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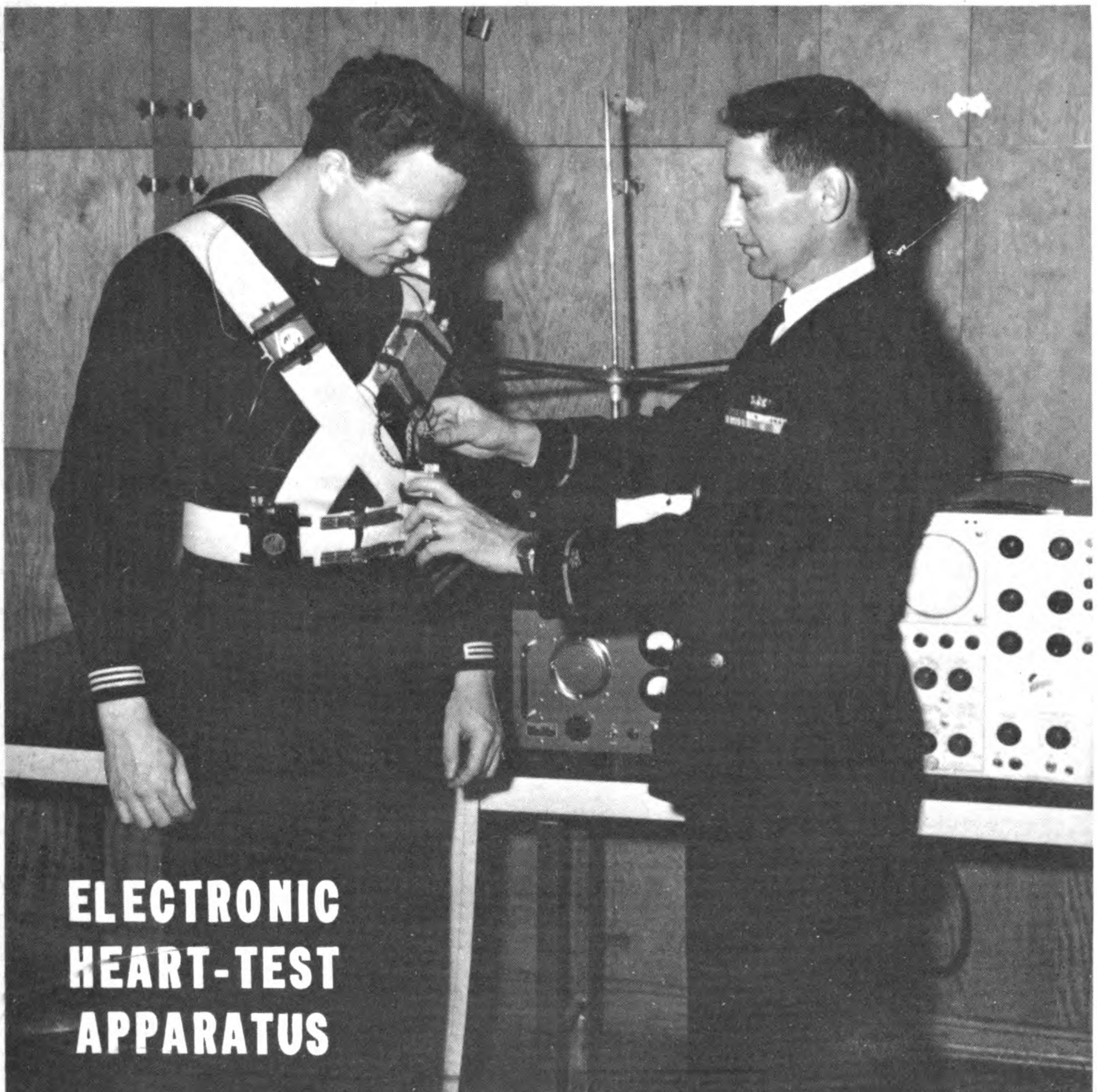
RESEARCH REVIEWS



NAVEXOS P-510

DEPARTMENT OF THE NAVY
WASHINGTON, D. C.

COVER PHOTO: Tests at the Medical Research Institute, Bethesda, Md., show effectiveness of a small electronic device with batteries in gathering data on heart action over an extended period of time to include the varied activities of the subject. A healthy subject is having the harness adjusted as a test starts.

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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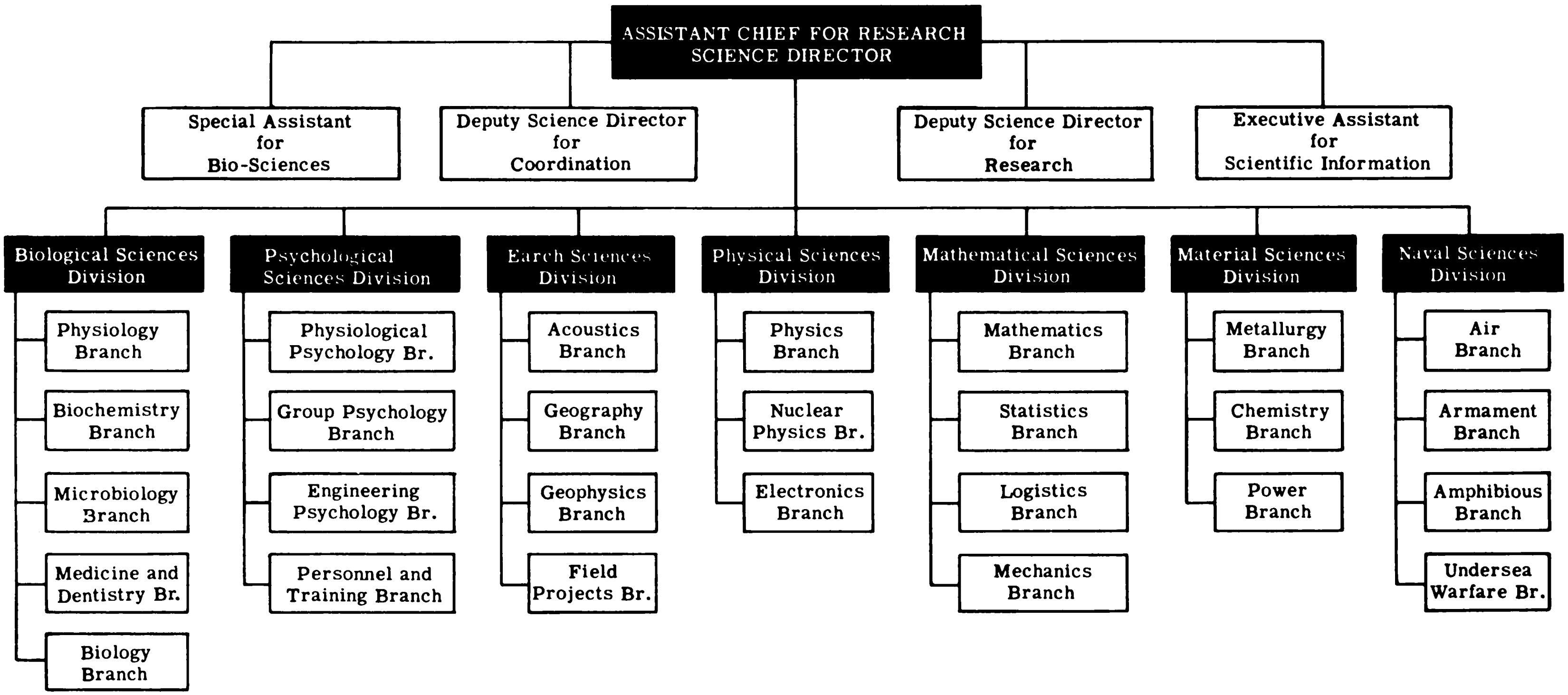

Organization of ONR Research Group which is responsible for the ONR contract research program

The Navy's Role in Support of Basic Research*

I. Estermann

Director, Material Sciences Division
Office of Naval Research

One of the most important changes in the activities of many universities during the last 15 years is the tremendous increase in research in the physical and biological sciences. Where, for example, the average physics department may have had about a dozen graduate students in 1939—and not all of them engaged in serious research activities—there are now 50 to 100 or more. Similarly, the number of post-doctorate researchers of all ranks has risen by a large factor. And concurrently, research budgets have increased by an even larger factor. In summary, research in many universities, where it was formerly only a minor part of campus life, is now "big business."

An examination of the financial side of the picture discloses that most of this "business" has a single customer, The Federal Government, with the Defense Department and the AEC paying the largest share of the bill. And it is not exactly a secret, that the interest of these Government agencies in research does not stem from philanthropic emotions, but from the inseparable connection between modern warfare and scientific-technological development.

When shortly after the outbreak of World War II it became evident that a successful defense against the new weapons developed by the Germans demanded new and unconventional military tools, it also became apparent that the U. S. Government, and especially its Army and Navy, lacked sufficient facilities to carry out the necessary research and development effort to get these new tools. Under the masterful guidance of Doctors Bush, Conant, Compton and others, the National Defense Research Committee (NDRC) and the Office of Scientific Research and Development (OSRD) successfully mobilized the scientific manpower of the country and created the necessary facilities in an incredibly short time. The accomplishments of these organizations, competently assisted by expanding older government laboratories and by many existing university departments, are too well known to merit description.

The abrupt demobilization following VE and VJ days in 1945 threatened the collapse of the whole national research structure. Some large special facilities, like the Radiation Laboratory at MIT, were closed, factories dismantled, scientific equipment sold or given away as surplus, and research contracts with universities cancelled. Simultaneously, the large number of veterans returning to the universities

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*Based on a lecture before the Physical Society of Pittsburgh on 12 May 1955.

created an increased demand for teaching time which fell on the scientists who had remained on or returned to the campus. There was little time and little money left for research at universities, and few opportunities for the younger scientists who had grown up with the Defense Laboratories.

But "research interest" seems to be a habit-forming affliction. The older scientists who returned to their academic positions, and their younger disciples, who during the war developed a taste for this activity, were reluctant to give it up. In particular, the professors who had spent the war years working almost exclusively on applied problems, including development and often straight engineering projects, expressed a strong desire to return to the pursuit of knowledge for its own sake.

