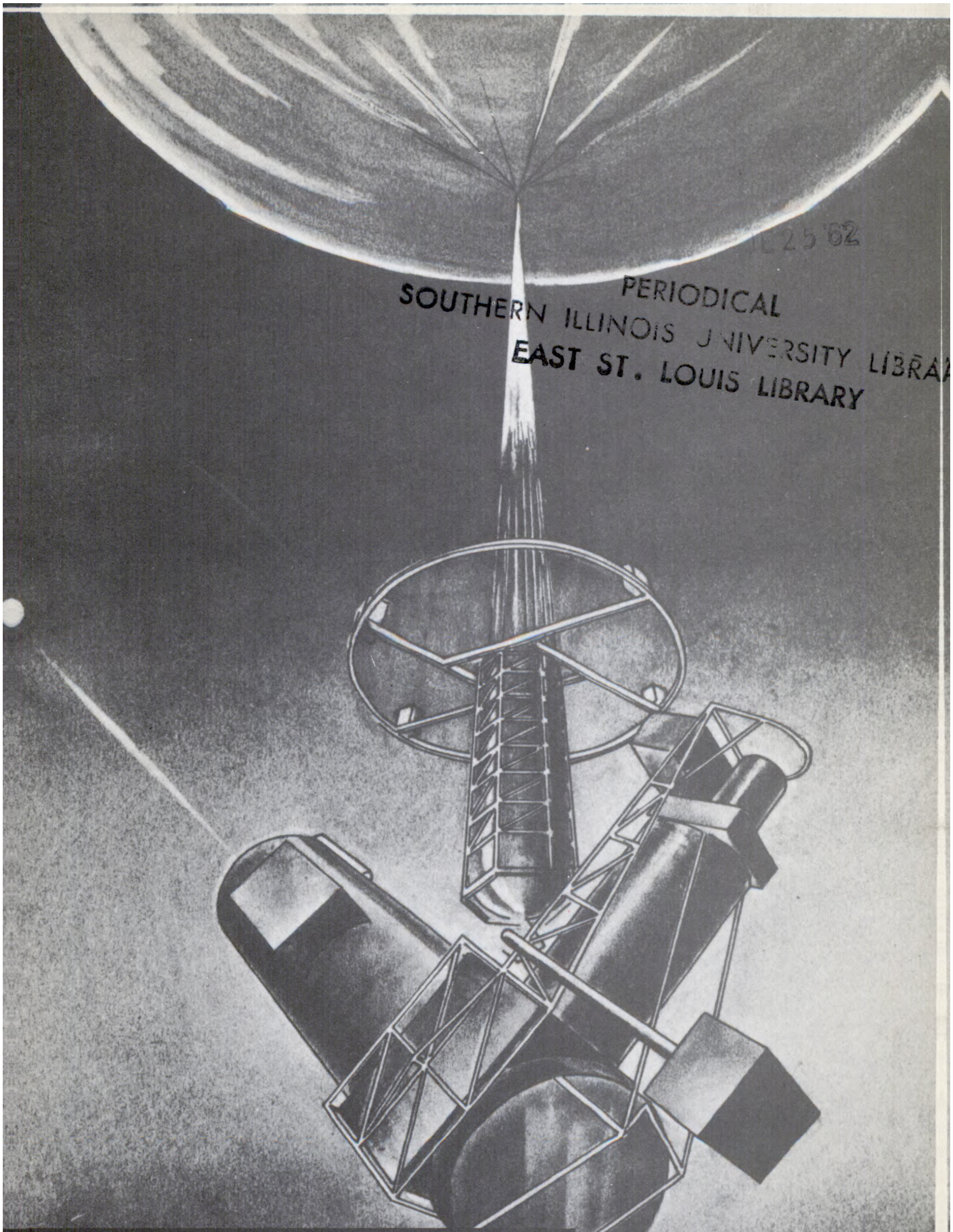
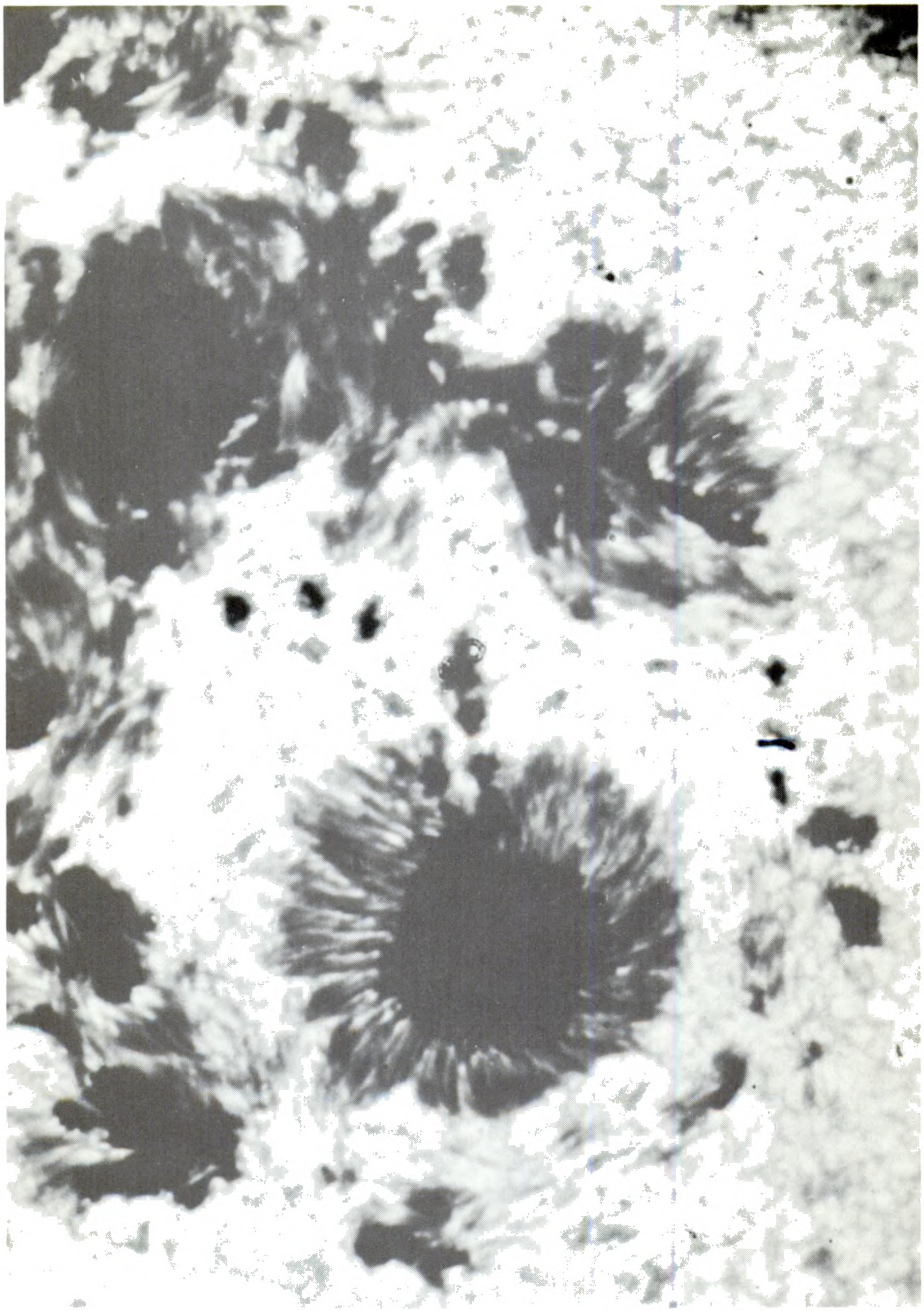


