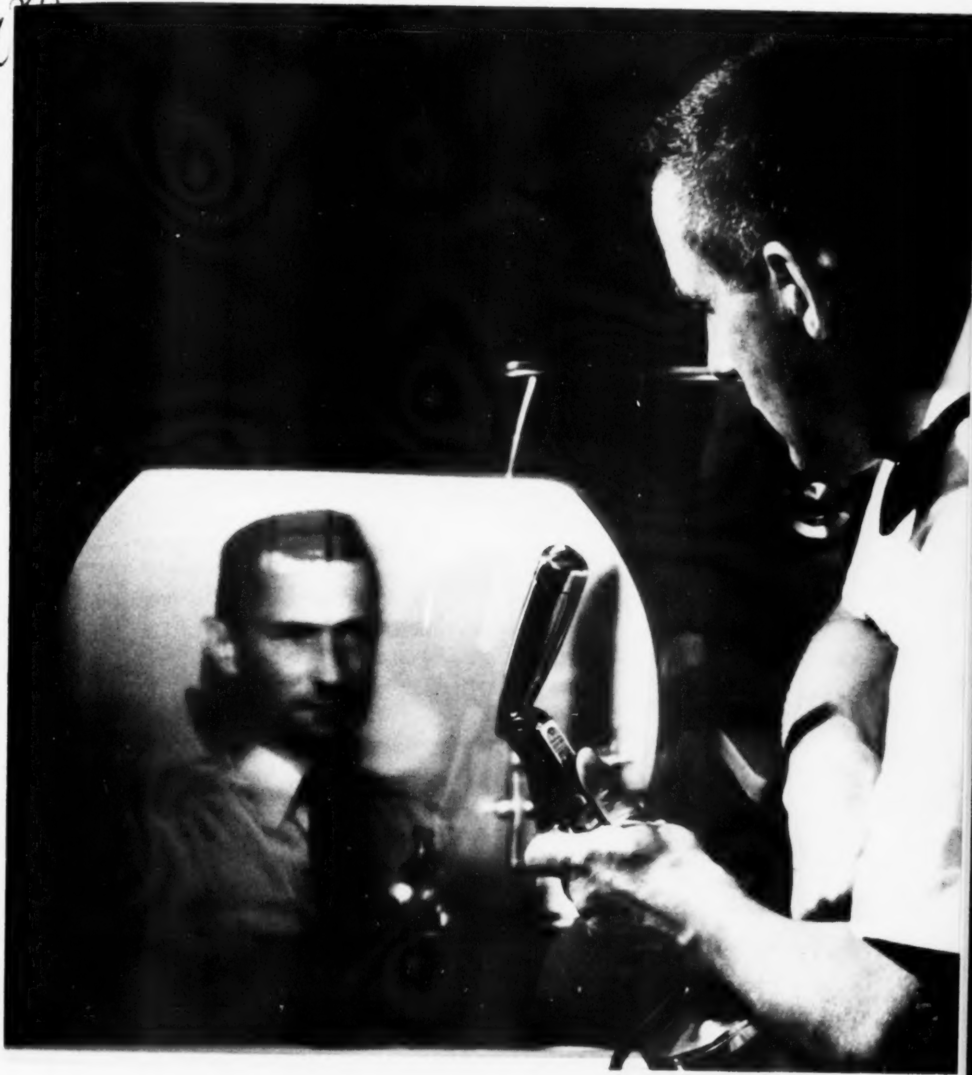
OFFICE OF NAVAL RESEARCH NOVEMBER 1958

RESEARCH REVIEWS



DEPARTMENT OF THE NAVY

WASHINGTON, D. C.

NAVEXOS P-510

Farewell to Vanguard

On October 1, by an executive order of the President, Project Vanguard was transferred from the Navy to the National Aeronautics and Space Agency. In taking over the Project, NASA gave to the 150 members of the Vanguard staff the option of transferring to the new agency or remaining at NRL. Most of them have elected to go with the Project.

NASA is in full operation, administratively, but as yet it has no laboratory quarters. So for a long time to come--probably a year or more--Dr. Hagen and his associates will remain where they are, either at NRL or at Cape Canaveral and the various tracking stations. But henceforth they will be directed by NASA and will be paid from NASA funds.

On the date of transfer, Vanguard still had four satellite launchings scheduled for its research commitments with IGY. Dr. Keith Glennan, the Administrator of NASA, has promised that the firing schedule will be continued as planned. For the future, Dr. Glennan has said ". . . just what will be done beyond completion of the present program is not, as yet, clear. Certainly, the exploration of science and space is going to continue at a high priority."

In brief review, ONR and NRL can be justifiably proud of the records achieved by Vanguard while it was a Navy project. The program was initiated, planned, and carried through entirely as a scientific venture. No military rockets were used, so there was no conflict or interference with the Nation's development of guided and ballistic missiles. In 32 months the Navy and its contractors designed and built a successful launching vehicle, constructed a series of scientific satellites containing a radically new line of highly sophisticated instruments, created an elaborate network of tracking stations, and launched a satellite that is expected to stay in its orbit for 200 years or more. Even the miscalled "failures" contributed their share of know-how to the art. Indeed, the Vanguard techniques and hardware are so highly regarded they have been borrowed for other projects: Vanguard second and third stages, plus eight retro-rockets, are key components in the Air Force shots at the moon.

The Navy is proud on another score: that it was their Laboratory that was able, through the years, to develop a research team capable of carrying forward one of the most imaginative scientific projects ever undertaken by Americans. For instance, John Hagen, Vanguard's Director since its inception, went to NRL in 1935. As Head of the Radio-Frequency Research section for nearly two decades, he was instrumental in sponsoring radio astronomy as a major program. He was, until Vanguard, the first superintendent of the Atmosphere and Astrophysics Division. Another example is Homer Newell, who joined the Laboratory staff in 1944 and quickly became the leader for Upper Atmosphere Research. Dr. Newell has been wearing so many hats recently, it is hard to know whether to label him as Science Coordinator for Vanguard, or Superintendent of the Atmosphere and Astrophysics Division, or Chairman of the Panel on Rockets, U. S. Committee for IGY. Now he is with NASA as Assistant Director for Basic Sciences.

They have been a notable crew, those men of Vanguard, and the Navy is glad to say, "Proud to have had you aboard."

Thermoelectricity: Power Hope for Tomorrow?

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The utilization and control of energy is a problem that has always confronted man. One might even describe man's struggle on earth as one continuing attempt to use the sources of energy available to him with greater efficiency. Of these sources, the one he has utilized to best advantage is heat. But even with all of the capabilities modern technology bestows upon him—for example, such conversion schemes as the steam cycle with turbines and electric generators, and systems for converting heat energy into mechanical motion, then into electricity—man has been able to use heat with only a limited degree of success.

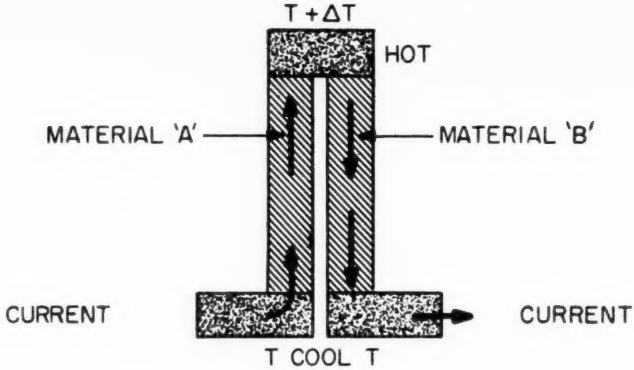
Another facet of this problem is the need to distribute, or pump, heat from one area to another. The pumping of heat, as in refrigeration, is normally achieved electromechanically with such equipment as pumps, compressors, and radiators. But these devices take up considerable space, require maintenance, and are not as reliable as we would like them to be.

What, then, is likely to be man's next move in this perennial struggle?

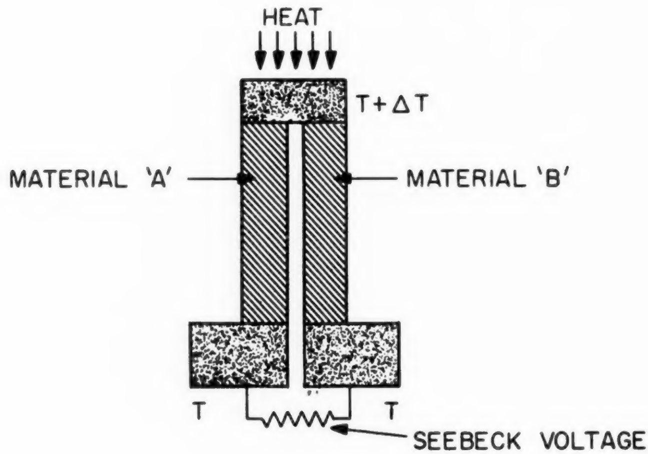
Recently, the United States Navy has been investigating the possibility of directly converting heat into electricity. Along with the belief that this will lead to more efficient use of heat energy comes the belief that heat can be economically pumped from one place to another by electrical means. The best description of these phenomena can be given by considering several effects in solid materials which, when properly used, will convert heat energy directly into electricity or cause an electrical current to create a heat-pumping action. These effects are known as the Peltier Effect, the Seebeck Effect, and the Thomson Effect.

The Peltier Effect, discovered in 1834 by Jean C. A. Peltier, can be described as follows: Given a circuit of two dissimilar electrical conductors carrying an electric current, one can observe heat being evolved at one junction and being absorbed at the other. This heat is proportional to the current flowing through the couple. The phenomenon can be reversed; that is, reversing the direction of the current flow reverses the sense of the temperature difference. In effect, we have here a heat pump, capable of cooling or heating depending on which junction one examines. Refrigerators using this principle have been developed both in Russia and in the United States and are called Peltier Coolers.

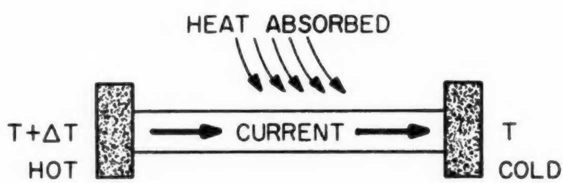
The Seebeck Effect was discovered in 1823 by Thomas J. Seebeck. It occurs in this way: If one forms a circuit of two different conductors and forces one junction to be hotter than the other, a voltage can be



Heat pumping by the Peltier Effect.



Conversion of heat to electricity by the Seebeck Effect.



