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RESEARCH REVIEWS

Navy's New Fire-fighting Jeep

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One of the nutrition-stress problems that researchers at the Thurston Laboratories were interested in was the effect of diet changes upon resistance to sub-lethal doses of harmful radiation. Here Dr. Ershoff and an assistant, Mr. H. B. McWilliams, prepare animals for exposure to X-rays as part of this phase of the experiments. Liver was found to be helpful in minimizing harmful reactions to such radiation.

Nutrition and Endurance

Benjamin H. Ershoff

...is Director of Research at the Emory H. Thurston Laboratories and an associate professor of biochemistry at the University of California. He has published some 60 papers on nutrition.

Since antiquity the belief has persisted that the eating of certain foods would affect the physical performance of man. Thus the primitive hunter ate the heart of the beast he had slain so that he might gain the courage and cunning of his adversary; and to this day there is a widespread belief that certain foods such as fish and eggs will increase the fertility, libido, and potency of man.

The belief that man may gain the characteristics of his adversary by eating parts of his body no longer is tenable; but the fact that food may affect one's morale, attitudes, mental processes, physical vigor, and the ability to withstand stress is one that modern science has clearly demonstrated.

This was emphasized on a mass scale in the occupied countries of Europe during the war. The Nazis recognized the tremendous importance of B-complex vitamin deficiencies as a military ally and conscious efforts were made to strip the conquered countries of foods rich in these elements. For where the native population was deficient in the B vitamins, their will to resist was undermined; as a group they were more resigned to their fate and less inclined to participate in underground activities and organized sabotage.

It is becoming increasingly apparent that diets which may be adequate under "normal" conditions may be inadequate for resistance to stress. These observations are of utmost importance to the men responsible for the planning and preparation of military rations. Consequently ONR, in collaboration with other Defense Department agencies, is sponsoring research projects to determine to what extent dietary factors affect the ability of military personnel to function under conditions of stress (including hemorrhage, trauma, burns, shock, etc.).

It has been observed that the ability of an animal to survive and recover after extensive injury and loss of blood is dependent to a considerable degree on its nutritional state. Similarly, an animal's diet profoundly affects its ability to survive when exposed to low temperatures (such as occur in Arctic regions), low oxygen pressures (such as occur at high altitudes), or multiple exposures to sub-lethal doses of X-irradiation (similar to that which occurs in the vicinity of an atomic explosion).

Unfortunately results obtained with experimental animals will not necessarily be valid for man. For this reason tests must be repeated on humans before their authenticity for man can be established. In the past, however, man and the rat have frequently reacted in a similar manner to changes in diet.

Investigations in this laboratory have been concerned with the following problems: (1) the effects of mild (sub-clinical) nutritional deficiencies on subsequent resistance to stress; (2) the effects of transient deficiencies on subsequent resistance to stress; and (3) the effects of an unidentified factor (or factors) in liver on animals exposed to diverse types of stress.

It was observed that a sub-clinical deficiency of riboflavin (B_2) or Vitamin A, which had little if any visible effect on animals under normal conditions, markedly impaired their ability to survive under conditions of low temperature. Such a deficiency also increased the lethal effects of X-irradiation in the rat. These findings suggest that diets which may be adequate for military personnel under ordinary conditions may be inadequate if personnel are exposed to low temperatures or other adverse circumstances.

Stated in another way, what we ate last year, last month, or last week may definitely determine whether we recover from shock, from exposure to hard radiation, from injuries, or from being poisoned by chemical agents.

Other findings from this laboratory indicate that once an animal has been nutritionally deficient, its ability to adjust to stress may be impaired for months or even longer after its deficiency has apparently been cured. Thus rats depleted of Vitamin A early in life and then fed large doses of it continued to show an impaired ability to survive exposure to low environmental temperatures months after all symptoms of vitamin deficiency had been ameliorated. There is evidence to indicate that similar results may occur in man.

On the basis of such findings it may be desirable to screen military personnel for a history of past nutritional deficiencies before assigning them to duties where they may be exposed to undue stress. For once a person has been nutritionally deficient, his ability to survive after exposure to low temperatures, atomic radiation, or injury may be impaired for months or even years after the deficiency has apparently been corrected. Obviously such persons will be more likely to become casualties than persons who had never previously been deficient.

One of the most striking findings of this laboratory was the observation that there exists in liver and certain other foods a factor, or factors, apparently stemming from none of the known nutritional elements, which markedly increases the ability of rats to withstand exposure to various kinds of stress. One experiment of particular interest to naval personnel was the demonstration that liver markedly increased the ability of rats to swim in cold water.

Immersion, as the result of falling overboard, abandoning ship, or bailing out, is a real threat to the man at sea. To find out what effect diet has on chances of survival under such conditions, experiments were conducted with three groups of laboratory animals which differed only in respect to the diets fed. Group I was placed on a purified ration containing the various vitamins in synthetic form; Group II's diet was similar but contained increased amounts of the known B vitamins; Group

Laboratory technicians carefully record the swimming time of rats.

III was fed the same purified diet as Group I but received in addition a small daily supplement of liver. Measurements were made of the length of time that rats would swim when immersed in water at a temperature of 68° F before remaining submerged for a period of 15 seconds.

The rats in Group I swam for an average of 13 minutes (range 5 to 29 minutes); those in Group II averaged a similar period (range 10 to 23 minutes). However, only 3 out of 12 rats tested in the liver group (III), swam for less than 2 hours (63, 83, and 87 minutes); all other rats in Group III were still swimming at the end of 120 minutes, at which time the test was discontinued.

The selection of the end point was based on preliminary studies in which it was observed that rats seldom remain submerged below the surface of the water for more than 5 seconds and almost never for more than 10 seconds. As the end point of a swim was approached (under the conditions outlined for Groups I, II, and III), the rat would submerge for periods of 5 to 10 seconds with increasing frequency and could reach the surface only with obvious difficulty. Rats remaining below the surface for more than 15 seconds almost invariably drowned.

Rats fed the liver ration also showed an increased ability to withstand multiple doses of sub-lethal X-irradiation and the prolonged administration of toxic doses of a number of drugs, including thyroid, atabrine, and cortisone acetate.

It is clear that good food for the military man is more than a morale builder; it can actually save his life or make a more efficient fighter out of him. For obviously in the situations of anxiety, danger, and rugged physical conditions that he encounters, the fact that certain foods increase his ability to withstand stress assumes great importance. There are, of course, many facets to the problem that are as yet incompletely understood. When further research throws light on these it is certain that not only the Armed Forces but the population in general will be able to attain greater endurance and improved health.

Methyl Alcohol Poisoning

Albert M. Potts

. . . Assistant Professor of Ophthalmic Research at Western Reserve University, holds a Ph. D. from the University of Chicago, where he did research during the war for the Manhattan Project.

A well-known chemistry professor at the University of Chicago is fond of remarking to his classes how kind it was of Providence to have made at least the second member of the aliphatic alcohols (ethyl or, more popularly, beverage alcohol) relatively non-toxic. Ignorance that this is not true of the first member of the series (methyl or "wood" alcohol) has been the cause of the death and blindness of thousands of persons in all parts of the globe.

Interestingly enough, methyl alcohol or methanol poisoning is, in its origin, a uniquely American problem and a Twentieth-Century American problem at that. Until 1895 only one case of methanol poisoning had been recorded in the world literature; since that time thousands of cases have occurred and for 16 years every one of these was from the North American Continent. The explanation is a curious one. Until 1890 the only methanol available was "wood alcohol," prepared by the dry distillation of wood. This was a nauseating fluid, with an offensive odor, that no one in his right mind would drink. In 1890, however, a practical process was developed in this country for purifying wood alcohol to the point where it was virtually tasteless and odorless. The product was widely publicized as "Columnian Spirits", "Standard Wood Spirits", "Colonial Spirits", "Union Spirits", "Eagle Spirits", "Cologne Spirits", etc. At first manufacturers vehemently denied the toxicity of their product, and later they made every effort to conceal its poisonous nature. This tax-free material sold at 50 cents per gallon, as compared to $2.50 per gallon for taxed grain alcohol. These two factors— cheapness and cultivated ignorance— were an irresistible sales booster which caused death or blindness for many a thirsty customer. In 1904 a report of 275 cases was presented in the Journal of the American Medical Association with a plea for stopping the manufacture of "Columnian Spirits" and substitution instead of a cheap denatured ethanol. This was never done, however, and in the middle Twenties the advent of synthetic methanol made from carbon monoxide and hydrogen put an even purer and cheaper and consequently more dangerous product on the market.

Thus, ever since the turn of the century, when access to sufficient quantities of ethyl alcohol has been denied— as it was in the Prohibition Era or among the Armed Forces in the two World Wars— cases of methanol poisoning rose alarmingly above the usual number caused by "smoke" drinking along skid row. In World War II the astounding proportion of six per cent of all blindness in the Armed Forces was due to methyl alcohol intoxication! And this statistic does not even include patients who died blind from the poison. More recent literature contains five reports from the United States Navy alone concerning 127 cases of methanol poisoning in World War II. Moreover, this is by no means an

Radioactive methanol was used to follow the course of the poison through the body. Here a research assistant operates an apparatus used in this phase of the experiments. It is used for combustion of the C^{14} methanol.

exhaustive account, but merely the product of those medical officers who reported their cases in the literature. Sources of methanol supply cited in these reports included such varied items as Japanese fuel, refrigerator leak detector, and anti-freeze.

