OFFICE OF NAVAL RESEARCH

JUNE 1951

RESEARCH REVIEWS

Research Reservists at SDC Seminar

NAVEXOS P-510

DEPARTMENT OF THE NAVY
WASHINGTON, D. C.

COVER PHOTO: Part of the group of 52 Research Reservists who attended the Seminar at the Special Devices Center last month are inspecting a radar trainer which simulates on a small scale the operations of the AN/APS radar employed in navigation and bombing. It is used to train bomber crews by making them familiar with the scope images of the terrain over which they will fly and the targets they will bomb. For other aspects of SDC's training program which Reservists learned about, see the article and pictures, pp. 28 to 30.

Approved by Bureau of the Budget, 13 April 1948.

In this issue

New Navy Equipment In Action

Smoke and flame billow upward from a tank of blazing fuel oil as Navy fire fighters work to extinguish it with recently developed equipment. The new triple-pump generator they are using, which was devised to fight blazes at tank farms, mixes foamite, water and air in just the right quantities to put out the fire efficiently. The use of experimental conflagrations like this enabled the Navy to perfect equipment and chemical mixtures that would quench fires quickly with a minimum of danger to firemen.

Fighting Fire With Foam On Ship and Shore

Even in this modern scientific age, when research has provided countermeasures against many lethal weapons, the problem of fighting an old enemy--fire at sea--has remained a serious one. Now a great step forward has been taken in combating this hazard. In the opinion of the experts, the United States Navy now possesses the most efficient system in the world for fighting fuel fires at ship or shore stations. This is the result of ten years of constant research and development of a unique type carried on by ONR's Naval Research Laboratory.

NRL's improved fire-fighting methods, which have been conclusively battle-tested in Korea, use mechanically-produced foams containing air, water, and protein solutions as extinguishing agents. The study of such fire-fighting foams was started at the Laboratory in 1934, when research was begun to determine their usefulness for fire protection on the flight deck of the old USS LEXINGTON. Later, work was begun to determine their efficiency in extinguishing large petroleum tank fires at shore and advanced-based installations.

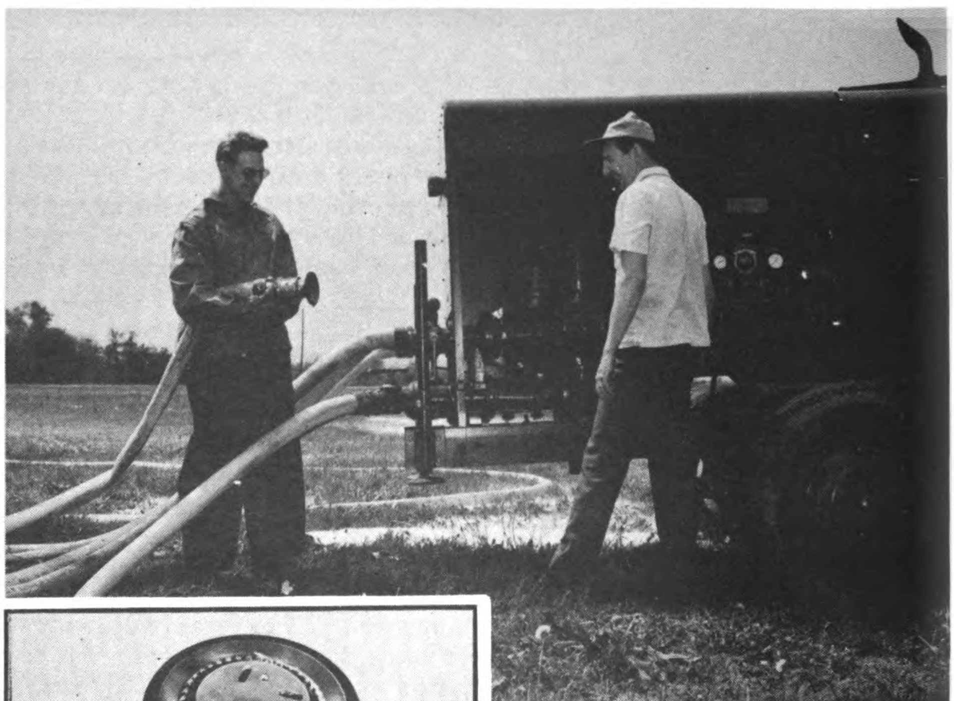
NRL scientists used physical and chemical tests and employed literally thousands of small-scale gasoline and oil test fires to obtain data. Their work confirmed the theory that only after the water in these foams put out the fire by its cooling effect could a vapor-proof barrier of foam be laid over the gasoline or oil to prevent it from igniting again. Now the chemical ingredients of the foam and its water content have been pinpointed, and special equipment has been designed to put these substances to work.

In cooperation with engineers of the Bureau of Ships, the Naval Research Laboratory has recently completed the redesign of large-capacity piped-foam systems aboard U. S. aircraft carriers. These are the systems that have proven themselves in the Korean conflict. They can be put into operation in just 12 seconds by reliable push-button remote control.

For fighting oil and gasoline fires on land, the Laboratory, in cooperation with members of the petroleum industry, has perfected an entirely new foam-generating and pumping unit. The principle involved in this work has a rather interesting history, for the rudiments of it had been discovered by British fire-protection experts during Britain's fight against German air attacks in World War II. The conflagrations resulting from the mass bombing of London and its environs were extremely effective in rendering useless much of the fire-fighting equipment attached to the sides of burning oil and petrol tanks. The equipment, similar to that widely used in this country, consisted of pipes which would carry foam to the top of the tanks so that it could be spread over the burning surface of the fuel. Unfortunately, since the fires were not extinguished quickly enough, the tanks often collapsed, and with them the foam-carrying pipes. British investigators, looking for new methods, discovered that mechanical foam could be injected into the bottom of a tank containing flaming fuel oil, whence it would rise to the top to extinguish the fire.

To verify the results of the British investigators, the Laboratory launched a detailed investigation. In particular, the foams used by the British were studied. These investigations revealed that the extinguishment of fires by the sub-surface injection method depended directly on the amounts of water in the form of foam that reached the hot or burning oil layers. They also found that the reason the technique was so effective was that it applied the water to the area of the flaming oil where it would do most good--that is, to the cooler part of the heated layer. When the foams were applied to the top of the burning fuel, instead of from the bottom upward, much of their effectiveness was lost through conversion into steam.

The new equipment developed by NRL, as a result of these studies, is the first motorized apparatus engineered specifically for fighting only oil and gasoline fires. It is both life-saving and time-saving. It consists of three pumps, powered by a 200-horsepower motor, which can deliver up to 2000 gallons per minute of wet, fire-extinguishing foams at line pressures of 60 pounds per square inch. This equipment can be used to apply the foam to the surface of the burning oil, or it can be used to inject the flame-quenching chemicals through oil pipeline inlets at the bottom of the tank. The pressure generator is provided with portable



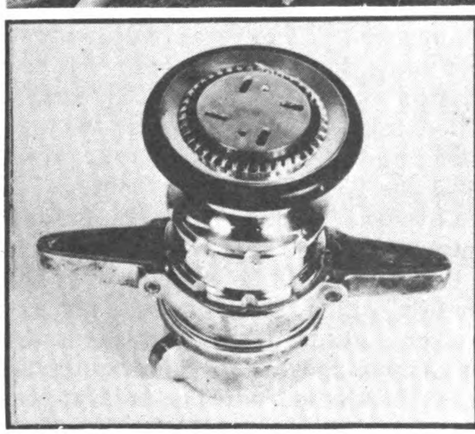


Figure 1. These two Navy firefighters are discussing the feature of the new equipment that is expected to save many lives--the nozzle of the hose (see inset). Specially developed for use against fuel fires, it adjusts to deliver foam either in a straight line over long distances or in a cone-shaped spray. Thus, the fireman can control the foam injection at a safe distance.

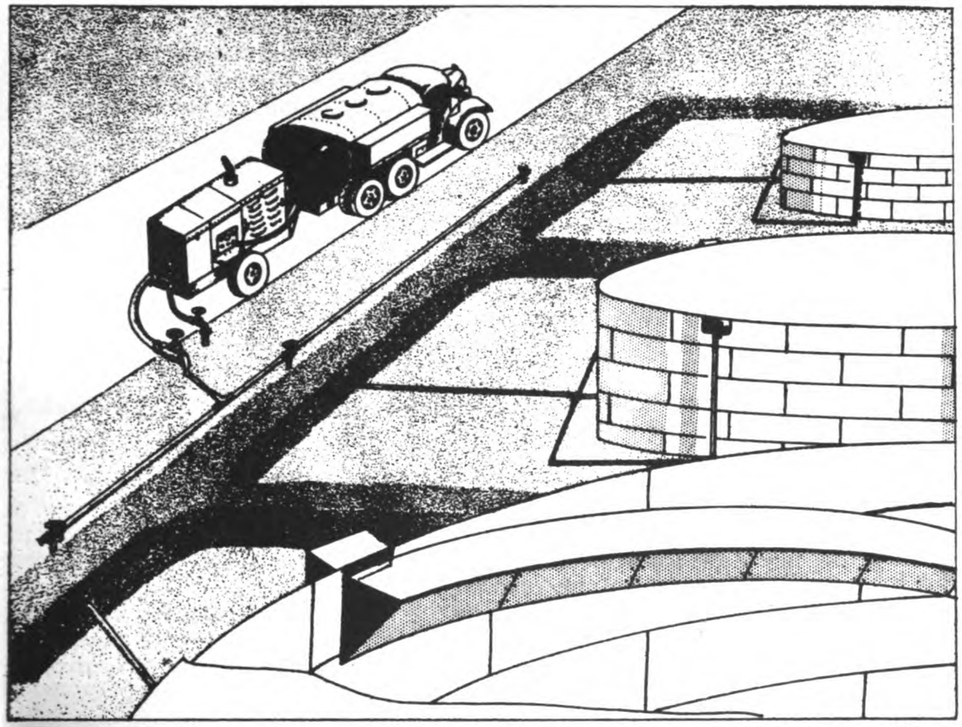


Figure 2. Layout of subsurface injection system in Navy tank farm.

hoseline foam outlets and there is a special adjustable nozzle. The latter enables the foam to be delivered in a straight stream over long distances or in a protective, cone-shaped spray, depending on the conditions of the fire. These features are highly important, for they protect the fire fighter, who can control the foam injection at a safe distance.