NAVAL RESEARCH REVIEWS

JULY 1961

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH



This extremely clear, close-up photo of part of the sun was made at 80,000 feet with a Navy Project Stratoscope-I balloon-borne telescope on August 17, 1959. The black spots are cores of relatively cool gases embedded in strong magnetic fields. These cores are enveloped in outward-moving warmer gases that look like whispy filaments. These gases produced a magnetic storm causing major disturbances in long-range radio communications on earth on August 16, 1959.

Project Stratoscope - Telescopes in the Sky*

John D. R. Bahng
Department of Astronomy
Princeton University

The problem of solar granules—seen as tiny bright specks densly spread in very great numbers over the sun's surface—has been studied for many years by Prof. Martin Schwarzschild of the Princeton University Observatory. These granules are thought to be rising currents of turbulent gas that play an important part in the transport of heat from the hot solar interior outward into space. They are so minute that they are difficult to observe. Years of study by every available means gave an indication of the possible existence, in the sun's photosphere, of turbulent elements with a diameter of only 150 miles. Granules of this size would be too small to be photographed by ordinary techniques. For, even under the most favorable conditions, our atmosphere is never entirely quiet and motionless. Thus, astronomical photographs taken from the ground are always somewhat fuzzy, and the finest details that a telescope is capable of producing are blurred by the motions of the atmosphere above it.

STRATOSCOPE I

Project Stratoscope I was planned specifically to solve this observational problem by carrying a large reflecting telescope well above the densest part of the atmosphere. The telescope is carried aloft by an unmanned balloon to an altitude of approximately 80,000 feet. At this height, about 96 percent of the atmosphere lies below, and the blurring effect of our atmosphere can thus be avoided. The project is cosponsored by the Office of Naval Research and the National Science Foundation (with additional funds for a television link for Stratoscope II supplied by the National Aeronautics and Space Administration).

The Stratoscope-1 telescope has a 12-inch-diameter paraboloidal quartz mirror with an eight-foot focal length. The image formed by this mirror is sent into an enlarging system which produces a solar image nearly two feet in diameter. A small area of this image is photographed by a special 33 mm. camera which takes one picture each second (with an exposure time of one-thousandth of a second) for about two hours. The instrument was built by the Perkin-Elmer Corporation of Norwalk, Connecticut.

In pointing the telescope, pairs of photocells were used to find the sun and cause the telescope to center on it. The photocells are so arranged that the telescope points at the center of the sun when both "eyes" of a pair see the same amount of light. If the telescope is not pointing correctly, one eye receives more light than the other and this information activates the servo motors which redirect the telescope until the pointing is exact. By using several pairs of photocells the

*Adapted from an article in the Princeton Alumni Weekly, Vol. 61, No. 18, pp. 3-6.

telescope is pointed both in azimuth and elevation. No man sent aloft in a pressurized cabin could keep the instrument as accurately "on target" as does this automatic device.