Future historians will record it as an extremely fortunate coincidence for the well-being of the United States that a few farsighted men in the OSRD and in the Navy recognized the fact that the wartime triumphs of applied science were based on the utilization of the results of basic researchers of earlier decades, and to a considerable extent, of other nations. They realized that, in order to be able to repeat the technological successes of the past war in the next emergency, new scientific facts had to be discovered continuously, and that this was only possible through a vigorous research program. The only way to accomplish this under the then existing economic conditions was through support of research by the U. S. Government. No other agency being available, the Navy created the Office of Research and Inventions, in 1945, which by Public Law 588, 79th Congress, became the Office of Naval Research.

It is no accident that the Navy took this decisive step ahead of other, and possibly on strictly logical grounds, better adapted agencies of the Federal Government. As a matter of history, the Navy had always been in closer contact with technology and the physical sciences than any other government department. It is, e.g., a little known fact that the National Academy of Sciences had its origin as an Advisory Committee to the Secretary of the Navy. Moreover, fighting ships are complicated technical machines and their efficacy depends not only on being there "firstest with the mostest," but also with the "bestest." And that the last condition demands continuous research effort was well recognized in the Navy. Thus, ONR (and its short-lived predecessor, ORI) were not altogether strange phenomena.

While many groups in the Navy have responsibility and active programs involving physical and biological sciences, ONR occupies a focal position. To explain its mission and functions, it seems best to quote from the preamble to Public Law 588, which states as its purpose:

"To establish an Office of Naval Research in the Department of the Navy; to plan, foster, and encourage scientific research in recognition of its paramount importance as related to the maintenance of naval power and the preservation of national security; to provide within the Department of the Navy a single office, which, by contract and otherwise, shall be able to obtain, coordinate and make available to all the bureaus and activities of the Department of the Navy, world-wide scientific information and the necessary services for conducting specialized and imaginative research; to establish a Naval Research Advisory Committee consisting of persons preeminent in the fields of science and research to consult with and advise the Chief of such Office in matters pertaining to research."

The law itself and the implementing directive issued by the SecNav specify in greater detail the various obligations of the head of the ONR, the Chief of Naval Research. To discharge these responsibilities, the Office of Naval Research has a number of organizational components (see Frontispiece chart), of which the following three shall be singled out here as being most relevant to the subject namely, the Navy's role in support of basic research.

- The Research Group, for conduct of research by contract at universities and other laboratories, including non-profit, commercial, and Government establishments.
- The Naval Research Laboratory, for conduct of basic, and applied research, and development.
- The London Branch Office, for liaison with the scientific world in the United Kingdom and Western Europe.

Best known to the academic world is the Research Group, which handles most of the relations between the Navy and the universities.

The Public Law establishing ONR and the implementing directives leave no doubt that ONR was created to serve the research needs of the Navy, and that these needs are definitely practical. Was, therefore, the support of basic research by ONR in its early years only an emergency measure to take care of the problems of the scientific community caused by the demobilization after the war; or is the support of basic research an integral and continuing part of ONR's (and the Navy's) research program? The answer to this question requires a somewhat deeper analysis of the concepts, "basic" versus "applied" research. It may be suggested that this distinction is in many cases partly one of motivation, and to a lesser extent, of the interval between the performance of the research and the time when the question is asked.

What is generally called basic research deals with problems undertaken by an investigator out of curiosity about the way nature operates, and without regard to practical needs or applications. If it is "important," its results will lead to a better understanding of the laws of nature on a broad front; more frequently, it will add a bit to the storehouse of factual knowledge, waiting there until a sufficient number of similar bits of knowledge have been added to allow the construction of a new law which in turn may predict unknown data and suggest new experiments. The function of applied research is to provide knowledge needed for the solution of a specific problem. The scientist doing basic research may not be interested in practical applications of his results, but the chances are pretty good that sooner or later his results will find an application. On the other hand, the "applied" researcher may produce just the data that are needed to complete the jig-saw puzzle posed by nature that the "basic" researchers have failed to find. In a slightly facetious way, the difference might be expressed as follows: The basic researcher does what he thinks should be done, and the applied researcher does what somebody else thinks should be done at a certain time. Which of these two approaches is more interesting or more productive depends to a larger extent on the wisdom of the person suggesting the problem than on the usefulness of the result.

So much about the motivation. Regarding the time delay, it is a general experience that basic research results have statistically excellent probabilities to find applications sooner or later. And it is also a characteristic development of the present epoch that this time delay becomes shorter and shorter as technology advances and becomes more complicated. Thus one may say that the basic research is the early phase of the applied research.

Many of the most important developments have resulted from research undertaken with a very different purpose. As an example, basic studies in the field of solid-state physics have led to increased knowledge of the very important materials called semi-conductors, which in turn are finding practical applications in electronic devices (rectifiers, photoconductors, and transistors) on an ever-increasing scale. On the other hand, research motivated by the need for better performance of these devices has produced important new knowledge about the fundamental properties of the solid state. Where can one draw the line between basic and applied research in this area?

There is some justification in saying that even in the thus defined applied area there is no absolute certainty that the results will find useful application. It is quite possible that the data searched for cannot be obtained because some more basic information is lacking, or that when they are obtained, show the problem in a different light from that originally conceived.

Since the research program of the Navy must not only support the immediate needs of the Navy, but has to anticipate also its needs ten and twenty years hence, it seems not only justified but inevitable that a part of its research effort should be assigned to what is called basic research. The Navy's needs in this respect are no different from that of industry, which is supporting basic research on an increasing scale. The real problem for the Navy research administrator is two-fold: How to arrive at a reasonable balance of basic and applied work, and how to distribute the basic research effort among the different scientific fields. It would be nice if one could formulate this problem in terms of the calculus of variations and maximize the output. One approach is to look into the "crystal ball," or in other words, resort to what more conservatively may be called considered judgment.

When ONR was first organized, it was the only major government agency supporting basic research through a contract program. Today there are a number of other Government agencies that are similarly engaged, and the efforts of these agencies can support each other. As a result, the originally very broad program of ONR has been gradually adjusted to the more specific needs of the Navy, drawing for the more general research objectives also on the programs of the other agencies. The need for Federal support of "general purpose" research, which was anticipated already toward the end of the war, and which was strongly advocated by scientists, government research administrators, and members of Congress, has resulted in the establishment of the National Science Foundation. Its operation on a very broad front made it possible for the military research agencies and for the AEC to sharpen their programs in accordance with the requirements of their mission. This, however, does not mean the abandonment of basic research which remains an integral part of their research programs. This is in accordance with the Executive Order 10521 of March 17, 1954—"Administration of Scientific Research by Agencies of the Federal Government," which states in Section 4:

"As now or hereafter authorized or permitted by law, the (National Science) Foundation shall be increasingly responsible for providing support by the Federal Government for general purpose basic research through contracts and grants. The conduct and support by other Federal agencies of basic research in areas which are closely related to their missions is recognized as important and desirable, especially in response to current national needs, and shall continue."

The question of distribution of effort between applied and basic research and within the basic area needs to be given careful consideration. The Research Group program is (dollar-wise) about evenly divided between basic research, applied research (including early development), and operational studies. The basic program can be classified into three categories:

- Research in scientific areas of vital interest to the Navy, but only of minor interest to other segments of the nation. Examples are: oceanography, arctic research, upper atmosphere research, hydro-mechanics, and certain areas of chemistry and metallurgy. In these areas, the Navy is the major sponsor, and attempts to stimulate interest in the scientific community.

- Research in scientific areas of vital interest to the Navy and at the same time to industry and other government departments. Among them are: solid-state physics, nuclear physics, radiation, optics, hydrobiology, microbiology, applied mathematics, meteorology, psychology, and personnel training. In these areas the Navy participates with other sponsors on a comparable scale.

- Research in scientific areas more remote from foreseeable application to Navy problems. In these areas, the Navy sponsorship covers only a modest fraction of the national effort, just enough to establish a "listening post" in order to maintain contact with these fields in case new results or requirements change the situation. Examples are: cryogenics, spectroscopy, and general chemistry.

As important as a steady flow of new scientific knowledge is the continuous production of trained scientists and the encouragement of scientific thinking. The basic research program of the Office of Naval Research in universities is contributing to the creation of an atmosphere favorable to the development of imaginative scientific talent which we can no longer, as in the previous generation, import from the older centers of learning. For both these objectives, which are essential for the implementation of the Navy's mission, the Navy must have access to and maintain close contact with the scientific community in universities, non-profit institutions, and commercial laboratories. The Office of Naval Research basic research program has been effective in fostering and preserving this mutually beneficial relationship.

Wire-Tap on the Heart

At the Naval Medical Research Institute in Bethesda a Navy Captain, Dr. Norman Lee Barr, has developed a radio-broadcasting version of the electrocardiograph. With the device it is possible to telemeter the action of a patient's heart while he is exercising or working.

The electrocardiograph has, of course, been used for many years as a diagnostic tool by heart specialists. Electrodes are strapped on the patient—generally on an arm and a leg—and the electrical impulses from the heart are recorded as wavy lines on a pen-and-ink recorder or on an oscilloscope. By studying the record of the alternate beat and relaxation of the heart much can be learned about the working condition of that essential pump. At least one heart can be compared against another; an abnormal pulse-record can be compared against a normal one.

The principal shortcoming of the electrocardiograph has been that the patient must always be at rest. It takes time to strap on the electrodes, so the heart has a chance to settle down to at-rest operation, even if the patient has been exercising recently. Also, with many patients, the mere fact that he is being tested with some mysterious gadgetry may influence his heart action and give a misleading record. But most important, it is impossible to obtain a comparative reading on the same heart under varying degrees of exercise.

Now, with a medical version of a walky-talky, it is possible for the patient to walk around, run, play golf, go up and down stairs, or work at his job—or a simulation of it—and the varying work-load on the heart will be faithfully recorded at the receiving station. Moreover, a patient becomes so accustomed to the electrodes that he is scarcely conscious of them. Thus the record will no longer be influenced by his emotional reaction to the test.

