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RESEARCH REVIEWS

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WASHINGTON, D. C.

COVER PHOTO: Naval Officer and civilian engineer discuss the Navy's air-drop automatic weather station, the "Grasshopper." As soon as the parachuted case hits the ground the six ungainly legs unfold, the body is propped upright, the antenna is elevated, and the station is ready to chirp.

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

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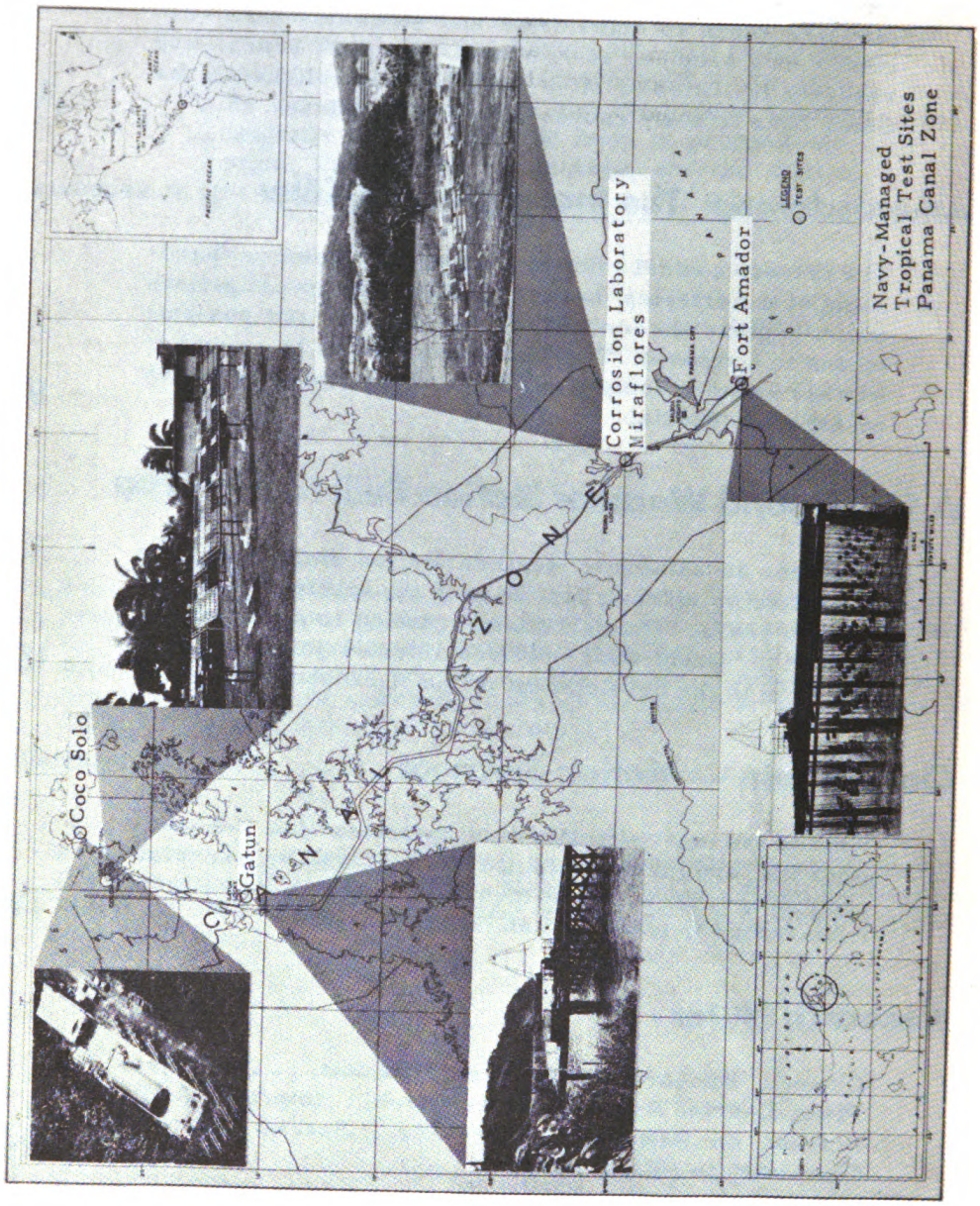

Tropical Deterioration Research

Panama Canal Zone Facilities

World War II was not very far along before it became apparent that pre-war planning fell woefully short in providing proper design for electronic communications equipment and materials used in the tropics. This kind of equipment, so vital to military operations, not only gave poor performance in the critical early period of the war, but in many instances failed to arrive in good condition at tropical theaters of operation. The heat, humidity, and other conditions took their toll during shipping, and in some cases the communications equipment would not operate upon arriving at its destination. Much of the equipment that survived the trip and could be used, deteriorated rapidly and was of little or no value to the operating forces.

These difficulties with electronic equipment created an atmosphere of uncertainty on how satisfactory the performance might be, and how long some of the vital components might hold out before failing. To meet the deficiencies, the Navy along with technical groups from the other services swung into a program which attacked the problem. Stop-gap measures were adopted, sometimes of unproven value, to retard the rate of deterioration of critically needed materials and improve their condition upon arrival.

From its very inception, considerably in advance of World War II, the Naval Research Laboratory assumed a major role in the development and perfection of electronic communications equipment. Thus it was inevitable that such urgent problems related to the performance of electronic equipment in tropical environments be referred to this Laboratory. Initial efforts of a stop-gap nature were designed toward protecting equipment in being. Subsequent programs have been pointed toward a more basic understanding of the phenomena involved with a view of supplying basic information to be incorporated into new designs. Thus the post-war program has emphasized studies which are producing more fundamental information on the cause and effect of tropical deterioration. The data derived from this program are being used in the design of current equipment; as additional facts become known, they may be expected to contribute to designs and prototypes that are still more efficient.

At the beginning, the Laboratory's major attention in this field was devoted to overcoming the susceptibility of electronic assemblies to tropical deterioration. This called for studies of the mode of attack of microorganisms on each of the materials of construction used in the equipment. These included plastics, cellulosic insulators, a variety of metals, and, in particular, assemblies of components derived from dissimilar metals. To handle such problems the Microbiological Section of NRL's Chemistry Division was established.

The over-all responsibility for coordinating tropical deterioration research was vested in the Office of Scientific Research and Development (OSRD). This Office, in addition to its coordinating activities, supported a broad program of its own. To do the job, OSRD established a

field station at Fort Sherman, Canal Zone, where experiments could be conducted in an environment most closely related to that in which equipment would function. In 1945 following closely the end of the war, the Office of Scientific Research and Development was dissolved. Recognizing the value and need for continued effort in this field, the Chief of the Office of Naval Research and Inventions (now Office of Naval Research) initiated collateral action with the War Department, which provided for the continuation of essential portions of the deterioration program. As a part of the new arrangement, the Naval Research Laboratory was given the management of the Tropical Exposure Site at Fort Sherman, C.Z. It was further provided that this facility continue to be available for the use of all technical branches of the Army and Navy, and subsequently the Air Force. This arrangement continues to date with each of the departments actively participating.

By 1952 Naval Research personnel had become quite familiar with the program and well acquainted with the scientists at another laboratory in the area—the Corrosion Laboratory of the Panama Canal Co. This activity was established initially to study problems related to the enlargement of the facilities of the Canal. As early as 1950 plans for extending the Canal were placed in abeyance, but the laboratory continued to provide useful information for meeting problems of maintenance for the Canal. Following a decision of the Panama Canal Company to discontinue the Corrosion Laboratory, its active management was transferred to the Naval Research Laboratory in November 1952. With this acquisition, the facilities available to NRL in the tropics were expanded considerably. In addition to the exposure sites already in service, four new ones were provided (Frontispiece) along with well equipped chemical and physical laboratories. As a part of the agreement under which the laboratory was transferred, the basic corrosion program of the Corrosion Laboratory was to be continued.

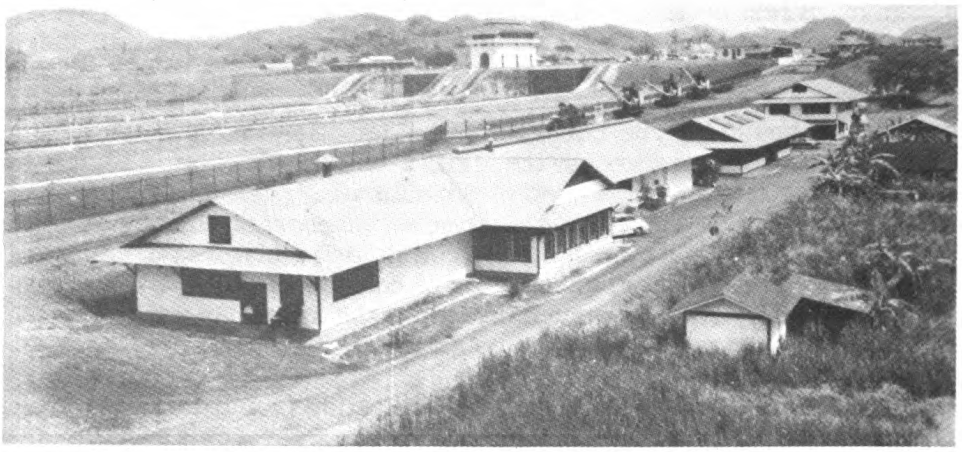

Figure 1 - Three principal buildings at the Corrosion Laboratory

Figure 2 - The Chemistry Laboratory is well equipped

NRL is supported in this effort by the Engineering Research and Development Laboratories, Fort Belvoir and by the Panama Canal Company, each of which continues to maintain a close interest in the basic program of the Corrosion Laboratory. As a result of this arrangement, the original long-range program on corrosion in the tropics is being preserved and continued, and as specific phases of this project are concluded, facilities become available for undertaking additional studies peculiar to the tropics. As with the Tropical Exposure Site, the Corrosion Laboratory and its auxiliaries are available to all branches of the military service. Currently, test teams from the Chemical Corps and Army Engineers are at the Corrosion Laboratory (Figures 1, 2, and 3) making extensive use of its varied facilities in studying problems of immediate concern to their respective Corps.

