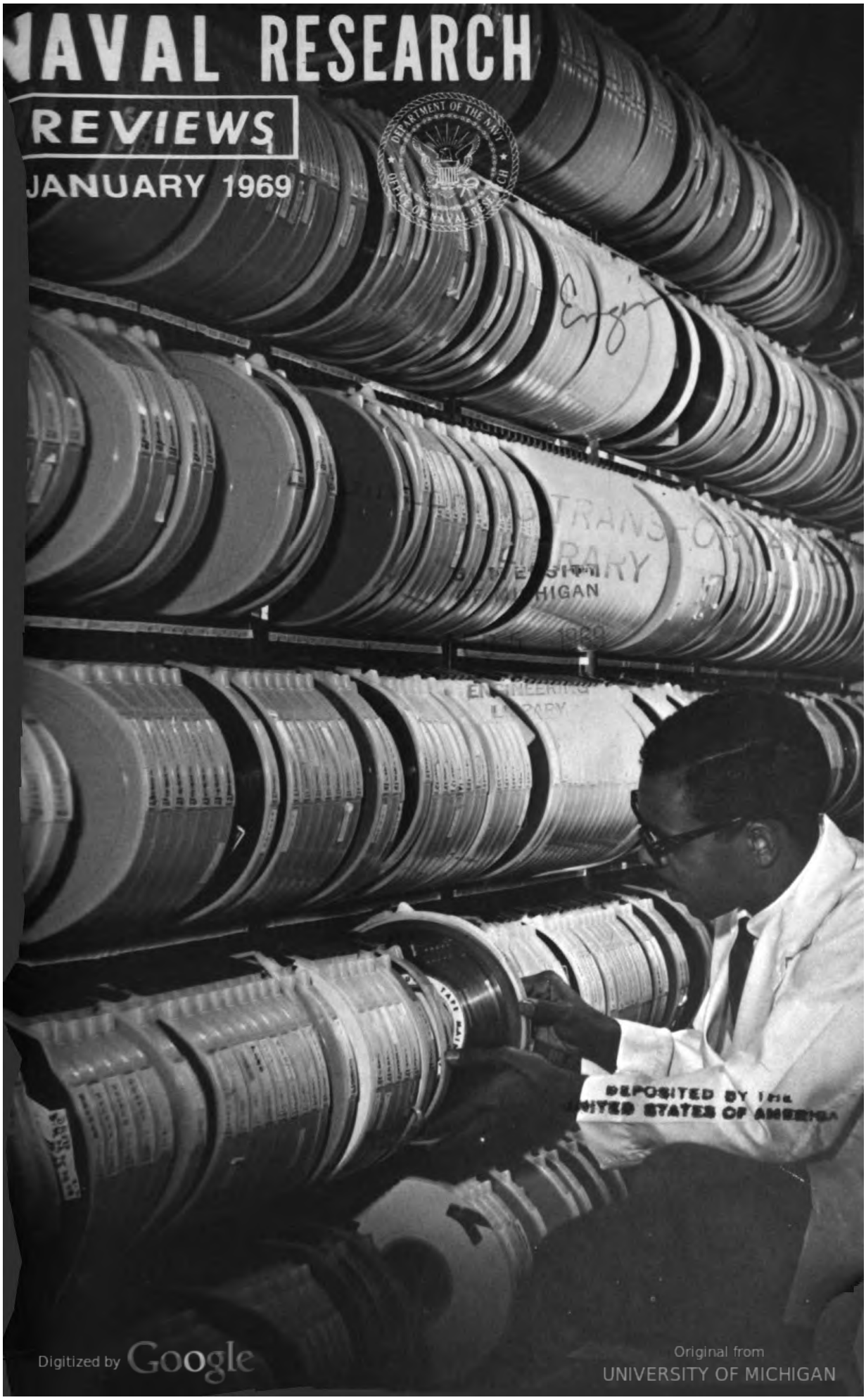
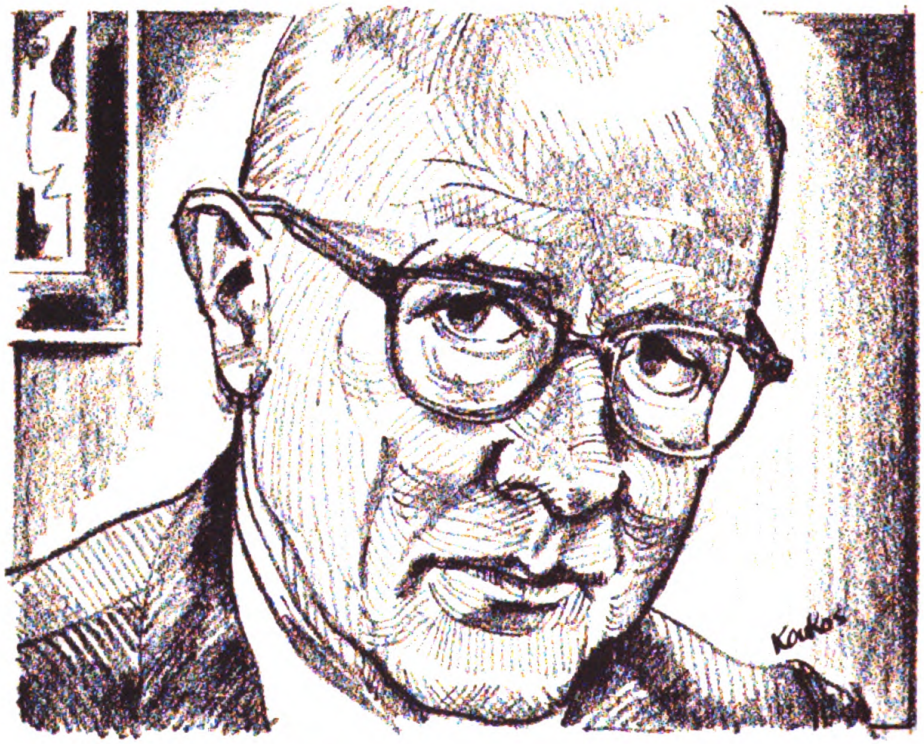


Portraits in Science



Dr. Frederick Seitz

AFTER RECEIVING A PH. D. FROM PRINCETON SEITZ WENT TO THE GENERAL ELECTRIC LABORATORY TO DO RESEARCH IN SOLID STATE PHYSICS, PARTICULARLY CRYSTAL LUMINESCENCE. IN 1940 SEITZ WROTE THE MODERN THEORY OF SOLIDS, WHICH BROUGHT THE KNOWLEDGE OF THE FIELD INTO A SINGLE MONOGRAPH, WHICH HAS LASTING INFLUENCE IN THE FIELD.

ONE OF SEITZ'S MOST IMPORTANT CONTRIBUTIONS DURING THE WAR WAS PRODUCING CHEMICALLY PURE SILICON FOR USE IN RADAR DIODES. SEITZ WAS THE FIRST TO INTERPRET THE ELECTRICAL CONDUCTIVITY OF THE VARIOUS GRADES OF SILICON IN TERMS OF INTRINSIC AND IMPURITY COMPONENTS. THESE STEPS MADE IT POSSIBLE TO PLACE THE USE OF BOTH SILICON AND GERMANIUM AS SEMICONDUCTORS ON A RELATIVELY SCIENTIFIC BASIS.

IN 1949 SEITZ WENT TO THE UNIVERSITY OF ILLINOIS WHERE HE ORGANIZED AN INTERNATIONALLY FAMOUS CENTER IN SOLID STATE PHYSICS, WHICH WAS IN PART SUPPORTED BY THE OFFICE OF NAVAL RESEARCH. SEITZ WAS A MEMBER OF THE NAVAL RESEARCH ADVISORY COMMITTEE AND ITS CHAIRMAN FROM 1960-62.

IN 1962 SEITZ WAS APPOINTED PRESIDENT OF THE NATIONAL ACADEMY OF SCIENCES. WHEN THE POST BECAME A FULL TIME JOB IN 1962, SEITZ TOOK THE POSITION FOR A SIX YEAR TERM. JANUARY 1, 1969, SEITZ WILL BECOME THE PRESIDENT OF ROCKEFELLER UNIVERSITY, NEW YORK CITY.

The Naval Biological Laboratory

Dr. Neylan A. Vedros
Naval Biological Laboratory
Oakland, California

In 1934 Professor Albert P. Krueger organized the Naval Reserve Laboratory Research Unit No. 1 on the campus of the University of California in Berkeley. Under the able direction of Dr. Krueger (later Captain, MC, USNR), the Research Unit studied infectious disease causative organisms of immediate interest to naval personnel. This was the beginning of the Naval Biological Laboratory (NBL).

By 1941 the Research Unit occupied several laboratories in the Life Sciences Building on the University campus; its mission was the development of a laboratory and field program for the evaluation of influenza vaccine. During these beginning years the Research Unit studied airborne infections; twenty publications attest to their studies from 1934 to 1941. (An excellent review of airborne infections was published by the Unit in *War Medicine,* V4, p.1-30, 1943.)

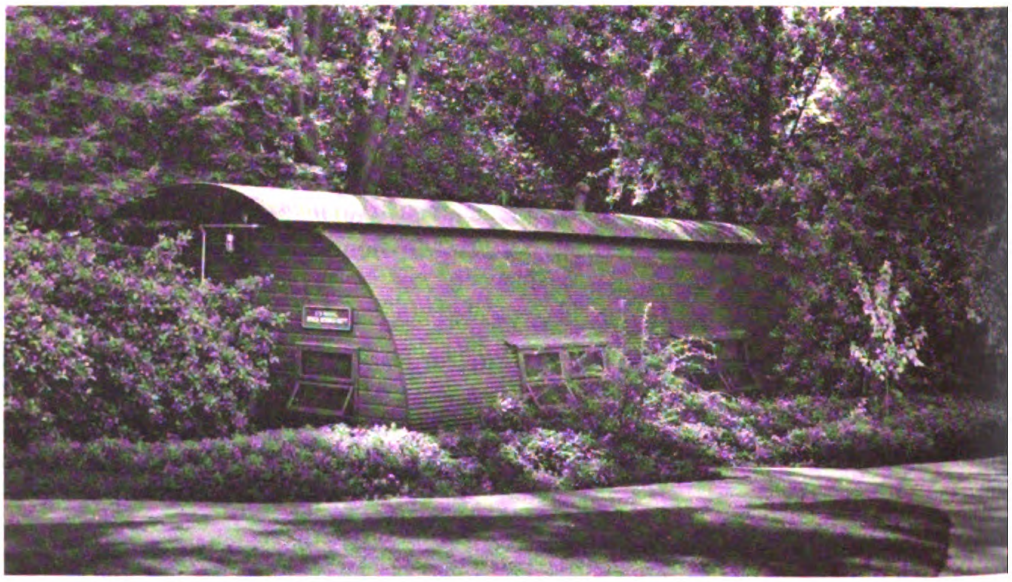
In 1944 the Research Unit was renamed Naval Medical Research Unit No. 1 (NAMRU#1). The organization and function of NAMRU#1 was the basis on which all other Naval Medical Research Units were later patterned.