Absorption of heat by the Thomson Effect.

observed in the circuit. This voltage, called the Seebeck Voltage, is proportional to the temperature difference (ΔT) and depends on the materials comprising the circuit. The most common application of this effect is the thermocouple. One end of the couple is placed into a medium of known temperature and the other into a medium of unknown temperature (T). The voltage developed by the Seebeck Effect is an indication of the temperature difference between the two systems, from which the unknown temperature can easily be calculated. Until recently, the magnitude of this voltage was so small that power conversion by this method was not considered. However, materials are being found that exhibit characteristics which make power conversion by this method possible.

William Thomson (Lord Kelvin), one of the founders of thermodynamics, examined the effects of Peltier and Seebeck 30 years later, and predicted an effect which now bears his name—the Thomson Effect. This phenomenon is the absorption or evolution of heat in a conductor carrying an electrical current in the presence of a temperature difference. This effect refers to the properties of one material only. It is a relatively small effect, but is necessary for a complete understanding of these processes.

By using the First and Second Laws of Thermodynamics, Thomson derived some classical relationships between the named effects. From his expressions one can get a feeling for the factors which affect power generation, heat pumping, and refrigeration. From his equations (the Kelvin Relations) one can derive an expression which indicates the efficiency of an element as a power generator or as a heat pump. This expression, called the figure of merit and denoted by Z, is $Z = \theta^2 (\sigma/\kappa)$. Here, the Seebeck coefficient (θ) is an indication of the thermoelectric voltage developed in the system, σ is a measure of the electrical conductivity of the couple, and κ is the thermal conductivity of the couple. Thus, we have a guide for the choice of materials that will effectively utilize these phenomena. For instance, some semiconductors—those solids which conduct electricity better than insulators but not as well as metal conductors—have a much higher ratio of electrical conductivity to thermal conductivity, thereby making conversion more efficient.* Recent semiconductor theory shows that thermal conductivity may be considered the most important single factor in the efficiency of the system.

If the right material can be found—one with high enough conversion capability as well as the proper physical and chemical traits—many exciting applications can be perceived. Perhaps main power for transportation can be provided by converting heat to electricity, which drives motors. Heat energy of nuclear reactors may be converted directly to electricity without turbines, reduction gears, and auxiliaries. Perhaps the nuclear submarine can utilize this energy-conversion scheme. Satellites could be powered by such a thermal battery, using radioactive waste fuel as the source of heat. Silent, motorless refrigerators could be developed, and rooms could be air-conditioned or heated by using a thermoelectric heat pump. The temperature of human blood or organs

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*Another significant term in deriving the efficiency is the Joule heat (I^2R), which occurs when electrons move in a conductor.

could be carefully controlled during critical transplants and surgery. The list of applications is endless—if the appropriate material can be found.

Devices can be made which will compete for small-volume refrigeration and for power conversion on a low-power level. Russian engineers have already marketed a semi-commercial thermoelectric refrigerator which has been used in the jet plane TU-104. A dew-point hygrometer cooled thermoelectrically, temperature controls using the Peltier Effect, and a radio set powered by the heat of a kerosene lamp are among the long list of marketed products. A thermoelectrically cooled vapor trap for use in vacuum systems has been designed. More powerful generators—of 200 to 300 watt capacity—are also being manufactured.

The Office of Naval Research has undertaken a program devoted to the fundamental aspects of this problem. Both experimental and theoretical studies are being conducted on thermal conductivity at Massachusetts Institute of Technology, Battelle Memorial Institute, The National Bureau of Standards, New York University, and Yale University. Many other tasks are exploring the processes which, indirectly, will contribute to a better understanding of the basic phenomena involved in thermoelectric conversion. Battelle Memorial Institute, General Mills, and Servomechanisms, Inc., are investigating compounds particularly interesting as thermoelectric converters. Fundamental investigations are being started on other materials, such as liquids, which may exhibit properties necessary for thermoelectric conversion.

Recently, ONR's Committee on Thermoelectric Power* presented the Office with its report. The Committee's goal was to "assemble an accurate account of present scientific understanding of thermoelectric converters, together with a comprehensive picture of research and development currently in progress." The report, called "Thermoelectric Converters," will be used by ONR and the Navy Bureaus as a guide in planning future programs.

The Bureau of Ships has recently begun a program to develop both thermoelectric power production and thermoelectric cooling into a practical energy-conversion and utilization system. Overall efficiencies have been achieved in the order of seven percent; that is, seven percent of the heat put into the element is converted into electrical energy. Some materials have been estimated to have overall conversion efficiencies of fifteen percent, and even higher efficiencies in particular temperature ranges. These include thermionic diodes, liquid systems, gaseous plasmas, and combinations of these. If advances can be made to attain efficiencies of the order of fifteen percent, then this method becomes competitive with many conventional systems. Those who are now engaged in research and development in this field believe that the

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*The Committee was comprised of Professor G.C. Danielson (Chairman), Iowa State College; Professor H. Y. Fan, Purdue University; Professor F.C. Brown, University of Illinois; Dr. W. W. Scanlon, Naval Ordnance Laboratory; and Dr. E. Burstein, Naval Research Laboratory.

fifteen-percent figure is not only possible but can be surpassed. Progress may be slow, but the gain is worth the effort if the thermoelectric conversion process can become practical.

On September 3 and 4, 1958, the Naval Research Laboratory sponsored a Conference on Thermoelectricity in Washington, D. C. Nearly 500 engineers and scientists heard descriptions of measurement techniques, materials research, the latest in theory, and many applications. One interesting highlight of the meeting occurred when one speaker pointed out that his voice was being amplified by a thermoelectrically powered public address system. It consisted of a burner for heat, an array of solid thermo-elements producing d.c. power, an electric transistorized amplifier, and conventional microphone and speakers.

The interest shown in this conference and other meetings indicates that many companies are considering serious research and development in this field. Thus it appears that a new household, factory, and military term has been added to our already vast list of energy-conversion techniques—THERMOELECTRICITY.

"Do-it-Yourself" Manual for Satellite Observers

A simplified method of predicting satellite courses has been published for the benefit of volunteer observers by the National Academy of Sciences.

With this "do-it-yourself" manual, volunteers can utilize simple orbital elements--such as inclination of the orbit plane to the equator and distance to the center of the earth at the low point of orbit--to figure out where to look for artificial earth satellites in any given locality. Orbital elements are disseminated by IGY World Warning Stations, and by the volunteer organizations for tracking of IGY satellites--MOONBEAM (radio), MOONWATCH (telescope) and PHOTOTRACK (camera). Civil Air Patrol radio facilities also will be used where high speed transmission is required.

Volunteers who use the manual and the accompanying forms in computing their own predictions need perform no operation more complicated than long division. After placing the orbital elements on the form, the observer goes through the calculations outlined step-by-step on the form. These enable him to find first the orbit plane, and then the time and longitude where the satellite will cross his latitude. Additional calculations will allow the observer to determine the position of the satellite as viewed from his location.

The method was devised by Leonard N. Corimer of the National Academy's IGY staff; Norton Goodwin, director of the volunteer IGY satellite tracking program; and Reginald K. Squires of the Naval Research Laboratory. It is described in the manual, "Simplified Satellite Prediction From Modified Orbital Elements," available for one dollar from the Publications Office, National Academy of Sciences, Washington 25, D. C.

Simplified Medical TV: Product of Navy Research

Ken Thomas

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Simplified closed-circuit television from the National Naval Medical Center in Bethesda, Maryland, will be shown in New York for the first time on December 11 during the 34th annual Greater New York Dental Meeting at the Hotel Statler. The audience will see demonstrations of dental techniques developed by the staff of the Naval Dental School. Adolph G. Wagner, D.D.S., General Chairman of the Meeting, has notified 18,000 member dentists that the new Navy television system may be the answer to a need for practical television in dental schools in the United States.

Such professional interest in simplified medical TV would be premature if it were not for research begun almost 10 years ago at the Naval Training Device Center (Research Reviews, July 1956). At that time, TV was generally recognized as a potentially effective instructional medium, but it was also known to have major deficiencies for this application. The drawbacks were—

- The equipment and techniques, "borrowed" from commercial TV, were costly and cumbersome.
- The "cast" had to perform in a studio.
- The instructor was coached in acting. Even while teaching, he was often advised by the director, the script editor, the floor manager, and numerous technicians associated with studio TV. The instructor's dilemma in those early days is emphasized by a few anguished words spoken by a distinguished Princeton professor when he looked at a recording of his own presentation. "Good Heavens!" he exclaimed. "Is that what I did?"

The research begun in 1949 by NTDC led to the development, in 1952, of the Instructional Television System (I-TV-S). The equipment utilized was portable, and it could be operated by only one technician. Another advantage was that it did not need to be set up in a studio, but could be operated at any location the instructor desired—in his office or classroom, and in the shop, laboratory, or auditorium. Also, it called for no advisors for the instructor.

This forward stride carried researchers only part way toward their objective. The remaining task—developing a distribution system—was begun by NTDC in 1953 in cooperation with the National Institutes of Health in Bethesda. The resulting flexible system, installed in the NIH Clinical Center in 1955, was designed to distribute signals—

- In Monochrome or color TV.
- From natural teaching points to natural viewing points.
- Between two or more points simultaneously.
- Other than TV signals; for example, electrocardiogram, electroencephalogram, and facsimile signals.
- From other medical activities.
- For transmission to other medical activities.
- From broadcast television.

At the Naval Medical Center, 68 different locations at which programs can be either originated or received have been established along the distribution line, and more may be added. Six of the buildings on the 242-acre site linked by the distribution system are the Clinical Center, the Hospital, the Medical Research Institute, the School of Hospital Administration, the Dental School, and the building housing the TV master control. The type of junction box installed at each location is shown in Figure 1.

Two types of portable vidicon* TV originating systems—color and monochrome—have been developed by the Navy under contract with DAGE Television Division of Thompson Products Corporation. This equipment has been integrated into the overall system under the supervision of LCDR Edward W. Bird, NNMC TV Project Officer.

One of the portable vidicon color systems is shown in Figures 2 and 3. It can be moved to any desired junction box, and there can be plugged in and operated by one technician. The camera-and-boom unit (Figure 2) is wheeled into a room containing the teaching material to be televised. The operator is stationed in the hall outside the room, where he manipulates the camera by remote control. His console (Figure 3) not only can accept program signals from this room, but also from one or two other points in the distribution system, such as a laboratory or the classroom of another instructor. The operator monitors the signals from the different sources and, when directed, cuts them into the line leading to central control, where motion picture sequences and slides can be inserted into the program as required.