The study of the chemistry and physics of extinguishing fire began at NRL back in 1929. Since 1938 the work has been concerned principally with investigating foams and other chemicals used for dealing with oil and gasoline fires, for these are the Navy's principal hazards. Under the direction of Richard L. Tuve of the Chemistry Division, a foam-fire engineering laboratory, staffed with chemists and chemical engineers, has devoted its complete time to the basic studies of fires in these fuels. Many other innovations, besides the recently developed apparatus, have resulted from this work.

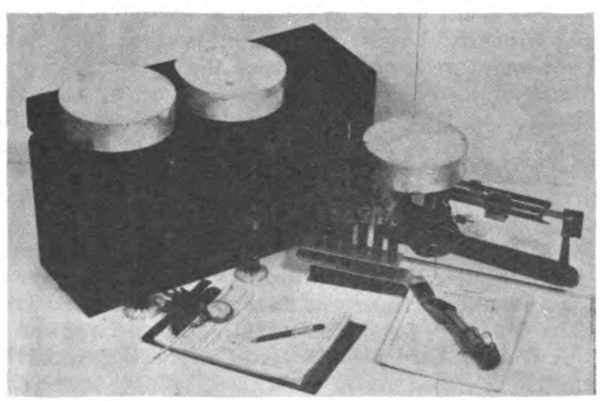


Figure 3. Foam test kit set up for use.

Standard test methods were devised for rating fire-fighting foams. In this connection, a special "NRL Foam Testing Kit" has been developed for determining the efficiency of existing fire-fighting installations. This has been used widely in surveys of shipboard, land station and crash fire fighting installations in all of the Armed Services. Since the control of fires is by no means an exclusively Navy problem, the information gained has been shared with the National Fire Protection Association and the American Petroleum Institute, as well as other industrial organizations. Thus, this research, which has been aimed principally at improving our Navy's efficiency, will also help the Nation as a whole fight one of its most expensive enemies--fire.

Dental Injuries Resulting from Atomic Explosions to be Investigated Under New ONR Contact

The effects of atom bomb explosions on the teeth and gums--a problem that has been of interest to medical men since Nagasaki and Hiroshima were blasted--will be investigated by University of Pennsylvania's School of Dentistry under ONR contract. Working in new laboratories, experts will seek means to prevent and cure damage to mouth tissue resulting from radioactive materials.

Bleeding of the gums was one of the first signs of injury in victims of the explosions of the first atom bombs in the two Japanese cities. Later, A-bomb experiments conducted at Bikini Atoll in the Pacific, and other nuclear fission work using the Oak Ridge, Tenn. bomb-pile, confirmed the early appearance of such lesions. Thus, the project at the University of Pennsylvania emerges as a potential protective agency for civilian populations and armed forces which would be in danger of atomic attacks in future wars.

The studies at the University of Pennsylvania will be carried out by the Department of Oral Pathology of the Dental School under the direction of Dr. Paul E. Boyle, Professor and Chairman of the Department of Oral Histology and Pathology. These investigations will be coordinated with those made by research teams from the Naval Medical Research Institute and the National Naval Medical Center. One task of the experts at Pennsylvania will be to supervise the preparation of tissue specimens and to collaborate with NMRI in classifying and evaluating them.

Actual work on animals exposed to radiation in Navy experiments has already begun at Pennsylvania. At Bikini Atoll in the summer of 1946 an atom bomb was dropped by airplane upon an armada of 73 ships, many of which harbored sheep, goats, rats, monkeys and other animals. Since that time other experiments have included bombing of animal objects. Many of these are now available for scientific studies by medical authorities. This work has now begun in the University of Pennsylvania laboratories.

To carry out the new program university authorities are presently concerned with the problem of obtaining qualified laboratory personnel. Competent technicians familiar with hard tissue preparation are somewhat scarce, and for this reason courses are being offered to train workers in this field. High school graduates who have had courses in chemistry and zoology are eligible to enroll. The course will extend for about 11 months and tuition will be about $200.

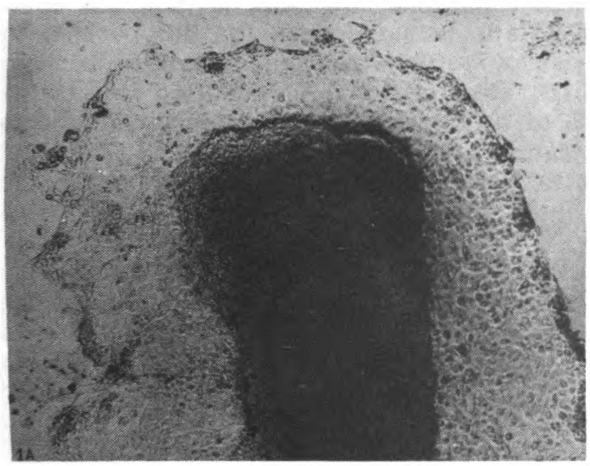
Pictures for Visualizing Allergy

by

C. M. Pomerat
University of Texas

Like the modern battleship with its antiaircraft guns, depth charges, radar and other protective devices, the human body is provided with a complex series of gadgets designed to meet a variety of attacks from the outside world. But while research on armament is aimed mainly at construction of new weapons, investigations of living creatures attempt to explain the effectiveness of biological protective devices that are already well established.

Workers under ONR contract at the University of Texas (Medical Branch) are analyzing a variety of bodily defense mechanisms with the final aim of improving the body's ability to deal with injuries, with harmful germs, and even with the threat of alcoholism! The development of new instruments and special experimental techniques are now



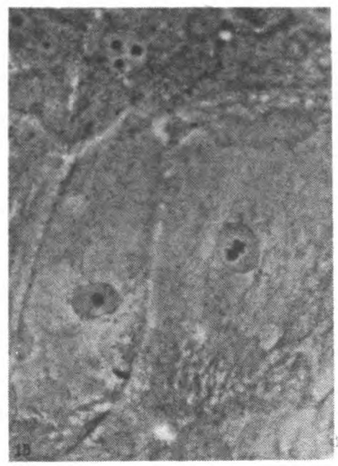


Figure 1A (left) shows picture of tissue culture of human nasal mucosa made with a low-power ordinary light microscope. Phase contrast microscopy was used to make 1B, which is a magnification of the living cells of the culture shown at left.

offering great promise in the study of one of the most baffling disorders which cripple human efficiency--allergic reactions.

Allergies are so common that it probably is unnecessary to describe their symptoms at any length here. Most people are familiar

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Charles M. Pomerat (A. B. Clark University, A. M. and Ph. D. Harvard) has been Professor of anatomy at the Medical School of Texas University since 1943. Previously he held teaching positions on the staffs of Clark University and the University of Alabama. He has also done research for the Woods Hole Oceanographic Institute and the Bermuda Biological Station.

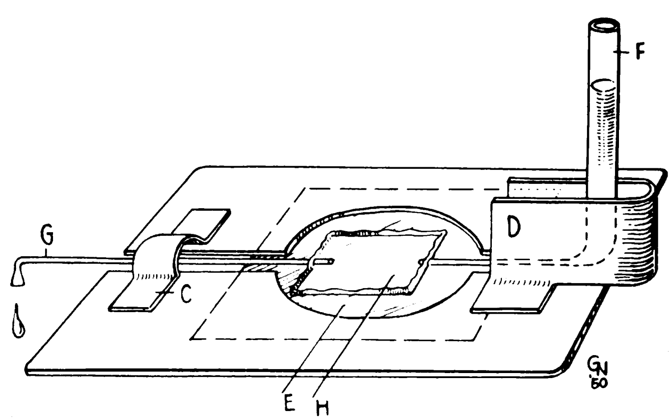
with some of the common types--hay fever or sensitivity to certain foods or drugs are examples. In general allergy is characterized by respiratory distress, skin irritations and probably by many upsets in the functions of the internal organs. They are produced in sensitive people by pollen, industrial chemicals, by-products in the metabolism of germs and by many different types of foods.

As a preliminary step in studying the nature of allergies, susceptible cells are grown from the bodies of people who suffer from well-marked disturbances of this nature. Sheets of skin cells can be cultivated in dishes, from small slivers of human skin. Tiny specimens obtained from the lining of the nasal passages and from the lungs of animals are utilized to make cultures of what scientists call respiratory epithelium--meaning the type of membrane that covers the breathing passages. Figure 1A shows such a culture from human nasal tissue. The dark central portion of the picture is a piece of skin from a man suffering from the irritation produced by house dust. Surrounding this central mass is a plate of cells one layer thick as it appeared five days after the culture had been placed in an incubator maintained at body temperature.

Once the cultures are grown, scientists want actually to see what happens to them under various conditions and have developed special methods of observing them. One technique devised for this purpose is called "phase contrast microscopy". This technique was used to make the picture shown in Figure 1B, which is a highly magnified view of individual cells from the type of skin culture we have described. The sharp details shown in this photograph are due to the special technique which obtains increased contrast between objects that would otherwise be hard to distinguish from each other.

Not only is it possible to grow the cells of people with allergies and to photograph these in the living state at high magnification, but one may also make direct observations of what happens if a chemical is suddenly brought into contact with the elements under study. A device called a perfusion chamber, shown in Figure 2, has been designed for

Figure 2. Perfusion chamber used in the study of the action of chemicals on living cells.



