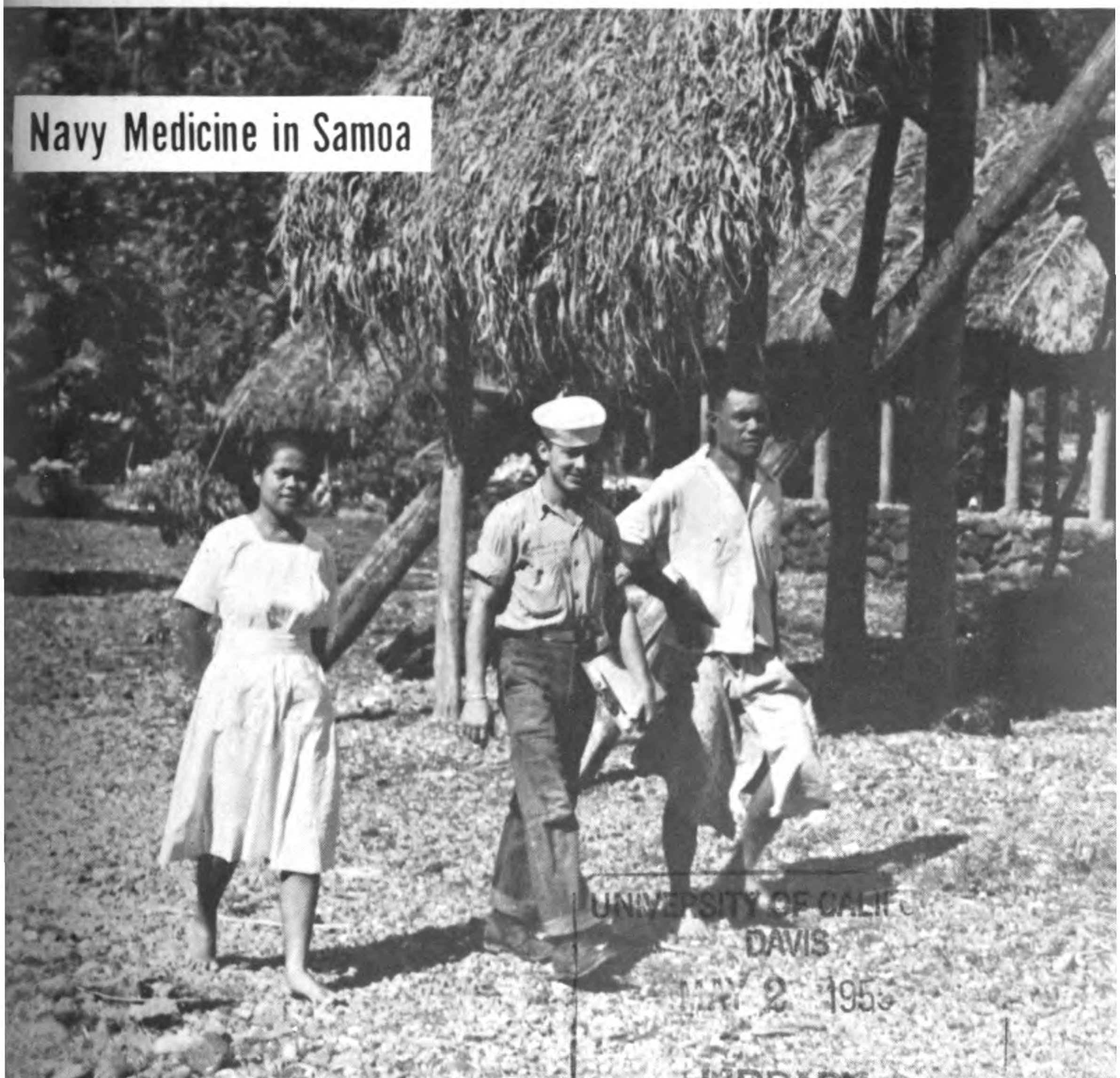
OFFICE OF NAVAL RESEARCH AUGUST 1952

RESEARCH REVIEWS



NAVEXOS P-510

DEPARTMENT OF THE NAVY
WASHINGTON, D. C.

COVER PHOTO: A native nurse, a U. S. Navy inspector and a village chief team up for the weekly sanitation inspection of a Samoan village. Such public health measures have helped make the islands among the best governed in the Pacific. At present the Navy is trying to stamp out a disease that has afflicted both natives and military personnel there. See "New Facts on an Old Disease," pp. 20-26.

Approved by Bureau of the Budget, 14 February 1952

In this issue

Two employees of the Naval Research Laboratory, Hester Snee and James Seward, inspect the workings of an electronic digital computer which has approximately 600 plug-in units. When something goes wrong with one of them it can be removed as easily as a bureau drawer and repairs can be made without extensive rewiring. This is only one of the ways in which unitization can be used to minimize electronics maintenance.

Minimizing Electronics Maintenance

by

William McGuigan
Stanford Research Institute

Every 100 million dollars worth of electronic equipment procured by the military today will require at least one billion dollars worth of maintenance before it wears out. At least that's the estimate indicated by previous experience. This makes reliability the most important aspect of electronics. Unfortunately, however, reliability--like a billion dollars--is rather difficult to visualize.

A lack of reliability can be more easily understood when it is described in terms of its consequences. The high cost is only part of the problem. Equally important are the severe drain on skilled manpower and the fact that the equipment does not always work when it is most desperately needed. To investigate the methods of overcoming these difficulties, the Stanford Research Institute has been working for approximately two and one-half years under the sponsorship of the Office of Naval Research.

Our proposed solution to the problem involves a combination of unitized packaging and built-in fault-locating devices. Neither concept is new; both have been incorporated in many equipments. We might even confess that the combination is not new. The aim here has been to integrate the work of many engineers into a pattern which has special merits for military electronic equipment.

To understand the reasons behind unitization and fault-locating aids to maintenance, consider Figure 1. After an equipment has been safely installed and tested, the average rate of failure can be expressed as a constant percentage of components failing per unit of time. This leads to curves of the shape shown, representing three different degrees of reliability. They are worth a little study. The lowest--10 percent of the components failing every 15,000 hours--is an approximate level for military equipment now operating. For some systems this level is too high, for others, too low. However, the curve gives an idea of the approximate level to be expected under service conditions.

The center curve, like the lowest, shows the approximate average reliability of present components now in military environments but leaves out failures due to vacuum tubes. To those engineers and manufacturers who would improve our systems by developing components there is something of an object lesson in this curve. For example, the entire level of

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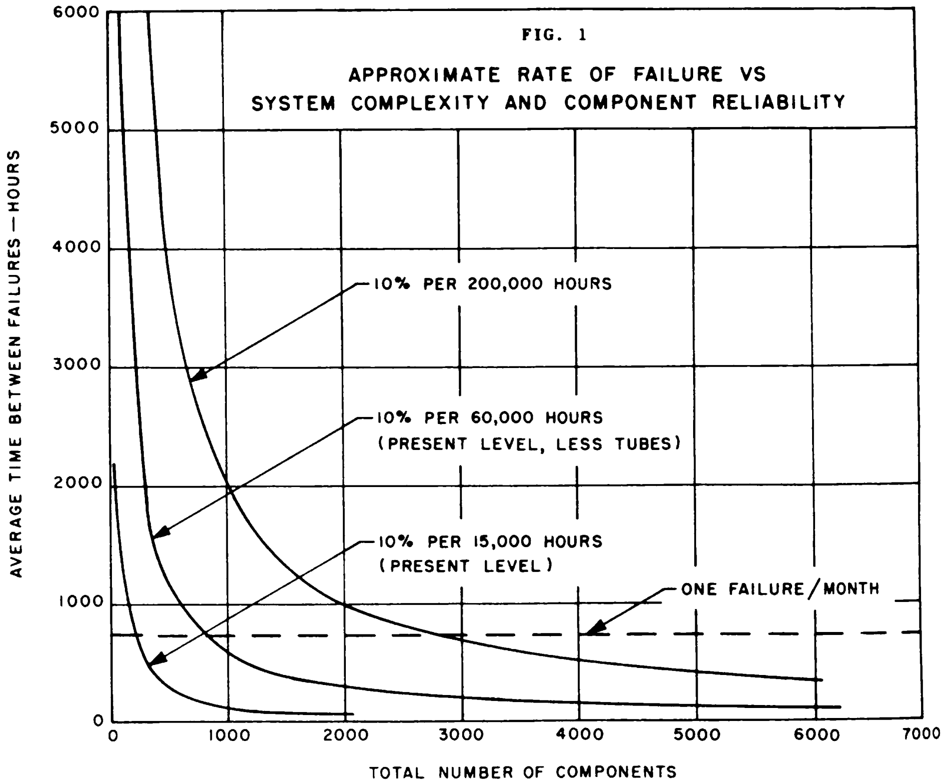
William D. McGuigan, Head of the Equipment Engineering Group of the Engineering Department at the Stanford Research Institute, has been engaged in equipment development and preproduction problems at numerous university and industrial laboratories. He graduated from the Massachusetts Institute of Technology in 1942 with a degree in physics.



reliability increases by a factor of four if the vacuum tubes are improved to the point where their reliability is equal to that of the other components. Unfortunately, this isn't easy. The combined efforts of the radio industry and military agencies have done wonders in improving tubes over the past ten years, but it has been estimated that it would take at least ten more years to bring all tubes up to the present standard of other components.

The upper curve indicates a method which may be more promising for achieving reliability. The failure rate of 10 percent of the components in 200,000 hours (about 23 years) is proposed as an acceptable goal for military reliability. This, on the average, is over ten times the reliability of present military equipment, yet it has been exceeded in many types of commercial and industrial electronics. The difference lies not in the improved quality of components but rather in the careful control of component environment. Most of the components can last indefinitely under proper laboratory conditions.

From the skilled manpower viewpoint these curves represent only part of the problem. The military cannot plan its maintenance around an average rate of failure. Instead, it must be prepared to make immediate repairs on an emergency basis. A rough check of personnel requirements in the fleet indicates that at least ten times as many technicians are required for emergency maintenance as are indicated by these average curves.

To reduce the peak load of emergency maintenance three things must be done. First, fault-locating devices with sufficient sensitivity to anticipate failures must be devised. Thus incipient failures might be removed before they occur; this converts some of our emergency maintenance to routine maintenance. Second, fault-locating devices and panel layouts must be devised which will speed emergency maintenance by enabling the skilled technicians to work faster. Third, a system of replaceable packaging must be developed to permit the deferment of some of the repairs. The civilian analogue of the latter is the spare tire on an automobile, which provides a way of deferring the repair of a flat tire to a more convenient time.

Figure 2 is an artist's version of what might be done to unitize a radar system. Of course there are thousands of possible variations; this particular one is only intended to illustrate the possibilities rather than the method. The units shown are visualized as blocks of IF strips, video amplifiers, AFC units, power supplied separate components in the modulator, range mark generators, range units, and indicators. The artist pictures the units as being similar to the tuning units on the old APR-4 receiver, plugging into the system as required.