To provide the more-than-average amount of illumination needed at the pickup point for vidicon color, a special light was required. This was developed by Dr. Michael Klein at the University of Kansas Medical Center (See Figure 4 and inside back cover). The remarkable Klein light fits on the camera housing and provides focusable, coaxial illumination at the maximum intensity of 15,000 foot candles. The problem of cooling the light has been solved by means of special glass filters.

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*The word "vidicon" refers to a camera tube which has a photoconductive type of light-sensitive surface and a scanning beam of low-velocity electrons. It was developed by RCA.

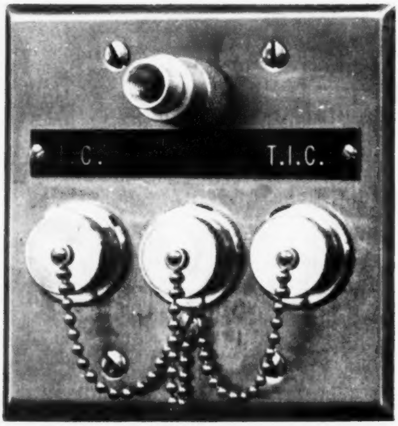
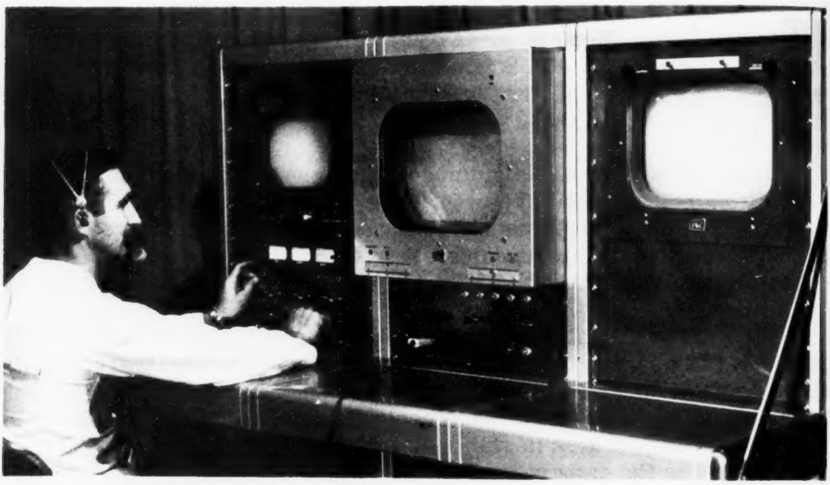


Figure 1--One of the 68 junction boxes in the distribution system at NNMC. Top junction is for TV and program audio, originating or receiving; left, for conference intercommunication; right, system intercommunication; center, spare.

Figure 3--A technician manipulates the remote camera at the portable console and monitors the pictures on a screen.



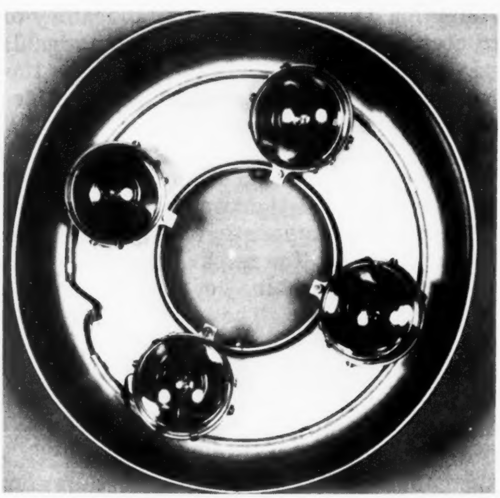


Figure 4--The Klein light, showing the filtering roundels that prevent excessive heat from reaching the surgical subject. The photograph on the inside back cover shows the light installed on the camera.

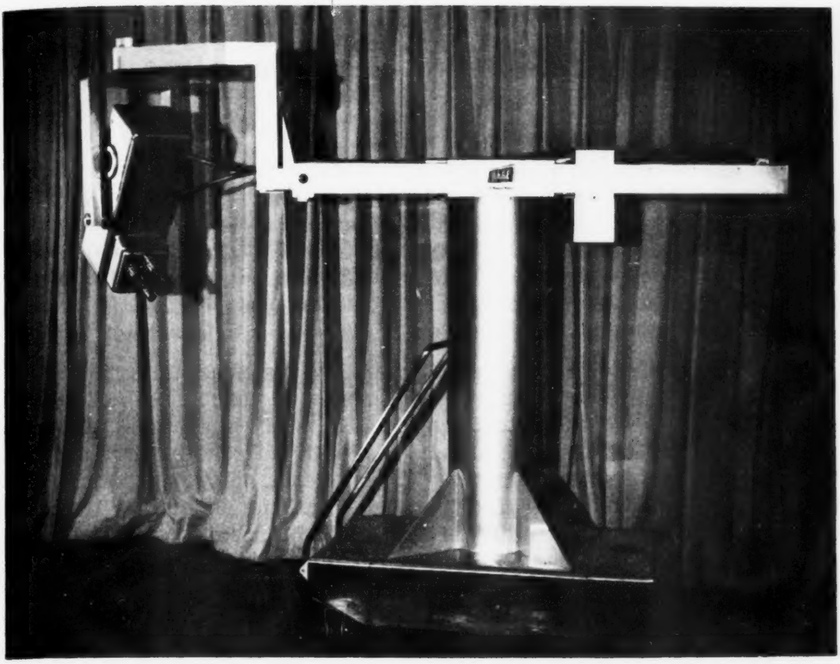
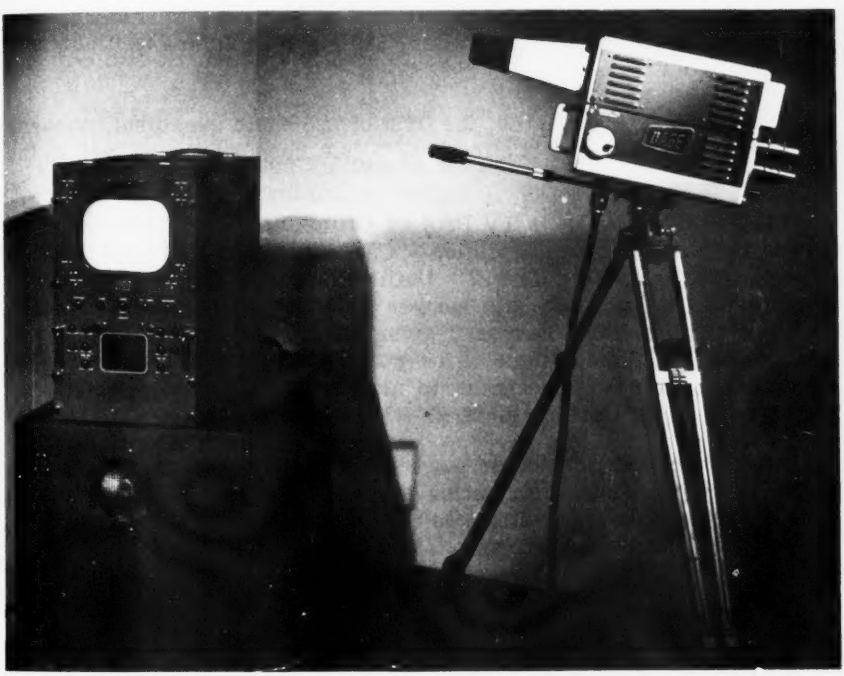


Figure 2--The vidicon color camera on portable boom. The camera is remotely controlled at the system's portable console (see Figure 3).

Figure 5--Monochrome camera system.



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The portable vidicon color system is being evaluated as a teaching tool for routine presentations in a closed circuit. It is not intended to originate the occasional medical production that reaches the general public via broadcast television.

The second type of portable vidicon TV—the more familiar monochrome system—is shown in Figure 5. The value of this comparatively simple and inexpensive medium for teaching medicine was established in 1955. In that year, Dr. Robert Jackson of the Naval Training Device Center made a partial analysis of NNMC's curriculum. His results indicated that monochrome TV is suitable for 54 of the 60 subjects analyzed. In other words, color TV is needed only when color is used as a teaching material.

So far, nothing has been said regarding the effect of instructional TV on one of the most important elements of teaching—the two-way communication between student and teacher. For generations, students have been sitting in the same classrooms with their instructors, raising their hands when they had questions or comments, and getting immediate responses. Then TV came along and separated the instructor from his students. A number of efforts were made to incorporate the dynamics of the classroom relationship into the TV presentation, but none was very successful. At NNMC, however, the communications link has been restored. This has been possible, in part, owing to the favorable conditions which exist at the Center for a workable talk-back system. The students, who are at a professional level, observe TV in relatively small groups and formulate their questions carefully, thus wasting no time with irrelevant discussion. A student wishing to respond to the instructor's "Any questions?" first presses his microphone button, thus clearing the audio line in the distribution system. His question is heard not only by the instructor, but also by the students at all other receivers. The technique of the questioner in "talking" to the TV picture is illustrated on the front cover.

Thus, through research, the first of two basic questions concerning instructional TV—"Is it effective?"—has been answered, and in the affirmative.

LCDR Bird, NNMC's TV Project Officer, is now looking for the answer to the second basic question—"Can the price of this effectiveness be reduced to a practical level?" Until NNMC's evaluation of the system has been completed, this answer will not be known for certain. However, the evaluation has been going on now for 11 months and has given some strong indications of the cost, maintenance, technical personnel requirements, time taken to move portable equipment, and the quality of the vidicon color picture. These indications are—

- The cost of the distribution system is about the same as that of a conventional distribution system. The cost of the portable vidicon camera systems is about one half that of conventional studio camera systems.
- The operating cost of the portable vidicon equipment is estimated to be as little as one-tenth that of standard studio equipment. Routine maintenance of electronic equipment is required, but not to the extent that it is for studio-type systems.

- Fewer technicians are needed than for a regular studio operation. Only two technicians are being employed during the first year of evaluation of the system. They maintain and operate all of the equipment, including two vidicon color cameras, two vidicon monochrome cameras, and all associated display facilities.

- The average time required to shift a color camera system from one point to another within a building is 15 minutes, and between buildings, 30 minutes. Two minutes are allowed to make junction-box connections, and 15 minutes for warmup and testing. The average time taken to move a monochrome system is somewhat less than to move a color system.