The technique of electrocardiography is based on the fact that the muscles of the heart in flexing and relaxing create a variable and measurable electric current. The electromotive impulses from the heart muscles vary in intensity from a slight wavy curve during the period of relaxation to a sharp peak corresponding to the beat, as can be seen in the Brush Recorder pen-and-ink record, Figure 1. The current from the heart is of low frequency, as compared to that of the chest muscles, so a frequency-controlled pickup can filter out the high-frequency "noise" caused by breathing and leave a clear signal from the heart muscles. The locus on the heart that seems to give an optimum signal is the left auricular-

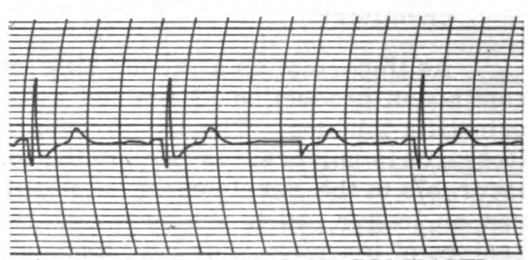

Figure 1 - Typical electrocardiogram of a healthy subject exercising. Notice the skipped heart-beat due--probably--to the subject holding his breath momentarily.

ventricular node--a spot a little left of center on the heart, as seen from the front.

The radio system as devised by Captain Barr and his assistants consists of the following components: electrodes, amplifier, radio transmitter and batteries—all worn by the patient (see cover photo); and receiver, amplifier, speakers, and recorders located in the laboratory.

The electrodes are very simple—made by dropping a generous drop of molten solder onto a bared wire-end placed on a sheet of glass. When the solder hardens it forms a flat disc a little larger than a shirt button. The electrodes are glued directly on a patient's skin with collodion and held securely in place by adhesive tape. Generally, three are used—two on the chest and one on the back--to set up a "push-pull" circuit through the auricular-ventricular node. The leads are passed through the collar opening of the patient's jumper to the amplifier which, together with the other components, is carried on a cross-belt harness worn over the clothing.

The amplifier is a five-miniature-tube circuit packed in a thin metal container about the size of a cigarette box (see Figure 2). It was designed and built in the laboratory at NMRI. It is powered by flashlight-type batteries, stored separately in their own container.

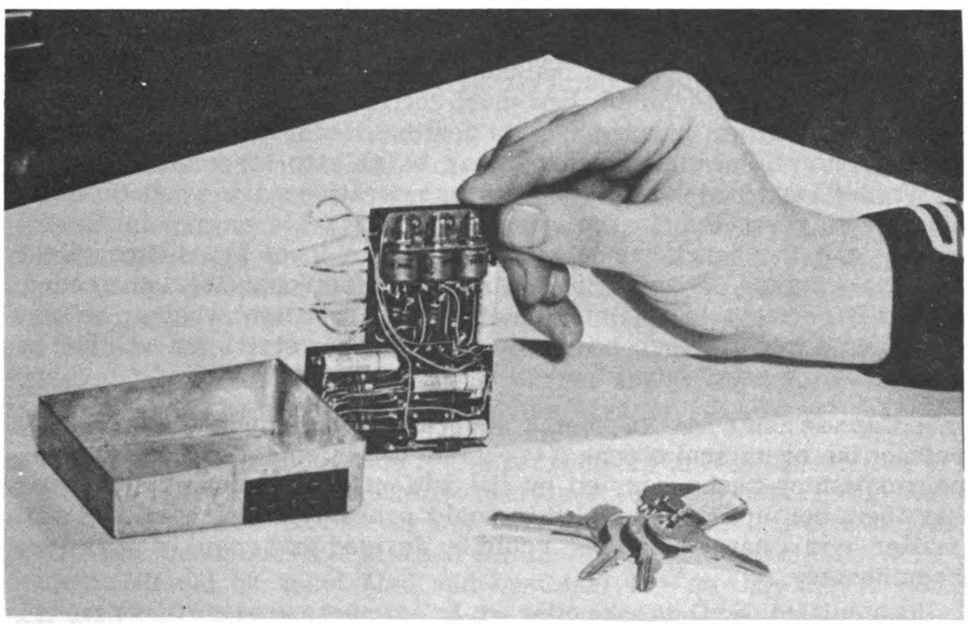

Figure 2 - Miniature electrocardiograph pickup and amplifier with the case. An improved version is being designed to include batteries.

The transmitter is a commercially made radio almost as small as the one used by that durable comic-strip detective, Dick Tracy. (Another use of this vest-pocket radio is on the Edward R. Murrow "Person to Person" TV show, where it is worn by interviewees to avoid trailing around microphone cords.) It is frequency modulated, has about 1/10 watt power, and it's range is limited to about 1/4 mile. Like the amplifier, it has a separate pack for its batteries.

There is nothing particularly unconventional about the receiving station, which is simply a highly selective FM receiver with a built-in amplifier. Its precision is such that it picks up the faint signals from the miniature transmitter clearly, in spite of surrounding structures, flourescent lights, and electrical equipment elsewhere in the Institute buildings. The output can be switched to a high-fidelity speaker, to a cathode-ray oscilloscope, or to a Brush recorder, or to all three together. Thus the heart beats can be "seen," heard, and recorded. A dial on the receiver console provides a direct indication of the pulse rate.

It should be emphasized that the "noises" heard on the speaker are not the friction heart sounds such as would be picked up by a stethoscope or close-pressed microphone, but are amplified electrical impulses ultimately transformed into sound electronically.

The net result, however, is a series of sounds very similar to those heard through a stethoscope. The heart beats are heard as regularly spaced "thump thumps." The contraction of the chest muscles, associated with breathing, produces higher frequency, electrical discharges. These in turn are heard as a series of rushing sounds, like distant waves breaking on a shore.

So far, the radio-electrocardiograph has been tried out only on healthy subjects—enlisted men assigned to NMRI. Now, however, arrangements have been made with the Naval Hospital to use cardiac patients as well.

In coronary cases, for instance, the new device may be of considerable help in determining how much activity an individual can undertake without further endangering his health. Here, the degree of exercise is critical, because the heart may be able to force blood through calcified ("hardened") arteries with comparative ease when the individual is at rest. But as soon as he exercises his oxygen intake increases and the heart has to pump harder to force blood through the inelastic arteries. By studying the radioed electrocardiograph record, Captain Barr hopes that he may be able to tell a patient whether he may continue his job, whether he can go up and down stairs, or whether he must remain a semi-invalid.

Captain Barr has suggested several improvements that could be made on the equipment before it is put into use by doctors. For instance, the two battery-packs carried by the patient could be combined in one container, the miniature amplifier could probably be streamlined still smaller, and a harness or vest could be devised that could be worn less conspicuously.

These are in the nature of refinements, however, because the equipment already works effectively—providing a valuable new clinical device for the heart specialist.

An original contribution to knowledge may be divided into three phases: during the first it is ridiculed as not true, impossible, or useless; during the second, people say there may be something in it, but it would never be of any practical use; and in the third and final phase, when the discovery has received general recognition, there are usually people who say that it is not original and has been anticipated by others.

---Sir James Mackenzie

An Instrumentation Reference Center

ENS R. E. Gomory

Physics Branch, Physical Sciences Division
Office of Naval Research

In a project jointly sponsored by the Navy, the Air Force, and the Atomic Energy Commission, an instrument reference and consultation center has been set up at the National Bureau of Standards in Washington. This reference organization, which forms part of the Office of Basic Instrumentation (OBI), is intended to be a center to which Department of Defense instrument problems can be brought for consultation with instrument experts, and where instrument knowledge, now widely scattered and inaccessible, can be assembled, systematized, and brought to bear on research and development problems. Information gathered will be furnished as effectively as staff limitations permit in response to letters of request, telephone calls, etc.

At present, instrument information is rather inaccessible. It is hard to gather the information necessary to answer questions like "What techniques have been tried for measuring the rapidly varying high temperatures of jet engines?" and "How can the flow of blood in very small tubes be measured without an appreciable back pressure and without damaging the blood for use in living organisms?"

In some cases an instrument or technique capable of making the desired measurement may have been developed already. New and improved techniques occur constantly during the course of research in physics, chemistry, biology, and other fields. However, a description of the measuring techniques developed during the research forms only a part of the published article which describes the research results and which appears in the appropriate physical, chemical, or other technical periodical. Only workers in the same field and interested in the same research problems will be aware of the new measuring technique, although it may be applicable in a variety of other situations.

This, then, is the difficulty. Improvements in instrumentation are scattered throughout the scientific literature and their description tends to be submerged in the research of which they are part. Nevertheless, instrument problems have much in common from field to field and developments should be assembled and systematized so that they become accessible. This is one function of the reference and consultation center.

To aid OBI's instrument experts in gathering information relevant to problems brought to them for consultation, a novel library of instrument information is being organized and is now emerging from the experimental stage. OBI analysts are scanning current literature in many fields. Developments in acoustics, aeronautical engineering, computers, and a great variety of other scientific specialties are good sources for instrument developments. When something new is found an abstract is written on specially classified abstract cards. It is planned to furnish copies of abstract cards upon request by the use of microfilm service.

It is not enough, merely to assemble this material. A large part of the problem is to be able to produce the right information in response to a question. To do this, the OBI is making use of a novel multi-aspect classification system and the so-called "peek-a-boo" method of information retrieval (Figure 1).