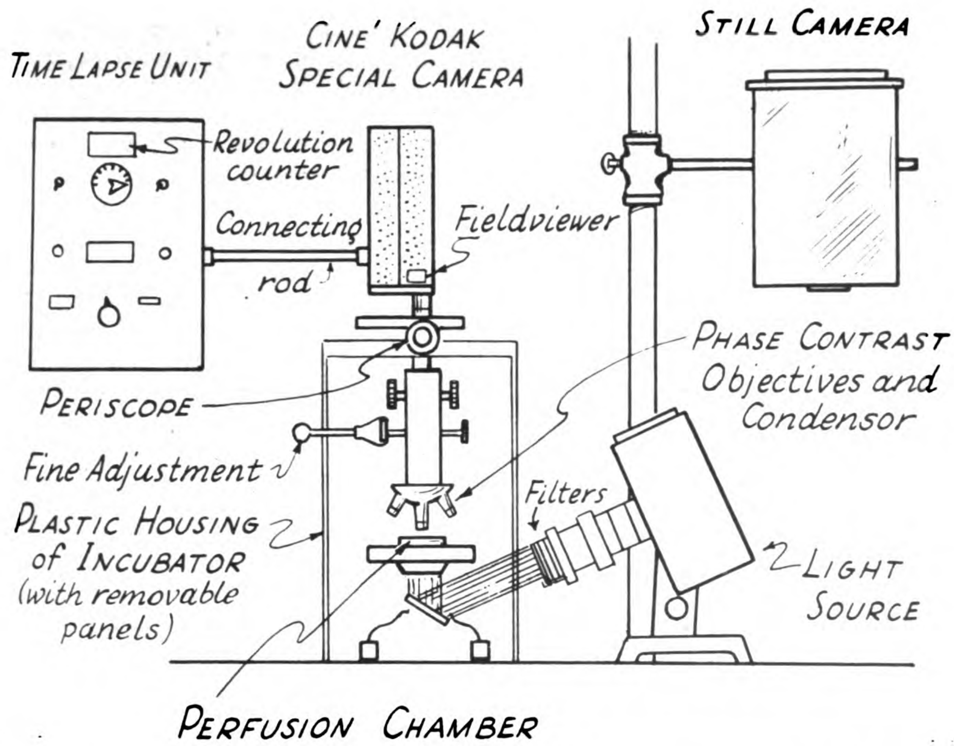


Figure 3. Set-up for still and moving picture photography used in recording the activities of living cells in relation to various chemical substances.

this purpose. A large thin cover glass (E) is attached to a metal frame by means of hot paraffin. A smaller cover glass, on which the tissue culture growing (H), is inverted in the center of the preparation so as to rest upon the tips of the capillary portions of the glass inflow (F) and outflow (G) tubes. A mixture of hot paraffin and beeswax is used to seal the margin of the small to the large cover glass, thus creating a chamber upon whose ceiling the cells are migrating.

The installation shown in Figure 3 is used to make still pictures of what happens in the perfusion chamber. In addition, by swinging out the bellows of this unit from its position over the eyepiece of the microscope, a cine camera can be moved into this position and attached by means of a connecting rod to a time-lapse unit which can be regulated to take pictures at 1, 2, 4 and 8 frames per minute. Pictures which are made at the latter speed, but projected at the standard speed of 16 frames per second, speed up the action by a factor of 120. This, in other words, is the opposite of slow motion; events which took place during a two-hour period can be viewed in one minute! In this way many cell activities can be analyzed--the movement of cilia (hair-like projections on the surface), activities of the margin of migrating cells, movements of the granules of cellular substance and many other motions, including cell division.

In typical experiments using these techniques, the activities of cells from the respiratory membrane are recorded for a four-hour period, during which the chamber is being perfused with the nutrient solution used to cultivate the cells. The substance (called an antigen) known to produce the allergy of the patient can then be introduced into the inlet tube. Subsequent study of the film makes it possible to see just what happens in the cell when the irritating agent is introduced. Since current theory holds that allergic reactions are probably set off by histamine, other experiments can be designed to analyze the action of this chemical as well as a large number of so-called anti-histaminic drugs.

So far our work has merely proved the feasibility of this program. We are still in the process of establishing the necessary base lines. That is, we are determining what effects are produced by varying the composition of the nutritive medium, its relative acidity or alkalinity, the osmotic pressure and the temperature. Specifically we want to see what effect these variables have on the different moving parts of the cells.

Tests of Night Vision May Aid Early Diagonoses of Disease

Tests of night vision may lead to the early discovery of certain ailments before they have done serious damage to the body, according to Dr. W. J. Holmes, ONR investigator at the University of Hawaii. Dr. Holmes believes that night blindness may be one of the first indications of liver disease, brain tumors, head injuries or nutritional deficiencies. But this doesn't mean that you should rush off to the doctor in alarm if your after-dark eyesight is below par--for as yet research has not gone far enough to prove that connections definitely exist between disease and this defect in sight.

Dr. Holmes has, however, made some interesting observations about our ability to see after dark. Because most of our seeing is done under daylight conditions, studies of the way we see at night have been somewhat neglected. Dr. Holmes has found that doctors, nurses and technicians are often unaware of the great differences between the day- and night-seeing eye. For this reason their examinations have not yielded as much information on the subject as they should have.

In his own work, Dr. Holmes has found that there are many possible reasons for the eye's inability to function normally in the dark. For example, there are apparently considerable differences between certain races in this ability. Eskimos apparently can see in dim light better than people of other races, while the Japanese tested were less adept than members of the white race. Diet possibly plays a part in these variations, for Vitamin A is essential to good night vision. Heredity also seems to exert some influence; children can apparently inherit night blindness from either parent. Like color blindness, however, the inability to see in poor light is more frequently found in men than women.

One factor that apparently has no connection with the ability to see in the dark is intelligence. But emotional factors--fears, worries, lack of confidence--are highly important. Training in most cases can improve this ability, but hypnosis has been found to be of no value.

Dr. Holmes has outlined a method for the systematic examination of night vision and is writing a book which can be used as a guide in such clinical work.

Who's Who in Naval Research

CAPT Robillard

CAPT George Nelson Robillard, ONR's Assistant Chief for Patents and Patent Counsel for the Navy, is a tall, lanky Lincolnesque figure with an easy sense of humor. He is always ready to throw good-natured satire at the social foibles of mankind and is quick to perceive the humorous aspects of any situation. This sense of perspective, plus a mind that has been thoroughly trained in both legal and scientific fields, stand CAPT Robillard in good stead when he is faced with the problems resulting from the weird convolutions of patent law.

CAPT Robillard was born two score and nine years ago, and graduated from the Naval Academy in 1924. After two years of service with the Fleet, he resigned to follow his bent in law. In 1930, fresh with a law degree from St. John's University of Brooklyn, he joined the firm of Bartlett, Eyre, Scott and Keel where he specialized in patents, trademarks, and copyrights. By 1937 he was a member of the firm of Lindsey and Robillard of Hartford, Connecticut, which concentrated on patent law.

In 1942, he returned to active duty with the Bureau of Ships, rising quickly to the rank of Captain in recognition of the effective service he gave to the Navy. During his evenings he has been a Lecturer in Patent Law at American University. In June 1947 he assumed his present duties with the Office of Naval Research. As Patent Counsel for the Navy, he is charged with the responsibility for Navy-wide administration of all matters pertaining to patents, inventions, trade marks, copyrights, royalty payments, and related matters.

CAPT Robillard's division analyzes invention disclosures which are a Navy responsibility and prepares and prosecutes patent applications on new devices for the Navy. Division members work with the Department of Justice in solving certain complex patent cases, and they are the core of the advisory staff in the technical bureaus and Navy research laboratories on patent problems which grow out of Navy and contractor research.

It's a big job and heavy responsibility. CAPT Robillard is aware of the many legal implications which may develop from the findings of almost every research project. It takes a man with stamina, keen judgment and a sense of humor to bear the load. And that's CAPT Robillard, who seems able to take it all in his stride--with the courage and know-how to get the toughest problems solved.

Poisonous Fish--
a Medical-Military Problem

by
Bruce W. Halstead
College of Medical Evangelists

Fish poisoning is one of the unsolved problems of medical science. Although it has been investigated widely, much of the research has been uncoordinated and has done little to clear up the confusion which exists on the subject. Yet a better general understanding of poisonous fish--which ones they are, where they are located, and what causes their harmful effects--is badly needed. It is a serious medical and military problem.

Even the term "poisonous fish" has caused confusion in the minds of some, for it has been mistakenly applied to fish which produce their injurious effects by injecting their venom with teeth, spines, or stings. These are more accurately termed "venomous". The term "poisonous fish" refers only to those specimens whose flesh, when eaten by human beings, produces toxic symptoms which are scientifically termed "ichthyotoxism."

An instance cited by two researchers (Vonfraenkel and Krick) demonstrates the military importance of fish poisoning. On one occasion 30 sailors, representing 55 percent of the crew of a small Navy landing craft, were severely poisoned by eating a large barracuda in the Marianas. The intoxication made the employment of a relief crew necessary to operate the vessel. During combat, when the service of each individual is essential, it is obvious that poisonous fish might constitute a serious menace.

The poisonous fish problem also has its economic aspects. As a public health problem, it will have increasing significance as the fisheries of the tropical Pacific are developed. In November and December of 1944 in Honolulu, there were two outbreaks of fish poisoning after the eating of sea bass from Midway and Christmas Islands. A total of 38 individuals were known to have been poisoned. When such an incident occurs, the remainder of the catch must be discarded at a loss of thousands of dollars. Even more serious, both fishermen and consumers refuse to have anything to do with fish which come from a potentially dangerous area. It is evident that this results in the danger of depleting certain fishing grounds while other valuable regions go untouched.

Bruce W. Halstead received his B.A. in zoology from the University of California and his M.D. from the School of Medicine, College of Medical Evangelists. From 1935 to 1943 he served as an assistant in the Department of Ichthyology at the California Academy of Sciences, San Francisco. While at the Academy he developed a working knowledge of ichthyological research techniques. His research has dealt mainly with poisonous and venomous fish and at present he is Project Director of a research program on ichthyotoxism that is being sponsored by ONR and the United States Public Health Service.

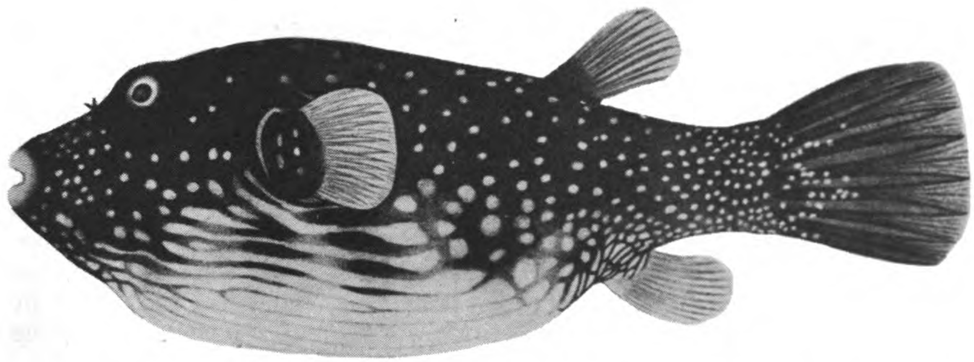


Figure 1. Maki-Maki, sometimes called the Deadly Death Puffer (Tetraodon hispidus Linné). This species, typical of the numerous puffers found in tropical seas, usually causes death about five hours after it is eaten.

