of AEC. From 1 October, he has been Deputy Director of the Division.

In 1947, Dr. Shilling came to the Office of Naval Research where he served for six years successively as Director of the Medical Sciences Division, Deputy for BioSciences, and Special Assistant for BioSciences. During his last two years with ONR, he was also director of the Research Division, Bureau of Medicine and Surgery, Department of the Navy.

Navy Exhibit

Shown above is a photograph of one of the Navy's research exhibits at the 10th Annual Instrumentation-Automation Conference held in Los Angeles from 12 to 16 September. Leading Naval research laboratories showed some of their latest developments at the show.

On the Naval Research Reserve

A Reservist Reviews the NRL Seminar

Over a period of two weeks last August, 25 Research Reserve officers were given a comprehensive survey of the scientific program of the Naval Research Laboratory. At our request, LCDR M. S. Allen, Commanding Officer of NRRC 11-4, Long Beach, Calif., jotted down some of his impressions of the seminar.

"It is a shame that more Reservists did not apply for this training. NRL was prepared for 50, but only half that number showed up. I believe this poor showing does not reflect a lack of interest, but a general feeling among Reservists that only a select few can rate so attractive an active-duty assignment. As it was, 25 more could have had an experience I can best describe as Opportunity with a capital 'O'.

"More than 100 lectures and demonstrations were presented to the members of the Research Reserve by some of the country's leading scientists. Not only that, but some of the information imparted was in the nature of 'in advance of publication,' and as such gave added zest to the proceedings. For example, one scientist told of the effects of gamma radiation on the properties of materials. In another session, some of the significant results from rocket investigations of the upper atmosphere were presented—illustrated by motion pictures taken at an altitude of more than 150 miles.

"Of particular interest to the Research Reserve officers present was the experimental equipment—and the opportunities to operate this equipment. It was one of life's big thrills to pick up an aircraft far out to sea, and to track it to its landing point.

"As interesting and informative as the demonstrations and lectures were to the scientific officers in attendance, even more stimulating was the insight given into the philosophy of research followed by the laboratory scientists.

"In talking about some of the investigations concerned with the tremendous speed of the newer jet planes, one of the NRL scientists described the research plan as follows:

" 'First we analyzed the problem into its primary phases. Next we ascertained, phase by phase, just how much improvement would result if all difficulty were removed. Then we began work by first directing our attention to the problems which if solved would result in greater over-all improvement in the piece of equipment being studied.'

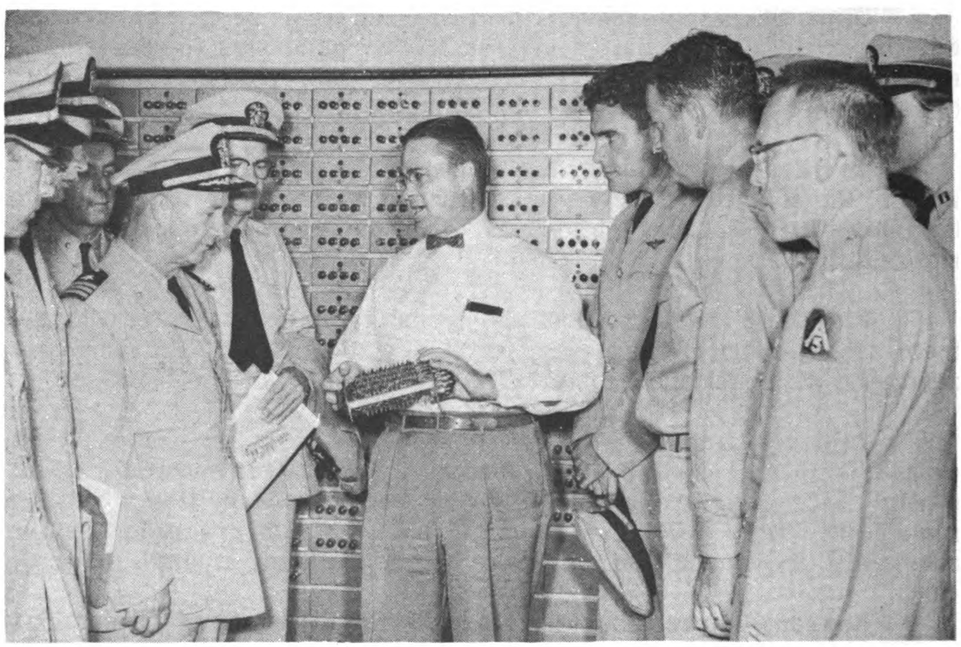
"A strong impression was made on the members of the seminar by a first-hand discussion of procedures such as this one. No doubt any of the group facing a corrective research problem will hearken back to the words of wisdom heard at NRL.