In 1946 a contract between the newly established Office of Naval Research and the Department of Bacteriology, University of California,

Aerial view of the Naval Biological Laboratory at the Naval Supply Center, Oakland, California

Berkeley, provided for basic academic research and graduate instructic in the fields of airborne infections and medical microbiology. Most the instructors for the program were scientists who had been wit NAMRU#1.

During the post-war years increased student population made re search space at Berkeley scarce. A new site was needed in the Sa Francisco area to house the research laboratories and still be nea the Berkeley campus. In 1950 such a site was chosen at the Nav Supply Center in Oakland; the Naval Biological Laboratory (NBI was formally commissioned by the Secretary of the Navy's letter c 23 April 1950. The mission of NAMRU#1 was integrated with th research program of NBL. One building was retained on the Berkele campus, which now houses a portion of NBL's research on *Neisseri* Environmental Microbiology, and Virology.



NBL quonset hut, located on the Berkeley campus of the University of California

Today the main laboratory consists of eleven buildings where facili ties such as work hoods, isolation rooms, and ventilated cages permi work with highly infectious microbial organisms. Access to the labora tory is through a change room where street clothes are removed and special laboratory clothes are put on. There is a storeroom, glassware washing area, media preparation unit, photographic studio, and labora tory for physical chemistry and for work with saprophytic micro organisms.

The School of Public Health, University of California administers NBL under a contract with the Office of Naval Research. In 1952 the University established a Scientific Advisory Committee which reviews NBL's proposed programs after they have been reviewed by ONR

The Committee is appointed by the Chancellor and its members serve three to five years.

In 1954 the first full-time Scientific Director was appointed for the University of California—NBL—NAMRU#1 organization. The delineation of the responsibilities of the Scientific Director, Officer-in-Charge of NBL, and Commanding Officer of NAMRU#1 were redefined by written agreement between the sponsoring agencies and the University. This agreement has been revised and brought up to date (ONR Instruction 5450.5A of 29 April 1968).

In 1957 NBL was established as a laboratory in the University of California School of Public Health and two years later formal NBL research assistantships were offered to graduate students. Since 1957 NBL has directly supported 14 successful Ph. D. candidates, one Doctor of Public Health, two Masters of Public Health, and is currently supporting four Ph. D. candidates. An additional 14 military officers have acquired graduate degrees during their tour of duty at NBL-NAMRU#1. The research of the graduate students and of the faculty members who collaborate with NBL staff members is directly associated with the overall NBL research program for the Navy.

In 1961 the Scientific Director was appointed as Professor in the School of Public Health by the University. Succeeding Directors have continued to be faculty members of the University. NBL is now one of the University's major laboratories and a "national resource" for its expertise in the instrumentation and handling of highly infectious airborne disease organisms.

Understanding of the biological and physical behavior of airborne microbes is complex and requires not only basic studies on the microorganisms themselves but the subtle blending of sophisticated engineering and biophysics necessary to conduct these studies. In addition to research on the survival of airborne biological organisms, the investigator must be concerned with host-parasite relationships, immunity, and epidemiology.

It was a natural scientific evaluation that over the years, studies at NBL extended from the behavior of microbes in man's immediate environment to his travels beneath the sea (hyperbaric) and to outer space (hypobaric). During the past few years, research has also been conducted on the behavior of microbes in environments other than air, such as fresh and marine water, air pollutants, various gas mixtures, and defined organic vapors.

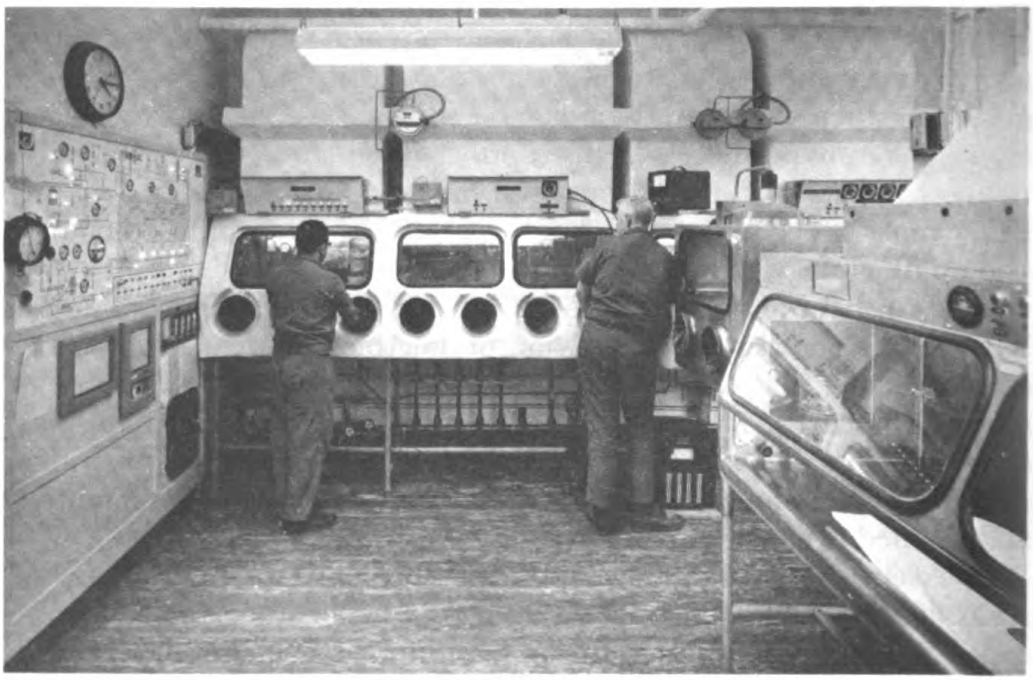
In essence, NBL has developed the capability to study almost all areas of microbiology as applied to man in his total maritime environment. Evidence of this fact can be seen in over 400 scientific publications and numerous technical reports and monographs.

The present research programs of NBL are encompassed in three broad areas: Aerobiology, Medical Microbiology, and Environmental Microbiology.

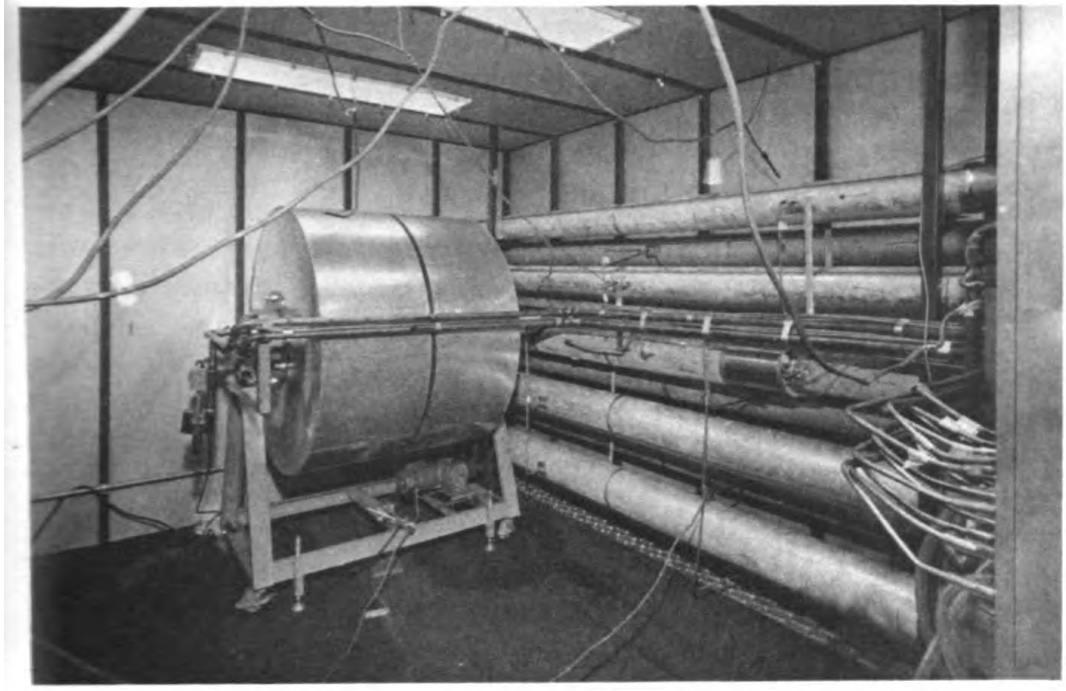
Aerobiology

Eight roller drums of 1500-liter capacity. Drums are located in rooms with controlled temperature, humidity, and air flow.

For nearly twenty years, NBL has had a continuing program on the development of instrumentation for the study of airborne particles. Originally settling tanks with forced air movement were used to observe the behavior of biological materials for short periods of time. In 1954 the rotating toroid drum was developed at NBL. This instrument, which has been adopted by aerobiology laboratories throughout the world, permits the study of airborne particles for periods of time up to a couple of weeks. In 1967 a completely automated series of eight 1500-liter toroid drums were constructed. This sophisticated second generation of basic aerobiological instrumentation permits the study of the most pathogenic microorganisms under conditions of adiabatic shifts in relative humidity and temperature. Present



Control panel and Class III work hoods for two of the eight drums in the previous figure. Following exposure, animals are air-washed and passed through a separate air lock to Class II work hood in lower right.



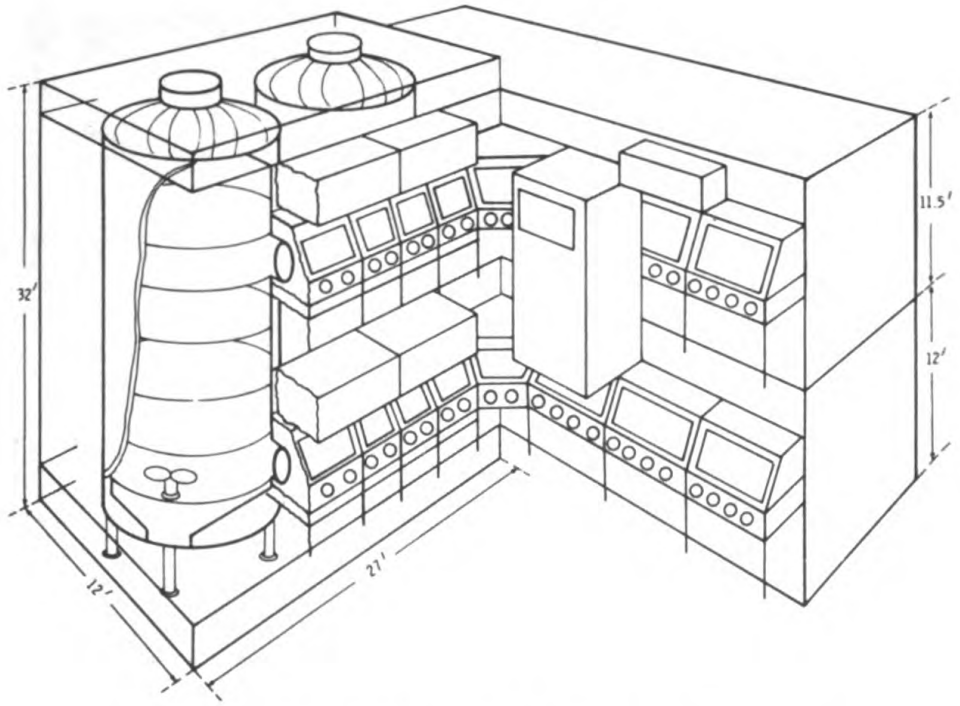
Two 500-liter roller drums and dual aerosol transport apparatus, housed in room with controlled temperature and humidity

studies are being conducted with such organisms as *Neisseria meningitidis, Mycoplasma, Adenovirus,* and hospital strains of *Staphylococci.*