Ichthyotoxism provides a classical example which illustrates that a little knowledge can be very dangerous. For example, two specimens of puffers, Tetraodon meleagris Schneider, which were practically identical in appearance, were tested for the presence of toxins. One of the specimens was from Hawaii, the other from the Phoenix Islands. Tests revealed that the Hawaiian specimen was harmless. Therefore one might conclude that all members of the species T. meleagris are harmless. Yet subsequent experiments demonstrated that the specimen from the Phoenix Islands was deadly, producing violent clonic convulsions and death in a mouse in four minutes and fifty seconds.

Since fish poisoning has presented such serious problems the question arises as to why more has not been accomplished toward its solution. Actually the need for more thorough basic research on poisonous fish has long been recognized by workers in ichthyology and preventive medicine. Numerous reports and case histories have appeared in the literature throughout the years, but comparatively little original investigative work has been accomplished. Moreover, much of the literature disagrees on which fish species are poisonous and which are not. As a result, military personnel and other transients in the tropics are advised to secure their information regarding poisonous fish from the native populace, but information derived in this manner is usually incomplete, incorrect and conflicting. The frequent use of vernacular fish names even in scientific literature and the failure to obtain correct classifications have resulted in much confusion. A common name for a given species in one locality may be the same one used to designate an entirely different form in another area. In addition, many of the reports have been written by medical workers rather than by biologists, which accounts for some of the gross errors in classification. On the other hand, fish experts have contributed little to clarify the medical aspects of the problem. Since thorough study of poisonous fish involves both zoological and medical factors, failure to combine the research techniques of the two has resulted in mediocre accomplishments and an inadequate evaluation of the problem.

One of the main reasons for our inadequate knowledge in this field has been the lack of logistic support. The limited travel facilities provided by commercial organizations in areas where fish poisoning occurs have been a very real problem. Moreover, the lack of adequate preservation and refrigeration facilities in the field, and the difficulties in transporting specimens to the laboratory have been additional complications. These are just a few of the basic reasons why the poisonous fish problem still remains in something of a muddle.

Fish poisoning has been designated by the following terms: the Pacific type, Ciguatera or Caribbean type, and Tetrodon or Fugu (puffer) poisoning. All three are correctly termed ichthyotoxism. Judging from the clinical evidence available, they are essentially the same, but differ in the degree of virulence. Tetrodon poisoning, caused by the puffer or balloon fish, Tetraodon[1] apparently is the worst form. Victims usually die within five hours after eating the flesh of this specimen, which is distributed widely throughout most warm seas. Strangely enough, not all species of puffers are poisonous; many of them are considered an Epicurean delight! Recent tests have demonstrated that a species of puffer which is edible in one locality may be poisonous in another; thus it is easy to see how the uninformed may make fatal mistakes. Indeed, more than a score of deaths have been reported in Japan each year as a result of eating puffers. Tetrodotoxin, the substance responsible for puffer poisoning, has been isolated and studied by Japanese scientists, whose biochemical research on Tetraodons is of excellent quality. However, their work has been limited mostly to Japanese species. The manner in which the fish become toxic, the number of such species and their distribution are still unknown.

The virulence of the Pacific type of fish poisoning varies considerably, depending upon the type of fish eaten, and the place where it was caught. It is estimated that there are about 300 poisonous species in the Central Pacific (Figures 2-6), many of which are unrelated and widely distributed. There are no reliable statistics available, however, as to the exact number of species or the incidence of the disease, but the over-all mortality rate is said to be 2 to 3 percent. Actually the term Pacific type of ichthyotoxism is somewhat ambiguous and will probably be more accurately defined or changed when additional information becomes available.

Ciguatera, or the type of fish poisoning found in the Caribbean region, is the least virulent form. The patient seldom dies even though the symptoms may be severe during the acute phases of the disease. Ciguatera is most prevalent in the Virgin Islands of the West Indies. The species which cause it are the sierra, [Scomberomorus regalis (Bloch) (Figure 7)], cavallas, hard-tails, jacks, etc. (Caranx spp.), great barracuda [Sphyraena barracuda (Walbaum) (Figure 8)], groupers (Mycteroperca spp.), amberjack [Seriola falcata (Cuv. & Val.)], and other closely related forms. Though the term Ciguatera has sometimes been used to include tetrodon poisoning, it more correctly refers to the nonfatal type of poisoning that is caused by fishes exclusive of puffers in the Caribbean region.

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[1]Correct spelling of the generic fish name is Tetraodon and not Tetrodon. However, since the spelling of the terms tetrodon poisoning and tetrodotoxin are deeply entrenched and do not come within the Rules of Zoological Nomenclature it is considered advisable to leave them in their original form.

Five Deadly Fish

The fish shown here would make very dangerous eating. They represent more than 300 species in the Central Pacific which are said to be poisonous. Actually, the five shown here are toxic only in certain localities in the tropical Pacific; in other areas they are edible.

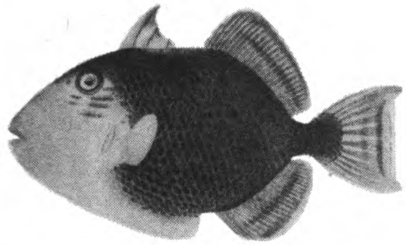

Figure 2. Humuhumu or Triggerfish

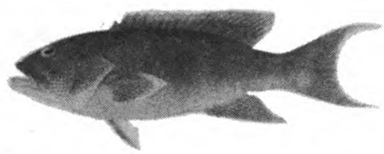

Figure 3. Opupe or Sea Bass

Figure 4. Puhi or eel

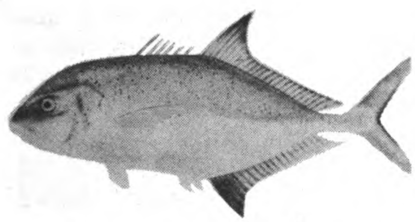

Figure 5. Black Ulua

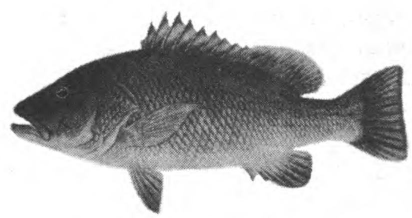

Figure 6. Red Snapper

The clinical picture of fish poisoning is bizarre, but the appearance of certain symptoms is surprisingly consistent. One of the first to develop is a tingling about the lips and tongue, which soon spreads to the hands and feet and gradually develops into numbness. These symptoms may appear immediately or at any subsequent time within a period of thirty hours. In addition gastro-intestinal symptoms seem to be present in about 75 percent of the cases. The usual symptoms are nausea, vomiting, diarrhea and abdominal pain. Later additional neurological symptoms may develop. Generalized motor incoordination, muscular weakness, paralysis, irritability, and convulsions are common. Patients also frequently complain of a choking sensation which apparently is caused by a laryngeal spasm. This distress is aggravated by the production of excessive bronchial mucous and saliva. Fish poisoning is further characterized by joint aches, malaise, chills, fever, prostration, profuse sweating, metallic taste, intense itching, skin eruptions, transient blindness, and painful urination, etc. However, the incidence of this latter group of symptoms and their progression is subject to considerable variation.

One of the most striking symptoms is the sensory disturbance in which the temperature sensations of the individual are reversed. Hot objects feel cold to the touch and cold objects feel hot. Victims complain of the same peculiar sensation in drinking hot or cold fluids. While in the Virgin Islands during fleet maneuvers in 1938, an American naval officer was poisoned from eating an amberjack (Seriola falcata).[2] Fortunately, he suffered only a mild attack and soon recovered. But four weeks later he was observed in the mess hall blowing on his ice cream in order to cool it! This singular disturbance has been consistently reported from widely scattered areas over a period of 174 years. To date we have been unable to locate a record of any other toxin or chemical substance capable of producing such systemic effects.

The "loose tooth sensation" is another unusual symptom frequently present in ichthyotoxism. The patient complains that his teeth are loose, though examination reveals that they are just as solid as before. This symptom is present also in paralytic shellfish (mussel) poisoning.

Recovery from a severe attack of fish poisoning is usually very gradual, with weakness sometimes persisting for weeks or months after specific symptoms have disappeared. Unfortunately an attack does not impart immunity and there is no known specific antidote or anti-toxin at the present time.

Because of the accompanying gastro-intestinal disturbance, ichthyotoxism has been frequently confused with other types of food poisoning. However, careful analysis of the symptoms of salmonella, staphylococcus food poisoning, and botulism reveals that fish poisoning is a distinct clinical entity. Though persons may become ill from eating fish which has undergone bacterial decomposition, this is merely one of the ordinary types of food poisoning and should not be confused with true ichthyotoxism. Judging from the available evidence the latter is caused by a toxin capable of producing an aconitine-like reaction and it is not believed to be bacterial in origin. Whether it is a poisonous alkaloid or some other closely related substance is not definitely known. Moreover, it is not known to what extent the toxin is peculiar to certain species. The spotty geographical distribution of the problem would lead one to believe that the feeding habits of the fish are involved in the production of the poison.

Reports on the occurrence of the disease during certain seasons are conflicting. A few species, e.g., barracuda and puffer, appear to be more toxic during the reproductive season of the year, but apparently this is not true in the case of most other poisonous fish. Existing records reveal that fish poisoning may occur during any season of the year.

Speculation on the cause of fish poisoning dates back to Peter Martyr, the first historian of the West Indies, who wrote concerning Ciguatera in 1530.[3] Martyr was of the opinion that the flesh of these fish became poisonous because they ate the poisonous manchineel berry, (Hippomane mancinella Linné). Engelbert Kaempfer was probably one of the first to record tetrodon poisoning in the Orient.[4] In his exhaustive

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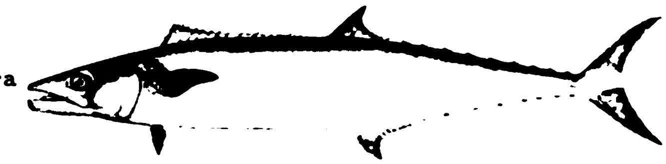
[2] Mann, W. L., Fish poisoning in Culebra-Virgin Islands area. U.S. Nav. Med. Bull. 36(4): 633, 1938.