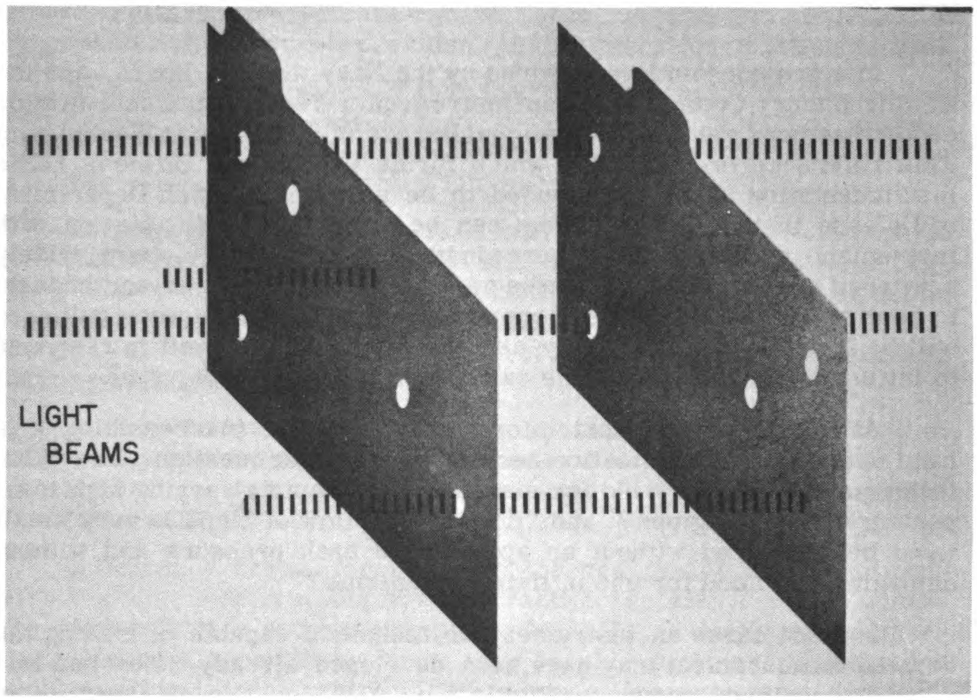

Figure 1 - Peek-a-boo system

In the multi-aspect classification system each abstract card is assigned a number of key words describing different aspects of the instrument information it contains. For example, a key word or words is assigned to describe the "measurand," the physical property or effect being measured by the instrument. Typical words would be "acceleration" or "voltage."

A total of ten descriptive aspects are used for classification at present, and with each aspect is associated a list of terms from which the key words for documents can be chosen. Descriptive aspects now being used are:

Aspects	Key Words
Measurand.	acceleration, voltage, elongation, etc.
Operating Principle.	electromagnetic, photochemical, piezoelectric, etc.
Object on which Measurement is Made.	weapon, cavity, explosive, etc.
Name	accelerometer, galvanometer, etc.
Field of Application.	ceramics, aviation, etc.
Stage in Development.	performance, prototype, component, design, etc.

Figure 2 - Peek-a-boo equipment in use

Aspects	Key Words
Function in Measurement	amplification, calibration, entire measurement, etc.
Character of Document	bibliography, patent, book, etc.
Performance Characteristics and Ranges	stability, bandwidth, range, etc.
Limitation of Measurand	underwater, transient, periodic, etc.

To illustrate further, here is an abstract of a fictitious German article on accelerometers:

Abstract No. 2863

NIEMAND, ADOLPH, Accelerometers for aircraft or projectile applications. Wissenschaft. Z.34:800, 1965 (in German). Performance characteristics and calibration of lightweight piezoelectric and capacitance type accelerometers for measuring instantaneous and transient accelerations of shocked and vibrating mechanical structures in military applications are discussed. The accelerometers were designed to operate in a temperature range from -150° to 350°F, have the lowest natural frequency near 100,000 cycles with an acceleration range up to 100,000 g. A comprehensive bibliography is included.

This information would be classified by key words covering each of the descriptive aspects as follows:

(measurand)	acceleration, vibration, shock
(operating)	piezoelectric, capacitive
(object)	weapon, aircraft
(name)	accelerometer
(field)	aviation, military
(stage)	performance
(function)	calibration, measurement
(character)	bibliography, Germany
(performance)	portability, 10^6
(limitation)	instant, transient, low, high, temperature, frequency

and these key words are added to the abstract card by the analyst.

This multi-aspect classification lends itself to rapid retrieval of information using the so-called peek-a-boo searching system (Figure 2). The physical apparatus of this searching system is a collection of large cards called peek-a-boo cards. There is one card for every key word used in the classification system. For example, there is a card entitled "acceleration" and another entitled "electromagnetic" and so forth. The connection of the peek-a-boo cards with the abstract cards is through a positioned hole-punching system.

On each of the large peek-a-boo cards is a rectangular array of rows and columns. Each abstract card corresponds to a unique position in this array. Abstract card No. 2863 corresponds to the intersection of the twenty-eighth column and the sixty-third row on all the peek-a-boo cards. If one of the key words in the classification of abstract card 2863 is "acceleration," a small hole will be punched in the 2863 position on the "acceleration" peek-a-boo card. Similarly for each key word used in the classification of the abstract, a hole is punched in the peek-a-boo card bearing that key word. This hole is always punched in the special position which corresponds to the abstract card, and which is in the same position on all the peek-a-boo cards.

This procedure is repeated for each of the abstracts. As a result the holes in the "acceleration" peek-a-boo card provide, by their positions, the numbers of all the abstract cards dealing with acceleration; and in general the set of holes in each peek-a-boo card gives the abstracts associated with a particular key word.

Of course most instrument information is inadequately described by one word; one rarely wants all references to anything as all-inclusive as "acceleration." By superposing peek-a-boo cards we can obtain the abstracts dealing with sets of terms. For example, if the "acceleration" card is placed on top of the "aircraft" card, the only holes that continue through both cards are those corresponding to abstracts dealing with both aircraft and acceleration. And of course, still other cards can be added.

When searching for instrument information the procedure is simple enough. From the lists of key words, the words that characterize the desired information are chosen and the corresponding large peek-a-boo cards are selected. These are then laid one on top of the other on a glass plate lighted from below, and the light shines through the holes common to all cards and gives the numbers of the appropriate abstracts. If too many abstracts result, more modifying words may be added to further specialize the subject, or if too few, some words should be dropped or others substituted.

As an example, consider an inquiry such as, "What has been done to measure blood flow without destroying the blood?" Using the special dictionary provided to convert the natural words of the questioner into the key words used in the system, we find that blood splits into the two words "liquid" and "biological." As we are interested in measuring flow we choose the peek-a-boo "flow" card, and as we wish to preserve the blood, the dictionary gives the heading "non-destructive testing." Superposing these four cards and possibly adding the "measurement" card, we at once find the numbers of all the references dealing with non-destructive measurement of the flow of biological liquids. Then, since the abstract cards are filed by number, the appropriate cards are quickly obtained.

When using the searching system the OBI instrument expert would probably make further use of the flexibility of the system by trying various operating principles such as "sonic" or "electromagnetic" and using these peek-a-boo cards in combination with some of the others. In this way he can discover what has been developed in the way of flow-metering using sonic and electromagnetic devices, even though this work may have been unconnected with biological applications.

This inherent flexibility of the system has proved to be a tremendous advantage in the tests made with the multi-aspect and peek-a-boo systems, while in the experimental stage. The system is now being put into actual practice and the abstracting rate is expected to reach 1200 abstracts per month by December. It is estimated that a yearly rate of about 15,000 abstracts will cover advances in instrumentation and provide the OBI's instrument experts and through them the Navy with an accessible and organized source of instrument knowledge.

Bibliography on the Arctic

Volume 5 of The Arctic Bibliography, a project of the Arctic Institute of North America, has recently been published by the Government Printing Office. The Arctic Bibliography is being jointly supported by the U. S. Army, Air Force, and Navy by means of an Office of Naval Research contract with the Arctic Institute of North America. The objective of this project is to compile an annotated bibliography of all publications dealing with research, development, engineering, exploration and other activities in Arctic Areas.

The preparation for Volume 5 included a search of 5,494 publications with twelve different languages represented. Forty percent of the publications analyzed were in English, 30 percent in Russian, 13 percent in German, and the balance scattered among nine other languages. The 1268-page volume has an index that contains more than 20,000 subject-geographic items.

The Variable-Angle Launcher

The U. S. Naval Ordnance Test Station operates torpedo test ranges in a lake formed by Morris Dam on the San Gabriel River, about 20 miles east of Pasadena, California. On a peninsula extending into this lake at a point approximately 3000 feet upstream from the dam, is the Variable-Angle Launcher (see photo inside back cover). This is a unique facility used for studying water-entry conditions and underwater-trajectory characteristics of full-scale projectiles.

The launcher with its supporting instrumentation is a powerful research and development tool which makes it possible to test projectiles under accurately controlled conditions.

The principal structure consists of a movable all-welded steel bridge 22 feet wide, 35 feet high, and 300 feet long—the longest all-welded steel bridge in the United States.

The bridge supports two launching tubes—one 22.5 inches, and one 32 inches in diameter. The structure is so designed that additional launching tubes may be added as the need arises. The bridge, counterbalanced by a ballasted car on the back slope of the structure, can be moved to give vertical angles varying from 0 to 40 degrees. The lake

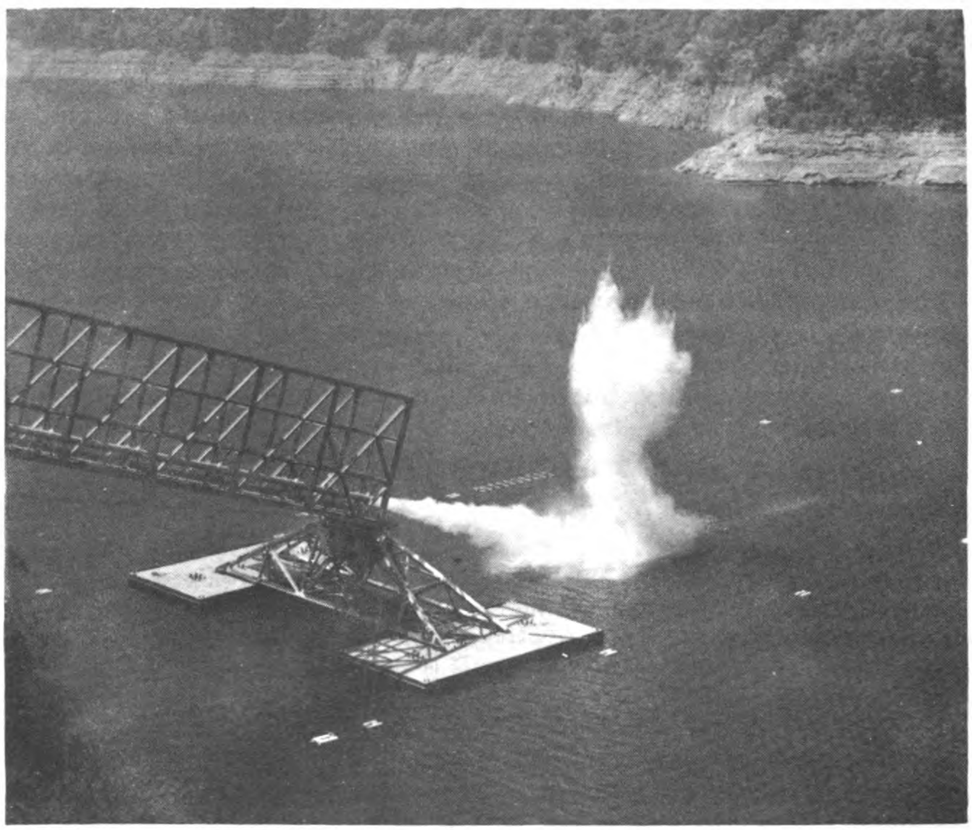

Figure 1 - Launching velocities of 1000 ft per sec for torpedoes are attained with the equipment at Morris Dam

end of the bridge is supported on a bridge connecting two 35-by-60-by-12-foot welded-steel barges and is laterally restrained by adjustable windstay cables. At the shore end, the launcher bridge is supported on a steel carriage. The carriage has special trucks permitting it to roll on the heavy rail sections which are anchored to the concrete structure.

