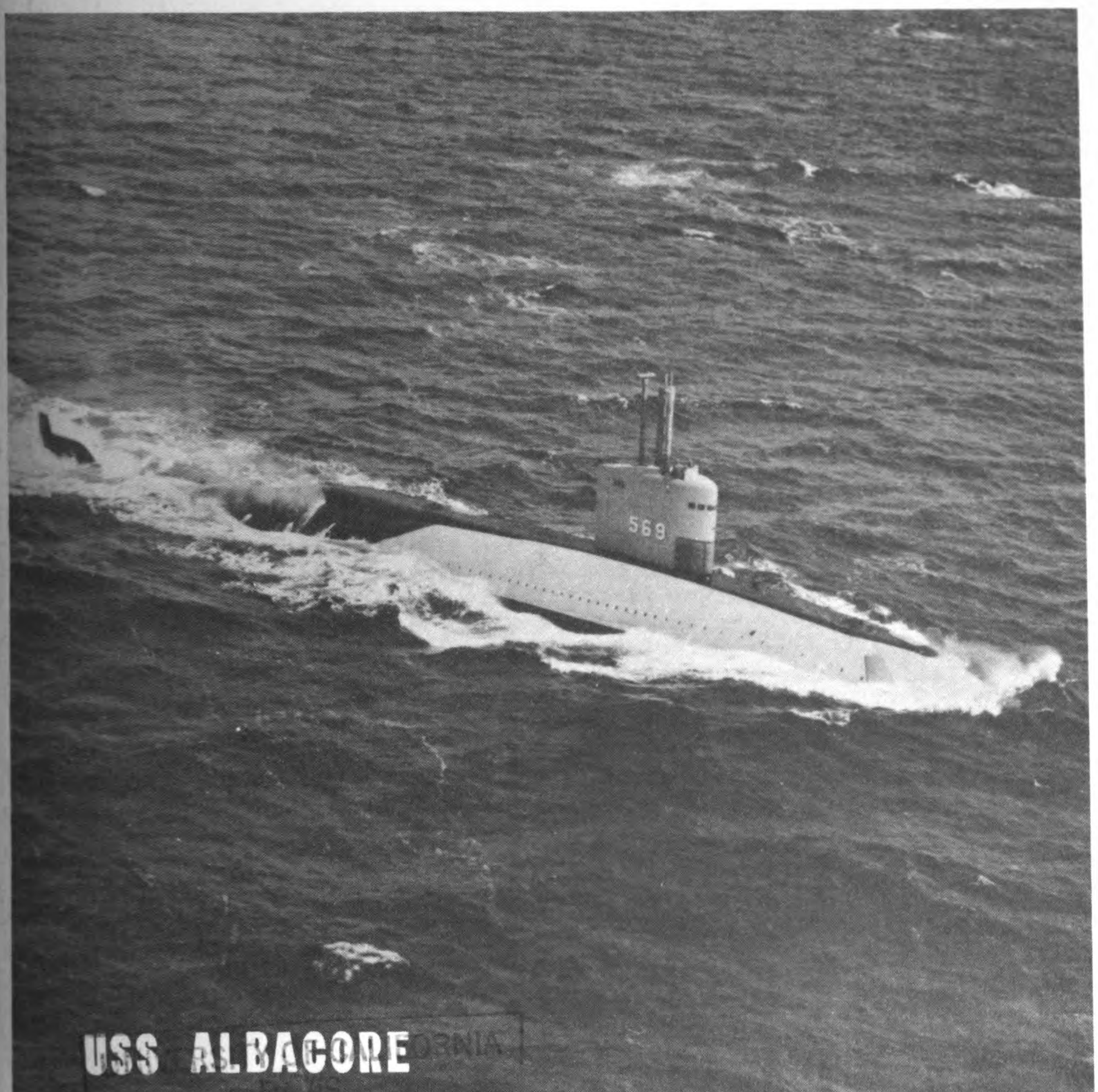
Q1
R45
March 1955

OFFICE OF NAVAL RESEARCH MARCH 1955

RESEARCH REVIEWS



JUL 1 1955
LIBRARY

NAVEXOS P-510

DEPARTMENT OF THE NAVY
WASHINGTON, D. C.

Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA
Generated for member (University of Maryland, College Park) on 2015-08-14 15:15 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

COVER PHOTO: ALBACORE's "body of revolution" hull is designed for speeds higher under water than on the surface. In this month's lead-off article the Chief of Naval Research has much to say about this post-war experimental boat.

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

Research Reviews is listed for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. Subscription price: $ 1.50 per year in U.S. and Canada; $ 2.00 per year, foreign; $ .15 per individual copy.

Approved by Bureau of the Budget, 14 February 1952

Generated for member (University of Maryland, College Park) on 2015-08-14 15:15 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

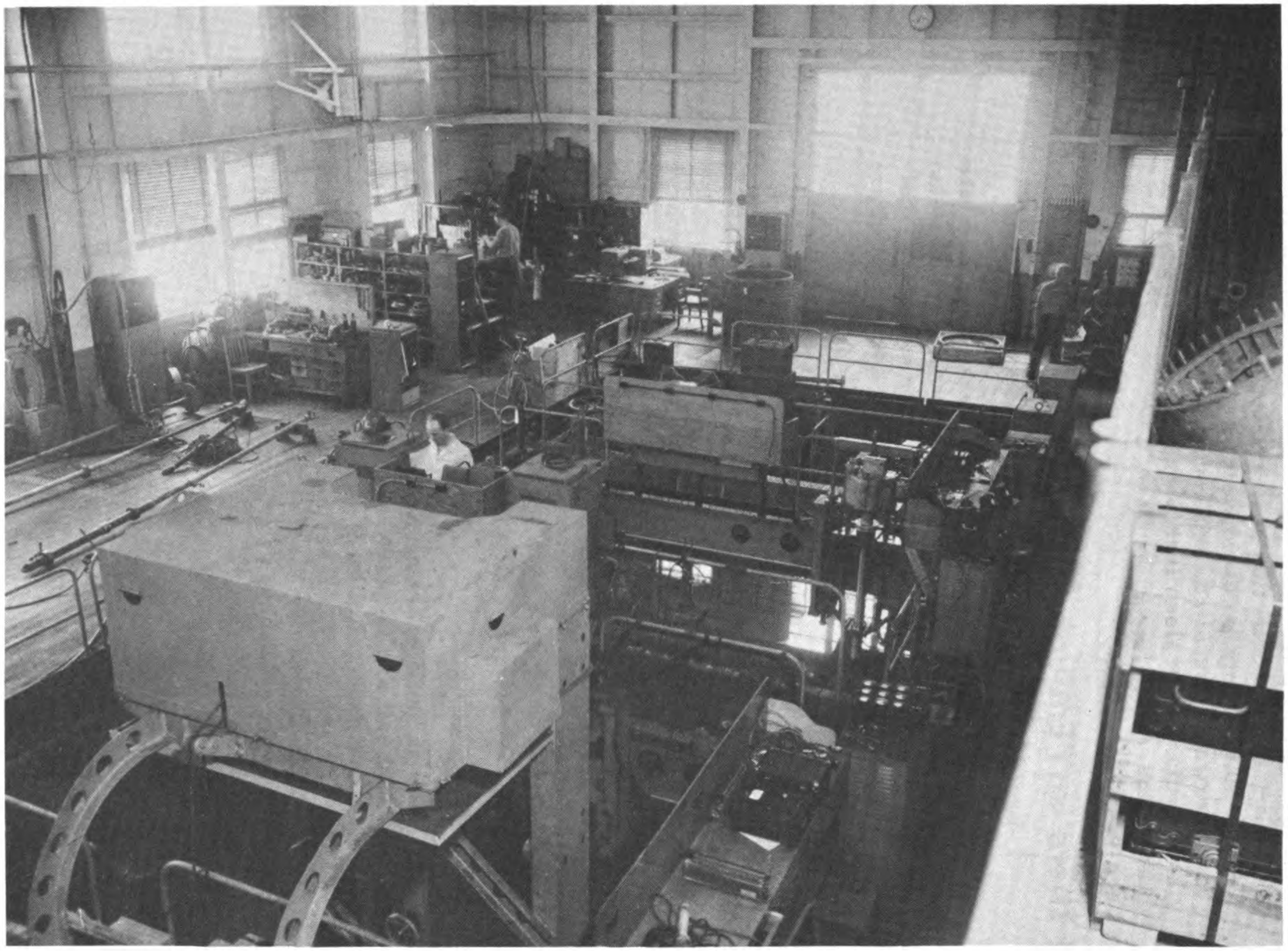
Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

In This Issue

Generated for member (University of Maryland, College Park) on 2015-08-14 15:15 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

Generated for member (University of Maryland, College Park) on 2015-08-14 15:15 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google



Interior of a sound barge. An array of sound-emitting gear, pickups, and movable bridges almost hides the open-bottom "well."

Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA

The Navy's Stake in Underwater Acoustics*

Rear Admiral Frederick R. Furth, USN
Chief of Naval Research

Since 1945, technology has permitted great strides forward in undersea warfare. More efficient hulls, new kinds of propulsion machinery, a greater knowledge of undersea conditions and the sharp improvements in underwater communications have permitted broadening the scope of our undersea arm, in addition to increasing its striking power. Undersea warfare as a naval science has come of age.

The Navy's new submarine ALBACORE is a fine example of postwar submarine progress and a good illustration of a Navy approach to submarine development. ALBACORE can travel faster under water than any other United States submarine now operating.† Her high speed is due mostly to her shape, which is hydrodynamically superior to any of our other submarine designs. She can make the same speed as a streamlined Fleet-type submarine on about half the horsepower.

ALBACORE is an experimental submarine. She is a test vehicle to help the Navy exploit every possibility opened up by the prospect of completely submerged operations. Up till now, submarines have had to be designed to operate on the surface, and have had surface-piercing hulls similar to those of cruisers. With nuclear power, we have the prospect of totally submerged operations and can design our boats to take advantage of this fact. So we need to find out all we can about streamlined bodies of revolution—in this case a submarine hull completely surrounded by water.

In designing ALBACORE, the Navy made a thorough study of airship research. The National Advisory Committee for Aeronautics tested models in a wind tunnel at Langley Field. The hull form which evolved is shaped much like an airship. It appears to be highly successful. ALBACORE is the first submarine ever constructed which can make high speeds under water with less horsepower than she would need for the same speed on the surface. The investigations which the Navy can make aboard her should provide basic information for submarines that can outperform or outfight any sub in the water today.