[3] Martyr, P., cited by Gudger, E. W., Poisonous fishes and fish poisonings, with special reference to Ciguatera in the West Indies. Amer. Jour. Trop. Med. 10(1): 47, 1930.

[4] Kaempfer, E., cited by Yudkin, W. H., Tetrodon poisoning. Bull. Bingham Oceanogr. Coll. 9(1): 4, 1944.

Figure 7. Sierra



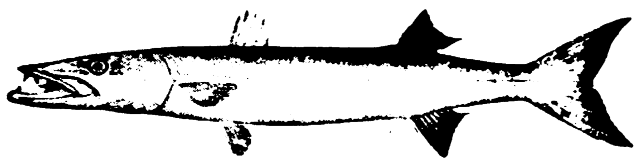


Figure 8. Great Barracuda

These two fish are representative of a relatively small group in the Caribbean area. They are capable of producing a type of poisoning known as Ciguatera, which is ordinarily non-fatal.

history of Japan which was written in 1690, he describes in detail the results of the promiscuous eating of puffer. One of the earliest works concerning the Pacific type of ichthyotoxism was written by W. Anderson[5] in 1776. In comparing Anderson's clinical account with that of Khlentzos[6] which appeared in 1950 a striking similarity of the symptoms is noted, even though the offending fishes were two unrelated species. The most recent complete accounts regarding tetrodon poisoning, Ciguatera, and ichthyotoxism in the Pacific, were written by Yudkin[4], Arcisz[7], and Hiyama[8], respectively.

There have been numerous explanations of the cause of ichthyotoxism, but in most instances the theories have not been accompanied by laboratory and field research. The following diverse sources have been suggested:

1. Copper-contaminated water resulting from shipwrecks, war materials, or naturally occurring copper deposits.

2. Manchineel berries (Hippomane mancinella).

3. Poisonous marine invertebrates (dinoflagellates, jellyfish, corals, palolo worms, mollusks, etc.).

4. Poisonous marine algae of various kinds.

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[4] Kaempfer, E., cited by Yudkin, W.H., Tetrodon poisoning. Bull. Bingham Oceanogr. Coll. 9(1): 4, 1944.

[5] Anderson, W., An account of some poisonous fish in the South Seas. Philosoph. Trans. Roy. Soc. London. 66:544-552, 1776.

[6] Khlentzos, C. T., Seventeen cases of poisoning due to ingestion of an eel, Gymnothorax flavimarginatus. Amer. Jour. Trop. Med. 5(30): 785-793, 1950.

[7] Arcisz, W., Ciguatera: Tropical fish poisoning. U.S. Fish and Wildlife Service, Spec. Sci. Rept., Fish. No. 27: 1-23, 1950.

[8] Hiyama, Y., Poisonous fishes of the South Seas. U.S. Fish and Wildlife Service, Spec. Sci. Rept., Fish. No. 25: 1-188, 1950.

5. Chemical contamination of the water by war materials containing nitrocellulose and other chemicals.

6. Bacterial contamination of the flesh of the fish.

The time-worn hypotheses involving copper poisoning and manchineel berries have no scientific basis and are in disrepute. As to the suggestion that marine invertebrates and algae are involved, this cannot be considered established, for analyses of the stomach contents of poisonous fish have never been conducted. Nor have the few workers who have conducted bacterial studies in the Caribbean and tropical Pacific been able to produce evidence supporting the theory that putrefaction causes the harmful effects. Moreover, the symptoms of ichthyotoxism differ considerably from any type of bacterial poisoning that has been described to date.

Some evidence has been presented, however, which indicates that the dumping of war materials has a bearing on the increase in fish poisoning which has occurred in certain localities. For example, certain fish (sea bass, cavallas, snappers) were commonly eaten at Fanning Island up until the year 1945, when large quantities of war materials were dumped in the vicinity of the Island in July. Between February, 1946, and April, 1947, there were 95 cases of fish poisoning among the population of 224 people. Is this just coincidental? On the other hand, it is an established fact that ichthyotoxism has existed in various other areas in the tropical Pacific for many decades prior to World War II.

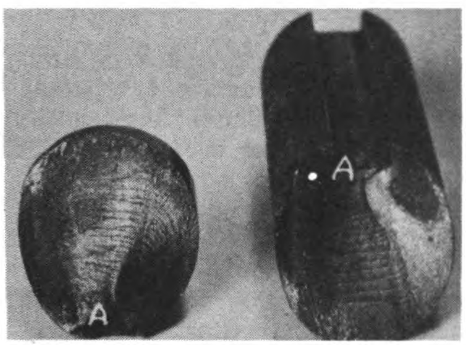
For the past five years the writer has been engaged in compiling an extensive bibliography on poisonous and venomous fish. The literature is being abstracted in preparation for the publication of an exhaustive review and annotated bibliography on the problem of ichthyotoxism. The bibliography will contain about 1000 references. As a result of the excellent cooperation given by the Office of Naval Research, U.S. Public Health Service, Pacific Oceanic Fishery Investigations, Office of the High Commissioner of the Trust Territory of the Pacific Islands, Civil Aeronautics Administration, Pacific Science Board, Pacific Science Council, Bernice P. Bishop Museum, Division of Fish and Game, and the Department of Public Health, Territory of Hawaii, it has been possible to develop a long-range program of field and laboratory research regarding these noxious fish. At the present time, fish and ecological and epidemiological data are being collected in the Phoenix and Line Islands. The emphasis of the study is on the neritic fish species. Whenever possible the fish are collected in duplicate and are divided into two groups. One group is permanently preserved for future taxonomic reference and the other is used for the preparation of tissue extracts. Screening tests consist of intraperitoneal injections into mice and the feeding of tissue samples to cats. It is the ambition of the investigator to screen-test as large a series of reef fish from as many different island areas in the tropical Pacific as possible. Attempts will be made to conduct field studies during various seasons of the year in order to determine if there is any seasonal variation in the poison content within a given species of fish in each locality.

Sporadic and dabbling investigations usually contribute additional confusion to the existing poisonous fish muddle. Valid conclusions and results of lasting value will be the product of thorough and critical research conducted over an extended period of time. It is with these thoughts in mind that the present project has been launched.

Fatigue in Metals

by
Thomas J. Dolan
University of Illinois

Many parts of modern machines such as engines, pumps or turbines must withstand during their normal life numerous repetitions of service loads. These parts seldom fail because of fracturing or stretching under a single application of a load. Probably more than 80 percent of the service failures develop as a gradually growing microscopic crack after a large number of repetitions of load; finally, after the crack has reached sufficient size, a sudden complete rupture of the part occurs. These drastic fractures (of the types shown in Figures 1 and 2) have been commonly referred to as "fatigue" failures, although this name is misleading. A better term would be "progressive fracture."



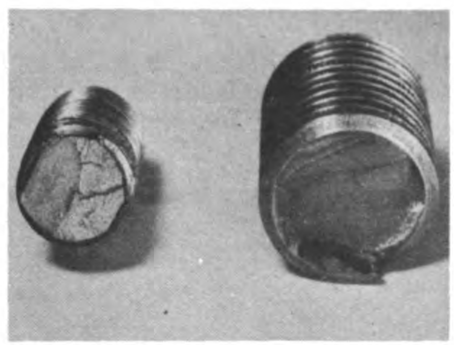


Figure 1. Fatigue failures in parts subjected to repeated loads. Two specimens at left show fracture of shaft starting at (A) near end of keyway. Those at right show fractures of bolts starting from root of thread.

Even in the most ductile metals the fracture usually resembles a fracture in brittle material, since there is no observable plastic distortion of the part as a whole. During the latter half of the nineteenth century the diagnosis of this malady was that the material had "crystallized" and thus had become embrittled. The peculiar crystalline appearance of the fractures led to this erroneous belief because of the absence of the large plastic deformations that occur when the same metal is fractured under a single, gradually increasing load. The metallurgical microscope, however, has shown that all metals are crystalline in their original "unstressed" state, and that no over-all grain-growth in the crystalline structure occurs as the result of repeated stressing.

In members subjected to repeated loading, an abrupt change of section such as a fillet, keyway or hole, is usually referred to as a notch or "stress-raiser" which develops a serious concentration of stress. (Note

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Thomas J. Dolan completed his academic studies at the University of Illinois where he has been on the staff since 1929. For the past five years, he has been engaged in research on various methods of experimental stress analysis and properties of materials, with special emphasis on the fatigue strength of metals.

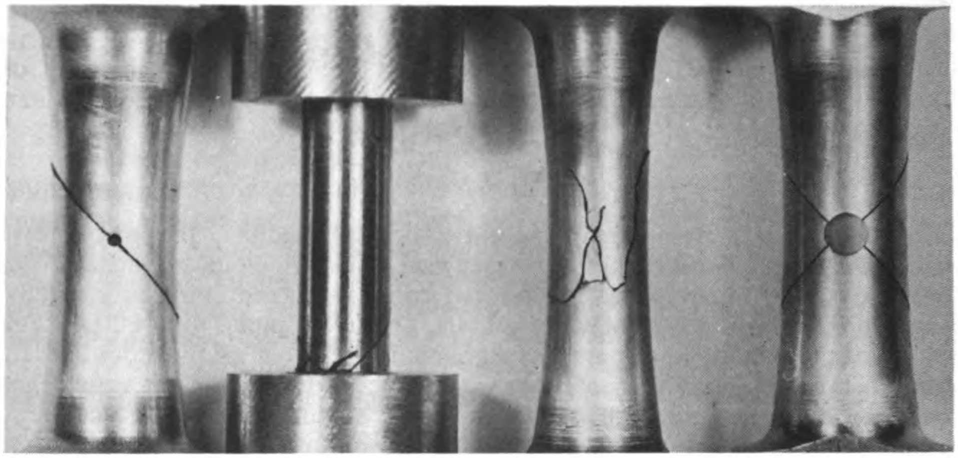


Figure 2. In these typical fatigue cracks in steel specimens subjected to repeated torsions, it should be noted that cracks usually start at holes, or fillets.