The first reason for constructing a system of this type is that it permits some control of the component environment. Components which cannot work at a high temperature are isolated from sources of heat which might appear in various units. Components requiring special isolation from shock can be more easily handled in small units than in a large cabinet.

With this type of packaging, there might also be an improvement in the functional operation of the equipment, since a unit which performs below standard could be replaced without disrupting those remaining. Moreover, if the radar is required to operate at a new frequency, the magnetron, waveguide, duplexer, and antenna components could be changed without a completely new installation, avoiding the usual difficulties and demands on skilled manpower. Personnel would be more familiar with the components in this system, because changes would not have to be made as often and the units could be used in a greater number of systems.

The system just described is suitable, say, for a destroyer. It contains range-markers, anti-jamming features and other devices normally required on a fighting ship. A greatly simplified version, adequate for a lesser vessel, perhaps an LST, can be made by merely eliminating the special units not needed. It has a minimum of extra features--only one pulse width, one repetition frequency. The manufacturer has the opportunity to produce a greater quantity of any unit because it can be used in more than one system; maintenance personnel familiar with the one system will also be familiar with the other system.

This figure also illustrates one method of effecting an emergency repair. Units which offer special advantages in some conditions can be removed from the system without catastrophic results. For example, if an AFC unit developed a short circuit it could be removed, leaving the simpler manual system adequate for emergency requirements.

Figure 2 raises a number of questions as to whether or not unitized packaging and built-in fault-locating devices are practical. What happens to the circuits if they are divided? Are extra components, such as amplifiers and impedance matching devices necessary? What about the

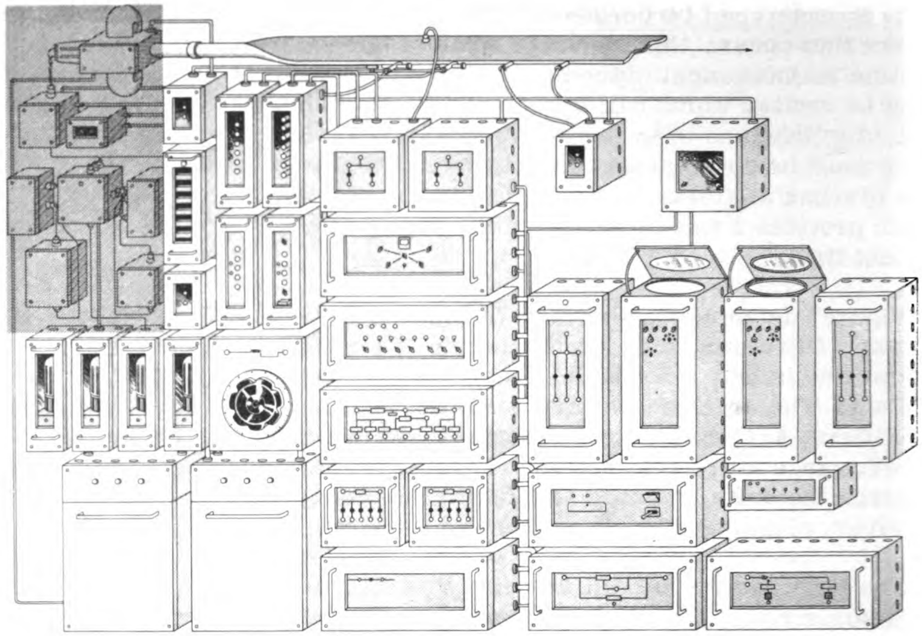


Figure 2. A possible version of a unitized radar.

size of the fault-locating equipment? Can adequate fault location, for example, be incorporated without leading to a maintenance problem which is almost as big as that in the parent equipment?

To answer these questions, the Stanford Research Institute took, as a practical example, one of the Navy's standard air-search radars. A laboratory model of the radar was built with unitized circuits so that the feasibility from a circuit viewpoint could be checked. Investigation was confined to the transmitter, receiver, and video portions of the system, excluding the indicator and antenna features.

The laboratory equipment we used is shown in Figure 3. The rack at the left contains the high-voltage power supply, modulator, and magnetron components. The center rack has the units arranged behind panels, the IF video and AFC units at the top, a meter panel, AC distribution, control, and power supply units. The third rack to the right has a panel at the top which simulates the remote operator's panel. Below this is a built-in monitor scope with its laboratory power supplies. A system of this size cannot justify its own scope, but a monitor scope is included to see what the complexity would be for a system of any size.

A better idea of the units in the transmitter can be obtained from Figure 4 which shows the high voltage rectifier units. It consists of the rectifier tube, its socket, a filament transformer, and a pilot light to signal the arrival of primary power to the transformer. Other assemblies, such as the thyratron, the network discharge diode, and the high-voltage transformer are all packaged in a similar way--the major components being combined with the trivial ones which relate to the unit's function.

The fault-locating system is based on a series of monitors which enable the operator to detect deviations from normal performance anywhere in the radar. Figure 5 shows the simulated operator's panel, which is the remote point from which the rest of the equipment would be controlled. For this radar system the operator can monitor the transmitter peak power and the receiver noise figure. To monitor peak power he sets the switch below the meter to transmitter and looks to see if the meter reads within the colored region of the scale. If it does not, the transmitter needs attention.

To check the noise figure, the technician switches the meter into the second detector of the receiver. Here the reading depends on the "grass" level, or the current in the second detector. This is proportional to the gain and is adjusted to the red line at a meter reading of 12 by means of the receiver gain control. The operator then turns on a noise tube by means of a switch, adding a calibrated amount of noise to the input to the receiver. If the reading does not rise into the colored range of the scale, the noise already present in the front end of the receiver is large compared to that added by the calibrated noise source.

The noise source used in noise-figure measurement consists of a neon tube patterned after RCA designs which is inserted through one side of the TR cavity. The coupling is adjusted so that the noise tube does not detune the cavity in the fired condition.

Another part of the fault-locating system is a color-coded meter panel. When the operator discovers incorrect operation, a technician below decks uses this unit to repeat the over-all measurements to check the equipment in greater detail. This unit consists of a meter, a four-position switch beneath the meter selecting major areas of the system, satellite switches which further subdivide each of these sections of the radar, and a built-in crystal checker of the Airborne Instrument Laboratory type. A person with little training can use the meter panel to detect deviations from normal operation because each of the spots opposite the various switch positions has a characteristic color. This color is repeated on one of the many scales on the meter, and for normal operation the reading should be within the corresponding colored range.

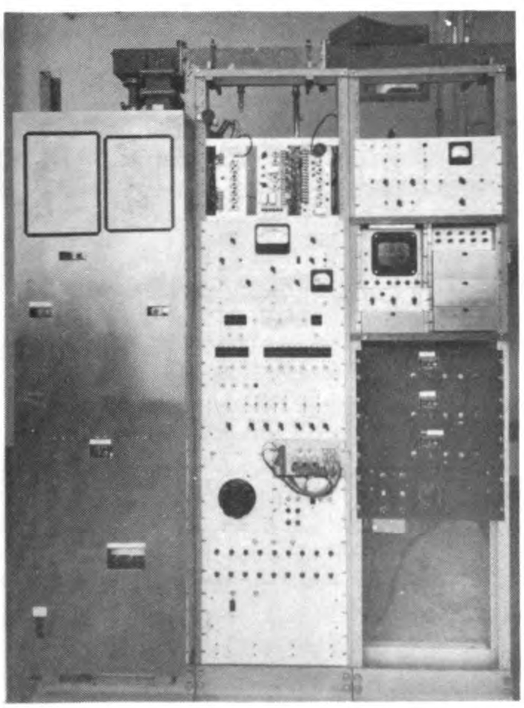


Figure 3. Laboratory model of radar with unitized circuits.

Another aid in rapid trouble shooting, patterned after power station practice, is the treatment of the AC distribution panel which is shown in Figure 6. The phantom schematic on the front panel provides a rough check of the power flow to various circuits of the system. The black portions of the picture are circuit breakers, but they could be fuses if desired. If a technician cannot ascertain trouble by means of the neon indicators or circuit breakers, reference to the schematic drawing will show that the circuit diagram is arranged in the same pattern as the panel layout. This eliminates the problem of orientation within the unit.

Although such an arrangement makes an individual unit more understandable, the problem of showing how units are connected, without referring to an instruction book, still remains. Since the overall monitors permit separate distinction of transmitter troubles from receiver troubles, separate block diagrams can be supplied for each of these portions of the system.

To summarize, experimentation with a working

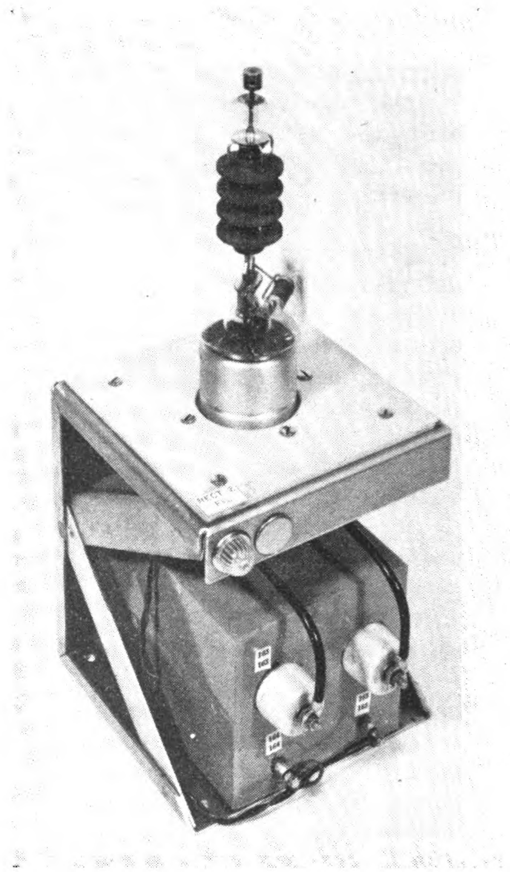


Figure 4. High-voltage rectifier units.

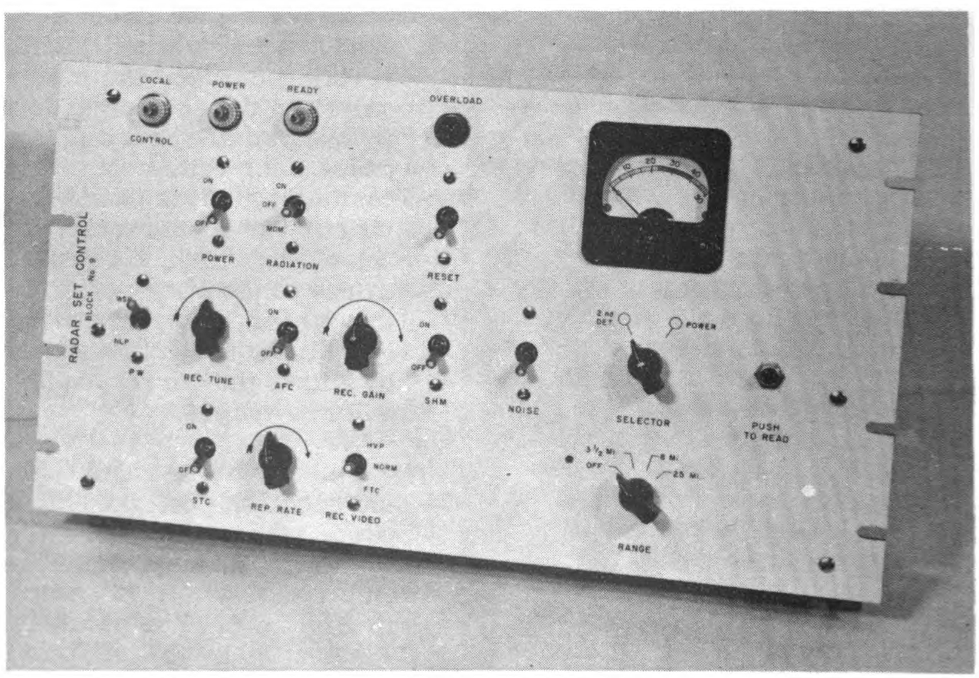


Figure 5. Simulated operator's panel.