The development of nuclear power and our growing knowledge of undersea conditions open the door to important developments in the future of undersea warfare. The submarine is part of a flexible weapons system. It has enormous potential for carrying out a variety of missions in support of the Navy's historic role—maintaining control of the seas. Allow me to try to summarize the potential military future of the submarine by listing some of the tasks for which the submarine is suited:

---

*Condensed from an address to the Tenth Navy Symposium on Underwater Acoustics.

†The talk was made before the sea trials of the NAUTILUS.

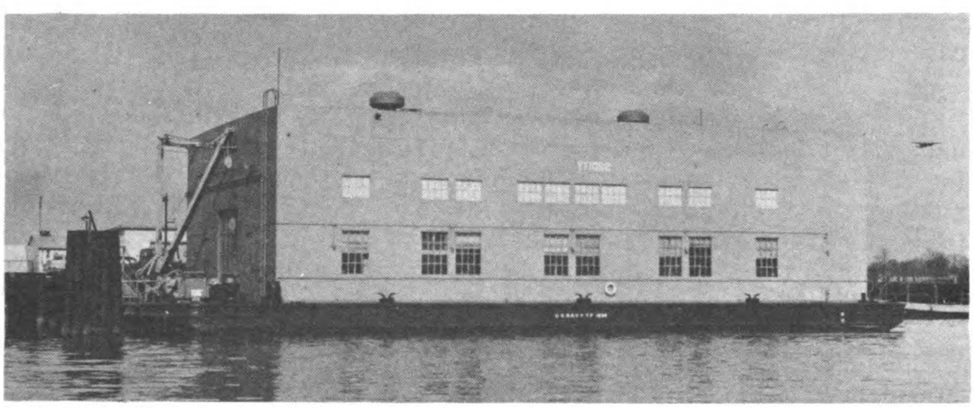
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated for member (University of Maryland, College Park) on 2015-08-14 15:15 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

- The task of denying the use of the seas to the enemy by eliminating his surface navy and his merchant marine. This is the traditional role of the submarine.
- To sink enemy submarines and destroy their bases as part of the anti-submarine warfare forces.
- To act as part of the fast carrier task forces and support and protect these forces by serving as sonar-radar pickets.
- To guide and deliver guided missiles for the destruction of land targets.
- Acting as part of the amphibious forces, to land saboteurs and to effect reconnaissance, to land and support troops, and to provide logistic support on our beachheads under enemy air control.
- To provide lifeguard services and air-sea rescue for our air forces, particularly in water over which the enemy has control of the air.
- To contribute to the continental air defense, as early warning radar pickets, far offshore.

This outline of possible future missions for the submarine emphasizes the growing importance of underwater acoustics research to naval operations. No other technique for the solution of many undersea warfare problems appears to offer the versatility and the over-all effectiveness of acoustics. We have already made much progress through the application of this tool to the problems of detection, tracking, fire-control, quieting, homing, navigation and communications.

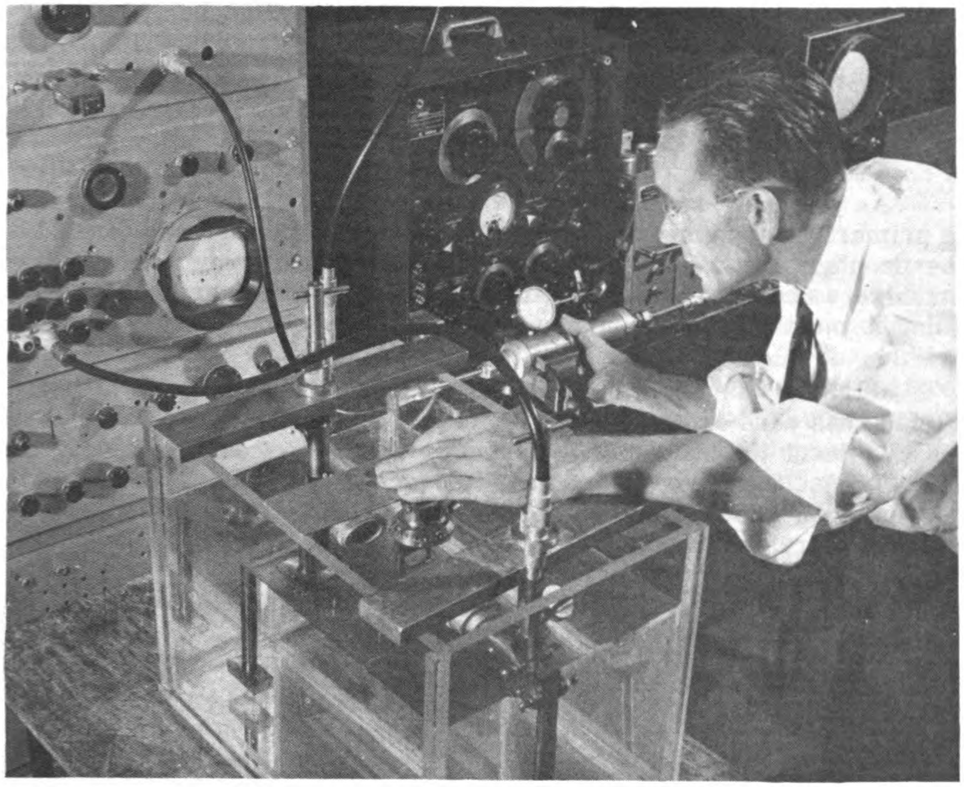
The basic means of underwater communication today is sonar. Sonar devices are the eyes and ears of the submarine. In the past, sound gear has been secondary to the periscope as a means of communication for the submarine commander. In the future it will be the primary means of prosecuting an undersea attack. The success of our future submarine operations will rest to a large extent on new and more exact knowledge of the behavior of sound in sea water and the use of this knowledge in development of underwater listening equipment.

With the development of nuclear-powered submarines that can traverse the ocean without surfacing, long-range subsurface navigation



Exterior of NRL Sound Barge, shown in Frontispiece.

Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA
Generated for member (University of Maryland, College Park) on 2015-08-14 15:15 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google



High-frequency sound in the laboratory

is a growing problem. These submarines must have the means for navigating over long distances without ever being able to take a bearing on any celestial body or radio beam.

Just visualize for a moment the vastness of the oceans, and try to picture the problem of the navigator. He is perhaps several hundred feet below the surface. He is out of sight of all familiar terrestrial landmarks, sun or stars. He has been submerged since leaving Boston Harbor or Key West several days earlier. Tomorrow or the next day he must be able to tell the captain exactly when and where to surface, in order to come up directly offshore from a tiny base in the Arctic Ocean. If the destination is an enemy target in unfamiliar waters, the job is even harder.

The submariner of the future may turn to undersea phenomena or physical features for his bearings. He may find the submerged mountain peak or the underwater canyon as comforting and reassuring as the familiar headland or lighthouse of today. There are a number of possible means for underwater navigation of submarines, and our research in underwater acoustics is playing an important role in their development. Navigation by echo sounder using the topography of the ocean floor is one promising possibility. Even today a sonarman in a submarine can pick up a reef or some other obstacle in unfamiliar or poorly charted waters.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated for member (University of Maryland, College Park) on 2015-08-14 15:15 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Another set of acoustic problems extremely important to the submariner are those involved in quieting. When our submarines are on patrol, we know that the enemy will be looking for them with his own sonar, so it is extremely important to keep down their noise level, in order that they will not be betrayed by the sound of their own machinery.

As you know, keeping down the noise level of running machinery is primarily an engineering problem. But before the engineer can tackle the problem, he must have a standard. He must know exactly what machinery running at what speeds produces the noise, and beyond what point he must do something about it.

Our own Underwater Sound Reference Laboratory at Orlando, Florida has done extensive work in developing standards for acoustical measurement and standards for acoustic devices. This laboratory also offers consulting services to our contractors. Those of you who are encountering problems in this field, and did not know of this service, may be interested in taking advantage of it.

The Navy has recently set up an acoustic testing area specifically for determining machinery noise standards. The requirements for such a test area were very exacting. It has to be an area of quiet, unruffled water, relatively deep and relatively unaffected by marine life. It had to be free of noisy fishing boats or passing ships. Both the Atlantic Coast and Gulf Coast waters were too shallow, and in the warm southern waters of the Pacific, Gulf and Atlantic Coasts there is too much interference from fish noises. However, Carr Inlet in Puget Sound proved a satisfactory site, and a 110-foot steel barge has been equipped there with the required test instruments. The first series of tests was conducted with the submarine BASHAW which was recently converted into an experimental vessel employing the latest sound-reduction techniques. A suspended hydrophone recorded the submarine's machinery noise.

Problems connected with submarine operations comprise the largest group of undersea warfare problems. We must also be concerned, however, with others not so directly associated with submarines, but which also form an important part of undersea warfare.

Mines and torpedoes are our primary undersea weapons, and modern torpedoes use acoustic methods for homing on their targets. Acoustically activated mines are another part of the picture. Countermeasures against enemy mines and torpedoes also involve underwater sound. Sonar is very versatile as a means of underwater detection, as in clearing minefields. It can be of great assistance to underwater demolition teams trying to locate obstacles in the waters off an enemy beach, so they can be cleared prior to landing operations.

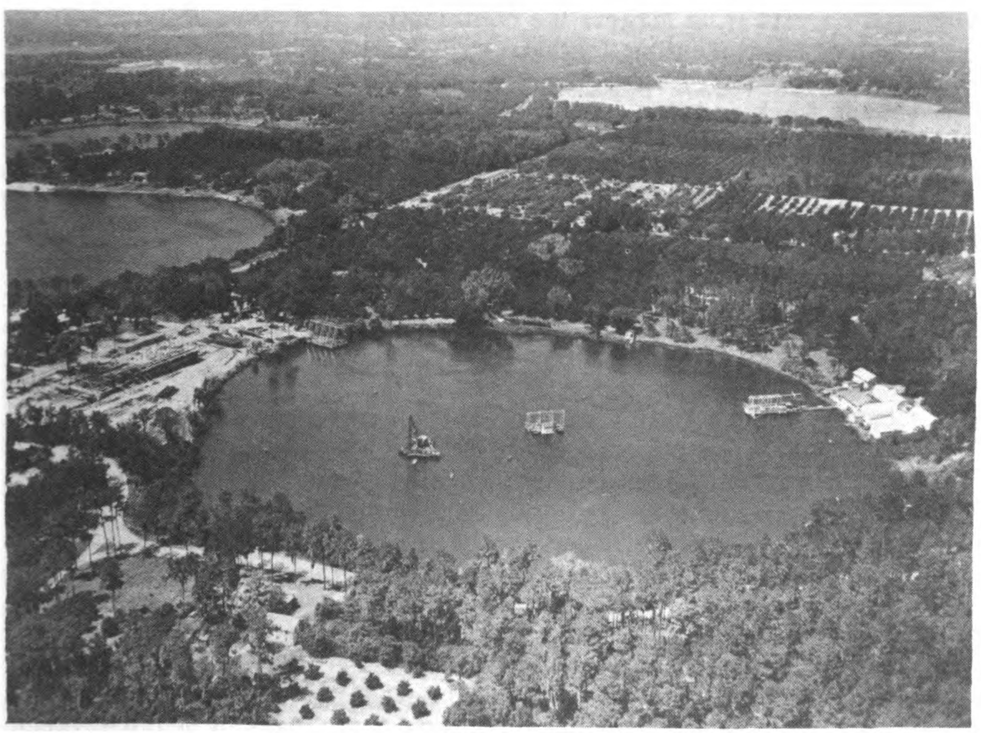
As a result of all these operational factors, the Navy has a big stake in underwater acoustics. We must be assured that basic research is being done in the many scientific fields which have a bearing on underwater sound, in order that our development programs can keep on devising and perfecting the equipments needed by our submarines, our escort vessels, our minesweepers and our demolition teams.