Projectiles are launched by means of compressed air suddenly released from a 500-cubic foot air flask by a specially designed quick-acting valve. The launcher is designed to produce launching velocities up to 1000 feet per second with a 1500-pound missile (Figure 1). Projectiles launched into the reservoir have a clear range 1000 yards long and at least 200 yards wide. The average depth of the water near the launcher is approximately 150 feet when the reservoir is at its lowest normal level.

Both external and internal instrumentation has been designed and constructed to increase the value of the data obtained from the launchings. Sideview, rearview, and overhead cameras record the path of the projectile. The underwater trajectory is traced by an underwater sound range consisting of an array of hydrophones. Further information is obtained from a series of nets which are strung across the range and are perforated by the torpedo. An elaborate system of instrumentation within the torpedo provides information on position and behavior. In one day, it is possible to make six launchings with complete external instrumentation consisting of cameras, net, and hydrophones; or three launchings with both complete external and internal instrumentation.

Built-In Living Conditions on New Navy Ship

A new-type Navy ship, the USS CARRONADE, has built into it the latest improvements in living conditions as designed by Raymond Loewy Associates, the well-known firm of industrial designers in New York. As a preliminary, the designers studied shipboard arrangements, compartment layouts, furniture designs, lighting systems, color schemes, and other improvements affecting living conditions before incorporating them into the new ship.

As the first ship to benefit from the planning of the Loewy organization, the USS CARRONADE has such habitability features as: (1) Improved crew living spaces, with berths curtained from recreational areas, lightweight panels between parallel tiers of berths to provide privacy, individual bed lights, better ventilation, and tables for letter writing and games; (2) Four-place, plastic-top tables and upholstered chairs in the crew's mess hall—these replace long tables and benches; (3) An ice cream-soda fountain "gedunk" stand for the crew; (4) A modern cook's galley, with electric ovens, deep fryer, griddles, electric mixer-chopper, potato peeler, garbage grinder, and dishwashing machinery; (5) General use of eye-pleasing colors and mural decorations, and installation of program-selecting loud speakers throughout the ship. The speakers have individual volume controls and performance comparable to "hi-fi" sets.

Illumination with Radioactive Isotopes*

L. J. Boardman

Photometry Branch, Optics Division
Naval Research Laboratory

Artificial light has been useful to man for a good many centuries, and considerable ingenuity has been displayed from time to time in devising a better, more convenient source of illumination. The aims of those who have worked with problems of developing a better artificial light may be summed up as a search for a long-lived, brilliant, convenient type of illumination which at the same time would not be complicated by cumbersome sources of power and other necessary but burdensome auxiliary apparatus. From the days of light from candles and oil lamps to the present day with its electric lights, it has been necessary to supply fuel at regular intervals to maintain light, or to replace short-lived batteries and lamps, or to have machinery available for the generation of electrical power.

The requirement of brilliancy in artificial light has been well satisfied, but the goal of simplicity of construction and fuel-less operation have not yet been attained. Nevertheless, the radioactive self-luminous phosphor excited by some of the new radioactive isotopes has interesting properties which approximate, under restricted circumstances, the characteristics of an ideal source of illumination. The practical arrangement of this type of phosphor of particular interest to Navy is the deck and personnel marker. This is a simple, self-contained source of illumination which can be made to radiate in a variety of colors and which has a useful luminous life of many years. The luminance is relatively low so that the marker has limited applications. There have been, however, recent important advances in obtaining much higher luminances.

COMPARISON OF RADIUM AND ISOTOPE-EXCITED MARKERS

It has been known for nearly 50 years that small amounts of a radium compound mixed with zinc sulphide will cause the phosphor to radiate light in the middle portion of the visible spectrum. This type of luminescence has been used to make watch, clock, and gage dials legible in the dark.

With the advent of World War II, military activities carried out under cover of darkness became a major factor in warfare. All possible lighting aids were investigated for their usefullness in these night activities; and among those found to be of special value was the radioactive self-luminous zinc marker in the form of a circular luminous disk 1 or 1-3/4 inches in diameter. When protected by a strong transparent plastic casing, this type of marker was used to mark personnel,

*Condensed from NRL Report 4546, June 1955.

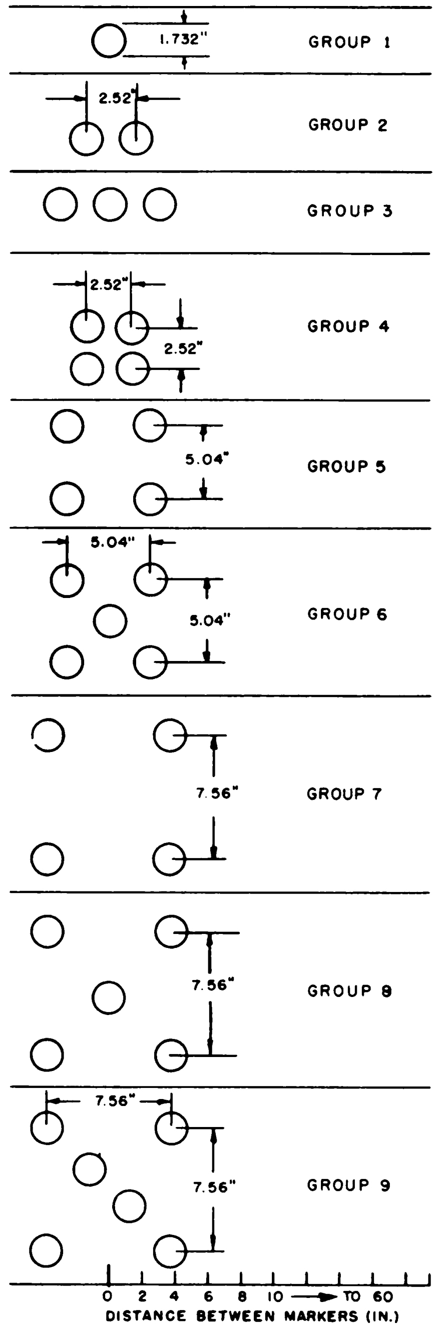

Figure 1 - Arrangement of various groups of markers used in the illumination tests

decks, bridges, trails, and other objects which needed to be identified during night military activities.

With the introduction of the artificial radioactive isotopes, the self-luminous marker has taken on new and improved characteristics. The useful luminous life of the marker has been lengthened materially because the excitation by the beta rays from the isotopes does not destroy the zinc sulphide crystals as rapidly as the bombardment by the heavy alpha particles of radium. As a consequence of this decreased destruction of zinc sulphide, markers may be made many times brighter with the isotope excitation than with the radium.

Another unique property of the isotope-excited marker lies in the fact that it can be produced in a range of colors and yet have a long useful life. However, the larger amounts of the radioactive material that are required to excite red and blue phosphors will reduce the length of the useful life of the zinc sulphide. Recently, the luminance of the green marker has been increased to 300 effective microlamberts. This is ten times as much as bright moonlight on a clear night.

MARKERS AS SOURCES OF ILLUMINATION

Since no definite information regarding the use of radioactive self-luminous material as sources of illumination was available, a series of investigations were undertaken to obtain some answers to various questions. The low-and the new high-luminance green markers were included in the investigations. Measurements were made of the illumination of a white wall by various colored single markers and groups of markers having the same color. The luminance of the central illuminated area was obtained as the distance between wall and markers was increased. Likewise, the distributed luminance of the wall was measured and the curves on values found gave the luminance at any point on the wall where any failure of tests were found, such as ability to read signs and other printed material, acuity tests, and tests in the choice of tools.

The wall was illuminated by a single radioactive self-luminous 1-3/4-inch marker excited by strontium-90. Readings were taken on the central luminance with markers of five colors as the distance between wall and marker was varied. The central luminance of the wall was obtained by substituting a white sheet of paper for the wall so that only this portion gave light to the eye. Had the whole wall been illuminated, the eyes would soon lose much of their dark adaptation. The luminances of the markers were 54.3, 48.0, 28.3, and 26.8 microlamberts for the green, yellow-green, orange, red-orange, and the blue, respectively. The differences occur because of the varying luminous efficiencies of the phosphors. The proportion of strontium-90 in the blue, orange, red, and red-orange markers is actually greater than that in the more efficient green and yellow-green phosphors. These differences must be kept in mind in evaluating their usefulness as sources of illumination.

The arrangement of the various groups of markers is diagrammed in Figure 1, all drawn to scale, including a portion of the wall. The center of each group is directly opposite the center of the illuminated area of the wall. The values of the luminance of the white walls as measured for the Group 4 arrangement of markers are shown in Figure 2. Only two high-intensity green markers were available. It was found that one of these gave higher luminance values than any group of one to six of the low-intensity green markers in producing wall illumination.