TROPICAL ENVIRONMENT FACILITIES

Quite recently headquarters for this tropical activity have been located in the main laboratory building at Miraflores about five miles inland from the Pacific entrance to the Canal. The Scientist-in-Charge has the administrative responsibility for the local organization. However, technical management of the Tropical Exposure Site at Coco Solo remains with NRL in Washington. Office space as well as adequately equipped laboratories are provided at Miraflores for the local staff. The main laboratory building contains a variety of equipment for conducting all sorts of chemical and physical investigations in addition to which there is a well equipped machine shop, a museum (for displaying exposed samples for further study) and a photographic laboratory. Storerooms are well stocked with essential laboratory equipment and chemicals for conducting a variety of studies peculiar to the tropics.

In 1953 the Tropical Exposure Site was shifted from Fort Sherman to a point near Coco Solo (Inside Back Cover). The major installations

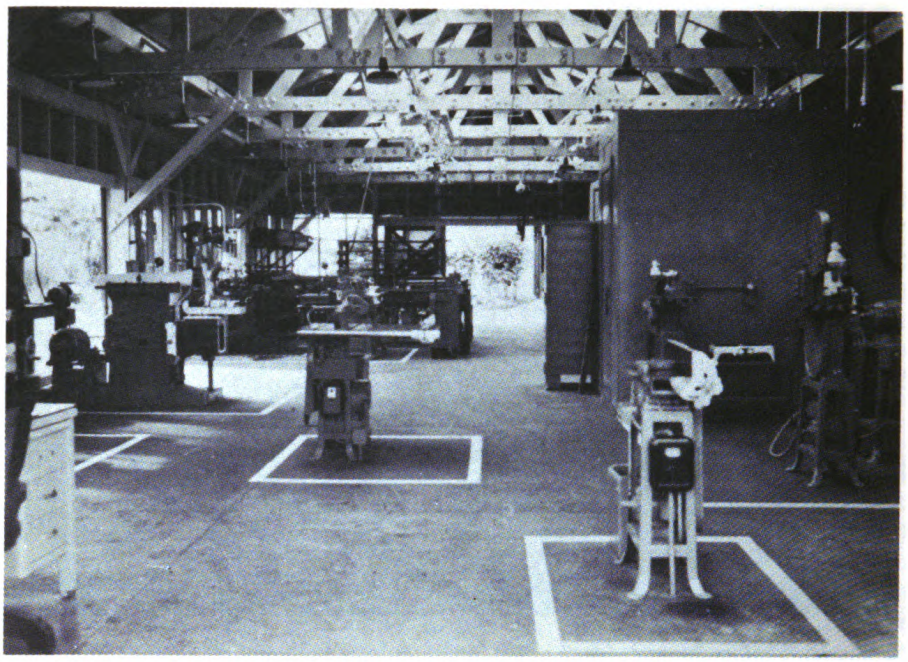

Figure 3 - Shop area of the Corrosion Laboratory

here (Figures 4, 5, and 6) consist of a concrete laboratory building, a quonset hut for housing auxiliary facilities, and an area of exposure racks. Dense jungle areas surround this site affording ample opportunity for the evaulation of sizable quantities of material in a semi-rain forest environment.

A tower (Figure 4) has been erected at the Site to insure the collection of meteorological data from a location more desirable than somewhere near the ground. Records are compiled on rainfall, sunlight distribution, temperature, and humidity. The laboratory is equipped adequately for mycological studies and for a variety of electrical and electronic tests.

Of perhaps critical interest is the availability of adjacent areas for conducting exposure tests under tropical conditions. Perhaps the largest single item studied at the Site to date was a jet engine built by the General Electric Company for the Bureau of Aeronautics. Packed in a hermetically sealed container, the engine was for more than a year exposed directly to the wet, humid environment of the jungle. This provided a thorough check on the reliability of the packaging under adverse, but likely to be encountered, conditions.

The Miraflores atmospheric racks are maintained for exposing panels of metal, paints, plastics, etc. to the clean uncontaminated atmosphere of the area. These racks are situated approximately 5 miles from the ocean (Figure 5). Additional racks are available on the pier over sea water at Fort Amador for conducting similar exposures. Together, these sites permit comparison of relative corrosion rates at two contrasting locations. Near the Atlantic Ocean, atop the Washington Hotel in Colon, additional racks are maintained for exposing specimens

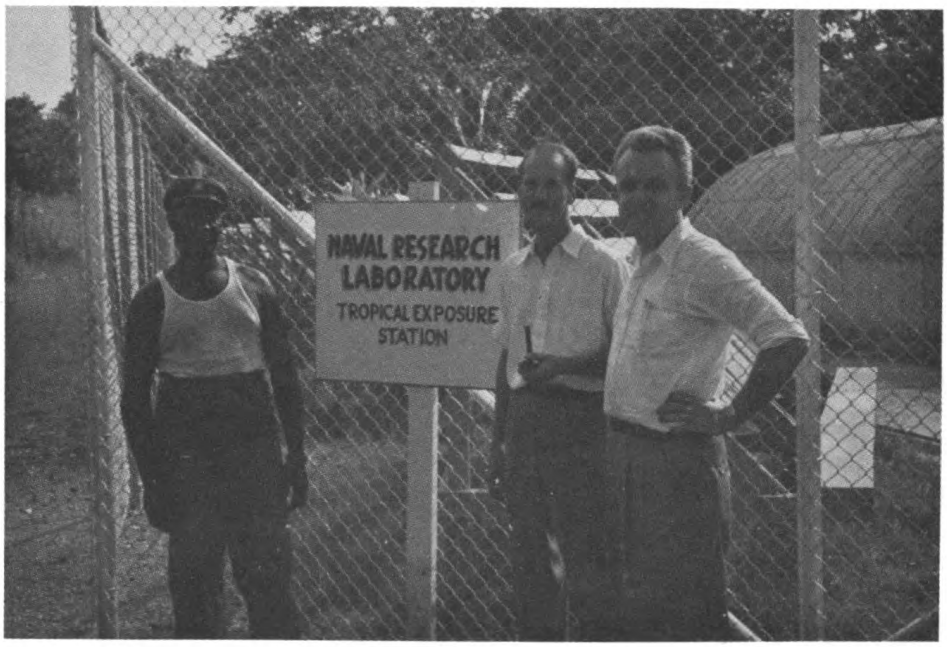

Figure 4 - Members of the staff at Coco Solo

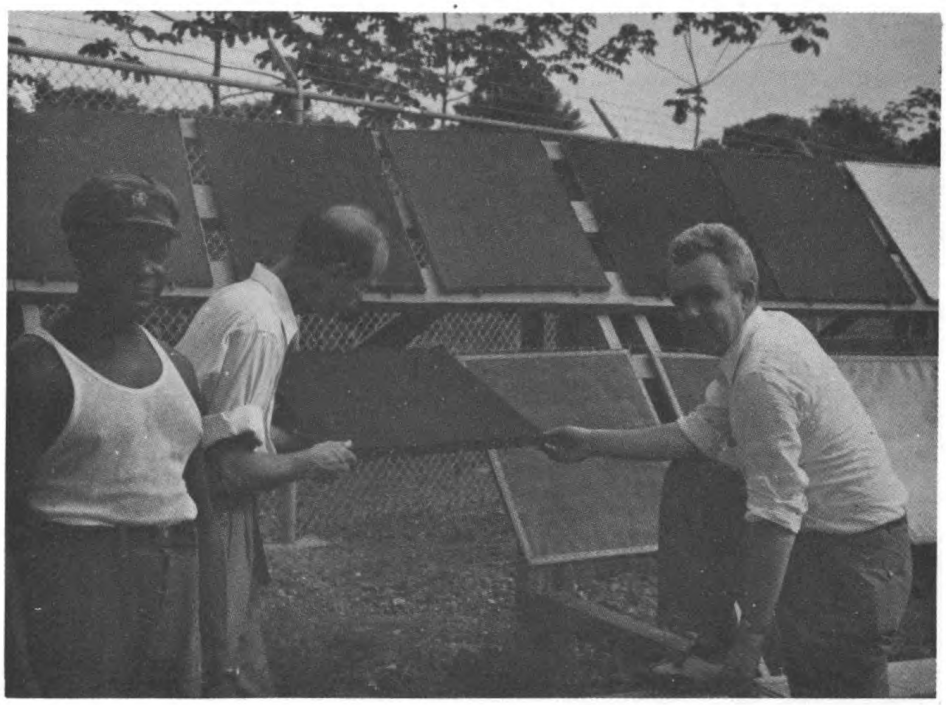

Figure 5 - Weather-coated fabrics on exposure to direct sunlight at the Tropical Exposure Site