These figures give some idea of the magnitude of the problem but not of its complexity. Of all problems of poisoning of this magnitude few are in such a muddled state scientifically as this one. This is in part

TABLE I. The Certain Lethal Dose of Aliphatic Alcohols

	Rabbit		Man	
Alcohol	gm/kg	m.mol/kg	gm/kg	m.mol/kg
Methyl	14.2	450	1-1.25	31-39
Ethyl	10.0	215	6-8	130-175
Propyl	2.8	47	-	-
Butyl	3.7	46	-	-

From various sources in: Von Oettingen, The aliphatic alcohols; Public Health Bulletin 281, U. S. Government Printing Office (1943).

understandable if one considers its unique difficulties. Let us first look at the difficulty of establishing the human toxic dose. Wood alcohol, before being drunk by humans, is usually mixed with varying amounts of other fluids— water, fruit juices, or ethyl alcohol-containing liquids. This type of dilution is haphazard at best, but when one adds to this the difficulty of getting information on the dilution or amount taken from a habitual alcoholic, a semi-comatose individual, or a criminally liable supplier, the problem of establishing how much a patient drank is a serious one. Add to this the unknown effect introduced by the presence of ethyl alcohol and evaluation is very difficult indeed. It has been said on good authority that two teaspoons (8 cc) of methyl alcohol may make a man permanently blind and one ounce (30 cc) may kill him. The dose

One of the dangerous advertisements common at the turn of the century.

generally accepted as lethal, however, is about 75 to 125 cc; and cases are on record of individuals surviving amounts up to 260 cc with no signs of poisoning. Of course a certain variability of response is noted in the effect of any poison, but this amount of variability is beyond the expected range. A multitude of explanations has been offered, but none is wholly satisfactory.

A second source of confusion lies in the difference in response between man and experimental animals. Ingestion of a lethal dose of methanol in man is not followed immediately by any striking symptoms. Even inebriation is minimal— far less than that produced by an equivalent amount of ethyl alcohol. This latent period usually lasts for 24 to 48 hours, but can be shortened to 6 to 12 hours by extremely high doses. The end of the latent period is marked by the onset of dizziness, nausea, and severe abdominal cramps, followed by dilated pupils, loss of vision, cyanosis, coma, and death. The time between the onset of symptoms and death may range from 2 to 24 hours. A large percentage of the survivors of a near-lethal dose are totally blind and many others have a central blind spot which reduces vision to 10 percent of normal. A laboratory finding which is quite uniform in humans is an uncompensated metabolic acidosis. The acid formed is unidentified but is known not to be acetone bodies, lactic acid or formic acid. Many authors claim miraculous cures solely as a result of combating the acidosis with intravenous antacids and one of these papers, which presented a controlled series of cases, is quite convincing in this respect.

Contrast with this the fact that in the ordinary laboratory rodents the LD_{50} (i. e., the dose that kills 50 percent of the animals) is 10 - 11 gm/kg (grams per kilogram of body weight), roughly ten times the figure (75 to 125 gm/70 kg) quoted for man above. In animals there is no latent period, but immediate coma from which the animal never recovers.

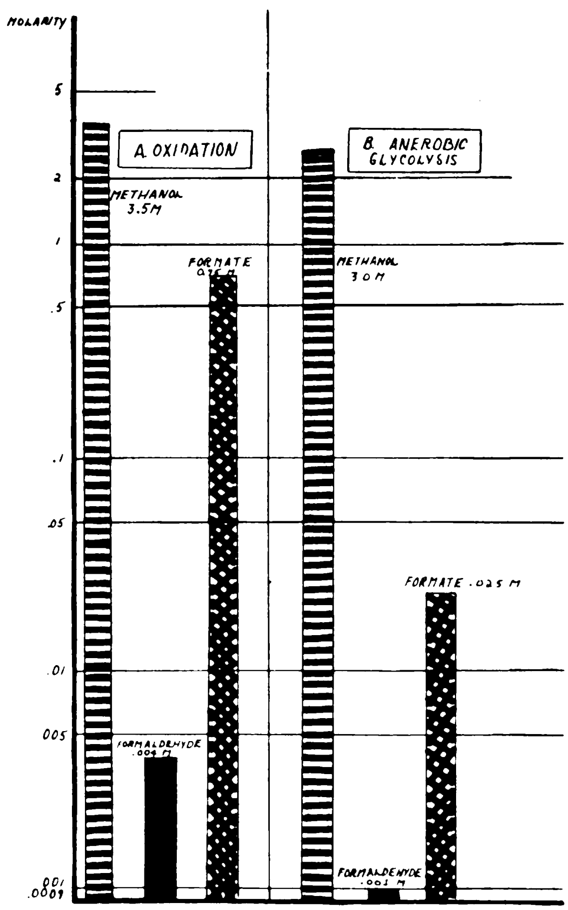
Notice the misleading words "pure refined spirit for domestic use".

Moreover, there has been no unequivocal demonstration of acidosis or of blindness in experimental animals. Thus it begins to appear that one is dealing with two separate entities. In other words, methanol may poison man and experimental animals in two different ways. Thus, extreme caution must be exercised when drawing conclusions from animal experimentation.

Further complicating the picture is the problem of the proximal toxic agent—i. e., what is the specific substance that actually causes death? Because animals do tolerate moderate doses of methanol well, and because of analogy with other alcohols, some workers have said that methanol is not the actual toxic agent. They believe that some other substance—either present as an impurity or formed during metabolism of methanol in the body—is the true noxious substance. The idea that impurities cause methyl alcohol poisoning, however, was pretty well discredited when the advent of synthetic methanol demonstrated that it was just as poisonous as wood alcohol. Even as late as 1936, however, a leading textbook attributed methanol toxicity to fusel oil contaminants.

The idea that a metabolic product—not the alcohol itself—really does the poisoning has gained support, and those who claim that methyl alcohol itself is the proximal toxic agent have diminished with the years. There are many who claim that formaldehyde or formic acid, the two intermediate oxidation products between methanol and carbon dioxide, are the actual poison. Ferdinand Flury, the eminent German toxicologist, was an enthusiastic proponent of the formaldehyde theory. Flury was, perhaps, the first to point out that whereas formic acid is a fairly toxic substance, the actual oxidation product found in tissues is sodium formate, a compound well tolerated by the animal body. Keeser and Vincke demonstrated that if conditions were properly adjusted, formaldehyde could be detected chemically in minced liver incubated with methyl alcohol. If too much liver is present, no formaldehyde is found because it combines with the tissue and disappears. Failure to find formaldehyde was one factor which made earlier workers minimize its role in methanol poisoning. More recently the extensive studies of other investigators have brought the formic acid theory into prominence once more, although no direct proof is adduced for its preeminent role.

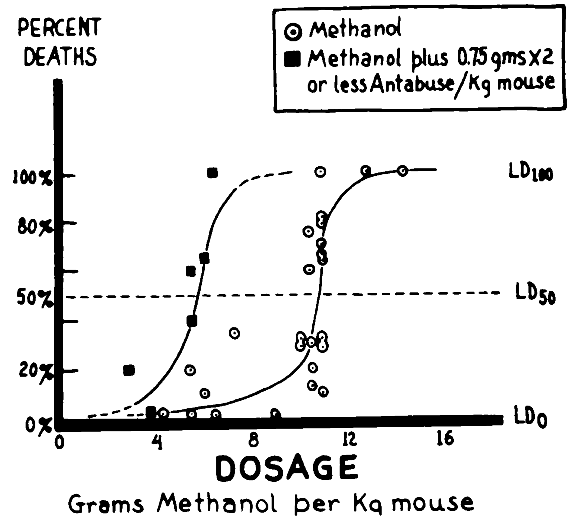
Let us summarize the areas in which confusion exists. Methanol is a toxic substance whose LD50 for humans is unknown and whose very nature precludes gathering accurate data. The available figures show extreme variation in individual human susceptibility and a marked difference between humans and experimental animals. The latent period and the severe acidosis characteristic of human poisoning are totally lacking in experimental animals. The nature of the proximal toxic agent is completely unknown; three compounds— methanol, formaldehyde, and formate— have each been violently accused, with a half dozen impurities playing minor villainous roles in the literature.



Levels of methanol and oxidation products which give 50 percent inhibition of retinal metabolism are shown here.

In considering what contribution the Western Reserve group might make to this 50-year-old problem it seemed to us that it might be well to try a fundamental rather than an empirical approach. If one were able to understand the basic biochemical process involved in methyl alcohol poisoning, a rational therapy might present itself.

One of the areas of special interest was the nature of the proximal toxic agent. Since we are particularly interested in the effects of methanol on vision, we have conducted a series of in vitro experiments on surviving retina, using inhibition of the metabolic activity of the retina as a measure of toxicity. Methanol, formaldehyde, and formate were investigated in turn, and it was found without exception that the most toxic substance of the three was formaldehyde. The most susceptible metabolic activity proved to be the utilization of carbohydrates in the absence of oxygen (anerobic glycolysis). Subsequent work has shown the inhibition to be localized in an important enzyme (hexokinase) essential for this mechanism. The extreme degree of inhibition can be seen in the graph on page 8. It is evident that formaldehyde is 3, 000 times more active than methanol and 25 times more active than formate in producing this effect. If one assumes that 8 or even 30 cc of methanol can produce blindness, and if one assumes 100 percent conversion to formate or to formaldehyde, the only substance of the three present in amounts large enough to damage the retina of a 150-lb man, for example, would be the formaldehyde. As a matter of fact, only 18 percent conversion of the formaldehyde would be necessary. This is a crude oversimplification, but it clearly points out that formaldehyde is the only substance present in anywhere near the concentrations necessary to damage the retina.