Generated for member (University of Maryland, College Park) on 2015-08-14 15:15 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA

In underwater sound, more than in almost any other scientific field, the responsibility for research designed to meet Navy needs rests with the Navy. The Navy is practically the sole user of underwater-acoustic devices, so there is virtually no industrial support for this kind of research. Furthermore, since undersea warfare is a Navy responsibility, the other military services do not perform research in this area.

To maintain a truly comprehensive effort in underwater acoustics—that is, an effort that covers all the areas necessary to meet our obligations to the Fleet—involves a broad span of activities. It can probably be stated that the term "underwater acoustics" is not truly descriptive of the work the Navy supports in this field, or the physicist would have it under control. Actually, the work involves a score of different scientific disciplines, as is immediately evident to anyone who looks at the programs for these underwater-sound symposia. Physics, chemistry, oceanography, the material sciences and biological sciences are all important to our program.

The work done in these diverse areas must all be brought to bear upon the Navy's problems in the field of underwater sound. With so many scientific disciplines involved, the work is bound to require a great deal of integration. It is the responsibility of the Office of Naval Research to bring about this integration, and to see that the results of these research programs are made available for use in the development programs carried on by the Navy's material bureaus.



U. S. Navy Underwater Sound Reference Laboratory

Generated for member (University of Maryland, College Park) on 2015-08-14 15:16 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

If There Isn't Enough to Eat

Freeman H. Quimby
Head, Physiology Branch,
Biological Sciences Division, ONR

It may seem inappropriate or at least untimely to devote space to this question for readers whose communities currently know food as a problem of surplus rather than want. Nevertheless, it is a fact that 80 percent of the world's population today is suffering from some degree of undernutrition. Undernutrition dominates all but a few favored areas of the globe. The situation becomes increasingly paradoxical upon the realization that—despite the present surplus of eggs, butter, milk, potatoes, etc. in the United States—millions of our people are not well fed. Moreover, crop failure, economic depression, and war can change the present abundance of certain food into a general food shortage. Food was critical in World War II and may be more so in the event of another war. A strong case could be made for the thesis that food was the greatest factor in the capitulation of the Germans in World War I, and of the Japanese in World War II. The possibility of contamination of food stores, crops, and soils as a consequence of an atomic war must be considered. But any type of war will reduce the quality and quantity of food for uncounted millions of people. Hence, the problem of providing adequate rations within the limits of restricted intake is a most important one.

Knowledge of the effects of food deficiency, despite man's long experience with it, is largely the contribution of modern science. There are numerous interesting instances of fasting mentioned in the Bible. Physical results are rarely mentioned, but David did speak of having been made weak and thin from fasting. Elijah is reported to have made a 40-day journey on the strength of two meals, and Nebuchadnezzar was supposedly restricted to a diet of grass for seven years. Many such stories exist, but the most informative and most useful one is to be told by trained scientific observers.

Perhaps the best way to present what is really known about starvation is by prediction of the effects on you should you experience a limited type of food supply. If you are an average male adult and if you were forced by some circumstance to restrict your food intake to 1,800 calories per day, or half the amount you now enjoy, for a period of six months, a number of changes would occur as a result. The sensation of hunger would not disappear as it does in total fasting. Thoughts of food would fill your mind; you would be preoccupied with the desire for food, not only during the period of undernutrition but for weeks or even months after adequate rations were made available to you. At the end of the six months, you would have lost about 50 pounds of your vital tissues. Most of this weight loss would be from your muscles, leaving you weak and incapacitated for physical work. Although your eyes would appear dull and lusterless, there would be no lessening of your ability to see. There would be no deleterious effects on the senses of hearing, touch, of taste. Your mental faculties would be as sharp as ever—but you

Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA
Generated for member (University of Maryland, College Park) on 2015-08-14 15:16 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

would be too depressed, too mentally and physically lethargic, to mobilize this retained brain power effectively. You would probably avoid social contacts and, in those necessary, would show restrained irritation.

An interesting fact in connection with your unaltered intelligence is that your brain would be one of the few organs, if not the only one, to maintain its normal size and weight. One of the organs which would shrink is your heart, and it would beat only about half as fast as it normally does. Your blood pressure, herhaps for the first time since you took that worrisome job, would take a turn downward. All of your body processes would slow down, attempting to conserve energy in order to economize on calories. A slight drop would occur in your body temperature, but you would feel colder than your actual body temperature would indicate. You would, for example, require three or four blankets for comfort even during the warm days of the summer. Although your physical sensation would be typical of cool weather conditions, your desire for water would be that typical during hot weather; you would consume, roughly, double your normal amount of water.

Semistarved Japanese captured during World War II

Once you were well established in a state of inanition (weakness from starvation), you would not only be more susceptible to certain diseases, but such diseases would be more apt to prove fatal. For example, you would be more susceptible to tuberculosis and, once infected, you would be more in danger of death by it. On the other hand, studies and statistics show that you would be subject to no greater risks from diphtheria, cancer, hypertension, or surgery. They also show that, if you were a diabetic, your condition would be significantly improved.

Fasting, in fact, has been proposed as a remedy for certain conditions. Indigestion is a good example. One study has shown that mental performance was improved after fasting. Another experimenter tried fasting one day in three for three months and noted benefit, especially when a relatively high fat diet was used. The increased endurance sometimes noted when fasting is probably due to hypertrophy of the adrenal gland, whose secretions make it possible to tap commonly unused resources or reserves. There are benefits from undernutrition in certain cases of specific conditions, some benefits occurring during the period of food restriction itself. For example, psoriasis (scaly red patches on the skin) usually becomes less severe under conditions of malnutrition. Investigations are now underway to determine if simple starvation or special starvation (fat or protein) can be substituted for the rice diet in the treatment of patients with high blood pressure.

333838 O - 55 - 2

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated for member (University of Maryland, College Park) on 2015-08-14 15:16 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

The 28,500 Philippine and American prisoners who died within 60 days at Camp O'Donnel in the Philippines (several hundred each day out of a total of 75,000), and the additional 2,400 who died during a period of eight months at the Cabanatuan Prison Camp illustrated a much greater death rate than would occur from moderate caloric restriction alone in a group of persons like ourselves. The actual causes of these deaths were the "death march," malaria, improper sanitation, dysentery, and lack of medical supplies, rather than semistarvation. This increased liability to certain infectious diseases in chronic inanition is due to the fact that there is a marked decrease of the number of white cells in the blood, and hence in the body's immunity to disease. It might gratify you to know, however, that if you survived the period of famine, your disease-resistance mechanisms would not have been permanently damaged, and they would be restored to normal by consuming adequate amounts of high-quality protein.

Your wife and children would fare better than you would under the stress of semistarvation, and in the struggle for survival they would be more likely to succeed. Of course, your children would be retarded in growth. In fact, in Holland and France recently, changes in growth were noticed even in the absence of other marked symptoms of nutritional deficiency. Upon return to an adequate diet, your boy or girl would begin to grow again. Perhaps they might even grow more rapidly than they would have on a normal diet. You might not detect it, but the children would grow a little even during food limitation. Dutch children in the famine following September 1944 are reported to have stopped growing, but this simply indicates that they grew so slowly that growth was not detected. Numerous investigators have discovered independently that chronic underfeeding does not bring the growth process to a complete standstill. Although growth is limited to the skeleton, it nevertheless occurs and does so even when there is no gain in body weight. Bones are known to grow even while depleted of minerals.

If what is known to occur in other vertebrates is true of humans, the period of retarded growth might even add to the life expectancy of your children. It has been observed that trout retarded in growth will outlive those that grow normally. Similarly, it has been noted that retarding the growth of rats by caloric restriction makes it possible to extend their life spans far beyond the ages at which they normally die. In the laboratory rat this increased longevity is due to the slower development of chronic diseases of the lungs, lower incidence of tumors, and possibly to slowing the aging processes of special organs, such as the kidneys. It now appears possible that maximum growth rate is not conducive to the longest, healthiest life. Someone has said: "Eat when you should, after that eat what you will, but do not eat too much of it."