- The quality of the vidicon color picture has proved acceptable both to instructors and students in the situations tested. Comparisons of color TV pictures received from vidicon and image-orthicon cameras in identical lighting situations have shown a quality difference in favor of the more sensitive image orthicon. The Klein light has improved the quality of the vidicon picture.

From these indications it appears that the NTDC-NNMC simplified TV is fashioning an important place for itself in the modern medical world. Already, plans are being made to form a closed-circuit instructional TV network within the Washington metropolitan area. Programs will originate from NNMC and the Walter Reed Army Medical Center, and in addition to being exchanged by the two institutions, will be distributed by microwave to all other military medical centers in the Washington area. The closed-circuit network will be used for instruction on a wide range of medical topics, as well as for bringing doctors of the two institutions "together" for clinical conferences and to observe the practice of various surgical techniques.

The Navy's simplified TV has many other applications, too, not only within the medical profession, but also outside it. Thus as the new system makes important inroads in medicine, it is paving the way for its use in many other realms as well.

Vitro Laboratories of Silver Spring, Maryland, has been awarded a contract by the Office of Naval Research to conduct a study of a manned stratosphere laboratory for scientific and technological studies 100,000 to 120,000 feet above the earth's surface. The study is an extension of the STRATO-LAB research program initiated in 1954 by ONR.

A small radio beacon developed recently will enable search parties to locate downed pilots more easily. The beacon, which is installed in the parachute backpack, is activated when the parachute opens, transmitting beeps which may be heard by a homing receiver as many as 80 miles away.

Volunteering for Extra-Hazardous Duty

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Of the many implications of the nuclear age, one of the more obvious and least pleasant is its danger to man. As time goes on, and man is exposed to larger radiation doses, just learning to survive at all may become a hazardous occupation. And for many men—particularly those in the military services—there will be extra hazards, those that have always gone hand-in-hand with military activities. In the new age, however, these dangers will be intensified. We now have nuclear-powered submarines that can carry missiles with nuclear warheads and can lie submerged in enemy waters for long periods of time. For the future we can foresee nuclear-powered aircraft carrying thermonuclear bombs on long range missions. And for the more distant future, we can imagine nuclear-powered space ships soaring from planet to planet. Perhaps assignments to the crews of these vehicles should be called extra-extra hazardous. But however they are identified, they will be an important feature of the nuclear age and thus deserve consideration. For one thing, we should give some thought to the type of men who will volunteer for them. Several years ago one of the research psychologists at the Naval School of Aviation Medicine asked for volunteers for an experiment involving exposure to hypoxia conditions. One of the volunteers became so emotionally upset that he was withdrawn from the experiment and referred to the hospital for psychiatric treatment. Was this a typical situation? Are volunteers for hazardous duty assignments likely to be the kind who would go to pieces in an emergency?

Although it has been common practice in the past to select men for extra-hazardous duty from groups of volunteers, rather than on some other basis, little research relating to volunteering has been done. Furthermore, the results of the few studies that have been made are controversial. It has been suggested by some researchers that volunteers are likely to be the severly maladjusted. For example, one group of investigators found that volunteer subjects for pharmacological experiments showed an incidence of serious psychological difficulties that was twice as high as would be expected in an unselected college population. Another group found that their volunteers for a psychological experiment were more likely to be introverts and were more moody than nonvolunteers. On the other hand, a third group of researchers found that their volunteers consistently had more self-esteem than non-volunteers, and that the difference between volunteers and nonvolunteers on a security-insecurity basis was not significant. Thus they concluded that this "excludes the possibility that volunteers are more neurotic than nonvolunteers." In an analysis of combat fighters and nonfighters, it was found

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that the fighter tends to be more intelligent, more socially mature, more emotionally stable, and to volunteer for extra-hazardous duty assignments more frequently than the nonfighter. Other studies have revealed that more men volunteer for a research project when they observe a project assistant volunteer than when the assistant declines to volunteer. The latter research was the only research reviewed in which the experimental conditions of volunteering were manipulated.

In an attempt to learn more about the characteristics of the men who "step forward" when the call for volunteers is given, the authors undertook an investigation involving 1,154 naval cadets at the Preflight Training Center, Pensacola, Florida. Specifically, the purpose of the study was to relate willingness to volunteer for dangerous tasks with other personality traits and thus, if possible, to characterize the volunteer and nonvolunteer more precisely. The conditions under which the experiment was conducted were as follows:

- Five hundred and ninety-two of the subjects were asked to volunteer for an experiment involving exposure to extreme cold temperatures, and 562 of the subjects were requested to volunteer for an experiment involving exposure to cosmic radiation. In actuality these projects were fictitious, but this was not known to the cadets.

- Seven hundred and twenty-one subjects were asked to volunteer during the first week and 433 during the fifteenth week of preflight school.

- Finally, 630 subjects were requested to sign their names on a roster publicly in front of the group and 524 were asked to sign their names on small slips of paper and pass them concealed to the investigators.

Four hundred and eighty-nine naval cadets volunteered under these experimental conditions and 665 did not volunteer. Psychological test results, preflight grades, age, education, and attrition data were available for both the volunteers and nonvolunteers.

Let us look at the results for the different experimental conditions. Significantly more subjects volunteered for the cold-exposure experiment than the radiation-exposure experiment, and significantly more subjects volunteered during the fifteenth than the first week of training. There also were important differences in the number of volunteers who signed their names publicly during the fifteenth week and the first week.

The scores of the Minnesota Multiphasic Personality Inventory were available for 192 volunteers and 291 nonvolunteers. On only one scale of the inventory—that relating to femininity—was there a significant difference in the scores of the two groups. This indicated that the volunteers were slightly more feminine in their interests than the nonvolunteers. There were no large differences between the scores of the two groups on the Aviation Qualification Test (general intelligence), Mechanical Comprehension Test, and Flight Aptitude Rating, but the volunteers did have higher scores on all of these. On the whole, the volunteers were younger and had less education than the nonvolunteers.

The volunteers also had significantly higher officer-like-quality grades than the nonvolunteers. Furthermore, there were considerably more preflight student class officers among the volunteers than the nonvolunteers. That these men may have been the source of a subtle social pressure is indicated by the fact that during the first week's experiments, when their influence was nil (they had not been elected yet), fewer cadets volunteered publicly than during the fifteenth week, when their influence was high. In other words, in deciding whether or not to volunteer, the regular cadets were probably influenced by the decisions of the class officers. This likelihood is consistent with the results of one of the investigations reported on page 13, which showed that subjects are more likely to volunteer if they observe a project assistant volunteer beforehand.

The greatest differences between the two groups were in attrition from the flight-training program. These were as follows:

- Volunteers had significantly less overall attrition than nonvolunteers.

- Nearly twice as many nonvolunteers dropped at their own request from the flight-training program as did volunteers.

- Nonvolunteers had more attrition for disciplinary reasons than volunteers.

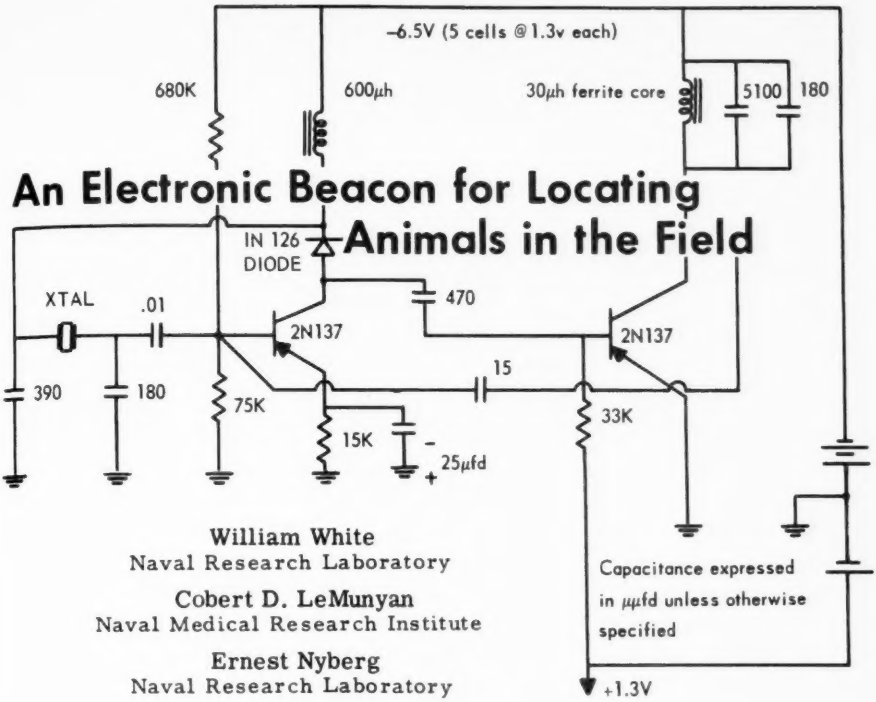
- There were more deaths due to training accidents among the volunteers than the nonvolunteers, but this difference was not statistically stable because of the low number of cases.

- There was no significant difference between the groups for attrition due to flight failure.

It is evident from these results that far from being seriously disturbed, the volunteers for this research project were actually superior in many respects to the nonvolunteers. This was particularly true insofar as the desire to complete flight training was concerned. The volunteers also excelled in leadership, as indicated by the fact that more of them were selected as preflight student class officers than nonvolunteers, and by their higher officer-like-quality grades.

Let us visualize a future situation where these men have their "wings" and are assigned to a squadron aboard an aircraft carrier in one of the trouble spots of the world. The squadron commander asks for volunteers for a particularly hazardous mission. Will we expect these volunteers to demonstrate resourcefulness and other leadership qualities, or will we find them giving up in the face of danger? The findings from our experiment lead us to the former conclusion—that they will continue to uphold the finest tradition of the naval aviators of the past.

An Electronic Beacon for Locating Animals in the Field



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In the study of certain diseases of mankind, a fortunate situation sometimes occurs—one finds that some animals are similarly afflicted, thus permitting the disease to be studied in ways not otherwise possible. Recently, such a situation involving a kidney disease called glomerulonephritis was found to exist. Under certain conditions, a version of this disease is found in the common woodchuck (M. monax) in his natural habitat. In an effort to take advantage of this situation, The Johns Hopkins University and the Naval Medical Research Institute are studying the incidence of the disease among large populations of woodchucks.