VARIOUS TESTS USING LOW-INTENSITY MARKERS

Reading Test. Tests were made to determine the ability of a dark-adapted person to read signs illuminated by the various groups of markers. Two sizes of letters in black, green, and yellow against a white background, and white letters against a black background illuminated by markers were placed adjacent to each other in the form of a square. The low-intensity green, yellow-green, and blue markers were used for illumination. The letters were of a size used for a large percentage of emergency signs. The first group, designated as A, formed four words one above the other, and the second group, B, was the word EXIT. The characters were placed in the illuminated area where the light from the markers was most intense. The legibility that resulted is shown in Table I. Maximum legibility occurred with black letters against a white background, while minimum legibility occurred with green and yellow letters that gave less contrast with the white background. White letters on a black background were not as legible as black letters on a white background.

Tool Test. Some measurements were made to determine the ability of an operator to locate tools and to differentiate one tool from another in the dark when his only source of illumination was one of the previously described groups of radioactive self-luminous green markers.

TABLE I

LEGIBILITY RESULTS ON READING TESTS WITH SHORT WORDS

Color of Marker	Avg. Luminance of Markers (effective μL)	Distance from Marker to Letters (inches)	Maximum Distance at Which Every Letter is Legible						
			Black Letters on White		White Letters on Black	Green Letters on White		Yellow Letters on White	
			A	B	B	A	B	A	B
			(inches)						
Green	54	6	50	210	180	25	80	40	90
		15	30	150	130	15	60	30	70
		30	20	90	70	10	50	20	50
		50	10	60	45	-	30	10	30
		80	-	40	35	-	20	-	20
Yellow-green	50	6	50	200	160	25	80	15	40
		15	30	140	130	15	50	15	30
		30	20	90	60	10	30	-	20
		50	10	50	30	-	20	-	15
		80	-	30	20	-	15	-	10
Blue	21	6	40	120	120	20	60	30	80
		15	25	100	100	10	50	15	60
		30	15	70	50	-	30	10	30
		50	-	40	30	-	20	-	15
		80	-	15	15	-	-	-	10

Notes: Short words of "A" were lettered 1-1/8" high x 5/8" wide with strokes 1/4" thick
The letters formed four words which were placed one above the other
The single short word of "B" was lettered 5-1/2" x 2-1/8" with strokes 3/4" thick
The word was EXIT

The tools were a 9-inch screw-driver, a 6-inch pair of pliers, and an 8-inch crescent wrench placed in turn against the illuminated wall, that is, a piece of white paper that could be moved with the tool along the black wall to a position X where the remote side of the tool became indistinct. The markers would illuminate a white wall against which the tool was placed, and the position X on the wall gave the radius of the illuminated area within which the tool can be readily chosen. Table II gives these radii when the various groups of markers are placed at the distances from the wall as shown. The observer is at the same distance from the wall with his line of sight perpendicular to the wall looking for the tool. This statement is necessary, because when the eyes are close to a very faintly illuminated wall, the outline of the shadow of the tool can be made out well down to the threshold of vision, too low to measure visually for the dark-adapted eye.

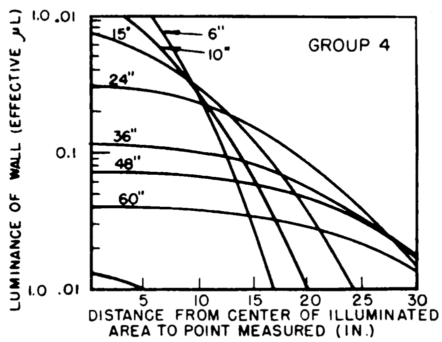

Figure 2 - Luminance of a white surface measured in a test with four markers (Group 4) placed at distances up to 72 inches. The numbers on the curves denote the distances between the group of markers and the white wall

TABLE II

TESTS FOR LOCATING TOOLS

Green Marker Illumination	Radius of Area Illuminated by Green Markers at Distances Ranging from 6 to 60 Inches					
	6	12	24	36	48	60
	(inches)					
Group 1	9.3	15.3	14.7	6.5	-	-
Group 2	13.0	17.7	25.7	19.3	12.6	-
Group 3	13.7	22.7	29.7	31.3	28.7	-
Group 4	15.3	20.0	29.3	29.3	28.7	-
Group 5	15.7	24.0	30.7	29.7	28.7	22.0
Group 6	15.3	25.7	34.3	36.0	34.7	25.3
Group 7	17.7	25.0	32.7	35.3	29.7	20.5
Group 8	17.7	26.7	34.7	39.7	36.0	25.0
Group 9	17.7	27.0	35.3	44.3	38.7	32.3

NOTE: Shown here are the comparative lengths of radii of the illuminated area within which the tool can be distinguished when illuminated by green markers with an average luminance of 54 effective microlamberts

From the luminance corresponding to the center and the value of X on the illuminated wall, it appears that the lowest level of illumination at which a workman can do certain types of work and locate and select his tools with a reasonable degree of ease is about 0.02 effective microlambert. Also, the area of useful illumination from a group of markers has approximately its maximum value when the markers are held 24 to 36 inches from the work. The tools are best seen against a dark background if painted white, because of the greater reflectance. A green tool is more easily distinguished than a yellow tool, regardless of the color of the marker. Against a white background, the color of the tool is immaterial since the tool appears as a shadow.

Acuity Test. Since in some applications it might be necessary to read characters over as large an area as possible, it is of some interest to determine the legibility of black letters against a white background at various points in the area illuminated by light from radioactive self-luminous markers. To do this, the observer attempted to distinguish between four groups of black letters against a white wall. His eyes were always 24 inches from the letters. The groups of letters were B-R, P-D, O-C, and E-F; they had a height of 24 millimeters, a width of 14 millimeters, and 5-millimeter stroke. One pair was used at a time, with one letter above the other so that each letter would be equally distant from the center of the illuminated area. The letters were moved horizontally along the wall to a position where their identity disappeared. This position was usually quite sharply located. Table III shows the comparative distances of legibility at point where letters become illegible.

TABLE III

ACUITY RESULTS - BASED ON TWO-LETTER COMBINATIONS

Distance from Marker to Wall (inches)	Test on Letters to Become Illegible Distance from Center of Illuminated Area					
	BR & PD Combination			OC & EF Combination		
	Marker Group 1	Marker Group 4	Marker Group 9	Marker Group 1	Marker Group 4	Marker Group 9
	(inches)					
6	7	13	16	7	14	18
12	9	18	23	8	19	24
24	4	22	33	3	23	34
48	-	10	36	-	11	40
72	-	-	8	-	-	13

NOTES: Legibility is for black letters on white wall.
Illumination is by various groups of green markers with an average luminance of 54 effective microlamberts.
Distance is from center of illuminated area to point where the letters become illegible.

VARIOUS TESTS USING HIGH-INTENSITY MARKERS

Letter Test. The same letter test was made with the green markers of 300 effective microlamberts as was made with the markers of lower intensity. Any one of these markers was better than four of the lower intensity type.

Tool Test. Conclusive results were produced by tests on the choice of tools in the light of the high-intensity green markers. Here, again, one 300-microlambert green marker has the preference to four low-intensity green markers.

RADIOACTIVE HAZARDS

Personnel using the radioactive self-luminous markers are completely protected from beta radiation when the construction of the marker is in accordance with BuShips requirements. However, because of the high-energy of the beta radiation from strontium-90, there is emitted from the marker a certain amount of secondary gamma radiation which must be taken into consideration. For the green markers of 1-3/4-inch diameter and about 80 to 100 effective microlamberts, this amounts to about 12 milliroentgens per hour when a counter probe is placed in immediate contact with the marker. However, this amount of radiation falls off rapidly with the distance so that one inch from the marker the radiation level falls to 2 or 3 milliroentgens per hour, which is well under tolerance. These figures were obtained by actual laboratory measurements using a Geiger counter. Because of the greater beta activity of the high-luminance markers, the secondary gamma radiation from them becomes quite large. Therefore, somewhat greater precaution in handling these markers should be taken. With appropriate design of the holder for the markers and with good judgment exercised on their use, the radiation danger can be eliminated.

CONCLUDING REMARKS

Because the maximum sensitivity of the eye occurs in the region of the spectrum in which the green marker radiates, and because of the higher luminous efficiency of the green phosphor, the green marker is the only one that need be considered for practical application as a source of illumination. A single green or yellow-green marker of the lower intensity type carried in the hand makes it possible for one to make his way among obstacles in the dark, and even read a newspaper or write notes if the paper is held near the marker. The results of the various studies show that radioactive self-luminous deck and personnel markers can be used as simple, inexpensive, and reliable sources of illumination to assist some military operations.

A few possible applications are:

- Illumination of dials and gages. A green marker of about 100 effective microlamberts placed 12 inches from the characters will enable a dark-adapted observer 2 to 3 feet away to read the usual panel dials accurately.

• Source of illumination to read maps, orders, and instructions under dark conditions where general illumination is not desirable. The marker can be held close to the work and the characters will be legible to the observer at a comfortable reading distance. The eyes may need to be corrected by glasses for night myopia.

• Illumination of emergency and exit signs. Here the characters are large and the marker can be placed relatively close to the sign. The observer's distance may be 12 to 15 feet away.

• Standby illumination of darkened space caused by power failure. One high-luminance marker will illuminate a room 15 feet long, 10 feet wide, and 8 feet high sufficiently well for a dark-adapted person to recognize other persons in the room and to locate obstacles, stairways, and doors. A 50-microlambert marker in the hand will enable one to make his way in the dark.

• Standby illumination to operate emergency valves and gears. A high-luminance marker placed within two or three feet of the gear to be operated will allow the operator who had been working in daylight to perform the necessary duties from one to three minutes after being plunged into total darkness.

Marine Biologists Meet

A conference on the potentialities and problems of marine biological laboratories was held in Rome, Italy, on April 18 through 23, 1955. This conference was sponsored by the International Union of Biological Societies and supported by the Office of Naval Research and the National Science Foundation. Representatives of the principal laboratories from all parts of the world were present and initiated the conference with presentations on the facilities of the biological laboratories in each area represented. Dr. R. W. Hiatt of the University of Hawaii was chairman of the conference and discussed the facilities and major programs of the U. S. laboratories.