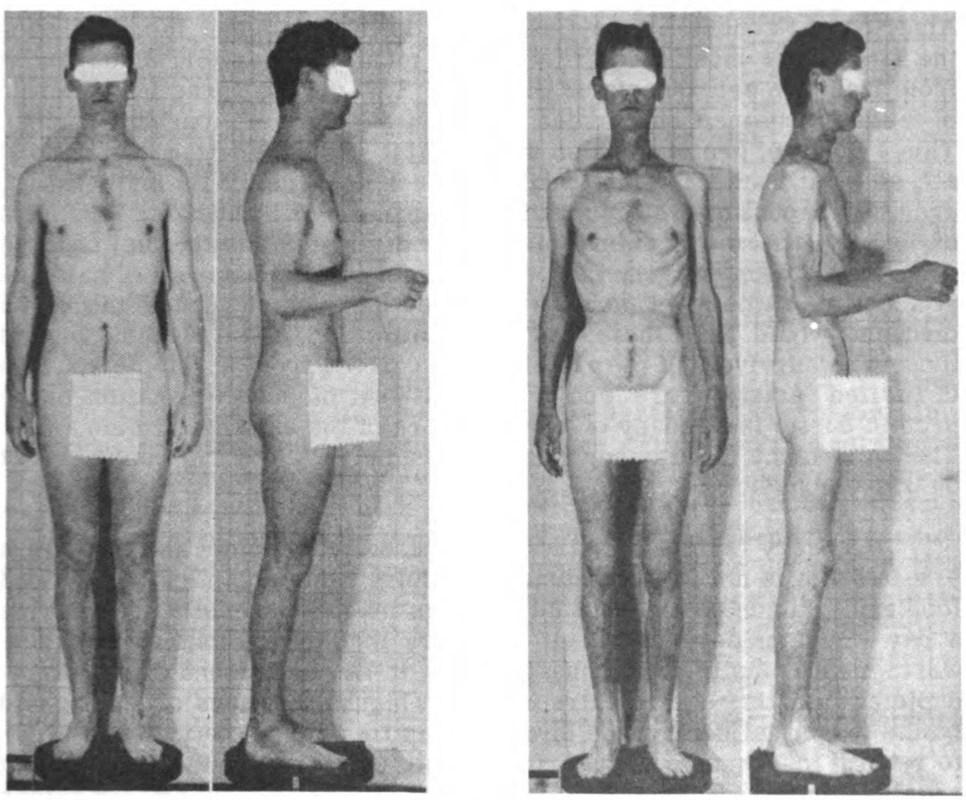
There would be an interesting adaptation in birth rate among all of us if severe famine became our lot. Deficiencies in glandular function would "see to it" that young mouths were not added to consume the already scanty food supply. Slowing of reproductive function in malnourished populations was first noted by early Greek physicians, but the cause was not learned until more recently. Among women the reproductive cycles are disturbed and ovulation may cease, while in men there is atrophy of the sex glands. Recent examples of these

Generated for member (University of Maryland, College Park) on 2015-08-14 15:16 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA

changes were noticed among women in the Singapore civilian internment camps, most of whom ceased to menstruate. Testicular atrophy was frequently found among American military personnel held for long periods in Japanese camps. The decrease in birth rate during famine may be equalized later by a proportionate extension of reproductive capacity.

There is also a general glandular and hormonal imbalance in undernutrition. Evidence of this is seen in the enlarged breasts of 6 percent (300 cases, ages 18 to 64) of the prisoners at the Cabanatuan prison camp in Japan. It is interesting to note that this condition appeared mostly during rehabilitation—3 to 12 weeks after return to a normal diet. The breasts of these men resembled those of a female at puberty; several showed a slight secretion from the nipple. Both theory and recent evidence suggest that the changes occurring in all of the glands during chronic starvation may be corrected by adequate feeding alone. The administration of hormone supplements during rehabilitation, except in special cases, is not only unnecessary but may be inadvisable.

Much of what has been learned about nutrition and undernutrition will be useful in the event of a food famine (such as we have been



Studies in Controlled Semistarvation. Volunteer subject before and after 24 weeks on 1570-calories-per-day diet in University of Minnesota experiment. From: "Biology of Human Starvation," Ancel Keys, et al, Univ. of Minn. Press, Copyright 1950.

Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA
Generated for member (University of Maryland, College Park) on 2015-08-14 15:16 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

supposing) or castaway experience. In the case of the latter, however, it must be admitted that the chances for survival depend less upon food than upon morale and fortitude, protection against environment, equipment to facilitate rescue, injury or sickness, necessity for energy expenditure, and water or water-providing apparatus. One can survive much longer without food than without water. In the event of temporary food shortage, we should attach considerable comfort to the fact that in warm climates as little as 100 grams or 400 calories of carbohydrate (sugar or starch; such items as beans, corn, peas, dates, figs, bananas, prunes, raisins, bread, pastries, oatmeal, tapioca, etc.) per day would be adequate to maintain physical capacity for a period of about 10 days. This amount of carbohydrate reduces the minimum urine water requirement through its sparing of body protein and prevention of ketosis (acetone in the blood).

The minimum water intake necessary to prevent dehydration during fasting is a little less than a quart a day for a 155-pound man engaged in mild physical activity under average environmental circumstances. If protein alone (egg white, cheese, lean meat) is available during fasting, however, this amount of water would not be adequate.

In severe food shortage over a long period of time the proportion of fat, carbohydrate, and protein are more important than the total amount of food. A diet containing 1,000 calories was fed to the 9,000 American prisoners at the Cabanatuan Prison Camp in Japan. During the first eight months, there were, as mentioned earlier, 2,400 deaths from inanition and associated diseases. That diet was practically devoid of fat and contained only about 60 calories of protein (one-half ounce). This amount of protein was so small that it was little better than none at all, since at such a low total intake and in the absence of fat in the ration, even the amount of protein provided could not be fully utilized. Inclusion of just a little more animal protein and some fat in the diet of these American prisoners, even while maintaining the total amount of calories at about the same level, would have saved the lives of most of those who died and would have increased the morale and physical endurance of those who survived. If the protein were derived from vegetable sources of limited variety, there would be likelihood of poor utilization of the protein due to inadequacy of one or more of the essential amino acids. The importance of animal protein in extremely low caloric intake cannot be overemphasized.

Recovery from semistarvation is usually complete and the return to a full diet is not usually attended by undesirable complications. Good food easily digested and frequent feedings in the amount of 3,500 calories a day would achieve your full recovery in 8 to 12 months. It may be worth mentioning in this connection that it has been found that protein-depleted animals require extraordinarily high proportions of leucine and lysine (essential compounds of complete proteins) in their diet in order to rebuild lost muscle tissue. It may be, therefore, that recovery food requirements could be met best by specific dietary supplements rather than by hyperalimentation (eating great quantities of food) in general.

In eating the first food after a period of total starvation, one must observe caution. Both experimental evidence and the experience of

Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA
Generated for member (University of Maryland, College Park) on 2015-08-14 15:16 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

professional fasters has shown that ingestion of protein following a period of total fasting is often accompanied by toxic manifestations (violent retching, vomiting, and diarrhea). It is a fact worth knowing that this reaction can be prevented by previous ingestion of carbohydrate, in other words, by first eating sugar or starch before partaking of a meal with a large protein component.

You may want to know what your nutritional status is at this moment. In a book entitled "Clinical Nutrition," Ancel Keys states that in a healthy young man, fat makes up 12 percent of the total body weight. If your amount of fat is less than 9 percent, or if the folded skin of your abdomen is less than 5/8 inches thick, you may consider yourself undernourished.

The "Maser"

An unusual microwave amplifier--the MASER, for microwave amplification by emission of stimulated radiation--has been developed at Columbia University under joint Army-Air Force-Navy (ONR) sponsorship. Among its possible applications is the measuring of time with extreme accuracy. Thus, for the first time, the accuracy of the currently accepted standard (the earth's rotation) has been exceeded. When functioning as an "atomic clock" the maser amplifies oscillations of 24 billion cycles per second from ammonia molecules undergoing energy-state transitions in an inhomogeneous electric field. The frequency variation over periods of the order of a few seconds is a very small fraction of one cycle per second, and over longer periods it is not more than several cyles per second.

The maser is far more sensitive than vacuum-tube amplifiers and virtually noiseless as well, so that it can be made to amplify radio signals far too weak for vacuum-tube amplifiers to handle.

Briefly stated, the principle of the maser is as follows: A stream of ammonia molecules at a few millimeters pressure is admitted to an evacuated chamber in which an inhomogeneous electric field is maintained. Ammonia molecules, because of the arrangement of their component atoms, constitute tiny electric dipoles. Therefore, the stream is split by the inhomogeneous field into two divergent principal beams of oppositely oriented molecular dipoles. One of these beams enters a resonating cavity and here some rather fascinating phenomena occur: the presence of the inhomogeneous field increases the probability of a given molecule's being excited to radiate when struck by a photon emitted from another molecule--since the dipoles are all in the same direction. Thus, to oversimplify, something roughly analogous to a chain reaction occurs, producing resonance in the cavity if enough molecules are present. The resulting microwaves are piped to their destination through an evacuated waveguide.

Two of these instruments have so far been constructed and are now in operation at Columbia Radiation Laboratory under the direction of Dr. Charles Townes, the originator of the idea. The device began as a basic research project, but it now shows promise of immediate practical application in such fields as microwave reception and transmission, navigation, and precise examination of molecular and atomic structure.

Generated for member (University of Maryland, College Park) on 2015-08-14 15:16 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA

Contouring Ocean Waves

Wilbur Marks
Research Associate in Physical Oceanography
Woods Hole Oceanographic Institution
Woods Hole, Massachusetts

If the sea surface were regular and behaved according to the laws of classical hydrodynamics there would be little difficulty in understanding and predicting wave phenomena. The fact is that ocean waves are most complicated, and, since the day the first man put to sea, very little has been found out about the behavior of the surface of the oceans. Popular sea stories tell of terrible storms with waves often one hundred feet high which break vessels in two. Less frequent but more destructive are the tsunami, or tidal waves, which may travel thousands of miles across the ocean completely unnoticed, until upon reaching a distant shore suddenly swell to a height of forty feet or more and crash down upon the beach, unleashing enough energy to destroy a small city. Of equal fascination are the tales of becalmed sailing vessels; an absolutely flat sea with hardly a ripple for days on end is perhaps in its own way more terrifying than the most violent upheaval of the surface.

Man finally realized that the only way to combat this mysterious and restless phenomenon was through a thorough understanding of the "nature of the beast." Sailing men observed certain peculiarities of ocean waves which seemed to occur repeatedly under the same conditions. From these observations theorems were postulated for prediction of occurrence of surface phenomena. One such "rule of the sea" concerns swell as the forerunner of storm waves. Another predicts that every fifth (or, in some areas, seventh) wave will be higher than the others. Refraction and reflection patterns were recognized and used as aids to navigation. Many other such rules are still in use today whether they have been verified or long since disproved. In the last 150 years, the scientist has gradually come to regard the sea surface as a fit subject for scientific inquiry, although theory has always preceded experimental verification by many years. Gerstner developed the theory of surface waves in 1802 and Stokes modified it in 1847. However, it was not until the METEOR expedition (1925-27) that observational data began to be available in the laboratory.

With the second world war came a demand for a practical wave-forecasting method to facilitate naval operations. Although the rules set forth to predict the waves were found to be adequate, it was realized after the war that there was still a great deal to be learned about ocean waves.

Wave research in this country is being supported by several groups, of which ONR is the most active. As a direct result of this activity, a wealth of information has been produced in recent years. Another consequence is that wave theory has again outraced observation and experimental verification. Indeed, the problem of observation of waves in deep water has long plagued the oceanographer. Instruments have

Generated for member (University of Maryland, College Park) on 2015-08-14 15:16 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA

been constructed and others are being developed at the Woods Hole Oceanographic Institution and at other oceanographic research centers which will be of great value in making open-sea measurements.