In conducting such studies, one is obviously ahead of the game if he is able to locate the animals easily. This fact was impressed on two of the authors (LeMunyan and Christian) while investigating woodchucks in 1956 and 1957. After live-trapping and tagging a number of these animals, the authors released them in 400 acres of meadowland. Then came the job of finding them again for observation. This wasn't easy, especially while the animals were underground, because they sometimes had to be dug from their burrows. Often this work was done in vain, for upon reaching the bottom of a burrow, it was found to be empty. After a few such experiences, the authors decided that they would save a lot of time and effort, and avoid much frustration, if they could devise a system whereby the woodchucks would reveal their hiding places—in other words, if they could provide the animals with built-in radio transmitters. Of course, such devices would have to be small enough to insert in the animals' bodies without injuring them and powerful enough to transmit a signal a number of yards from the burrows.

The idea was not new. As early as 1953, CAPT N. L. Barr of the Naval Medical Research Institute had used such a technique on humans, but for a different purpose. While investigating the physiological effects of jet aircraft flight on pilots, he found that physiological data could be telemetered from a pilot back to the laboratory, and there recorded for future study. Transducers were used to convert information about the pilot and his equipment into electrical energy suitable for radio transmission by ultra high frequency modulated transmitters. Although these units were satisfactory for CAPT Barr's study, they were much too large and heavy for ours.

That a device of the proper size and weight could be developed to insert in an animal was indicated by R. S. Mackay and B. Jacobson of the Karolinska Institute in Stockholm, Sweden. They developed what they termed the endoradiosonde, an extremely small transmitter which could be swallowed by an animal and tracked through its body. The frequency of this device transmitted information about pressure, while its rate of pulsation revealed temperature changes. Mackay and Jacobson suggested that a similar device might be built to conduct long-term in vivo animal experiments.

Before we could begin designing such a transmitter, a number of factors had to be considered. In addition to being small and light in weight, the device had to be of such shape that it could be introduced easily into the peritoneal cavity of the animal and anchored with sutures. Also, its frequency had to be free of local interference, low enough to be capable of a 25-yard range even when the transmitter was buried several feet underground, and low enough so that doubler or tripler circuits would not be needed. Furthermore, the transmitter's power supply would have to be as light and compact as possible, with a minimum life of six months. Finally, the antenna would have to be contained within the package of the transmitting device.

In the original model, a transistor in a self-excited, self-pulsing oscillator circuit was used. Although this unit was inexpensive and of simple construction, it had several disadvantages. For one thing, the pulsing oscillator, designed to conserve battery power, shifted frequency and swept through the band pass of the receiver so rapidly that only a click could be detected. Most of the other features of the model proved successful, however, and were incorporated in the plans for future models. One of these was a three-inch ferrite-rod transmitting antenna.

In the model which finally evolved from our investigations, crystal-control (0.19 to 0.55 megacycle range) was substituted for the simple LC resonant circuit of the original oscillator, and a blocking circuit to provide pulsation was retained. Use of crystal-control proved to be both an advantage and a disadvantage. It improved transmission by stabilizing the frequency, enabling the signal to be detected easily by the receiver, but it also caused the oscillator to operate at a lower power input, thus shortening the transmitting range. To extend the range it was necessary

The miniaturized radio transmitter. Above, line-up of component parts. Center, assembled. Bottom, sealed and ready for insertion in animal.

to increase the transmitter's power. We did this by adding another radio frequency stage—a second transistor—to the unit. With this modification, the transmitter produced a signal powerful enough to reach the receiver at the required distance.

Except for the half-watt resistors, all of the components used in the transmitter were miniaturized. The resistors were mounted so as to take advantage of their size—that is, to form a framework around the two mercury batteries. To stabilize the parts and to protect them from vibration and shock, the assembly was potted in a plastic foam.* Before this material had completely hardened, wire loops were installed for suturing the unit in place in the animal. The assembly was then sealed by dipping it in an epoxy resin.†

Before using the resin, buttons of this material were placed in the bodies of 16 different animals and left there for periods of from seven to ten days. They were then removed and the surrounding tissue examined for possible irritation. No adverse effects were noted in any of the experimental animals. Other samples of the material were subjected to several sterilizing agents to determine whether they would affect the resin. The agent selected for use was a solution of benzylkonium chloride. Although this sterilizer was satisfactory for our purposes, we found that if it was left in contact with the epoxy resin for long periods of time, it caused pitting.

The completed unit weighed about 4-1/2 ounces and measured about 3 inches by 1-5/8 inches by 1/2 inch.

The receivers chosen for use with the transmitter were surplus Army Command Receivers (Type BC-453-B) having a tunable range of 0.19 to 0.55 megacycles. One receiver was equipped for use in the laboratory, and two others were converted into mobile units for use in the field.

To determine how well the transmitter worked, we first tested it at various locations inside the laboratory. Next, we buried it in the earth behind the building, at a depth of three feet, as a check on ground attenuation. Then, a unit was inserted in a dead animal and the body closed to simulate field conditions. As a further preparation for its use in the field, we experimented with several methods of inserting it in living animals. For this purpose, three woodchucks were live-trapped and brought to the laboratory. One unit was inserted through a three-inch transverse rectus incision into the peritoneal cavity, and there allowed to float free. Another was introduced through a three-inch midline incision and placed in the peritoneal cavity. A third was placed through a midline incision into a space formed by separating the subcutaneous layers; it was then sutured in place on the left side of the midline.

*This material, called Eccofoam, is a foaming polystrene with a density of 10 pounds per cubic foot. It is manufactured by Emerson and Cuming, Inc., Engineers and Manufacturers, 869 Washington St., Canton, Mass.

†This material, labeled Castiplast No. 11, is manufactured by National Engineering Products, Inc., 435 Washington Bldg., Washington 5, D. C.

For one month, while the incisions healed, the animals were kept in isolation cages. They were observed daily so that measures could be taken to control infection or sloughing, should they occur, and to be sure that the transmitters remained in place. We found that the transmitter inserted subcutaneously broke through the outer skin, exposing about 1/10th of the unit. However, the other two units—inserted into the peritoneal cavity—remained in position and functioned well.

The tests showed that at the chosen frequency, attenuation by the animal body was minimal. They also showed that in most cases the transmitter's range was about 25 yards above ground and about 18 yards below ground. Since our test area is gridded by roads every 50 yards, we expect to experience no difficulty in locating the animals. The miniature batteries used in the unit had an average life of 161 days, only slightly less than the 180-day life we had aimed for.

Although the transmitter has proved useful for our purposes, it may have several disadvantages for application to studies carried out in other areas or in other animals. One of these is its cost—about $25, excluding labor—which would be too much for many investigations, unless the transmitter could be recovered and used again. Another is its size, which prohibits its use in animals smaller than a woodchuck. A third disadvantage is the transmitting range—18 to 25 yards—which may be too short for many study locations, particularly those not accessible by car; however, a self-contained portable receiver could be used in such areas.

Turning now to the other side of the ledger, we see that these drawbacks do not substantially reduce the value of the instrument. Our experience indicates that it might be possible to modify the transmitter so that it can be used not only to locate animals, but also to report on their physiological activity. For example, plans are now underway to add thermistors to the unit to permit the transmission of data on temperature variations. With the addition of other miniaturized sensing instruments, it might be possible to transmit information on blood pressure, respiration, and electrical potentials of the heart as well.

Still further improvements are planned. One of these is to produce a different type of case for the transmitting unit. While the plastic-foam potting coated with epoxy resin has proved very satisfactory as a means of stabilizing and sealing the unit, it prevents easy recovery of the component parts once the batteries have become depleted. Thus, as an alternative, we are contemplating the use of sealable polyethylene cartridges; the possibility also exists of separating the transmitting device from its power supply so that the batteries may be renewed.

It is too early to say as yet what may be the future of miniaturized radio transmitters in biological studies, but the results of the work done so far are very encouraging. Our hope is to be able to telemeter more information to greater distances using packages even smaller than the one described here.

Contracting for Naval Research Abroad

If one were to stop at 8 Rathbone Place, London, he would find himself in a small office occupied by only two people—a U. S. Navy officer, CDR Newell Atwood, and his secretary. The fact that a U. S. Navy officer has an office in London probably would not arouse the visitor's interest particularly, but the title of the office might, for it is rather long and impressive—Navy European Research Contracts Program. In explaining what it meant, CDR Atwood would probably say something to this effect: It is a program whereby the U. S. Navy provides scientific institutions of Europe with funds to conduct basic and applied research on subjects which for various reasons are not being explored by Americans, but which are still of interest to the Navy.

Were the visitor somewhat familiar with the Office of Naval Research, under which NERCP functions, he might be curious about something else. He would know that ONR had another office here—the Office of Naval Research, London (ONRL)—with a staff of more than a score of scientists. Why, he might ask, are there two offices? The Commander would explain that the two offices are administratively attached, but have distinctly different functions. The purpose of ONRL, he would say, is to maintain scientific liaison with European scientific communities; in other words, to keep posted on research developments in Europe. The purpose of NERCP, on the other hand, is to contract for research in Europe.

Such questions as these indicate that the little office at 8 Rathbone Place is not widely known. But this is not surprising when one realizes that the program was established only two years ago. Similar offices had been opened by the Air Force, in Brussels, Belgium, in October 1952, and by the Army, in Frankfurt, Germany, in May 1956. In fact, it was partly on the suggestion of representatives of these offices—who believed that much European research would be of interest to the Navy—that NERCP was initiated.

Among the Navy officials chiefly responsible for the creation of NERCP is the Assistant Secretary of the Navy (Air), Garrison Norton, who holds strong views about the benefits to be gained from European research. During the past year he told a Senate committee: "I want to emphasize the importance of pooling our scientific resources to the greatest possible extent with the enormous reservoir of research talent in Europe. . . . There is something about European education and environment that breeds good research. . . . I have made it a personal crusade to increase the interchange of basic research information between scientists of the Free World, and have repeatedly joined forces with my counterparts in the Army and the Air Force in attempts to remove obstacles holding back and sometimes damming the stream."

The Navy's effort in European contract research is a modest one. Fifteen contracts are now active, most of them averaging about $10,000. During the first two years the program has been in operation, 21 contracts, costing $736,000 have been handled. In soliciting these, NERCP has followed the same policy that ONR itself does. Contracts are let to stimulate research in areas of science in which large gaps in our knowledge exist. However, the Navy does not authorize a European contract if a similar research effort is being conducted in the United States.

CDR Atwood, who spends about half of his time traveling to various European scientific centers, operates his office as a two-way channel between Europe and Washington. From representatives of Navy Department Bureaus and Offices he receives requests to invite certain European research investigators or facilities to submit research proposals. In asking for proposals, CDR Atwood does not specify what the Navy wants to learn, but suggests instead that the European scientists consider investigating problems in which they are interested.