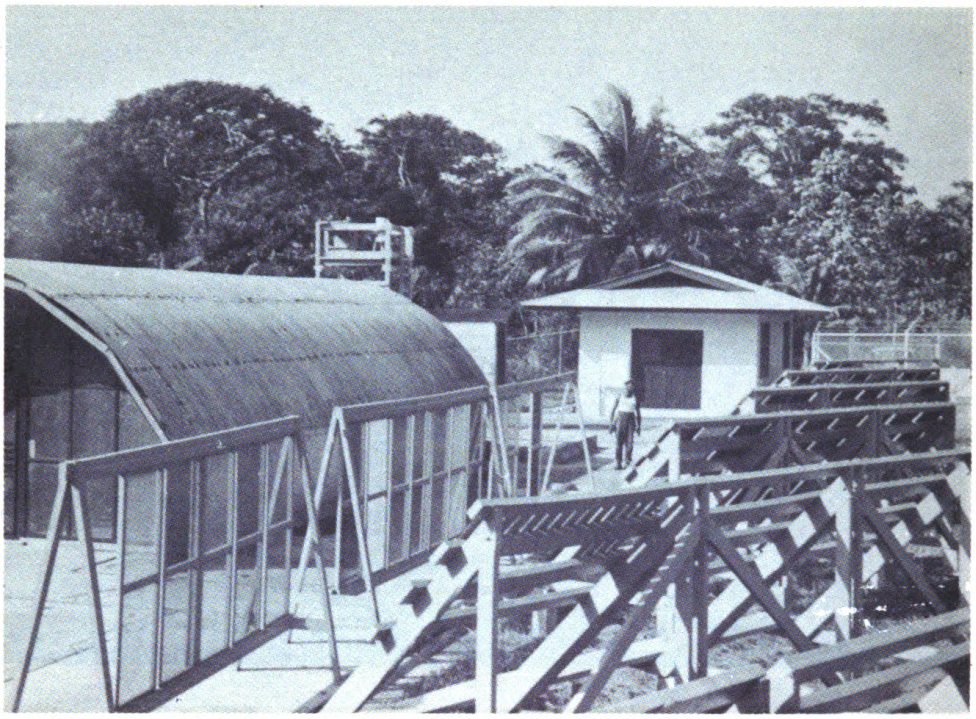

Figure 6 - General view of the Tropical Exposure Site, Coco Solo

Figure 7 - Tower for meteorological instruments

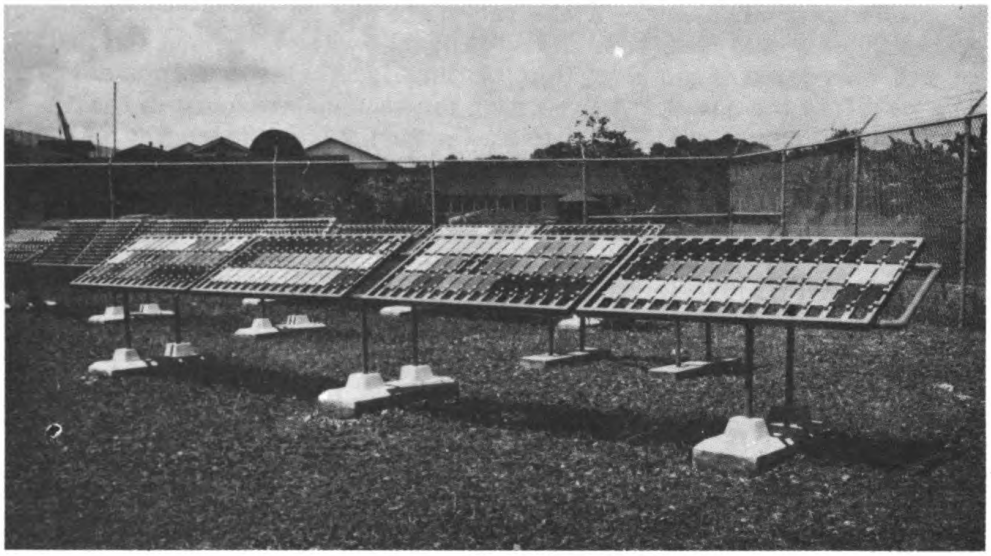

Figure 8 - Exposure racks at Miraflores

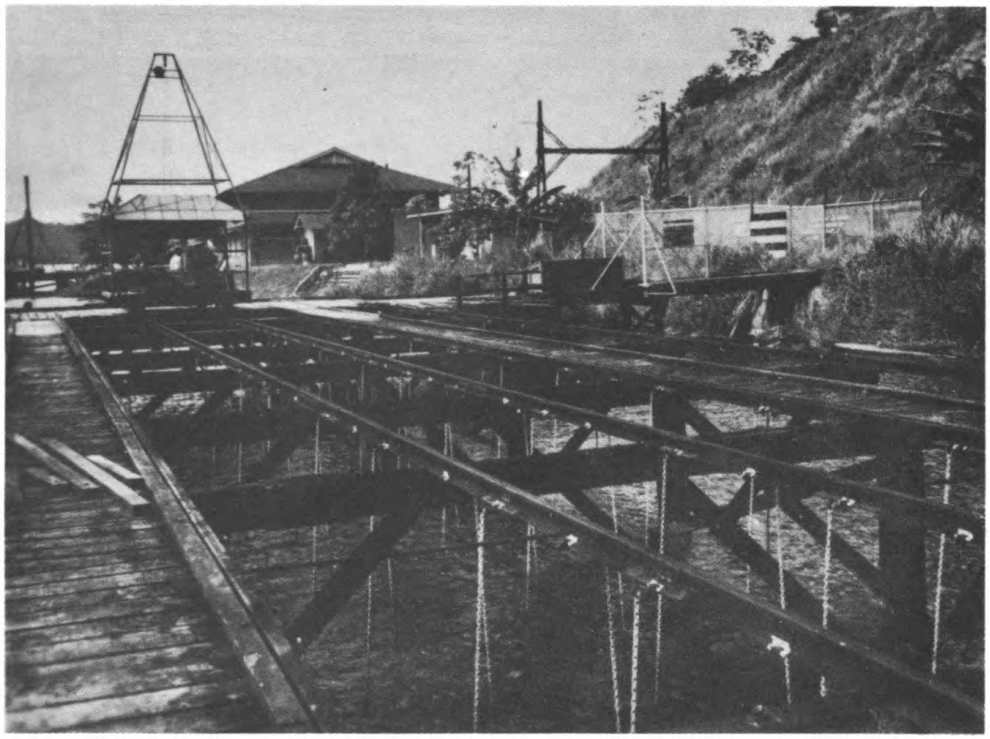

Figure 9 - Fresh water exposure pier at Gatun Lake

in salt-laden atmosphere. These racks are 55 feet above sea level and approximately 225 feet from the edge of the water of Limon Bay. The rate of corrosion of metal at this location is accelerated considerably as a result of the salt spray present in the atmosphere much of the time. As at Miraflores and Fort Amador, the racks are constructed of corrosion-resistant steel with porcelain knobs spaced in such a way that specimens can be placed easily in the racks but insulated from the structural metal.

For fresh-water immersion tests, facilities are maintained by the Corrosion Laboratory at Lake Gatun (Figure 6) and at Fort Amador (salt water) (Figure 7). At both locations are piers equipped with specimen racks for immersion tests. Since the water level in Gatun Lake is fairly constant, only continuous immersion tests are possible. The current flow around specimens at this location is negligible. A hoist car is used for placing and removing specimen racks. More data may be obtained in tests conducted in the salt water location at Fort Amador because of the tides and other conditions oceanic in nature.

It is customary for the various branches of the government who plan to use the tropical environmental facilities to draw up a fairly complete statement of their own equipment and materials. Then a second list is compiled on materials, services, etc. that NRL as managers will supply. The Scientist-in-Charge of the Tropical Exposure Site may be addressed at Box 802, Coco Solo, C.Z., and The Scientist-in-Charge at the Canal Zone Corrosion Laboratory at Box 2001, Rodman, C.Z. Initial arrangements for use of either of these facilities must be made through the NRL Washington, D.C. office by addressing: Director, Naval Research Laboratory, Attn: Code 6120, Washington 25, D. C.

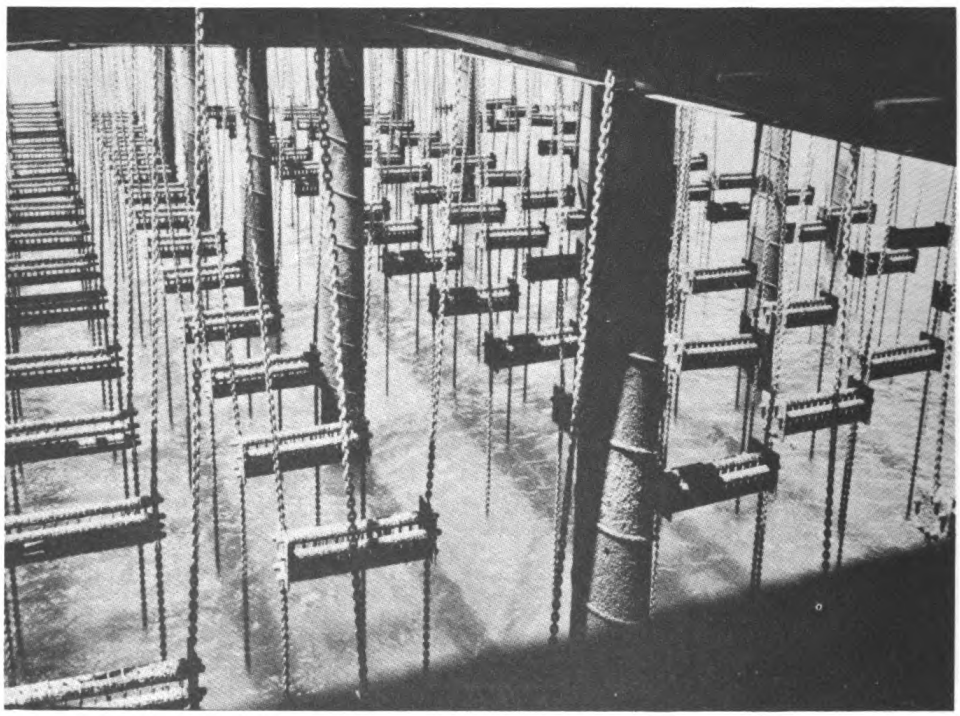

Figure 10 - Testing facilities beneath Fort Amador pier (low tide)

Atherosclerosis: The Inconspicuous Killer

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Medicine and Dentistry Branch

Among the foremost and vicious habitual offenders in the "rogues' gallery" of diseases which prey upon man with rapid or eventual conquest are heart disease, cancer, pneumonia, tuberculosis, and common infections. (Vital Statistics of the United States, 1954). The rapid advance of antibiotics and other chemotherapeutic agents, however, has resulted in a reduction of the number of deaths due to the last three disease entities. On the other hand, despite the enormous struggle for the defense of man against heart disease and cancer, these two killers continue their ravages of human life.