The most recent investigations have produced theories which predict the motions of a ship in an irregular seaway. Of prime importance to the solution of this problem is the accurate description of the sea surface in which the vessel operates. In a problem of this type, a knowledge of the initial state plus an understanding of the laws governing the motions of fluids may result in a calculation of the final state—in this case, a prediction of the wave parameters at some future time or at some distant place.

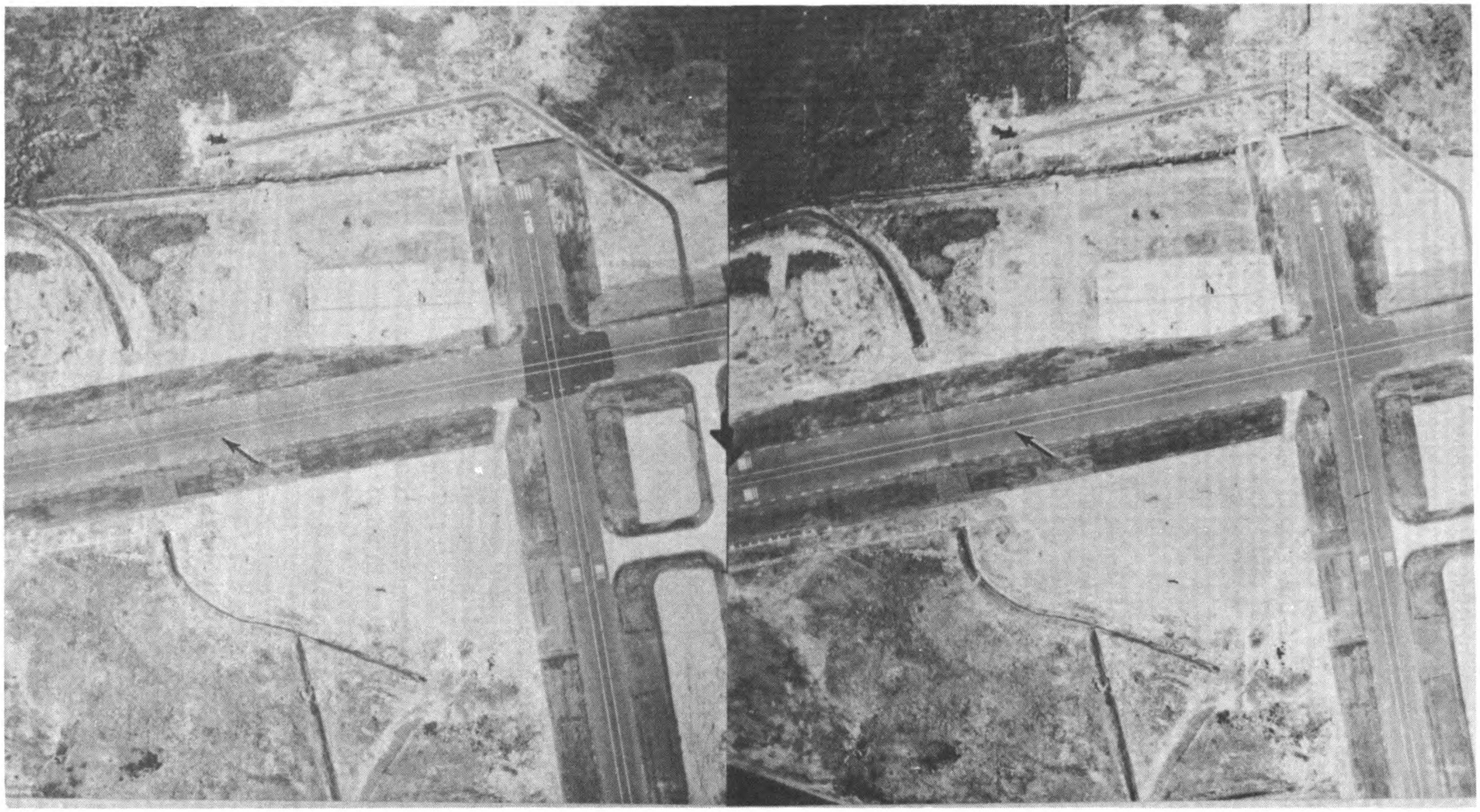
The complexity of the sea surface rules out a precise mathematical description of every "bump" on the ocean, either in time or in space, but a way to describe the features of the surface has been found in a statistical approach to the problem.

The energy in the waves can be described by a spectrum which is a function of wave frequency and direction of travel of the spectral components. This energy spectrum can be found if the sea surface is "captured" (accurately described) in either time or space. Many methods have been tried, with only partial success. A wave pole, for example, records a time history of the waves as they pass a fixed point. In 1952, Professor Pierson of New York University and the author calculated the energy spectrum as a function of wave frequency alone, but nothing was known about the distribution of energy with respect to direction of travel. That is, all the features of the sea surface could be described for a fixed point as a function of time, and even for the whole surface at any given time, but nothing could be said about the wave motion as a function of both time and space. The question arose, "Where does the wave go after it passes the pole?" It is this all-important question of the direction of travel of the various components of the wave-energy spectrum which we must answer to provide the key to many practical problems. This argument holds for all such single-point observers. Perhaps a battery of wave poles is the answer, but the theory governing the analysis of such data has not yet been derived.

An attempt has been made to record the sea surface with a sensitive radio altimeter mounted in an airplane which makes a run over the sea surface. In this case, wave frequencies (periods) are distorted because the plane cannot fly perpendicular to all the wave crests all the time, and directional information is, at best, inferred. Some other attempts at wave measurement have been made: Pressure elements placed on the ocean bottom to record the pressure of the water column above, moving and stationary submarines equipped with pressure elements and accelerometers (to explain the submarine's vertical motions), ships equipped with pressure elements and accelerometers, and several other methods which are variations of the above. A good deal of thought was given to the Sonne strip camera as a means of "laying a carpet down on the sea surface;" that is, a narrow three-dimensional strip of the sea surface is recorded by a fast, low-flying airplane. Here, the field of view is too narrow to determine the direction spectrum.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated for member (University of Maryland, College Park) on 2015-08-14 15:16 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Generated for member (University of Maryland, College Park) on 2015-08-14 15:16 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google



Test stereo-pair used to determine reliability of electronic link used to fire cameras simultaneously. Altitude 3,000 ft, separation 2,000 ft, speed of plane 150 mph, speed of truck on runway 40 mph (in opposite direction).

Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA

The next logical step is consideration of high-altitude stereo-photography. This medium can yield the information necessary to satisfy all of the conditions imposed above with respect to determination of the energy distribution as a function of frequency and direction of travel of the wave components. It is necessary, however, to know the relative height of the sea surface at several thousand discrete points. In order to do this the waves are contoured in a manner similar to land mapping. The data is fed into an electronic computer and the end result is the two-dimensional energy spectrum of the waves.

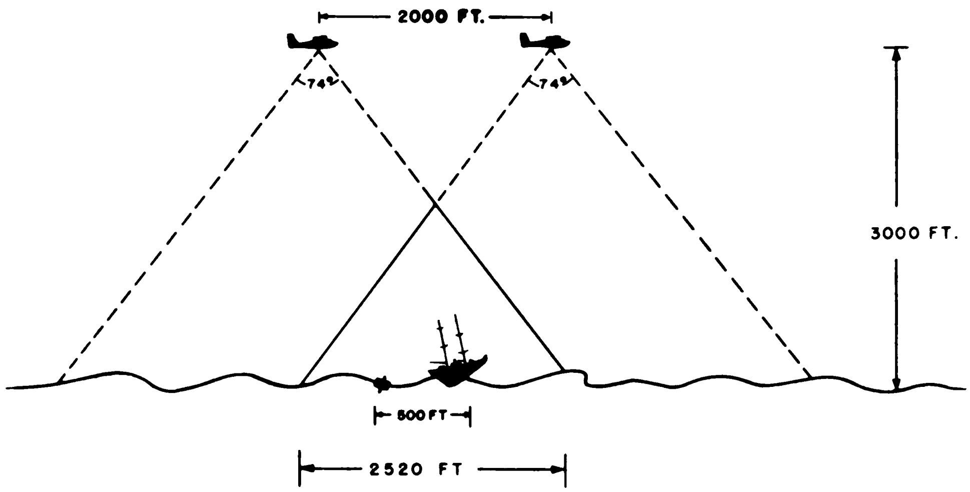
In order to capture—photograph—enough of the sea surface for computation purposes, it was necessary to use two planes flying in tandem. A camera in each aircraft was triggered at the same instant by an FM signal sent out by the master plane. To show that the electronic link would actually fire the two cameras simultaneously, oscillograph measurements were made on the ground with the engines of the two airplanes turned up, and these tests indicated that the cameras could be fired within one millisecond of each other. In further substantiation, a test flight was made over the airfield and parallel to the runway. The plane traveled at 150 knots; a truck traveled in the opposite direction at 40 knots (the fastest wave speed anticipated). The photographs were made with various delays installed in the cameras. That is, one camera was purposely fired 5 milliseconds after the other one. Then the delay was reversed. The result was that in no pair of photographs could it be visually ascertained that there was any change in position of the truck. Furthermore, the photos were enlarged 25 times and no difference could be measured that was greater than the measuring error itself. The Naval Air Development Unit, South Weymouth, Mass., (Research Reviews, January 1955) supplied the planes and pilots that flew this tricky mission. With their help, the flying problems were kept to a minimum, and many technical difficulties were avoided.

Stereo-photography of the sea surface involves certain problems not encountered over land. The sea presents a relief pattern which is always moving and changing its shape, and it offers no fixed marks which can be used for ground control. However, in the case of a rough sea (waves 15 to 20 feet high), there is a great deal of contrast between the foam (due to breaking wave crests) and the water and this can be utilized for the separation of tonal values in the photographs. The serious problem of reflected glare can be overcome if the pictures are taken at a time of day when the sun is at a relatively low altitude (40 degrees) or, ideally, when there is a high overcast.

The operational procedure involved the use of two P2V's flying in tandem 2,000 feet apart and at an elevation of 3,000 feet. Each plane was equipped with a standard mapping camera (CA-8) and the cameras were triggered simultaneously from the forward (master) plane by the FM radio link. The planes flew directly into the wind. This eliminated crabbing, reduced the ground speed and allowed the major wave crests to pass at right angles to the line of flight.

To help establish some sort of ground control, the research vessel ATLANTIS of the Woods Hole Oceanographic Institution was stationed in the area of operation. The vessel towed a target raft 500 feet behind it.