Effect of antabuse on methanol toxicity. Note the sharply increased toxic effect.

In another study of methanol poisoning in mice it was found that a subtoxic dose of Antabuse (an anti-alcoholism drug) roughly doubled the methanol toxicity (i. e., halved the LD_{50}). It is believed that Antabuse, when given to individuals before a dose of ethyl alcohol, inhibits the further oxidation of ethanol beyond the acetaldehyde stage. Thus acetaldehyde accumulates and makes the imbiber sick. It is our conclusion that methanol toxicity is likewise increased by inhibiting oxidation of methyl alcohol beyond the formaldehyde stage, allowing formaldehyde to accumulate. This is substantiated by later work in which we found that certain substances which neutralize formaldehyde counteracted the additional toxicity due to Antabuse, but not the initial toxicity of the methanol itself.

Actually this paper has touched on only a few of the aspects of the problem which we are studying. There are many others under investigation, for the problem is a complex one. At present one is faced in methanol poisoning with an entity like an iceberg—much more extensive than it appears on the surface. On the basis of work to date one can approach the problem with some hypotheses—educated hunches, perhaps—only partly substantiated by experiment. It is our sincere hope that further experimentation will bring this strangely redoubtable problem nearer to a satisfactory solution.

A Unique Multiple Tube Manometer

H. W. Ibser

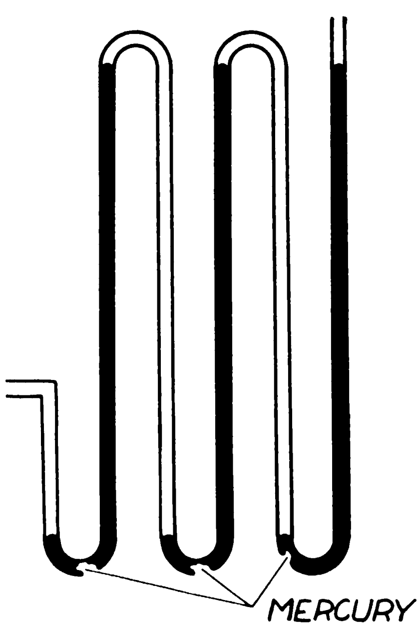
...who holds a M. S. from the University of Wisconsin, is writing his Ph.D. thesis on experiments made with the manometer.

John R. Roebuck

...a graduate of McGill University, was on the teaching staff of the University of Wisconsin until his retirement in 1947.

The oldest and simplest way to measure fluid pressures is to use a glass U-tube containing a liquid whose displacement into one of the arms of the tube indicates the pressure applied to the other arm. In order to measure higher pressures, early physicists merely made the branch of the "U" in which the liquid rises longer. During the nineteenth century the French physicist Amagat constructed in a mine shaft a mercury-containing column hundreds of feet long, and his countryman Cailletet attached a similar tube to the Eiffel Tower in Paris. The lack of temperature control of the mercury in these columns made precise measurement with them impossible, although Cailletet used the clever scheme of stretching along the Eiffel Tower manometer tube a wire, the electrical resistance of which served as an index of the average temperature of the mercury column, so that the density of the mercury could be calculated.

The determination of high pressures by somewhat less heroic measures was made possible by the advent in German and Dutch laboratories of the multiple column manometer. Such an instrument, shown below, consists of a number of mercury columns placed side-by-side between common top and bottom levels. The pressure generated by the first mercury column (the right-hand column in the figure below) is transmitted, by a fluid less dense than mercury, from its lower end to the upper end of the second mercury column; the pressure at the lower end of the second column is similarly transferred to the top of a third column, etc. Oil, water, and gases have been used for transmitting pressures between the mercury columns of such instruments. The total pressure generated is nearly equal to that of a single mercury column n times as long as any one of the n columns actually used. A multiple manometer capable of measuring approximately 30 kg/cm^2 may be conveniently housed in a rather ordinary laboratory room; one built of glass has, in fact, been installed at the National Bureau of Standards. The problem of temperature control is much simpler than for an equivalent single tube, so that movement



Multiple column manometer.

of the mercury surfaces during a reading because of thermal expansions and contractions of the manometer fluids can be adequately limited.

Lower end of the multiple tube manometer in operation at University of Wisconsin.

The careful determinations of the thermodynamic properties of fluids which have been made at the University of Wisconsin have led to the development of a unique instrument for the precise measurement of pressure—a nine-column manometer with a range of 200 kg/cm^2. About 57 feet high, it is housed in a shaft extending from the basement to the fourth floor of the building in which the Department of Physics is located. The manometer tubes are of steel, as glass is unreliable at the pressures used, and steel is the only common metal not attacked readily by mercury. The steel tubing used has an inside diameter of about 1/16 inch and an outside diameter of 1/4 inch; it does not stretch appreciably at 200 kg/cm^2, and less than a liter of mercury suffices to fill the nine columns.

The liquid used for transmitting pressure between the columns is toluene (C_7H_8), chosen because it is a pure compound and therefore not subject to change of density by evaporation or other means; moreover, it does not attack steel or mercury. Its specific gravity is about 0.86 at room temperature. It is available, highly purified, at moderate cost.

The toluene-mercury surfaces can be observed through windows made of transparent bakelite. These windows, in the form of tubes, are supported by heavy steel jackets into which they are inserted after having been shrunk by cooling. Each bakelite tube is made about two thousandths of an inch larger in diameter than the hole in the steel jacket, at room temperature. When both are then cooled to liquid air temperature the bakelite tube, which contracts more than the steel jacket, is about one thousandth of an inch smaller than the hole, and may be easily slipped into place within the jacket. Then the assembly is slowly warmed to room temperature. Light can be transmitted through the bakelite tube by means of two narrow slots in opposite sides of the steel jacket, parallel to the axis of the tube. Such a prestressed bakelite tube experiences only compressive stresses, not tensions, when subjected to fairly high internal pressure; one of ours has withstood pressures of 400 kg/cm^2.

The lengths of the mercury columns of the manometer are read by two operators, one at the top and one at the bottom of the shaft. The levels of the mercury-toluene surfaces for each column are read simultaneously by the upper and lower operators, using short-focus telescopes which can be swung on vertical axes from the surfaces to a measuring tape. The invar measuring tape used was made for the purpose by the Swiss Societe Genevoise d'Instruments de Physique.

During a reading, the average temperature of the manometer used for calculating the densities of the mercury and toluene is obtained from thermometers located at several levels. The steel tubes composing the manometer proper are surrounded by a circulating bath of kerosene, but they are so extensive that it is difficult to hold the manometer's temperature constant to within less than a few tenths of a degree centigrade. This and other possible sources of error make it desirable to determine the consistency of the manometer's readings when the instrument is balanced against an independent pressure source known to be constant. It is difficult to produce such a source having a pressure approximately equal to the maximum pressure obtainable from the manometer; we have used the expedient of testing the manometer against a rotating piston gage.

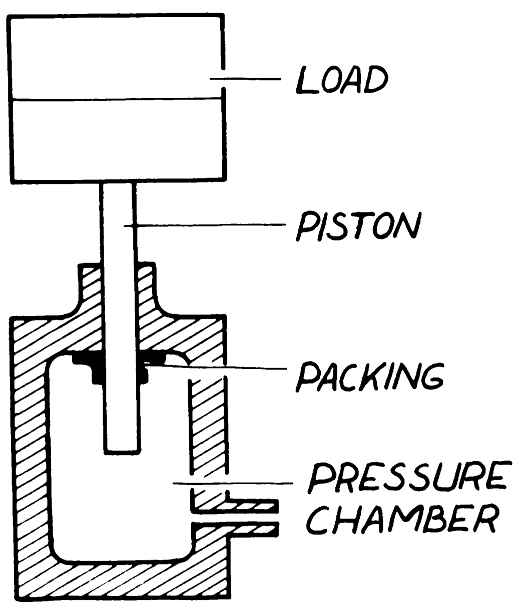
A rotating piston gage (below) consists essentially of a carefully made cylinder, the lower end of which extends vertically through the wall of a strong pressure chamber filled with liquid, and the upper end of which is loaded. The pressure inside the chamber will be equal to the load on the piston divided by the cross-sectional area of the piston.

By rotating the piston, the effect of static friction between it and the packing through which it enters the chamber can be eliminated.

Our piston is of 5/8-inch diameter, uniform within about two wavelengths of yellow light. Although this precision approaches the best practically attainable, the corresponding variation in the cross-sectional area of the piston is more than one and one-half parts in 10,000. We can, however, increase the sensitivity to better than one part in 10,000 by using a particular zone of the piston when balancing the manometer against the piston gage in order to test the manometer.

Since the piston load need not be changed in making a series of test balances, no very accurate knowledge of its magnitude—about 870 pounds to generate 200 kg/cm^2 — is needed.

Manometer readings made against the rotating piston can be reproduced to within one hundredth of one percent. The test reflects errors of both the piston gage and the manometer; the latter is probably even more reliable than the test indicates.