The inconspicuous killer, subject of this article, is the uncontrolled and slyly devastating disease of blood vessels known as "atherosclerosis," commonly referred to as "hardening of the arteries." Atherosclerosis has been considered in the past as a chronic disease of little or no consequence to the military services. However, it is of considerable relevance to the Navy and other Department of Defense agencies from the standpoint of obtaining improved diagnostic and predictive standards which might be employed for purposes of selection, assignment, and retention of flight personnel. In aviation it must be kept in mind that successful flight performance is related to certain coordinations and skills often found only in physically fit persons. Efficiency and alertness during long flights are most essential. Sudden attacks of anoxia (lack of oxygen), a mild or severe heart attack, or other circulatory system disorders which could result in jeopardy to the pilot, his flying mates, or to the mission, can be caused by this disease. Today cardiovascular problems such as atherosclerosis have become of vital concern due to the stresses involved in flying modern combat aircraft.

Although this disease has rather obvious implications in aviation medicine, it is not related exclusively to the flier. The military population in general, particularly those of middle age and older, are probably just as susceptible to atherosclerosis and its consequences. As a matter of fact the incidence of circulatory system disorders, other than rheumatic fever and rheumatic heart disease, among naval personnel today is about 11 per every 1000. Of course, not all of these cases are atherosclerosis, but many of them may be consequent to this malady. There is no reason to believe that military personnel are exempt from such disorders as myocardial infarction, brain hemorrhage, and other sequels of atherosclerosis, particularly when they are under severe stress. For instance, in myocardial infarction (most often the result of a blood clot developing on the surface of a hardened atherosclerotic plaque in the coronary arteries) the blood supply to heart muscle itself is diminished or cut off completely, resulting in what is commonly referred to as a "coronary" or heart attack.

The following findings by the Armed Forces Institute of Pathology are a very excellent connotation of the relative importance of this notorious disease to the military. Among 300 autopsies performed on

U.S. soldiers killed in action in Korea, this disease was evident in 77.3 percent of the hearts. More amazing is the fact that the ages of these soldiers ranged from 18 to 48 years, the average being 22.1 years. The disease process varied from "fibrous" thickening to large atheromatous plaques causing complete obstruction in one or more of the major coronary vessels. (Journal of the American Medical Association, 152: 1090, 1953). Statistics such as these are appalling. All of the above conditions were apparently non-contributory to the death of these men. However, no one can say what would have happened had they lived through the Korean War.

In general, atherosclerosis is the complex result of degenerative and reparative processes which lead to increased rigidity, diminished elasticity, and decreased caliber of arteries, and is the chief cause of coronary heart disease, brain hemorrhages, and many kidney disorders. To date no effective measure has been developed for the prevention and management of the disease. As a matter of fact, symptoms of the disease are more or less obscure and, consequently, accurate diagnosis is difficult. Although an increase of fatty substances in the blood is associated with atherosclerosis, this diagnostic test is not proof positive. A rise in blood pressure is another symptom, however; not always can it be said that a person with high blood pressure has this disorder. Thus due to the lack of definitive symptoms most of the diagnoses of atherosclerosis go on undetermined.

Unfortunately, no drug or other preparation has been demonstrated as significant in altering the development of atherosclerosis. Many leads have been explored, but none has proved practical from the aspect of clinical value. As a result, there is in effect today a broad and intensive research program in this country, and throughout the world, for the purpose of trying to uncover the cause, improving diagnostic procedures, and searching for agents which might be beneficial in treating this disorder.

In the early 1900's, atherosclerosis was considered to be merely a normal process of ageing. It was the firm belief then that the disease was characteristic of extremely ambitious, much overfed, white, male executives and professional men who were under continual stress. This comprised misconception number one.

Then, about 1912, the brilliant work of Anitschkow demonstrated that atherosclerosis was more than a process accompanying stress and old age, and showed that it could be produced experimentally by feeding rabbits a diet high in cholesterol. Until just recently this work was misinterpreted and it was the conviction of many that this fatty molecule, cholesterol, was the cause of atherosclerosis when it was consumed in excessive quantities in the diet. Although, cholesterol does play an important part in this disease process, as will be shown later, the above idea was misconception number two.

That these beliefs were erroneous is borne out by the fact that atherosclerosis is not confined only to the obese man. Women, too, of all ages acquire the disorder (particularly those over fifty) with a percentage of incidence nearing that of men in the same age group. Men of

all physical stature have been victims of the disorder. Cases of atherosclerosis have been reported in adolescents. And medical history shows that examination of the mummies of Egyptian priests, overfed but not under stress, revealed the presence of the disease. Finally, vegetarians, whose diet contains very little cholesterol, have been shown to be victims of atherosclerosis.

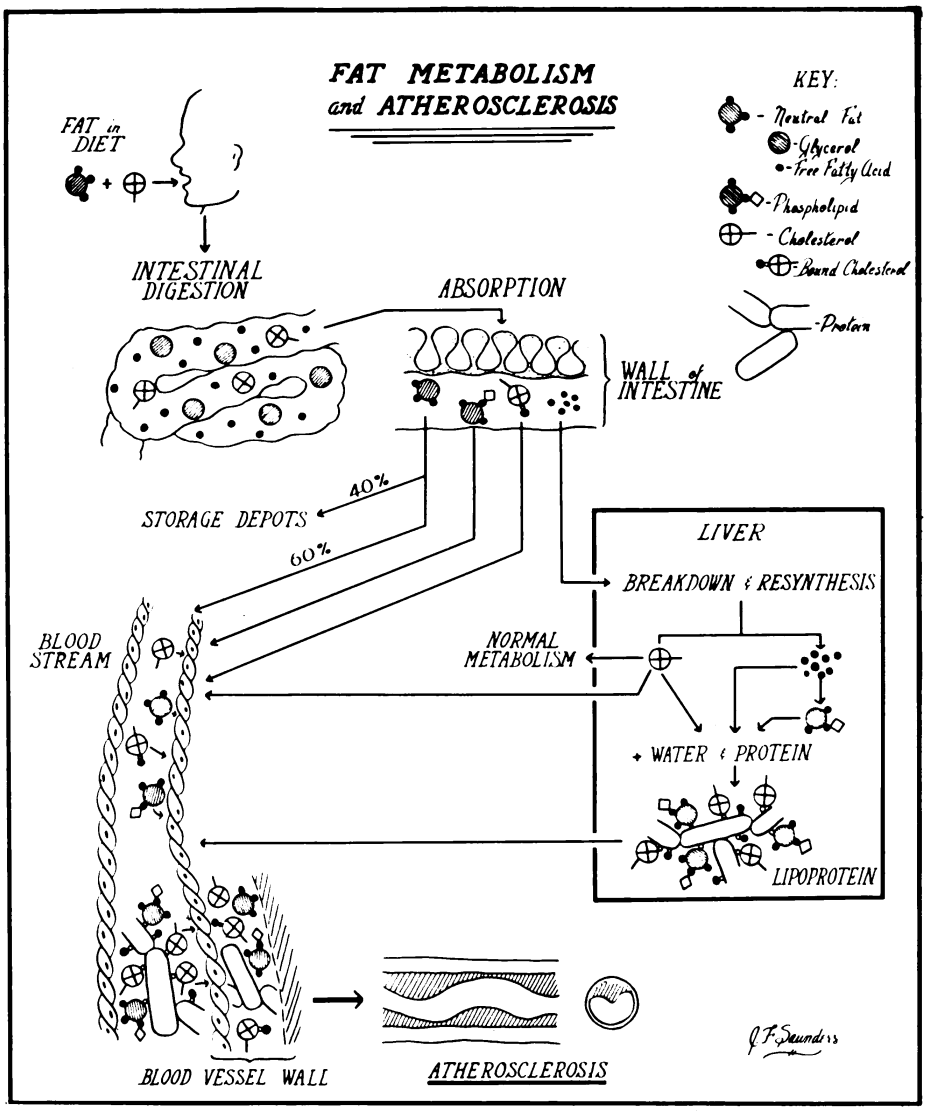


Figure 1 - Theoretical pathway through which a high fat-high cholesterol diet is ultimately related to the artherosclerotic process

Recently it has been shown that the synthesis of cholesterol in the body accounts for more than ten to twenty times that taken in as part of the diet. The body's ability to build so much of this substance is not an unusual property, for cholesterol is very useful to body economy. It is a known fact that every known type of cell in the body that has been

examined contains cholesterol, and that cholesterol is very predominant in nerve tissue. Further, it acts as a precursor to many of the body's hormones and to certain vitamins. Yet, cholesterol appears to be the most abundant substance found in the plaques typical of atherosclerosis which occur in the blood vessels of those afflicted with the disease.

In view of the foregoing, therefore, a significant result of the work of Anitschkow, although providing many with a misconception of the atherosclerotic process, was to give investigators a very useful tool for the study of this disease. After many years of intensive research with the experimentally produced disease in animals, several promising theories have arisen as to the cause of atherosclerosis.

The most promising of these is the utilization of dietary fat and the resynthesis of fats and cholesterol from fatty acids in the body. Complex fats taken in as part of the diet are digested and absorbed from the intestine as fatty acids (Figure 1). Some of these are reconstituted to complex fatty acids and neutral fat, of which 60 percent goes directly to the venous circulation without going to the liver. The remaining 40 percent is sent to the storage depots of the body. The fatty acids not reconstituted are broken down by oxidative processes in the liver to 2-carbon compounds (C-2 groups) or acetate radicals, and they become building blocks for the synthesis of cholesterol and other fatty acids. Protein and carbohydrate degradation also contributes to the liver's supply of C-2 groups. Thus, through the synthesis of an excessive amount of cholesterol and fatty acids in the liver caused by a possible metabolic derangement and an additional amount of dietary vholesterol, the first step in the process of this dreadful disease is fulfilled. That is, a supply of the primary constituents of the atherosclerotic plaque is available.

Secondly, in the liver the cholesterol, free fatty acids, and other fats—primarily phospholipids (neutral fats which contain phosphorus), attach themselves to proteins of blood and form complex molecules known as lipoproteins (fat-containing proteins) and so enter the circulating blood. Through some mechanism then, which is unknown, the fats, cholesterol, and protein become deposited in the inner wall or intima of the artery and form multiple, elevated, pale-yellow patches or plaques which are characteristic of atherosclerosis (Figure 2).