Generated for member (University of Maryland, College Park) on 2015-08-14 15:16 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA



Schematic representation of operational procedure

The distance between this raft and the ship was monitored during the entire exercise by a sonar buoy, located on the raft, which received a radio impulse from the vessel through the air and retransmitted the signal to the vessel through the water. The travel time was recorded every 2 seconds by a Leeds and Northrup Speed-O-Max recorder installed in the research vessel.

The planes adjusted their altimeters to the barometer on the ship at the time the pictures were taken. The distance between the two planes was maintained nearly constant at about 2,000 feet by means of a range finder located in the slave plane, which utilized the wing span of the master plane as base line.

It is necessary for the purposes of prediction that a number of stereo-pairs be contoured. The exact number depends on the highest frequency waves present and on the short-crestedness of the sea surface. In order to determine the energy spectrum of the sea surface a grid of spot heights must be made, and the spacing of the grid depends on the parameters mentioned above. The points on the grid might be read from the contours directly but the interpolation between contours is difficult even when the shape of the sea surface between contours can be seen from the pictures. The analysis of the stereo-pairs requires great skill. The Photogrammetry Division of the Navy Hydrographic Office has undertaken this arduous task.

High-altitude stereo-photography of the sea surface from two airplanes flying in tandem has produced a sequency of 100 stereo-pairs (see inside back cover), which show waves ranging in height from one to ten feet. The heights at discrete points on these photographs will yield the two-dimensional energy spectrum of the sea surface. It is hoped that this information will establish confidence in new theories which describe the behavior of ocean waves and will pave the way for improvement in ship design and for increased accuracy of wave-forecasting techniques. Perhaps it will even help solve the problem of why ocean waves are as they are.

Generated for member (University of Maryland, College Park) on 2015-08-14 15:16 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA

Conditions Affecting Cooperation

Morton Deutsch
Research Center for Human Relations
New York University

Picture, if you will, the following situations:

A fire breaks out in a crowded theater where there is only one exit. If everybody tries to such out at the same time, there will be confusion and panic and many lives may be lost. Yet if they cooperate in an orderly exit everybody stands a better chance of getting out safely.

Workers in a munitions plant are being paid on a group piece-rate basis, so that the more the group produces, the higher is each individual's pay. The work is unpleasant and it is difficult to determine how much work one person is doing. Any individual may feel that he'll be better off if he shirks his work and coasts along on the efforts of the others. Yet if they all coast along, they all will be worse off than if each works effectively.

A member of a combat team knows that firing his rifle will draw the attention of the enemy to his position and increase his danger. Yet, if he does not fire frequently, the team will be less likely to survive and complete its mission successfully.

A group of naval aviators is flying on a mission. If a wingman sees an opportunity for an easy kill, he may be tempted to detach himself to engage an enemy aircraft, thus increasing his prestige. Yet the safety and success of the fliers as a group depends on their remaining in formation.

A number of men in life jackets are floating in the water after their ship has been sunk. Each one has a chance of reaching shore if he breaks away from the rest. But if each one makes for the shore, many will drown. If they stay together the group will be more easily spotted by rescuing aircraft and more will be saved.

Two staff officers are working on the same problem; each wants to win the favor of the commanding officer. They may pool their efforts and try to work out the best solution together or each may try to outshine the other and not let the other one know what ideas and information he has.

If we carefully examine these situations we will note that although the situations differ, a crucial determinant of the fate of the individuals in each case is their ability to initiate and maintain cooperation. Owing to the great importance of these facts to the Navy, social psychological research under ONR contract at New York University (since September 1952) is principally concerned with the conditions affecting cooperation. A brief summary of the theoretical notions and of recent results follows.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated for member (University of Maryland, College Park) on 2015-08-14 15:16 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

THEORETICAL CONSIDERATIONS

Consider the individual who is confronted with the choice of co-operating or not (e.g., of working together with others or of working alone). The choice to be made is in many respects similar to any other choice—whether to eat a dessert or not, for example. That is, there are general psychological principles which are applicable to any choice. In general, one can assert that an individual will choose, from a set of alternatives, the alternative which has the highest "effective attractiveness." The effective attractiveness of an alternative is a function of two sets of factors: those which influence the desirability of the alternative, and those which influence the subjective estimate of the probability that this alternative will lead to the desired result.

The following are some of the factors that are considered determinants of the desirability of cooperation: (1) The attractiveness of the activities one expects to engage in as determined by their difficulty, their meaningfulness, their interest, etc., (2) the attractiveness of the experiences that one expects to undergo as the result of the activities of others, (3) the attractiveness of the other potential cooperators, (4) the attractiveness of being identified as a member of the group, (5) the attractiveness of secondary goals whose attainment may be facilitated or hindered by engaging in cooperation, (6) the immediacy with which cooperation leads to the desired goal.

The subjective estimate of the probability that cooperation will be successful is considered to have two supporting factors: (1) The individual's perception of the likelihood that the skills and resources existing among the potential cooperators are adequate for the performance of the cooperative task, (2) the individual's perception of the likelihood that the necessary skills and resources would be made available for a cooperative endeavor.

With regard to each of the factors affecting the individual's perception of the desirability and the probability of success of cooperation, three types of circumstances are relevant: (1) The objective state of affairs—e.g., what is the maximum possibility of accomplishing a given cooperative endeavor with the existing skills and resources among a given group, (2) the information received by the individual concerning the objective state of affairs, as determined by such factors as the following: the number of potential cooperators, the nature of the communication linkages among them,* the incentive and ability to communicate and to be communicated to in each of the potential cooperators, the information available among the potential cooperators, the time available for communication, etc., (3) the personality of the individual, which determines the interpretation of the information received by the individual.

So far, our discussion has presented some aspects of a theory of choice, with illustrations appropriate to consideration of the individual decision to cooperate or not. This theory, in its most general form, is

*See "Communication Patterns in Small Groups" by M. E. Shaw, Research Reviews, January 1955.

Generated for member (University of Maryland, College Park) on 2015-08-14 15:17 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA

applicable to any choice situation. However, the decision to cooperate or not is in some respects crucially different from the decision to eat one piece of pie rather than another. When you choose a piece of pie, the pie doesn't have to choose you to eat it in order for you to do so. However, when you choose to cooperate with another, the other person must choose to cooperate with you if cooperation is to be realized. In other words, the choice of cooperation implies some perception of "mutuality." By "mutuality" we refer to the fact that each potential cooperator's choice to cooperate or not is affected by his perception of the perceptions of the other potential cooperators. At least two unique problems arise as a result of the "mutuality" consideration. These are the problems of resolving differences with regard to how to cooperate among the various potential cooperators, and the problem of "mutual trust." The latter is one of the principal objectives of our current research.

The problem of mutual trust arises from the possibility that if, during cooperation, each cooperator is out to obtain maximum gain at minimum cost for himself (without regard to the gains or costs to the others), cooperation will be unrewarding for all or for some. That is, making customary assumptions about individual motivation, it can be derived that if any individual is out to obtain the best result for himself without regard to social considerations, cooperation cannot produce the best motivational resultant for others. To illustrate further, consider the implications of the fact that it is rarely possible to distribute the fruits of cooperative endeavor simultaneously. Suppose five men have agreed to build five homes cooperatively, and this is their only motivation for cooperation. Then someone's house will be finished first, and, since the house is the only reason for his contributing effort, he will have no motivation to contribute further effort. If he doesn't contribute further effort, the houses of the others may not be built. But if this is a known possibility before cooperation is initiated, why should any potential cooperator wish to cooperate or how could the various individuals come to an agreement about the temporal distribution of the fruits of cooperation?

It is beyond the scope of this article to review the theoretical thinking we have done about the conditions affecting "trust." However, we may note that the interrelationships among such concepts as "trust," "risk-taking," "hope," "suspicion," "fear," "trustworthiness," "responsibility," "integrity," "hostility," "malevolence," and "benevolence" have become clarified.

SUMMARY OF SELECTED RESEARCH RESULTS

- Time Perspective and Cooperation

Time perspective may be defined as the perceived ratio of the time available to reach a goal to the time required for all activities necessary to reach the goal. Thus the smaller the time perspective ratio, the more the individual feels the need to hurry to achieve the goal. He may feel, for example, that he has ten minutes to finish something that should require twenty minutes. One would therefore expect, within certain limits, a decrease in the perceived likelihood of reaching the goal as

Generated for member (University of Maryland, College Park) on 2015-08-14 15:17 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

the time perspective ratio decreases. Experimental study has confirmed this expectation and has demonstrated that an individual's choice between "cooperating" or "doing it alone" can be determined by the relative time perspectives of these two alternatives. Further, an important factor influencing an individual's perception of the time needed for successful cooperation (particularly when the total time available is small), is his perception of how long it will take to establish and get cooperation underway.

Panic by a crowd in the face of a dangerous event often reflects the feeling that it would take too long to establish an orderly means of group cooperation. Everyone, feeling an intense time pressure, rushes to escape by himself and the result is a chaotic, self-defeating mass of people who, in their individual frenzies, interfere with and turn against each other.

- The Effects of Cooperative and Competitive Relationships on the Perception of Social Relationships with Others

In this study, we were concerned with two questions: (1) How will the nature of an individual's relationships with two others influence his perceptions of the relationships between these two others? (2) how will his perception of the relationships between two others affect his relationship to one of them when he has a specified relationship to the second?

In general, the results of research indicate that an individual tends to perceive other people as cooperative or competitive according to their relationship to himself. If, for example, one of two people cooperates with him and the other seems hostile, the individual tends to perceive the two as competing with each other. If one of the pair competes with him and the other seems hostile, he sees the two as cooperating with each other.

Another interesting observation is that an individual's perception of relations between himself and others is colored by his perception of competition or cooperation between these other people. If he observes a cooperative relationship between two people and knows one of these is hostile to him, he tends to see the other person as also hostile to him. If, on the other hand, he sees the relationship between the two as competitive and knows one is hostile to him, he will tend to perceive the other as cooperating with him.

- Expectations of Success and Determinants of Group Formation

This experiment was concerned with the conditions influencing an individual's estimate of the chances of reaching the goal via group effort. It was found that individuals who previously had been in a group which experienced success were considerably more optimistic about reaching their goals through group effort than were individuals who had been in a group which had failed in a joint endeavor. On the other hand, a generally optimistic mood or a generally pessimistic mood, as influenced by reading about optimistically or pessimistically slanted incidents,

Generated for member (University of Maryland, College Park) on 2015-08-14 15:17 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA

had little influence upon their assessments of the group's chances of success. In other words, the solidly grounded experience of past success is more likely to be influential in determining an individual's perception of his chances than are pep talks.

• Cooperation and Mutual Trust

Two persons play a game in which, if each person chooses to maximize his gains and minimize his losses, both persons will lose. Both persons can consistently gain only if there is mutual trust between them. However, if one partner chooses to trust the other, it is to the other's immediate interest to doublecross him.