On the following days there were extended discussions on ways in which the contributions of marine biological laboratories could be improved in the fields of education and research in the biological sciences. Growing out of these discussions were such problems as the financial support of marine biological laboratories, communication of marine biological information, recruitment and international exchange of scientific personnel, geographic gaps in distribution of marine biological laboratories, relations between marine biological laboratories and oceanographic research on the one hand and fisheries research on the other, and ways in which laboratories in the same area might best cooperate in joint use of equipment and facilities. It was decided that a permanent organization should be established for future conferences in this field, and that an international directory of marine biological laboratories be compiled.

The conference included representatives from Norway, Germany, France, Egypt, Japan, Sweden, Yugoslavia, Denmark, Scotland, England and Canada, and Hawaii and the United States. Several of the talks included motion picture films of the laboratories and aquariums. Of particular interest was a film shown of the Red Sea Marine Biological Station which contained scenes of marine life which were exceptionally rare and beautiful.

Research Notes

Dr. Killian is New Deputy Chief and Chief Scientist at ONR

The duties of Deputy Chief and Chief Scientist of the Office of Naval Research have been taken over by Dr. Thomas J. Killian who succeeds Dr. E. R. Piore. As a scientist previously connected with ONR he returns as no stranger to assume the responsibilities of this position.

Shortly after ONR was established in 1946, Dr. Killian became Chief of the Scientific Branch and the following year became Science Director. During the time between 1951 and 1955 when he was away from ONR, he was Chief Scientist for the Office of Ordnance Research, U. S. Army, and then Dean of the School of Engineering and Architecture at Catholic University, Washington, D. C.

Dr. Killian's varied experience includes Navy service during World War II. Beginning as a Lieutenant in 1941, he was promoted to attain the rank of Commander in 1944 when he served with the Chief of Naval Operations as Airborne Early Warning Officer and Guided Missiles Officer. Continuing in the Reserves after returning to civil life, Dr. Killian was appointed Captain in 1953.

The industrial experience of Dr. Killian includes that of Director of Research of the Barkon Tube Lighting Corp. of Seattle, Wash. There he was in charge of developing a carbon dioxide color-matching lamp and several other gaseous discharge devices. Later he became Technical Director of the Frink Corp. in New York, where he was in charge of development of all kinds of lighting equipment, and of research in the field of colorimetry.

Dr. Estermann Receives Award

Dr. Immanuel Estermann, Deputy Science Director for Coordination and Director of the Material Sciences Division of the Office of Naval Research, has received the 1955 "Pittsburgh Physics Award."

The presentation was made by the Physical Society of Pittsburgh at a meeting in Pittsburgh on 12 May. Dr. Estermann was honored for his contributions to fundamental physics while a professor at the Carnegie Institute of Technology. With assistance from ONR and from the Research Corporation, he organized and developed the Low Temperature Laboratory at the Institute.

Dr. Estermann received a D.Sc. in physical chemistry from the University of Hamburg in 1921. His doctoral thesis on the mechanism of crystal growth has been published and is a favorite footnote in the literature. After teaching a year at the University of Rostock, he returned to Hamburg and collaborated with Nobel prize winner Dr. Otto Stern on molecular beam research.

For his distinguished work Dr. Estermann was appointed an International Research Fellow of the Rockefeller Foundation at the University of California. Subsequently he joined Dr. Stern at Carnegie Tech as an associate professor of physics. During the war, he worked at Carnegie for the NDRC and the Manhattan Project. Resuming his basic work at Carnegie after the war, Dr. Estermann became a contract researcher and later a consultant to ONR. His interest in the naval research program finally caused him to forsake his teaching assignment and to accept a position as Director of ONR's Material Sciences Division.

Dr. Ewing Gets Navy's Highest Civilian Award

The highest Navy civilian award was recently conferred on Dr. W. Maurice Ewing, director of the Lamont Geological Observatory, long associated with projects of the Office of Naval Research. Currently he is working on marine magnetic measurements, on submarine gravity measurements, and on marine seismic studies. The citation reads in part:

"For his outstanding contributions to the U. S. Navy in the scientific development of undersea warfare. His vigorous pursuit of general understanding of marine phenomena has placed him at the forefront of the fields of oceanographic geophysics and underwater acoustics. His contributions to the National Defense may be measured by the fact that the Navy's ability to detect submarines acoustically rests to a large extent on his early work on the propagation of sound in the ocean. . ."

Science Coordination Endorsed by Hoover Committee

The most recent report of the Commission on Organization of the Executive Branch of the Government (Hoover Committee) has a statement on research and development. Dr. Mervin L. Kelly, President of Bell Telephone Laboratories, was chairman of the Task Force Subcommittee concerned with this phase of government operations. Their "Recommendation No. 11" has this wording:

"That the Secretary of the Navy and responsible senior Navy officers give strong administrative support to the new functions of the Office of Naval Research in coordinating and integrating the development program of the Navy. A staff adequate in size and of the highest research and development competence be provided, and the programmatic recommendations of the Office of Naval Research be implemented."

Accurate and minute measurement seems to the non-scientific imagination a less lofty and dignified work than looking for something new, yet nearly all the grandest discoveries are made this way.

W. D. Bancroft

Rain-Making Tests

The idea of a control over the weather through artificial "seeding" of clouds is scheduled for a new series of tests. In the past, the Office of Naval Research has carried out a varied program to arrive at some conclusions about controlling weather through seeding with dry ice particles from aircraft and with silver iodide crystals from ground generators. An interested party to the series of experiments and tests was the Weather Evaluation Board appointed by President Eisenhower.

In April of this year some results were announced on a series of tests carried out by Operation SCUD sponsored by the Office of Naval Research and carried out by a group of specialists at New York University. These tests were conducted along the East Coast and extended from operational areas as far north as Massachusetts to others as far south as Florida. The evaluation of the results from Operation SCUD was by an outside group headed by Prof. John Tukey at the Forrestal Research Center, Princeton, N. J. On the basis of this evaluation, a statement was released which said, "No evidence of any large-scale meteorological effects due to seeding."

The feeling developed within the President's Advisory Committee on Weather Control that while wide-area control was not effective, there might be possibilities of success in an operation of somewhat limited scope. Thus plans have been laid for Operation OVERSEED which will test cloud-seeding methods from the foot of Mount Washington, highest of the White Mountains in New Hampshire. The project will begin in the fall. Silver iodide crystals will be dispersed by ten generators used in Operation SUCD, and by other types favored by commercial operators.

Computers Used in Experimental Weather Forecasts

Beginning in May, a new chapter is being written in the mechanics of weather forecasting through the use of a high-speed electronic computer at the National Weather Analysis Center, Suitland, Md. The special forecast unit was developed and became an accepted accessory to the prediction of weather as the result of a program sponsored jointly by the Air Force, Navy, and Weather Bureau. The research of the Navy in this direction began in 1947 when the Office of Naval Research supported preliminary investigations at the Institute for Advanced Studies, Princeton, N. J. (Research Reviews, April 1954).

As the computer now contributes to a forecast, derived information serves to provide prognostic weather charts which show the atmospheric flow at the surface and at various levels in the upper atmosphere. Other charts show the future distribution and the amount of upward and downward motion at levels where clouds and precipitation form. Forecast periods will probably be for 24 hours during the time the high-speed computer is being thoroughly tested. Also the area will be limited at the beginning to most of North America; later larger areas will be covered.

The computer is also being put to work on another burdensome task of meteorologists—namely, analysis of the weather charts. The machine will be instructed to process raw observations as they are received from hundreds of weather stations. It then "decides" on values at the strategic in-between points which are needed in preparing forecasts with the computer.

The great advantage is that the machine will relieve the meteorologist of the job of drawing isobars and similar lines on upper-air weather charts. Although much of the drudgery of calculations will be taken over by the computer, interpretation of the improved prognostic weather charts to predict the local weather at various points will remain the problem of the weather forecasters. As he is gradually relieved of the necessity of the making of the large-scale background forecast, he will be able to devote more of his time to studying the small-scale effects, and to take into account more effectively, topography, coastlines, and other influences on local weather.

The experiment at the National Weather Analysis Center is being followed with a good deal of interest by other countries. The British Meteorological Office has assigned a meteorologist to work with the computer unit for a year.

Book on "China's March Toward the Tropics"

A monograph written by Harold J. Wiens of Yale University under a contract with the Geography Branch of the Office of Naval Research has been the basis of a recent book titled "China's March Toward the Tropics." The southward penetration of the Han-Chinese has been traced from early times, and an analysis has been made of the significance of the physical geography and the cultural characteristics of the people. These factors have in the past affected routes of migration and the assimilation of the non-Han Chinese, and they also affect present southward migration.

The monograph was written in 1952 and revised in 1954 to include some of the more recent developments in Southeast Asia. The Geography Branch at ONR reports that the monograph which reached the notice of other services through formal announcements and information exchange on projects, generated considerable interest. A number of requests were received from the Army and Air Force for copies of the monograph.

Proceedings of Symposium Published

A recent publication, "Origins of Resistance to Toxic Agents," contains the proceedings of the symposium on drug resistance sponsored jointly by the Office of Naval Research and the University of Pennsylvania. The Proceedings was edited by Dr. M. G. Sevag, an ONR contractor from the University of Pennsylvania, and Dr. Roger D. Reid and Dr. Orr E. Reynolds, both of ONR.

The book, published by Academic Press, N. Y., contains the papers presented by the various speakers and the discussions which followed the various sessions. Topics include: resistance to microbes; resistance to herbicides and insecticides; tolerance and addiction to drugs and alcoholism; resistance factors, infectious agents, and cancer cells; physiological, chemical, and genetic viewpoints.

On the Naval Research Reserve

Research Reserve Seminars for Fiscal 1956

The Bureau of Naval Personnel has issued BuPers Instruction 1500.8B, establishing officially the seminars and courses authorized for the separate programs of the Naval Reserve.

The following seminars are established for the Research Reserve:

Seminar	Convening Date
Research Reserve Seminar, ONR, Washington	11 July 1955
Nuclear Sciences Seminar, Idaho Falls, Idaho	25 July 1955
Naval Research Laboratory Seminar	15 August 1955
ONR West Coast Seminar	29 August 1955
Nuclear Sciences Seminar, Oak Ridge, Tenn.	28 November 1955
Special Devices Center Seminar, Port Washington, N. Y.	9 April 1956
Nuclear Sciences Seminar, Brookhaven National Laboratory, Upton, L. I., New York	4 June 1956
Seminar on Research Methods, Columbus, Ohio	18 June 1956

In every case convening date is listed as the Monday on which the seminar actually convenes. Orders will be written to report on preceding Sunday.