"It was apparent to the visiting officers that there exists at NRL a close harmony between the theoretical scientists concerned with basic science, and the engineers who are faced with the solution of the problems on which they have no guiding data. One entire division—the Applications Research Division—has as its major responsibility the coordinating of scientific and engineering advances at the Laboratory with the problems faced by the operating fleet.

"Attendance at the NRL seminar has been of great value to the officers of a Research Reserve company which might be seeking a problem of interest to the Navy, and which would serve as a company project. Many of the NRL problems are of an unclassified nature, and aspects of them would not only be of value to the Navy, but very probably would in some way benefit the employers of personnel within the Research Reserve Company that worked on the problem.

"For instance, the Navy interest in corrosion could well be extended into a problem for a reserve group as the effects of corrosion are considerable on Reserve Fleet vessels. My own company in Long Beach meets very close to the Pacific Reserve Fleet Base, and is endeavoring to include as one of the projects for the current year, research on and inspection of corrosion conditions on mothballed vessels.

"The line-up of the training program was a nice piece of work on the part of NRL and the local Company W-2 made up of reserve officers employed at the Laboratory. Members of the Seminar join in giving them a hearty, 'Well done.' "



At NRL Seminar, D. H. Gridley of the NAREC Computer Section talks to Reserve Officers

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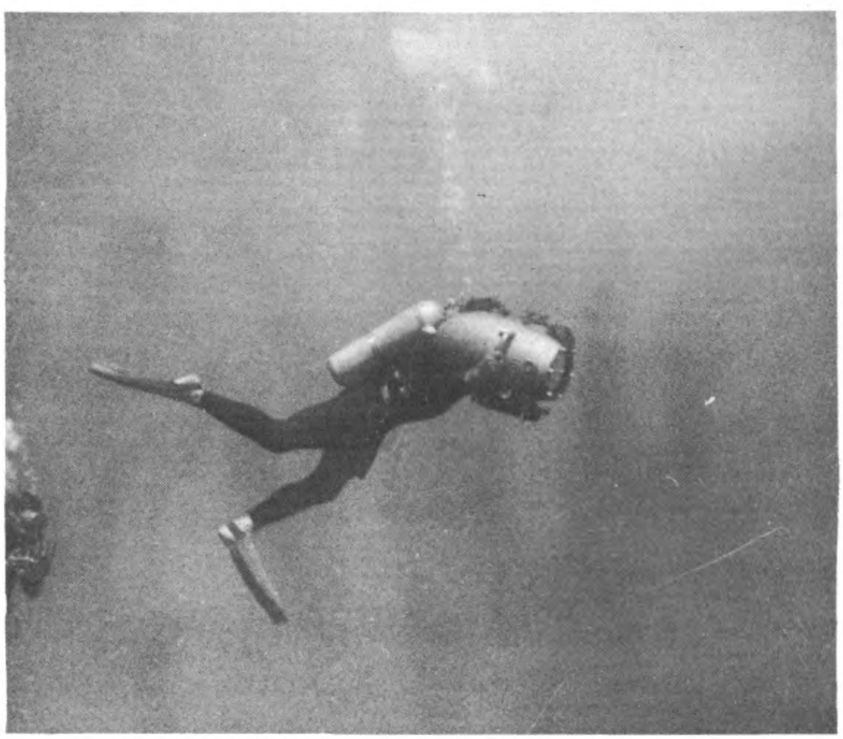
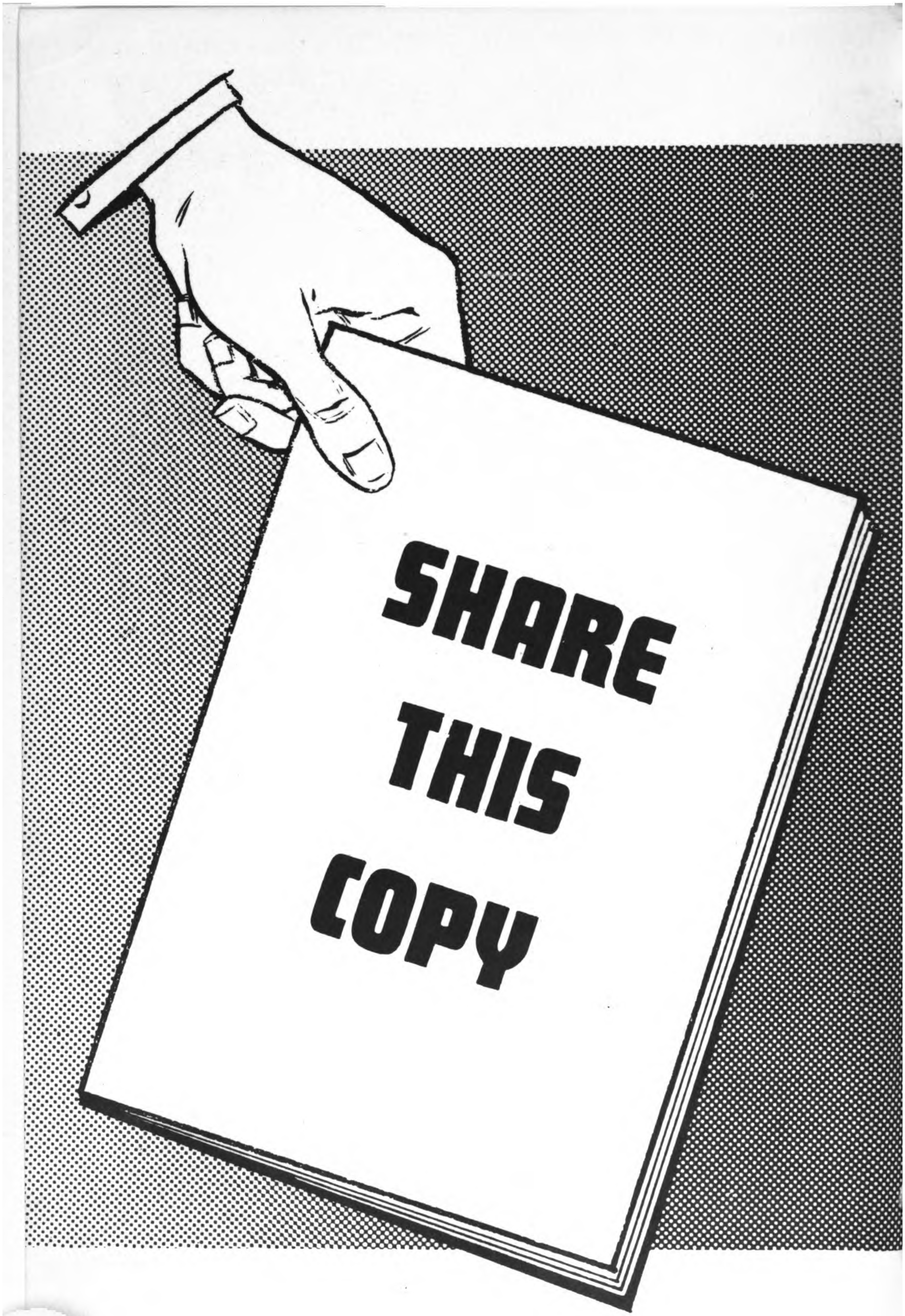
Underwater photographer ready for action



Teamwork is the watchword in underwater photography
See story on p. 18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