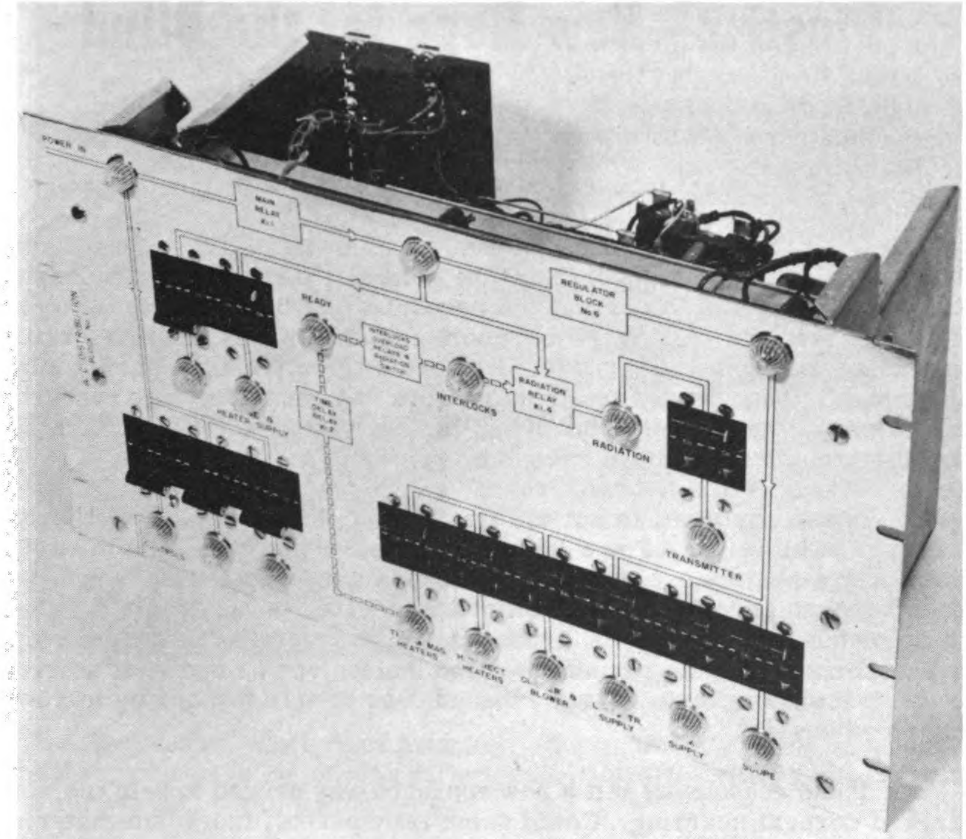


Figure 6. AC Distribution Panel

laboratory model of one of the typical fleet radars has answered, at least in part, some of the questions raised earlier. First, the circuits are virtually unchanged from standard practice. Division points can be chosen which involve few, if any, additional components; certainly the total increase due to unitization should not be more than one or two percent. Second, the complexity of the fault-locating system appears to follow a pattern in keeping with the size of the radar system. Obviously the bigger the system the greater are the number of points that must be monitored. A fault-locating system consisting of indicator lamps adds approximately three components (an indicator light, its socket, and a dropping resistor) for every monitored point. If a monitor system consists of a switched meter, approximately four components per monitored point will be required (a series dropping resistor, a switch, a plug and a jack to get the connection from the point being monitored to the meter panel). If more complex systems are used a minimum of components must be included before the first reading is made, so a large number of added parts is unavoidable. It should be noted that in a unitized system most of the fault-locating devices would themselves be units; therefore, they may or may not be permanently connected to the system.

The benefits from unitization and built-in fault-locating devices are in addition to those derived from equipment miniaturization and standardization. Assuming that the latter are inevitable, unitization becomes doubly advantageous by allowing a temporary solution of its own and facilitating these changes in the long-term development of better systems.

Plastics—New Hope for the Blind

by

William Stone, Jr.
Massachusetts Eye and Ear Infirmary

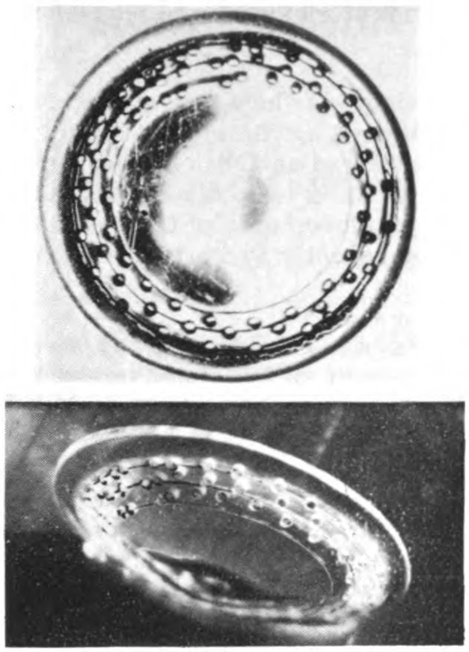
There are 90,000 people in the United States partially or completely blind because of scarred corneas--the normally transparent covering of the iris and pupil of the eye. To a percentage of these people, who can now look forward only to the boredom and difficulties of using braille and doing basket weaving, science offers a tentative hope of regaining their sight. Though only preliminary work has been done, our research indicates that an operation involving the insertion of plastic disks in the eye may repair the damage caused by corneal scarring.

Of course our work is not the first aimed at helping the victims of this type of blindness. For a long time ''eye banks'' have been in existence where healthy eye tissue from donors was preserved for grafting onto diseased or injured eyes. Unfortunately the operation proved a sad disappointment in many cases. Approximately 25 percent of the patients regained their sight; the remainder found themselves as badly off as ever because the transplanted tissue clouded over or was invaded by ingrowing blood vessels.

For these reasons we felt a new approach was needed to help the victims of corneal scarring. Could some transparent, inorganic material be substituted for the faulty corneas instead of living human tissue? The possibility seemed worth a try, although there were some initially discouraging indications. The primary objection was a long-cherished belief that any foreign material incompletely covered by tissue would soon be forced out of the body.

An observation made during the war, however, seemed to indicate that this did not always occur. Dive bombers were frequently damaged so badly that their plastic cupolas shattered, imbedding many minute particles in the eyes of unfortunate pilots. In several cases the particles were so small and so numerous that removing all of them would have meant removing practically the entire cornea. Many of them were therefore left in place and, strangely enough, they produced little or no reaction. As a result of this observation, medical researchers felt it would be interesting to determine how the cornea would tolerate larger pieces of plastic. This line of research was followed here at the Massachusetts Eye and Ear Infirmary. Work was started about three years ago.

William Stone, Jr., an Assistant in Ophthalmology at the Massachusetts Eye and Ear Infirmary, has long been interested in both military and civilian aspects of eye surgery. After a residency at the Eye and Ear Infirmary he entered the Air Force, served in its Eye Clinic in Miami, Fla. and eventually became Chief of Eye Service at Walter Reed Hospital in Washington. His work on artificial implants earned him the Bronze Medal of the American Medical Association Convention in 1948.



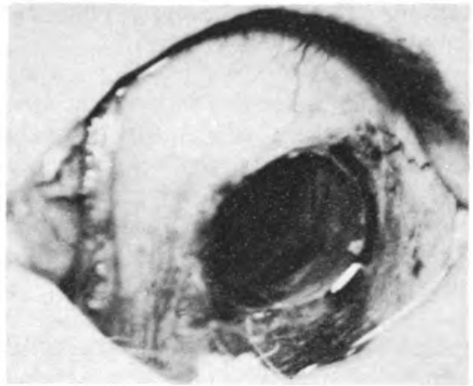


Figure 1

Figure 2

Plastic disks like those shown at left may someday save thousands from living out their lives in darkness. Tiny holes allow eye tissue to take hold of the artificial cornea.

Above is a rabbit's eye shown after insertion of such a disk.

The first results were disheartening. Plastic disks of various shapes and sizes, placed in rabbits as full-thickness grafts, all extruded (i.e., were thrust out) within two weeks.

This discouraging result suggested that an entirely new operational procedure should be devised. Accordingly, some 26 months ago, a new principle was explored, involving the use of a technique which had previously proved successful in the implanting of artificial eyes. The procedure had two stages. First the cornea was split into two layers by means of an incision made at its edge. Then the plastic disk was slipped between the two layers--much as a slice of ham is slipped between two pieces of sandwich bread--and the incision was sewed up. Now the disk was held firmly in place by the corneal tissue itself; soon eye tissue grew into the small holes provided for this purpose on the edge of the disk. Thus the little circular piece of plastic actually became an integral part of the eye. When this had taken place the second stage of the operation could be performed. This consisted of cutting a hole out of the front layer of the cornea and, if necessary, out of the back layer also. Thus a "window" of clear plastic was provided in the cloudy cornea, out of which the subject could see.

Since we began these experiments 15 months ago, nine rabbits have been subjected to the operation. Two late extrusions occurred because of the shape of the implant. The others are still in place. Figure 1 shows the plastic disk which is being used at present, while Figure 2 shows the scarred cornea of a rabbit after the second stage of the operation. The eyes are white and quiet.

Work is continuing on the project, for much still remains to be done before it can be used on human beings. The size, shape and fabrication of the plastic disks must be perfected and they must be tried on dogs and monkeys as well as on more rabbits. But we hope that eventually this operation may help to restore the sight of many who have given up hope of a return of vision.

Another phase of our work, involving some of the same operational techniques, will be of interest to those who have artificial eyes. Everyone is familiar with the disagreeable appearance of an artificial eye which may have a superficially genuine look but which is immediately revealed as false by its lack of synchronism with the movements of the real eye. This problem has been satisfactorily solved recently by work here at our laboratory.

This research, like that on plastic corneas, was given impetus by World War II. Battle injuries resulting in the loss of an eye emphasized the need for improving the mobility of the artificial replacement.