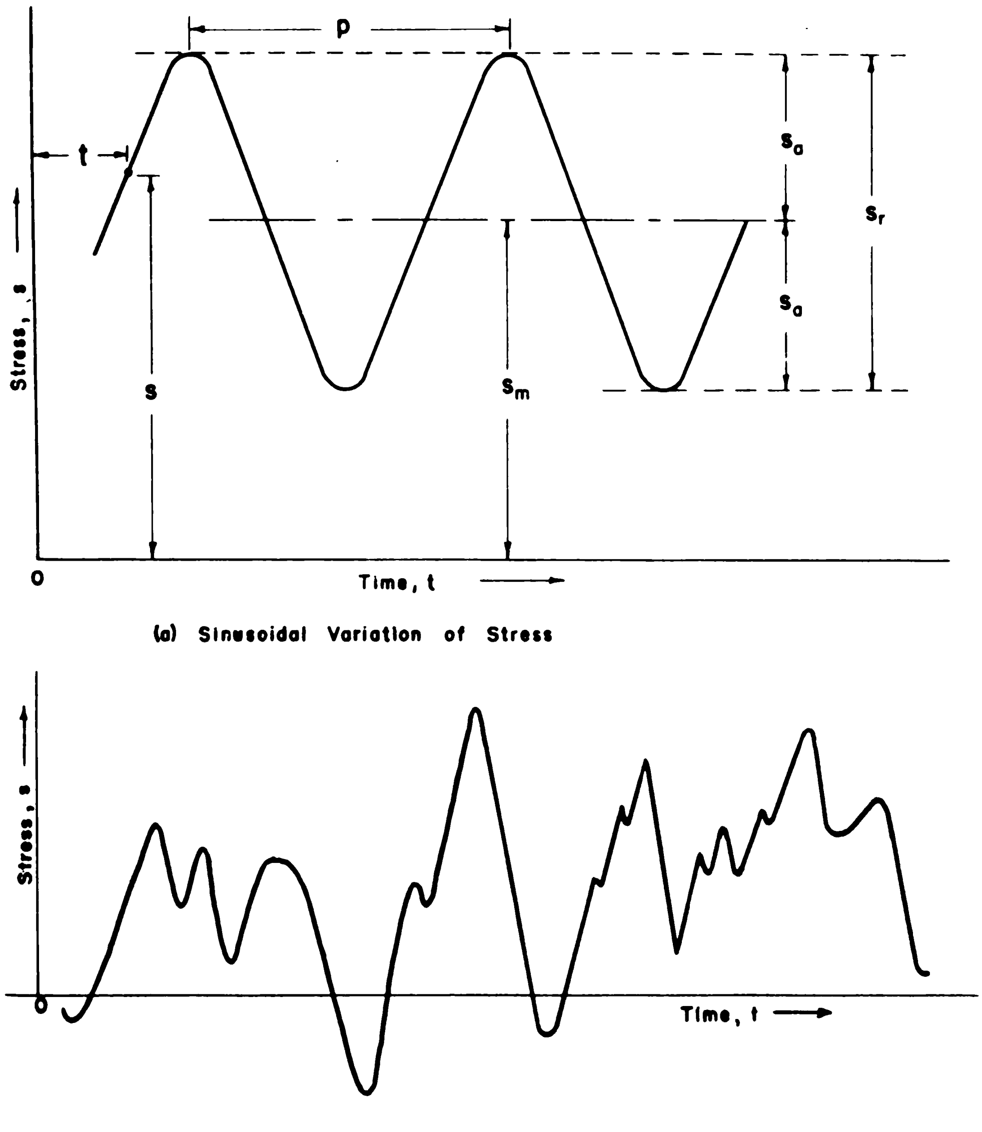
location of failures in Figures 1 and 2.) Stress-raisers are hardly avoidable in engineering practice since they may occur as: (a) "metallurgical notch" inherent in the material due to inclusions, blow-holes, quench cracks, or decarburization; (b) "mechanical notch" (grooves, holes, screw threads, gear teeth or surface irregularities); (c) "service notch" developed by chemical or corrosion pitting, nicks, erosion, chafing, or fretting. "Fatigue" failures usually develop at notches for which the nominal calculated stresses are far below the static elastic strength of the metal. As indicated in Figure 3, the failure first becomes observable as a minute crack after the loads have been repeated many thousands or millions of times. Once started, the crack itself is a location of very severe concentration of stress; thus, a crack tends to be self-propagating.

Figure 3. This photomicrograph of low-carbon steel shows fatigue cracks beginning at small corrosion pit.
The fine cracks designated by "C" propagate across the grains on certain preferred planes which differ in orientation for the various crystals. G indicates a grain boundary of a crystal.

During the past 100 years, experiments have been made to learn more about the factors governing the strength of materials subjected to repeated applications of load. The basic mechanism of the initial damage however, and the conditions leading to progressive crack formation have not been satisfactorily explained. Gaps remain in our knowledge which make it impossible to predict quantitatively and with certainty the fatigue strength of a machine member in service. This has resulted in relatively inefficient use of critical materials for optimum economy, for efficiency of operation, and for maximum strength-weight ratio for applications where minimum weight is of extreme importance.

The difficulty of predicting the strength of a particular machine part is emphasized by the many factors that alter the fatigue strength. The principal influences may be grouped in general categories as follows:

1. The initial mechanical properties. These may be varied by changes in chemical composition, and by heat-treatment which alter metallographic structure.



(a) Sinusoidal Variation of Stress

(b) Complex (Non-repetitive) Stress History

Figure 4. Contrast between types of dynamic stress history.

2. The processing of the member. Such operations influence the surface finish, inherent residual stresses, plastic deformations and resulting crystal breakup induced.

3. The geometrical shape and over-all size of the member. These factors affect the stress distribution, stress gradient, and method of calculating the stress.

4. The loading conditions. These determine whether uni-axial or bi-axial stresses are developed and control relative magnitudes of the alternating and mean stresses of the loading cycle. Other more complex types of stress history of the type shown in Figure 4 are also often encountered in service.

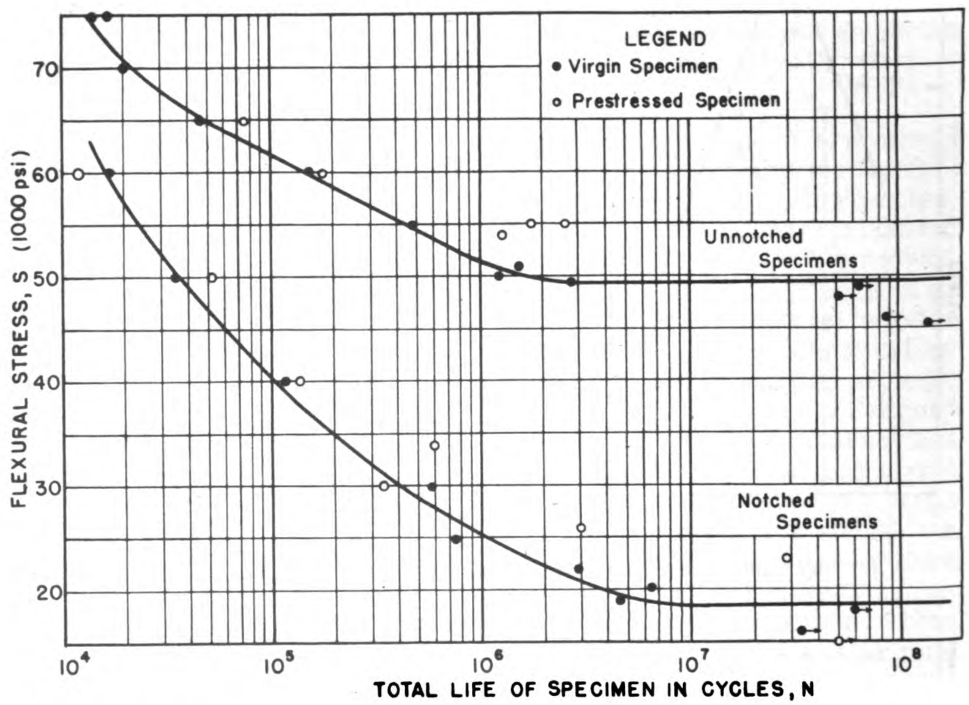


Figure 5. S-N curves for SAE 1045 steel in reversed bending. Notched specimens had a small circumferential V-groove. Arrows on plotted points indicate specimens that did not fail. "Prestressed" specimens had previously been cycled at stresses below the endurance limit. Each point represents a test of one specimen.

5. The environmental conditions. These include the presence of corrosive atmosphere, erosion, and elevated temperatures.

The information available on fatigue properties of metals has been obtained primarily from repeated tension or bending tests in which the stresses are essentially uni-directional. The loads are usually applied in completely reversed cycles (that is, with the mean stress, S_m, zero, in Figure 4a). The procedure involves testing a group of like specimens, each at a different (but constant) stress amplitude. The results are then plotted in a "S-N diagram" (Figures 5 and 6) to determine the stress at which the trend of the data approaches a horizontal line. For steels a fairly definite "knee" occurs in the curve, and the stress at which the curve becomes horizontal is called the "fatigue limit". Presumably stresses below this "limit" do not cause fracture even though they are repeated an indefinitely large number of times. For non-ferrous metals such as the aluminum alloy in Figure 6, however, no sharp break occurs in the curve and the "fatigue strength" is arbitrarily designated as the stress that will cause fracture if repeated 100 million or 500 million times.