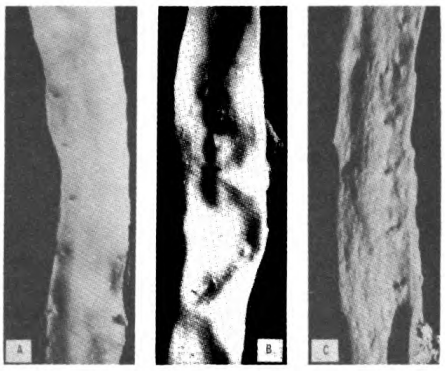


Figure 2 - Atherosclerosis: (A) aorta grossly free; (B) aorta with minimal atherosclerosis--scattered patches; and (C) aorta with severe atherosclerosis with an appearance resembling the bark of a tree

Finally, concomitant with the deposit of these substances in the blood vessel wall, there is a deposit of calcium, magnesium, and

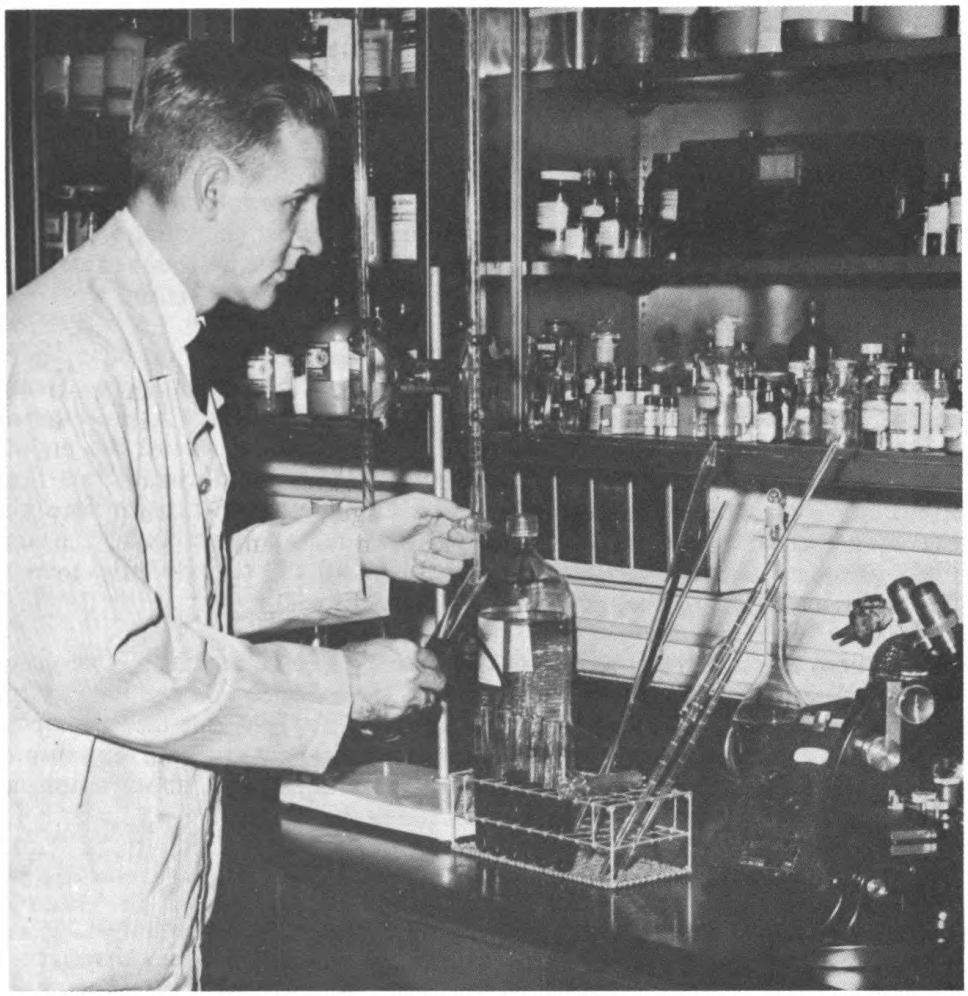


Figure 3 - Research conducted by Joseph F. Saunders in a phase of a broad program to bring about a better understanding of atherosclerosis

manganese. The calcium is responsible for the hardening or calcification of the plaques and presents the reason for referring to this disease as "hardening of the arteries." The role of the other two trace metals in the formation of the plaque is still obscure.

In brief, this appears to be the most logical approach to date in defining the way in which atherosclerosis is brought about. The remaining theories have great merit; however, they do not appear to be as predominant as does the one just cited. What can prevent its widespread occurrence and very large death toll? Much is being done about the problem, but atherosclerosis is not a simple process. There is no single cause or definitive characteristic which can be pin-pointed and attacked accordingly. It is the result of a multiple number of metabolic disorders which converge under appropriate conditions within the body and bring about their devastating result. Consequently, the problem is being attacked from such aspects as anatomical structure of blood vessels and their degenerative processes, biochemical relationships, hereditary influences, dietary considerations, and many other factors. For example,

in an experiment on atherosclerosis (Figure 3), the author attempted to interfere with the intestinal absorption of cholesterol in rabbits through the use of a chelating agent.* The objective was to interfere with the prosthetic group of an enzyme, such as magnesium, which is essential for cholesterol and fat metabolism. It was found that after five weeks of treatment with this agent no appreciable effect was apparent as to interference with cholesterol metabolism and atherosclerosis. Thus by piecing together like a jigsaw puzzle the results and knowledge obtained from the multitude of research projects concerned with atherosclerosis, perhaps in the near future the problem will approach solution.

As to the present methods of treating this disorder clinically, there are only two which are prescribed. These are to place patients of suspected atherosclerosis on low fat diets, and to administer agents known as lipotropic agents. The low fat diet is intended to curtail the supply of the most characteristic substance of the atherosclerotic lesion. The lipotropic agents are chemical agents which have an affinity for fats and are thus able to assist the body in the normal metabolism of fats. Eventually, new chemical derivatives will be found in the extensive search for these agents, and they will be applied clinically.

From all of the research efforts in progress, a good set of clues for "diagnosing the case" will eventually be defined. At the same time the "modus operandi" of the disease may be brought out into the open. And, finally, perhaps will come the chemotherapeutic agent capable of "handcuffing" this inconspicuous killer into comparative submission, as the antibiotics did to many of the infectious diseases.

The research discussed here was not ONR sponsored, but it was performed by a member of the ONR staff. Mr. Saunders received a Master's degree in June of this year from Georgetown University on the basis of his laboratory studies into causes and treatment of atherosclerosis. It is as evidence that the man at a desk is not necessarily out of touch with the laboratory, but can continue to grow and develop in his scientific field that this article is published here.

--Editorial Note

*A chemical substance which is able to form complexes with metals of the body economy and thereby prevent or curtail their utilization in natural metabolic processes of the body.

New Supersonic Wind Tunnel

The University of California has a new supersonic wind tunnel at its engineering field station located at Richmond, California. This wind tunned--200 feet long, 3 feet in diameter, and capable of testing speeds up to Mach 6--is the largest of its kind in the world and represents the result of combined planning and financial support by the Office of Naval Research, the National Advisory Committee for Aeronautics, the Office of Scientific Research, and the Air Research and Development Command of the U. S. Air Force.

A 200-Pound Weather Station Built to Air-Drop

The weather is something the Navy intends to be well informed upon during the four years of Operation DEEPFREEZE in the Antarctic—to start in conjunction with the forthcoming International Geophysical Year, July 1, 1957 to December 31, 1958. A small robot weather station weighing only 200 lbs will be dropped from an airplane onto the polar ice-cap at a place of optimum value in providing meteorological information valuable to forecasting the weather.

One of the things the planners of the Operation are anxious to do is to establish an advance base near the South Pole. Although little weather history is available, what has been gathered indicates a frequent occurrence of high winds in this area. Because cargo planes cannot successfully drop supplies when the surface wind exceeds 30 miles per hour, there is a chance that a 2000-mile round trip could be made to no avail. Since the plan calls for parachute delivery of supplies to the camp area for a period of 9 weeks prior to sending men to establish the camp, the parachute-droppable automatic weather station is a logical answer to the problem of scheduling cargo plane traffic at times when winds at the camp site are low enough to permit air delivery.

The 200-lb robot weather station has come along from small beginnings, and has had bestowed upon it the careful attention of scientists in some of our best known government laboratories. It was in 1942 that ideas jelled enough to set up a specific project for the development of an automatic weather station at the Bureau of Standards. Then the U. S. Navy Electronics Laboratory at San Diego took over, and the station was improved and developed as a fully automatic weather unit which could:

- Be dropped by a parachute which detached itself upon impact with the ground,
- Erect itself at the point dropped through ingenious mechanical devices which also self-righted the station in the process,
- Take weather information at predetermined intervals—surface wind speed, wind direction, temperature, barometric pressure, and humidity,
- Transcribe these observations automatically into international Morse Code and transmit at a speed of 17 words per minute by radio.

This early set (Figure 1) was 6 ft 8 in. long, 18-1/2 in. diameter, and weighed 176 lbs. It required a 30-ft extended type parachute which had an automatic release assembly. This station, with a number of modifications, is the equipment which will be used in Operation DEEP-FREEZE. The operating life has been increased from 15 to 60 days; improved instrumentation, weather sealing, and a larger parachute have been provided.