A rotating piston gage used to test the consistency of the manometer.

Who's Who in Naval Research

Dr. John N. Adkins

Ever since ONR's Earth Sciences Division was established its Director has been Dr. John N. Adkins. The Division's rather general title covers some 284 projects, embracing physical and geophysical fields ranging from under water acoustics to the military aspects of human geography. Appropriately, Dr. Adkins is a geophysicist whose specialty is earth-physics. Behind a quiet and unassertive front, he is also a capable and experienced scientific administrator.

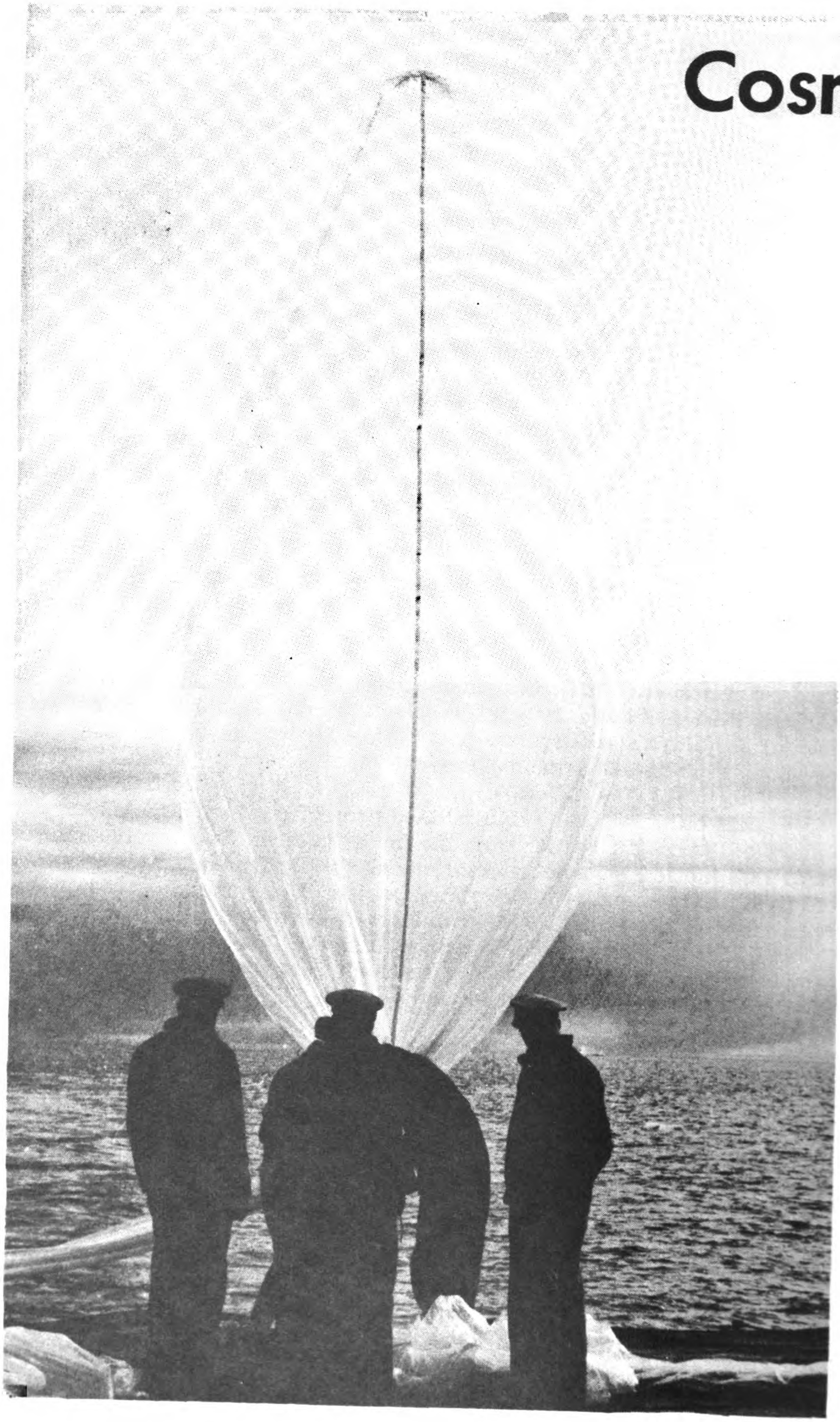
One of ONR's youngest division heads, Dr. Adkins was born in Spokane 41 years ago. A good while later he went south to Stanford, transferred to Sacramento, and ultimately graduated from the University of California in 1936. He stayed on at Berkeley with a teaching fellowship and obtained a Ph. D. in seismology in 1939. The National Research Council then granted him a fellowship at MIT and shortly after Pearl Harbor he joined a small group from MIT working under Louis Schlicter on submarine detection from the air.

This early work led to a related project in which Dr. Adkins and others of the original group were the investigators. The development of MAD (Magnetic Airborne Detector) under OSRD "Division 5" was one of the first assignments. As a related project, Dr. Adkins worked on the evaluation of the British ASQ, which was somewhat similar to MAD. Other OSRD assignments for the group took Dr. Adkins from the laboratory in New London, Conn. where so much work was done on detection, to other laboratories at Quonset and Mineola, L. I.

When the War was over he stayed on at Mineola, working on military contracts conducted by the Airborne Instruments Laboratory—a private concern which continued the government research left over when OSRD activities were terminated. In the fall of 1946, however, Dr. Adkins went back to MIT, this time as Assistant Professor of Geophysics. In 1948 he was loaned to ONR and before his time ran out the Earth Sciences Division was established and he was asked to be its Director.

At present there are four branches under his direction: Geophysics, Geography, Acoustics, and Field Projects. The first includes oceanography, meteorology, and solid-earth— or terrestrial—physics. The second covers physical geography and extends into the special fields of photo-interpretation and Arctic research. The acoustics contracts include underwater sound as well as the phenomena of sound as a field of physics. The fourth category— "Field Projects"— is a sort of omnibus appellation that covers the strictly military application of the other three.

Cosmi

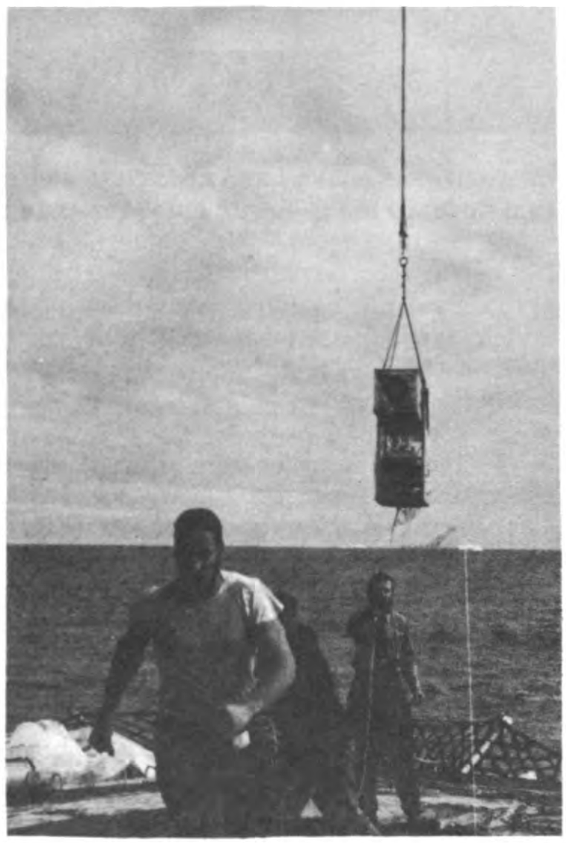


ıys at Geomagnetic Zero

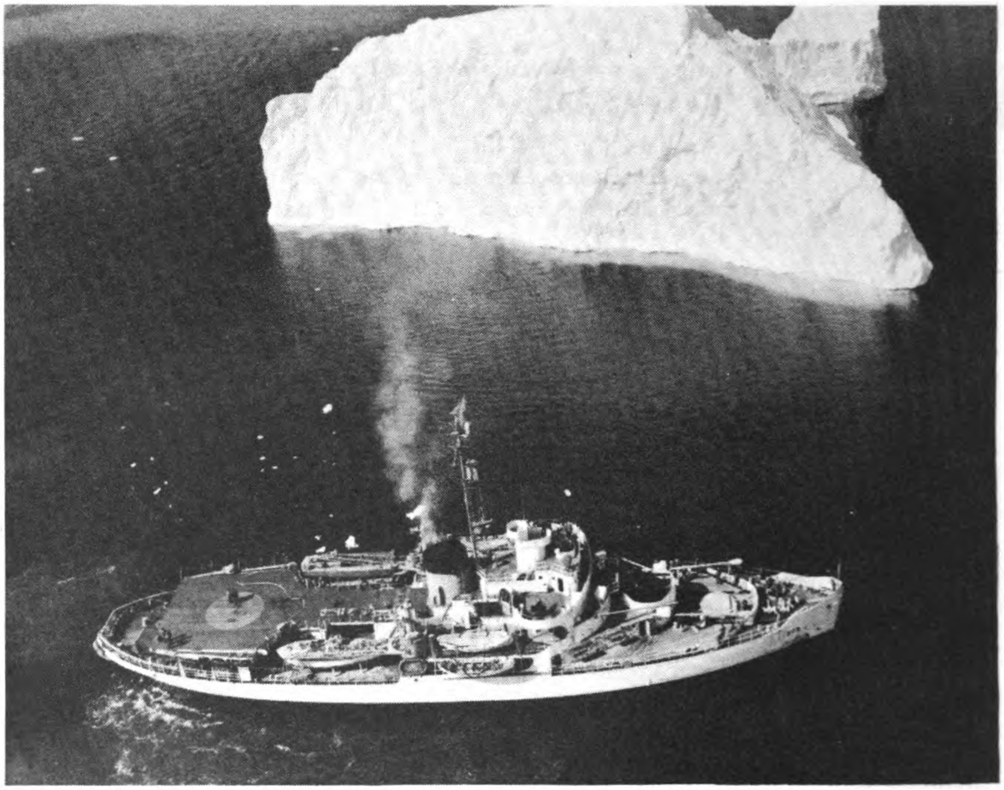
Navy researchers are using the Far North as their latest jumping-off place for exploring new frontiers of knowledge.