There are numerous service conditions involving complex states of stress, or for which the imposed loading varies in a random fashion

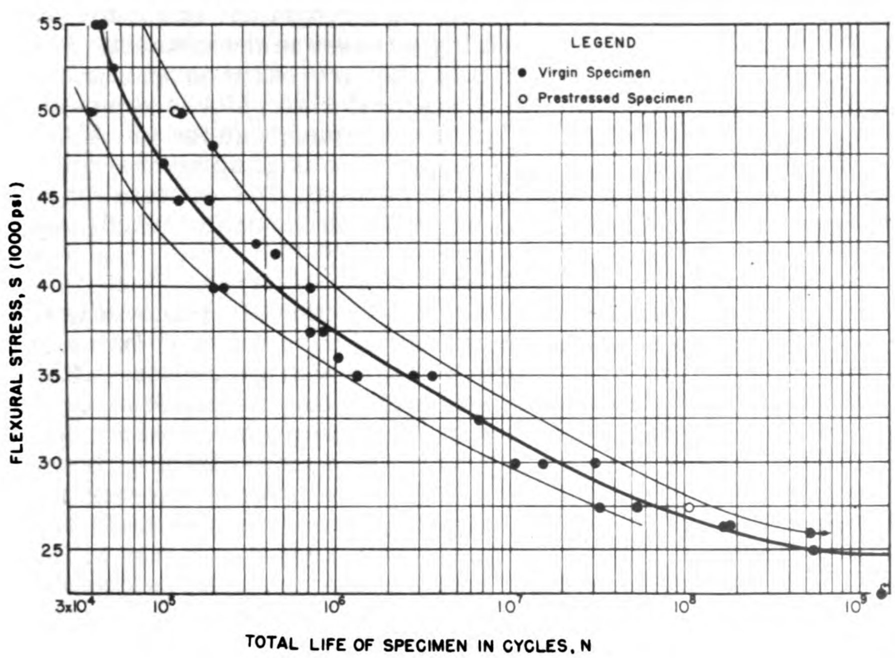


Figure 6. S-N curve for unnotched specimens of 75S-T aluminum alloys in reversed bending. Light lines have been drawn in to indicate the approximate range of "scatter" of life in these tests. Note that one specimen was stressed for more than one billion cyles without fracture.

as shown in Figure 4b. The variation of loads imposed on an airplane wing by the gusts encountered in flight is an example of this. The values of fatigue strength determined in the laboratory under constant stress amplitude (Figure 4a) do not adequately foretell the behavior of members subjected to these complex combinations of service conditions.

Experimental studies usually have been concerned with determining the over-all effects produced by varying the physical conditions of an experiment (such as specimen shape, material, heat treatment, and range of stress). Little is known, however, of the sub-microscopic structural changes within the material that lead to the observed "effects". Studies are being sponsored by ONR at the University of Illinois to learn more of the basic nature of "fatigue damage" in its early stages. There is need for the establishment of a quantitative theory of the mechanism by which a fatigue fracture is developed and propagated. Until more complete fundamental knowledge is obtained, the engineer must rely on empirical relationships between the conditions imposed during testing and their effect on typical structural materials. Phenomenological[1] measurements of changes in fatigue strength caused by processing treatments were not the prime objective of the research but they have been included, since such changes influence the experimental data obtained to analyze the mechanisms of damage.

In devising design formulas for proportioning machine members, simplifying assumptions must be made in predicting the magnitude and variation of the loading, in appraising the strength and uniformity of the metal, and in calculating the resulting stresses in the member. Practically all commonly-used design formulas are based on an "idealized" set of assumptions involving: (a) elastic material, which is homogeneous and isotropic; (b) loads applied only a few times, and for which the detailed reaction of the member during each loading is identical with that for the previous loading cycle; and (c) a method of processing of the member which does not materially alter the mechanical strength characteristics of the material.

For design purposes it is customary to think in terms of nominal stresses computed from equations based on the "idealized" material and conditions. Though these assumptions are only crude approximations of the behavior of real metals, they yield satisfactory results from an engineering design viewpoint for ductile materials subjected to loads repeated only a few times. In members subjected to repeated loading, however, the behavior of real metals departs significantly from the idealized conditions, and the resulting simple design equations are inadequate for prediction of strength. For example, the slowly applied load that will fracture a small specimen of a ductile steel is approximately twice as large as the load that, when repeated millions of times, will cause the specimen to fracture by developing a spreading crack. Hence, it becomes imperative that laboratory investigations search out and interpret realistically the behavior of actual materials, and define the conditions which lead to the initiation and propagation of a fatigue crack. Micrographs like those in Figures 3 and 7 indicate that metal is not homogeneous but rather consists of a heterogeneous aggregate of crystalline grains. When the elastic strength of any crystal is exceeded, localized deformation bands, usually referred to as "slip bands," develop within the crystal. These are sometimes seen in only a few scattered grains, but as the stresses are gradually increased, they multiply until practically all grains are greatly fragmented and deformed. In a fatigue test, however, the repeated

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[1]"Phenomenological" refers to characteristic behavior defined in terms of phenomena that can be measured by large-scale, or visible observations. In contrast, events on a microscopic or sub-microscopic scale occur in a different manner, at an earlier stage in the process, and are essential in determining the specific effect of altering important variables.

loading localizes these effects on a few crystals in regions of high stress concentration.

Figure 7. Photomicrograph of slip bands in crystals of high-purity aluminum after repeated stressing. (G is a grain boundary, while lines designated "L" are slip bands.)

Any valid concept of the mechanism of fatigue damage in metals must take these facts into account. It appears that the significant actions which lead to fatigue failure originate in a more localized region than can be accurately treated by means of the "ideal material" and static load concepts. A careful synthesis needs to be made of the essential elements such as: (a) the readjustments on an atomic scale which precede or accompany adjustments by slip in microscopic areas; (b) the influence of accompanying residual stress; (c) changes in the strength properties induced by a previous stress history or by thermal treatments; and (d) the instability and "aging" that change the strength properties of metals repeatedly stressed at elevated temperatures.

To improve our knowledge of fatigue, it seems necessary to select an approach new to many engineers. This approach involves delving more deeply into the physical nature of crystals and their modes of deformation and fracture, and using statistical methods in evaluating the behavior of the polycrystalline structure. As a portion of this investigation, an attempt has been made to formulate hypotheses regarding the nature of the adjustments that take place and of the conditions influencing these interactions in the polycrystalline metal. Many of these concepts are still somewhat vague, but appear to offer a fruitful approach for further study. Such factors as temperature, grain size, and presence of foreign atoms influence the behavior on a sub-microscopic scale. These in turn must be synthesized and interpreted in terms of the phenomenological behavior that one would then expect in a large-scale (micro or even macro) fatigue test observation.

Briefly, the theory thus far devised visualizes fatigue damage starting within the disordered groups of atoms that border the crystal boundaries and those which comprise the slip bands. This damage may consist of forced relaxation or actual rupture of the bonds between adjacent atoms, resulting in a place change of the individual atoms. Disruption of atomic bonds eventually occurs as a result of the statistical or chance variations in conditions among the disordered groups of atoms during the repetitive cycles of loading. The processes of slip and crystal fragmentation contribute to fatigue damage in the early stages by developing additional regions of unordered material in which many highly stressed bonds may exist between groups of atoms.

Many phenomena observed in fatigue testing may be interpreted on the basis of these concepts and qualitative predictions may be made of

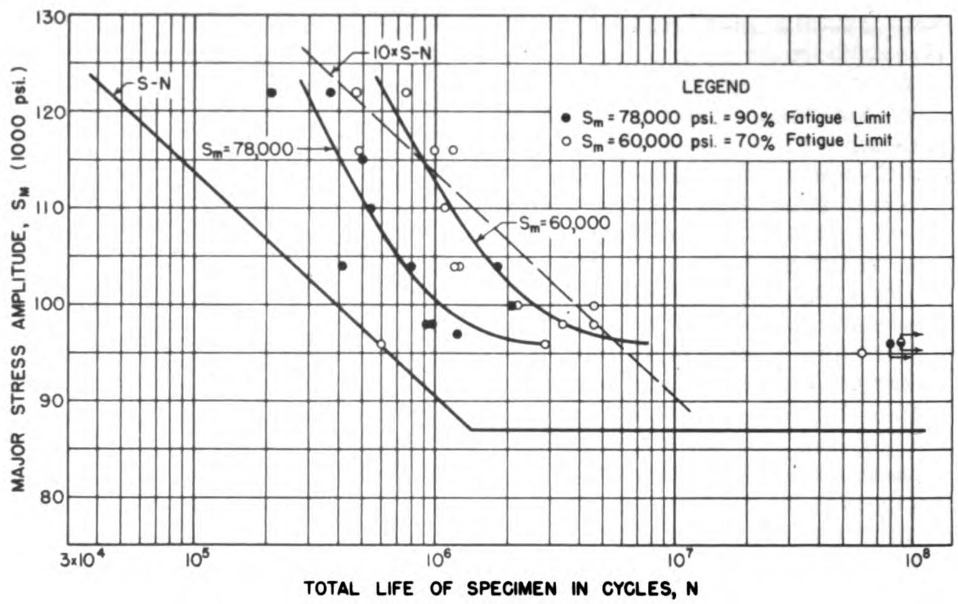

Figure 8. Fatigue life of SAE 4300 steel subjected to 1000 cycles of stress S_M after each 9000 cycles of stress S_m. Points are plotted at values of the major stress in the test, and for the total life including all cycles at both stress levels. Arrows indicate specimens that did not fracture. The solid line labelled "S-N" represents the normal S-N curve for these specimens.

the variation in fatigue strength produced by changes in the grain size, dispersion of hardening constituents, temperature, previous strain history, and shape effects. Tests are being conducted to check predictions of the effects on fatigue life produced by various treatments--for example mild heating during intermittent rest periods.

Because of the heterogeneity of a polycrystalline metal, the response of the parts to an over-all external load will necessarily be heterogeneous. One must, therefore, consider the material to be built up statistically of elements which have a range of values in size and whose strength is inversely proportional to their size (or to the spacing of hardening constituents such as the carbides in a steel). By employing the principles obtained from the mathematics of statistics and by microscopic observation of the range of grain sizes present, attempts are being made to evaluate the maximum and minimum strength variations in the crystal structure from phenomenological behavior in hardness and tensile tests, and to correlate these with fatigue test data. Several significant groups of experiments have indicated that the fatigue strength of a given metal is primarily dependent upon the closeness of the spacing of the hardening constituents (iron carbides in the case of steel), whereas for single-phase metals (such as alpha brass) the strength is an inverse function of the crystalline grain size. Cold-working of a single-phase metal has the effect of reducing the crystallite size and thus of improving its fatigue strength.

There exists a considerable difference of opinion as to whether the increases in fatigue strength observed after cold-working of a metal are due to the accompanying favorable residual stresses induced or whether the improvement is due primarily to increased mechanical strength (that is, due to work hardening caused by operations such as cold-rolling, shot peening, etc.). Experiments are being conducted to observe on a phenomenological scale the individual effects of inelastic deformation and residual stress on fatigue properties. Because of continual readjustments by slip during repeated stressing, however, one cannot predict the final "shake-down" conditions of residual stress and plastic deformation which govern the final strength of the member.