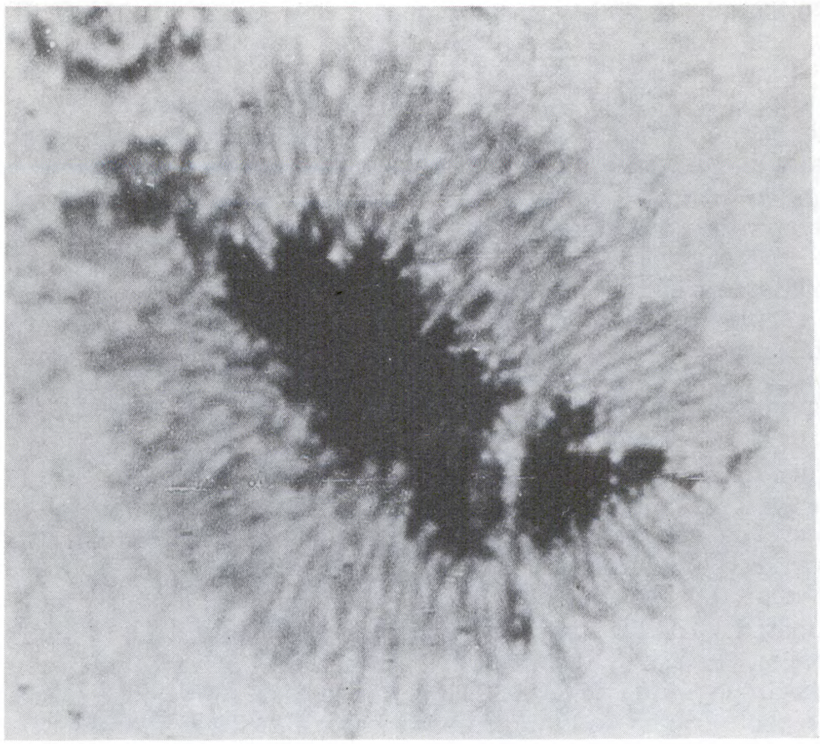
The balloons which carried the equipment aloft were manufactured and operated by General Mills Inc. of Minneapolis. Made of polyethylene film only two-thousandths of an inch thick, the balloons were some 200 feet high and 140 feet in diameter when fully expanded and contained more than one million cubic feet of helium. Strung beneath the balloon was a cargo parachute of the type used to air-drop jeeps. The pointing control and telescope were connected to the shroud lines through a friction coupling which slips just enough to prevent the turning of the pointing control from winding up the shroud lines.

A test flight was made from New Brighton, Minn., on August 22, 1957. In this flight a "dummy" telescope was flown to test the pointing ability of the system. This flight showed beyond any doubt the feasibility of the instrument in attaining the objective. On September 25, 1957, the real telescope was flown, again from New Brighton. Three weeks later (October 17), the experiment was repeated from Huron, S. D.

During these flights, photographs of the solar surface were taken that had a higher definition than had ever before been obtained. Three main features were observed on these photographs. First, the granules come in widely assorted sizes. Many of them are only about 150 miles in diameter, as expected, but some are as large as 1,000 miles. Second, most of the granules have the complicated shapes of irregular polygons. Third, the dark areas differ sharply from the bright ones; they tend to form a connected net of narrow lanes separating the more substantial bright spots.

Stimulated by the success of 1957, improvements and additions were made to obtain better and more high definition photographs. The additions included a television link built by the RCA Laboratory near Princeton, and a radio control for focusing and fine pointing the telescope. By July 1959 Stratoscope I was ready to fly again. Four flights were made from Lake Elmo, Minn., during the following three months. During each flight, the TV link, which is almost identical to the system used in the TIROS weather satellites, enabled astronomers on the ground to see what was being photographed by the balloon-borne telescope high up in the stratosphere, but without the resolution of the telescope. With the radio control link, they were able to move the telescope about so that it would point to different parts of the sun and to change the focus at will to get the best results. Even though the telescope was miles away in what would be most uncomfortable and hostile surroundings for humans, the astronomers were able to manipulate it as if it were on the ground next to them. Even more astonishing and rewarding than these engineering feats were the scientific results obtained on these flights.

The number of high-definition photographs of the granules was much greater than that obtained in 1957. The new material also included many excellent photographs of sunspots, whose quality far exceeded anything ever obtained from the ground. Moreover, thanks to the TV and radio



White dots in the center of a sunspot are shown clearly for the first time in this photograph taken 80,000 feet above the earth through a Stratoscope-I balloon-borne telescope. Less than 200 miles in diameter, these spots are apparently convection cells of rising gases, hotter than the surrounding area, but strongly suppressed by the magnetic field of the sunspot. The long diameter of the umbra (black area) is roughly the diameter of the earth.

links, long sequences of photographs were obtained covering the same region on the solar surface over a period of time. Thus, for the first time it was possible to study with precision the changes which take place on the face of the sun. The material is still being analyzed at the Princeton Observatory but already some interesting and new results have become apparent.

The granules are found to change more slowly than was thought previously. In fact, they last on an average of eight minutes, which is twice as long as the old photographs from the ground seemed to indicate. This longer lifetime is more in accord with a more recent theory concerning the behavior of granules on the solar surface. But perhaps the most interesting result is connected with the filaments surrounding the dark sunspots. These filaments turn out to be extremely thin and to live much longer on the average than the granules. The sunspots, which appear black in ordinary photographs, are about 2000 degrees cooler than the rest of the sun's surface. Furthermore, very strong magnetic fields are associated with the sunspots. Such magnetic fields are known to have strong effects on the motion of hot gases; these effects might well explain the peculiar shapes and long lives of filaments surrounding sunspots.

In the fourth flight of 1959, a special film was used to bring out the details inside the dark sunspots. These photographs show that there are many bright dots which last for about 30 minutes. These are bright in comparison to the dark sunspots, but still much fainter than the filaments and the granules. While much has to be learned about the true nature of these dots, we do know that they are extremely small—less than 200 miles in diameter. There is a possibility that they are similar to the regular granules but strongly suppressed by the magnetic field of the sunspot.