In the ordinary artificial eye, there is no attachment between the stump of muscles and the overlying shell, and thus the action of the muscles is poorly transmitted to the shell. To rectify this defect this laboratory devised a plastic implant, partially surrounded by a tantalum meshwork, to which the eye muscles were attached. The front surface of the meshwork was exposed, so that a peg from the overlying artificial eye might fit into a hole in the implant. Not only did muscle and connective tissue of the eye grow very readily into the tantalum meshwork but more surprisingly the cells of the socket membrane, which had been purse-stringed around the neck of the exposed area, grew into the edge of the meshwork and completely sealed off the wound. Thus an effective barrier was created against ingress of both fluids and bacteria. Even though the front surface of the implant was not covered by tissue, no infections occurred behind the implants.

One hundred and seventy-five of these movable implants have been placed in patients at the Massachusetts Eye and Ear Infirmary in the past four and one-half years. There have been few extrusions and the eyes move in almost perfect synchronism with the real eyes. During the first year and one-half, as with any new operative procedure, certain complications were noted: Secretion, granulation tissue, difficulties in performing the secondary implant, and four extrusions caused by implants made improperly. With changes in the operative technique and hygiene of the socket these complications have been eliminated.

A very encouraging feature of the technique is that it has given excellent results when used on patients who have had their eyes removed many years previously. The implant has been successfully placed, for example, in a patient who had lost his eye 35 years ago.

In assessing the value of our work on artificial eyes and plastic corneas it is important to remember that both lines of research promise the successful use of a newly recognized surgical principle--the retention by the body for an indefinite time of a foreign body incompletely covered by tissue. We were not the first to accomplish this, for Strock, a dental researcher, has had a tantalum tooth, exposed on one surface, imbedded in a patient's jaw for 13 years. Our work has far advanced the procedure necessary for use of the principle in eye surgery, however, and has already resulted in greatly improved artificial eyes. We believe that soon the technique can be used in the more vital work of averting tragedy in the lives of a percentage of people who have been blind for years.

Who's Who in Naval Research

Dr. Estermann

One of the saddest plaints of those who deal in government research is that "Industry" or "The colleges" keep wooing good scientists away from the civil service. But occasionally Uncle Sam gets them back. Dr. Immanuel Estermann, Head of ONR's Material Sciences Division, is an example. A top-notch physical chemist, he patriotically worked for NDRC and the Manhattan Project during the war and went back to Carnegie Tech after the shooting was over. Then came the wooing in reverse. First as a contract researcher, later as a consultant, and finally as a division head (on leave from Carnegie), Dr. Estermann became more and more interested in the naval research program. Finally, last January, he resigned his professorship in Pittsburgh and began house hunting in the Washington area.

As one might expect from his name, Dr. Estermann is a native of Germany - born in Berlin in 1900. After graduating from secondary schools, he shopped around several universities (Giessen, Berlin, Freiburg) and ultimately obtained a Ph.D. from Hamburg in 1921. His field was Physical Chemistry. His doctoral thesis on the mechanism of crystal growth was so accomplished that it has been published and republished and is still a favorite footnote in the literature. After that he taught for a year or two at the University of Rostock and then returned to the University of Hamburg. By 1931 he had climbed the ladder to Associate Professor.

It was during this Hamburg period that Estermann began his long and fruitful collaboration with Dr. Otto Stern (Nobel Prize in Physics - 1945), doing research on molecular beams. A number of distinguished papers won him recognition and he was appointed an International Fellow of the Rockefeller Foundation, with an initial assignment at the University of California. This was his first visit to the United States. He must have liked the academic atmosphere here, for in 1933 he left Germany for good and joined Dr. Stern at Carnegie Tech -- as an associate professor of physics. During the peaceful years of teaching, and in the hurly-burly of NDRC (research on dark-trace tubes) and Manhattan Engineer projects he added to his professional stature by turning out an impressive number of learned papers -- over 60 to date.

Dr. Estermann's present charge, the Material Sciences Division, supervises all ONR contracts for fundamental and applied research in Metallurgy, Organic Materials, Chemistry, and Power. The program covers the range from such theoretical investigations as the solid-state physics of metals to the intensely practical chemical problem of eliminating slag from naval boilers.

Dr. Estermann married while he was still a young instructor at Hamburg. The eldest of his two daughters was born there and the second during his stay at Berkeley. The latter is, incidentally, now a Senior at U. C.; her sister is a language instructor at Brandeis University. The family headquarters is at present in the huge Broadmoor on Connecticut Avenue, but the Estermanns hope they will soon find a house in the Chevy Chase area.

Rather self-effacing, Dr. Estermann hides his competency behind horn-rimmed glasses and a soft, slightly accented voice. His personality suggests the quiet intellect of the profound student rather than the extrovert joviality we commonly associate with the word "boss". Somehow he looks like a scientist. According to his subordinates, he is a lovable man - considerate, kindly, fond of people and intelligent conversation, and possesses a sense of humor that is subtle but lively and amusing.

Pulse Jet with 200-hour Operating Life Developed at Naval Research Laboratory

A pulse-jet engine, much like those employed in the "flying stovepipe" of World War II, but with an operating life of 200 hours instead of 40 minutes, has been designed by Navy scientists. The new design was developed in the Thermodynamics Branch of the Naval Research Laboratory of the Office of Naval Research.

The engine is expected to find military use primarily in subsonic, expendable applications, such as the guided missile field. Because the operating life of 200 hours compares favorably with the normal flight time before overhaul of conventional reciprocating aircraft engines and because the engine is light, simple, and easy to construct, it is expected to advance the application of pulse-jet engines to helicopter rotors. Several aircraft companies are now investigating such applications, under Government contracts. Interest has also been shown in the development as a low-cost substitute for the smudge pots used for protecting orchards against frost.

Wherever possible, parts were designed light and flexible to "give" under the explosion force from the combustion chamber and absorb the energy. This has permitted the use of "ordinary" construction materials instead of expensive and scarce alloys normally required for parts subjected to high impact and fatigue stresses.

Because the engine is a relatively new type, without pistons, fly-wheels, or a well-defined combustion space, the theory of its operation is still not fully understood. It is therefore not practicable to predict all of its potential uses or even its ultimate capabilities.

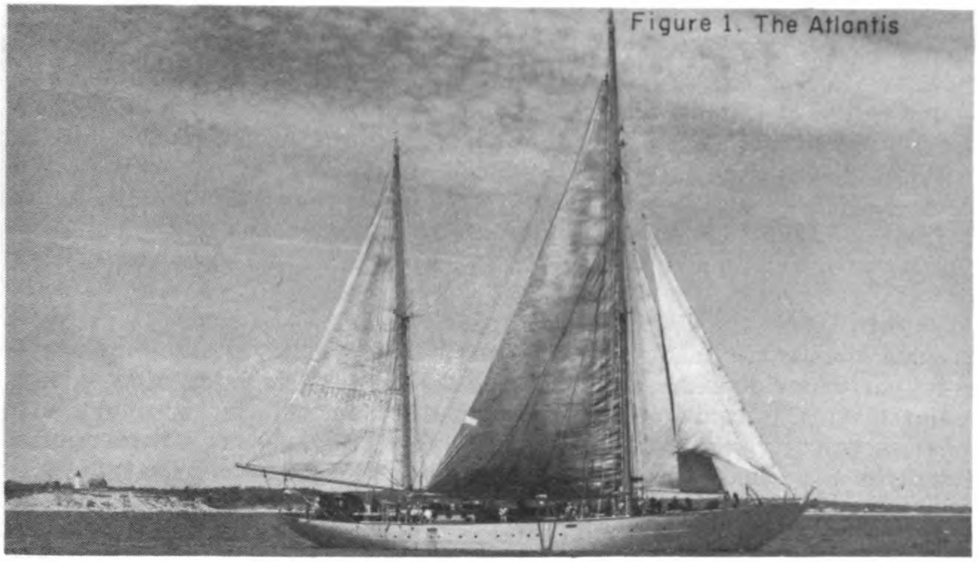


Figure 1. The Atlantis

Oceanography in the United States

by

Gifford C. Ewing
Scripps Institution of Oceanography

The oceans of the world are a paramount national interest of the United States. From the military point of view this fact is perhaps too obvious to dwell on, beyond stressing that since our current military problems are all extra-continental, they are evidently all transoceanic. Our economic interest in the oceans is less evident because in the past we have drawn most of our resources from the land. Now, however, we are the world's heaviest consumers of material resources and of energy. Furthermore, our population growth and rising living standards are causing the rate of consumption to grow in an exponential way. It is probably safe to state that known world resources are inadequate to support the general world standard of living at the level already enjoyed in the United States. As the demand increases, the exploitation of the resources of the ocean is bound to become of major importance to the United States as it already has to Japan, Norway, England and several other maritime nations.

Some notion of the extent of these resources can be gained from the calculation that the dissolved solids of the oceans, containing nearly every

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Gifford C. Ewing received his Ph. D. from the Scripps Institution of Oceanography and has been associated with the Institution since that time as an instructor and researcher in marine science. Currently he is interested in problems of the sea surface and its effect upon radar. He has served on several advisory panels and committees for the Government. This article is an abridgment of a paper he prepared for the Geophysics Branch of ONR.

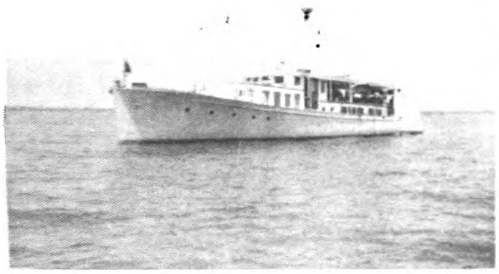
known chemical element, measure 50 quintillion metric tons, enough to form a layer of material more than 500 feet thick over the land area of the Earth. In terms of energy resources, the importance of the oceans is due to the circumstances that 72 percent of the sun's energy falls on the sea and that, acre for acre, the sea is more productive than the land. Not only does the sea contain enormous unexploited food resources, but these resources are high in protein which enhances their relative value. Barring an unforeseen turn in the trend of our national development, we can ill afford to procrastinate the vigorous exploitation of the oceans.

At the present time, the Navy is by far the largest consumer of oceanographic knowledge in the United States. This is natural since the ocean is its particular domain. In addition, in the competitive exigencies of war, major tactical advantage frequently results from relatively minor technical superiority. An example is furnished by the see-saw between mine measures and countermeasures. Among Navy activities which draw heavily on oceanography for basic information are the Bureau of Ships, the Hydrographic Office, the Bureau of Ordnance, the Naval Research Laboratory, the United States Navy Underwater Sound Laboratory, the United States Navy Electronics Laboratory, the Chief of Naval Operations and his office, the Fleet Sonar School, the Amphibious Force, the Bureau of Medicine and Surgery, the Bureau of Yards and Docks, the Bureau of Supplies and Accounts and the Bureau of Aeronautics. It is well to reflect that this demand is largely a phenomenon of the last decade. As the intricacy of naval operations and armaments increases, the need for technical understanding of the sea is certain to grow at an ever increasing rate. Thus it is altogether appropriate that the Office of Naval Research should be the government agency to sponsor and patronize civilian research in the field.