Many a record fell by the wayside recently when ONR scientists climbed to the "top of the world" to launch balloon-carried rockets from the U. S. Coast Guard icebreaker EASTWIND. It was the first time such measurements had ever been made so close to the North Geomagnetic Pole; it was the first time rockets had ever been launched from balloons; and it was probably the first time a ship operating under its own power had ever been able to penetrate so far north. The icebreaker EASTWIND was eventually forced by the heavy ice pack to Latitude 82° 38′ 20″. The Geomagnetic Pole is generally considered as being at 78° 30′N, 69° 0′W in western Greenland, near Smith Sound.

The objective of the journey was to get more data on the still-mysterious cosmic ray particles which originate in the sun. The project was part of an ONR program which supports study of cosmic ray physics over the entire surface of the earth. Actually such investigations at the Geomagnetic Pole were expected to have unusual significance. On most parts of the earth the magnetic field deflects the approaching cosmic-ray particles so that they travel in a curved path. If the energy of the particle is below a certain critical or "cut-off" energy for its particular direction of approach, it will never reach the earth. Thus, at most places on the earth, there are wide variations in the cosmic radiation. At the Pole, however, the field causes a minimum deviation. Thus low-energy particles have a greater chance to "get through". Scientists felt that if it were possible to get above most of the earth's atmosphere at the Pole, it would be possible to



A neutron counter is being launched on a balloon as a scientist races to man a radio receiver. Shown opposite is the tow balloon which will hoist the radio transmitter aloft so that it can send back data on the flight of the neutron counter.



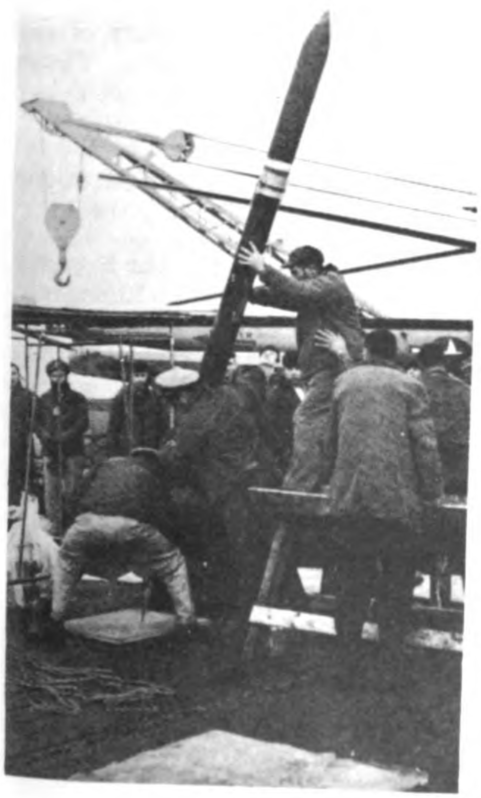
measure the energy and charge of the incoming primary cosmic radiation down to much lower energies than at any other place on earth.

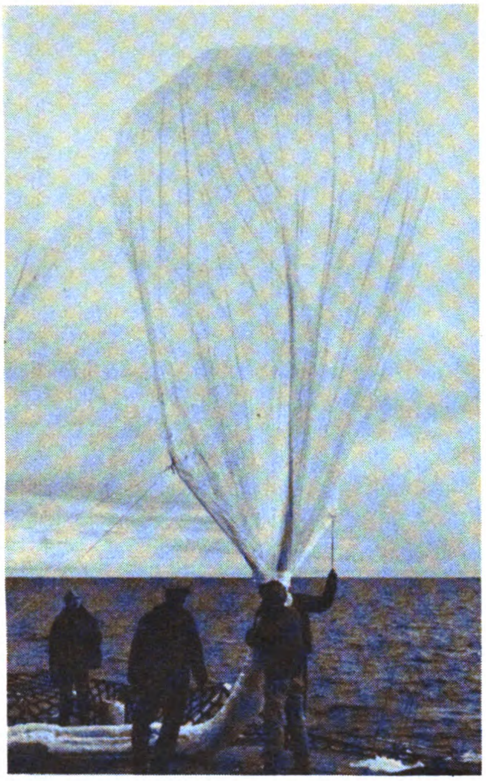
To get above the earth's atmosphere the scientists used thin-skinned plastic balloons, manufactured by General Mills, ranging in diameter from 55 to 85 feet. These carried three types of experiments: balloon-rocket experiments; neutron counter experiments; and nuclear emulsion plates.

The balloon-rocket experiments were, perhaps, the most interesting and unique of the three. Navy Deacon rockets, originally designed by the Bureau of Aeronautics for weather investigations, were launched on the balloons to altitudes of about five miles, where a very simple mechanism fired them almost vertically upward. Some of them traveled to altitudes of about 40 miles. Each one carried either a Geiger counter or an ionization chamber to measure the primary cosmic radiation. These data were telemetered back to the EASTWIND, and there recorded and analyzed. Thus it was unnecessary to recover the rockets amid the icy wastes. The great advantage of these experiments was that though the rockets were very small (about 8 inches in diameter and 11 feet long) they were able to reach altitudes comparable to those attained formerly by much larger and more expensive missiles.

Equipment recovery was attempted in the case of the nuclear emulsion plates, but without much success. These plates, which record the passage of cosmic radiation through photographic material, were flown to altitudes of about 90,000 feet. One set of the equipment parachuted to Ellesmere Island and another to the Greenland Icecap, within ten miles of the Geomagnetic Pole. Unfortunately snow storms prevented Navy

Coast Guard and Navy photographers recorded almost every phase of the operations. Opposite is an aerial shot, taken from a helicopter, of the EASTWIND en route to the launching site. At right personnel are tying lines on the balloon to keep it from twisting as it rises. Below (at left) one of the rockets is being lifted to an upright position so that it can be hoisted by the inflated balloon. At right a cellophane cover is being placed over it to protect the scientific instruments from freezing in high-altitude cold. Once above the clouds the rocket is warmed by the sun and the jacket retains the warm air against it as it rises even higher.





The balloon has started to rise as helium is introduced into its head.

Take-off! Lines have been cut and the next stop is at about 40,000 feet.

helicopters from recovering the equipment, though there is still some hope that it may be found during the spring by Greenlanders or Eskimos.

The neutron counter experiments measured the intensity of the neutron component of cosmic radiation as a function of altitude. These measurements were a continuation of experiments carried out at lower latitudes with the same type of equipment.

Nine civilian and naval scientists from many different institutions participated. They included:

LT M. S. Jones, Jr., CEC, USN, Project Director for the Nuclear Physics Branch, Physical Sciences Division, Office of Naval Research; Dr. J.A. Van Allen, Professor of Physics, State University of Iowa, Iowa City, Iowa; L.H. Meredith, Department of Physics, State University of Iowa; L. F. Blodgett, Department of Physics, State University of Iowa; Dr. M. J. Swetnick, Assistant Professor of Physics, New York University, New York City; R. K. Soberman, Department of Physics, New York University; H. Neuberg, Department of Physics, New York University; J. R. Smith, Aeronautical Research Laboratories, General Mills, Inc., Minneapolis, Minnesota; and H. E. Froehlich, Aeronautical Research Laboratories, General Mills, Inc.

On the whole most of the balloon launchings were considered highly successful, but it is too early to determine exactly what scientific results were obtained. It is safe to predict, however, that when the laborious process of analyzing the data is completed, our knowledge of cosmic ray physics will be greatly expanded.

The Sea and the Land

George F. Carter

. . . Chairman of the Geography Department at Johns Hopkins University's Isaiah Bowman School of Geography, directs an ONR project aimed at determining ages of Chesapeake Bay terraces.

The "restless sea" is a phrase often used but usually applied to periodic tides and wind-blown waves. In a broader sense the sea is also restless in that it shifts its boundaries in relation to the land. One usually thinks of these great changes as having occurred in past geologic times and having little to do with modern problems. But if we concentrate on the past million years we find that the sea has been and still is actively moving. The rates of change are of significance, even in practical ways, and in geologic terms they are spectacular.