Before the current model (See Cover Photo) came to its present state, it passed through many stages of development at the National Bureau of

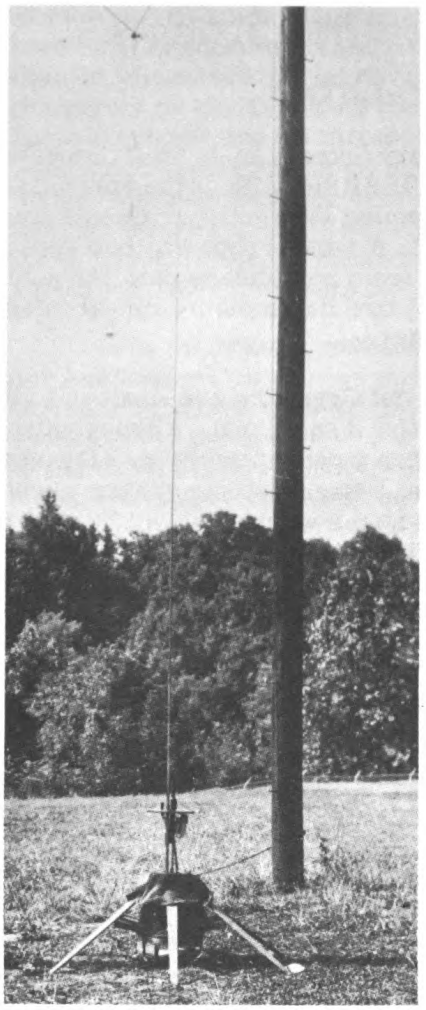


Figure 1 - Early model of "Grasshopper"-type automatic weather station

Standards, the Bureau of Ships, the U. S. Navy Electronics Laboratory, the Bureau of Aeronautics, and the Electronics Test Division of the Naval Air Test Center, Patuxent River, Md. Somewhere along the line the robot weather station earned the name "Grasshopper" because early models, using spring driven legs, hopped violently when the springs were released.

For a while after 1942 the whole idea lay dormant, until in 1954 the Bureau of Aeronautics requested that the automatic weather Station program be re-opened and available equipment re-evaluated. The recommendations of the Patuxent Naval Air Test Center were reviewed, and the Naval Research Laboratory proceeded further to develop the automatic station along lines that would not only be of benefit to the members of the exploratory expedition during the four years of Operation DEEPFREEZE, but would be useful in other Navy activities.

Of greatest importance was the modification of the earlier model to permit operation in sub-zero weather. The pneumatic system for actuating the mechanical legs, in particular, had to be rebuilt so it would hold a charge of air for several days and would function properly (see strip of photos) even though the temperature was as low as -50° F.

The model delivered to NRL was badly in need of repairs. This was occasioned by the fact that the station was designed to be a disposable unit, yet had been used repeatedly in tests and demonstrations.

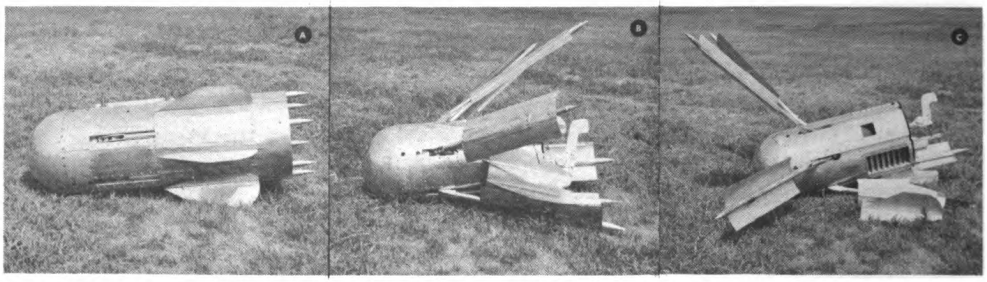


Figure 2 - As soon as it lands, the . . .

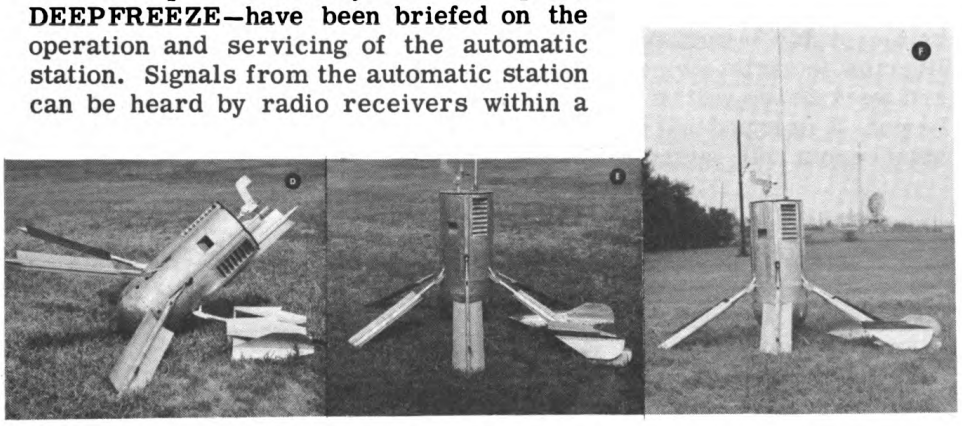
The parachute was of particular concern to the NRL scientists working on the remodeling. There were two considerations which called for a larger parachute: (1) the remodeled station was equipped with larger batteries, and, (2) the landing site in the Antarctic was known to be on a plateau between 4000 and 5000 ft high. After a study of all sizes of standard parachutes, a decision was made on the standard 35-ft chute. This replaces a nonstandard 30-ft chute with an extra skirt extension.

Not only must the station be equipped with heavier batteries, but it requires better equipment for gathering weather data. NRL scientists worked out a number of improvements.

A new miniature propellor-type anemometer was developed for the station. The one to be used has a full scale up to 80 knots and provides resolution of less than one knot. It has demonstrated accuracy within one knot at any reading throughout the entire scale of 80 knots, and appears to be sufficiently rugged to withstand the shocks expected when the chute opens and when the station later lands on the ice-cap.

The original barometric pressure transducers were made to cover limited ranges, a circumstance that was operationally inconvenient. Taking advantage of recent improvements in the ability of a manufacturer to make transducers, NRL scientists substituted a newer type which covers a 200-millibar range. In another improvement, a timer of a new type was substituted for the one formerly installed. With the instruments modified to give satisfactory performance, attention was directed to weather sealing. One of the more annoying problems of designing weather instruments to be used in the polar regions is that of blowing snow. The individual components of the station and the entire instrumentation and control enclosure were sealed with special boots, coverplates, and gaskets as double insurance against snow penetration.

Two of these robot weather stations are being reworked, one for the DEEPFREEZE Operation, the other for separate evaluation. The "Grasshopper" that goes to the Antarctic has its work cut out—providing operationally useful weather information. Officers from Task Group 43—the Navy unit set up for DEEPFREEZE—have been briefed on the operation and servicing of the automatic station. Signals from the automatic station can be heard by radio receivers within a



robot unfolds its legs and props itself erect.

radius of 800 miles. With call letters at the beginning, in the middle, and at the end of each transmission, the five items of meteorological information will be given and repeated as shown in Table I.

TABLE I

SEQUENCE OF TRANSMITTED WEATHER INFORMATION

Order of Transmission	Information Sent	Typical 3-letter Group*	Times Repeated
1	Call Letters	NIG	4
2	Wind Direction	BVB	3
3	Wind Speed	VTI	3
4	Temperature	TMI	3
5	Atmospheric Pressure A	UBT	3
6	Atmospheric Pressure B	SSD	3
7	Call Letters	NIB	5
8	Wind Direction	BVB	3
9	Wind Speed	VTI	3
10	Temperature	TMI	3
11	Atmospheric Pressure A	UBT	3
12	Atmospheric Pressure B	SSD	3
13 μ	Call Letters	NIG	1

*These 3-letter groups are used for illustration and would change as meteorological conditions change at the weather station.

Three-letter code groups in Morse International Code will be broadcast at the rate of 17 words per minute. The total time of each transmission is approximately three minutes. A pre-set schedule is governed by the timer which actuates a fresh broadcast every six hours.

The batteries will power the station for 60 days or until such time as members of the expedition arrive at the location. When personnel are at the station, it can be shut off, turned back on, the arrangement of the schedule can be changed, batteries re-charged, and a more flexible use made of the equipment. During the course of the four years the robot weather station is with Task Group 43 in the Antarctic, it is expected to be thoroughly tested under polar weather conditions, and parachute deliveries on various types of terrain will be conducted. Any latent flaws and weaknesses will be uncovered by the use to which the equipment will be put. It is hoped that the robot weather station will emerge as a highly serviceable unit, suited to the needs of the Navy.

Navy Scientist to Assist in Establishing Brazilian Laboratory

Allen H. Schooley, Superintendent of NRL's Electronics Division, will leave in early January for Rio de Janeiro to assist the Brazilian Navy in the establishment of a naval research laboratory. He expects to be away for about a year on this assignment, for which he was nominated by the Chief of Naval Research.

Once Again -- Motion Sickness

Dr. Richard Trumbull
Physiological Psychology Branch
Office of Naval Research

It is not uncommon for research to assume the aspect of a re-search, a new look at a problem. Often this is prompted by the development of new techniques or equipment or the refocusing of an old problem against a new setting. The current Joint Committee for the Study of Motion Sickness, a truly tri-service venture, came into being through the latter. The simple question "What is the most effective drug against motion sickness?," arose as a basic consideration in developing coordinated purchasing procedure. This prompted one more look—a new effort at research on a very ancient problem confronting man as he attempts to go faster, farther, higher and deeper than his phylogenetic predecessor.

Concern over human comfort and, more practically, performance decrement under various types of stress, has resulted in a most varied attack upon this problem by many different disciplines through an equally intriguing variety of methods. The approach generally appears to have been dictated by the investigator's preconception of cause. The early history of motion-sickness studies features the anecdotal method wherein ship doctors or others responsible for the welfare of passengers or the operational readiness of troops employed ingenious concoctions, the rationale for which often escape the reader. Indeed, the fact that many of them were found to be of benefit and passed down from one generation of surgeons to another was a tribute to the stamina of the human organism and an early warning of the individual differences which were to plague any investigator of the problem.

If one believes the sickness is due to motion, itself, he finds that some individuals are sick in one situation and not in another. A sailor who can sail upon every type of ship except a destroyer would be an example. Before the reader jumps to any conclusion, we hasten to add that another sailor can sail upon anything but an aircraft carrier. If one then believes that it is due to "motion of some sort," he is confronted with the individual seated comfortably in a neighborhood theater extending his experiences with that unusual feeling through the medium of Cinerama or some other visual presentation. The doctor has sought an explanation in "weak stomach" and peristaltic movements; the engineer, in various features or combinations of pitch, roll and yaw of vessels; the neurologist, in a "vomiting center;" the physiologist, in types of motion or conflicts of sensory cues; and the psychologist, in anxiety, early childhood experiences or more subtle aspects of "unconscious" derivation.