STRATOSCOPE II

Encouraged by the results of these experiments, plans are already underway for Project Stratoscope II: an attempt to photograph planets, galaxies and nebulae with a clarity never before possible. This will employ a larger reflector whose ability to see details will be three times better than the Stratoscope I telescope, but will also be vastly more complicated. The Stratoscope II program is now in the preliminary testing stage. Heart of the project is a balloon-borne 36-inch telescope which will be lofted to 80,000 feet (more than 15 miles), where it will permit photographs to be made with a resolution greater than from the ground by a factor of three to five.

Princeton has awarded a contract to a private research organization, Vitro Laboratories, Silver Spring, Md., to serve as program manager for Professor Schwarzschild. Vitro's role is to supervise the development of the balloon system, evolve launching and recovery techniques, and plan and conduct the launches.

The balloon is to remain aloft throughout the night while observations are being made. Among the first objectives of the astronomers are:

- Analysis of the divisions in Saturn's rings, possibly throwing more light on the factors that determine the orbits of the many particles that make up the rings.

- Studies of the sudden atmospheric changes that take place on Jupiter—which may help to explain Jupiter's mysterious Red Spot—and of the possible relationships they may have to solar magnetic storms.

- Close examination of the gaseous nebulae between stars (from which new stars are formed), thereby providing possible clues to the way our own sun was formed.

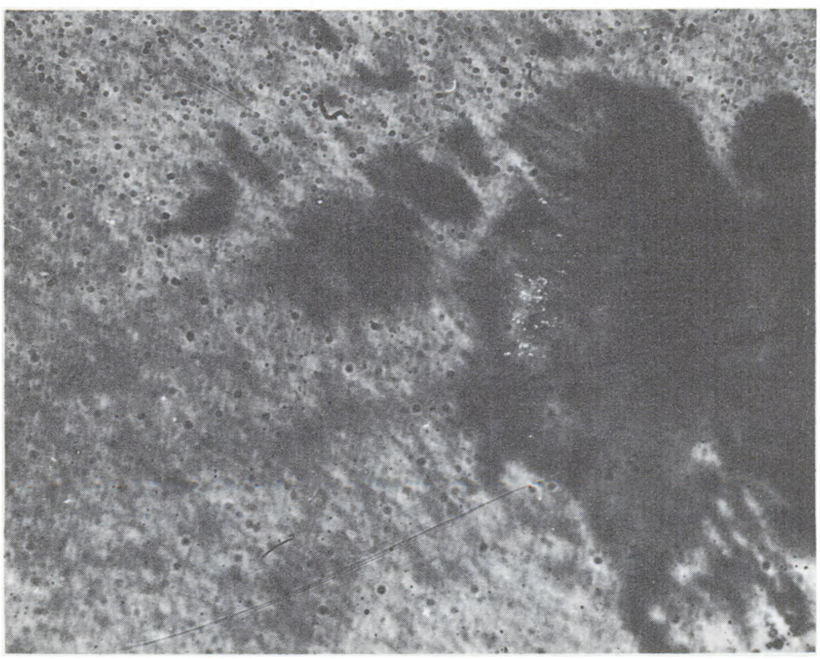
- The possibility of achieving man's first look at the surface of cloud-shrouded Venus through brief holes in the cloud cover, if the holes exist.

A balloon system to lift the telescope payload—which weighs about 6300 pounds including associated electronic equipment—is under development by the G. T. Schjeldahl Co., Northfield, Minn. The balloon will be made of a new material developed by Schjeldahl for the Office of Naval Research and successfully tested with small balloons. Known as S-10, the material is basically Mylar plastic reinforced with a dacron mesh and is lighter and stronger than polyethylene. A method of utilizing a helicopter to capture the balloon and its payload as it descends in order to achieve a soft landing is also under development.

An initial test of a helicopter-towed device for snagging the balloon has been completed by the Naval Air Development Test Unit, South Weymouth, Mass. The first test launch of the new system with a dummy payload and of the helicopter retrieval method is tentatively scheduled for the fall of 1961. The target date for the full-scale launch with the telescope will depend upon the success of prior tests, but will probably be very late this year or in the spring of 1962.

The telescope itself, designed and developed by the Perkin-Elmer Co., Norwalk, Conn., is now under construction by that firm. This is an L-shaped structure, with one arm measuring about 25 feet and the other nearly 19 feet. This unique instrument, with a theoretical resolving power of 1/10 of a second of arc, will have the ability to distinguish two golf balls 15 inches apart from a distance of 500 miles.

Corning Glass Works, Corning, N. Y., has fabricated the 36-inch, fused-silica optical mirror for the telescope. This is the first time a fused-silica blank of this size has been successfully formed. Fused silica is used because it is unaffected by the sharp changes in temperature such as Stratoscope II will experience. The mirror has been



The high definition of this Stratoscope-I photo makes it possible to study the interrelations between the magnetic field of the sunspot (dark area) and the surrounding area. (Photo courtesy of General Mills, Inc.)

ground with unusually high accuracy to a true parabolic shape with a tolerance of one-millionth of an inch.

While the telescope is at altitude, it will be focused and monitored by means of a remote-control television system and a 70-station command channel developed by RCA Laboratories in Princeton. This TV system, utilizing RCA's new high-resolution image orthicon tube, will be further developed for the satellite telescope observatory planned by the National Aeronautics and Space Administration. The telemetry system will be provided by the Sierra Research Corporation, Buffalo, N. Y. There are many problems connected with the design and construction of the Stratoscope II telescope but they do not seem insuperable. There is every hope that this instrument will be ready soon to help us further advance out knowledge about the astronomical world around us.