The situation we are utilizing can take many different forms; an illustration of its basic features is provided in the following example. Two people have to choose, at the same time, between pressing a red button and a green one. When both press red buttons both lose $1; when both press green buttons both win $1; if one presses a green button and the other a red one, the presser of the red button wins $2 and the presser of the green button loses $2. If each person tries to maximize his gains by pressing the red button, both will lose. If there is mutual trust, both will press green buttons and consistently gain. But in such a situation of mutual trust it is to the immediate advantage of one partner to doublecross the other by pressing the red button. Each person knows exactly what the situation is but he doesn't know, as he makes his own choice, what his partner's choice will be. For both of them to press green buttons, each must be trustworthy and must perceive the other as trustworthy.

We have utilized experimental situations similar to the one described above to study the effects of different types of motivational orientation upon readiness to develop mutual trust. The results may be summarized as follows: When both individuals are oriented only to their own welfare (each is out to win as much as possible for himself without regard to how the other person does), both individuals end up losing because neither of them can trust the other or get the other to trust him. When both individuals are competitively oriented to outwinning each other, there is even more distrust than under the individual orientation and the participants lose even more. When each individual is oriented to the other's welfare as well as to his own, each trusts the other and each wins.

We are presently performing experiments directed at understanding what minimum social factors can be introduced to convert the situation of distrust to a situation of trust by changing individually oriented motivation to socially oriented motivation. It is our belief that this research will give considerable insight into the conditions which enable people to work together for their mutual benefit, and will contribute to our understanding of the social psychological factors which lead people to be responsible rather than irresponsible to the trust which others place in them.

Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA
Generated for member (University of Maryland, College Park) on 2015-08-14 15:17 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

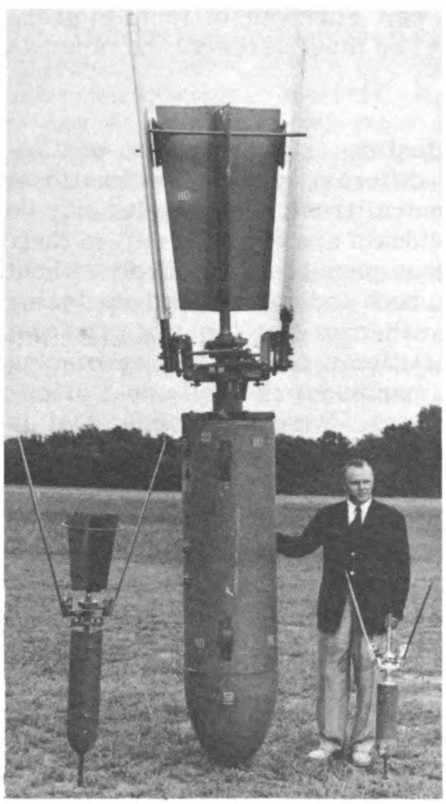
Research Notes

"Rotochute"

Among the recent accomplishments of the ONR-Kaman Aircraft Corporation partnership is a new device for airborne supply of confined combat areas.

This device, known as a "Rotochute," permits aircraft to drop supplies from lower altitudes at higher speeds and with greater accuracy than is possible with conventional parachutes which, being dropped from relatively high altitudes, are subject to wind drift that makes pin-point landings difficult. Moreover, high-speed, low-altitude drops by rotochute keep the cargo planes below the effective range of large-caliber anti-aircraft fire and greatly reduce the time spent over the drop area.

The rotochute consists of two rotor blades attached to a hub, the entire assembly resembling the rotor of a small helicopter. This pinwheel, in turn, is attached to one end of the standard military M2 supply container used for supply drops. The blades fold back 90 degrees and telescope to one-half their extended length, permitting the rotochute and container to be carried on the external bomb rack of a high-speed aircraft. When the plane passes over the drop area, the container with its rotochute is released in the same manner as a bomb would be released. As soon as the device clears the aircraft, the blades begin spinning and swing 90 degrees into operating position. Centrifugal force extends the telescoped blades to their full length and the container comes to earth at a slow rate much as a helicopter lands by autorotation (power off). Further development of the rotochute will incorporate a device projecting from the nose of the container which, upon contact with the ground, will increase the pitch of the rotor blades, thus further slowing the rate of descent and reducing the impact with the ground.



Kaman Aircraft Photo

Two series of tests with one-sixth and one-third scale models were performed to establish the practicality of the rotochute prior to the more recent full-scale tests. The full-scale model, with the fully loaded M2 container, was dropped at high speed from low-flying F7F's.

The use of rotochutes for dropping men is still in the realm of speculation, but there appears to be some feasibility in the idea of rotochute-equipped pilot-ejection seats.

Generated for member (University of Maryland, College Park) on 2015-08-14 15:17 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

ONR Expands Operations Research

Owing to the vast complexity of modern warfare and the increasing demands of national defense, the Navy has established an Operations Research Division (Code 200) under the directorship of Dr. Harvey Hall, formerly Technical Director of the Naval Sciences Division. The position vacated by Dr. Hall is now filled by Dr. E. H. Seymour, formerly Associate Technical Director (Engineering and Development).

The old Operations Research Group, previously part of the Naval Sciences Division, has been transferred to the new division. At present the principal contractor is MIT, which for several years has been carrying on operations research for ONR and for the Chief of Naval Operations. (See: "Operations Research in the Navy," Research Reviews, Oct. 1952).

Viking XII

To a public that likes to see records broken, the twelfth Viking flight on 5 February was a disappointment. The 45-foot rocket zenithed at 144 miles, far short of the 158-mile record (for a single-stage rocket) set by Viking 11 last May. Out at White Sands, however, setting altitude records is not a primary aim.

The special purpose of the Viking 12 firing was to investigate—through temperature-measuring instruments installed in the war-head—the "thermal barrier," now the number-one problem in supersonic flight. Unlike the sound-barrier, the thermal barrier presents greater difficulties the faster an aircraft travels, and at certain speeds overheating by skin-friction reaches the danger point. The Viking, climbing at speeds up to 4100 mph, is an ideal vehicle for studying these effects.

Kudos

NRL's leading specialist in surface chemistry, Dr. William A. Zisman, was awarded the 1954 Hillebrand Prize by the Chemical Society of Washington. Not long ago he was given the Distinguished Civilian Service Award, particularly for the development of a completely new lubrication system for aircraft machine guns during the Korean War.

Another recipient of the Distinguished Civilian Service Award (the Navy's highest for civilians) was Dr. Harold S. Stewart, also of NRL. The award was in recognition of Dr. Stewart's significant work in the development of nuclear weapons.

Garbled Nomenclature

In reporting, last month, on the International Geophysical Year, Research Reviews should have said that the U.S. National Committee for IGY was selected by the National Research Council and the National Academy of Sciences--not the American Academy of Sciences.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

Generated for member (University of Maryland, College Park) on 2015-08-14 15:17 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

On the Naval Research Reserve

Curriculum Development

The response to the request made by the Research Reserve Officer for local companies to assist in the 'development of curriculum material has been encouraging. Letters from the field requesting further information in the scope and method of preparation of the curriculum have indicated the need for establishing a roughly chronological approach to the development of any section of the proposed curriculum.

A letter recently written to a Commanding Officer who had requested such advice is reproduced herewith, less heading and close, for general guidance.

"Our concept of a roughly chronological approach to develop any section is as follows:

a. Determination of reference sources locally available. Suggested nearby sources would include the NROTC, NRTC, and other Naval Activities in the area.

b. Accumulation and initial scanning of reference material for aptness and adequacy.

c. Initial breakdown of section by subject area, and organization of the company to develop individual lesson plans.

d. Development of the lesson plans and bibliography.

e. Final write-up and review.

Where does ONR (Code 120) come in? First, we will endeavor promptly to fill requests for reference material. Such requests should be forwarded after review of the material locally available, to fill in gaps in the information derived from such material. This approach will enable us to determine roughly what may have to be furnished other companies using the lesson plans developed.

Second, as a need for a training aid becomes apparent we will take steps to find out if an applicable aid is in existence and readily available, or to have one prepared.

Finally we will review the end product, combine it with the other sections, and publish and distribute the whole curriculum. Special care will be taken to ensure that the bibliography required to prepare the lesson from the lesson plan is available to every Commanding Officer.

The format desired follows that used in NavPers 91809, Curriculum for units of the Volunteer Naval Reserve Officer Program. In respect to content, I believe your principal difficulty will arise in limiting yourself to eight lesson plans. The field of logistics [for instance] covers the determination of requirements, procurement and storage (berthing and messing), and distribution of people and things at the executive, administrative and operating command levels. So you can see that there should be no dearth of materials.

Generated for member (University of Maryland, College Park) on 2015-08-14 15:17 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA

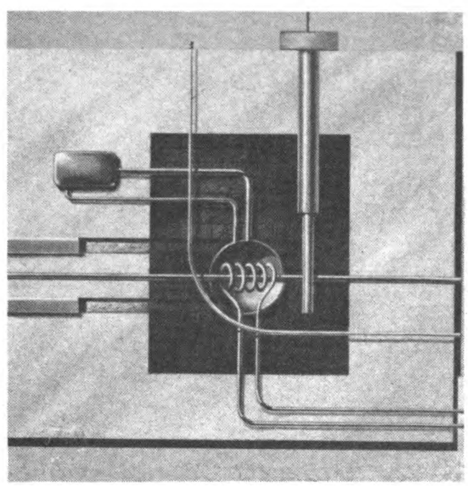
It is suggested that in the early stages of a project, an officer of the company apply for AcDuTra at ONR (Code 120) for assistance in initial orientation and development of source material.

One final comment. It is our hope that when the curriculum takes final form, it will be possible for a company to cover the material in a given lesson by obtaining an expert in that field to address them on the subject or by taking a field trip to an appropriate activity. The lesson plan then would become a guide for the Commanding Officer in directing the questions asked the speaker, or in arranging an informative tour. In other words we want to aid, stimulate and guide the Commanding Officers without establishing a rigid conformancy."

Nuclear Reactor Presentation

In keeping with general theme for the current quarter's curriculum, APPLIED NUCLEONICS, Research Reserve Company 11-4 (San Pedro) heard a talk by Dr. Harry Pearlman the project director of the Atomic Energy Research Department of North American Aviation Inc., at the regular meeting of 19 January 1955. Members of the Petroleum Company and representatives of other branches of the services were present. Through the courtesy of the Commander of the Long Beach Naval Station an announcement of the meeting was made in the orders of the day and active duty officers from the naval shipyard also attended. All members of 11-4, incidently, have either completed or are currently enrolled in the Navy nucleonics correspondence course.