On any vessel sailing today, the passenger finding comfort in some home remedy, ranging from charms to autosuggestion, feels sorry for some other passenger confined to a stateroom resembling a pharmacist's paradise complete with the latest products from 20th century laboratories and some appropriate receptacle. As one becomes acquainted with these many variables and inconsistencies in the history of motion sickness, he shares that wonderland of Alice which seems to grow "curiouser and curiouser." It was the apparent fruitlessness of the above

approaches that resulted in the decision to seek "a most effective drug" by a major operational analysis.

Of primary concern was the availability of some operation large enough to allow comparison of a number of drugs in the same circumstances. The need for such a comprehensive approach became apparent during the preliminary collection of empirical data wherein differences in experimental design precluded comparisons. The majority of studies had been designed to evaluate the role of some one factor which the investigator believed to be important. Were he convinced that the problem was physiological, the report would give no data upon the type of ship, nature of the sea, or the manner in which the subjects occupied their time. In most instances, but few drugs had been used and these decided upon because they shared some chemical structure in common or were believed to be indicated through involvement of some digestive or neurological function or center.

A preliminary step was taken by the Physiological Psychology Branch of the Office of Naval Research through a review of the literature and compilation of experimental data upon drug effectiveness. These studies included a series of tests on reactions of personnel traveling in vessels and aircraft of various sizes, under various conditions and many types of motion-producing machines which swung, rotated or raised and lowered the subject at various speeds and cycles. Attempts to obtain some picture by comparing such varied studies were futile. However, this review did allow a preliminary screening of over 40 drugs and a means for limiting the number to be tried in subsequent operations.

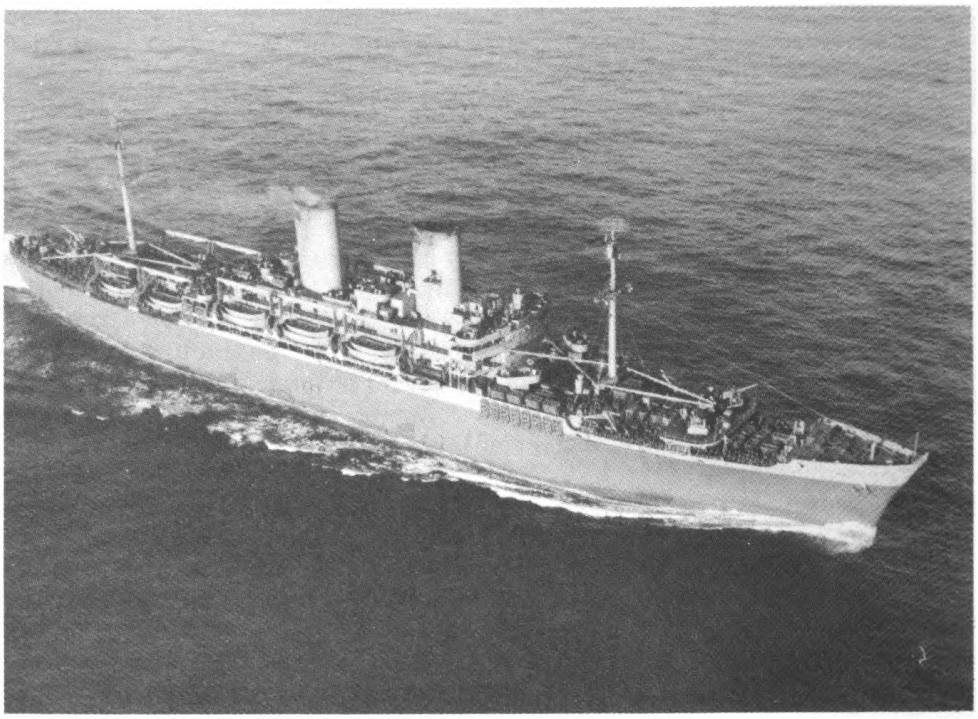


Figure 1 - Typical troop transport on which study of motion sickness was made

At this point, representatives of the three services and certain civilians who had played a major role in World War II studies were called together to consider the current status of motion-sickness drugs and to prepare a method for answering the question posed above. Thus, the Joint Committee for the Study of Motion Sickness was established, with Dr. H. T. Karsner of the Bureau of Medicine and Surgery as chairman and with Dr. R. Trumbull of the Office of Naval Research serving as secretary.

Limiting the number of drugs to be screened had advantages but there continued to be a need for some large-scale operation which would provide samples large enough to assure statistical confidence. The obvious answer was troop movement by sea transport (Figure 1). Decisions were made relative to the drugs to be studied, the number of subjects desired per drug, the nature of experimental teams to sail with each crossing and other mechanics of such an extensive study. Fortunately, the pooled experience of those present could anticipate most of the problems. With the U. S. Air Force School of Aviation Medicine assuming the role of integrator on the first study through its representative, Dr. H. I. Chinn, the process of obtaining the cooperation of drug companies, assembling foot lockers of capsules, identification and questionnaire cards, and other equipment soon was under way.

Figure 2 - Two men at left volunteered to be subjects for motion sickness study

Teams of five men each, representing the tri-service nature of the study, were scheduled for each crossing of the Atlantic. Generally, these individuals returned from Europe by air to minimize their loss to their regular units or to allow another trip within the shortest period of time. In some few instances enough individuals elected to return by sea transport to allow some preliminary studies of new drugs upon which data had not been available in the first compilation. The teams were

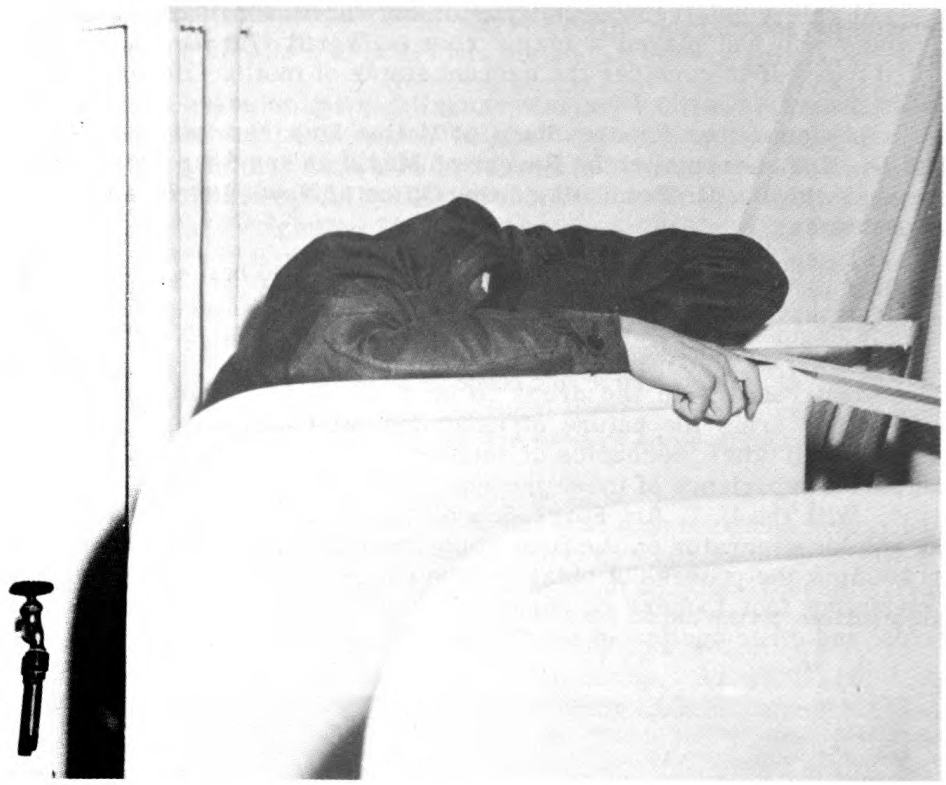


Figure 3 - Effectiveness of a drug was judged by how seasick a man becomes

responsible for distributing the capsules, being sure that the drug was taken, and obtaining biographical records as well as data on protection and side effects. Each drug as well as the placebo (a capsule containing no active drug, a "bread pill") was enclosed in a standard capsule preventing any identification by the subject.

The subjects (Figure 2) were volunteers who received briefing relative to the nature of the study and their role in it prior to sailing. Approximately 95 percent to 98 percent of each group volunteered for the study. The report upon this sea-transport phase of the study will be issued shortly by the Air Force as report Number 1 of the Committee. Suffice it to report here that Bonamine^{R} and Marezine^{R} demonstrated significantly greater effectiveness than the other drugs under the conditions of this study. An interesting finding was that the former was nearly as effective in one administration as in the designed series of one with each meal (7 to 11 capsules), depending upon the sea state. In all instances, the criterion was vomiting (Figure 3), in recognition of the unreliability of personal report of other symptoms. Both Bonamine^{R} and Marezine^{R} attain their effectiveness by temporarily reducing the responses of the semi-circular canals in the inner ear. They have relatively few undesirable side effects such as drowsiness. Marezine^{R} is also believed to have an anti-histaminic action and possibly a general application to the therapy of nausea and vomiting.

Meriting more than casusl mention was the enthusiastic cooperation characteristic of this entire venture. The Military Sea Transport

Service personnel, the various levels of the military structure, and the drug companies gave of their time and effort in a situation where failure by any one could have terminated the study.

A second report under the Committee will be a bibliography on Motion Sickness compiled by the Physiological Psychology Branch of the Office of Naval Research during its early accumulation of data upon drug effectiveness. It is anticipated that further reports will be forthcoming as the committee turns its attention to air transport, small landing craft operations, performance decrement, and other military situations demanding maximum comfort and operational effectiveness of personnel.