The exploration of the sea under Navy sponsorship has had a distinguished history, beginning with the work of Lt. M. F. Maury in the 1840's and 50's. Yet there have always been some who thought oceanography "a useless piece of extravagance and folly" because the ocean is a region "not only wild and unexplored but uninhabited and worthless." The error of this view has been made increasingly apparent by every returning expedition. Because the sea is the sphere least hospitable to man, it is the last to be explored and understood. Many who turn away from the sea do so hoping that "what we don't know can't hurt us." They are unconcerned that we know less about the ocean basins than about the bright face of the moon. Others are content to use, in a routine manner, such oceanographic contributions as tide and current tables, desalination kits, bathythermographs and sonar ranging charts without giving credit to the basic science from which these things come. Before long, the "jog-log"[1] is likely to be on every Navy ship, but few will know that its development grew out of investigations by a theoretical oceanographer studying the dynamic level of the Florida current.

Rather than set up its own laboratory to carry on oceanography research (one already exists in the Oceanographic Division of the Hydrographic Office) the Navy has chosen to underwrite the cost of projects in several existing civilian institutions. Furthermore, ONR is not closely specifying the <u>kind</u> of investigations to be undertaken, so that basic research, development and surveys, and exploitation of oceanographic knowl-

[1] Geomagnetic Electrokinetograph



Figures 2-4. Floating Laboratories

Sea-going scientists are using these small ships for a big job--that of dredging up the scientific truth about the vast oceans. Only two institutions are represented by the three vessels; above are the Crest and the E. W. Scripps from the Scripps Institution of Oceanography; at left is the Joan Bar II of the Chesapeake Bay Institute of Johns Hopkins University.

edge can be carried out as concurrent programs within each institution. Also, it is recognized that giving a rather free hand to civilian investigators tends to foster healthy competition and leads to special lines of attack by the competing research groups. It is noteworthy that at the present time there is no type of oceanographic work that at least one of the civilian laboratories is not doing successfully for the government. Lastly, one of the greatest needs today is the training of men in the science of oceanography, and that can best be done by institutions which already have instructional staffs.

Where, then, are these laboratories and institutions? Fortunately on or adjacent to all three of our major coastlines. Considerable importance attaches to the variation in the character of different environments as, for example, between the deep temperature gradients of the Western Atlantic and the shallow ones of the Eastern Pacific or between the shallow estuaries of the East Coast and the fjords of the Pacific Northwest. The advantages of having oceanographic facilities in each major type environment are that newly discovered principles can be examined for their generality, equipment can be tested under widely varying conditions, and situations to be expected in various inaccessible areas of the world can be studied by available analogy.

THE ATLANTIC SEABOARD

The Atlantic Seaboard with its intense currents, deep thermocline, broad continental shelf, shallow "drowned river" estuaries, and terrestrial climate, is characteristic of the western edges of oceans. Similar situations are found on the Asiatic Coast. Special features are the southward flow of icebergs, the Florida and Gulf currents, the continental slope water, the mid-Atlantic ridge and the Sargasso Sea. The Atlantic intermediate water mass, partly formed by the efflux of heavy Mediterranean water, defines the SOFAR channel in this region.

The Woods Hole Oceanographic Institution is the major facility on the Atlantic Seaboard, and by reason of being the oldest oceanographic laboratory in the United States, is the most experienced. Two ocean-going ships are regularly operated, in addition to one which is now on loan from the government, and general oceanographic research is carried out in connection with surveying activities in the North Atlantic which have been continued for twenty years, the longest sustained program yet accomplished by oceanography. Woods Hole has been far more active in research undertaken for the Navy than any other laboratory, particularly in the field of underwater sound. The institution also leads the field in assistance to industry with such problems as pollution. No formal teaching is done, though liaison is maintained with Harvard, M.I.T., Brown, New York University, Yale, Rhode Island University, and Columbia.

The Chesapeake Bay Institute, a fairly new branch of Johns Hopkins University, is strategically situated (near Annapolis) to study shallow estuary problems such as harbor flushing and sedimentation. Two inland waterway vessels are operated in a research program directed toward the development and conservation of the biological resources of the Bay. These studies are, of course, of considerable value to the Navy. As only one instance of this, the mud that affects the "setting" of oysters also affects the setting of mines.

The Lamont Geological Laboratory of Columbia University specializes in marine geophysics and geology and in studies of the propagation of underwater sound. Through arrangement with the Woods Hole Oceanographic Institution, students are trained in geophysical techniques aboard the vessel ATLANTIS. The Laboratory is located at Palisades, New York, high above the banks of the Hudson River.

The Narragansett Marine Laboratory of the University of Rhode Island is located on Narragansett Bay about five miles from Kingston. The Laboratory is mainly devoted to the problems of biological oceanography, some of which, such as fish noises, are of interest to the Navy. Biological productivity of the high seas is being studied by means of plankton hauls which have been made regularly by the weather ships. In addition to the training of students, the Laboratory is engaged in a survey of the Bay under the sponsorship of the Hydrographic Office. The Laboratory supports one small research vessel of the New England Dragger type.

The Bingham Oceanographic Laboratory of Yale University is mainly devoted to problems of marine ecology studied in Long Island Sound by means of chartered local fish boats; to quantitative studies of biological productivity; and to the physiology of fishes, with special emphasis on vitamins. The Sears Foundation at this activity publishes the Journal of Marine Research, the only American journal devoted exclusively to this field.

The University of Miami has recently established a Department of Oceanography. The personnel here are using small craft to study the Florida current and marine biology. Liaison is maintained with the Cuban Navy which is also interested in the oceanography of the area.

Figure 5. The Lil-Joy of the Narragansett Marine Laboratory of the University of Rhode Island.

THE GULF COAST

The Gulf Coast area is characterized as the American Mediterranean, not only because of its strategic importance but also because, like the European Mediterranean, it consists of a series of deep basins separated by relatively shallow sills. Due to the oceanographic "lapse rate" the apparent temperature of the water in these deep basins increases with depth. The wide shelf area is interesting for its oil resources and because of the enormous discharge of the Mississippi, the world's third largest river. Meteorologically the area is of special interest because of the frequency of tropical storms.

Texas A and M has, in the last two years, organized a Department of Oceanography and has initiated a regular oceanographic survey of the Gulf, using ship facilities cooperatively with the U. S. Fish and Wildlife Service and smaller craft offered by some of the petroleum companies. In the past, considerable marine research has been carried on in the geological, chemical, biological and engineering departments of the College with the result that the Oceanographic Department is receiving wholehearted support and encouragement from the rest of the faculty. The Department is one of two in the United States that is offering undergraduate instruction in oceanography.

THE PACIFIC COAST

The Pacific Coast is characteristic of the eastern boundary of oceans the world over and in many respects is analogous to western Europe.

Its special oceanic features are the sluggish southerly coastal current, seasonal upwelling, steep shores with a narrow shelf, a shallow thermocline, very low oxygen content, and long-period waves. In contrast to the Atlantic Coast the climate is maritime rather than continental. In the south, evaporation greatly exceeds precipitation and run-off with the result that the flushing process in San Diego Bay, for example, is quite different from anything on the Atlantic Coast. The Puget Sound area constitutes an enormous oceanographic hydraulics laboratory with every sort of condition typical of fjord coastal estuaries such as are found in Northern Europe. High salinity gradients, high velocity currents and every conceivable type of turbulence are found here. In case of war, this body of deep water, protected from enemy interference and from sea storms, would be a most valuable testing ground.

The Scripps Institution of Oceanography of the University of California at La Jolla is the chief oceanographic facility on the Pacific. A program in general oceanography is prosecuted and in addition the associated Marine Physical Laboratory is undertaking a unique program in this important field. Together with the neighboring Naval Electronics Laboratory, the three form the most powerful oceanographic group in the world. Four ocean-going vessels are operated, with a fifth soon to come out of the yard. Scripps maintains the only fully established academic program in oceanography in the United States although five other universities have made auspicious beginnings and will soon be well recognized. The Ph.D. degree in oceanography is offered at Scripps, as well as special courses, leading to the master's degree, which are given to military personnel. During the war it was the chief center for training naval officers in techniques for forecasting sea, swell, and surf.

The Oceanographic Laboratories of the University of Washington at Seattle and Firday Harbor, although founded at about the same time as Woods Hole, were a war casualty. Postwar rehabilitation has been slow, but the University has recently established a Department of Oceanography and a sea-going vessel has been obtained. The Department, like Texas A and M, will offer both undergraduate and graduate instruction leading to the Ph.D. in oceanography.

The College of Engineering of the University of California at Berkeley is the foremost engineering facility in the marine field. The group specializes in problems of beach erosion and amphibious operations. However, no work at sea is carried on, so that within the purview of this paper it is sufficient to say that the large and varied program and superb engineering facilities and faculty give to this institution importance of the first rank.

SUMMARY

The Department of the Navy in its sponsorship of oceanography is fostering a real and growing national asset. The program would be of increased significance if more emphasis were placed on marine resources but perhaps that will become the function of other government agencies. Considering the vastness of the task at hand, the present size of the national effort in oceanography (about 4 million annually) is very modest, and it appears that a modest expansion in the program will not do much more than keep pace with rising costs in our expanding economy. If activity in the science of oceanography is not to be curtailed, support will have to follow the rise in the national income. Normal growth will be limited as well by the rate at which the facilities can be economically expanded and adequately staffed. Until our national effort in oceanography is commensurate with that in agriculture and mining, it cannot be considered in danger of over-expansion.

The U.S. Navy's First Oceanographer

Matthew Fontaine Maury

Oceanography is a vast and important field that has only recently begun to receive the proper attention within this country. The Reviews has become "oceanography-conscious" and it is hoped that many articles on this entrancing and many-sided subject will appear in future issues.

The study of the oceans is, of course, by no means new. People have been writing about it ever since Homer described the navigational hazards encountered by Ulysses in the Straits of Messina. But it was an American naval officer, CDR Matthew Fontaine Maury, who dignified the subject with a scientific approach. He charted the currents of the ocean and proved that these immense streams have stability and direction and that they have a profound effect on climate. He taught the Navy how to navigate with the seas rather than against them.

Maury entered the Navy from Virginia in 1825. He made a hobby of the sea itself and studied its every aspect and mood during a trip around the world in the "Vincennes" in 1836. From this came his first notable work --a textbook on navigation. In 1839 he was maimed by an accident aboard ship, but the Navy wisely kept him in the Service, transferring him to the Naval Observatory. A physical geography of the sea, wind and current charts, a plot of the Gulf Stream, a navigational guide for transatlantic steamers, and many similar works were the fruits of his long tour at the observatory. His fame became world-wide in 1853 when he organized an international maritime conference in Brussels.

In 1861, Maury the Virginian resigned from the Federal Service and accepted a commission in the Confederate States Navy. After the South had lost its cause, he went to Mexico and became the maritime advisor to Maximillian, remaining there until the ill-fated Emperor was overthrown. Then Maury returned to Virginia and was, until his death in 1873, Professor of Physics at VMI.