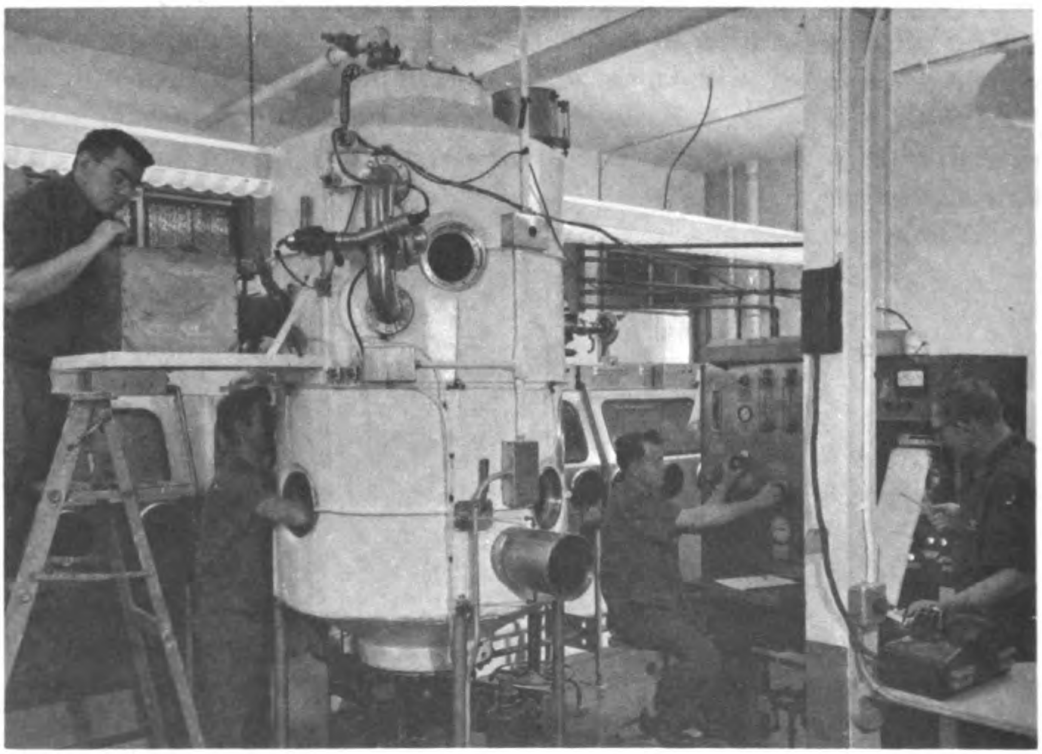
The third generation of basic aerobiological instrumentation, which is being developed, will consist of a programmed aerosol environment. It is anticipated that this system will permit the study of micro and macroparticles in dynamic environments which will simulate natural field conditions.

Other current studies are:

- Dual Aerosol Transport Apparatus (DATA)—an instrument used for the study of the effects of rapid shifts in relative humidity on biological behavior of various oral bacteria.
- Microaerofluorometer (MAFIA)—a sensitive instrument that detects fluoroescent particles as dilute as one in one liter. A fluorescent particle (Calcofluor) technique has been developed which is being used to follow the movement of air masses in hospitals, dental clinics, barracks, ships, and the outside environment.
- Studies with identical aerosol equipment in several countries are being conducted for standardization of techniques.
- Evaluation of continuous impingers developed at NBL.
- Studies on biological behavior and virulence of bacteria and viruses under hyperbaric (up to 18 atmospheres) and hypobaric (to seven psi) conditions.
- Studies on the effect of air pollutants and sunlight on the biological behavior of airborne bacteria.



Schematic drawing of proposed Aerosol Programmed Environment (APE)



Settling tank with automatic readout and transfer system of exposed animals. This system is used for study of the effect of air pollutants on infectious organisms and host response.

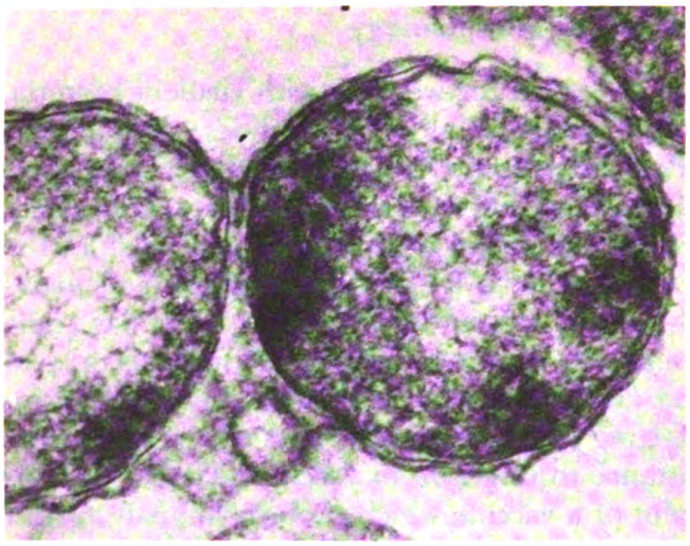
Medical Microbiology

Techniques have been developed for working with virulent bacteria, fungi and viruses. Using special containment facilities methods for growth and study of *Pasteurella pestis, Pseudomonas pseudomallei, Coccidioides immitis* and influenza virus have been devised to provide safety for personnel and yet enable significant work to be done. Much of the work includes exposure of animals to the infectious agents and maintenance of the infected animals for study. From this work has come procedures for determining the extent of infection of animals or man when living in an endemic area, elucidation of some factors which maintain virulence of the infecting organisms and factors which are important for developing resistance to infection in vaccinated animals. This has led to the development of a vaccine which protects animals against *Coccidioidomycosis* and which is being considered for study in the protection of man. Recently, interest has been developed in an expanded program with *Neisseria,* particularly with studies on the antigenicity and virulence of meningococci. Because of the current interest in the genetics of *N. meningitidis,* the Bureau of Medicine and Surgery of the Navy established a Neisseria Reference Laboratory at NBL in 1968. Besides carrying out studies of properties of recently isolated strains of *Neisseria,* this laboratory serves as a repository of new and historical cultures of these bacteria for use by scientists in this country and abroad.

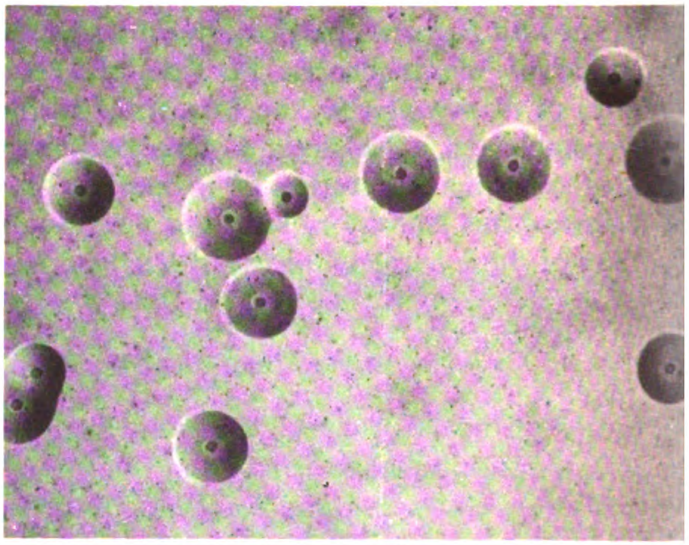
Environmental Microbiology

Studies of the persistence of microorganisms in atmospheres of different composition have led to the definition of survival patterns of a number of species under various conditions of relative humidity. These studies are continuing with the expectation that modifications of conventional air-conditioning equipment may provide means for altering or reducing the microbial content of certain atmospheres. In addition, studies are being conducted on the microbial profile of certain closed living quarters such as deep sea habitats, submarines, or special military housing units. The results of these studies are being correlated with instances of infections among occupants of the habitats and the general ecology of naval personnel in their maritime environment.

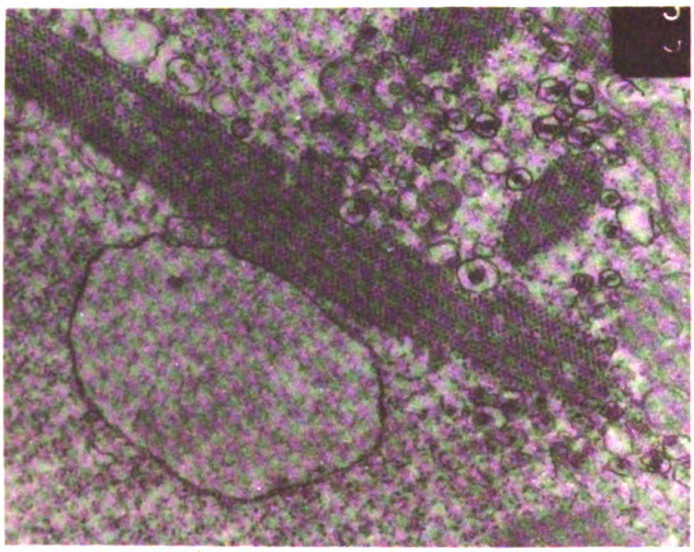
The Naval Biological Laboratory provides a sophisticated laboratory for investigating microbial and biological problems which are encountered by the Navy. The research being conducted is done in full cooperation with, and in many instances in collaboration with, qualified naval officers who are conversant with field activity surrounding the research. In many experiments, naval personnel and contract personnel work side-by-side on a research project. The laboratory



a. Thin section of the bacterium Neisseria meningitidi *(magnified 100,000X)*



b. Colonies of human strain of mycoplasma (magnified 80X)



c. Crystal formation of Vesicular Exanthema Virus in PK cell (approximately 35,000X magnification)

also provides consultation services by which personnel from other commands make visits of varying lengths of time, either to become familiar with some aspect of work in progress or to gain an insight into the general capabilities of the laboratories. In general, naval personnel have found that they can get a sound, scientific appraisal at NBL of a particular project or problem which is of immediate concern to the operational efficiency of man and material in naval environments.