Navy Hydrographic Office Celebrates Its 125th Birthday

In 1830 the U. S. Navy Department rented a house in Washington and established in it an office known as the "Depot of Charts and Instruments." Into this Depot were collected charts—practically all of them printed abroad—sailing directions, compasses, spyglasses, etc. Here the navigational equipment was repaired and charts were corrected and shipped out to the fleet.

A century and a quarter later, the U. S. Navy Hydrographic Office has become the largest publisher of charts and navigational data in the world. It transmits frequent broadcast of hydrographic information of immediate use to ships and aircraft, naval and commercial. It operates a directly assigned fleet of eight survey and reconnaissance vessels. It has become a center for research in oceanography, hydrography, and ice phenomena.

The man who gave the establishment an international reputation—who changed it from a mere repository and repair facility—was, of course, Mathew Fontaine Maury. Lieutenant Maury had taken a leading part in the United States Exploring Expedition of 1836-37. This expedition, the first in a long succession of naval scientific voyages, had roved the seas from Brazil to Antarctica, and from Java to Alaska, resulting in the accumulation of a vast store of new knowledge—not only of geography but of ocean currents and prevailing winds. Later, Maury was placed in charge of the Depot and remained there 19 years, until 1861. The sailing charts issued during this period demonstrated to mariners that there were pathways in the seas which, if followed, could save weeks of time on a long voyage.

Shortly after the Civil War, the Depot lost the small astronomical facility it had been building up since 1837. The latter was designated the Naval Observatory, and the parent agency was renamed the U. S. Navy Hydrographic Office. Its director is known as the Navy Hydrographer, a position now held by CAPT J. B. Cochran, USN.

In modern times, aviation, electronics, photography, and multiple-color printing give mighty assists to the timely publication of navigational information. Water depths are instantly obtained by the electronic sounding device; loran tells the position of the sounding vessel when out of sight of shore landmarks; shoreline topography can be mapped by aerial camera; helicopters taxi surveyors and their equipment to and from hard-to-reach positions ashore; hydrographic news is received in radio messages or teletype from all quarters of the ocean. All this meticulously gathered information is collated in "Pilot Charts" and in the weekly "Notice to Mariners."

The rented house in Washington has grown to a huge rectangular structure just over the S.E. District Line, in Suitland, Maryland. The increased size of its headquarters is only one measure of the vastly expanded service the U. S. Hydrographic Office is giving to those who navigate on or over the seas.

Chicago "Research for Progress" Exhibit

The Office of Naval Research Chicago Branch Office and the John Crerar Library in Chicago joined forces to produce an exhibit entitled "Research for Progress", last summer, which proved to be one of the most successful ONR-sponsored exhibits to date. This exhibit covered many of the phases of naval research with special emphasis on publications resulting from the ONR contract research program.

The John Crerar Library is a particularly suitable place for such a display. Established in 1895 in the heart of Chicago, this massive, fifteen-story building is the largest library in the United States devoted exclusively to the literature of the many scientific disciplines. Because of its wide use by engineers, doctors, scientists and post-graduate students, it is frequently referred to as "the University Without a Campus" and its collections and services are primarily directed to the needs of advanced study and research. The success of the exhibit is attributable to the close cooperation and physical association of the library and the Branch Office. An estimated 2,500, who work in the various fields of science, visited the exhibit. Reports indicate they appreciated the diversified work of ONR and the literature produced as a result of its research.

A large number of technical reports were included in the scientific literature used throughout the exhibit. A survey limited to only fourteen scientific journals showed that more than two hundred papers, covering ONR-sponsored research, were published in these journals during 1954.

One exhibit which aroused particular interest was from the germ-free-life laboratory, LOBUND Institute, at the University of Notre Dame. With the techniques perfected, it is possible to obtain animals germ free and rear them under sterile conditions, investigating fundamental biological problems. Other exhibits, placed throughout the library, depicted developments in aerodynamics, engineering, chemical, dental and medical research, and nuclear and aereological study.

In addition to bringing the work of ONR to the Chicago scientific public, the exhibit had displays designed to show ONR's place in the Department of Defense and the scientific community as well as informing scientists of the official channels for an ONR-supported research project from conception by the scientist, to the award of the contract—and subsequent assistance given to the scientist and his institution by the ONR Branch Office. The progress of a simple invention from the time it is offered until a patent is issued was charted and illustrated by actual documents of an application.

One of the outstanding results of this exhibit was the expressions of surprise and approval that came to Mr. Henkle, Librarian, that the Office of Naval Research was interested in so much basic research as evidenced by the various aspects of work displayed there. Many of the visitors remarked how pleased they were to note that ONR research made contributions to civilian as well as naval interests.

Navy Uses Plane-Carried Rockets for Research

The Office of Naval Research's program to gather information on the upper atmosphere has been extended to include plane-launched rockets. Recently the Naval Air Station, Chincoteague, Va., was the scene of tests in which rockets were launched vertically from a Navy "Banshee" jet fighter at an altitude of 30,000 ft. The rocket then launched proceeded to an altitude of 90,000 ft.

The new rocket-aircraft method, called "Rockair" will provide a practical and inexpensive tool for research observations at high altitudes. During the feasibility tests, only cosmic ray studies were made. There are, however, many possible applications of the new plane-rocket method. Useful information can be obtained, for example, on ambient air temperatures, air densities, ozone concentrations, and high-altitude winds.

Improved Radio Antenna on New Navy Icebreaker

The Navy's newest icebreaker, USS GLACIER, has been equipped with a special 1200-ft antenna which is balloon-supported and popularly known as a "skyhook" antenna. Consequently, the GLACIER will be able to "get through" on long-range communication from the polar ends of the globe.

As developed at the Naval Research Laboratory, the sky-borne antenna is lifted and supported vertically by small zeppelin-type balloons about 30 feet long. Not only will the new antenna make it possible for the GLACIER to communicate over some 1,500 miles of polar distance, it will also serve to gather aerological and weather information.

Special Award in Chemistry to NRL Scientists

At the 128th annual meeting of the American Chemical Society held September 11-16, three Navy scientists received the Carbide and Carbon chemical award for the most outstanding contribution to the Division of Paint, Plastics, and Printing Ink Chemistry. At the Spring 1955 meeting of the Society, W. A. Zisman, H. W. Fox, and E. F. Hare presented the papers on which the award was based. The award, a new one in the field of chemistry, will be given annually.

Nine papers were presented by NRL scientists at the September meeting of the Society. The Metallurgy Division was represented by one paper, and eight papers were contributed by scientists working in the Chemistry Division.

On the Naval Research Reserve

100th Naval Research Reserve Company Activated

When orders were delivered to LCDR Arden F. Sherf, USNR, as Commanding Officer of Naval Reserve Company 3-11, Ithaca, New York on 27 October 1955, the one hundredth company of the Research Reserve was officially launched. Captain Theodore Blanchard, Special Assistant to Chief of Naval Research for Reserve, and LCDR William C. Remick, Reserve Program Officer, ONR, New York, were present to represent the Office of Naval Research at the activation meeting. LTJG R. E. Ash, Commanding Officer of the U. S. Naval Reserve Training Center represented the Commandant, THIRD Naval District.

On the preceding evening at Toledo, Ohio, Captain Blanchard and LCDR Remick had participated in the activation of Naval Reserve Research Company 4-10. LT Charles A. John, USNR was installed as Commanding Officer of this company.

On the 19th of October Captain Blanchard and LCDR Herbert T. Wordell, RPO, ONR Chicago, participated in the activation of Naval Reserve Research Company 9-24 at Waterloo, Iowa. The NINTH Naval District was represented at this ceremony by LT G. N. Scaboo, Commanding Officer of the Naval Reserve Training Center at Waterloo. Mayor Pat Touchae of Waterloo was present to welcome the new company on behalf of the citizens of Waterloo and District Judge Blair C. Wood welcomed the new group on behalf of the Naval Advisory Board. CDR John O. Chellevold, USNR, is Commanding Officer of the Waterloo Company. The activation ceremony took place at the Naval Reserve Training Center.

Figure 1 - Waterloo Company NRRC 9-24. CDR Chellevold, the new unit's Commanding Officer, is at CAPT Blanchard's left.

Quotas Announced for Aviation Medicine Seminar

Change No. 3 to BUPERS INSTRUCTION 1571.4A (Naval Reserve Active Duty for Training - Fiscal Year 1956) has officially announced the quotas for the Seminar in Aviation Medicine to be conducted under the sponsorship of the Office of Naval Research and The Naval Air Training Command. This seminar will be conducted by the U. S. Naval School of Aviation Medicine at Pensacola, Fla. during the period 13-26 May 1956. The following quotas have been established:

DISTRICT	QUOTA
1	4
3	6
4	6
5	3
6	5
8	4
9	7
11	3
12	4
13	3
PRNC	5

The seminar will be devoted to scientific and operational problems related to the biological factors in Naval Aviation. While the priority for the seminar is for members of the Research Reserve, applications from members of other Naval Reserve programs or from the Army or Air Force Reserve programs will be considered on the basis of available facilities. The subject matter will be of interest to scientists in fields allied or basic to medical research.

It is expected that in addition to the fifty billets allocated above for Research Reservists, an additional fifty spaces will be available to qualified applicants from other reserve programs.

Program Officers Conference

A Research Reserve Program Officers Conference has been scheduled to convene at the Office of Naval Research, Washington, D. C. on 24 January 1956. At this conference, which will be of three days duration, the Special Assistant for Reserve and his staff will review the status of the program with the RPO's and establish objectives for the coming year. Commanding Officers of Naval Reserve Research Companies are urged to bring to the attention of their respective program officers any matters which they would like to have included in the agenda for this conference.

There are now an even hundred Research Reserve Companies—enough, certainly, to generate an occasional news item or short article that goes beyond the interest of one unit. A few such items would make this section of Research Reviews much more interesting.

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*Articles are arranged chronologically under the ONR Division having cognizance of the research described.
†Written by the editorial staff of Research Reviews.

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Aerial view of Tropical Exposure Site near Coco Solo (See story beginning page 1)

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