Dr. Halstead Receives Award

Dr. Maurice H. Halstead of the U. S. Navy Electronics Laboratory has been awarded the Commanding Officer and Director's Special Annual Honorary Award for Scientific Achievement in recognition of his outstanding contributions to research and development. He conceived and developed the NEL International Algorithmetic Compiler (NELIAC), now nationally recognized and widely used. Basically, NELIAC is a technique whereby the special language that one computer uses is automatically translated into a common language which another computer will accept. The technique has been expanded to include translations written in a foreign language.

Lead in the Air

During a recent investigation of the geochemistry of lead conducted by Dr. E. D. Goldberg of Scripps Institute of Oceanography, it was found that automobile exhaust gases contribute 160,000 tons of lead per year to the atmosphere of the United States. - M. C. S., ONR Pasadena

New Physics Chief at NOL

Dr. Z. I. Slawsky has been named Chief of the Physics Research Department at the U. S. Naval Ordnance Laboratory at White Oak, Maryland. He replaces Dr. S. J. Raff who left to work for the Bureau of Naval Weapons, Washington, D. C.

Biology - A Weapon for Peace*
Or Why We Need an "IBY"

Roger D. Reid
Director, Biological Sciences Division
Office of Naval Research

The basic objective of science is generally, and always should be, human betterment. Although it is unfortunate that scientific knowledge must sometimes be directed to less noble purposes, that same knowledge is often ultimately used to improve man's social and economic status. For example, the sciences which produced the holocaust at Hiroshima and made ballistic missiles a reality are the same ones that are giving us a basic understanding of the physical laws of the universe.

The race for arms superiority is costing the world colossal sums in terms of money, time, and human effort. The result seems to be nothing more than a progressive stalemate based on fear. It is also common knowledge that, while the Gods of War are growing fat on their diet of hate, greed, and mutual distrust, many millions of human beings are undernourished, underhoused, and have inadequate health facilities and educational and social opportunities.

Technology has made it possible for about one-third of the world's citizens to enjoy a reasonably satisfactory standard of living. In the United States we enjoy great comforts and conveniences, over-production of food, and superior diets. This is not the case in many less-favored countries where Communism finds fertile fields for its seed to germinate and the weeds of discontent flourish. Science has made gigantic strides in improving the conditions for peoples favored by geography and human and natural resources but has failed to meet the needs of many others. It is my belief that biology can help to meet these needs and those of the rapidly expanding population. Using the knowledge and techniques of chemistry, physics, and mathematics, biology will make giant strides for human good and at the same time reduce the tensions and conditions which lead to war.

There is a growing belief among scientists that the science of biology should be upgraded in importance, nationally and internationally. Hans Selye has said, "we cannot afford to concentrate all our attention upon the physical sciences..." A. M. Weinberg, Director of Oak Ridge National Laboratory, agrees. He has said: "One of the most important responsibilities of science at large is to redress the balance between the physical and biological sciences, and to direct more of the world's scientific resources along lines which are more nearly concerned with the issues of human happiness." And Aldous Huxley, philosopher and novelist, wrote: "It is only by means of the sciences of life that the quality of life can be radically changed."

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*This paper is based on a lecture delivered by the author at the 13th Reserve Research Seminar, Washington, D. C., 15 June 1961. The opinions or assertions expressed are not to be construed as official or reflecting the views of the Department of the Navy.

Biology has not reached the high state of development found in the physical sciences for several reasons. One is its comparative youth, but probably the most important reason has to do with the complexity of biological problems and the difficulty of isolating the variables involved. In comparison with the biological sciences, the physical sciences utilize relatively general laws which are clearly and individually demonstrable in rather clear examples. Biology, on the other hand, deals with the many complicated and interacting characteristics of living organisms, many of which cease to exist or are completely out of context when singled out for study. Techniques needed for investigating life processes at submicroscopic or molecular levels have only recently been developed by adaptations of physical technology.

Biology is also retarded because of the current fashions that relegate it to a place of relatively low esteem in science, resulting in inadequate support of research on basic biological problems. By comparing the amount of money available for support of research in the various scientific disciplines, it is obvious that only those aspects of the biological sciences pertaining to the relief of suffering and death by disease are in any measure adequately supported.

There has been a great deal of comment concerning loss of national prestige because we seem to have fallen behind the Soviets in the space race. By some yardsticks this undoubtedly true; by others it is not. Are people in India, for example, really worried about whose satellite is orbiting Venus? Or do the Congolese care which nation owns the copyright to photographs of the moon's backside? What concerns them is their empty bellies, their bare feet and bodies when winter comes, and the lack of medicine to relieve their chills and fever. Gandhi is quoted as having said, "To the millions who go without two meals a day the only acceptable form in which God dare appear is food." Can science dare less? It seems to me that man should pursue activities in which human knowledge and skills are matched to human needs. It is important that our energies be expended on those enterprises designed to raise the standards of health, nutrition, and general well being in all parts of the world. How wonderful it would be if Toynbee's prediction were to come true that the 20th Century will be remembered as the first time in history that man set about distributing civilization's benefits to all mankind.

Although progress in biological sciences may not have kept pace with other scientific disciplines, we should recognize that a great deal has been accomplished. On the credit side of the ledger, many of the crippling diseases of man have been brought under control. There is much more to be done to relieve the misery and suffering caused by infectious and metabolic diseases. Malaria is still the world's number-one killer of men, tuberculosis is far from controlled even in the U.S., and the ever-present possibility of epidemics of smallpox, plague, or influenza fills us with humility. Therapeutic and preventive measures are adding years to the lives of unfortunates who live with metabolic diseases, some of which are heritable. In so doing, however, there is a probability that the number of persons so afflicted may increase. The answer to such problems may lie hidden in the realm of that new field of science called molecular biology, or the not-so-new but still young sciences of biochemistry and genetics.