From European investigators, CDR Atwood receives inquiries about possible Navy support for their research. His first action in each case is to refer the inquiry to Washington to determine if the Navy Department is interested. Only after Washington gives the nod does he invite the scientist to submit a formal proposal. In general, the research proposals obtained by NERCP are unclassified, although under certain circumstances classified projects can be handled.

Proposals accepted for support are financed with funds provided by the sponsoring Navy Bureau or Office, with a representative of the activity concerned serving as scientific officer. However, CDR Atwood may be designated to act for the scientific officer, if desired.

The contracts are negotiated by the Navy Purchasing Office in London, with CDR Atwood assisting NPO in working out the technical arrangements with the contractor. NERCP was set up in the same building with NPO, London, in order to facilitate this operation. Generally, fixed-price contracts are used, and the term is for one year, but the contracts can be renewed. The costs, which are estimated by the contractor as part of his proposal, must be in line with normal research costs in the country involved. Since research is less expensive in Europe, the costs often are between 20 and 50 percent of what they would be in this country for the same type of research. This makes it possible for Navy Bureaus and Offices with limited funds for research to participate in the program, provided they require research which meets the criteria of the program.

The Chief of Naval Research is assigned responsibility for the execution of the program and for its coordination throughout the Navy. Administration of the program is the responsibility of ONR's Special Assistant for R & D Liaison. Direct communication between Navy Department Bureaus and Offices and the NERCP office in London is authorized.

The Navy is not the only organization that benefits from NERCP. National research organizations of the European countries involved in the program benefit also, for they receive reports on the results of the studies. In addition, they have the right to approve or disapprove a contract. This provides a check against the possibility of a research institution overloading itself with projects. In other words, every effort is made to avoid interfering with the country's regular research program.

European countries now holding contracts under NERCP include the United Kingdom, France, Italy, West Germany, Norway, and Belgium. Other countries whose scientists have submitted proposals now under consideration are Sweden, Spain, Austria, and Israel.

The type of research that is supported varies considerably. One contract is with Professor A. C. B. Lovell of the Jodrell Bank Radio Astronomy Station, Manchester, England, for the investigation of galactic and extra-galactic radio emissions. Another, for $75,000, is with the Compagnie Generale de Telegraphie Sans Fils of Paris, France, for the theoretical and experimental investigation of low-noise figure electrostatic barrier grid storage tubes having high resolution and low disturbance. Still another contract—with Professor Ernst Lubcke of West Berlin—concerns acoustics research for the Bureau of Ships. Additional contracts are held in both England and Germany for hydrodynamics studies requested by both the Bureau of Aeronautics and ONR.

A valuable contract completed not long ago was with Jacques Piccard of Switzerland, son of Professor August Piccard, for a program of deep dives by Navy scientists in the Piccard Bathyscaphe TRIESTE off the coast of Italy.

One significant feature of the program is that it is closely coordinated with the European research contracting offices of the Army and the Air Force. The three Services work in liaison with ONRL, which, while not involved in contracting activities, furnishes them with information about European scientific capabilities. Since June 1956, formal coordination meetings have been held at regular intervals by the three Services to insure that their activities in Europe are complementary. In this way, the three Services get the maximum benefit from each other's work. Also, full cooperation with the European scientific community is assured.

We have said what NERCP is and have described how it functions. But we have not given all the reasons why we need it. One of the most important of these is contained in the SecNav Instruction of November 27, 1956, establishing the program, and in SecNav Notice 3920 of October 22, 1958, implementing the program. It is that "the critical shortage of trained manpower makes it urgent that this country pursue every available means in order to meet the requirements of our increasing demands for new equipment and other essential developments." By utilizing the research facilities and capabilities of Western Europe and the United Kingdom, we can find in many instances "a ready solution to a problem and free our own scientists and engineers to concentrate their efforts in other areas."

The trial period of one or two years for NERCP, specified when the office was established, has been completed, and the program has been evaluated by Secretary Norton and RADM Rawson Bennett, USN, Chief of Naval Research. Their verdict is that Navy research contracting in Europe is to be continued and, if necessary, expanded. This is a good sign, for it is an indication that no stone is being left unturned in the search for the research "vitamins" needed by our continually growing Navy.

Research Notes

New Rocket Designed by Meteorologists

Of the many new words added recently to the dictionary of military terminology, one of the more significant to the meteorologist is ARCAS, for it refers to a small, low-cost rocket capable of lifting a 12-pound payload to an altitude of 200,000 feet. It does this by means of a single-stage solid-propellent motor that weighs only 72 pounds and measures only 4-1/2 inches in diameter and 6 feet in length. The new tool for weather research was developed by the Atlantic Research Corp., Alexandria, Virginia, under contract with the Office of Naval Research. The Navy's Bureau of Aeronautics and the Air Force Cambridge Research Center are also supporting development of the rocket.

Unlike other rockets now used for atmospheric research, the ARCAS was designed by meteorologists. Instead of modifying available military weapon-type rockets, these scientists designed an entirely new system. One difficulty in adapting a military rocket for research purposes is the strain and stress the high acceleration rates place on the rocket instrumentation. To avoid this problem, ARCAS was designed to rise with a low acceleration rate. For this reason, and because of its small size and low cost, the vehicle can be used in many types of atmospheric research programs, including those carried out by colleges and universities.

ARCAS is equipped with a separation device that contains two pyrotechnic charges. These eject the nose cone and a parachute assembly at the end of the rocket's upward flight. Several different instrument packages are now under development. These will be placed on a standard base plate which may be attached to the parachute shroud lines and inserted into the fully assembled rocket. The parachute, made of 1/2-mil mylar, has an extended skirt to ensure a stable descent, and is coated with aluminum so as to be radar-reflective. A two-inch sealed hem contains a few cubic centimeters of methanol, which vaporizes at altitude to provide the necessary inflation pressure.

The launcher, also designed by Atlantic Research Corp., weighs 390 pounds. It can be assembled by two men in two hours and can be used either on land or aboard ship.

The rocket's first research flights—to obtain data on temperature and wind profiles—are expected to be made early in 1959.

Rocket Observations of Total Eclipse

As the moon completely blanked out the sun, like someone shutting out the lights in a room at night, five Nike-Asp rockets with fiery red tails streaked skyward from the USS POINT DEFIANCE in the South Pacific. The rocket experiment, conducted by the Naval Research Laboratory as part of a program undertaken to measure solar activity for the International Geophysical Year, was timed to coincide with the total eclipse of the sun which occurred on the 12th of last month.

The rockets were equipped with detectors for measuring X-rays and ultra-violet radiations from the sun. Previous rocket experiments have shown these radiations to have a pronounced effect on the ionization of the upper atmosphere of the earth and thus on radio communications. One aim of the experiment was to determine the distribution of intensity of the various ionizing radiations across the solar disc. This was accomplished by launching the rockets at such time intervals that measurements could be made high in the atmosphere during several phases of the eclipse, including totality.

The rockets reached altitudes of 139, 148, 142, 150, and 55 miles. Reactions of the detectors were transmitted by radio from the rockets to two telemetry receivers on the POINT DEFIANCE. Two rockets were fired during totality, with a time interval of only 45 seconds between launchings, in a successful demonstration of push-button rocketry. Both rockets passed through the cone of totality as planned.

A sixth Nike-Asp was fired the following day to make background measurements. It reached an altitude of 159 miles. As the rocket's flight coincided with a huge, unexpected solar flare, data obtained by its instruments are expected to be of great value to the IGY program.

Preliminary examination of telemetry data obtained during the eclipse flights indicates successful measurements of X-ray and ultra-violet Lyman Alpha radiation. It is expected that detailed analysis of the data will bring forth valuable information about the role of the sun in controlling the ionosphere of the earth.

The experiment was directed by Dr. Herbert Friedman, newly appointed supervisor of the Atmosphere and Astrophysics Division, NRL. Also participating in the studies were the National Bureau of Standards, the University of Wisconsin, the California Academy of Sciences, the U.S. Naval Radiological Defense Laboratory, the Sacramento Peak Observatory, and the High Altitude Observatory of Colorado.

The Cooper Development Corporation of Monrovia, California, prime contractor for developing the rockets, began preparing for the eclipse experiments as early as November 1957.

A.S.T.M. Medal Given to ONR Metallurgist

At the recent annual meeting of the American Society for Testing Materials held in Boston, Dr. Oleg D. Sherby of the Office of Naval Research, London Branch, received the Society's Charles B. Dudley Medal. This award was made for a paper published in the Proceedings of the A.S.T.M. entitled "The Effect of Creep Stress History at High Temperatures on the Creep of Aluminum Alloys." It was shared with two other co-authors of the paper, Mr. T. A. Trozera and Professor John E. Dorn of the University of California, Berkeley. Dr. Sherby performed the research which formed the basis of the work during his tenure as a research engineer with the Institute of Engineering Research at the University of California.

A Critical Look at Transducers

Transducers—electromechanical devices for converting pressure, displacement, acceleration, force, and similar mechanical quantities to electrical signals—have many applications, but are in greatest demand for missile and aircraft flight testing. When so used, the electrical output of a transducer is transmitted by a wire line or by radio telemetering to a recording device. There is a weak link in this system, however—the limiting performance of the transducer itself. To learn exactly what the drawbacks are, and thus provide a basis for improving the performance of transducers, the National Bureau of Standards has undertaken a study of these instruments for the Navy's Bureau of Aeronautics, the Air Force, and the Army Ordnance Corps.

In any evaluation of missile and aircraft flight-test instruments, the environmental conditions encountered are of basic importance. The transducer program, directed by E. C. Lloyd, Chief of the Mechanical Instruments Section at NBS, provides data on the performance of transducers over significant ranges of ambient conditions. The conditions imposed are temperature, temperature shock, pressure, vibration, and acceleration; extremes of humidity, pressure shock, and acoustic vibration are included in cases where their effects may be important.

In addition to the general performance studies, attention has been focused on special problems arising in certain transducer applications, as for pressure and acceleration measurements.

In missile and aircraft flight testing, more measurements are made of pressure than of any other quantity. One serious limitation to the use of transducers in this area has been lack of information on their dynamic performance. To obtain such data, a shock tube, designed and built specially for the purpose, has been employed. This apparatus provides a pressure step-function of known value, which can be applied to the transducer pressure gage under study; the response of the gage is then detected by an oscilloscope and photographically recorded for further analysis.