For example, the tidal gauge records at Baltimore and elsewhere along the Eastern Seaboard indicate that since 1900 the sea has been rising at varying speeds: From 1930 to 1947 at the rapid rate of .02 foot per year, seven times as fast as it rose from 1895 to 1930. Thus the total rise since 1895 has been about five inches—a rate which, if continued, would be catastrophic to such low-lying lands as the Delmarva Peninsula. In fact, had the sea moved at the 1930-1947 rate since colonial times, there would have been a six-foot change in sea level—definitely noticeable in dock works. A quick check of such installations, however, shows that they are not six feet too low! Thus we may conclude that sea level was changing at a faster rate from 1930-1947 than in other years since colonial times.

But why should the sea be rising in this century, and how do we know that it is the sea and not the land that is moving? The first part of this question is relatively easy to answer. During our own century, there has been extensive thawing in high latitudes. Permafrost has been retreating rapidly, forests have been moving north, and glaciers and ice caps have been melting at spectacular rates. Since glaciers and ice represent cubic miles of water locked up on the land, land-ice melt adds water to the sea, causing its level to rise. We have, then, two observed phenomena: First, tide gauges indicate a rising sea level in the Twentieth Century; second, studies of glaciers and climate indicate extensive ice melt. The connection between the two is obvious.

That land moves is also known, and it may be assumed that some lands bordering the sea are now in motion. Such movements, however, which may be either up or down, tend to be localized and generally are slower than changes due to ice melt. It is well known, of course, that the land near the ancient ice caps is still rebounding relatively rapidly from depression caused by the weight of the ice. Parts of Finland, for example, are growing rapidly as land emerges from the sea! But it is worth repeating that such land movements are local, and probably exceptional; furthermore, every case must be proven by examining each local area separately. On the other hand, we know the sea has been and is now rising throughout the world.

This raises questions of practical importance. Is the sea going to continue to rise at this rate? How far could it go if all the ice were to melt? Is it possible or advisable to take such possibilities into account in planning shore installations?

Estimates of the amounts of ice on the land (principally in Antarctica and Greenland) indicate a possible ultimate sea-level rise of about 100 feet. We can hardly plan for such a contingency! The shoreline of the whole world would be drastically changed. The East and Gulf coasts of America, for example, would be altered beyond recognition. Long Island, most of New Jersey, the Delmarva Peninsula, most of Florida, and great slices of the other coastal plain states would be under water. The Chesapeake Bay would cease to be a bay, while an inland sea would be created in the San Joaquin-Sacramento Valley; the Imperial Valley would become an extension of the Gulf of Lower California!

Is this likely to occur? If so, when? These questions are hard to answer, because some of the evidence is a bit contradictory. In general during Recent time[1] sea levels have risen, but they have not done so at a steady rate. This makes prediction a touchy business. For example, since the time of Christ sea level seems to have been remarkably stable. The ancient harbor works in the Near East do not seem to be seriously out of line with modern sea stands; the dock installations at Caesarea, partly built in the time of Herod, are still sound. This would not have been true, of course, if sea levels had been rising at the 1930-1947 rate for thousands of years. One explanation for this puzzling situation is that the stability of the sea levels may be more apparent than real; that is, during the 2000 years since Christ, the sea may have fallen slightly and then returned to present levels. Moreover, we must remember that 2000 years in geologic terms is not very long. Thus the fact that sea level has remained relatively stable during this time does not mean that it has reached its peak. These suppositions, however, do not help us in our attempts to predict the immediate future. Since the level of the sea has changed in an irregular way since the end of the last ice age, we have nothing consistent on which to base any detailed forecast.

It is not, however, impossible to guess the general trend. Though there have been periods (i. e., the last 2000 years) when sea level has seemed to change little, an over-all view of Recent time shows that there have been generally rising sea levels accompanying fluctuating but progressive retreat of the glaciers. It is something like the frog who jumps three feet up the hill and falls back two; eventually he will reach the top, though his progress may be intermittent and slow. Likewise, though there may be interruptions in the melting of glaciers and the rise of the sea, progress, from the over-all viewpoint, is steady and consistent.

One thing, at least, is certain: We are in the terminal phase of a glacial period and this means that we should expect rising sea levels.

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[1] Recent time is the geological term for the period since the major retreat of the last ice age began, variously estimated at 12,000 to 25,000 years ago.

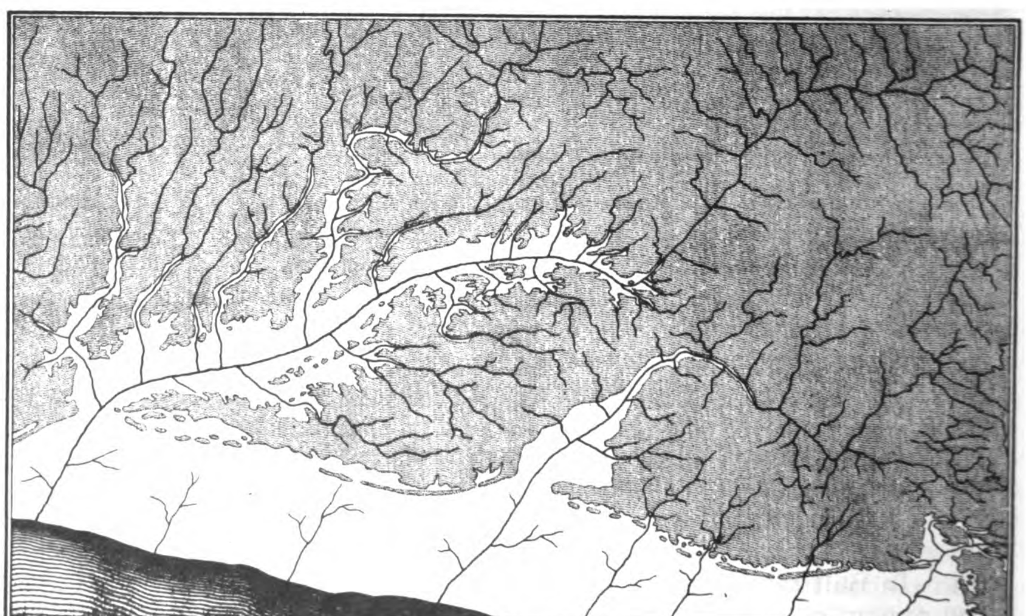
An approximation of the shore lines that would result in the Chesapeake Bay area from a melt of all of the remaining land ice in the world.

True, we cannot prove that the oceans will continue to swell, but the ice is available for melting, and we have past records to show what effect this produced before. Thus conservative planning of harbor installations should provide for an 18 to 24-inch sea level rise within a century.

In this connection it would be interesting to take a look at some of the installations on the Atlantic Seaboard which have passed the century mark. I don't know the history of our naval installations in detail, but I am sure that some have serious erosion, drainage, and flooding problems. In Baltimore's inner harbor, for example, the filled land is flooded on every "exceptional tide" today. Did this happen 200 years ago when this land was filled? Or did they then have about 24 inches of clearance which a rising sea has now over-reached? It would also be interesting to know about San Diego Bay, where very extensive dredging operations have made land for both civil and military bases. Did the engineers allow for a rising sea there and the prospects of drainage, flooding and erosion a century from now?

We can take a longer view of this problem and still find that it applies to modern times. When the sea stood 300 feet lower than it does today, the gradients of all streams entering the sea must have been changed and valley trenches must have been cut across the Continental Shelf.[2] Although there should be as many of these as there are streams reaching the sea, only a few are known! This means either that we have a very inadequate understanding of the details of the Continental Shelf (which is entirely possible) or that most of the valleys were filled with sediment as the sea rose.

The latter supposition is borne out by an examination of the delta of the Mississippi River, which shows that a deep filled valley[3] does indeed exist there. In the case of the Susquehanna, the situation is not quite so clear. It is certain that in glacial times this river, with its tributaries, the Potomac, Rappahannock, and James, must have been a mighty stream. Thus it should have cut a valley across the Continental Shelf comparable to its great drowned valley,[4] the Chesapeake Bay. A study of the Chesapeake Bay, however, reveals that the silting-up process proceeds with astonishing rapidity. Thus, though there has been a rapid rise in sea levels in modern times, the Bay is lamentably shoal. In other words, it has been filling up with sediment faster than the water level has been rising. Geologists believe that the trench cut by the Susquehanna River has been similarly filled up. Research should someday show that a filled valley, like that existing in the Mississippi, crosses the Continental Shelf off the Chesapeake Bay.



Land-sea relationships on the Eastern Seaboard during a glacial period.

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[2]The Continental Shelf is the submerged portion of North America.

[3]A filled valley is filled with sand.

[4]A drowned valley is filled with water.

This picture might be appropriately entitled: The Mark of the Sea on the Land. The street pattern about Mt. Soledad at La Jolla and Pacific Beach outlines the 100-foot, mid-Pleistocene terrace with fair accuracy.

Knowledge useful to work within the Bay can be derived from this line of reasoning, for young muds are poor foundation materials. When, in very recent times (geologically speaking), the sea stood 300 feet lower, the Susquehanna must have had a deep valley. Thus there must be deep trenches in the Chesapeake Bay filled with young and little-consolidated materials, and similar materials must lead up into each of the rivers entering the Bay. Since the Bay existed throughout at least half of Pleistocene time, there should be a series of such trenches marking various courses of the river during intervals of low sea levels caused by glacier movements. The presence of such mud-filled trenches in the Chesapeake Bay was once conversationally predicted and then unexpectedly confirmed by borings for the Bay Bridge which revealed just such a mud-filled trench as theoretical considerations called for. Evidences of similar materials filling old valleys are to be found in reports on pollen studies from such areas as southern England, north Germany and many other areas.