While scientific progress in the realm of human health has surpassed advances in the control of plant and animal diseases, prevention of a few plant and animal diseases has helped materially to increase supplies of certain types of food. The application of genetics to agriculture has led to the development of new varieties of plants that prosper under environmental conditions which would have inhibited their ancestors. New varieties of wheat have made it profitable to extend by seven fold the acreage on which it can be grown in Canada, Australia, and Argentina. Hybrid corn varieties yield 20 to 30 times that of its ancestral Indian maize. Practical plant and animal breeding have produced varieties that yield larger quantities, of better quality and with less waste, often in a shorter growing time. Indeed, it is now possible to "tailormake" many plants and animals to meet almost any desired requirement.

FIELDS TO CONQUER

Biology has made much progress through the years but the future holds much greater promise than anything we have yet accomplished. The new tools, techniques, and knowledge provided by the physical sciences open new vistas and opportunities for obtaining a basic understanding of such fundamental biological phenemona as inhibition, adaptation, hibernation, sporulation, germination, metamorphosis, resistance, and the synthesis and transfer of biological energy.

Adaptation

We know very little about the tremendous adaptive capacity of living things. Plant breeders have used empirical methods to develop plants that are adapted to normally adverse climate or soil. But, to exploit fully the adaptive ability of plants or animals, we must first try to understand the basic factors in such adaptability. It would be helpful to know the "inhibitor" which prevents the germination of seeds of desert flowers for many years, yet turns the landscape into a sudden blaze of bloom at the first substantial fall of rain; or how the desert horned-toad can live on an almost water-free diet; or how the African lungfish can remain alive in dried mud for many weeks without elimination of urine. We ask, what are the properties of the protoplasm of the slime mold that allow it to be a streaming fluid in one stage and a dry, brittle solid in another? By studying these characteristics of adaptability the biologists can be expected to learn to build new plants that can be grown profitably on lands we presently consider sub-marginal for agriculture because of a lack of one or more necessities, such as rainfall, minerals, nutrients, sunshine, or favorable temperature.

Energy Transformation

Probably the greatest unknown among the many great secrets of life is the mystery of biological energy and energy transformations. In photosynthesis, chlorophyll traps solar energy and converts carbon dioxide and water in the presence of enzymes and cofactors into glucose and other substances which animals, in turn, use as a source of energy. The carbon cycle, so simple in principle yet so complex in detail, is further complicated because we know so little about photosynthesis. The

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transfer of energy to animals from that trapped in the tissues of plants presents still another mystery. Some clues to, and a partial understanding of, the mystery have recently been discovered by biochemists working on the transfer of energy that takes place during bioluminescence. For example, one compound essential for energizing life processes, such as the transmission of nerve impulses, contraction of muscles, division of cells, and formation of optical images has been found to be adenosine triphosphate (ATP). In addition to ATP, each process, of course, requires and utilizes its own set of specific enzymes and cofactors.

Cell Division

Another fundamental problem of biology is that concerned with cell division. Starting with a single, fertilized human ovum, a few dozen successive divisions occur, giving rise to ten trillion highly specialized cells of the tissues, and organs of the human at birth. What are these "waves of determination" that regulate embryonic development? Investigations have shed some light on this problem and practical applications of this minimal knowledge now make it possible to use chemicals that regulate blooming in some plants and fixation of carbon dioxide in others.

Population Explosion Problems

We have recently been hearing a great deal about a world population explosion. We must indeed be concerned over the failure of food production to keep abreast with population growth. However, the problem is not insurmountable. It is basically a biological one which has some rather obvious biological solutions if we but find and apply them. Perhaps a better understanding of the basic biology of human reproduction will yield information which will make it possible to control populations and to improve humanity qualitatively rather than merely increase it quantitatively.

To meet the needs of our rapidly increasing population, we must intensify our search for means to understand and apply basic biology. It has already been shown that basic biology can be applied to these problems with gratifying results. There can be no doubt that, as our knowledge increases, the benefits will be intensified.

Biology and Space Travel

Aside from the immediate practical problems of establishing and maintaining a desirable balance between food production and population, biology is needed to accomplish the ultimate goal of space science.

If men are ever to journey to the planets and stars, we must know the biological effects of cosmic radiation, extreme temperature variation, weightlessness, meteoric collision, synthetic air, and food-waste cycling. We must determine the biopsychological effects, not only of these factors, but also of disorientation and illusions of space and time.

The powerful engines and intricate devices needed to send and guide satellites and space vehicles to the stars and planets are relatively simple in comparison with the biological (life-support) systems involved in successful transportation of man on extended trips into outer space.

The problems in the biological sciences have such profound social and political implications that they cannot be left entirely to individuals or solitary laboratories. Important as individual research is—and it is extremely valuable to scientific progress—we can no longer afford the luxury of leaving biological research to the chance that someone may come up with an essential bit of information. We must define our problems and make a concerted effort to find answers. If this were done on a national or international scale there is no doubt that the results would be most satisfying.

The recent International Geophysical Year yielded much valuable information and proved that the first and most important objective of science is the welfare of man. As nations work together toward this objective, they find that scientific accomplishment is more important than fighting wars. Because biology promises so much for humanity, coördinated international effort in the biological sciences should prove more effective than that in any other field of science in developing permanent peace.

I have therefore proposed an International Biological Year—or Decade*—because it will take many years to appreciate fully how biology is, in fact, an effective weapon for peace!

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*This proposal was first made publically by the writer at the Second Symposium on Gnotobiotic Technology, Notre Dame University, May 8, 1959. Proceedings of the Symposium on Gnotobiotic Technology, University of Notre Dame Press (1960) p. 103.