Considerable effort has been expended also on the testing of transducers employed as accelerometers. The calibration of such instruments presents no difficulties at frequencies of from ten to several hundred cps. But at lower frequencies it does, because satisfactory test equipment has not been available. Two methods have been devised for getting around this problem. One entails rotation of the accelerometer in the earth's gravitational field, and the other makes use of a specially designed dual centrifuge. Both provide a known frequency input to the accelerometer under test.

Such studies have yielded much knowledge concerning the inherent characteristics of transducers as well as requirements for transducer applications. As the investigation is a large one—just keeping abreast of the many transducers being offered by manufacturers requires a substantial effort in itself—the work will continue. Future activity will include the further development of test methods, measurements of transducer performance, and a review of the characteristics of transducers of foreign manufacture.

Navy Honors Undersea-Warfare Leaders

Three members of the Committee on Undersea Warfare of the National Academy of Sciences—National Research Council were honored recently for their contributions to the Department of the Navy in the field of scientific research and development. At an informal dinner at the Cosmos Club in Washington, ADM Arleigh A. Burke, Chief of Naval Operations, presented Navy Distinguished Public Service Awards to Dr. Eric A. Walker, president of Pennsylvania State University, and Dr. Gaylord P. Harnwell, president of the University of Pennsylvania. To Mr. John S. Coleman, executive secretary of the Division of Physical Sciences of NAS-NRC, ADM Burke presented the Navy Meritorious Public Service Award. The citations read, in part, as follows:

Dr. Eric Arthur Walker. ". . . As Chairman of the Committee on Undersea Warfare from 1955 through 1957, Dr. Walker provided leadership and inspiration for this group of outstanding scientists, whose advice on highly complex long-range research and development problems enabled the Navy to achieve increased capabilities in undersea warfare. During his tenure as Chairman, Dr. Walker's keen insight and unceasing efforts brought to the Navy scientific and technical assistance of the highest caliber in all elements of undersea warfare, particularly antisubmarine warfare, and promoted an increased awareness and understanding of their interrelationships. . . ."

Dr. Gaylord P. Harnwell. ". . . As Chairman of the Committee on Undersea Warfare . . . from 1950 to 1955. . . . Dr. Harnwell provided the leadership and inspiration through which this Committee made notable contributions in the areas of antisubmarine warfare, psychological warfare, mine countermeasures, amphibious operations, hydrodynamics, power, and propulsion. Through his devotion to the interests of the Navy, a reservoir of scientific talent informed on undersea warfare problems was maintained and expanded, ready to meet any national emergency. . . ."

Mr. John S. Coleman. ". . . As Executive Secretary of the Committee on Undersea Warfare . . . from 1946 to 1953, Mr. Coleman served outstandingly to enhance the effectiveness of the Committee's advisory role. His initiative was instrumental in bringing the Committee's efforts to bear on many problems of great importance to the Navy, resulting in such contributions as the comprehensive postwar survey of research relevant to undersea warfare, particularly antisubmarine warfare, the institution of undersea warfare symposia, increased understanding of amphibious warfare concepts, and many others. . . ."

The Committee on Undersea Warfare was established by NAS-NRC in 1946 at the request of the Chief of Naval Research to provide the continuing advice of professional scientists on scientific and technical matters relating to the Navy's undersea warfare programs. The Committee's activities include analysis and review of the Navy Department's general program of research and development in undersea warfare, the proposal of new fields of investigation and new projects for research and development, and the collection and dissemination of scientific and technical information in these fields. All members of the Committee serve without compensation.

The Effects of Cold-water Immersion

In a recent issue of the Medical News Letter (Bureau of Medicine and Surgery) an account was given of the effects of cold-water immersion on humans. The account was written by CAPT Russell G. Witwer, MC, USN, a senior flight surgeon, for distribution to all aviators within his sphere of influence. A shortened version of the report follows:

Needless to say, the greatest danger experienced by a pilot after abandoning his aircraft in cold climates is the temperature, the most immediate effect being excessive body cooling, which may cause heart failure. Fatal cooling is more apt to occur in water than in air because wetting greatly decreases the insulating effect of clothing, displacing the layers of still air that normally surround the body and hold the heat inside.

Death from immersion in very cold water (50° F. and below) has been reported to occur within a very few minutes after a pilot has abandoned his aircraft. Even when the water temperature is as high as 70° F., the time that a man immersed in it will remain alive is limited to about 40 hours. A gradual fall in body temperature will take place, and the blood volume will decrease because of the transmission of blood fluid to the tissues when the temperature falls. In warmer water, however, a man can survive for several days (4 or more). After that length of time he will collapse and drown as a result of fatigue.

The approximate periods a man wearing clothing that is not watertight may be expected to survive when immersed in water of various temperatures is indicated below. The tabulation is based in part on laboratory experiments.

Water Temperature (Fahrenheit)	Survival Time (Hours)
32	Less than 1
40	1/2 to 3
50	1 to 6
60	2 to 24
70	3 to 40
80	Indefinite

The belief that rapid rewarming of chilled survivors is dangerous has been disproved by medical investigators. Survivors whose body temperatures have been lowered to levels which can be fatal should be rapidly rewarmed. Hot water (about 120° F.) should be used. If the pilot is conscious, water this hot will be painful to him, but will not scald him. He should be kept in this bath for ten minutes, then removed, gently dried, and placed in warm blankets. If his temperature does not rise, he should again be placed in hot water until his temperature reaches 93° F.

Survivors who are exposed to moderately cold temperatures for relatively long periods should be rewarmed much more slowly, preferably by heating pads or blankets.

Tractor Party Conducts Variety of Studies in Antarctic

One of the major explorations planned for the IGY in the Antarctic began the middle of last month when a party of scientists left Little America on a four-month 1,400-mile tractor journey. Led by Albert P. Crary, Deputy Chief Scientist for the U. S. IGY Antarctic Program, the group was to cross the ice shelf between Little America and the Skelton Glacier, then work its way up the glacier to the Victoria Land Plateau. From that point, the course was to lead westward to about 130 degrees east longitude, then turn back toward the U. S. Naval Air Facility at McMurdo Sound.

Crary and his companions are travelling in three powerful Snocats with cabs specially equipped for comfortable bunking. A creavasse-detector unit—an electronic device which gives warning of dangerous areas—has been installed on the lead vehicle. This vehicle also has a miniature gyrocompass as well as sun and magnetic compasses and other facilities for navigation, plus a radio. Another snocat carries seismic, gravity, and magnetic equipment and a second radio. In the third vehicle are messing facilities and the primary communication station. Four 2-1/2-ton sleds are being hauled by the Snocats.

Three resupply flights were scheduled to be made while the party is enroute from Little America to the top of the Skelton Glacier—one last month and two earlier this month. The flights were to be made by aircraft of Operation Deep Freeze IV, which is being carried out by Navy Task Force 43 under the command of RADM George J. Dufek.

More than a dozen specific scientific studies are being undertaken by the group. These include:

- Measurements of surface elevations along the traverse route (by altimetry and transit levelling). Determinations of ice thickness and water depth under the ice (by seismic reflection). Identification of underlying rock (by seismic refraction).
- Measurements of gravity and magnetism. The latter deal with horizontal and vertical field strength and with declination.
- Examination of the character of the snow to depths of about 33 feet. This will be done by digging shallow pits and boring holes. It will include observations of snow hardness, grain sizes and shapes, densities, and temperatures. In addition, samples of snow will be taken for isotope analysis. The primary aim of these studies will be to determine the annual snow accumulation.
- Determination of the volume of ice flowing down Skelton Glacier onto the ice shelf (by measuring absolute movement and ice thickness). Measurement of internal temperatures and the direction of flow of plateau ice (by seismic refraction).
- Mapping of the locations and elevations of mountain peaks flanking the Skelton Glacier.
- Glacial geological studies aimed at turning up evidence of past glaciation.
- Measurement of surface meteorological conditions, including temperature, pressure, wind speeds, wind direction, cloud cover, and cloud types.

Observations of Russian Astronomy

During a recent visit to the U.S.S.R. to attend the Tenth General Assembly of the International Astronomical Union in Moscow, Dr. G. F. W. Mulders, Chief Scientist of ONR's Pasadena Branch Office, toured a number of that country's astronomical institutions. An account of some of Dr. Mulders observations follows:

The western world still has by far the largest instruments for optical astronomy as well as for radioastronomy. The largest optical telescope in Russia is a 50-inch reflector (taken from Germany after the last war) located in the Crimea near Simferopol. This is exceeded in size by about a dozen reflectors in the rest of the world of up to 200-inch aperture. It should be remembered, however, that a small telescope equipped with an electronic image converter becomes as powerful as a large telescope. The Russians actually have a successful image tube, with which they have done much photographic as well as spectrographic work in the infrared. The visitors were shown infrared spectra of air-glow and aurora which would be impossible to obtain with reasonable exposure times by ordinary photography.

Furthermore, the lack of large instruments is partly compensated for by the great numbers of scientists, assistants, and computers at each institution visited. The Pulkova Observatory near Leningrad, which was completely destroyed during the war, has been rebuilt and is now probably the largest observatory in the world in terms of manpower: The staff totals 400, of which 150 are scientific personnel. With such a staff, full use can be made of all observational material gathered, whereas at the large observatories in the United States, such as Mt. Wilson and Palomar, far more data can be obtained with the huge instruments available than can be reduced by the small staffs.

At the new Crimean Astrophysical Observatory Dr. Mulders saw beautiful solar equipment, comparable in quality to the McMath-Hulbert Observatory of the University of Michigan.

In general, Russian electronics equipment appears to be excellent. It is frankly copied from the West, and such components as photoelectric tubes and photomultipliers are frequently of British make. The Russians have a very healthy attitude about copying equipment which has proved to be good elsewhere. For instance, the Russian-made computers at the Pulkova Observatory appear to be identical to IBM equipment. But the Russians are also very clever at designing new equipment. For example, instead of copying our Schmidt telescopes, Maksutov of the Pulkova Observatory designed the "meniscus" optical system, which gives comparable results at a much smaller cost.

The foundations are now being laid for a new 102-inch telescope at the Crimean Astrophysical Observatory. The mirror is being polished at the optical shops in Leningrad, and the instrument may be ready in about two years. A 236-inch reflector is planned for the future, to be completed, perhaps, in about 15 years.

These observations indicate that the United States still holds the lead in the race for supremacy in the field of astronomy, but, as Dr. Mulders points out, unless we make an all-out effort, the U.S.S.R. could very well overtake us in about 10 years.