The Nuclear Sciences Seminar at Brookhaven National Laboratory for the present fiscal year was successfully concluded on Friday, 10 June 1955. The Methods of Research Seminar at Columbus, Ohio convened on 13 June and is in session as this goes to press. More about these seminars in the next issue.

Plans for the ONR Washington Seminar, opening the seminar program for the new year on 11 July are confirmed, and an outstanding program has been established. Among those scheduled to address the group are the Hon. Donald Quarles, Assistant Secretary of Defense (Research and Development); the Hon. James H. Smith, Jr., Assistant Secretary of the Navy for Air; the Hon. Albert Pratt, Assistant Secretary of the Navy for Personnel and Reserve Forces; VADM R. P. Briscoe, DCNO (Fleet Operations and Readiness); and RADM F. R. Furth, Chief of Naval Research.

LCDR Wallen Talks to Oil Refiners

At a recent meeting of the Louisiana Petroleum Refiners Waste Control Council, LCDR I. E. Wallen in his civilian capacity talked on refinery wastes and turbid waters. Although he had used the arid portions of the Southwest as the proving ground for his remarks, he felt that the progress of recent years in control of wastes, had made it possible to clarify turbid waters. This is accomplished primarily by the addition of green and dry vegetation, farm manure, and organic fertilizer of any type. It has been established that sewage affluents tend to clarify the streams into which they empty. Lab and field experiments show that this clarification tends to remain and perpetuate itself.

LCDR Wallen is a member of NRRC 8-13 at Stillwater, Okla.

Enlisted Personnel with Research Qualifications

There has been a continuing concern over the fact that provisions for commissioning young men with qualifications suitable for the Research Reserve seem inadequate. In view of the interest among the membership in this problem, some consideration might be given to the types of personnel concerned and the opportunities which exist in each instance.

Actually, two categories of individuals are involved. The first is the man with prior military service as an enlisted man who upon release has returned to pursue advanced studies. Direct commissions are available to this group in a wide variety of technical fields, including the Allied Sciences program of the Medical Services Corps, provided general qualifications are met.

The second category of individual is the man who enlisted in the Naval Reserve and has never been called to active duty. If physically qualified, the man in this category is eligible for a general line commission through the Reserve Officer Candidate School, at Newport, Rhode Island. Under certain circumstances, he may qualify by the same means in a special line category or in a staff corps. In all cases he will be ordered to three years active duty upon successful completion of the school.

The lack of a Research designator hampers procurement specifically directed toward the Research Reserve. However, most of the qualifications of interest to the research program are embraced within the categories eligible for direct procurement.

The value of the Research Reserve as liaison between the Navy and the scientific community would be hard to overestimate. Efforts to increase the strength of the Research Reserve have relied greatly upon the present membership to interest qualified young men and to advise them of their opportunities. More specific information as to current prospects for a commission and the categories involved can be obtained from Commanding Officers of local companies.

Naval Reserve Research Company 3-10 Activated

Naval Reserve Research Company 3-10, Massena, New York, was officially activated on 15 June 1955. LCDR Lucius M. Hale, USNR, the Commanding Officer, accepted his orders from the Commandant, THIRD Naval District, and in turn delivered orders to the new company members.

CAPT Theodore Blanchard, Special Assistant for Research Reserve, represented the Chief of Naval Research at the activation. LCDR William E. Remick, Reserve Program Officer, ONR, New York, represented the Commandant in officially establishing the Company. Orders to inactive duty with NRRC 3-10 were delivered to LCDR Harold R. Bole, LT James T. Hendricks, LT John D. Bryant, LT(jg) John J. Loucks, LT(jg) Ralph E. Chilton, LT(jg) Roger E. Doty, and LT(jg) Linus J. O'Connell. A number of other officers whose applications are now being processed were present at the activation meeting. Prospects for increased membership are good, in view of the qualified personnel in the Massena-Ogdensburg area.

All hands extend best wishes for the success of NRRC 3-10.

NRRC 1-1 Has Annual Dinner Meeting

Naval Reserve Research Company 1-1, Boston, Mass., held its annual dinner meeting on 20 June 1955. CAPT L. D. Coates, USN, Deputy and Assistant Chief of Naval Research, was the principal speaker. CAPT Coates, who was introduced by CAPT R. W. Hart, Commanding Officer of NRRC 1-1, spoke on "The Administration of Research in the Navy."

CAPT Theodore Blanchard, Special Assistant for Research Reserve and CDR H. F. Burr, Training Officer and former Reserve Program Officer at ONR Boston, were in attendance. CAPT Blanchard's attendance at the meeting concluded a field trip on which he had addressed the Brookhaven Nuclear Sciences Seminar, the Seminar on Research Methodology at Columbus, Ohio, and company meetings at NRRC 3-10, Massena, NRRC 3-6 at Syracuse, and NRRC 3-4 at Rochester.

TRAINING OFFICER OF NRRC 9-22 CONDUCTS POLIO INVESTIGATION

Dr. Warren Engelhard in civil life is a bacteriologist at the University of Nebraska; in the Naval Reserves he is the Training Officer of NRRC 9-22, Lincoln, Nebr. A piece of polio research in Nebraska required some painstaking tests, which after discussion Dr. Georgi of the University's Department of Bacteriology, and Dr. Engelhard agreed to carry out over a period that extends until next summer.

The tests are on blood samples contributed by some 500 people – both children and adults – from the Huskerville community. This community has a remarkable situation. Although approximately 900 people live in an area of about four square blocks, there is one row of buildings in which there have been no cases of polio. This one row is identical to the three others that make up the community. All of the children of the community use a common playground, and service facilities such as grocery store, drug store, nursery, etc. are used by all alike.

As Dr. Engelhard carries out the tests on the blood samples, he will be looking for traces of polio antibodies. As there are three types of polio virus, each blood sample will be subjected to three different tests. The results may shed some light on why the one row of houses in Huskerville seemingly has this remarkable freedom from polio, and perhaps contribute some new facts useful in solving the problem as to whether or not polio is communicable.

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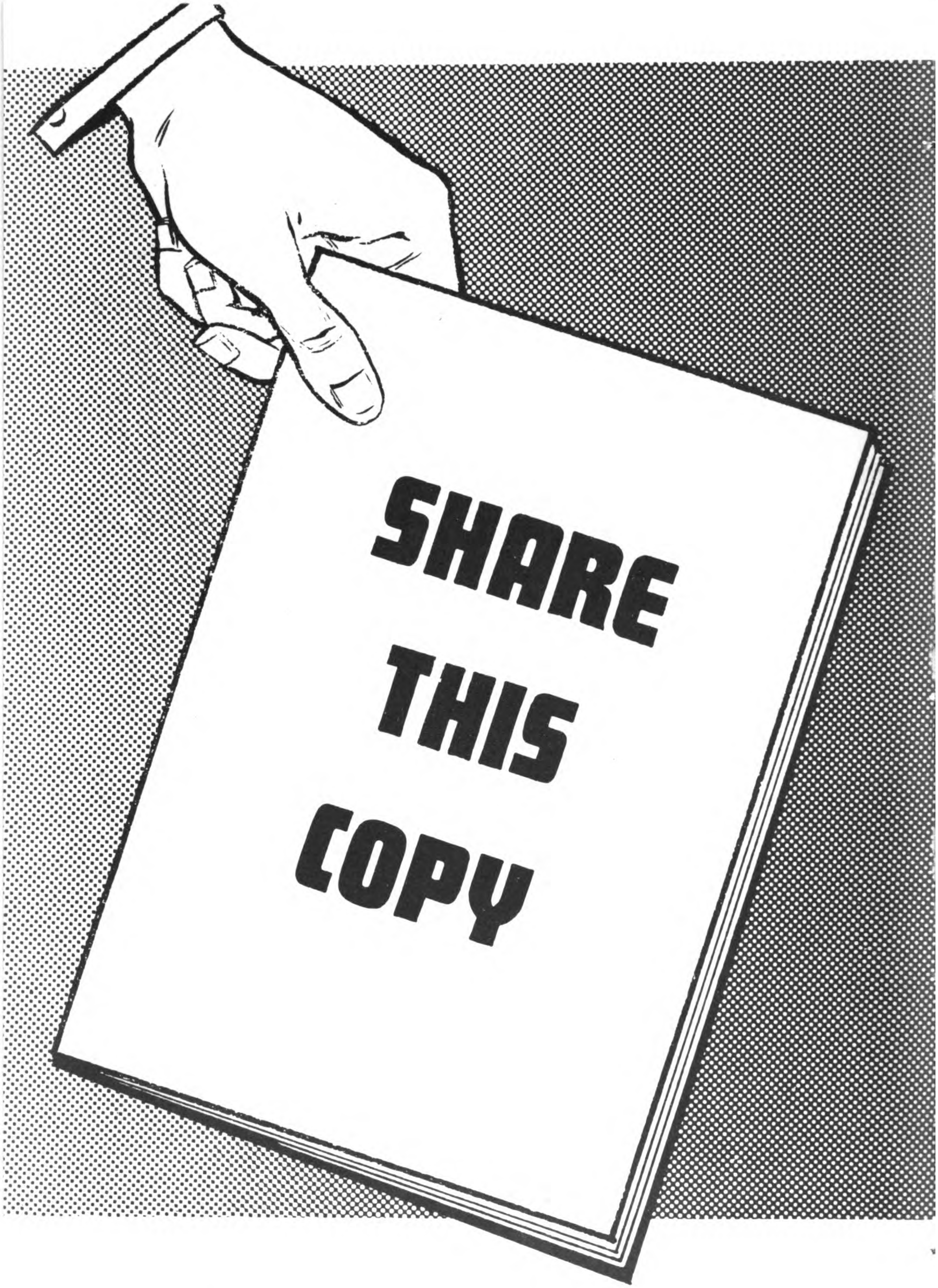
Variable-Angle Launcher at Morris Dam near Pasadena in Southern California (See page 14)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