Physiologic Studies During Chamber Saturation Dives

Relatively little is known about the environmental effects of living at depths greater than 300 feet at ambient pressures. Data have been obtained during only brief exposures and on only a few subjects. In order to gather more extensive information, the Deep Submergence Systems Project (DSSP) Technical Office Medical Department conducted a series of experimental chamber dives at the U.S. Navy Experimental Diving Unit (EDU) from February 1967 to May 1968. The psychophysiological research program during these dives was conducted by DSSP with the assistance of EDU, the Naval Medical Research Institute, Bethesda Naval Hospital, and the Naval Research Laboratory. Representing the most extensive effort yet undertaken to determine the effects on man living at very high pressures in a helium-oxygen environment, these divers were designed to measure the psychophysiological effects on a man's ability to work at great depths.

Saturation diving is a diving technique using the principle that, once the diver's tissues have gas saturation equivalent to the surrounding atmosphere at a given depth, he is considered to be "saturated" and can remain safely at that depth as long as necessary. For a diver at a specified depth, length of decompression (the time required to adapt the diver's body back to surface atmosphere) is the same whether he remains at depth for one day or one month. The capabilities which saturation diving provide will enable the Navy to undertake underwater salvage, construction, search survey, maintenance, and research tasks heretofore considered impossible for divers.

A preliminary report on fourteen saturation dives, ranging in depth from 200 to 825 feet, was based on 25,000 biomedical and psychological observations and measurements obtained in the course of these chamber dives.

Among the many routine studies were the hematocrit, hemoglobin, total white cell count, and the differential white cell count. No changes were found in any of these tests. No deviations were demonstrated in either the blood pressure or pulse rate other than those which might be expected to result from the limited degree of activity permitted by chamber confinement.

A study was undertaken to assess the cardiopulmonary functions of divers exercising while breathing helium-oxygen mixtures down to depths of 600 feet. Evidence indicates that man can perform strenuous work down to at least this depth without hypoventilation, significant carbon dioxide retention, or additional cardiovascular stress.

Although fluid intake decreased and urine output increased, urinalyses remained within normal limits throughout the saturation exposure.

Experiments were conducted to detect defects in visual function which might result from the high inert gas partial pressure. It was tentatively concluded that visual functions are not affected by helium-oxygen mixtures to depths of 825 feet.

Continued on Page 23

Naval Immunochemistry: Saving Me and Thee

Dr. Robert K. Jennings
Biochemistry Program Director
Office of Naval Research

"All the world is queer, save me and thee; and sometimes I think thee is a little queer."

We accept with some annoyance the naval practice of giving men who are being shipped to the far parts of the globe a dozen or more shots—for typhoid, cholera, plague, *etc.* The shots interfere with a man's effectiveness for a while, and there is some question as to whether so many shots given in a short time can be truly successful in producing immuity. Nevertheless, shots are worthwhile. No American serviceman died of lockjaw in the Philippines in World War II; however, many natives with wounds soiled with the same dirt succumbed. The Americans received their tetanus shots before arriving in the Philippines and were immune.

When a disfiguring wound has healed, the physician may strip skin from a less conspicuous part of the body and use it to replace scar tissue. The transplanted skin heals promptly into place and functions as healthy skin. If the skin had been taken from a similar location on someone else's body, such as a freshly amputated leg, it would not work. The body's power of self-recognition allows the vaccinated man to repel alien germ cells; we reject alien skin or organs as well, even when acceptance could mean survival.

If we were to place two bits of skin beneath the microscope, the best anatomists and chemists could not tell if they came from one man or from two. The two samples would be made of the same stuff; they would have the same structure; and they would be end products of the same kind of foods digested by identical gastric juices and rebuilt into flesh by identical chemical steps, whether done by one body or more than one. Isn't it just a little queer that there should be a difference between me and thee? And is it not queer that our bodies should know and respond to the difference?

Not all living things can make these distinctions. The ability, which is called immune competence, is characteristic of higher animals. It is first found in the evolutionary hierarchy at about the level of the hagfish. The biological rule that man in developing from conception to adulthood re-enacts a summary of the evolution of his species is good, if not relied upon too heavily. One might predict that man should be well developed in his individual growth before displaying immune competence since the species was pretty well along the evolutionary trail before this capability made its appearance.

The ability of mammals to distinguish between "self" and "other" appears about the time of birth. Not all substances can elicit an immune response in the adult at exactly the same time in the development of the individual; the time at which immune competence against a particular substance can first appear also varies from one species to another. But in every case, what is in the body when immune competence first appears is accepted by that individual as belonging there.

If tissue from animal X is implanted in animal Y before birth and Y, when grown, is given a bit of tissue or an organ from animal X, it will accept that tissue as a part of itself. In some laboratories there are white chickens wearing a patch of black feathers which are growing "upstream" with respect to the white ones. These birds have been made tolerant to the black donors at a very tender age. Later skin from the black chicken was turned around and transplanted. It grew normally and produced normal feathers; normal for the heredity which dictated the color and orientation of the feathers.

Chimeras

Composite animals of this sort, made from parts of several animals, are known as chimeras. A chimera may be a pretty queer beast, but it does not have to be. All that is needed for the chimeric state is for cells or tissues from one individual to take hold and grow, functioning as their own heridity dictates, in another. The most famous chimera at the moment is Dr. Blaiberg of South Africa, who survived heart transplant surgery.

If a surgeon knew that John Jones, who is to be born next week, would be in need of a new heart at some distant date, and if he knew that at that date, Joe Doakes, who was born last week, would be finished with his, the surgeon could implant a bit of Doakes tissue in the unborn Jones baby in preparation for the future heart transplant. When the time came, the Doakes heart would be just as much at home in the Jones body as it was in the body of Doakes. Such a plan calls for a good deal of foresight on the part of the physician; and unfortunately the art of soothsaying has lagged behind that of surgery.

A more practical approach would be to learn how immune competence works and how it can be turned on or off at will in the adult. The first step is to find out what "self" means in biochemical terms, and the second step is to find out what biochemical events occur when alien biological substances invade the body. Such matters are the business of the immunochemist. This article explains why the Office of Naval Research, which is devoted to the generation of new knowledge useful to the Navy, should be supporting immunochemical studies in a dozen universities across the country.

What is Naval Immunochemistry?

The meaning of immunochemistry should be self-evident; however, the nature of Naval Immunochemistry is not. The problems of a heart transplant patient may be shared by naval personnel, but they are problems which are also important to civilians. The possibility of organ transplantation emphasizes the potential value of basic information concerning the immune response, but it is not really a major consideration in the allocation of naval funds.

For the ONR Biochemistry Program research must be basic and must show promise of generating facts the Navy is going to need. Since basic research is an exercise in the exploration of the unknown, the term Naval Immunochemistry seems to be a contradiction; we cannot know what the explorer will find, so we can hardly guarantee that his search will turn up something more useful to sailors than to salesmen.

Immunochemistry can be naval when it is directed toward areas where the findings will be of use to the Navy. To do this one must first make a judgment as to where progress seems to be leading and then guess what the Navy will need in the future. The first is a matter of reviewing the state of the art and the second is speculation without scientific merit. Immunochemistry is concerned with what the body recognizes as alien and the chemistry which permits this recognition. It deals with the substances the body makes to repel alien parts, and the chemistry involved in their selective action on the alien substances.

In the middle of the last century, it was recognized that alien organisms, germs, when entering the body dead or alive caused the body to make a substance which acted against the germs. Later it was discovered that cells did not have to be disease agents, and that substances produced by cells, if made from large enough molecules, could have the same effect. Such materials were called antigens, generators of anti-substances. Because new properties appear when an antigen is introduced into animal blood, it was concluded that the blood must now contain some chemical body which reacted specifically with the antigen, hence "antibody."

In spite of technical difficulties, quite a few discoveries were made about antigens and antibodies and how they behave. Since antibodies were found to react with two molecules of antigen, they could be said to have two "specific reactive sites," both alike. Because antibodies reacted specifically with antigens, it was apparent that the reactive site must have some chemical relationship to some chemical aspect of the antigen molecules, which also had specific reactive sites, related to but different from those of the antibody. As many as fifty antibody molecules can attach to a single antigen, which can be thought of as a structure studded with identifying chemical groups on its surface. Small and easily purified molecules could not stimulate an immune response in animals.

However, if such simple molecules were hooked onto big protein molecules, antibodies would be formed which could react specifically with the small "prosthetic" substances.

When natural antigens and antibody react, the two "hands" of the antibody each grasp one of the many appropriate structures on an antigen molecule, generally fastening two such molecules together. Since other antibody molecules may grasp the same antigen, the result is that a great antigen and antibody lattice-work forms until it is no longer possible for the mass to remain in solution. A precipitate forms.

If the antibody is not mixed with antigen, but with the prosthetic substance, it still combines specifically as it was designed to do. In this situation only one antibody molecule can attach to one antigenic determinant group; the antibody is incapable of further reaction if it is mixed with a complete antigen later on. By studying what will inhibit the antigen-antibody reaction, it is possible to get some insight into the chemistry used by the white cells of the body, which manufacture antibody, to recognize the difference between "self" and "other than self."

There is a second line of immunochemistry research. If we inject chicken egg albumin into a rabbit, the rabbit will make antibody, all of which will be specifically precipitated if the serum is later mixed with a solution of chicken egg albumin in the right proportions. But if we mix that serum with turkey egg albumin instead of hen, only about 90 percent of the antibody will react; the rest will be left behind and can be precipitated if we now add chicken protein. If we first add duck albumin to the serum, perhaps only 30 percent of the antibody will react. Some of the serum which is left will react with either turkey or hen albumin, and some only with the hen protein. Studies of this sort can produce a diagram showing in quantitative fashion how closely related or how distant the several homologous antigens may be to each other. Such diagrams agree very well with the estimates taxonomists might make on the degree of relationship of the several species which produced the antigens involved. The molecules seem to reflect the evolution of the animal.

One way of looking at this process is that the egg albumin in an ancestral bird had certain natural prostetic groups. The mutation which produced the duck changed some of these prosthetic groups to a form which might be called "duckness." A later mutation leading to the turkey may have changed other facets of the molecule to produce the quality of "turkeyness," and still further changes added "chickenness." By injecting chicken egg albumin, the antibody factory is presented with determinants typical of turkey, duck, chicken and a host of other relatives we did not test for. Antibodies could be made for each. Testing with duck ovalbumin, we were offering no antigenic determinants specific for the more highly evolved birds, and so used only a part of

the antibody available. This is not the only or most acceptable hypothesis, but it cannot be set aside. The hypothesis produces a mental image of the skin cell as a body covered with proteins which may have some features typical of mammals, some typical of human beings and perhaps some peculiar to each of us as individuals. What we make in the way of protein is determined by heredity. Identical twins may have identical heredity, and be nearly indistinguishable antigenically. More distant relatives may be similar or identical if there are few factors to inherit. Based on the blood group substances, which are antigens in the red blood cells, there are only four main blood groups. The chemistry of these substances is well advanced, and it is possible to produce simple substances which serve as inhibitors for the antibodies involved.