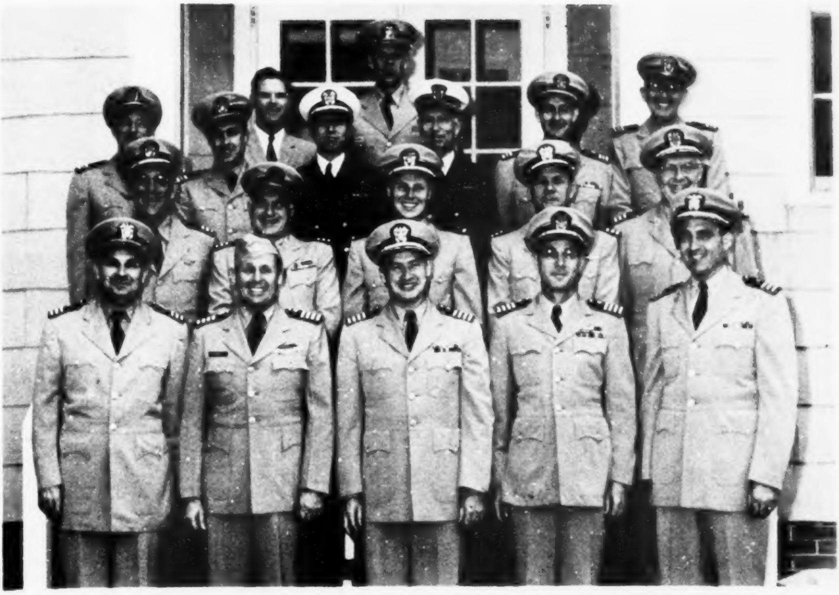
On the Naval Research Reserve

Commanding Officers Conferences

Two conferences of Commanding Officers of Research Reserve companies were held recently in the FIFTH and SIXTH Naval Districts. The conferences were planned and arranged by CDR Walter C. Avery, USN, Fifth and Sixth Naval District Research Reserve Liaison Officer, in cooperation with the Commandants of these Naval Districts. In attendance were the Commanding Officers or their representatives from Research Reserve companies in the two districts.

Commanding Officers of companies in the Sixth Naval District met at the Naval Air Station, Atlanta, Georgia, on October 4 and 5. In addition to the topics discussed by CDR Avery, presentations were made by CAPT J. P. Aymond, USN, Special Assistant to the Chief of Naval Research (Research Reserve), and by ENS R. J. Drath, USNR, Sixth Naval District representative. The agenda consisted of subjects pertinent to Research Reserve companies. Among these were the following: district plans, policies, and administration as regards the Research Reserve; scientific aspects of ONR; promotion policy and process; mobilization concepts; and recruiting.

On the following weekend, October 11 and 12, the conference for Commanding Officers of the Fifth Naval District was held in Washington, D. C. The agenda followed the same general line as that for the Sixth Naval District conference. Again presentations were made by CDR Avery and CAPT Aymond. The scientific aspect of ONR was presented by Dr. Harold Glaser of the Physical Sciences Division, ONR. The Fifth Naval District was represented by CAPT M. L. McCullough, Jr., USN, Commanding Officer, Naval Reserve Training Center, and Area Commander, Naval Reserve; and by CDR C. A. Bailey, USNR, Executive Officer of the Naval Reserve Training Center. A discussion of Naval Reserve public relations was given by LCDR Ted J. Bush, USNR, of the Navy Times staff. A panel discussion and summary concluded the conference.



PARTICIPANTS, FIFTH NAVAL DISTRICT CONFERENCE (photograph on facing page).

First row

CDR U. Liddel
CAPT J.P. Aymond
CAPT M.L. McCullough
CDR W.C. Avery
CDR C.A. Bailey

Second row

LCDR E.W. Peterkin
LCDR I.H. Bowman
LCDR H.L. Baier
CDR C.M. Preston

Third row

LCDR R.L. Chambliss
CDR J.W. Smith
CDR R.A. Kempf
CDR E.N. McWhite
CDR G.T. Strailman

PARTICIPANTS, SIXTH NAVAL DISTRICT CONFERENCE (photograph above).

First row

CDR H.M. Tatum
CAPT C. Kyselka
CAPT J.P. Aymond
CAPT F.E. Johnstone
CDR W.C. Avery

Second row

CDR R.C. Lafferty
CDR N.R. Buchan
ENS R.J. Drath
CDR J.D. Baer
CDR S.B. Sudduth

Third row

LCDR J.S. Luter
LCDR Q.W. Lindsey
CDR B. Zimmerman
LCDR L.N. Henderson
LCDR J.E. Land
LCDR P.F. Hurt

Fourth row

CDR N.J. Howard
CDR M.C. Bell

Membership Campaign that Saved a Company

The membership of Naval Reserve Research Company 5-6, Charleston, West Virginia, had dwindled to three officers. Although this had happened because many of the former members had either moved from the area or had retired, rather than because of inactivity on the part of the company, the fact remained that, owing to its size, the company did not meet the standards of the Research Reserve Program. This meant disestablishment.

But as the first steps were taken to dissolve the unit, another movement—to put the company back on its feet—was underway. Setting as their goal a total membership of ten, the three remaining members—LT A. C. Bowbeer, USNR, Commanding Officer; CDR A. A. Brown, USNR; and LT K. N. Arnold, USNR—set to work. Their campaign consisted of contacting qualified prospective members in the area—people new to the area or officers not then associated with a Reserve unit—and conducting group meetings for recruitment purposes.

The results of this effort? The goal was reached, and NRRC 5-6 (now with LCDR Irving H. Bowman, USNR, as Commanding Officer) is once again a going concern.

Boston Branch Office has New Executive Officer

CDR John A. Sharpe, USN, has reported for duty at the ONR Branch Office at Boston as Executive Officer and Assistant to the Commanding Officer for Research Reserve in the First Naval District.

CDR Sharpe's naval service began in 1934 in the Naval Reserve in San Diego. He soon joined the regular Navy and served in the old submarine tender USS HOLLAND for a year before entering the U. S. Naval Academy. After graduating as a member of the class of 1939, he spent a year aboard the carrier USS RANGER (CV-4).

Before and during World War II, CDR Sharpe served aboard destroyers, seeing action in the North Atlantic, the Aleutian campaign, and the New Guinea and Philippine campaigns. During the last year of the war, he commanded a destroyer operating against the Japanese in the Kurile Islands. This was followed by occupation duty in northern Japan.

His later service has included a year of postgraduate training at Annapolis in applied communications, followed by a year at the Underway Training Unit, San Diego. CDR Sharpe returned to carrier duty as Staff Communications Officer, CARDIV 3, in 1948. In May 1949 he began a two-year tour of duty as Commanding Officer of the Naval Communication Station, Kodiak, Alaska, and Staff Communication Officer for COM 17 and COMALSEAFRON. This tour was followed by a two-year assignment as Communication Officer, Staff, Commander Amphibious Force, PACFLT.

In 1953, CDR Sharpe returned to his first love—commanding a destroyer—this one the DOUGLAS H. FOX, based at Norfolk. While aboard this ship, he made an interesting cruise to Japan and Korea with the Seventh Fleet. His next two years were spent in Hawaii as Assistant Fleet Communication Officer, Staff, CINCPACFLT. Before reporting to Boston, CDR Sharpe served a year in the Plans Division, Staff, CINCPACFLT.

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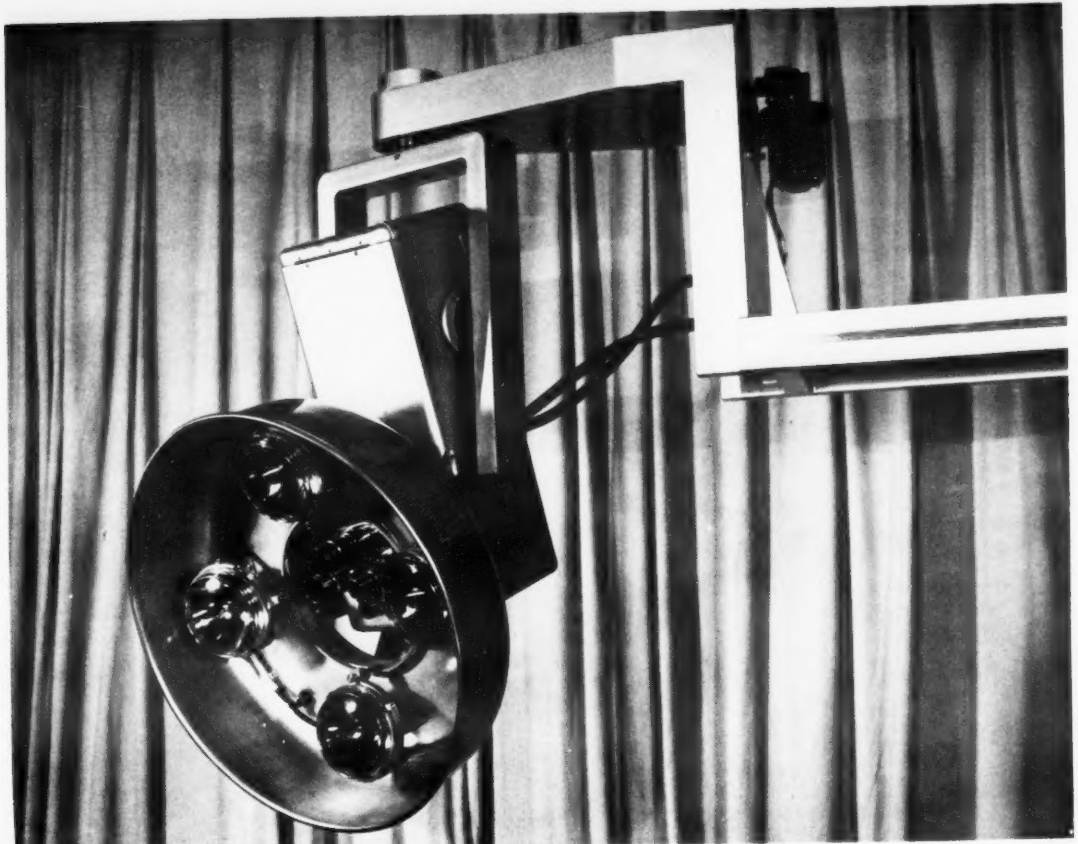

New light in medical TV. The Klein light, shown mounted on a TV camera, is equipped with special filtering roundels that prevent excessive heat from reaching a surgical subject. See article beginning on page 6.

In This Issue

COVER PHOTO: A demonstration of instructional medical TV. See article beginning on page 6.

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