New Facts on an Old Disease

by

G. F. Otto and L. A. Jachowski, Jr.
Johns Hopkins University

During World War II large numbers of military personnel in the South Central Pacific - particularly Marines in advanced training in American and Western Samoa - became infected with a disease called filariasis (well known because of the elephantiasis it produces). The symptoms of the ailment are so alarming, at least temporarily, that it gives rise not only to a medical problem but to a psychological problem of even greater proportions.

People get filariasis from the bite of a mosquito (aedes pseudoscutellaris which originally acquired the infection from a human being. The mosquito transmits to its human victim the immature forms of a tiny parasitic worm (Wuchereria bancrofti) which then invades the lymph-carrying vessels of the body. (Lymph is a colorless fluid present in all parts of the body; it forms an essential part of the circulatory system.)

Repeated infection over decades produces partial blockage of the lymphatic system, resulting in retention of fluid in the tissues of the extremities. Additional assault on the damaged lymph nodes by bacteria may contribute further to the blockage. The ultimate result in some individuals, after many years of repeated infection, may be an immensely enlarged (elephantoid) limb or scrotum, as fibrous tissue infiltrates the chronic swelling. Such conspicuous cases of elephantiasis are rare before middle life and their prevalence after that appears to vary with the extent and the intensity of the infection in any given area.

Such elephantoid conditions have never developed in American, European, or other transients whose exposure period was confined to a year or two. Since Marines were rarely exposed for more than a few months, the danger of permanent disfigurement was almost non-existent. Nevertheless,

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GILBERT F. OTTO (A. B. Kalamazoo College, M. S. Kansas State College, Sc. D. Johns Hopkins University) has long been interested in public health and the medical problems of the Armed Forces. An Associate Professor of Parasitology at the School of Hygiene and Public Health of Johns Hopkins University, he also serves as a consultant for the Naval Medical Research Institute and for the Communicable Disease Center of the U. S. Public Health Service.

LT LEO A. JACHOWSKI, JR. (Medical Service Corps, USN) is on temporary duty at the School of Hygiene and Public Health. Filariasis has been one of his major research interests; he started studies on its treatment at the Bethesda Naval Medical School after he entered the Navy in 1943 and served as officer-in-charge of the research team which studied it in American Samoa 1948-1950. A zoologist, LT Jachowski received his B. S. and M. S. from the University of Michigan.

Figure 1. Samoan ''fali'' in the open. Infection rate is lower in cleared areas like this.

the acute feverishness, tenderness, and transient swelling associated with the early stages of the infection resulted in temporary disability and a severe anxiety.

Consequently it became necessary to remove victims of filariasis from the area where it was prevalent to the mainland for convalescence and reassignment. At the same time medical personnel were assigned to study the characteristics and distribution of the disease with the hope of effecting better protection. Distinct progress was made during the war in obtaining data but a shift in the scene of military activities prevented the completion of the studies. It became clear, however, that the mosquito which carries the infection is primarily a ''bush'' mosquito utilizing a multiplicity of small collections of water for the development of its aquatic stages. Thus the usual methods of mosquito destruction by draining, filling, or chemical larviciding offered no prospect of success. However, the evidence obtained in Samoa during the war suggested that native villages were the foci of infection and attention was thus directed toward them. Unfortunately it was not possible in the time available to ascertain whether practical control procedures could be developed.

Accordingly, the Navy classified this as unfinished business at the end of the war. Visualizing the possibility of similar exposure of military personnel in the future and keenly aware of its responsibilities to the natives of the islands under its jurisdiction, the Navy, through the Bureau of Medicine and Surgery and the Naval Medical Research Institute, organized a study of filariasis in Samoa in which the Office of Naval Research is currently cooperating. Studies of the disease included attempts at control by the orthodox procedures in a series of relatively isolated villages.

Early in these studies several pertinent facts became obvious to us. Some of these had been known already but apparently had not been sufficiently considered in relation to the spread of filariasis. For instance, the Samoan in his native environment is customarily in his "fali" or house after dark and during the heat of the day. He is customarily abroad only in the early morning and late afternoon when working on his plantation or traveling to other villages.

These facts were interesting in view of data obtained from collections of mosquitoes from human bait at intervals around the clock. Such collections confirmed the previous evidence that these mosquitoes bite primarily during the daytime, but revealed much more than that. They showed that biting is more common in the early morning and late afternoon hours. These, of course, are the principal times at which the Samoan is abroad. Only on overcast days or during actual rain is there appreciable feeding by the mosquitoes during mid-day and very seldom will they feed after dark. Furthermore, examination of the blood of infected individuals around the clock confirmed the 1947 report of Eyles, Hunter, and Warren that the microfilaria are most plentiful in the peripheral blood in the late afternoon, and consequently are then most readily available to infect mosquitoes. Thus, the habits of the Samoans, the feeding times of the mosquitoes and the characteristics of the disease all combine to form ideal conditions for spread of the infection.

Another thing we noted was that Samoan villages were of two distinct types. The larger and more frequent type consists of a large open common or village green (the "malai") surrounded by thatched houses. Behind these are the thatched cook houses and behind these are the pig pens. The dense tropical jungle starts just beyond the pig pens or may encompass them to some degree. The village, including the houses, and up to or beyond the pig pen is open, or at most is partially shaded by large trees; there is no underbrush here. The second and less common type of village is the small settlement nestled in a cove. In such cases the "malai" is smaller and less conspicuous and the dense tropical underbrush extends to the houses, in many cases encompassing them.

The village set-up was of considerable interest in relation to the habits of the mosquito. Our initial studies confirmed the general impression that the mosquito carrier breeds and rests in the jungle. In the search for the resting places of adult insects, we have never found them resting in buildings, not even in the thatched Samoan houses. They most often rest in the crevasses of stone walls, on the underside of leaves, and in other similar places close to the ground in areas densely covered with low brush. They are truly "bush" mosquitoes and live almost exclusively in a "wild ecological niche". Even in the search for a blood meal the mosquitoes do not readily go into the open or enter houses in the open. This is markedly different from the habits of most malaria-carrying mosquitoes or those which transmit the so-called periodic filariasis in large continental areas. Such mosquitoes are either highly domestic or readily enter houses at night in the search of blood meals.

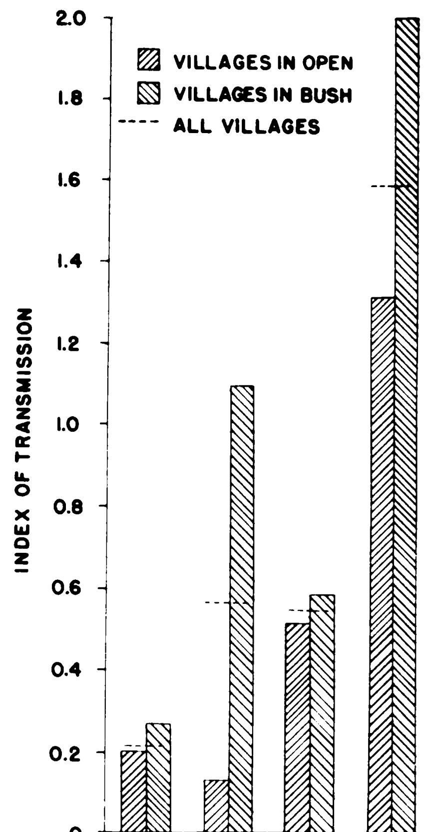
The undomestic habits of the mosquito which transmits filariasis cannot be readily reconciled with the commonly held view that the village is the focus of infection. Byrd, St. Amant, and Bomberg have most recently (1945) emphasized this generally accepted premise. Examination of their data shows that this emphasis resulted from clear demonstration of the fact that a higher percentage of mosquitoes caught on natives in villages was infected than was the case with mosquitoes caught on human bait in the jungles.

We were troubled by these apparently irreconcilable facts and undertook a careful restudy of this problem. It confirmed that almost twice as large a percentage of mosquitoes collected in the houses and elsewhere in the village were infected than was the case with those similarly caught in the jungles. Since the collections were on a standard time period, another fact quickly emerged. Often in the standard 10-minute period only one or two mosquitoes, and sometimes none at all, alighted on the bait in the houses or elsewhere in the village. On the other hand, from 50 to 150 were frequently collected on the same human bait in the nearby jungle, or in the plantation areas. Thus when the percentage of infected mosquitoes is multiplied by the density (the number collected from human bait in 10 minutes) a comparative set of figures is obtained which we have termed the Indices of Potential Transmission. Figure 2 graphically illustrates that the Index of Potential Transmission is by far the greatest in the jungle. The figure further illustrates that only when the house is actually in or near the bush, i.e., in the small villages, is the Index of Potential Transmission comparable to that in the bush itself. In the open "malai" there is little hazard of transmission in either type of village.

Confirmation of these findings is indicated by an analysis, as yet incomplete, of data we collected on Samoans, which suggests that the infection rate is materially higher among women and children in the small, bush-enclosed villages than among the same group in the larger villages. In both types of settlements the infection rate among men appears to be in general higher than among women.

Control procedures viewed against this background of transmission data take on an entirely different aspect than those which have been effective in the control of malaria, urban yellow fever, and other mosquito-born diseases transmitted by night biting, house-haunting mosquitoes.

Our own attempt at the control



COLLECTING STATION	OPEN	HOUSE	BUSH	BUSH
DISTANCE FROM CENTER OF VILLAGE	0 YARDS	25 YARDS	75-125 YARDS	150-275 YARDS

Figure 2. Comparison of indices of transmission for villages in the open with those for villages in the bush.

of this mosquito by the use of residual sprays (DDT) in the house had no demonstrable effect. The use of DDT as an aerial spray, however, has revealed some interesting possibilities. Such application of DDT was made over a small island (Aunnuu, off the main island of Tutuila) at approximately two-week intervals for over four months. This island is not only small (less than one mile across) but, unlike most of the volcanic islands in this group, has a fairly even contour so that all parts could be reached by aerial spraying. In addition, an attempt was made to utilize all other possible control procedures on this island. Every effort was made, for example, to eliminate or reduce the potential mosquito breeding places, at least those near the village. Furthermore, every man, woman, and child above the age of five was given two one-week courses of treatment with Hetrazan. The results were gratifying; the mosquito was apparently eliminated. How soon the mosquito population will become re-established from new importations or from undetected individuals or eggs, however, is unknown. It is far too early to determine the ultimate result.

Unfortunately when a similar aerial spraying program was carried out in a mile-square area around another village the results were much different. Immediately after spraying no adult mosquitoes were found within the sprayed area. Nevertheless, adult mosquitoes were as plentiful by the end of the two-week period before the next spray as they had been originally. As the program continued, this return between sprayings was diminished. Any hope of continued benefits, however, was shattered less than a year later when the mosquitoes were found to be just as plentiful as before the program was undertaken.

In spite of this discouraging development the results on these two villages appear to contain information of military value. Apparently transients such as military personnel can be protected by aerial spraying which is initiated immediately before or at the time of landing and continued at intervals during occupancy. Thus one more insect and one more insect-transmitted disease are added to the list of those which can be at least temporarily controlled.