An ideal approach to the problem of organ transplantation would be a scheme of tissue typing similar to the blood typing used to control blood transfusions without immunological disaster. Unfortunately, the present evidence suggests that there are perhaps as many as forty different determinants on the surface of tissue cells, serving as clues to identity. Because of so many variables, it is not likely that there will ever be a bank of viable skin from which could be drawn tissue indistinguishable antigenically from the skin of the man who needs it. Fortunately there may be only a few determinants which are highly potent in the sense of eliciting the formation of large amounts of antibody rapidly. Perhaps these can be typed and the rest ignored or somehow controlled. Immune competence can be eliminated entirely by destroying with radiation or poisons the cells which produce antibody. The animal so treated will not reject grafts nor will he reject disease germs. Not rejecting disease germs makes such an approach too risky. Perhaps a less drastic measure can control the weaker antigens and the more potent ones may be matched.

Immunochemistry in the Future

We know a good deal about antibodies, how they are formed and how they act. Also we know a little about the basis for biochemical individuality among antigens. We can make some things which serve as antigenic determinants, and in a few cases know pretty well what some natural determinants are. We can now distinguish several kinds of antibody and understand some of the details of their structure. However, we cannot isolate an antibody determinant group, account in precise chemical language for its reaction with the antigen, and synthesize similar structures. From future research new immunochemistry knowledge will emerge. How could it be useful to the Navy?

Antibodies are remarkably subtle analytical reagents. They can be used for forensic analyses such as determining if a blood stain is human

or not. Antibodies can identify rapidly and positively disease germs from infected fluids, drinking water, or air. They can also be used in organic analysis. During the first quarter of the century, a very few proteins in blood serum could be distinguished: albumin, globulins, and fibrinogen. Now, by making use of the selective capacity of antibodies, over two dozen distinct proteins in the same blood serum can be identified. Perhaps in the future we can reproduce artificially the same kind of selective combining arrangement of atoms, tailor-made to react with antigens of our choice.

If we could attach such an artificial determinant to a potent drug, which reacts only with kidney cells, the drug would attach only to the kidney when injected into the blood stream. In such an application the amount of the drug needed would be hundreds of times less than what we now use since we would not have to allow for the drug spreading over the entire body or being exposed to the various devices the body has for eliminating drugs. This could be important in the logistics of naval medicine, especially in dealing with epidemics in remote places or supplying drugs over long periods of time. Also the system could permit the use of drugs which are too poisonous to administer in large doses.

If an artificial determinant made specifically for sharks were attached to a poisonous material, manageable amounts of such a compound would quickly diffuse out into a cloud of molecules, probably too diluted to affect any forms of marine life except the shark. The material would accumulate specifically on the shark. Could such material be designed to build up to a lethal concentration on sharks approaching a life raft? Or could the principle be employed in dealing with barnacles or marine borers or other biological sources of mechanical difficulty in naval equipment? Could human saboteurs be denied access to anchored vessels?

There is also the question of the development of artificial antigens. Could we learn what the ancestral configuration is in whole classes of disease organisms, and then produce vaccines protecting us against many of them with one inoculation? Could we inject antibody inhibitors to protect skin grafts from the transplantation reaction, making skin grafting a much better shipboard therapy for burns?

Quite possibly the benefits from immunochemical research for the Navy will be different from anything suggested above. However, we can think of what might be expected from future immunochemical research and then conceive of naval uses for such knowledge. Some uses may be important to tomorrow's Navy in matters far removed from medicine; and some may prove vitally important for saving Me and Thee.

Electronic Computers in the Navy

Dr. A. Shostak
Office of Naval Research

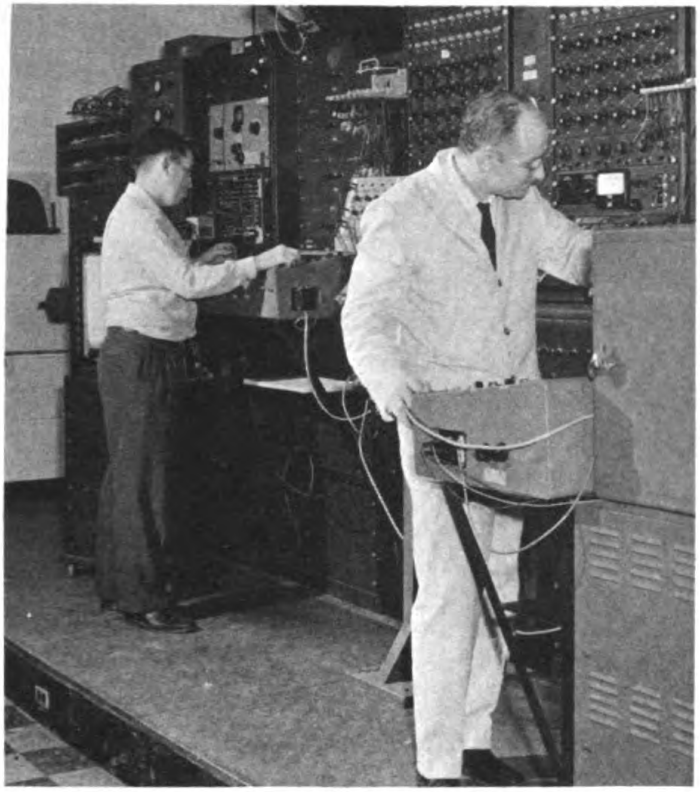
The U.S. Navy uses electronic computers in many operational, planning, design, and research activities. Because there is a constant stream of new applications, new high speed electronic computers, and computer methods, it is thought best to focus on the main uses, programs, and directions to appreciate the impact of computers in the Navy.

Computers have been used by the Navy longer than is generally realized. As long ago as 1944, officers of the Bureau of Ships were taking advantage of the automatically sequenced relay machine Mark I at Harvard to help solve some to the Bureau's material problems. In the late 1940's the Office of Naval Research and the Army Ordnance Command stimulated the computer field by encouraging research at Massachusetts Institute of Technology under project Whirlwind for developing advances in all electronic computers. This research included evolution of the magnetic core ferrite storage unit now widely used in most computers. The emphasis was in the direction of higher storage capability and higher access and arithmetic speeds. The Air Force's Lincoln Laboratories were able to exploit these Whirlwind features into studies in Command and Control methodology which were quickly assimilated in SAGE, Distant Early Warning, and other systems of the North American Air Defense Effort.

ONR made another important step to everyday military use of high speed computational aids by making a contract with the Control Systems Laboratory of the University of Illinois. About the time of the Korean War, Professor A. Nordsieck and colleagues at the Laboratory conceived the Cornfield System, a radar based, computer-controlled, air traffic surveillance and control system, which has had a major impact on the design of the Naval Tactical Data System (NTDS). The rapid advances in the computer field have been only possible as a result of research in related science and technology. Navy projects in solid state electronics, numerical analysis, physical and chemical properties of materials (such as rugged magnetic tape), and many investigations in logic, circuit analysis, coding theory, and machine languages furnished ideas and components which were swiftly incorporated into improved computer models.

The Navy's present and future plans for the high speed digital electronic computer may be categorized into several broad areas:

- Operational, such as in communications,
- Management such as in optimal allocation of available resources,
- Engineering design,



Early analog computer built at Naval Research Laboratory to map the paths of satellites

- Scientific research,
- Operations studies and analyses of the kind performed by the Center of Naval Analyses, Arlington, Virginia, a branch of OpNav concerned with fleet force strength, and planning and deployment decisions for the Navy and Marine Corps.

Other important applications will undoubtedly emerge as power and versatility of computers are recognized and increased. It will be useful to look briefly at each of these categories.

Operations

It is hardly necessary to point out that digital computers are used in a broad gamut of naval operational uses. These include surveillance, aboard ship and on shore, communications, missile fire control, gunfire control, cryptographic applications, sonar, and lofar signal analysis, combat operations center (COC), command and control data availability and presentation, ship navigation, ship and air repair.

A very high speed computing machine has been found necessary and useful in performing functions of sorting and tracking of a large number of air, surface and subsurface vehicles. The computer must also keep fleet and task unit commanders informed on position, relative threat, anticipated deployment and other characteristics of aircraft and ships, in a large area around these units. This system is the so-called Navy Tactical Data System (NTDS); the airborne version is called

ATDS; the Marine Corps version is MTDS. The heart of the NTDS is the AN/USQ-20, a high speed digital computer. This surveillance, control, threat evaluator, and presentation system has developed into a major weapon aboard many capital ships of the fleet, all within the last decade.

The Naval Electronics Laboratory Center, San Diego, California, has developed a ship communications distribution system which automatically examines headings of broadcast messages; the system is the General Address Reading Device (GARD). The system, which was installed ahead of the receiving tele-typewriters, provides for pre-selection of addresses and precedences of interest, and blocking the print-out of all unwanted messages. By using microelectronics logic circuits in its processor, the system can make simple decisions, such as printing the whole message, when the header is garbled. This machine, one of a variety of special purpose computers, has shown its value in security and in reducing the number of personnel required.

A similar system to GARD is the Message Processing and Distribution System (MPDS), which is installed in some Guided Missile Cruisers (CLG's). MPDS analyzes headings, recognizes duplicate messages, stores, retrieves, distributes, and makes a log of all messages. This again is a special computer-aided processing system which can store 5200 messages, and print out incoming or stored messages at the rate of 2400 words per minute, making six carbon copies at the same time.

In other schemes, sometimes using the NTDS computer on a shared-time basis, incoming transmissions are parity checked for accuracy and corrected when necessary. Repeat-back procedures are now more or less eliminated by automatic repetition of incoming messages, and the successful use of parity codes.

The Gunar, Mark 56, Mark 25, and Mark 63, as well as other famous gunfire control systems of World War II employed analogue computers and some still do; however, the trend is now toward digital machines, to control train, elevation, and other parameters of missile and gun use. In the case of the battle ship USS New Jersey the 16-inch guns aboard are controlled digitally. The Mark 86 light-weight gun mount, to be outfitted on many of the smaller ships, is also based on digital control.

Another important operational application is related to ship overhaul scheduling. Ship overhaul intervals are now decided in a rather arbitrary way based on experience. Depending upon ship type, a particular class of vessel is overhauled every 18 months or at some similar interval. Computer methods are being studied to solve this problem. Ship-scheduling is based on the physical shape of the ship, such as the condition of the boiler and auxiliaries. Then the computer decides whether the ship should come in for overhaul, and if so, to which shipyard it should be taken for quick and economic overhauling.

Upon arrival at the ship yard, a program of work to be done on the ship is set up. For instance if removal, overhaul, and replacement of pumps is to be performed, the procedure is first worked out and outlined by maintenance engineers. In the case of complex jobs such as nuclear submarines PERT is used as a scheduling tool. At Boston, Charleston, Philadelphia, and other yards, Univac-3 machines are already installed for this purpose. At one time an IBM 7090 located at Dahlgren, Virginia, was used for nuclear submarines. The Portsmouth, New Hampshire, yard makes a daily run of tapes for this purpose into the machine at Boston Navy Shipyard. Some limited use of computers has been made in new construction, scheduling and sequencing of shipping installation. However, in practice, new ship construction applications seem to be only somewhat marginally efficient.

Management

Because warfare and its research have become increasingly complex, it is necessary to rely on clever marshalling and application of resources to ensure superiority. From these resources comes the electronic computer, which has become vital in Navy management operations where it is used in a multitude of ways some of which shall be mentioned.