We can, of course, turn the calendar even further back and consider those remote times when the sea stood high against our coasts. During the last interglacial period, perhaps 200,000 years ago, the sea is thought to have stood at such levels as 75, 40 and 25 feet above modern levels. But since river valleys become filled at such times we should expect them to contain evidence of sediment deposits to elevations well above modern sea levels. These do, in fact, mark the lower reaches of many valleys. Striking examples are the deposits in the lower courses of the San Diego, San Diequito and Sweetwater river valleys in Southern California, which are standard sources of sand and gravel in the region. Similar fills flank the valleys entering the Chesapeake Bay region.

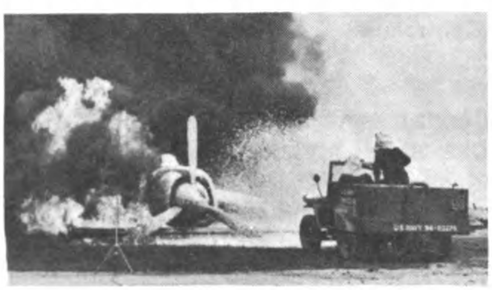
In the Chesapeake Bay and adjacent areas, especially to the south, some of these heritages from the past are great areas of sandy soil, and even extensive belts of just plain sand. These often show the location of old beach ridges. Such features dominate the Delmarva Peninsula; in fact the major drainage divide in Maryland's Eastern Shore is one of these sand ridges, probably caused by an interglacial high sea stand. It stands out as a barren area in the woods, forming a stream divide and serving as a road bed.

Here, then, is a case where changing sea levels have directly affected the use of land for economic and transportation purposes. There are many such cases. Young soils, mature soils, and old soils each have their own characteristics important to engineering and agricultural usages. For example, a young sandy soil is difficult from the trafficability point of view; the young sands of beaches are well known examples of hazardous going. An old sandy soil, on the other hand, may be so bound with iron as to form an excellent road material; the moderately old beach ridge on the Delmarva Peninsula is used as a thoroughfare and the ancient beach ridges of the San Diego Mesa are mined for stable materials for the road base of new highways. Thus it is important for practical reasons that we know the age of a soil. To the extent that studies of the time relations between sea levels, terraces, and soils can help us in solving practical problems, this seemingly ivory-tower research has practical possibilities.

The Navy's New Fire-Fighting Jeep

Flat-top landings should be much safer as a result of the development of a new fire-extinguishing system by the Naval Research Laboratory for use on crash fires. The apparatus, which is self-contained and mounted on a standard jeep, can deliver 1300 gallons of fire-quenching foam per minute for over two minutes without refilling. It can be manufactured for about $5,000, about one-sixth of the cost of most airport crash fire trucks in use today.

In the words of NRL scientists "anyone who can drive a jeep and pull a knob can operate the system." Upon arrival at the fire, the extinguisher is put into action simply by opening two valves and speeding up the jeep engine. A protective cone of fire-killing foam 30 feet in diameter can be spread around a trapped pilot or a consolidated stream of foam can be directed at a burning plane from a distance of 90 feet. The foam used is a new type which can be produced very rapidly.



Demonstration of fire-fighting jeep

ON THE NAVAL RESEARCH RESERVE

New Unit Activated at Clemson, S. C.

Members of VNRRU 6-11 and officers who participated in its activation.

Clemson College is the home port of the newest of the Volunteer Research Reserve Units, VNRRU 6-11, activated in ceremonies held there recently. Commanding officer of the group is LCDR W. G. Miller, Professor of Mathematics at this South Carolina college.

At present the unit has 16 members and it anticipates that its ranks will be swelled in the near future by about 15 more non-campus personnel in the area who are interested in research.

Reservists in the research unit include: LCDR L. D. Huff, LCDR T. J. Lindsey, LCDR Eugene Park, LCDR R. W. Smith, LT F. I. Brownley, LT A. T. Hind, Jr., LT D. I. Purser, LT Roy Wood, LTJG H. M. Cox, LTJG J. G. Dinwiddie, LTJG J. T. Long, LTJG T. L. Senn, ENS Lawrence Adams, ENS M. F. Steuer and Seaman V-6 F. P. Powell.

Present at the activation ceremonies were CDR F. L. Edmondson, Director of the Research Reserve, CDR R. E. Carpenter, reserve program co-ordinator, Sixth Naval District, LCDR M. C. Bell, Commandant's Local Representative at Clemson, and LCDR. W. J. Simpson, USNR Inspector-Instructor.

CDR Dimitroff Returning to Dartmouth Professorship

The Navy's loss is Dartmouth's gain— at least that was the feeling at ONR-Washington last month when CDR George Z. Dimitroff, VNRRU Training Officer, left to resume his post as Professor of Astronomy at the New England college. During his 18-month tour of duty CDR Dimitroff, who in civilian life is a distinguished astronomer, earned a reputation as a good shipmate and a human dynamo. He sent these comments to his fellow Research Reservists when he resigned:

From: Commander George Z. Dimitroff, USNR
To: The Members of the Research Reserve

After eighteen months of active service with the Research Reserve I am returning to civilian life and Dartmouth College.

I have elected to return to teaching because of personal obligations and because I feel that in these days when so many persons are leaving the teaching profession for more lucrative employment, those of us who have dedicated our lives to teaching must carry on to help fill the gap left as a result of the last war.

I leave ONR Code 233, the Research Reserve, with a mixed feeling of regret, pride, and anticipation.

Regret: because I am leaving a job that has been most exciting, full of wonderful associations, both at ONR—Washington, and in the field, and opportunities to serve the Navy both as a scientist and an officer.

Pride: because I have had the privilege of working for the Research Reserve program at a time when it has grown to full maturity and has attained a real stature and recognition.

And finally, anticipation: not only of the future in my personal re-establishment as an astronomer but in resuming once again my place in the ranks with the rest of the Research Reserves to carry on to the end that we will make the Research Reserve the important part of the Navy which we know it is and will always be.

CO's Confer With ONR Representatives

Shown above with CDR F. L. Edmondson, VNRR Director, are CO's of Ninth Naval District units, who met recently in Minneapolis with ONR Washington and Chicago representatives to discuss programs and mutual problems. VNRRU 9-6 was official host for the occasion.

CAPT Beltz Praises VNRRU 9-6's Exhibit Work

Naval Research Laboratory exhibit at Minnesota State Fair in St. Paul.

The Director of the Naval Research Laboratory, CAPT W. H. Beltz, recently sent the following letter to the Commanding Officer of VNRRU 9-6:

From: Director, Naval Research Laboratory

To: Commanding Officer, Volunteer Research Reserve Unit 9-6

Subj: Assistance rendered; appreciation of

1. The successful demonstration of the Naval Research Laboratory crystal exhibit to the thousands of people who viewed it at the Minnesota State Fair in St. Paul, Minnesota from 23 August through 1 September 1952 was made possible only as the result of the intelligent and willing assistance of officers of the Volunteer Research Reserve Unit 9-6. This was a positive educational contribution relating to the Navy's research mission.

2. It is desired that the Unit as a whole be commended and the following officers in particular:

CDR J. A. Wise	LT H. R. Courtney
LCDR E. J. Paulson	LT R. C. Wands
LCDR R. F. Bloom	LTJG T. E. Molitor
LCDR R. L. Simon	LTJG W. E. Ibele

LT M. J. Willette

SEA TRAINING FOR THE TECHNICAL RESERVE

CAPT Leonard B. Loeb, USNR (Ret.)

...can speak with considerable authority on the subject of sea duty for Navy scientists. Though not a VNRR member, his years of naval service "afloat" and his scientific experience (as Physics Professor at the University of California) have given him a special interest in unit activities, in which he has participated extensively.

As a Second Lieutenant, U. S. Army Reserve, in World War I, I was engaged largely in what today would be called scientific liaison and technical intelligence in France. As time wore on I became deeply impressed with certain unpleasant facts. Many devices developed by American scientists in support of the war effort were physically well conceived and sound but utterly useless for the practical purpose for which they were intended. On the other hand those developed hurriedly and cheaply by the French scientists, who had an enemy within their borders, were exceptionally useful. It was at once obvious that the American scientist, secure in his laboratory and with no contact with the fighting front, could not conceive of the conditions under which his gear would be used. The French scientist, however, was sent to the front, where the problem to be solved was acute. There, with the situation clearly in mind, he achieved a satisfactory, though perhaps not perfect, solution.

This situation with American scientists, it might be argued, could have been ameliorated had they been properly briefed by the Army officers concerned. Here again, however, there seemed to be no meeting of the minds—and this still holds true today, despite the improved training. The military officer, no matter how intelligent and well trained, is not in a position to know the highly technical developments in science and their possibilities for exploitation. The scientist, in turn, unfamiliar with the military problems, is unable to visualize the problem correctly from a tactical and utilitarian point of view.