Dr. Trumbull Heads ONR Division

Dr. Richard Trumbull has been appointed Director of the Psychological Sciences Division of the Office of Naval Research replacing Dr. Denzel D. Smith who resigned to join the staff of the National Science Foundation. Dr. Trumbull will also continue, temporarily, in his former position as Head of the Physiological Psychology Branch of the Psychological Sciences Division.

Gasoline Sniffing

Inhalation of high concentrations of gasoline may cause sudden loss of consciousness, coma, or even death. Lower concentrations may produce flushing of the face, followed by staggering gait, mental confusion, disorientation, ataxia, blurred speech, and difficulties in swallowing—a typical jag. After continued or repeated exposure to fairly high concentrations (chronic gasoline poisoning), the patient may lose his appetite and lose weight.

Automatic Detection for Radar*

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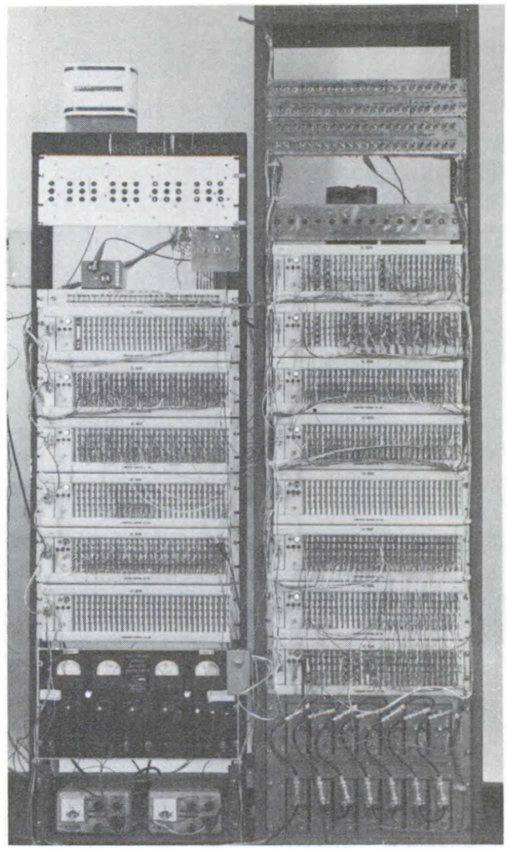
U. S. Navy Electronics Laboratory
San Diego, California

Most of the U. S. Navy search radar systems in use today depict the video or return signals on a display for operator interpretation. The effectiveness of the interpretation depends heavily upon the individual operator's ability at the time to sense the presence of echoes or blips from distant targets. At best, small targets at long distances are difficult to detect because of interfering noise either picked up by, or generated in, the radar receiver. To combat this interference, considerable effort has been expended toward reducing this noise or increasing the signal-to-noise ratio. Unfortunately, the noise cannot be entirely eliminated, and this results in a limit on the effective radar-detection and on how small a target may be and still be detected for a given transmitted power.

A approach to this detection problem is currently under investigation at the U. S. Navy Electronics Laboratory. This new approach is automatic detection based upon statistical theory. A machine, which is not subject to fatigue or boredom, is used for the detection of targets, which is the process of deciding between signal and noise. This standard involves a method of processing the radar video data and a criterion for deciding between noise and signal. Either analog or digital computer techniques are applicable in the detection process. Statistical methods recognize that in most applications, such as signal detection, the final decision can be in error. Hence, when a signal is present there is some possibility of either falsely interpreting a target as only noise, or vice versa. The probability of a false alarm is the ratio of the number of false signal decisions to total number of decisions in each case where noise is present; miss probability is defined in an analogous manner. When a machine is used, these can be computed with a high degree of reliability.

Regardless of whether the detector is a man or a machine, the detection and decision is based upon a sample of one or more observations of the received electromagnetic energy, after filtering and amplification by the radar receiver. Video data are usually sampled by switching-circuits which make their selection according to the delay with respect to the transmitted radar pulse. The delay corresponds to the region momentarily under surveillance. A multiplicity of ranges may require a number of detectors, each concerned with a particular range interval. If a directional antenna is used, as is usually the case, a signal decision by a detector indicates a target in the corresponding range interval in the direction of the antenna beam. The detector must

*Abridged by Bureau of Ships personnel from a somewhat longer report by the author.



Experimental binomial sequential detector for radar.

render a decision upon completion of the detection process. Decisions in favor of noise, however, are usually not reported. Signal decisions may be displayed or utilized in a number of ways, the ultimate being automatic initiation of the proper tactical response.

Automatic detectors can be classified according to the sampling process used. A detector which ascertains signals on the basis of a fixed number of observations-per-scan is called a fixed-sample detector; those that do not use a fixed number of observations are called sequential detectors. There are several advantages in using sequential detectors, but first let us review the two methods for comparison.

The usual scanning radar system receives a fixed number of observations, or return echoes, for a target on each scan of the antenna. The number is fixed by the antenna beam width, the antenna scan rate, and the pulse repetition rate. Fixed-sample detectors are specific for such a system. These detectors decide either for signal or noise on the basis of these observations and can be adjusted to provide a known false-alarm probability, as well as a known miss probability, for returned signals of specified strength. These detectors are optimum in the sense that, for a given false-alarm probability, the detector inherently has a correspondingly low miss probability.

A sequential detector performs each point detection process on an individual observation-by-observation basis. No unnecessary observations are made. Each time an observation is taken, the sequential detector decides among three alternatives: take another observation, decide in favor of noise, or decide in favor of signal. The final point decision and the number of observations required depend upon the data quality and sequence. The number of observations is not specified before the detection process begins; it is known only after the detection process is completed. It varies randomly as the detection process is repeated.