In Inventory Management, allowance lists are calculated and monitored; the provisioning process is expedited; load lists—yielding sequence, amounts and other data on each item are formulated; requisition control is effected; and material readiness is assessed. A good example of such a system is the Maintenance and Material Management System (3-M), in the Office of Naval Material. 3-M is essentially an information retrieval mechanism, which provides up-to-date, abbreviated information on maintainance matters, such as repair routines and special tools required for maintaining equipment at sea and on shore. The IBM machines 1410, 7080, and 360 at Naval Supply Depot, Mechanicsburg, Pennsylvania, are used in the various sub-systems of this program. From top management's point of view, 3-M facilitates the finding of good and bad equipment for procurement purposes or ascertains its state of readiness. In many naval stations comptrollers are using computers to assist in reporting progress, delays, and expected availability of the numerous projects of their commands.

Management applications also involve personnel requirements, use, location, and assignment. For instance, an algorithm has been created to assign medical doctors of varying backgrounds and experience to the naval hospitals which can best use their talents. The U.S. Marine Corps actually employs computers to assign recruits from basic training camps to their next duty. This has proved effective in the Corps. Bureau of Naval Personnel Project Compass is studying ways of doing something similar with the larger, more difficult problem of matching naval ratings to billets in which the men will serve most productively.

Navy Automated Research and Development Information System (NARDIS) which is under the direction of the Office of Naval Research is another Navy management function aided by computers. This program implements and keeps up-to-date data on all research and development sponsored by the Navy department, quickly delivering scientific, engineering, and administrative information in that field. Other studies at the Naval Weapons Laboratory evaluate computers and automatic data processors to determine what computers to buy for the required job.

Training Personnel

Naval personnel receive training several times in their careers. Computer Aided Instruction (CAI) has replaced the earlier method of Programmed Instruction, which presented textbook material to students then asked questions which could be answered yes or no, or true or false by individual students. For CAI each student uses a typewriter to maintain real-time contact with a computer. The machine provides textbook type information and asks questions which are then answered by the student or instructor. The U.S. Naval Academy is using the CAI method for instructing midshipmen in foreign languages, engineering, and mathematics courses. Television, cathode ray tubes, and other presentation modes act to complement this powerful method of teaching Navy men.

Activities concerned with education of sizable numbers of naval personnel, such as the Naval Air Technical Training Command, Memphis, and the Naval Training Research Laboratory, San Diego, are experimenting with CAI, usually collaborating with a university in formulating teaching methodology.

Training Devices

By far the largest use of digital computer machinery for training personnel is the 80 major trainers developed by the Navy Training Device Center, Orlando, Florida, for flight simulation, attack, and anti-submarine warfare training and other applications concerned with strategy and tactics. Naval stations at New London, Pearl Harbor, Key West, Charleston and other centers of intensified personnel training are equipped with those trainers. A SIGMA 7 machine at the Training Device Center is used in a human factors experiment in which the efficiency of training operators is conducted. Efficiency is measured by contrasting operator knowledge after operational flight training with that demonstrated in actual aircraft flying. All new Operation Flight Trainers such as those replacing the LINK trainers of World War II are now coupled with commercial, general-purpose computers which

have proved more flexible and valuable as training tools than their predecessors.

Engineering Design

It is important to the Navy to design effective ships which can be built in compliance with specifications which insure operational advantage over the enemy. The Naval Ship Engineering Center has evolved a computer-aided ship design and construction procedure (CASDEC), which aids in the requirement definition and conceptual design of new ships, and then generates several models of a ship such as a rubber ship. This is done by introducing the desired parameters of the modeled vessel (cruising range, speed, horsepower, *etc.*), general characteristics, and hull form. Flotation and other characteristics are developed. In the course of this programming, PERT-CPM is employed in such a manner that after the hull has been represented in digital terminology, the details of outfitting the new ships, such as sequence of electrical wiring and installation of piping, are determined and detailed on magnetic tapes, punch cards, or in other storage media.

Scientific Research

In solving scientific problems the Navy uses many digital, hybrid, and sophisticated analogue computers and simulators. Solutions of the partial differential equations in subjects like hydrodynamics, electromagnetic theory, material fatigue, and fracture problems are sought usually by difference equations methods. When bubble, spark, and emulsion chamber data of nuclear physics are examined, electric circuit analysis is performed with schemes such as Electronic Circuit Analysis Program (ECAP). Particle tracks are scrutinized for energy and reaction products. Acoustic signature adaptive processing studies are underway where pulses of transient repetitive signals are compared with previously stored pulses. If the comparison shows a strong similarity with previous pulses, the signal is automatically intensified and closely monitored.

The Nautical Almanac Section of the Naval Observatory, working with the Division of Naval Science of the U.S. Naval Oceanographic Office, uses an IBM 360 to prepare *Tables of Computed Altitude and Azimuth* (solutions of the spherical triangle to be used by navigators). The Observatory prepares *Sight Reduction Tables for Air Navigation* (H.O.249) as well as many other special computations and is cooperating on a new *Space Almanac*.

At the Naval Research Laboratory, a CDC 3800 machine does crystallographic structure analysis, antenna radiation pattern calculations, satellite trajectories, wave analyses, and telemetry data reduction.

General purpose scientific digital computer used for scientific computations at Naval Research Laboratory

The scientist in the laboratory depends on the computer for studying the effectiveness of explosives, combustion kinetics, and nuclear effects.

In universities and industrial laboratories supported by the Navy, it is difficult to find a major scientific program without a back-up computer facility which is either locally available or time-shared by remote control. Linear and dynamic programming, pattern recognition, and fast-Fourier integral solutions find wide application.

Operations Analyses and Studies

A large investigation program, using high-speed computing equipment, is analyzing naval operations, strategies, tactics, and warfare systems in their conceptual form. These studies enable SecNav, CNO, CNM, and others to make the best use of equipment and personnel. Much of this work for the Navy, Marine Corps, and the Joint Chiefs of Staff is done by the Center of Naval Analyses and by contractors such as the Naval Warfare Research group. Computer-aided studies in anti-submarine warfare tactics and requirement, in naval laboratory R&D planning, in air and amphibious warfare, in exploitation of sea resources, in logistics of turn-about operations of loading and off-loading, and in broader war gaming of strikes and target-kill probabilities have been or are being pursued. Fighter-to-fighter engagements,

using any of the weapons of modern naval warfare, such as missiles, are simulated to help ensure U.S. Navy superiority. Office of Naval Research programs are implemented by a General Electric computer, which is located in Washington, D.C. and serviced from the Main Navy Building by tele-typewriter using time-shared Fortran.

The Office of Naval Research now supports study tasks in the use of computers in automated shipboard steering and maneuvering, improved presentation devices, generation of efficient algorithms, inexpensive interfaces, linguistics, improved components, cybernetics, management, and intelligence.

National Research Council-Bureau of Medicine and Surgery Postdoctoral Research Associateship Program

The Navy Bureau of Medicine and Surgery, in association with the National Research Council, is offering postdoctoral research associateships at four of its research activities. Professors at universities, editors of scientific publications, and heads of scientific research organizations recently received a 23-page brochure describing the program, whose purpose it to encourage postdoctoral research in scientific areas. Opportunities of research within BuMed include such fields as aerospace medicine, behavioral sciences, biochemistry, bioengineering, biophysics, dentistry, environmental stress, experimental medicine and surgery, microbiology, parasitology, pharmacology, radiation biology, and tissue preservation.

Last year the only research activity involved in this program was the Naval Medical Research Institute, Bethesda, Md.; this year it is being expanded to include three more activites: Aerospace Medical Research Department, Johnsville, Pa.; Naval Aerospace Medical Institute, Pensacola, Fla.; and the Navy Medical Neuropsychiatric Research Unit, San Diego, California.

Applicants should have attained the equivalent of the M.D. or Ph.D. degree before entering upon the associateship. Awards will be made in the spring of 1969 for the one-year tenure which begins sometime after 1 July 1969. Selected by the National Research Council, Associates are given a stipend of $12,174. Requests for application forms should be addressed to the Office of Scientific Personnel, Room 604C, National Research Council, 2101 Constitution Avenue, N.W., Washington, D.C. 20418. Completed applications must be received in that office by 15 February 1969.

Continued from Page 9

To assess and quantify the ability of man to accomplish cognitive and perceptual motor functions in extreme hyperbaric environment, divers were examined in a variety of performance tests. In a memory study, it was found that the short-term memory (five minutes) remains about the same underwater as on the surface, but the long-term memory (one hour) deteriorates at great depths. It is possible that this change is related to stress or motivational factors, but it is more likely due to some physiological effect of high pressure or the helium-oxygen breathing mixture. In all areas there is a very gradual decrease in efficiency of performance with depth; however, the fine motor dexterity showed the least impairment. Indications are that man can work effectively at depths of 1000 feet.

Brightness of the Big Bang

Far infrared measurements made from a rocket more than one hundred miles above the earth indicate that the night sky is far brighter than predicted by radio observations. The combination of these results may have a strong bearing on current views of the origin of the Universe.

Proponents of the "big bang" theory (the idea that the Universe began as an extremely dense ball of matter, exploded, and expanded to its present size) had predicted the relative brightness of the universe at infrared and radio wavelengths.

The single rocket observation does not directly contradict these predictions, but it does indicate the presence of unexpected energy sources. These sources might be atmospheric, interplanetary, galactic, or external to the Galaxy. The measurements were made at wavelengths a thousand times longer than visible light but still far shorter than the wavelengths used by radio astronomers.

The work is reported in "Physical Review Letters," a publication of The American Physical Society, by Dr. Kandiah Shivanandan of the Naval Research Laboratory, Washington, D.C., and Drs. James R. Houck and Martin O. Harwit of the Cornell-Sydney University Astronomy Center in Ithaca, New York.*

The big bang theory predicts that the universe should be bathed in the residual radiation of the original explosion. During the past three years, astrophysicists have been measuring a background radiation, and these measurements have been interpreted by many as experimental verification of the theory.

Until now it has been possible to measure only the longer wavelength radiation that passes through our atmosphere. At these wavelengths, the strength of the emission predicted from the big bang fits well with the radio observations. However, measurements in the infrared are required to obtain strong confirmation of the shape of the predicted spectrum.

To measure the radiation at these wavelengths where the strength of the radiation from the big bang is expected to drop off sharply, it was necessary to send instruments above the earth's atmosphere.

In the present experiment, the astrophysicists sent up a rocket containing sensitive detectors that were cooled by liquid helium. One of the detectors measured radiation intensity that was about a hundred times stronger than that expected on the basis of previous radio observations.

Because there was only one measurement, less than four minutes of observing time, and the work is a pioneering effort in rocket measurements at these wavelengths, the result cannot be accepted as contradicting the big bang. However, there is considerable confidence in the work.

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*Kandiah Shivanandan, James R. Houck, and Martin O. Harwit, "Preliminary Observations of the Far Infrared Night Sky Background Radiation," *Physical Review Letters*. Vol. 21, No. 16 (11 November 1968).

and until it is either confirmed or disproved by subsequent experiments, its implications will remain tentative.