With this situation deeply impressed on my mind, I was glad of the opportunity to accept an ensign's commission in the newly re-organized Naval Reserve in 1923. Though it would have been possible to hold out for more rank on the basis of an established career as a physicist, I accepted the ensign's rank, since it enabled me to go on sea duty training and learn, from the ground up, the qualities, functions, and actions of the ships that made up our sea-going fighting force. In consequence, prior to World War II I had done duty ranging from engineering to deck watches on practically all fleet types of vessels except aircraft carriers and light cruisers. In addition I had been stationed at a Naval Air Station and had done experimental work at the Naval Proving Ground.[1] In the course of these training tours I became acquainted with many officers who became our leaders in World War II. Through these officers I was encouraged to take correspondence courses, the most important being the Naval War College Reserve Course on Strategy and Tactics. With

[1] Note that except for the Naval Research Laboratory there were not many research activities open to Reserve training before World War II.

this background it then became possible to appreciate the critiques of Fleet battle problems assigned as reading on cruises and to understand the strategical and tactical problems which influenced the design of ship types as a result of scientific research.

Without my background of active sea training duty, I could never have satisfactorily carried out the World War II duties assigned me. Even though I was shore-based (and filling just the sort of jobs in which many of you will serve) unquestionably my most frequent function was that of translating the needs of the operating Navy to my fellow scientists in terms of their art, and conversely of indicating to the naval officer the practical limitations of using scientific knowledge and ways of working intelligently with his more academic civilian colleagues.

For the scientist who goes to sea for the first time, there will be many surprises in store, though he may feel his theoretical knowledge should have prepared him for them. For example it is hard at first to conceive of the potential power of a 10, 000 ton vessel when it appears from land to be moving at a slow walk. Another effect striking to the novice is that of wind and sea on large and powerful ships, despite their power and inertia. This inertia manifests itself in the low acceleration for forward or backward motion. Thus, such ship-handling procedures as mooring, docking, getting underway, and towing, consume time unthinkable to the landsman. To moor a battleship in the simplest way requires well in excess of 30 minutes. Again, preparations for getting a ship underway after a night at a buoy are not a matter of minutes, but hours. Those inexperienced at sea may feel that these matters are of no concern to the technical reservist, but they are. Unless the scientist experiences and has the "feel" of these properties, he will be unable to appreciate certain tactical aspects of the gear he will design.

For example, the slowness of maneuvering introduces "dead times," when the vessel is highly vulnerable to attack. When maneuvering at full power with plenty of sea room, a modern Naval vessel is, of course, relatively safe. But engaged in evolutions where she is caught at rest or in a changing state of motion (even in a turn at slow speed) a ship is a prime target.

Let us be more specific as to what these factors may do to limit scientific development. It has frequently occurred to various scientists that a ship could be protected from torpedo attack by means of nets about the ship's hull or by more ingenious scientific devices that could detect and detonate the torpedo before it came within vulnerable range. To one who has watched the maneuver of streaming paravanes[2], however, the solution suggested above begins to have its drawbacks. When one also contemplates zigzagging at night in formation with a darkened ship, especially in a seaway of any proportions, the solutions proposed become almost fantastic. Thus the specialist officer himself can intuitively sense the reasonable, and if relegated to laboratory duty during war,

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[2]A torpedo-shaped underwater protective device with sawlike teeth in its forward end for use by vessels in mined areas to sever the moorings of the mines.

will feel less inclined to condemn "the brass" for killing some ingenious scientific idea or gadget. It does not take much imagination to recall an infinity of other problems such as communications and signalling, search, fire control, and detection, whose nature and solutions can never properly be appreciated unless one has been to sea. At one time before the advent of radar, I undertook for the Navy a study of binaural sound location on shipboard using the most modern acoustic devices of the time. When assigned the task I had my misgivings about shipboard noises. As it developed later, shipboard experience showed wind noises were, in fact, an unexpectedly serious factor. Thus, despite filters and other devices, the method was found practically hopeless, even though we could have reduced some of the background. It could be added on the positive side that if the technical reservist has sea duty appropriate to his skills, he may often observe situations that on account of his unique knowledge he alone can help in solving.

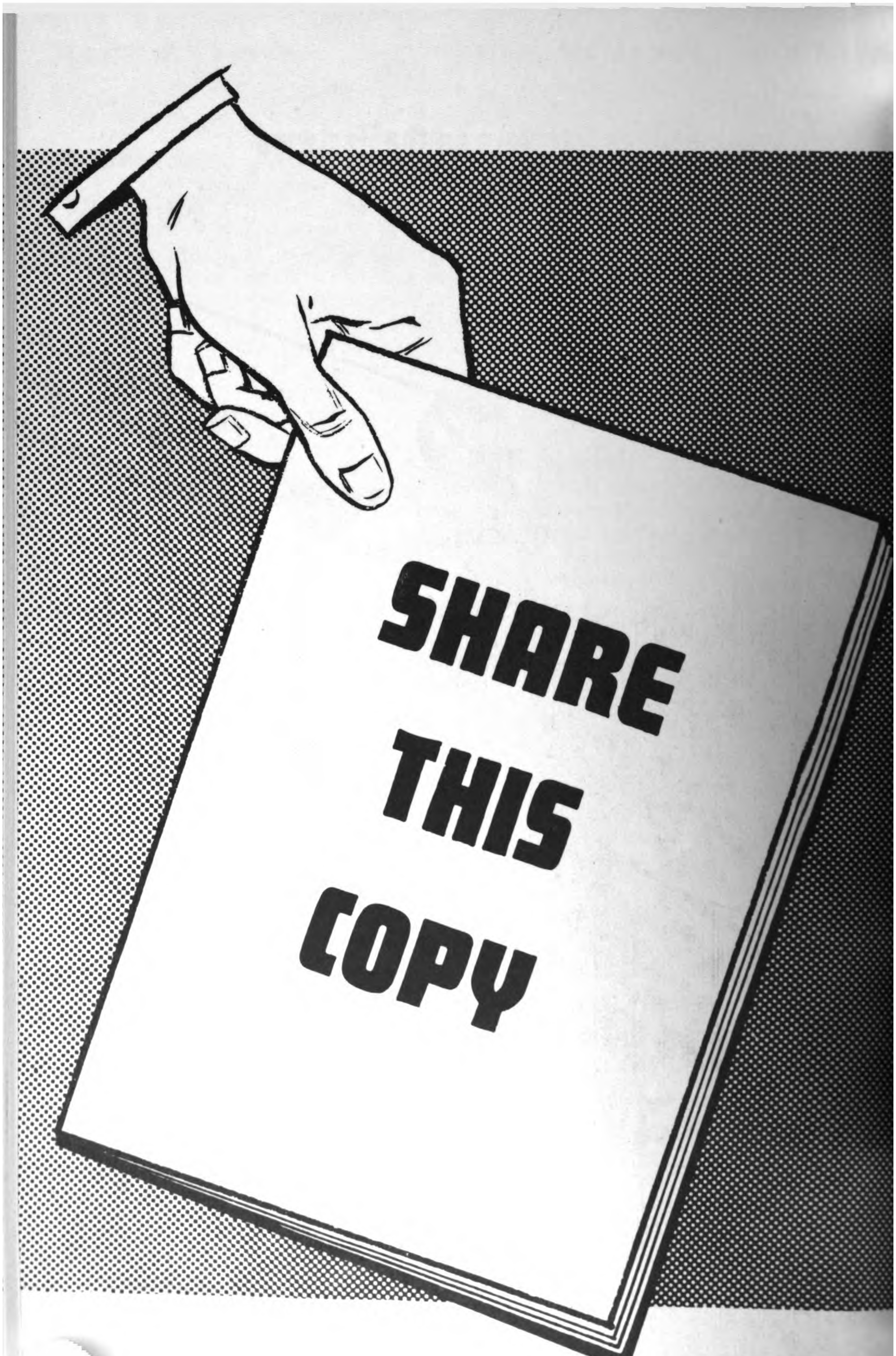
In summary, a technical or scientific reserve officer, no matter what specialized duties he will perform ashore, can never really be of effective use to the Navy in his profession and as an officer unless he has had training cruises at sea. There are no indoctrination courses or texts that can outline the situations and give the scientists the "feel" of the problem as well as can his own first-hand experience. To this I would like to add a personal observation garnered over many years of active scientific research, that the great and inspired solutions to technical and scientific problems come from those of qualified background who have had an intimate contact with the situation which affects the subconscious mind and permits intuitive genius to act.

Calling All Geographers

The Navy has good news for geographers, especially for younger members of the profession, who are wrestling with the problem of compulsory military service. An analysis of inquiries received by the Committee of Geographers in National Defense indicates that many members are contemplating military service in the near future and are anxious to learn about opportunities that are available to utilize their experience and training. Actually there are many active duty assignments in the Navy in which this can be done.

Professional geographers are uniquely qualified by their training and education to fill military assignments in naval intelligence, naval communications, photo-interpretation, or hydrographic activities. The Navy has therefore informed its Offices of Naval Officer Procurement that applicants with academic degrees and/or experience in the following fields of endeavor will be given consideration for commissions in the U. S. Naval Reserve: physical geography, geology, economic geography, cartography, map making, geographic research, photogrammetry, foreign languages and regional specialties. Any geographer interested in obtaining a commission should, at the earliest opportunity, contact the nearest Office of Naval Officer Procurement for further information. These offices are located in 27 of the larger cities and information on their addresses can be obtained from any Navy recruiting station or from other local Navy activities. Many of those who apply will find that they have qualifications which permit them to fulfill their military obligations by obtaining Naval Reserve commissions.

Balloon Watchers on the "Eastwind"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