In general treatment of infected individuals has been conspicuously unsuccessful in controlling disease on a community-wide basis. However, in view of the difficulties (some of which were anticipated) in the control of the mosquito, consideration was given to the possible value of "mass treatment" as a step in control. Two drugs, Arsenamide and Hetrazan, were available.[1]

Preliminary evaluation of the drugs was made by treating infected members of the Fita Fita guards, a Samoan unit or home guard of the U. S. Navy. When Arsenamide was administered in daily intravenous injections for 15 days, the microfilaria were eliminated or drastically reduced and there was no reappearance in the succeeding year. Regardless of the possible value of this drug in the treatment of individual infections, however, it is manifestly impractical, if not impossible, to treat an entire population with daily intravenous injections for 15 days. Accordingly, we do not, and did not, visualize this as a possible weapon in the control of the disease. The results are interesting, however, from

[1] We are indebted to Abbott Laboratories and Eli Lilly Company for providing Arsenamide and Lederle Laboratories for providing Hetrazan.

the point of view of effecting individual cures.

The other drug, Hetrazan, has the advantage of being administered by mouth. Past experience, however, has indicated that it should be administered three times a day for a period of not less than three to four weeks. We attempted to intensify this procedure by administering larger daily doses once a day for two weeks to a group of the Fita Fita guards. The results looked very promising and we were encouraged to give the drug extensive trial with this intensified schedule. Accordingly, in one village, in which no other control procedures were employed, every man, woman, and child was given Hetrazan once a day for 14 days. It is too early to indicate the ultimate results, but to date there are discouraging signs. There was a dramatic disappearance of microfilariae from the blood of the villagers, in most cases before the completion of treatment. There was some recurrence within five months, however, and a conspicuous recurrence within a year. Nevertheless, the fact that the number of microfilariae was still very low at the end of a year in comparison with the pre-treatment number indicated that the treatment had some lasting value. The most disconcerting development was the indication of a marked increase in the mosquito population in this village following the mass treatment of the populace! In laboratory experiments mosquitoes can be killed by heavy infections of filariasis, but we did not anticipate that the mosquito population, freed of this infection, would increase sizably. We are not certain that this is the case, of course, and the problem is being studied further. Nevertheless, there is the distinct suspicion that the infection is more lethal to mosquitoes than to man and that as the microfilariae diminish in the blood of man the mosquitoes increase in number. If such is clearly the case and mass treatment does not eliminate all the microfilariae for a long period but merely reduces the number in the blood, there may even be an increase in the rate of transmission.

Figure 3. Fita-Fita guard. Members of this U. S. Navy unit were treated for filariasis by researchers.

One cannot, on the evidence available, completely dismiss the possible value of mass treatment. Even if the treatment schedule we used should prove to be useless or even detrimental, it is possible that Hetrazan or some other drug can be administered in another, more effective pattern for control of transmission.

These studies of filariasis have indicated some effective precautions that can be taken by military personnel exposed to the danger of infection.

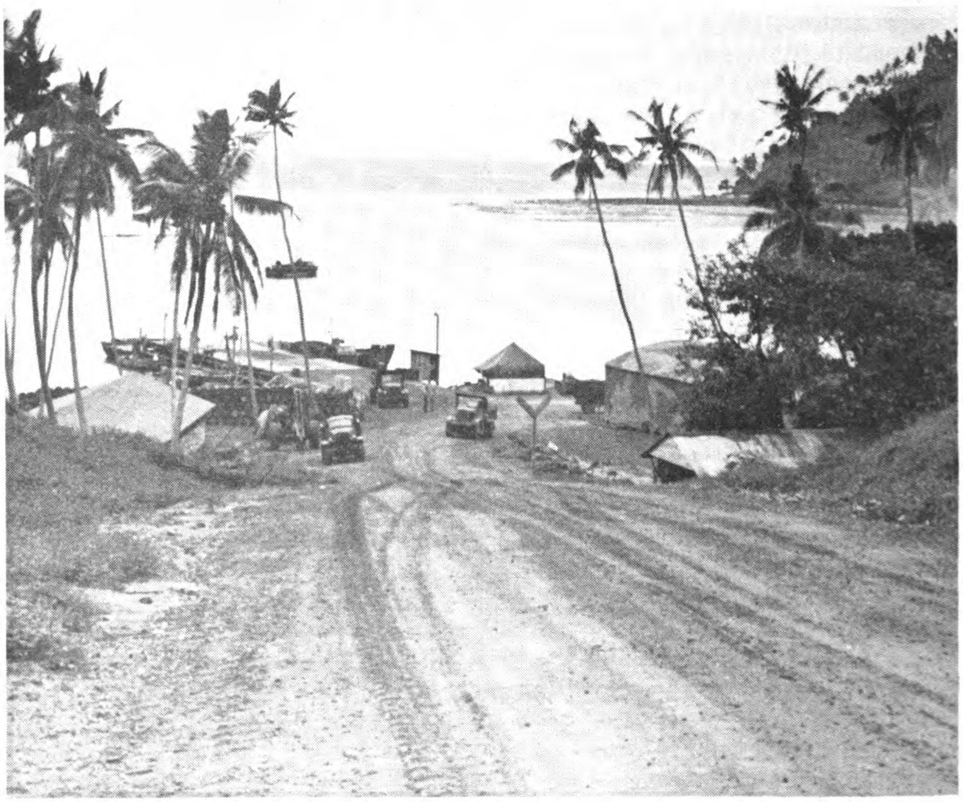


Figure 4. Harbor of Wallis Island, Samoa

Since the mosquito responsible lives in the "bush" and bites mainly in the early morning or late afternoon, jungle areas where infected natives may have traveled recently should be avoided. If it is necessary for large numbers of people to be in the "bush" during the day, repeated aerial spraying with DDT or some equally effective insecticide will offer excellent chances of protection. If this is not practicable, protective clothing and insect repellents are a necessity.

Though the work described has not indicated any certain methods of controlling the disease, the drugs Hetrazan and Arsenamide offer hope of curing the victims. More work will be necessary, however, before filariasis can be definitely removed from the list of those tropical scourges which are a hazard to our military men and to the natives in the Pacific.

On the Naval Research Reserve

Panic Prevention in Atomic Attack

VNRRU 3-1
New York City

> Since the subject of defense against atomic warfare is such a broad one, VNRRU 3-1 in New York City decided to attack an aspect of it on which little information was available. A study of the records on catastrophes of the past and of known plans for meeting atomic attack showed that nowhere was there a fundamental doctrine of the causes, effects and remedies for hysteria or panic.
>
> In view of this situation the director of Civil Defense of New York City suggested that recommendations on the problem would be a valuable contribution. This article consists of selected excerpts from a report which resulted from Unit 3-1's study.

A great deal of thought, time, and expense have been poured into the task of organizing for defense against atomic attack in New York City and in other important target areas of the country. The forces set up to prevent an attack are stupendous. It is generally acknowledged, however, that preparations should be made under the assumption that the enemy has accomplished a successful raid. Providing means of protection and escape thus becomes essential and although great efforts in this direction have been made they cannot be expected to be completely effective.

The British experience in World War II indicated that to a large degree the delay incurred in accomplishing military tasks was attributable to the anxiety of the civilian population. Fear engendered by unexpected bombing caused severe panic in London on several occasions, resulting in mass movements toward subway entrances and air raid shelters. In some cases the casualties induced by the crushing force of the panic-stricken crowd upon those already in shelters were far heavier than those due to blast and fire. It therefore seemed obviously worthwhile to analyze the factors which produce and maintain panic and the opposing factors which can be used for effective control.

Webster's dictionary defines panic as ''A sudden and overpowering fright... especially when accompanied by unreasoning or frantic efforts to secure safety.'' For present purposes emphasis will be placed upon the behavior resulting from overpowering fear in individuals of a confined group. The phrase ''confined group'' can be broadly interpreted to include everything from individuals in a closed room to the population of an area with limited avenues of escape. Within such a group panic falls into two general patterns: irrational excessive movement and apathy (fainting).

In general the precipitation of panic depends upon the occurrence of untoward events which evoke profound responses from individuals or groups. The response evoked depends largely upon the culture of the group under consideration. The environmental background, education, religious training, and sense of personal and civic responsibility influence the ease with which panic may be produced. Temporal and spatial circumstances may bear in either direction: if sufficient time is available for those threatened to evaluate the situation rationally, and sufficient space available for orderly flight from the threatened site, panic may not result from causes otherwise sufficient to produce it. The converse is equally true.

Within this broad framework specific circumstances, characteristics, and activities may be recognized as contributing factors, and others as inhibiting factors. Contributing factors - forces which act definitely toward the production and propagation of panic - encompass undesirable psychological and behavioral characteristics within the threatened group. Thus, excessive fear and anxiety caused by alarming rumors, technical misinformation and subversive propaganda prior to an event raise the susceptibility of the individual or group to panic. Resentment of real or fancied safety advantages enjoyed by others further contributes to panic. Such adverse conditioning leads to unreasoned, irresponsible individual efforts to attain safety and not only precipitates panic but also perpetuates it.

Measures opposing those harmful factors operate as inhibiting factors. Thus fear and anxiety in the group may be counter-acted to a large extent by re-education directed toward the correction of erroneous information and prevention of irrational behavior.

In addition, the drilling of the group according to a specific plan will establish rational patterns of movement within threatened or disaster areas and thus provide routes to safety and effective means of dispersal. Furthermore, information from an authoritative source, particularly if it is reassuring, will operate as a panic-inhibiting factor. In lieu of these measures the subsidence of panic comes about through physical and emotional exhaustion, the death of the individuals or dispersal of the affected groups.

Measures effective in preventing panic also operate in its control. Primary among these measures is the education of the general populace, as well as of specific groups, in pertinent facts of atomic warfare: the effects expected from atomic explosions and the actions required for the preservation of life. Reliable official information and channels for its effective dissemination are essential to this end. Extensive planning by competent authorities, both civilian and military, is required for the direction of all activity within the threatened area and its surroundings. General action plans based on the geography of the area and vital structures (roadways, bridges, etc.) within it must be made known to authorities concerned. Local action plans must be thoroughly learned by the general populace through enforced training so that useful actions become reflexes which operate even though conscious thought is suspended. The result of this regimen will be the reduction of frantic, useless motion so that panic may be avoided or readily controlled.

The Navy is in an excellent position to prevent panic and mitigate damage in the vicinity of Naval establishments and to act as a stabilizing force for the entire community. This can be accomplished in part by:

(a) Dissemination to all personnel, military and civilian, of correct technical information regarding the effects of atomic explosion; (b) Indoctrination of personnel in safety measures; (c) Furnishing of dependable information as it becomes available during the course of an atomic attack; (d) Maintenance of constant vigilance for individuals or groups attempting to spread rumors and propaganda to incite panic.

Effort by the Navy to keep its establishments operating will influence the surrounding neighborhood by increasing confidence in the defense organization.