The susceptibility of a material to the damaging effects of a stress-raising notch is not directly proportional to the stress as nominally calculated on the basis of an "idealized" material. Instead the reduction in fatigue strength is normally found to be somewhat less than the factor by which the calculated localized stress is increased. This again is evidence of the important difference in the behavior of real metals from those assumed for purposes of stress calculation. Naturally the relative susceptibility of a material to the damaging effects of a notch is important in choosing a metal for repeated stress service. Several studies are in progress to analyze the importance of grain size and spacing of hardening constituents on the "notch-sensitivity" of metals in fatigue.

Since machine members in service often encounter wide fluctuations in load (such as those illustrated in Figure 4b), studies are being conducted to measure the cumulative fatigue damage produced by several simple types of stress. Laboratory tests are in progress in which the amplitude of stress is changed at regular intervals. In Figure 8 some results of tests are shown in which 1000 cycles of a major stress S_M were alternated with 9000 cycles of a lower stress S_m. These phenomenological observations indicated many puzzling trends which require clarification by further study based upon the concepts of heterogeneous interactions. For example, it was found that the fatigue limit was not definitely a unique property of the steel; it may be altered by a previous stress history. Moreover, as Figure 8 indicates, an increase in the lower stress level from 60,000 to 78,000 psi resulted in decreased life, even though these lower stresses were below the "fatigue limit" of 87,000 psi, and normally would not be expected to cause damage. For extremely high values of the major stress, S_M, the total fatigue life was approximately that predicted by assuming failure to occur when the cumulative number of stress cycles of only this major stress reached the normal S-N curve. In general, the amount of damage caused by repeated stressing does not appear to be a simple linear function of the number of cycles of stress.

We hope that through statistical analyses of the heterogeneous interactions a theory may be evolved to evaluate quantitatively the principal factors affecting fatigue characteristics. Rational concepts of the mechanism of damage must be obtained and compared with results of phenomenological tests, if we are to evolve accurate design procedures for the engineer. The many recent developments in the physics of solids and mathematics of statistics should also contribute much to our knowledge of the behavior of polycrystalline metals under repeated loading. The cooperation of the physicist, metallurgist, mathematician and engineer are all needed for the solution of the important problem of fatigue in metals.

On The Naval Research Reserve

Civil Defense News

UNIT 4-8, CLEVELAND, OHIO

A real need for persons to train and educate the public in preparation for atomic attacks was revealed to members of this unit by conferences with the city's central Civil Defense Planners. Plans were immediately drafted to help in this essential work.

A panel of eight speakers is being organized to function as a unit in presenting information on the various phases of atom bomb attacks. Each speaker will prepare a ten-minute talk on one of the following topics: nuclear and physical aspects of the bomb; types of bomb attacks; blast and fire damage, radiological effects, communication and transportation problems. The technical background of each unit member will be utilized to the fullest extent in presenting the talks to various groups.

In addition to the speakers, a Visual Aids Group was established to supply any charts, graphs, or illustrations that the lecturers would require in presenting their ideas.

The speakers' team (and a team of alternates, to fill in if necessary) have already been chosen and practice sessions have been held. The local Civil Defense Board has been notified that the unit is ready for assignments.

UNIT 9-12, FT. COLLINS, COLO.

Speakers' teams have also been organized by this unit for the purpose of educating the public. Each team consists of two men. Three of the groups are assigned to lecture on defense against atomic and biological weapons, while the other two will give instructions on chemical warfare defense problems.

In addition, personnel of the unit have, from time to time, been consulted on organizational problems by officials of both the State and local civil defense groups. In fact, the unit has been designated by the Director of Civil Defense in Ft. Collins as an official advisory group to the local Public Health and Medical Divisions.

UNIT 9-16, LANSING, MICH.

The following members of the unit have been appointed as lecturers to aid in this city's program: LT Harold L. Taylor, who will speak on radiological effects and defense measures, LTJG Charles P. Pedrey, who will discuss psychological reactions to atomic attack; LCDR Ira B. Baccus, who will deal with physical destructive effects of atomic explosions; and Mr. Axel Anderson who will speak on biological warfare. The lecture program will be handled in cooperation with the Public Relations Committee of the Michigan Office of Civil Defense.

CO of Original VNRR Unit Made Captain

CAPT Frederick C. Wiesner

Mr. Frederick C. Wiesner, who has been a leader in the Research Reserve Program since its inception in 1948, and who headed the first unit ever established, has recently been promoted to the rank of Captain. This honor came to Mr. Wiesner as the culmination of a long record of valuable service to the Navy both in civilian and military posts.

CAPT Wiesner's career in the naval reserve dates back to 1929 when he was commissioned a lieutenant. This was the same year when he was naturalized a United States citizen. Mr. Wiesner originally came from Germany, where he graduated from the Naval Academy in 1914 and subsequently received an electrical engineering degree from the University of Charlottenberg. After serving in the German Navy, he came to the United States in 1922, and began a career with several industrial firms. His civilian work with the Navy was initiated in 1931, when he took a position with the Naval Inspection Service of the Bureau of Ships. During the war, at the request of the Navy, he remained on inactive duty so that he might act as Chief Electrical Engineer for the newly established Cramp Shipbuilding Company. In 1946 he went on duty as a Commander at the Engineering Experiment Station at Annapolis in the important job of heading the Captured Enemy Equipment Section.

CAPT Wiesner is now Batallion Commander in the Research Reserve Program. The units under his command are W-1, 2, 3, 4, and 5, all located in the Washington area. His present job in civilian life is directing the work of ONR's Power Branch.

Members of the Naval Research Reserve who attended SDC Seminar

Reservists Thoroughly Indoctrinated

in SDC Activities at Seminar

Fifty-two VNRR units scattered throughout the United States are now receiving first-hand information on the vital aspects of naval training from men who are "in the know" as the result of the first annual seminar held at the Special Devices Center last month. Officers who represented the various reserve groups at the Seminar were given a thorough indoctrination in the newest developments in this part of ONR's program--and they learned about everything from its philosophy and history to the actual practical use that is made of most of the gadgets devised by SDC. The seminar will be repeated annually to keep all Research Reserve units within the National Military Establishment up to date on naval training facilities.

As regular readers of the Reviews are aware, SDC is the agency of ONR which designs and constructs training aids and devices to teach Navy personnel the skills required for operating complex modern weapons (see May issue pp. 12-18). The equipment developed is distributed to training agencies of the Army, Navy and Air Force. As one of the essential links in the ONR set-up, SDC is a part of the national defense organization with which research reservists should be acquainted. That is why it was decided to send representatives to the seminar from as many of the various units as possible.

A number of distinguished speakers combined their talents to give the reservists a comprehensive picture of the government-supported research program in the United States and of SDC's part in it. The seminar began with a welcoming address and introduction to the center by CAPT P. J. Burr, Commanding Officer and Director of the installation. Later RADM Luis de Florez, USNR, who founded SDC and served as its first director, introduced the reserve officers to the history of synthetic devices. ONR was represented by RADM T. A. Solberg, Chief of Naval Research, who gave a brief review and history of the organization and by Dr. T. J. Killian, Science Director, who discussed the relationship between the OFFICE and the National Science Foundation. RADM R. S. Riggs, Assistant Chief of Naval Operations elucidated Naval Reserve plans.

The experts of the center took over the job of showing the reservists the different problems involved in their research and development work and the solutions found for these problems. One project that was of special interest to the officers was Project Cadillac, a human engineering undertaking still in the development stage. Its purpose is to device an airborne Combat Information Center that will use human abilities to the greatest extent possible to achieve maximum efficiency in this type of operation.

Activities of the reservists were by no means confined to the SDC, for several field trips were made to neighboring naval centers. One of

Plastic model of engine units of Fletcher type destroyer

the famed new hunter-killer submarines was made available for inspection at the U.S. Naval Underwater Sound Laboratory at New London, Conn. Other points of interest visited included the Naval Reserve Training Center at Freeport, L. I. and the United Nations Building in New York City.

International affairs were brought into the seminar on the closing day when Dr. Agar, acting director of the Special Service Division of the UN's Department of Information gave a talk on that organization. A first-hand view of the Korean war was offered by Mr. Hanson W. Baldwin, military editor of the New York Times and a graduate of the United States Naval Academy at Annapolis. Mr. Baldwin recently returned from the war-torn area.

At the close of the seminar many of the officers expressed their satisfaction with its results. It was felt that the variety and complexity of the problems involved in developing proper training devices had been clearly presented, so that representatives of the reserve units would be in a position to "spread the word" on naval training to members who were not able to attend the seminar.

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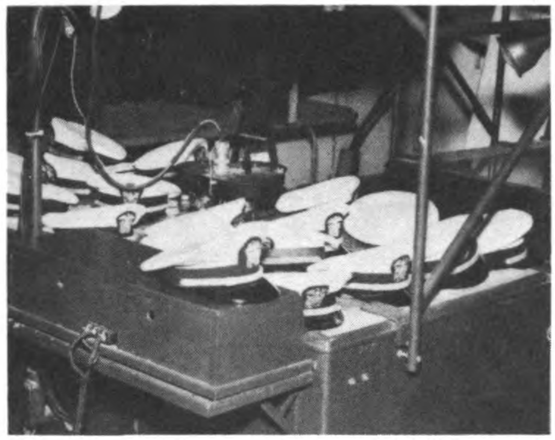
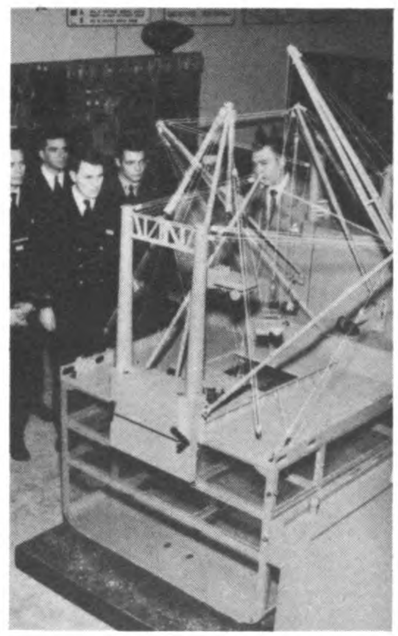
Seeing the Sights at SDC Seminar



Caps on Instrument Trainer show the reserves have landed

Gadget for demonstration of mechanical principles



Learning how the Navy loads ships

Equipment for ground training of flight engineers

Mockup of flight compass system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