The rocket payload was constructed at Cornell Universtiy under a grant from the National Aeronautic and Space Administration. It represents a continuation of previous work, started five years earlier, when Professor Martin O. Harwit became the first National Science Foundation-Supported E. O. Hulburt Fellow at the U.S. Naval Research Laboratory. Under this appointment he initiated the use of low temperature telescopes. The Naval Research Laboratory and Cornell University are the first groups to attempt low temperature rocket observations of this type.

BACKGROUND

In the late 1920's, Edwin Hubble demonstrated conclusively that there is a direct relationship between the distance of astronomical objects and the amount of red shift they display. Since red shift is the lengthening of the wavelength of radiation emitted by an object moving away from an observer, Hubble's relationship implies that distant objects are receding faster than nearby ones. This implication is now generally taken to mean that the universe is uniformly expanding.

Hubble's work and its interpretation form the basis of three competing cosmologies that are in current favor. In the steady state theory, the universe is expanding and matter is continually being created to keep the density constant. The big bang theory assumes that the universe started from a point mass, exploded, and has expanded to its present size since the explosion. The pulsating universe theory postulates that our present expanding state will be followed by a period of contraction.

The three theories have not been readily amenable to experimental test. Even the creation of matter, which is postulated in the steady state theory, is not a phenomenon that can be measured with present techniques.

However, when the big bang theory was developed in 1948, George Gamow and others calculated that the radiation from the original explosion should still be present throughout the universe in the form of radiation being emitted from a blackbody (perfect) radiator at a temperature of a few degrees above absolute zero. This radiation could be recognized because a plot of the intensity against the wavelength of a blackbody radiator gives a characteristic curve.

In 1964 Dr. Robert Dicke and his colleagues at Princeton University began setting up instruments in an effort to detect the background radiation. The next year they heard that Drs. Arno Penzias and Robert Wilson of Bell Telephone Laboratories had picked up, in their efforts to improve an antenna that had been used to track a Telstar satellite, a signal at a wavelength of 7.5 centimeters.

The scientists got together and concluded that the signal was part of a general background radiation surrounding them. The Princeton group suggested that it was blackbody radiation from the primeval fireball. Since the original discovery, the radiation has been measured at about six other wavelengths. All of the values have fit on the theoretical curve for the radiation from a blackbody radiator at a temperature of 2.7° centigrade above absolute zero.

A number of astrophysicists have proposed other mechanisms to explain the background radiation. These require that extragalactic radio sources emit more strongly than is generally thought to be the case.

The radiation predicted by these mechanisms is the same as that from the big bang theory at long wavelengths, but at wavelengths around 0.1 centimeter the intensity of radiation from a 2.7° blackbody radiator drops off rapidly.

This short wavelength radiation is strongly absorbed by the atmosphere, so it was necessary for the physicists from the Naval Research Laboratory and the Cornell-Sydney University Astronomy Center to get their detectors into a rocket package. The instruments were launched by Aerobee rocket last February.

The "Physical Review Letters" article reports on only one of the four detectors—the one capable of measuring the intensity of radiation with wavelengths 0.04 to 0.13 centimeters. The results show an intensity that is about 100 times stronger than that expected from a blackbody radiator at 2.7°. Stated differently, the intensity of the radiation at these wavelengths corresponds to a background temperature of about 8°.

The results will be challenged on two grounds. First, they do not support the relatively simple and very appealing big bang explanation of the background radiation. Second, they are in direct conflict with other measurements at the same wavelengths.

Direct measurements of the background radiation have been made down to a wavelength of 0.33 centimeters. However, there is an indirect method of measuring the radiation that involves observing certain energy states in interstellar substances.

Dr. Patrick Thaddeus, who holds appointments with the Institute for Space Studies in New York City and Columbia University, and two of his students, Victor Bortolot and John Clauser, have reported measurements at 0.26, 0.13, 0.056, and 0.036 centimeter wavelengths. The intensity at 0.26 centimeters fits well on the 2.7° curve. The other wavelengths give upper limits of the temperature that are lower than the 8° figure reported in "Physical Review Letters."

Obviously, more measurements will have to be made before the conflicting results can be understood. However, the necessary experiments are near the limit of our present technological capability, so it will probably be several years before the problem is resolved.

On the Naval Research Reserve

Reserve Assistants Meet in Washington

CAPT H. E. Van Ness, USN, Deputy and Assistant Chief of Naval Research, opened the annual conference of Reserve Assistants for the Research Reserve Program at the Office of Naval Research, Washington, D.C., on September 8, 1968. Because CDR R. W. Keniston, USNR, Special Assistant to the Chief of Naval Research was hospitalized, Miss E. F. Kehoe, CDR, USNR, and Training Officer for the Research Reserve, chaired the conference.

Recruiting, active duty for training, administrative pay billets, status and evaluation of Research Reserve Companies, visits and inspections to companies, and long range goals for Fiscal Year 1969 were discussed.

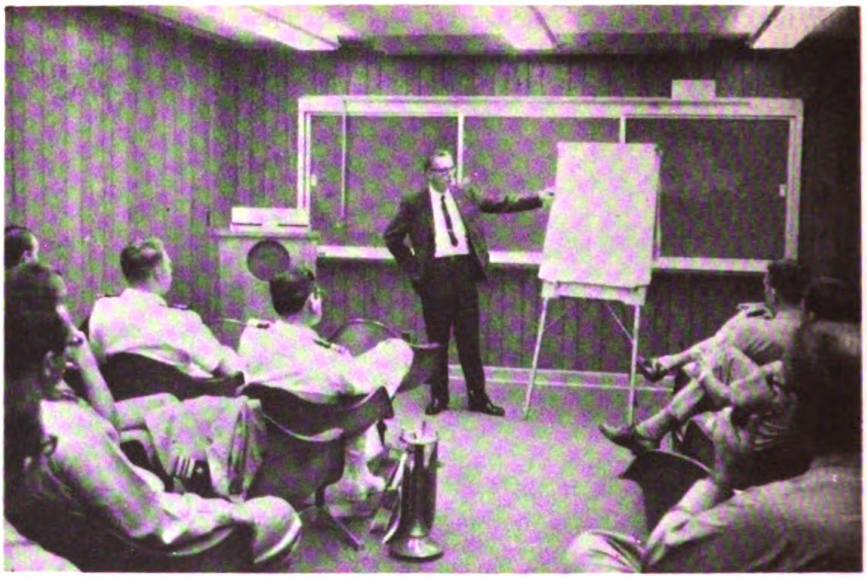
CAPT H. E. VAN NESS, USN, Deputy and Assistant Chief of Naval Research, right, addresses Research Reserve Assistants' Conference, Washington, D.C., 8-9 October 1968. Attendees were as follows: (left to right) CDR J. P. Johnson, USNR, ONR Pasadena; Miss Eleanor F. Kehoe (CDR, USNR), Training Officer and Fifth and Sixth Naval District Research Reserve Liaison Officer; CDR J. W. Tilford, USNR, ONR Chicago; CAPT C. H. Butt, Director of Administration, ONR Washington; LCDR G. R. Hoyman, USNR, Representative, Third Naval District; and CDR D. M. Aulick, ONR Boston.

NRRC 5-2 Program

NRRC 5-2, Blacksburg, Virginia, meets on the last three Mondays of each month at 2000 in 310 Hutcheson Hall on the campus of Virginia Polytechnic Institute at Blacksburg, Virginia. Most of the members come from the faculty of Virginia Polytechnic; several officers are from the Roanoke area.

The program for this year emphasizes anti-submarine warfare Speakers will include CDR Card (Commanding Officer of the Nava Reserve Training Center at Alexandria, Virginia), LCDR William C Melvin, Jr. (Aviation Recruiting Officer of NARTU Norfolk), and Mr. D. C. Montgomery (the first Ph. D. graduate of Virginia Polytechni in Industrial Engineering). CDR Card will speak on the submarine threat; LCDR Melvin will speak on Naval Aviation in ASW; and Mr Montgomery will talk about the military applications of graph theory In addition the unit will host Ambassador Maurice Taylor. Ambassador Taylor, who is one of the senior members of the State Department has had posts in many countries and is widely regarded as an exper in the field of foreign affairs. He will speak on national security.

NRRC 5-12 Conducts Briefing



LCDR Roy Shank, USNR, of Dahlgren's Research Reserve Company 5-12 discusses plans to improve Navy Gun Systems with members of the Naval Reserve Ordnance Division, Washington, D.C., who were visiting the Naval Weapons Laboratory (NWL). They were also briefed on NWL's mission and some of the current programs. The Company, which is largely composed of NWL employees, has conducted several briefings for visiting Reserve groups during the past several years.

NRRC 5-9 Presents Vietnam Report

The Third Quarter Program Committee of NRRC 5-9 located at the Naval Research Laboratory (NRL), Washington, D.C., presented a lecture series entitled "Vietnam Report."

The speakers selected subjects which gave a diversified and broad picture of the Vietnam war. A NRL electronics engineer, returning

rom a five month assignment in Vietnam as a Laboratories Representa-ve discussed "Some Scientific and Technical Needs of Our Military orces in Vietnam." A civil engineer with the Agency for International levelopment (AID) spoke on "The AID in Vietnam." A professor of overnment and Politics at the University of Maryland presented Political Aspects of the Vietnam Conflict." A Navy Captain, who just eturned from Vietnam, gave "Riverine Warfare in South Vietnam." n Air Force Colonel, who was a National Security Seminar team ember, spoke on "Developments in Communist China Relating to ietnam." The final presentation was given by MAJ William E. Day, SAF. MAJ Day completed 163 combat missions and over 500 hours of ombat flying time with the 602nd Fighter Squadron. He spoke on The Role of the Air Force Pilot in Vietnam."

Members of the Unit as well as many guests from NRL and other overnment activities made attendance very high. LCDR Herschel L. mith commands NRRC 5-9; CDR Arthur O. Parks was the Third Quarter Program Officer. NRRC 5-9 meets at the Naval Research aboratory on the first and third Friday of each month at 1630.

Astronomy Program at NRRC 11-7

NRRC 11-7, Tucson, recently met at the Kitt Peak National Observa-ory. There was a tour of the Tucson offices, laboratories, and shops, ollowed by a trip to the observing site at Kitt Peak. Later sessions by Kitt Peak personnel will cover "Latest Developments in the Technology f Large Optics" and "Labor Negotiations in a Research Facility."

At the Tucson Headquarters the unit toured instrument, electronics nd machine shops, engineering departments, mirror finishing and esting facilities, the library, and the CDC high speed digital com-uter. Following the tour the group met in the conference room to liscuss the 150-inch telescope being constructed for the mountain site nd the possibility of a later telescope several times larger. Films and ecent photographs of Kitt Peak's Southern Hemisphere observing site t Cerro Tololo, Chile, completed the presentation.