Dr. Pearlman and LCDR Allen



Reactor Model

Dr. Pearlman's presentation described the various types of research reactors, the fuel systems, and coolants now in use. The lecture was unusually well illustrated by a Color Film entitled NUCLEAR REACTORS FOR RESEARCH that the North American Aviation has prepared and which is available without charge. In addition an animated model of a new type water-column reactor was publicly shown for the first time at the meeting.

Generated for member (University of Maryland, College Park) on 2015-08-14 15:17 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA

The new commanding officer of Research company 11-4 is LCDR Myron S. Allen USNR, instructor of physics at the Long Beach City College and a scientific research consultant.

NRRC 3-1 is Six Years Old

NRRC 3-1 celebrated the Sixth Anniversary of its founding with a dinner meeting at the Commissioned Officers Mess at the New York Naval Shipyard on 21 January 1955. Guests of honor were CAPT Alexander Sledge, USN, Commanding Officer of the New York Branch Office, ONR; CAPT Theodore Blanchard, Special Assistant to the Chief of Naval Research; CAPT and Mrs. Robert H. Griffin, the former Commanding Officer of NRRC 3-1 and CAPT Edgar T. Coene, New York State President of ROA and C.O. of BuShips Unit 3-1. CAPT H. B. Stevens, USNR, Commanding Officer, briefly reviewed the Company activities during 1954.

The Company is especially proud of two of its members, LT Charles R. Borders, USNR and LT Robert W. Schubert, USNR. They were closely involved with the design and construction of the "NORC," the giant electronic computer built by IBM for BuOrd—rated as the fastest calculator yet. LT Borders was in charge of development and design of circuits and arithmetic, and LT Schubert had charge of mechanical development and design. The NORC will soon be moved to Dahlgren Proving Ground, so the entire Company planned to visit the present installation on February 24.

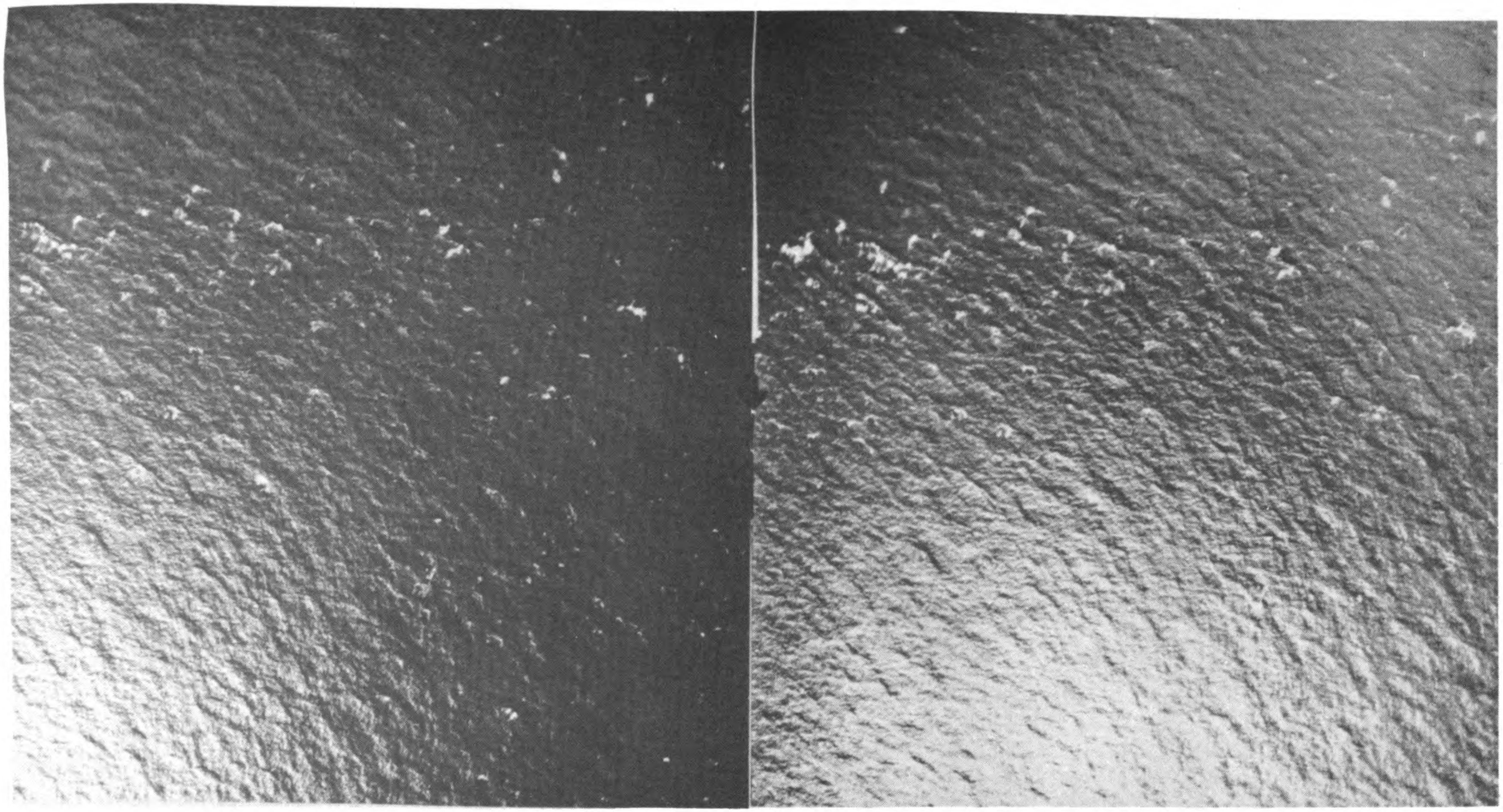
NRRC 3-1 through its Psychological Warfare Panel is sponsoring a series of six Seminars, at 4-week intervals, to be held at the Receiving Station, N.Y. Naval Base, for all Naval Reserve Officers in the Metropolitan area. These Seminars, which were previously presented by the Naval War College, have proved very popular and a large attendance is expected. Point credit for attendance has been approved by BuPers. CAPT William Extons, Jr. is Panel Moderator.

Naval Ordnance Research Computer (IBM Photo)

U. S. GOVERNMENT PRINTING OFFICE : 1955 O - 333838

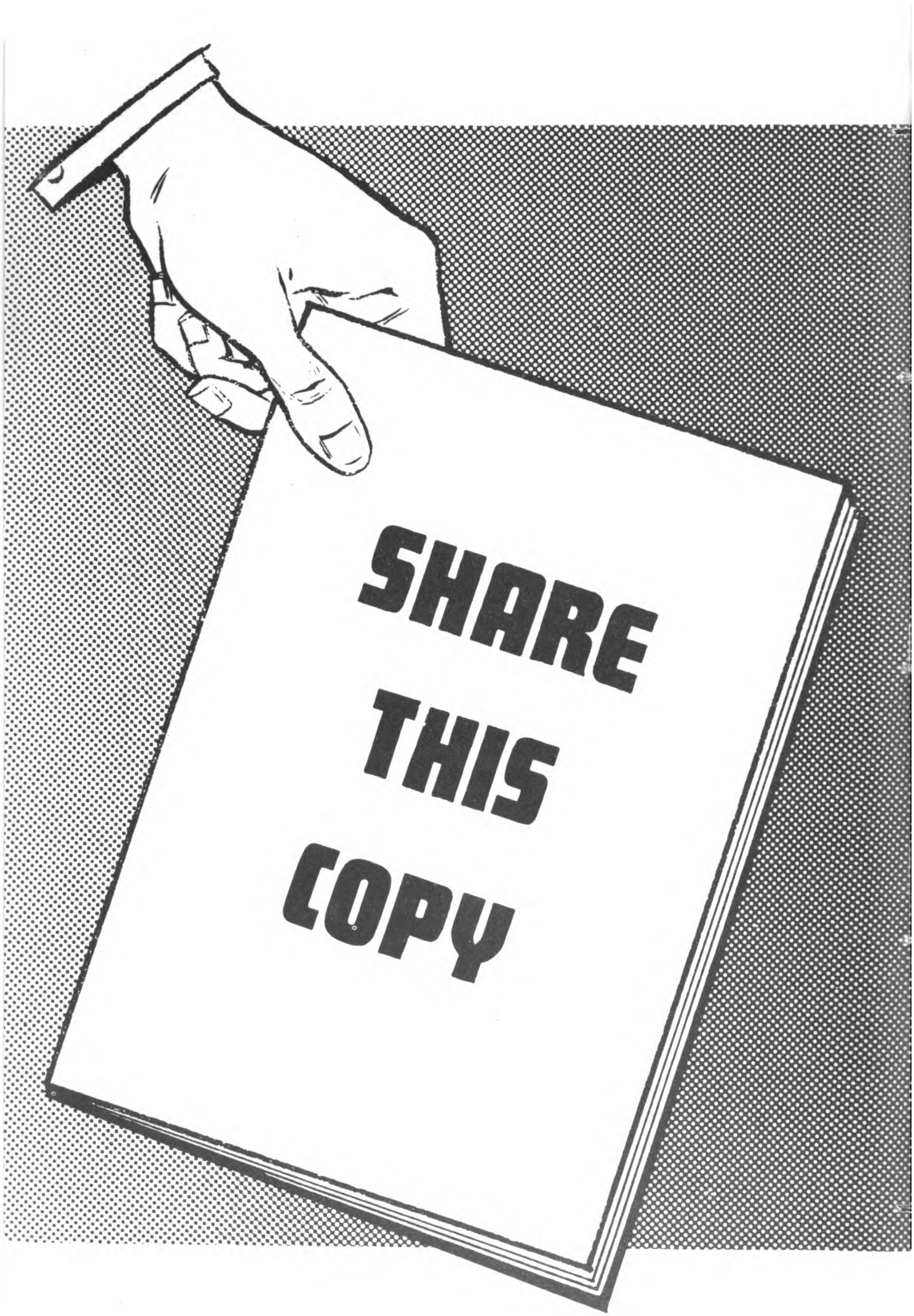
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA
Generated for member (University of Maryland, College Park) on 2015-08-14 15:17 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Generated for member (University of Maryland, College Park) on 2015-08-14 15:17 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google



STEREO PAIR OF OCEAN WAVES. Altitude 3,000 ft, separation 2,000 ft, waves 1-1/2 ft high. (See text, page 16)

Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA



Generated for member (University of Maryland, College Park) on 2015-08-14 15:17 GMT / http://hdl.handle.net/2027/uc1.$b672018
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA