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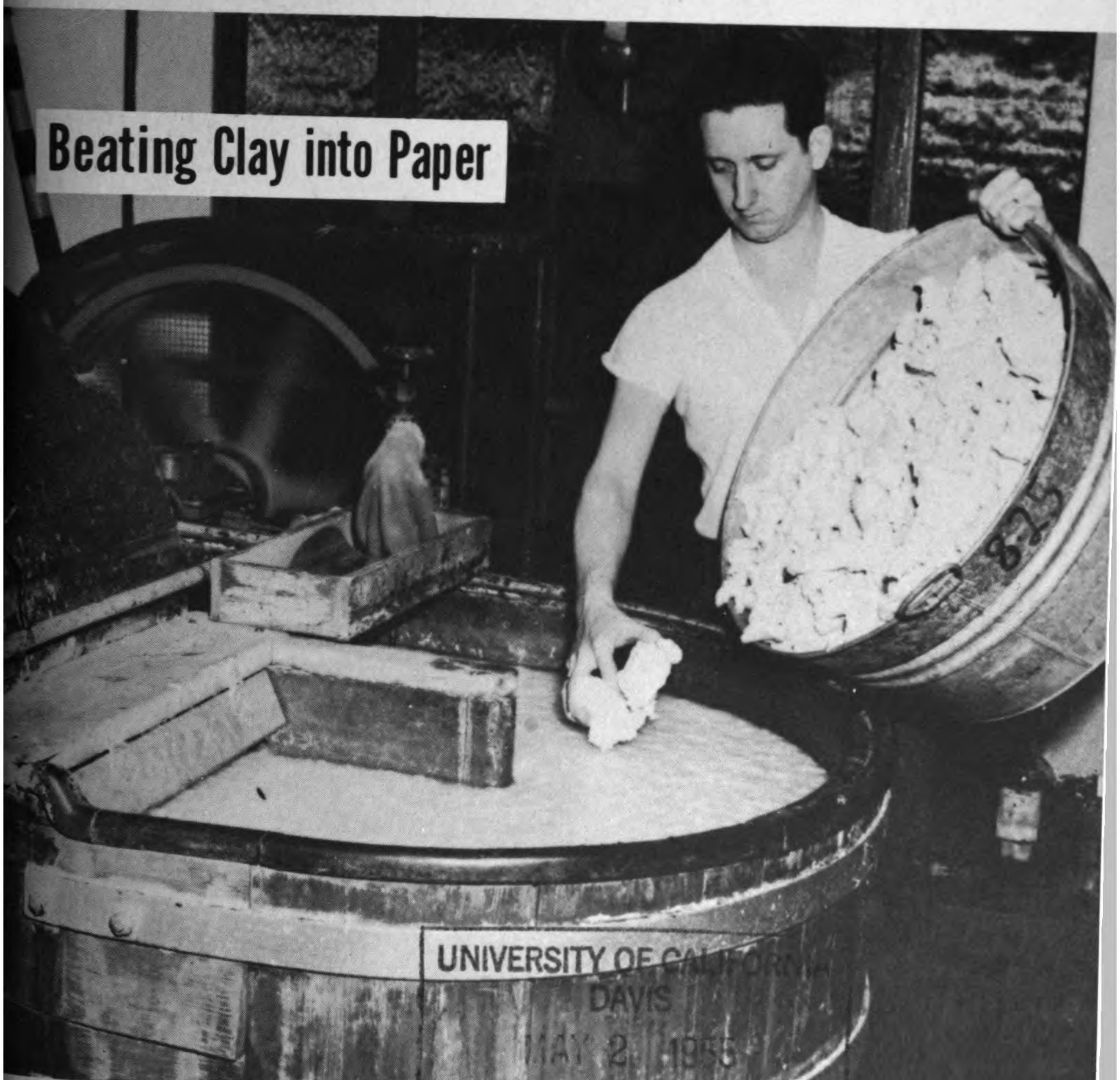
RESEARCH REVIEWS



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DEPARTMENT OF THE NAVY
WASHINGTON, D. C.

COVER PHOTO: The beating process is an old one in the art of making paper, but the materials used in this beater are something new. Into this experimental paper machine at the National Bureau of Standards go fibers of ceramic (shown in picture), glass, and silica. From these come remarkable specialty papers first developed in experimental handsheets at NRL. For more about them see "Specialty Papers for Navy Use" by T. D. Callinan on pages 7 to 9.

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 250, Office of Naval Research, Washington, D. C.

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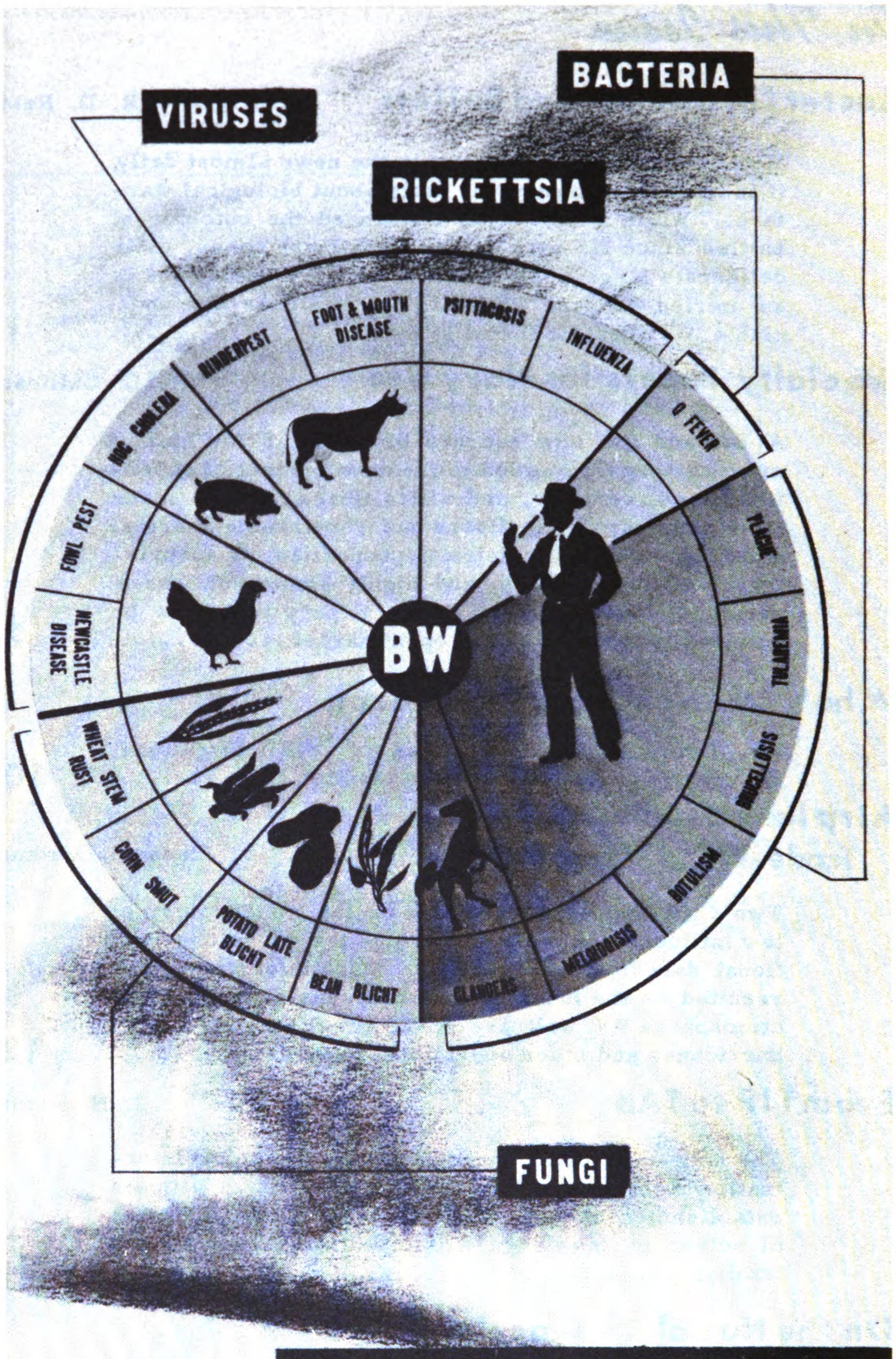


GERM WARFARE
its agents and targets

Bacteria, Bombs, and Bullets

Roger D. Reid

...Head of the Microbiology Branch at ONR, gave the following paper, June 19, 1952, to a Naval Research Reserve group, at the National Naval Medical Center.

In the 37th chapter of Isaiah, 35th to 37th verses, we read that the Assyrian troops at the walls and gates of Jerusalem were smitten by the Lord, and Sennacherib, King of Assyria, departed leaving a hundred and fourscore and 5,000 corpses. This event in 708 B.C. is probably the first record of a military operational failure due to epidemic disease.

The history of mankind is a history of wars, and the outcome of wars has often been decided by a third party—epidemic disease. In the 5th century B.C., Xerxes of Persia invaded Greece. Famine, fevers and frustrations weakened his troops. Epidemics of "pest" and dysentery rapidly reduced their number of 1,700,000 to 500,000, making it possible for the Greeks to inflict disastrous defeat on the invaders.

The period of the Crusades is marked by an uninterrupted series of epidemics, pestilence, and famine. For example, at Antioch in 1098 A.D. the besieging Christian army of 300,000 (including women and children) suffered losses of 100,000 in two months.

Napoleon's dreams of world conquest were shattered by his arch-enemy, disease. Even those countries conquered by the military might of "The Little Corporal" were finally abandoned because of his inability to cope with diseases endemic in such countries as Egypt and Russia.

The infant Republic of France was saved by an epidemic. In 1792 Prussia and Austria successfully invaded France to re-establish the Monarchy. The invaders were attacked by dysentery which, though it was non-fatal and of short duration, so weakened the Prussians that they were driven back across the Rhine by the French.

Our American history, too, bears scars of many epidemics. Some of these scars are proudly worn as testimony of the fires which forged a freedom dearly bought and now fiercely protected. The early traders and explorers from Europe introduced smallpox among the American Indians. Just before Plymouth Colony was founded, a severe outbreak of the disease occurred among the New England tribes. Whether because they were too occupied caring for their sick or because they feared new and greater scourges through further contact with the Europeans, the Indians refrained from molesting the colonists. By spring these Pilgrims were established and able to repulse the Indian attacks. The toll of smallpox among the Indians must have been very great.

Perhaps the reason Canada is not a part of the U. S. today is the failure in 1775 of the Americans to take Quebec and Montreal after a siege of several months. Withdrawal was forced by an epidemic of smallpox among the Americans.

Even the outcome of the Revolutionary War was influenced by disease. When Cornwallis surrendered at Yorktown his forces had been weakened by an epidemic that incapacitated 30 percent of his men. While the Civil War was finally ended in favor of the North, 223,000 (or 60 percent of the Union casualties) were victims of infectious disease—not wounds inflicted by the guns fired by their Southern brothers. During World War I an influenza epidemic circled the globe and took nearly twenty million lives. Its cost to the army was immeasurable. Such an epidemic during the Middle Ages would have been disastrous because of the far less effective sanitary measures, plus the lack of knowledge concerning causes of infection.

All of these diseases, with their influence on the history of man, have been due to "natural" causes. In these instances no effort was made to effect spread or incitement of epidemic by one army upon its opponent. Nevertheless, they do show the importance of disease in military operations. But man has been guilty of using germs to destroy his fellow by deliberately initiating disease to gain military objectives. For example, in 1346 the Tartars tried to start a plague epidemic in the city of Caffa by casting bodies of plague victims over the city walls. How effective this was, the record does not indicate.

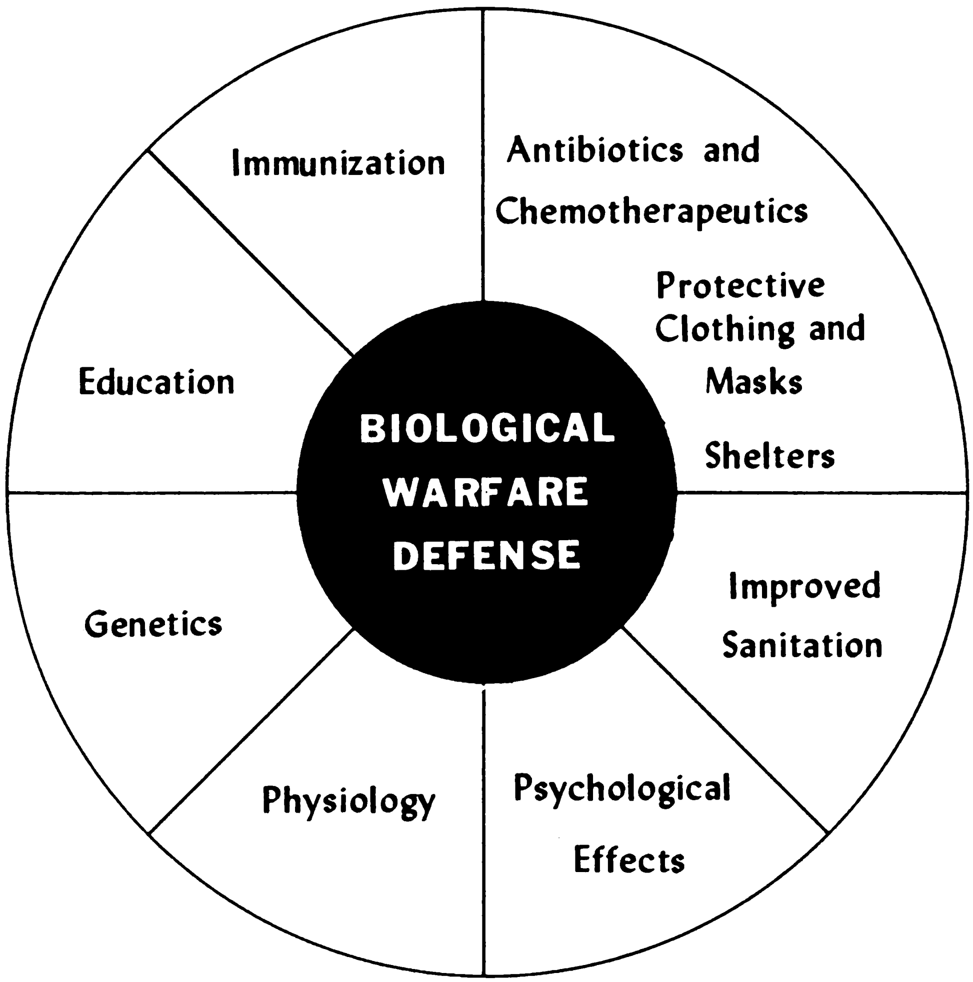
We do know that Napoleon was successful when, attacking the North Italian city of Mantua in 1796-97, he deliberately flooded much of the surrounding area to give endemic malaria a chance to become epidemic. This biological warfare attack was successful for the French, who were affected less by malaria, typhus, and dysentery than were their enemies. The city fell to the French after a ten-month siege.

In 1917 German saboteurs infected horses shipped from the United States for the AEF with glanders. Not to be overlooked was the "taxicab" army in Paris during World War I. The Huns employed infected prostitutes who lured the Doughboys into taxicabs where they contracted gonorrhea or syphilis. This was a genuine problem then. Thanks to penicillin, gonorrhea is not the military hazard it once was. In 1940 the Japanese tried to originate an epidemic of plague in Manchuria by dropping infected rice and clothing from aircraft.

So much for the past. Now let us turn to the present. What is biological warfare? Are the examples of epidemic diseases of natural origin really "BW"? Or is BW more than this? In the broadest sense of biological warfare we could include Hannibal's elephants, or Genghis Khan's cavalry horses—both new concepts of warfare, at that time, using biological agents. But modern BW is strictly bacteriological or germ warfare.

The most commonly accepted definition of BW is the "use of bacteria, fungi, viruses, rickettsia, and toxic agents from living organisms, to produce death or disease in man, animals or plants." The same thing can be said like this: "The use of microorganisms or their toxic products, etc." This is germ warfare, and that is what is meant by biological warfare today.

Modern BW has long-range or strategic applications. Its purpose is to cause disease or famine. In my mind, BW has much promise of usefulness when employed against animals and crops. Cause famine by disease to food sources, and the will and ability to wage war are lost. In this relation BW is a Navy weapon because it can have an effect like blockade—traditionally a Navy function.



Biological warfare agents may be grouped according to the probable target at which they will be aimed. Anti-personnel agents are those that cause disease or death in humans, and include some of those which have been responsible for the natural epidemics of the past. We have mentioned some of these—plague, dysentery and smallpox. There are others. But anti-personnel agents need not produce epidemics; that is, they are not always spread from one person to another. In some cases, only those who come in direct contact with the germ or its products would be affected. Examples of such diseases are: Botulism, a very serious type of food poisoning; undulant fever, or brucellosis, which is commonly transmitted from infected cattle or swine to man in milk or by handling infected animals; and rabbit fever, or tularemia, contracted by handling diseased rabbits or squirrels. A particular agent of BW would be chosen to suit the occasion, and its objectives would determine the choice. We would have to ask the question: Is the objective the death of many people or simply to make the enemy ineffective by causing much illness?

BW agents, especially those for use against man, do not necessarily kill; in fact, it might at times be better if severe illness occurred without death. Through proper choice and application, it is entirely within the realm of possibility that a short-term acute illness which affected a sizeable segment of population would have a decisive effect on any war effort. Other diseases might be chosen that are usually non-fatal but chronic, thereby causing a relatively long-term disability. Still other diseases might cause as much as 25 to 50 percent fatalities.

The Communists frequently refer to the "immoral and barbaric" aspects of germ warfare. LOOK WHO'S TALKING! Can one way of killing people be more moral than another? As a matter of actual fact, the proper use of BW can be the most humane way ever employed to wage war. Results could be obtained without wholesale slaughter or destruction. This is a factor in favor of BW.

But what about the future of biological warfare? Will it become the fearful and horrible weapon it has been pictured? I believe that it will not—at least so far as human disease is concerned. Widespread infectious diseases, while distressing to a community, large or small, are not new or mysterious. We have had them as long as the history of man is recorded. But the history of man records, also, his efforts to combat disease, and intelligent effort to do this goes back almost as far as the epidemics. In the last 50 to 75 years we have learned much, and now a certain amount of real control is at our command with the antibiotics. It would require "some doing" to start an effective epidemic in civilized nations today—and more to keep it going. There are no new and mysterious germs as some science fictionists would have us believe. On the other hand, man is pretty ingenious when it comes to improving on nature in ways to kill his fellow man.

Use of BW as defined as a purely tactical weapon appears to me to be very unlikely. The action of germs is slow and on the battle front the enemy must be stopped NOW— not in a few days.

Against animals and crops, however, BW assumes a potent significance. Use against them could cause serious shortages of food and animal products—all of military importance. BW agents offer infection with glanders among horses, foot-and-mouth disease among cattle, cholera among swine, and fowl pest among chickens. Not only would disease and slaughter of animals diminish the food supply of a nation, but leather, wool, and many medicinal products would be denied. Most plants of agricultural and industrial importance are susceptible to infectious diseases; wheat, rye and oats, for example, to the rust diseases which reduce yield; corn to a fungus called smut; potatoes, tobacco, and many other plants are vulnerable to virus infections and blights. Most of these diseases spread quite rapidly, and the only really effective means for control is the selective breeding of new, resistant varieties. Even against animals and plants, however, there is an undeniable drawback: Who can be sure that the spread of microbes will stop at the enemy's border?

The Communists have charged that the U. S. has spread plague germs from airplanes in North Korea. This charge has been denied by the Secretary of State and by high military officials. I believe them—in fact, I am sure the charges are false! It may be an attempt to cover up the inability of the North Koreans and the Chinese to control an epidemic of a disease that is always normally present to less explosive degree in that area. It may be deliberate and false propaganda to damage the United Nations, or it may be preliminary to their use of BW against us!

Certainly such propaganda is not new. On 20 May 1950 the Russian newspaper "Red Star" carried an article that began like this: "The ruling circles of the United States of America, possessed with an insane desire for world domination, are feverishly preparing for a new war. In making 'total preparations' for an aggressive war, the American imperialists are spending tremendous sums for the development and perfection of the most barbaric means for the mass destruction of people—these means include bacteriological warfare."

I'm sure that you remember the charge that the U. S. had spread potato bugs in Communist-held countries in Central Europe. This, obviously, was a trumped-up charge to excuse the inability of the Communists to control the pests. The sequel to the story was that the U. S. later sent potatoes to those same countries—to feed the bugs!

In any event, BW is a weapon that lends itself to covert use. Saboteurs, using germs, could create a serious nuisance if not a real threat. Conversely, the overt use of germ warfare, as charged in North Korea, does not appear to be a really effective use of aircraft and other military vehicles.

The significant factor, already apparent, in the use of BW is the psychological implication. Naturally, the Reds are playing this idea of BW by the U. S. upon their people and upon us at home. They are attempting to create a fear of BW comparable to that of the A-Bomb—and, regrettably, with some of our people, they are succeeding. In BW, we must also fear the very fear of BW!

Far back in the pages of history one finds the description of a military weapon called the "caltrop". This was an instrument with four iron points so disposed that, three of them being on the ground, the other projected upward. It was used primarily by cavalry troops; when the enemy began a charge the retreating cavalrymen tossed the caltrops toward the advancing men and horses. The hope, of course, was that both would be impaled upon the spikes.

I think that BW can be compared to the caltrop in several ways. It, too, has four points of attack: man, animals, plants, and the psychological factor of fear. Second, it will take a very strong arm to throw it and a sure aim to place it strategically. Third, the advancing enemy may find it comparatively easy simply to go around it. That is, skill and knowledge will certainly be required before BW is perfected for efficient use against us, and by then we may have attained sufficient knowledge of immunizations and disease control to get around it.

As a considered guess, I would say that application of BW toward crops and animals offers most promise. There is less chance of detection before damage is accomplished; and the effect on war potential could be both serious and frightening. The effect of the use of BW against plants and animals would be only slightly less than their use against man directly.

Now you would like to know what can be done—what we are doing—to protect ourselves from this threat of bacteriological warfare and perhaps to insure our readiness to use BW offensively. In spite of the long history of disease in warfare, biological warfare has never been extensively used in military operations. It is an untried weapon, the effectiveness of which can only be guessed. Until it is tried on a large scale in actual military operations, it is fair to say that it must remain a research and development item. While the responsibility for the research and development of BW has been assigned by the Research and Development Board to the Army, it is clearly stated that BW is not the sole property or responsibility of the Army. It is the responsibility of the Navy, Air Force, the U.S. Public Health Service, the Department of Agriculture, and every citizen in the United States.

The Navy has some very special responsibilities in this matter; reference has already been made to substitution of BW for naval blockade in countries like ours that could be self-supporting agriculturally. It is also the Navy's job to see that our shores are protected from blockade. Taking the assumption that BW is a form of blockade, the Navy must be prepared to defend the U.S. and its possessions from BW.

In addition to these rather broad and general interests of the Navy in BW, there are special problems of particular importance to the Navy. These deal with the protection of ships at sea or in port from BW attack; the protection of shore establishments; the protection of our field forces, i.e., marines. From the offensive side, the Navy must give special attention to means for use of BW that are specially adapted to Navy operations. These might include dissemination from submarines, carrier-based aircraft, and mines. The Bureau of Medicine and Surgery is especially interested in improving prophylactic and therapeutic means that would make a BW attack on naval personnel ineffective. ONR supports many contracts that contribute toward this goal.

The Navy generally is conducting research in many aspects of BW. Because of the current propaganda campaign of the Communists dealing with BW, this work is being intensified. We feel sure that we will be able to deal effectively with a BW attack and, equally important, our readiness to combat germ warfare and perhaps even to be prepared to use BW offensively, may prevent its initial use by our enemies—another case where freedom can be bought only at the cost of eternal vigilance.

An important by-product of this research will be the increased knowledge of diseases of man, animals, and plants. As a result of this new knowledge, it is a good bet that there will be fewer epidemics, fewer infections, and even better knowledge in the field of epidemiology and infectious diseases. Our fields and farms will become more productive, our foods more nutritious, and our general standard of health and living improved.

Specialty Papers for Navy Use

T. D. Callinan

. . .is Consultant to the Electricity Division, Naval Research Laboratory, in the field of solid and liquid electrical insulants.

During 1951, over 30 billion pounds of paper was made in the United States. Half of this went into board; 47 percent was writing, book, wall, wrapping, tissue, and newspaper; and the remaining 3 percent was in the form of specialty papers. Although in proportion the quantity of the latter is small, in significance these specialty papers rate high. They include absorbent papers for plastic-base laminates, condenser and cable paper, slot armor, and filter paper for gases and liquids. But most specialty papers available today are made from cellulose, and their production requires consummate skill on the part of experienced paper-makers. Care must be taken in opening the clumps in the beater. Otherwise the fibers will be shortened and a loss of strength in the finished paper will result. The fibers must be brushed and dispersed with care to permit the stock to pass through the systems of chests, pumps, and pipes, without clogging or settling to the bottom.

In the past, innumerable attempts by industry to produce such papers from rock-wool, blown-glass, and quartz fiber were unsuccessful, because the fibers settled out of the water. Thus it seemed from early industrial work that the solution to the problem of thermally stable dielectric paper rested on availability of high-grade magnetite-free chrysotile asbestos. Later, World War II demonstrated glaringly the absolute need for (a) techniques for purifying asbestos received from Canada, (b) reopening our own deposits in Arizona, or (c) discovering other inorganic dielectrics based on materials indigenous to the United States.

Recent studies at NRL, directed toward finding indigenous material, have demonstrated that inorganic fibers, when sufficiently fine, would indeed remain suspended and that consequently specialty papers could be made from Pyrex, ceramic, and even quartz fibers so long as their cross sections were about one quarter that of fine silk (0. 75 micron). Since this study, efforts have been made at NRL to encourage commercial investigation and exploitation of such superfine synthetic inorganic fibers for use in filter papers, dielectric papers, and nonflammable products, in order to create a constant source of supply of the specialty fiber for military use. As a result, these fibers may now be obtained in quantity on the open market. Moreover, there has been a marked reduction in price, accompanied by a substantial improvement in the mechanical properties.

Although these specialty papers are at the present time weak and highly porous, they are lightweight and heat-resistant and, after proper

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sizing and impregnation, they have possible use to the Navy as improved filters and electric insulation. Increased combat efficiency of the fleet, by substitution of heat-resistant and long-lived paper for inflammable wood-pulp papers now available, would justify much of the work undertaken.

Paper made entirely from glass fibers was first prepared on the experimental paper machine of the National Bureau of Standards on September 7, 1950. These production runs followed earlier work at NRL which had achieved experimental handsheets having qualities justifying the trial.

Fibrous glass is a soft, white material which feels like suede and is free from shot, slubs, or other inclusions. Physically, the fibers are smooth, cylindrical rods, different from common paper-making wood-pulp fibers usually employed. They have an average diameter of ten one-millionths of an inch (0. 25 micron), well within the colloidal range of matter; it is thought that this fineness has a critical bearing on results obtained. Glass fibers are produced synthetically either by blowing or by spinning a molten stream of glass or slag. Blowing results in a wool used extensively as thermal insulation, while spinning yields discrete threads or filaments. Wool may be separated into coarse and fine fibers, and those which are small in cross section (less than 1 micron) but of moderate length (greater than 1/64 inch) may be made into paper. Spun fibers, precisely because their manufacturing conditions are controlled, can be made sufficiently fine for paper-making, and no separation of the product is required. It is known that the preparation and the qualities of the fibers are functions of the surface tension of the melts and the conditions of spinning, but further research in this field is much needed.

Synthetic inorganic fibers other than glass also have been made into paper. The electrical properties of such papers, including those made from Pyrex-E glass, aluminum silicate, and silica, have been determined and the qualities compared with those of asbestos and mica paper. Methods for separating fine paper-making inorganic fibers from masses of rock wool have been developed, and this technique now offers a second source of supply in ton lots of the inorganic pulps. A study of the technology of synthetic inorganic paper-making has revealed the effect on the product of such variables as pH, temperature, consistency, and machine qualities and has resulted in development of stronger papers containing clay and resins. As a result of this developmental work, industry has been encouraged to expand their facilities and staffs for the effective exploitation of papers made from inorganic fibers.

The National Bureau of Standards, the Herty Foundation, and the Hurlbut Paper Company have all participated successfully in the production of inorganic papers. Under the direction of NRL, a total of 94 runs was made at the Bureau during the period September 7, 1950, to May 23, 1952. Eighty-five were glass fiber composites, five were ceramic fiber, and four were silica fiber. In 66 of these runs only glass was used, in five runs glass fibers were used with an inorganic binder, in three runs glass and cotton fibers were used, and in ten runs glass fibers were used with organic binders. The glass fibers employed were supplied by Glass Fibers, Inc., Waterville, Ohio, and Owens-Corning Fiberglas Corporation, Toledo, Ohio. The ceramic fibers are marketed by the Carborundum Company, Niagara Falls, New York, under the trade name "Fiberfrax," while the silica fibers are products of the H. I. Thompson Company, Los Angeles, California, and Glass Fibers, Inc.

These inorganic papers are highly porous, surprisingly soft, flexible sheets possessing remarkable absorbent qualities. They are mechanically weak when inorganic fibers are employed alone, but the electrical properties are exceptionally fine and the losses are one-fourth those of kraft paper. Dielectric constants of the synthetic inorganic fiber papers are in the order of 1. 05-1. 15; densities are correspondingly low (0. 2-0. 3 grams per cubic centimeter). Dielectric constants of the naturally occuring inorganic fiber papers are higher (3. 5) due to correspondingly higher densities. Electrical losses are lowest in the synthetic base papers (0. 0001 compared with 0. 6 in the natural products). Mechanically strong paper can be prepared by adding resins, and additional strength may be imparted by a filler such as bentonite. It also was found that dipping the paper in one of a number of varnishes markedly improved the mechanical and electrical properties.

Synthetic inorganic fiber papers are remarkable for their thermal stability, all being able to sustain temperatures of 500 degrees centigrade continuously. While papers prepared from ceramic or silica fiber paper were found to be mechanically weaker than those prepared from glass fiber paper, they had even greater thermal resistance. Thus at 670 degrees centigrade, neither of the former were in any way distorted, while glass fiber paper shrank and became quite brittle. An interesting quality of the silica paper was observed by Bloom, Zerfoss, and Von Batchelder at NRL in x-ray diffraction studies. They reported that a 5-hour treatment at 1000 degrees centigrade transformed the silica paper into alpha quartz, while a 4-1/2-hour treatment at 1500 degrees centigrade resulted in alpha Christobalite.

The most marked advancements in the field of inorganic papers are anticipated from current and future research. They are of two distinct natures: the development of new fibers and the development of new and more effective binders. Also expected are specialty papers made from such metallic fibers as aluminum, copper, silver, and zirconium fibers. These will be useful where electrical and thermal conductivity as well as radiation resistance requirements cannot be met by presently available fibers. Again, fibers having self-lubricating qualities, such as those of boron nitride, are expected to eliminate the tendency of the inorganic fibers to fracture when passed through a calender or press. Similarly, long-chain polymers having the flexible properties of the present organics but the thermal stability of the inorganics are in the offing. Finally, advances in the technology of fine, synthetic, inorganic paper-making are expected to bring into use such items as permanent record paper, nonflammable book paper, and heat-resistant insulating papers.

Who's Who in Naval Research

Edwin J. Kennedy

When a member of the public has invented something, or improved some gadget, that he thinks the Navy could use—to whom would he take it? Directly to Mr. Edwin J. Kennedy of the Inventions Branch, ONR. Mr. Kennedy's little publicized office is the clearing house for inventions submitted by the public and by uniformed personnel under AlNav 227, not only for ONR but for the entire Navy. Each plan, idea, or beneficial suggestion is checked, recorded, and then passed to the most appropriate research or development "desk" in the Department. Mr. Kennedy follows every case until it is either accepted or rejected, and writes the final letter to the inventor.

The cases that come in are from the American public, occasionally from members of the Service or from departmental employees, or are submitted—through ONI—from abroad. (They do not include the hundreds of "proposals" that are submitted by civilian scientists directly to ONR representatives for contract consideration.)

An inventions office for the Navy was recommended by the same Naval Consulting Board that fostered the Naval Research Laboratory. The first office, started in 1915 by Josephus Daniels, was called the "Aide for Inventions", and during World War I, the "Inventions Office, Navy Department." After the Armistice the duties were transferred to the "Technical Aide to the Secretary of the Navy", who also was the Director of NRL. After languishing almost to extinction during the 1930's, the function was revitalized, in 1941, as the "Office of Inventions" under the Coordinator of Research and Development. By the end of World War II, a fourteen-man force was kept busy re-screening the ideas forwarded to the Navy by the (civilian) National Inventors' Council.

In 1944, inventions and patents were linked together as the "Office of Patents and Inventions", the nuclear organization for Admiral Bowen's dream—the "Office of Research and Inventions." The latter is now, of course, ONR. Thus the files of the Inventions Branch go all the way back to 1915, and it is no accident of organization that the Branch is today an integral part of ONR.

The Inventions Office had always been a full duty or an additional duty of a naval officer. But when ORI was established it was decided that inventions could best be handled by a civilian not subject to periodic transfer, and Admiral Bowen began looking for a man having just the right qualifications. He found a retired electrical engineer who had patriotically taken a wartime position in the Naval Office of Procurement and Material (OPM). Mr. Kennedy accepted and took over in July, 1947.

He was born in Allegheny, Pennsylvania, but grew up in Canada and graduated (EE & ME) from Toronto University in 1908. Migrating back to the States he worked successively for Bell Telephone and Western Electric, finally becoming Vice President of the Haynes Industrial Engineering Corp. of Chicago. (While he was at Western Electric he was one of the engineers who helped develop the first dial telephone system.)

In 1917, Kennedy entered the Army, and was commissioned in the Chemical Warfare Service. He went across to France and developed several of the chemical weapons used in combat by the French Army.

After the war he became interested in radio, and served as Chief Engineer for the Signal Electric Co., and later for the Herbert H. Frost Co.—both manufacturers of radio equipment. From 1932 until his retirement in 1936, he was a consulting engineer for four electrical concerns. In 1943 he accepted a position with the Army Signal Corps at Ft. Monmouth, and transferred a few months later to the Navy's OPM in Washington. In that office he was in charge of the awards and incentives program, and editor of the Navy's "Industrial Notes."

Mr. Kennedy has no immediate intention of going back into retirement; he is too interested in the new schemes and gadgets that cross his desk. He believes that the Navy itself is the best source for new ideas. His chief ambition is to help establish an awards and incentives program, for officers and men, that will be comparable to the (civilian) Beneficial Suggestions Program.

Speaking of incentives, Mr. Kennedy has the best one for staying young: a youthful wife and three small boys. The Kennedys maintain this lively household in Silver Spring, Maryland. (A. T. D.)

Alaska Volcano to be Site of Cosmic-Ray Studies

Mt. Wrangell, 14,000-foot Alaskan peak, is to be the newest observation post for cosmic-ray investigators, if present plans go through successfully. Under the joint sponsorship of the Office of Naval Research, the U. S. Atomic Energy Commission, New York University, and the University of Alaska, cosmic ray and meteorological activities on this far northern active volcano are expected to begin in May or June.

Professor Serge A. Korff of N.Y.U. and Dr. Terris Moore, who is a veteran mountain climber as well as an experienced pilot and the president of the University of Alaska, are organizing the group which will tackle the topside research.

Airplane Studies of Trade-Wind Meteorology

Joanne Starr Malkus

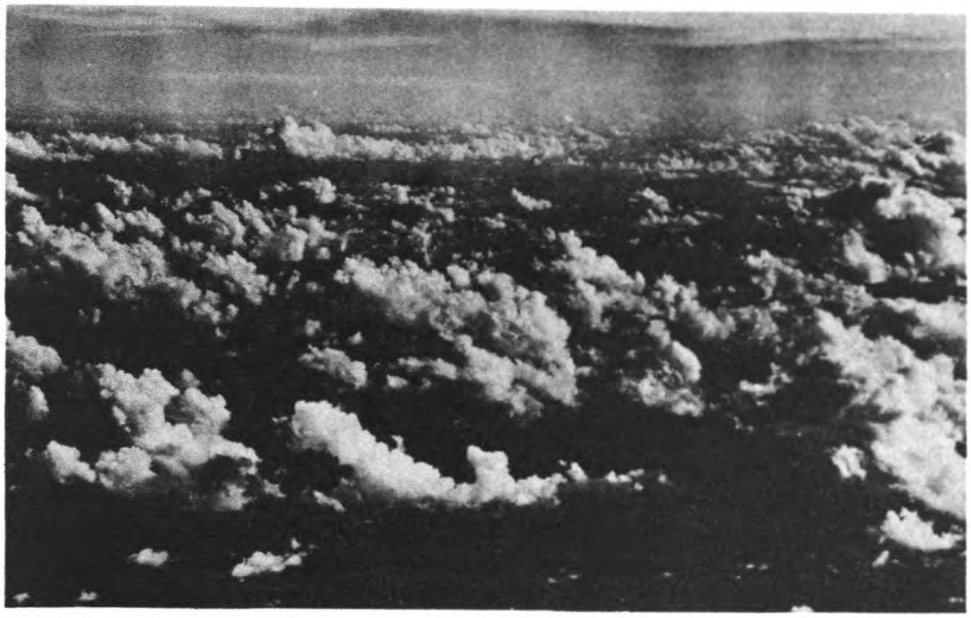
... Ph. D., University of Chicago, is a Marine Meteorologist at the Woods Hole Oceanographic Institution. She is co-leader of two ONR projects on trade-wind meteorology.

Almost everyone has watched a small, cottony cumulus cloud (like those on the inside back cover) cross the sky on a sunny summer day. In the present age of aviation-consciousness, most people are aware that it is this type of cloud, grown large and reaching to great heights, that forms the heart of the mighty thunderstorm. Fewer people know that clouds of this family, growing day and night over vast areas of the subtropical oceans, play an extremely vital role in the creation and maintenance of the large-scale wind systems of the atmosphere. These clouds, christened trade-wind cumulus, are probably the most dramatic and striking features of the lower atmosphere over those large regions of the globe (from about 10° latitude to about 30° latitude in both hemispheres) where the world's steadiest winds, the easterly trades, blow. Typical trade cumulus clouds are pictured opposite.

Only recently have meteorologists been studying the life processes of these clouds and learning of their important role in the operation of the great heat engine that is our atmosphere. This study is largely a consequence of three ONR-sponsored research programs in trade-wind and subtropical meteorology.

Up until the time of World War II, knowledge of low-latitude meteorology lagged, relative to the rapid advances in the studies of the fronts, cyclones, and waves in the westerly wind areas (latitudes of 30° to 60° in both hemispheres). This lag was due largely to a scarcity of observational data and not to underestimation by meteorologists of the importance of lower-latitude regions to the atmosphere as a whole. For it has long been known that nearly all the energy for driving the global wind systems is supplied to the air by the tropical oceans, which in turn have received a large excess of heat energy from the sun. During World War II, mainly in connection with campaigns in the Pacific, these regions and their weather became of significant operational importance to the Navy. As a consequence, the Office of Naval Research has sponsored several investigations, which have not only provided practical information on hurricanes and other operational hazards, but have also given meteorologists the opportunity to learn much about the fundamental processes at work in our atmosphere.

The war-time and early post-war advances in this field came largely from two sources: the first an ONR-sponsored investigation



Typical group of trade-wind cumulus clouds over the Caribbean Sea. Notice their softer, more drawn-out appearance compared to the mid-latitude cumulus pictured on the inside back cover.

in the Caribbean area made by scientists from the Woods Hole Oceanographic Institution, led by Dr. Jeffries Wyman and Alfred H. Woodcock. The work was carried out near Puerto Rico from a PBY-5A aircraft and a surface vessel, both equipped with meteorological instruments. The purpose was to study the structure and formation of trade-wind clouds and the mechanisms by which heat and moisture are carried up from the sea surface into the lowest air. The second program was concerned with larger-scale phenomena: the wave-like disturbances in the trade current and the formation and growth of tropical hurricanes. This study was christened Tyrena (TYphoon REsearch NAvy).

As an outgrowth of his work on Tyrena, Dr. Herbert Riehl of the University of Chicago analyzed a series of radio-balloon ascents in the Pacific from a group of three of the regular air-sea rescue weather ships and an island station. During one entire summer, these ships were located along the path of the trade-wind air, 1500 miles upwind of Honolulu, Hawaii. By examining changes in air structure, moisture, and heat content, from one ship to the next, Dr. Riehl and his collaborators were able to draw up a tentative "budget" for the lower trade-wind atmosphere: how it takes on its heat and moisture supply, what fraction of these quantities are lost or wasted, and what excess, over the original inflow, is exported.

The results from Tyrena and the Wyman-Woodcock Caribbean expedition supplement one another to provide the beginnings of a coherent picture of the trade-wind atmosphere, its mechanisms, and its role in large-scale processes, such as the creation of tropical storms. But wide gaps remain to be filled, and ONR-sponsored studies are still being carried on. Before describing them, however, a brief summary of some of the knowledge acquired to date[1] is essential.

It has long been known that the easterly trade-wind current divides itself into distinct layers, vertically superimposed upon one another, in which somewhat different physical processes are at work carrying the energy from the sea surface upward. The results of the Wyman-Woodcock and Tyrena studies showed rather conclusively that most of the energy (about 90 percent) leaves the ocean and is carried up in the form of water vapor, that is, by evaporation. The energy is thus stored in the form of latent heat in water vapor which is carried up and transported laterally. Some is exported at high levels and, much later and often far from the source, is released again as heat when the water vapor recondenses into liquid droplets. At present, we shall only be concerned with how the water vapor gets up to high levels in the trade-wind atmosphere. Its trip from there into middle and high latitudes, and its conversion back into kinetic energy of winds—among the most important and still unexplained meteorological occurrences—are beyond the scope of this article.

The diagram below illustrates what happens to the water vapor as the trade winds blow from right to left across the sea surface. Through the lowest or subcloud layer, it is mixed through the air by turbulent eddies, created when the wind blows over the rough waves, almost as

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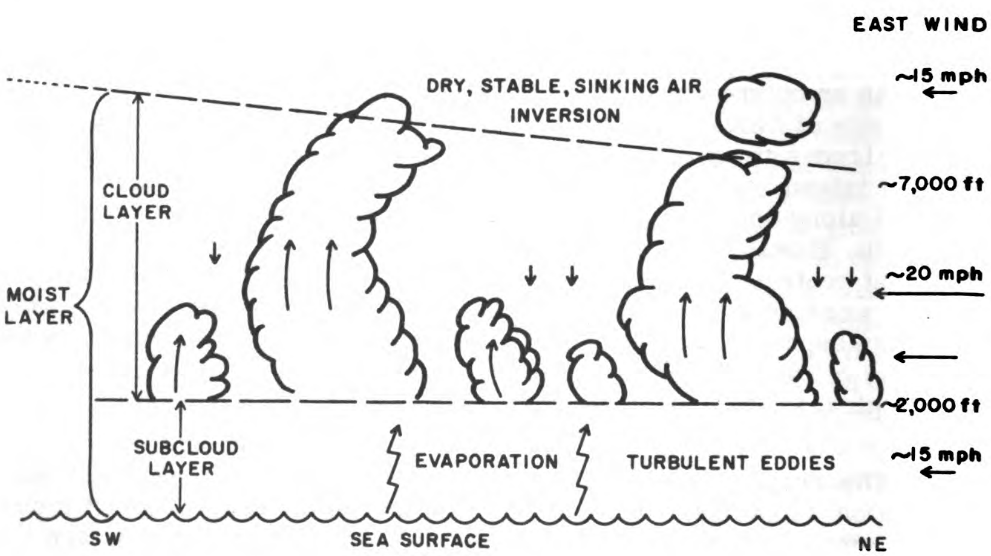
[1] It must be pointed out that prior to World War II and the ONR-sponsored programs, meteorologists had already learned many of the fundamentals of low-latitude meteorology. For the sake of brevity, no attempt is made here to sort out these contributions and attribute them to the proper sources.



Schematic cross section along the path of the trade wind. Typical winds at the various levels are indicated by arrows at the right.

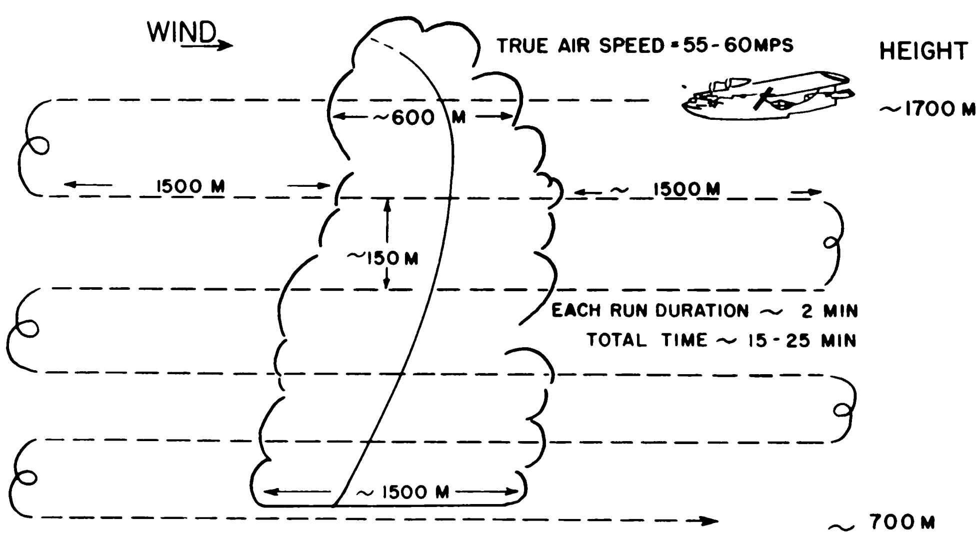
The meteorological instruments projecting from the forward turret of this PBY-6A include a psychrograph for wet- and dry-bulb temperatures, an anemometer to detect airspeed fluctuations, and the static head for a recording sensitive altimeter. The strain gages taped to the wind struts were used in studying the life characteristics of the airplane.

the cream is mixed through your coffee as you stir it. But this effect is felt through only about the first 2000 feet elevation, and above that another process must take over to carry the vapor still higher. This is where the trade-wind clouds enter the picture. In the cloud layer, which on the average extends from about 2000 to 7000 feet elevation, the clouds themselves are the transport elements. They may be thought of as warm, moist chimneys of rising air, which day and night are pumping vast quantities of moisture aloft. But there is usually a "top" to the cloud layer also, called the trade inversion, which is indicated by the uppermost dashed line in the drawing. This inversion consists of a layer of stable and dry air, which may be imagined as a kind of lid, hindering any further vertical development of the clouds. It has been observed, however, that a fraction of the clouds—those that are largest and have the strongest updrafts or vertical ascent rates—do penetrate a small way into the inversion layer. Here, their tops often are cut off from the rest of the column (as shown for the cloud on the far right). These cut-off tops then evaporate, thus supplying moisture to the dry inversion air.

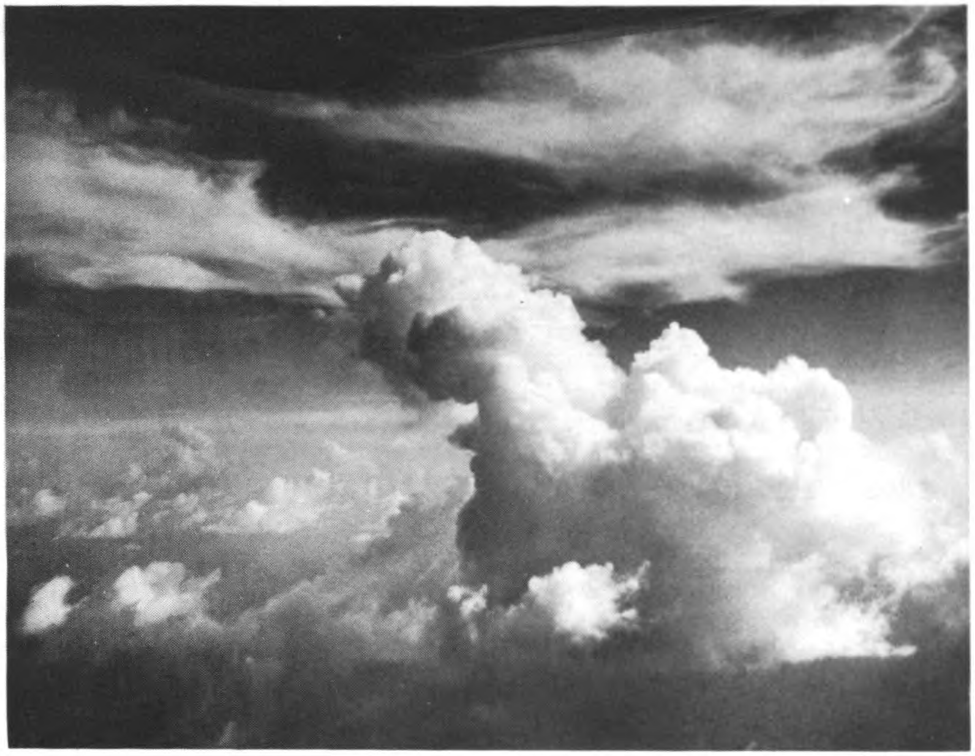
It has been shown plausible that this process is responsible for the downstream rise in height and weakening of the trade inversion also shown schematically in the drawing. Furthermore, in the vicinity of the waves in the trade current, the inversion is ordinarily much higher and weaker than the average, so that the clouds can grow up to great heights and thus fill the upper atmosphere with moisture. The question naturally arises as to whether the energy pumped upward in this manner, supposing it later gets transported to other regions, can possibly be enough to include fuel for all the mighty global wind systems. This question becomes particularly pertinent when we recall that one single hurricane in its lifetime consumes as much energy as that released by more than 30,000 A-bombs.

However, the cloud-pumped energy is also vast and its magnitude can perhaps be grasped by the following example: If an area of one-half square mile is 50 percent covered with trade cumulus, only a small fraction of which need be rising at any time, they can easily provide a net upward transport of latent energy in water vapor equal to that released by a 1000-pound bomb of TNT exploding every minute. If this is summed up over all the tropical oceanic area normally covered by trade cumulus, a net upward transport of latent energy is given which is greater by a factor of roughly forty or fifty than the rate of kinetic energy dissipation by all the wind systems of the globe. Thus the atmosphere is an inefficient heat engine, "wasting" much of the energy released by its water vapor fuel, a large fraction being lost by reradiation to space in tropical and subtropical latitudes.

Although the importance of the trade-wind atmosphere has now been rather well demonstrated, many questions remain to be answered. Why, even on disturbed and stormy days, do the clouds form in clusters only a few miles in diameter which are separated by clear areas 15 to 20 miles in diameter? What causes the clouds to start growing at heights of about 2000 feet above the sea and what fuel keeps them running? And even more important, why do most of the cloud tops terminate far below the trade inversion? Why do some few of them grow so large? We also want to know in more detail how the clouds effect the upward transport of moisture and how at the same time they transport other properties such as momentum and heat. Theoretical work carried on in the years since the



Each cloud studied was traversed at five or six levels in rapid succession with all instruments operating. Measurements are in meters; airplane speed was 55-60 meters per second or about 100 knots.



This photograph was taken in the plane of the wind of a typical trade cumulus studied in June 1952 by the Woods Hole group. The cloud formed over the ocean about 20 miles from St. Croix, Virgin Islands. It was in the vigorously growing stage when studied. The wind blows from left to right.

war (largely by the ONR-sponsored marine meteorology group at the Woods Hole Oceanographic Institution) points to answers to some of these important questions, but now further careful observations are needed to test their correctness and to indicate the way for further theoretical development.

For this purpose, in the first months of 1952, a PBY-6A aircraft (photograph on p. 15) was obtained by the Woods Hole group, on loan through the courtesy of the Bureau of Aeronautics. Considerable work has been done in preparing this airplane for use as a meteorological tool. It is necessary, in studying the growth processes of clouds, to have accurate measurements of many properties, both inside the clouds themselves and in the clear air of their immediate environment. Among the most important of these are: the temperature and moisture content of the cloud and its environment; the structure of the turbulence or roughness inside it; its vertical drafts and their distribution; the wind at various levels outside the cloud; and how much the cloud tower slopes or slants. The latter can be measured by means of aerial photographs, and many of the other measurements can be obtained with little difficulty. The measurement of draft speeds inside the clouds, however, is an extremely tricky problem, since the observations are being made from moving aircraft which may be rising or sinking on its own initiative.

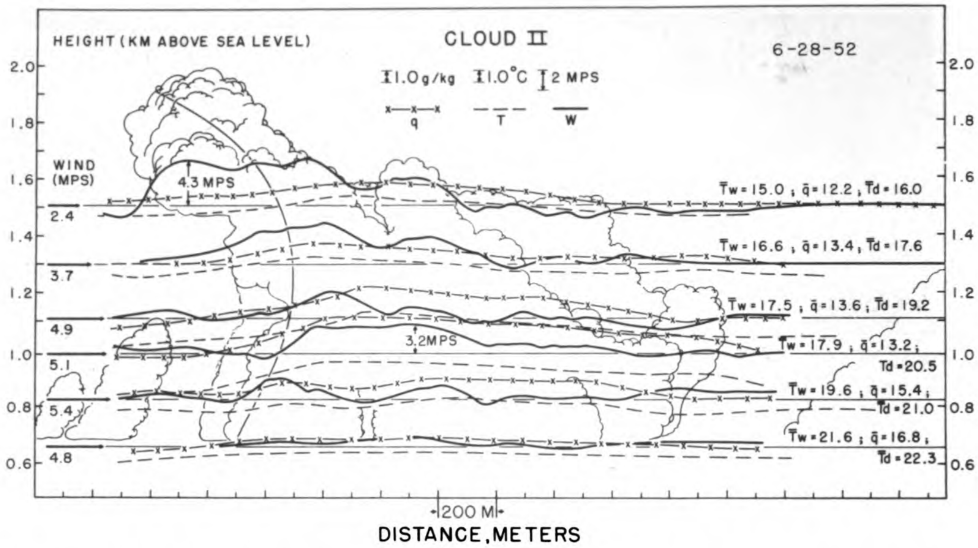
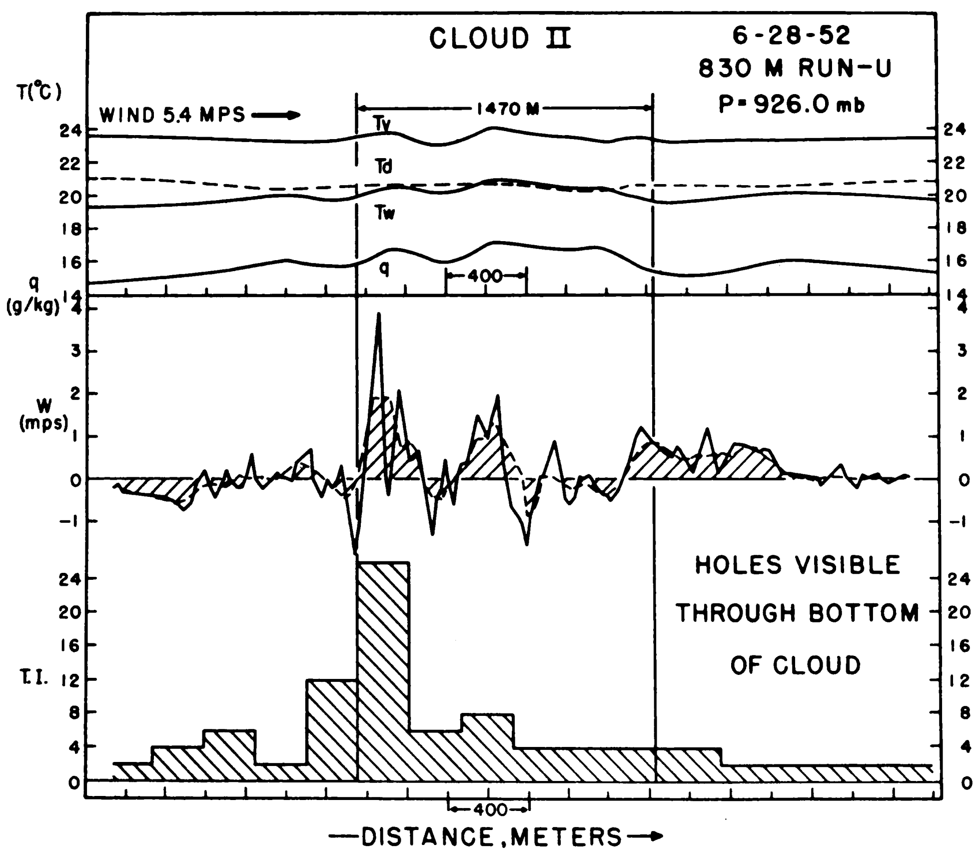


Diagram of a cross section of the cloud shown on the preceding page. Drafts within the cloud are shown by heavy lines; the maximum observed value is 4.3 meters per second. Temperatures (degrees centigrade) are shown at each level by dashed lines, and water vapor content in parts per thousand, by the x-ed lines. Figures to the right of the cloud are wet-bulb temperature, water vapor content, and dry-bulb temperature a short distance away from the cloud. The winds outside the cloud, determined by double drift measurements, are shown by the arrows on the left.

After considerable study of the lift characteristics and aerodynamics of the PBY, it is believed that an adequate technique for draft determination, based essentially upon accelerometers, has been worked out.

In June of 1952, a new expedition to the Caribbean area was made. Most of the flights were made in the vicinity of San Juan, Puerto Rico. They were carried out as shown in the figure on p. 16, with one prior flight past the cloud downwind at the topmost altitude, in order to photograph its profile in the plane of the wind. It is possible to locate each run made through the cloud on the photograph since a motion picture camera was operated from the nose of the plane, thus revealing at what point the cloud was entered. Results from a typical cloud are shown in the figures. On p. 17 is a photograph of the cloud in the plane of the wind as the aircraft flew downwind past it, preparatory to commencing the runs. The next two figures show the reduction and analysis of the data taken in flight. After reduction of all the remaining case studies of clouds to this form, the theories evolved concerning the dynamics of the clouds, their life cycles and growth processes, may be brought to test. Meanwhile, it has been possible to arrive at many interesting qualitative conclusions and suggestions from preliminary inspection of the results.

For example, it was found that the clouds over these oceans did not possess well-defined "roots" in the form of ascending unsaturated air columns or thermals, extending well below their bases down into the subcloud layer. On the contrary, clouds seemed to come into being when one or more of the random bunches of air, or eddies, normally swirling about in the sub-cloud layer reached its condensation level. The last picture shows a group of very small cloudlets, apparently formed in this manner. Light was also shed upon the important question of how a very tiny cloud, of this type, became an extremely large one. Series of photographs were made revealing the clustering or coagulation of several small clouds into one very large one, which was then able to grow up to great heights. On numerous occasions when the airplane attempted to study isolated cumulus, disappointingly enough to the observers, the clouds evaporated before the study could be completed. When the plane was flown through one cloud in a cluster of four or five close together, the clouds lasted beautifully, despite invasion by the aircraft, and some even grew to thunderhead proportions. Further support to this hypothesis was given by flights through clouds that were already large. Almost invariably, the interiors at lower levels of such large



This graph represents the top run of the diagram on the opposite page. The topmost curves are temperatures, in degrees centigrade: Tv is "virtual temperature," directly related to the buoyancy force or upward "push" of the cloud; Td is dry-bulb temperature; Tw is wet-bulb temperature. The curve q is moisture content in grams per kilogram of air. The w curves are vertical drafts in meters per second, the shaded curve being a running average. The lowest section marked T. I. indicates the development of roughness or small-scale turbulence. Note in this run (830 m) how the drafts broke up into several cells.

These tiny cloudlets, each only 100 or 200 feet in diameter, are frequently seen forming at the top of the turbulent subcloud layer in the trade-wind region. It is possible that several tiny cloudlets may aggregate in groups to form larger ones, such as those in the left background. It is hypothesized that trade-wind cloud clusters may originate in this manner.

clouds were found to be full of clear spaces or holes, through which the ocean below could be perceived. At these low heights the larger drafts became broken up into several of smaller diameter indicating that a cloud was actually a family or a cluster of what may once have been independent members. Clearly any theories describing the growth of trade cumulus must take these factors into account.

Another more extensive expedition to the trade-wind area is planned by the Woods Hole group this Spring. The field program is to be carried out in collaboration with a group of British meteorologists from Imperial College, London. The British group will be stationed on the small West Indian island of Anegada (18° 50'N, 64° 20'W; dimensions about 2 by 10 miles) in order to measure winds, low-level fluxes of heat and moisture, and make motion pictures of the clouds. The PBY will make its aerial investigations in the near vicinity.

Thus through the continuing support of the Office of Naval Research, it is becoming possible gradually to construct a clearer picture of the trade-wind atmosphere, which should not only contribute in a practical manner to human exploitation of these regions, but should eventually contribute to a better understanding of atmospheric processes in all parts of the globe.

From TIP to TAB

LCDR J. Heston Heald, USNR

...Head of the Reference Section of the Library of Congress, is temporarily on active duty at ONR as ASTIA Liaison Officer.

On June 15, 1945, the first issue of the Technical Information Pilot (TIP) was prepared by the Office of Naval Research (then the Office of Research and Inventions). On March 1, 1953, TIP was replaced by the Title Announcement Bulletin (TAB) of the Armed Services Technical Information Agency (ASTIA). Between these two dates much progress was made in the bibliographic organization of the thousands of scientific reports originating annually from the military-sponsored research program. The coming of ASTIA and TAB is another step forward in the progress of documentary control procedures.

On March 1, 1953, after long anticipation, the integration under ASTIA of the two activities, formerly known as the Navy Research Section (NRS), Library of Congress, and the Central Air Documents Office (CADO), Dayton, Ohio, became a reality. During recent months these two activities had experienced changes in name. NRS had become part of the Library's new Technical Information Division (TID) and CADO, which was the first of the two to be incorporated into ASTIA, had become known as the ASTIA Document Service Center (DSC). Under the integrated program NRS becomes the ASTIA reference Center (ARC) complementing the Document Service Center.

ASTIA was actually created by the Secretary of Defense on May 14, 1951, as a central report documentation program for the Department of Defense. Many meetings, conferences, surveys, and plans were necessary, however, before such problems as security, program, budget, personnel, etc., could be solved and the organization made ready for handling the vast flow of technical information being generated by the military research program. On the fortunate side was the fact that, during this formative stage, the two activities which were to be the principals of the agency were able to carry on "business as usual." Under the integrated program these two activities will remain in the same physical locations. The functions of each, however, are divided so that duplication of processing, acquisition, reference, etc., will be eliminated. The accompanying chart illustrates the division of functions.

ASTIA's raw material is in the form of unpublished technical reports from the research program of the Department of Defense, its offices, laboratories, and contractors. The services of ASTIA are in turn available to those engaged in this program. Thus, a diffusion of scientific knowledge within the military research family is promoted. In order to establish one's military connection and become an authorized user of ASTIA services, it is necessary to complete, with appropriate endorsements, a "Subject Field of Interest Register." The register forms, available from ASTIA, request: (1) Security clearance, if any, (2) military connection (contract, laboratory, office, etc.) and (3) subject or subjects of interest.

The authorized user will receive regular issues of TAB and be in a position to request other services as he may need them. Such services include abstract catalog cards, Microcards (micro-reproduction of reports laminated to the backs of 3-by-5 catalog cards), reports, references, and bibliographies.

The span of almost eight years covering the life of TIP represents a period of pioneering in the field of report documentation by the Office of Naval Research. Perhaps the first major impact of the technical report on the field of recorded knowledge came during World War II, under the program of the Office of Scientific Research and Development. OSRD exploited the scientific skills of the country largely through contractual arrangement with colleges, universities, and industrial institutions. The results of this research effort were submitted by contractors in thousands of reports, most of which carried a security classification and could not appear in published literature. During the war, little time was available for organizing this huge storehouse of information bibliographically, so that, in future research, utmost advantage could be taken of the work already done. More than 30,000 technical reports were left by OSRD and placed under cognizance of the Office of Naval Research.

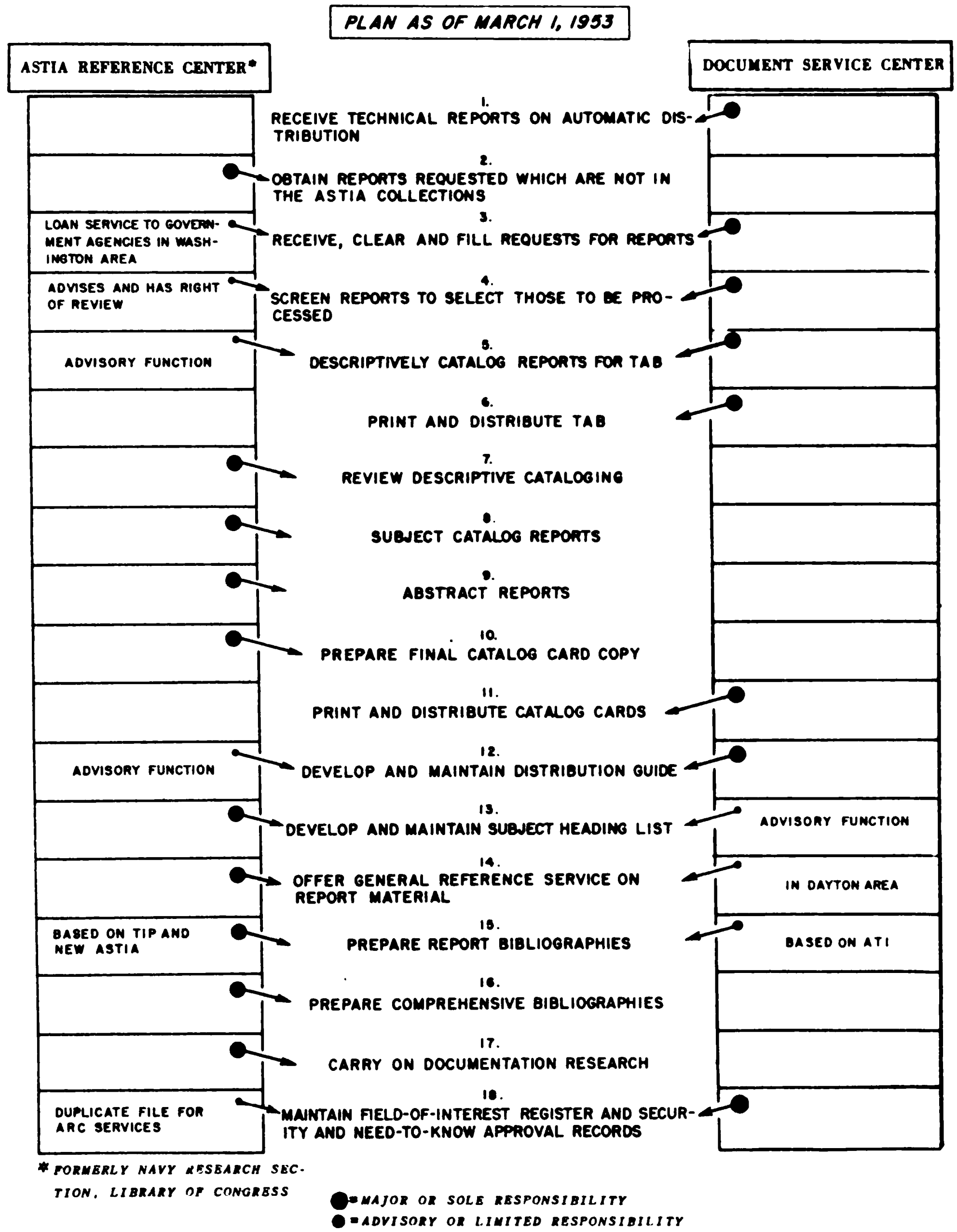
As OSRD was inactivated its pattern for promoting research was generally adopted by various offices of the Department of Defense. The contractor plan, so successfully employed by OSRD, was continued, supplemented by the several military laboratories. Thus, technical reports prepared by contractors, both universities and industrial institutions, and by service laboratories continued to be submitted in a steady flow.

ONR, at that time unique as a research organization within the Department of Defense, and charged with the dissemination of technical information for the Navy, faced the problem not only of salvaging previous information that was to a large extent unorganized, but also of keeping abreast of the current flow. Plans to meet this problem began early in 1945 and, as previously noted, TIP then appeared as an abstract bulletin.

TIP grew in popularity and soon became an organ around which a new documentation program was developed under ONR sponsorship. In the latter part of 1946, this program was launched under contractual arrangements with the Library of Congress when the importance of employing library skills and techniques was recognized.

In undertaking the ONR project, the Library of Congress found that several problems were presented which made the technical report, informal and unpublished, not readily submissive to the general rules for bibliographic processing of published literature. Some of the more important of these were:

DIVISION OF ASTIA FUNCTIONS



1. The usual system of identification by author was difficult since his actual identity was often hard to determine. The researcher in his quest for technical information was more likely to know the institution or laboratory or perhaps the sponsoring military agency which had done research in his field of interest. Hence, the "corporate author" moved into a more prominent position.

2. Reports did not readily lend themselves to the common library practice of arranging information by a subject classification scheme.

3. Use of an alphabetical subject approach required development of a subject heading list particularly tailored to up-to-date research terminology.

4. Security classification of many reports created documentary, stowage, and reference problems which had to be met by special controls.

5. The number of copies of a report prepared originally was small, adding to reference and availability problems.

6. People with background experience in report literature were scarce. In fact, the person with the ideal training in science and librarianship, plus experience, was a rarity indeed.

Gradually these problems—and many more—were solved and when ONR transferred the TID operation to ASTIA, it could do so with the consolation that much had been accomplished and that a real contribution had been made. Some of the accomplishments of the past six years follow in brief.

1. Work was begun under ONR contract on January 1, 1947, when some 60,000 reports and four people were transferred from ONR to the Library of Congress. In six years, the collection grew to almost 11 times the original number and the number of personnel increased to 130.

2. Rules for a new type of cataloging, tailored to the peculiarities of the report, were developed. A new 3-by-5 catalog card format was developed which enabled preparation of abstract catalog cards, TIP, TIP Cumulative Indexes, and report bibliographies from a single process. This new style of catalog card became so recognized that it has been adopted by the Atomic Energy Commission, the National Advisory Committee for Aeronautics, many other scientific offices and laboratories, and now by ASTIA.

3. At the outset there was no satisfactory subject heading list for report literature. Thus, as reports pertaining to new subjects were received, an authoritative List of Subjects Headings was developed. The third edition of this list containing over 30,000 subject headings listed alphabetically, with sub-headings, cross-references, and "see also's," is an extremely valuable reference tool.

4. An Interim Subject Classification was also prepared and used as a guide under which all Navy, and many Army and Air Force, projects have been classified, thus providing an easy subject approach to the research in current progress.

5. As the work progressed, requests for reference service increased from all three military departments and their scientific programs. Over 440,000 reports were furnished on a loan or retention basis. A "report bibliography" service was initiated to meet the demand for background information. This was furnished in the form of catalog cards which provided a quick cumulation of references and abstracts of reports dealing with the subject of interest. Almost 700 such bibliographies were prepared.

6. A comprehensive bibliography service was also available on a special transfer-of-funds basis. This type of bibliography represented a complete search of the known literature, published and unpublished. Fifty-four of these bibliographies were prepared, usually in pamphlet form, with annotations or abstracts and cross indexes.

7. Five hundred twenty issues of TIP were distributed to some 1500 users. Almost six million TIP catalog cards were distributed to libraries and offices requiring on-the-spot reference information.

In addition to the services of TID, a contract was let by ONR on January 1, 1951 with the Microcard Corporation to prepare Microcards for all reports processed by TID in the security classifications of unclassified and restricted. By means of the Microcard, as many as 60 pages of a report could be placed on the back of one 3-by-5 catalog card. This permitted, among other advantages, great reductions in storage space and immediate access to the report. Over 600,000 copies of reports were supplied on Microcard.

All of these services, with the exception of TIP, will be offered by ASTIA under the integrated program, and it is visualized that TAB will permit a broader and quicker announcement service than TIP could achieve. The release of classified information on a need-to-know basis is a well-established principle of security. As demand for TIP grew, it became more and more difficult to control its release on this basis. TIP covered many fields of science with informative abstracts of reports, and there were few persons having such wide interests. TAB, carrying only the descriptive cataloging entry for each report, is an announcement service which can be more freely distributed. Abstracts of documents are furnished by ASTIA, but only in the form of catalog cards distributed strictly on an established subject field-of-interest basis. Another asset of TAB is that it can announce the existence of a report much earlier than was possible in TIP—an important feature in the fast moving tempo of current research. This, of course, is possible because issuance of TAB is not delayed until abstracts are prepared. Still another advantage of TAB is the fact that a greater area of report coverage can be realized as a result of the unified ASTIA program.

The official address and telephone number of ASTIA headquarters is: Armed Services Technical Information Agency, Room 648, Lafayette Bldg., 811 Vermont Avenue, N. W., Washington 25, D. C. Telephone: LIberty 5-6700, Ext. 66281. The addresses of the two principal activities and the purposes for which each should be used are:

To: ASTIA Document Service Center Knott Building Dayton 2, Ohio Tel: Hemlock 0481	Send: New reports for ASTIA processing; requests for reports (unless covered in 2nd item below); requests for Report Bibliographies and other reference services (unless covered in 2nd item below); inquiries on Field-of-Interest Register.
To: ASTIA Reference Center Technical Information Division Library of Congress, Wash. 25, D. C. Tel: STerling 3-0400, Ext. 688	Send: Inquiries on Comprehensive Bibliographies; requests for service by government agencies in Washington area; reports now out on loan from TID, Library of Congress.

On the Naval Research Reserve

CAPT Grimes Speaks at Fourth Anniversary Meeting of NRRC 1-1

CAPT Clifton G. Grimes, USN, Deputy and Assistant Chief of Naval Research, was guest speaker at the fourth anniversary meeting, on 2 March, of NRRC 1-1 (the "M. I. T. Company," Boston, Mass.). From all reports, his talk was well received and highly informative. About 100 members, and several wives, were present at the dinner meeting, which was held at the Officer's Club, Boston Naval Shipyard. Pictured above with CAPT Grimes are CAPT Louis M. Smith, USNR, Commanding Officer of the Company, and CAPT Pleasant D. Gold, USN, Commander of the Boston Naval Shipyard. CAPT Grimes told the officers about ONR's current and prospective projects and how their Company could be of assistance in the program. LCDR R. K. Buchanan, USNR, Assistant to Captain Grimes, also spoke briefly. Other invited guests included CAPT F. B. Eggers, USN, Director of ONR, Boston, and CDR H. Wray Rohrman, USNR, Reserve Research Program Officer, who was toastmaster for the occasion.

Special Devices Program Sponsored by Amherst Company

An extremely interesting Special Devices program, presented on 20 January on the University of Massachusetts campus, is reported by Company 1-3 (Amherst, Mass.). CDR Robert Noe of the Special

Devices Center, Port Washington, N. Y. was scheduled to speak but was assigned additional duty in Europe and could not be present. However, he was ably represented by Albert M. Hassler, ALC. Chief Hassler and an assistant brought to Amherst a truckload of training devices and gave an illustrated talk to an enthusiastic audience of 550.

The program was given wide advance publicity by LCDR George R. Richason, Jr., CO, and a committee of NRRC 1-3 members composed of LT Joseph Steckel, LCDR Ernest Johnson, LT Joseph Marcus, and LT Edward Anderson. The great success of their efforts is evidenced by the number of groups attending which included, besides Company 1-3, the Army's 1224th ORR & D Group, the local section of the American Institute of Chemical Engineers, and the Audio-Visual Aids and Industrial Psychology classes at the University of Massachusetts. Also represented were the Univ. of Mass. chapter of Sigma Xi, Western Mass. Industrial Management Group, and staff and students of the Univ. of Mass., Amherst College, Mt. Holyoke College, and Smith College.

Chief Hassler presented in an extremely interesting manner some of the Navy's views on training. Although the formal talk ended at 2130, it was 2330 before the last of the audience could be separated from the Chief and his equipment. NRRC 1-3 wishes to thank CDR H. Wray Rohrman, ONR Boston Program Officer for his invaluable aid in this and other projects.

CNO Psychological Warfare Director Addresses Cornell University Company

At the 19 February meeting of NRRC 3-1, CAPT Charles H. Smith, Director of the Psychological Warfare Program of CNO, as guest speaker launched the study program on psychological warfare which has been assigned to the Company by the Chief of Naval Operations. CAPT H. B. Stevens, Commanding Officer of the Unit, opened the meeting with background material on psychological warfare. CAPT Exton, who will head the Psychological Study Panel, introduced the speaker.

CAPT Smith pointed out that the Navy needs psychological warfare personnel, but cannot afford to stockpile such personnel with the present manpower shortage. NRRC 3-1, therefore, will act on a pilot panel to see what contribution to Naval psychological warfare can be made by a reserve company. Guests included CAPT Mathews, Director of ONR New York Branch Office and Colonel George Kovach of Army Psychological Warfare.

Officially Activated Naval Research Reserve Companies

Company, Commanding Officer,
Time and Place of Meeting

1-1, CAPT L. M. Smith, USNR
1930, 1st & 3rd Mon.
Rm. 4-370, M.I.T.
77 Mass. Ave.
Cambridge, Mass.

1-2, LT C. E. Franklin, USNR
1930, 2nd & 4th Tues.
USNROTC Bldg.
Brown University
Providence, R. I.

1-2 Panel, LT E. C. Winslow, USNR
1600, 1st & 3rd Tues.
Rm. 305, Ranger Hall
Rhode Island State College
Kingston, Rhode Island

1-2 Panel, CDR Mary Sears, USNR
2000, 1st & 3rd Tues.
Oceanographic Institute
Woods Hole, Mass.

1-3, LCDR G. R. Richason, USNR
1900, 1st & 3rd Tues.
University of Mass.
Amherst, Mass.

1-5, CDR E. A. Wiggin, USNR
2000, 1st & 3rd Mon.
Stratton Hall
Worcester Poly. Inst.
Worcester, Mass.

1-7, CDR G. Z. Dimitroff, USNR
2000, 1st & 3rd Tues.
Wentworth Hall
Dartmouth College
Hanover, New Hampshire

3-1, CAPT H. B. Stevens, USNR
1915 Alt. Thurs.
Auditorium
Cornell Univ. Med. College
1300 York Avenue
New York 21, New York

Company, Commanding Officer,
Time and Place of Meeting

3-2, CDR D. S. Little, USNR
1930, 2nd & 4th Mon.
Special Devices Center
Engineering Bldg.
Port Washington
Long Island, New York

3-3, CDR Morris Beerman, USNR
2000, 1st & 3rd Mon.
USNRTC & MCRTC
3 Porter Avenue
Buffalo, New York

3-4, CDR H. C. Sheve, USNR
1930, 2nd & 4th Tues.
Harkness Hall
Univ. of Rochester
Rochester, New York

3-5, CDR D. S. Rowell, USNR
2000, 2nd & 4th Thurs.
Naval Science Lab.
Hammond Laboratory
14 Mansfield St.
New Haven, Conn.

3-6, LCDR H. W. Isleib, USNR
2000, 2nd & 4th Mon.
USNRTC
Syracuse (Liverpool),
New York

3-7, LCDR H. L. Shambach, USNR
2000, 2nd & 4th Thurs.
USNRTC
Scotia, New York

3-8, CDR Alfred Weeks, USNR
1930, 2nd & 4th Tues.
250 Park Avenue
Conference Room of General Foods
Personnel Offices, 7th Floor
New York, New York

Company, Commanding Officer,
Time and Place of Meeting

3-9, CDR J. S. Medd, USNR
2000, 1st & 3rd Wed.
Brookhaven Nat. Lab.
Upton, Long Island, N. Y.

4-1, CDR F. J. Trost, USNR
2000, 1st & 3rd Wed.
Nassau Tavern
Princeton, New Jersey

4-2, CDR F. C. Powell, USNR
1930, Alt. Thurs.
Franklin Institute
20th St. & Parkway
Philadelphia, Penna.

4-3, CDR N. D. Cole, USNR
2000, 2nd & 4th Thurs.
Rm. 1112 Science Bldg.
Carnegie Inst. of Tech.
Pittsburgh, Penna.

4-4, LCDR P. F. Norton, USNR
1900, 1st & 3rd Wed.
Rm. 200, Eng. "E"
Pennsylvania State Coll.
State College, Penna.

4-5, CDR Donald MacCreary, USNR
2000, Alt. Mon.
USNRTC
Foot of Madison St.
Wilmington, Delaware

4-6, CDR L. S. Beedle, USNR
1930, 2nd & 4th Wed.
USNRTC
Bethlehem, Penna.

4-7, LCDR L. J. Nowacki, USNR
1930, 2nd & 4th Tues.
Old Armory, Rm. 107
Ohio State Univ.
Columbus, Ohio

4-8, CDR Viktor Schreckengost, USNR
2000, 1st & 3rd Mon.
USNRTC
1089 E. Ninth St.
Cleveland, Ohio

Company, Commanding Officer,
Time and Place of Meeting

4-9, LCDR E. J. O'Toole, USNR
1930, 2nd & 4th Mon.
USNRTC
Dayton, Ohio

W-Battalion, CAPT F. C. Wiesner, USNR
2000, 3rd Thurs. last month of quarter
Auditorium, Interior Dept.
18th & E St., N. W.
Washington, D. C.

W-1, CDR C. V. L. Smith, USNR
2000, 1st & 3rd Thurs.
Nat. Academy of Sciences
21st & Const. Ave.N. W.,
Washington, D. C.

W-2, LCDR B. G. Bingham, USNR
1900, 1st & 3rd Thurs.
NRL Auditorium, Bldg. 8
Washington, D. C.

W-5, LCDR J. W. Krasauskas, USNR
2000, 2nd & 4th Tues.
Conference Room, NMRI
Bethesda, Maryland

5-2, LCDR F. D. Hansing, USNR
2000, 1st & 3rd Mon.
Virginia Poly. Inst.
Room 208, Price Hall
Blacksburg, Virginia

5-3, LT R. D. Housewright, USNR
2000, each Tues.
Camp Detrick
Frederick, Maryland

5-4, LT A. W. Tiedemann, Jr., USNR
2000, 1st & 3rd Thurs.
Room 202, Maryland Hall
Johns Hopkins Univ.
Baltimore, Maryland

5-5, CAPT R. D. Hughes, USNR
1700-1900, 2nd & 4th Mon.
Medical College of Va.
Richmond, Va.

Company, Commanding Officer, Time and Place of Meeting

6-1, CDR J. E. Boyd, USNR
2000, Alt. Thurs.
103 Physics Bldg.
Georgia Inst. of Tech.
Atlanta, Georgia

6-2, LT J. E. Land, USNR
1915, 1st & 3rd Mon.
318 Ross Lab.
Alabama Poly. Inst.
Auburn, Ala.

6-3, CDR George B. King, USNR
2nd & 4th Wed.
O.R.I.N.S.
Medical Division
Oak Ridge, Tenn.

6-4, LCDR C. L. Eggert, USNR
1930, 1st & 3rd Tues.
P. K. Yonge Bldg.
Room 134
Univ. of Florida
Gainesville, Fla.

6-5, LT R. M. Hodges, USNR
2000, 1st & 3rd Thurs.
USNRTC
Gulfport, Miss.

6-6, LCDR R. F. Schenkkan, USNR
1945, 2nd & 3rd Wed.
USNROTC Armory
Univ. of N.C., Chapel Hill, N.C.

6-8, CDR W. D. Daniel, Jr., USNR
2000, 1st & 3rd Mon.
Underwater Sound Ref. Lab.
Orlando, Florida

6-9, LCDR A. R. Robertson, USNR
1930, 1st & 3rd Mon.
Rm. 101, Baldwin Hall
University of Georgia
Athens, Georgia

6-10, CDR Norman R. Buchan, USNR
2000, 1st & 3rd Wed.
Rm. S-110, Memorial
Classroom
University of Miami
Coral Gables, Florida

Company, Commanding Officer,
Time and Place of Meeting

6-10 Panel, LT John H. Coleman, USNR
2000, 1st & 3rd Wed.
151 South County Road
West Palm Beach, Fla.

6-11, LCDR William G. Miller, USNR
2030, 1st & 3rd Wed.
Physics Bldg.
Clemson College
Clemson, South Carolina

8-1, LCDR John M. Scott, USNR
1930, 1st & 3rd Tues.
USNROTC Bldg.
Tulane University
New Orleans, La.

8-2, LTJG Olen A. Nance, USNR
2000, 1st & 3rd Wed.
Rm. 221, Coates Lab.
La. State University
Baton Rouge, La.

8-3, CDR Norman F. Rode, USNR
1930, 2nd & 4th Mon.
PMA Bldg. or Bolton Hall
Texas A&M College
College Station, Texas

8-4, LCDR L. J. Castellanos, USNR
1930 Alt. Wed.
USNROTC Bldg.
The Rice Institute
Houston, Texas

8-5, CDR Gilbert H. Ayres, USNR
2000, Alt. Tues. & Wed.
Chemistry Bldg, Room 15
University of Texas
Austin, Texas

8-6, LT Lauro Gutierrez-Vela, USNR
1930, Last Mon. of month
USNRTC
Galveston, Texas

Company, Commanding Officer,
Time and Place of Meeting

8-7, LT Clarence M. Ransom, USNR
2000, 1st & 3rd Wed.
USNRTC
1805 S. Yale Ave.
Albuquerque, N. Mex.

8-8, LT Robert G. Nisle, USNR
2nd & 4th Wed.
Senior High School
Bartlesville, Okla.

8-8 Panel, LCDR Dariel E. Howell, USNR
1930, 2nd, 3rd, 4th Thurs.
Oklahoma A&M College
Union Building
Stillwater, Oklahoma

8-9, LCDR Daniel F. Seacord, Jr., USNR
1705, 1st & 3rd Tues.
Rm. B-117
Los Alamos Scientific Lab.
Los Alamos, New Mexico

8-11, LT Edmond S. Hastings, USNR
1930, 2nd & 4th Thurs.
USNRTC
Orange, Texas

8-12, LT Wilbur G. Teubner, USNR
2000, 2nd & 4th Tues.
Fondren Sc. Bldg. Rm. 127
Southern Methodist Univ.
Dallas, Texas

9-1, LCDR Walter E. Peterson, USNR
1900, 2nd & 4th Tues.
Navy Pier Campus
University of Ill.
Chicago, Illinois

9-2, CAPT Chanucy M. Louttit, USNR
1930, 2nd & 4th Tuesdays
Room 149
Mechanical Engr. Bldg.
Univ. of Illinois
Urbana, Illinois

9-2 Panel, LT R. G. Dworschack, USNR
1930, 2nd & 4th Tues.
Library, Northern
Regional Research Lab.
Peoria, Illinois

Company, Commanding Officer,
Time and Place of Meeting

9-3, LT Edwin H. Young, USNR
1930, Alt. Mon.
Angell Hall, Rm. 18
University of Michigan
Ann Arbor, Michigan

9-3 Panel, LCDR Roy W. Drier, USNR
Houghton, Michigan

9-5, LCDR Orlando S. Knudsen, USNR
1930, 1st & 3rd Wed.
USNROTC Bldg.
Iowa State College
Ames, Iowa

9-6, CDR Joseph A. Wise, USNR
1930, 1st & 3rd Mon.
Room 4, Mech. Eng. Bldg.
University of Minnesota
Minneapolis, Minnesota

9-6 Panel, LT Gerald B. Spawn, USNR
2000, 2nd & 4th Wed.
ROTC Armory
South Dakota State College
Brookings, S. Dakota

9-7, LT L. N. Baker, USNR
1930, 2nd & 4th Thurs.
111 Stanley Coulter Hall
Purdue University
Lafayette, Indiana

9-8, CDR John H. Carter, USNR
2000, 1st & 3rd Thurs.
101 Crow Hall
Washington University
St. Louis, Missouri

9-8 Panel, LT Walter C. Broad, USNR
Thursdays
Bureau of Mines
Louisiana, Missouri

9-9, LCDR Robert Elgin, USNR
1930, 1st & 3rd Thurs.
204 Mechanics Hall
Missouri School of Mines
and Metallurgy
Rolla, Missouri

Company, Commanding Officer, Time and Place of Meeting	Company, Commanding Officer, Time and Place of Meeting

9-12, LT W. D. Thomas, USNR
1900-2100, 2nd & 4th Thurs.
Room 220, Chemistry Bldg.
Colorado A&M College
Fort Collins, Colorado

9-12 Panel, LT William F. Utlaut. USNR
1900, 1st & 3rd Tues.
University of Colorado
Boulder, Colorado

9-13, LCDR J. R. Maloney, USNR
1930. every Thurs.
USNRTC
Des Moines, Iowa

9-14, LTJG Ralph R. Caldwell, USNR
1930, Alternate Wed.
USNRTC
University of Wisconsin
Madison, Wisconsin

9-14 Panel, LTJG Keith W. Hardacker, USNR
1930, 1st & 3rd Tues.
Lecture Room
The Institute of Paper
Chemistry
Appleton, Wisconsin

9-15, LTJG T. E. Werkema, USNR
1900, 2nd & 4th Thurs.
Conference Room
Dow Chem. Co. Pers. Bldg.
Midland, Michigan

9-16, LCDR Ira B. Baccus, USNR
1930, 1st & 3rd Mon.
USN & MCTC
1620 E. Saginaw St.
Lansing, Michigan

9-19, CDR Arthur L. Benton, USNR
1945, 3rd Thurs.
Senate Chamber, Old Capitol
University of Iowa
Iowa City, Iowa

9-19 Panel, CDR John O. Chellevold, USNR
1930, 1st & 3rd Wed.
U. S. Naval Training Center
200 Riverside Drive
Waterloo, Iowa

9-20, LT Russell C. Mills, USNR
1930, 1st & 3rd Mon.
103 Haworth Hall
Univ. of Kansas
Lawrence, Kansas

9-21, LCDR Robert M. VanHouse, USNR
1900, 2nd & 4th Mon.
2792 E. Grand Blvd.
Detroit 11, Michigan

9-22, LCDR Lloyd W. Hurlbut, USNR
1930, 1st & 3rd Wed.
Military & Naval Sci. Bldg.
University of Nebraska
Lincoln, Nebraska

9-22 Panel, LCDR Benedict J. Jaskoski, USNR
1930, Alternate Tues.
(1st & 3rd)
Creighton Dental College
Room 7 - 26th & Calif.
Omaha 2, Nebraska

9-23, CDR Glen L. Hawks, USNR
1800, 2nd & 4th Wed.
Conference Room, Bldg. No. 2
Argonne Nat. Lab.
DuPage County Site, Ill.

11-1, CDR Frederick P. Dillon, USNR
2000, 1st & 3rd Tues.
Thompson Lab.
125 S. Grand Ave.
Pasadena, Calif.

11-2, CDR George Van Schliestett, USNR
2000, 1st & 3rd Thurs.
USNRTC
Pasadena, Calif.

11-3, LCDR Laurance B. James, USNR
2000, 1st & 3rd Mon.
Hancock Auditorium
Univ. of S. C., Room 109
Physics Biology Bldg. UCLA
Los Angeles, Calif.

11-4, LT Lawrence Lynn Whiteneck, USNR
1945, 1st & 3rd Wed.
USNRTC
San Pedro, California

Company, Commanding Officer, Time and Place of Meeting	Company, Commanding Officer, Time and Place of Meeting

11-5, CDR Serafino L. Giuliani, USNR
1930, 2nd, 3rd, 4th, Tues.
Special Devices Center
2548 Kettner Blvd.
San Diego, Calif.

11-6, LT Irvine B. Watts. USNR
2000, 2nd & 4th Thurs.
USNRTC
Phoenix. Arizona

11-7, LT John W. Stull, USNR
2000, 1st & 3rd Thurs.
USNRTC & MCRTC
1100 S. Alvernon Way
Tucson, Arizona

12-1, CDR R. M. Fincher. USNR
2000, 2nd & 4th Mon.
1000 Geary St.
San Francisco, Calif.

12-3, CDR L. S. Jacobsen, USNR
2000, 2nd & 4th Wed.
Room 268, Engineering Bldg.
Stanford University
Stanford, California

12-4, CDR Ennis B. Womack, USNR
2000, 2nd & 4th Thurs.
Room 103, McLane Hall
Fresno State College
Fresno, California

12-5, CDR John M. Dundon, USNR
1930, 2nd & 4th Wed.
Room 147, Corey Hall
University of Calif.
Berkeley, Calif.

12-6, LCDR Raymond M. Keefer, USNR
2000, 1st & 3rd Tues.
Tower Room, Univ. of Calif.
Animal Science Bldg.
Davis, California

12-8, CAPT George J. Higgins, USNR
Every other Wed. at 2000
Room 504, Bldg. 221
USN Postgraduate School
Monterey, California

13-1, CDR Blake D. Mills, JR., USNR
1930, 2nd & 4th Monday
Health Sciences Bldg. E-502
Univ. of Washington
Seattle, Washington

13-2, LCDR Donald R. Gustavson, USNR
1900, 2nd & 4th Tues.
American Legion Hall
Richland, Washington

13-3, LCDR W. G. Gnaedinger, USNR
1930, 2nd & 4th Mon.
Room 39, Ernest Holland Library
Pullman, Washington

13-4, LCDR Danny C. Marquez, USNR
2000, 2nd & 4th Tues.
USNRTC, Swan Island
Portland, Oregon

13-5, CDR Albert V. Logan, USNR
1930, 2nd & 4th Mon.
Rm. 104, Chemistry Bldg.
Oregon State College
Corvallis, Oregon

13-6, LCDR David J. Mallon, USNR
1930. 1st & 3rd Thurs.
City Hall
Idaho Falls, Idaho

Prospective Companies

S. Charleston, West Virginia
LCDR Bryan W. Stonestreet, USNR
1016 Summit Drive
Charleston, West Virginia

Logan, Utah
LT Dean K. Fuhriman, USNR
Irrigation & Drainage Dept.
School of Engineering
Utah State Agricultural College
Logan, Utah

Louisville, Kentucky
LCDR Raymond H. Wilson, USNR
Mathematics Department
University of Louisville
Louisville, Kentucky

State College, Mississippi
LT John A. Alford, USNR
Dept. of Animal Diseases
Agri. Experiment Station
State College, Mississippi

Tullahoma, Tennessee
CDR E. P. Wood, USNR
P. O. Box 1445
Tullahoma, Tennessee

Cincinnati, Ohio
LT John B. Hart, USNR
1519 Herald Avenue
Cincinnati 7, Ohio

Washington, D. C., W-6
CAPT Frank G. Kear, USNR
13 W. Leland Street
Chevy Chase 15, Maryland

NOTE: Please advise Promptly the Chief of Naval Research, code 830, Washington, D. C. of any changes or corrections to be made to this roster.

Transfer of Reservists to Ready Reserve

If you, like most of your fellow Reservists, have received a "Notification of Ready Reserve Status," don't be alarmed and take this as your cue to pack up the old sea bag. This Notification is being sent to members of the Reserve Program under the provisions of the Armed Forces Reserve Act of 1952. However, most of us are eligible for immediate transfer from the Ready Reserve (USNR-R) to the Standby Reserve (USNR-S1). A Reserve member who has fulfilled any one of the four conditions listed below can request transfer to the Standby Reserve.

(a) A total of five years' active duty in the Armed Forces of the United States; or

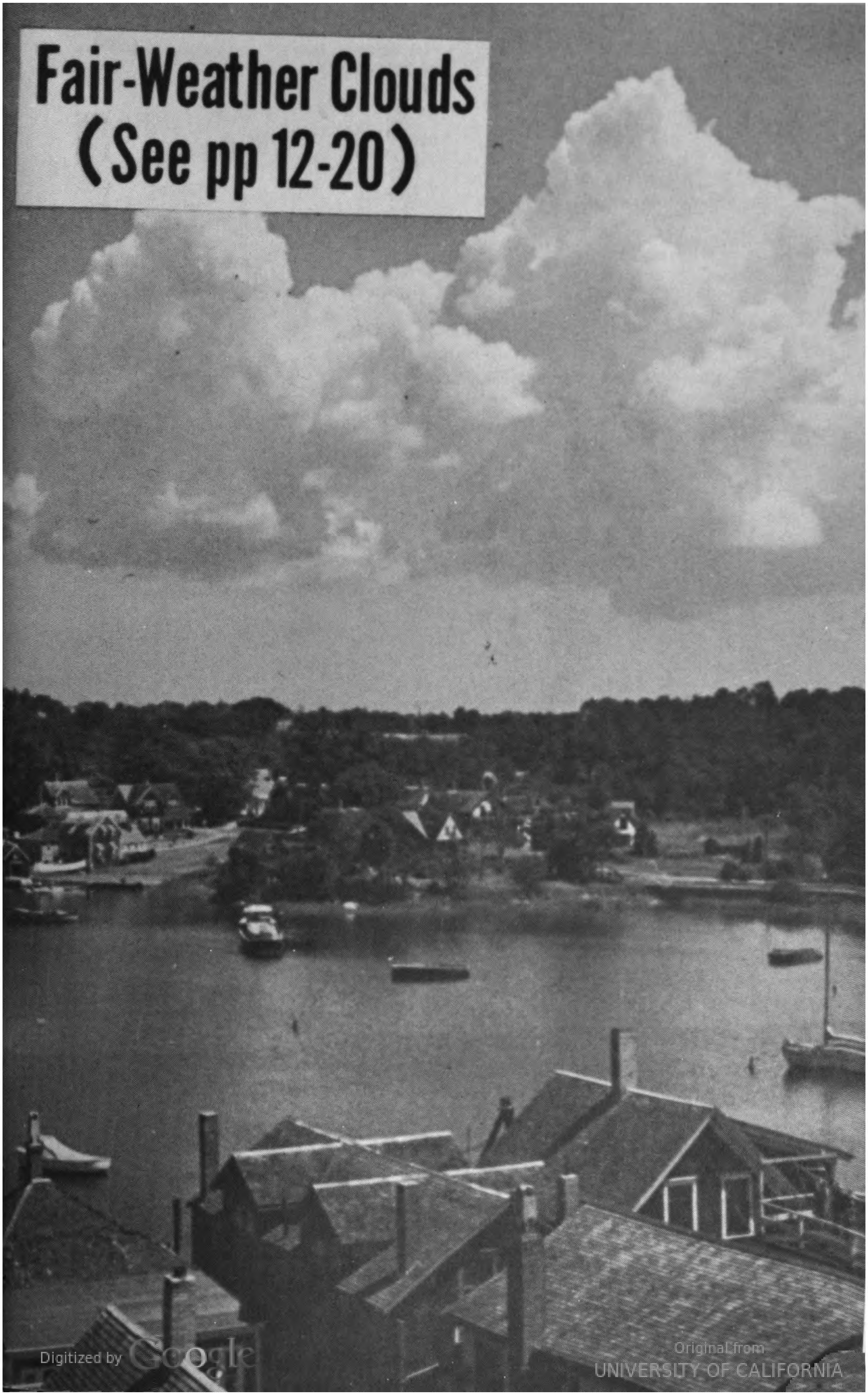
(b) Not less than twelve months' active duty in the Armed Forces of the United States between 7 December 1941 and 2 September 1945 and not less than twelve months' active duty since 25 June 1950; or

(c) A total of eight years' service as a member of one or more Reserve components subsequent to 2 September 1945; or

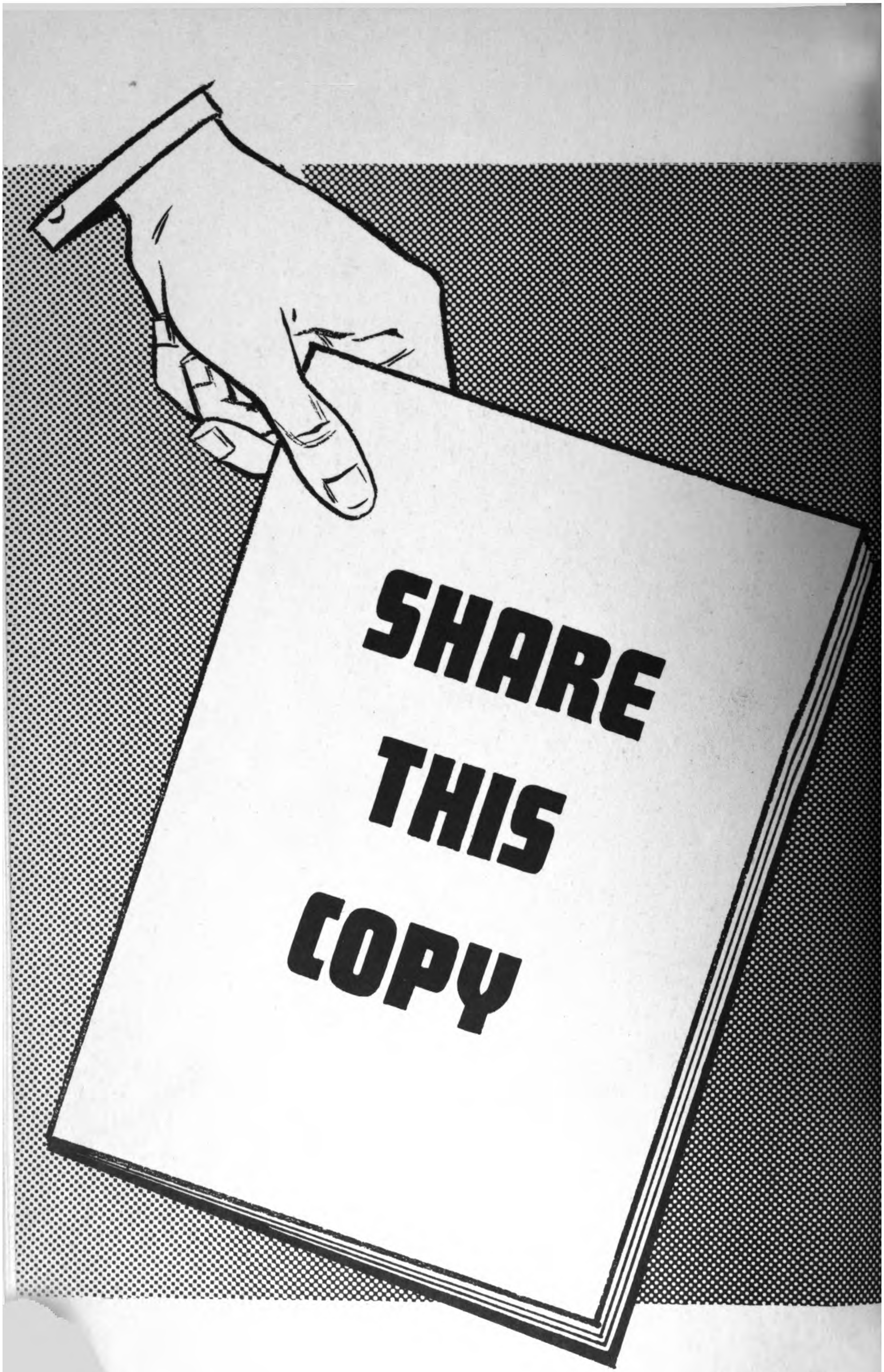
(d) A period of active duty in the Armed Forces of the United States which when added to satisfactory service in an accredited training program of one or more Reserve components totals not less than five years.

All Reservists who are qualified to transfer to the Standby Reserve are urged to do so by initiating a request on NavPers 3092 (officers) or NavPers 3093 (enlisted) which can be obtained from the Commandant of your Naval District. As our Program is authorized to include both members of the Ready Reserve and the Standby Reserve, those who are not eligible for such transfer can still remain associated with their Reserve Research Company.

U. S. GOVERNMENT PRINTING OFFICE : O—1953



Fair-Weather Clouds
(See pp 12-20)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