On a mountain, 53 miles Southwest of Tucson, the Company and sev-ral prospective members first viewed a 36-inch remote controlled elescope. Stellar telescopes, ranging in size from 16 inches to 84 inches, ere then examined, and the progress of construction of an additional 6-inch version was inspected. The trip through the 500-foot McMath olar Telescope highlighted the visit; the unit visited the 80-inch eliostat on top, traveled down the diagonal path formed by the water ooled windshield and interviewed an astronomer taking spectrographic neasurements in the observing room.

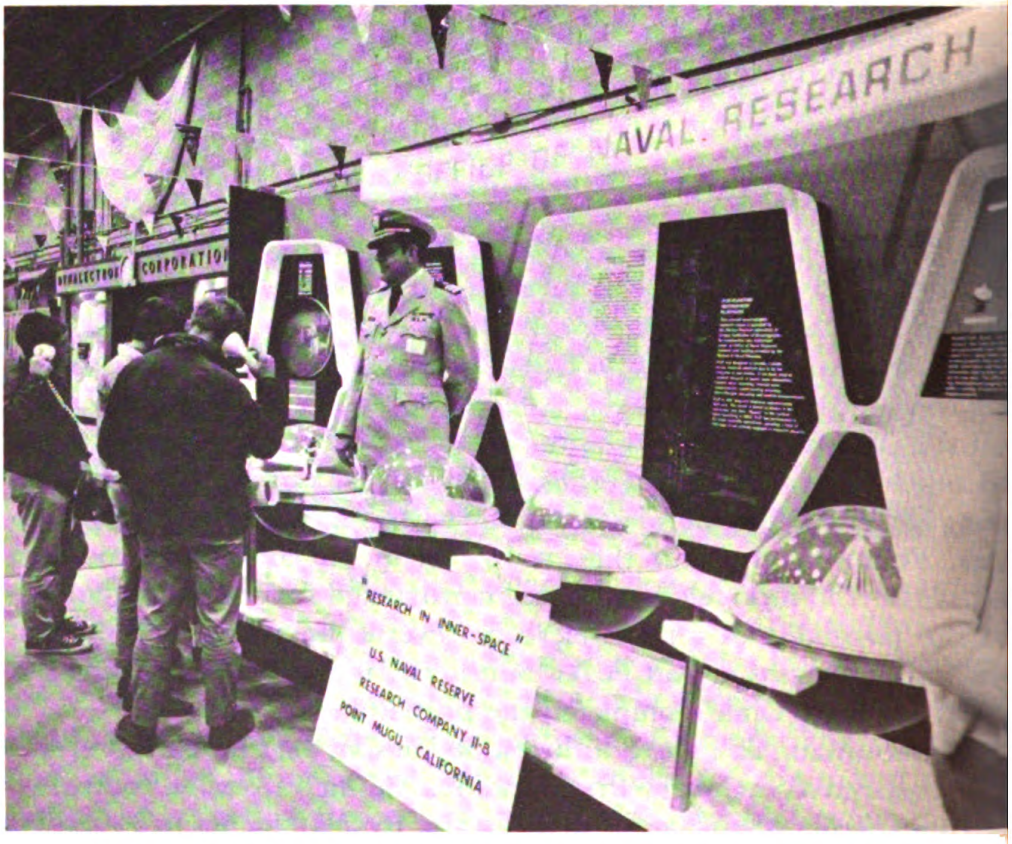
Astronomical topics have been popular with the unit during the last everal years because the excellent seeing conditions of Arizona have

brought many telescopes into the state. LCDR Miller, who was respons ble for the program, was a member and former Commanding Office of NRRC 11-7.

NRRC 11-8 Sponsors Booth at Space Fair

Members of NRRC 11-8, Point Mugu sponsored an exhibit booth a the 1968 Space Fair. The main exhibit was an oceanography displa which featured small scale models of Sea Lab, Hardiman, AGOR-1 Catamaran Research Ship, FLIP, Monster Bouy, and Alvin.

Last year NRRC 11-8's exhibit booth included static and working dis plays along with films on related Navy inner space research. Also ther were scale models of the USS WHEELING (Range Instrumentatio Ship), the Underwater Tactical Range at Barking Sands, Kauai, and scale model of a plastic Underseas Research Vehicle.



CDR Kent Yoke, USNR, mans the Office of Naval Research exhibit at the Space Fair which drew over 230,000 visitors.

11-9 Conducts Infrared Seminar

NRRC 11-9, meeting at Pitzer College in Claremont, California recently devoted an entire quarterly training schedule to the subject of infrared technology. The series of six sessions was presented as

eminar conducted by scientists and engineers prominent in the infrared ield. In addition to NRRC 11-9 members, the seminar was attended by 0 members of the industrial and academic community.

Sessions consisted of introductory and background material, the hysics of infrared detectors, optical, cryogenic, and signal-processing onsiderations, and infrared systems design criteria. Specific military pplications, such as fire-control systems, passive searching and tracking ystems, and mapping systems were presented.

The seminar was given with the cooperation of the Aerojet-General Corporation, Electronics Division, in Azusa, California, who furnished peakers and training materials from their Astrionics Department, hich is engaged in the development of infrared systems. Seminar essions were arranged and hosted by the NRRC 11-9 training officer, CDR A. I. Weinstein.

NRRC 11-11 Reports

Believing that an outstanding program attracts new members, NRRC 1-11, Santa Monica, California, has been emphasizing recruiting and rogramming. New members are needed to maintain a vigorous unit f sufficient size to warrant noteworthy speakers and significant field rips. The Commanding Officer, LCDR F. F. Stecker, USNR-R assigned ecruiting as a special activity problem to the command staff of Company 11-11. Under the guidance of CAPT J. H. Schroeder, USNR-R, rrangements were made with the Military Personnel Officer of local Naval Stations to distribute an information packet on the advantages f joining the Research Reserve to officers being released from active uty. In addition to the information packet, a brief news release, suitble for insertion in industry newspapers was prepared and copies given to the individual members of NRRC 11-11 for publication in heir company papers. These activities have resulted in six new members n four months, a significant gain for a small unit.

The general theme of the training program for the current quarter s the "Application of Space Technology." Presentations include:

- "Navigational Satellite Systems" (TRW Systems)
- "Life Support and Environmental Controls for Manned Space Flight" (McDonnell Douglas)
- "Laser Technology" (TRW Systems)
- "Status Report on Space Escape Systems" (Aeorspace Corporation)
- "General Outlook for Space Missions" (North American Rockwell).

CAPT P. H. Weems Addresses NRRC 5-4

CAPT Weems, originator of the Weems System of Navigation and pictured above with CAPT Lloyd E. Rozeboom of NRRC 5-4, was

guest speaker at a recent NRRC 5-4 meeting. CAPT Weems presented his system in actual chart forms and highlighted his presentation with personal experiences with his as well as with other navigational systems. He remarked, "The industry has been working for years to develop equipment with the continued reliability and accuracy of the sextant and the chronometer for navigation; and for the first time with the Naval Research Laboratory's Timation system we may have a working electronic system that can, with linear measurements, be as accurate as the sextant.

Tissue Bank Facility to be Installed at Naval Hospital, San Diego

For use in the treatment of Vietnam casualties, freeze-dried body tissues, especially skin, bone, and dura, are in great demand. While the feasibility of procuring and processing tissue in a research setting has been demonstrated, the facilities of the U.S. Navy's Tissue Bank at the Naval Medical Research Institute (NMRI), National Naval Medical Center, Bethesda, Maryland, are capable of meeting only one-seventh of the current demands for freeze-dried tissues. Because of the acute need to increase the procurement of tissues, preparations to establish a prototype tissue banking facility at and with the collaboration of the Naval Hospital, San Diego, are underway. This site was chosen because of the location, large size, and availability of tissue sources.

Before the San Diego tissue bank facility can be installed, the staff must be trained. A Navy Lieutenant and four tissue bank technicians began six months of intensive training at the Tissue Bank at NMRI on 1 October 1968 and will man the new facility. While the staff is studying in Bethesda, the San Diego Naval Hospital will renovate the former Preventive Medicine Unit No. 5 building for occupancy by the facility.

In April 1969 the staff at San Diego is scheduled to begin collecting units of tissue and then shipping the tissue, packed in dry ice, to NMRI for the freeze-dry processing to determine feasibility. After the facility has procured tissue for a year, the feasibility of extending the facility's capabilities to include freeze-dry processing will be determined.

Selected Contract Research Reports

The contract research reports listed below have been extracted from U.S. Government Research & Development Report 68, No. 16 of 25 August 1968, No. 17 of 10 September 1968, and No. 18 of 25 September 1968. Government agencies and their contractors who are registered with the Defense Documentation Center of the Defense Supply Agency may obtain copies from the Center at Cameron Station, Alexandria, Virginia 22314. Abstracts of the reports are found in USGRDR 68, Nos. 16, 17, and 18.

For non-DDC users, most reports may be purchased from the Clearinghouse for Federal Scientific and Technical Information, Department of Commerce, Springfield, Virginia 21151.

AERONAUTICS

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ASTRONOMY AND ASTROPHYSICS

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A Two-Component Log N-Log S Relationship; CalTech; Fomalont; AD-672 153

A Method to Measure Galactic Gamma-Rays and Electrons; Stanford U.; Dally; AD-672 326

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ATMOSPHERIC SCIENCES

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Universal-Time Control of the Low-Energy Electron Fluxes in the Polar Regions; Rice U.; Maehlum; AD-671 570

Vertical Gradient of Net Oxidant Near the Ground Surface at Barrow, Alaska; Wash. U.; Kelley, Jr. and McTaggart-Cowan; AD-671 775

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Planning an Experiment With Cloud Seeding; Calif. U.; Neyman and Scott; AD-670 780

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Sufficient Conditions for Optimality in an Infinite Horizon Development Plan; Stanford; Manne; AD-670 616

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Computer-Aided Technical Training Using Electronic Equipment On-Line with the CAI System; U. of S. Calif.; Huggett *et al;* AD-672 189

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Project Squid; Purdue U.; Bauer *et al;* AD-670 538

Human Effectiveness

Results of studies of recruit adjustment were summarized for the Chief of Naval Personnel as they could be applied to procurement policies at Navy recruiting centers. On the basis of these studies conducted by the Navy Medical Neuropsychiatric Research Unit, (MNRU) San Diego, new procedural guidelines were also written for psychiatric evaluation teams assigned to Navy and Marine recruit training commands. Current projects include a study of the maturing process of recruits in the Navy and a new laboratory program to assess the effects of chronic sleep loss, the recuperative value of sleep, and the relation of sleep to health and performance. Psychiatric epidemiological studies are now being made of Navy neuropsychiatric patients seen during the past three years at thirteen Navy clinics; 7,000 of these patients who returned to full duty are now being evaluated for their effectiveness. In another study determining the relation of stress to general health change, pertinent data are collected on personnel aboard selected ships during full deployment cycles.

ONR maintains close contact with MNRU participating in projects where data and procedures are shared. An example is the electro-encephalographic patterns, which were obtained under laboratory conditions at MNRU and were computer analyzed by programs developed under ONR contract.

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Magnetic tapes at Research Computation Center, Naval Research Laboratory. Magnetic tapes are primarily used as a computer data storage device. *See page 16.*

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