Regular and Reserve Establishments are scattered throughout the community. Their linking communications form an auxiliary method of contact which will assist civilian defense. The Naval establishments form a nucleus of trained personnel to deal with the problems of atomic blast and panic. Proper training to cope with atomic attack may easily be integrated into all regular training programs.

In the event of atomic explosion the Navy will find it necessary to call on its civilian personnel to take care of its increased activity and also to take the place of those absent. These civilians must be assured that they will be relieved of the responsibility of providing safety for their families so that they will be free to do the job of defense.

Proper integration of all Regular and Reserve establishments in a closely organized network for civilian defense will contribute immeasurably to the security of the community. Such a network will exert a definite influence to prevent panic.

Reservist Calls Washington Seminar "Outstanding in Every Respect"

The following letter, from LCDR Kenneth A. Bush, a member of Volunteer Reserve Unit 3-8, is typical of many that have been received as a result of the recent ONR-Washington seminar:

Dear Commander Edmondson:

Although I have scarcely arrived home, I received so much stimulus from my participation in the seminar that I wanted to make it a matter of record at the first opportunity. The program was outstanding in every respect, and the manner in which it was carried through deserves the highest praise.

Specifically, this training duty has given me (a) a better understanding and appreciation of the scope and magnitude of the Navy's scientific work; (b) a realization of the abilities and capacities of the high-level personnel, both civilian and officer, currently entrusted with vital duties; (c) a resurgence of interest in the Navy.

To speak quite frankly, I entered upon this duty more from a sense of obligation than from any other stimulus, since I have taken no active part in the Reserve worthy of mention. I return from it firmly determined not to allow this condition to continue. In other words, this duty has turned a phlegmatic Reserve into a vitally interested Reserve. As a first step

I am giving a report to my Unit about the seminar this week, and I hope that other occasions may frequently arise when I may be of service to the Navy. As a matter of fact, I became familiar with one or two problems where I may be helpful, and if I secure some results here, I shall surely inform the interested parties. These problems were brought to my attention at Bethesda.

Trusting that I may have the pleasure of renewing my acquaintance with you and with Commander Dimitroff in the not too distant future, I remain

Respectfully yours,

Kenneth A. Bush
Lt. Cmdr., USNR

BuPers Book Will Aid Unit Planning

CO's who occasionally have to rack their brains to find constructive and workable programs for their units should not overlook a good source of ideas which is available to them. The Bureau of Naval Personnel has issued a booklet, "Curriculum for Units of the Volunteer Naval Reserve Officer Program", which promises to be a gold mine in this respect.

While the book is not aimed specifically at the needs of the Research Reserve, many of its ideas can be adapted to fit in with the VNRR program. It suggests courses which can be organized in six classifications: I - Instructor Training; II - General Officer Training; III - Naval Administration; IV - Ordnance and Gunnery; V - Seamanship and Navigation; VI - New Developments.

The book outlines in detail methods for organizing courses in any of these fields, giving specific texts which can be used, suggesting subjects for lectures and discussions and citing films and recordings which may prove helpful.

Every unit is entitled to one of these books. CO's who have not already received a copy may obtain it from the Bureau of Naval Personnel in Washington.

Radiological Defense Courses

Courses in the vital field of radiological defense are now available to Research Reservists the year round at Fort McClellan, Ala. Two-week courses will be given, beginning on the following dates: 1 August, 10 October, 5 December 1952 and 30 January 1953. This instruction is highly recommended to all reservists for training duty.

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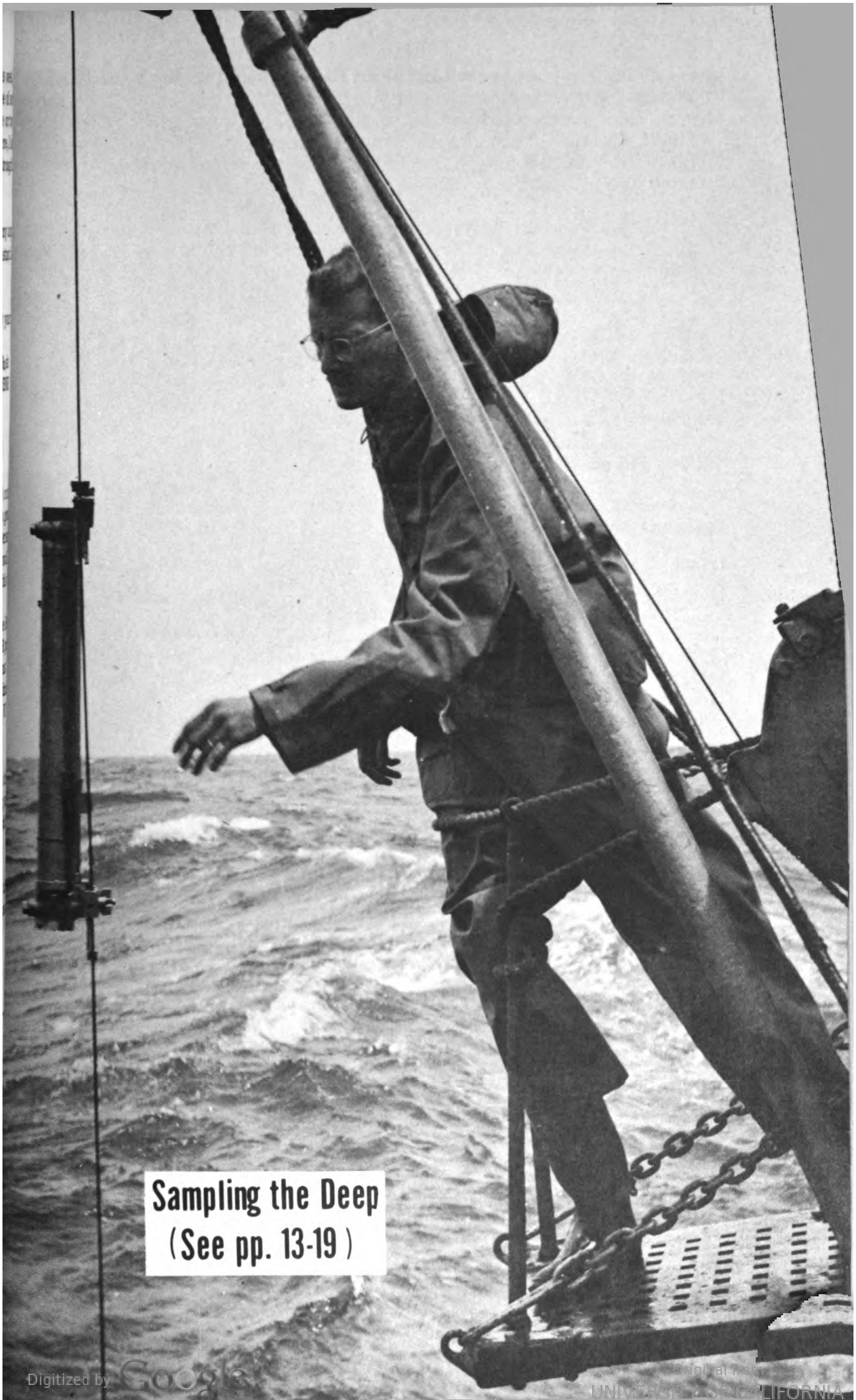
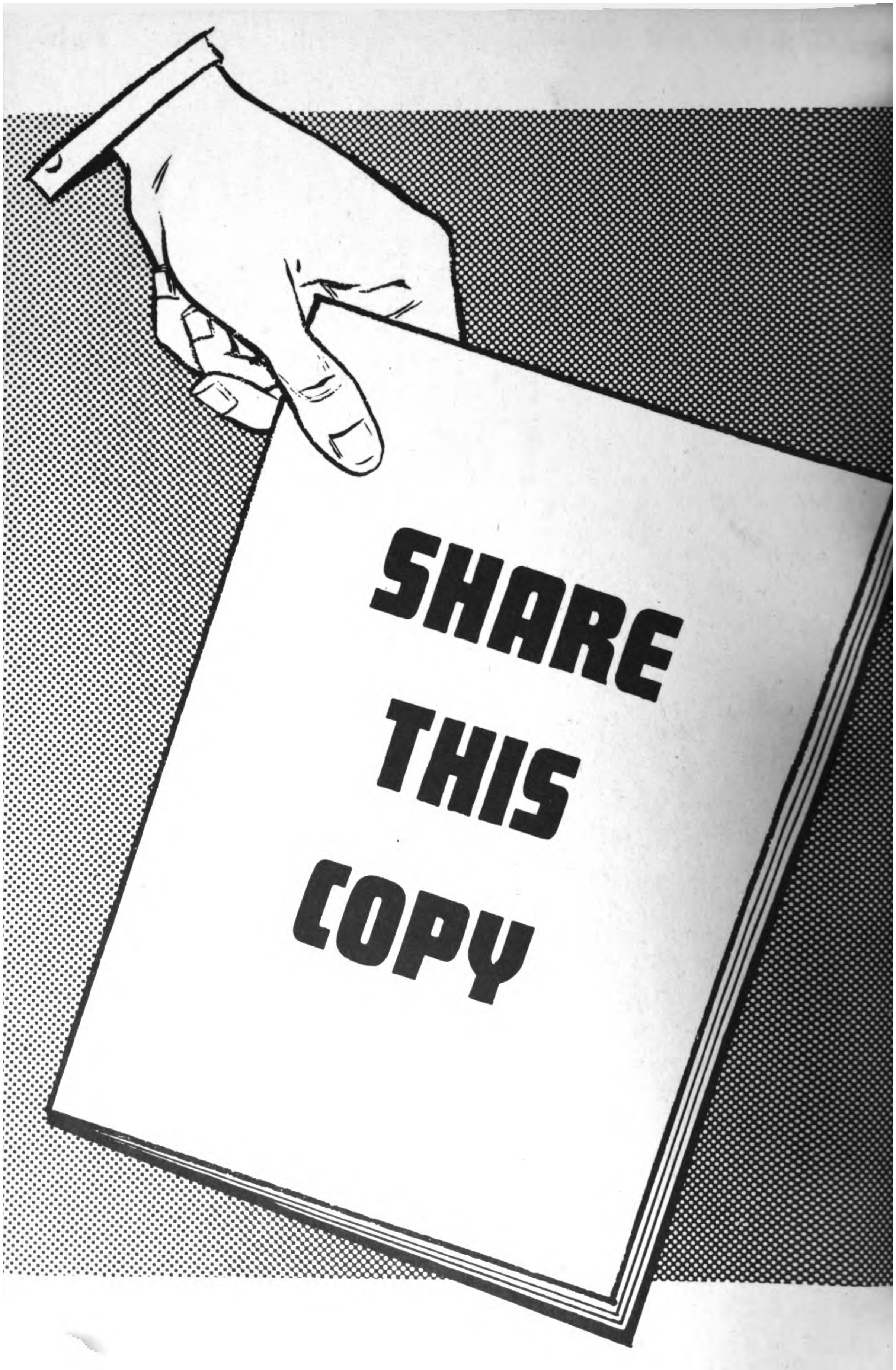

Sampling the Deep
(See pp. 13-19)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