The flexibility of the sampling process is important. It is the key to the improved performance of sequential detectors. It also generates some of the problems encountered in application. The scanning radar system, so well suited to fixed-sample detection is not readily adaptable to sequential-detection methods. The scanning process, however, can be modified in order to achieve the advantages of the sequential detection. This requires that the sequential detector control the antenna scanning process by holding the antenna beam in one position during the detection process. Whether the decision is for signal or for noise, the antenna beam is moved to the next position upon completion of the decision. Hence, the antenna looks in any given direction just long enough for the detector to reach a decision and no longer.

Since the number of observations, or length of detection time, varies from case to case, the antenna scans in an irregular manner. The antenna must dwell on one fixed position until the sequential detection process is complete. While the antenna dwell time thus varies, the result is an increased average scan rate. The increased average scan rate is achieved at the same miss probability as that of the slower fixed-scan rate system. More opportunities are provided to detect a target, and the effective radar detection range is consequently increased.

This control is readily achievable in electronic scan antenna systems. The chief advantage of the sequential detector is the comparatively small number of observations it requires. The savings, compared to fixed-sample detectors, range from around 30 percent to over 90 percent in detection time.

A sequential detector has been constructed and performance tests conducted on simulated signal and noise situations. The photo shows the experimental detector, simulation equipment, and units used for storing the experimental results for analysis. The experimental results agree with the theoretical predictions to a high degree. Since the detection process is basically statistical in nature, a large number of repetitions of a test situation are conducted: 10,000 for most cases.

This detection process has been tested both with and without signal to observe both the false-alarm and miss probabilities. These probabilities as well as the average decision time have agreed experimentally with theory within the expected random variations.

To illustrate that reliable detection processes can be conducted at small signal levels, a signal 30 db below the noise has been simulated.

The detector was programmed to have false-alarm and miss probabilities of approximately 10^{-5}. Approximately 200 sequential detection processes have been conducted. The average decision time was in agreement with theory and, as expected, there were no false alarms and no misses. It is recognized that automatic detection can be extended beyond the simple dichotomy of deciding between signal and noise, for the detector can be designed to decide among many signal and noise alternatives. Thus the decision process can constitute a signal-classification process where such additional parameters as velocity, identification, number of targets, track, or other relevant characteristics enter into the decision process. The detection processes, of course, become more complex both in instrumentation and in terms of performance characteristics. If there are "n" different states, including the noise-alone condition, there are then "n" different possible correct decisions and n(n-1) types of errors. However, these complexities reflect upon the decision process rather than on its automation. It follows that the same complexities exist, whether or not recognized, in the human decision process and must be resolved if a decision is to be reached.

Both the theoretical and experimental aspects of the investigations outlined are continuing efforts. Although certain results are approaching the application phase, many areas are open to future investigation. Emphasis is being placed upon the development of the theory and philosophy of decision processes applicable to future automatic radar. This emphasis should lead to a faster reaction capability as new requirements in automatic detection develop.

New WHOI Vessel

The Woods Hole Oceanographic Institution is planning a new research vessel. Financed by a grant from the National Science Foundation, the ship will be first wholly new addition to the WHOI fleet since 1931, when the ATLANTIS was built. She will be 195 feet at the waterline and will have welded steel construction and twin-screw, steam-powered propulsion. The vessel is expected to be ready for scientific work by early 1963.

NEL Gets New Director

Dr. Ralph J. Christensen, former Associate Technical Director of the U. S. Navy Electronics Laboratory of San Diego, has been appointed Technical Director. He will be in charge of the eight scientific divisions of the Laboratory.

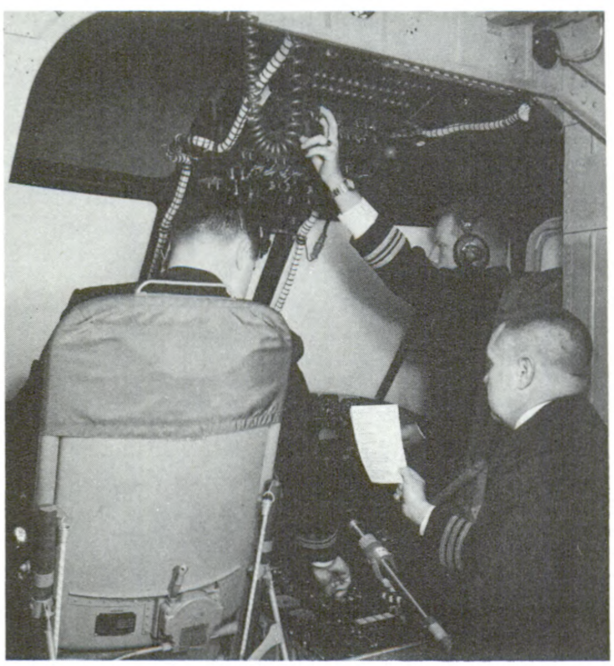
Research Notes

Helicopter Flight and Weapons Simulator

The Navy recently received its first helicopter flight and weapon-system simulator after a series of final tests that included an unusual demonstration of its capability as a trainer. An electronics design engineer without any previous helicopter flight experience, operated the simulator for a number of hours and then successfully piloted the Navy's large, advance-design helicopter, the HSS-2, through a series of typical maneuvers.

The helicopter trainer, the first ever to be produced, duplicates the full performance range of the new, all-weather HSS-2 built by Sikorsky. Equipped with the AN/AQS-10 sonar, the HSS-2 is designed as an advanced system for anti-submarine warfare and is scheduled to become operational this year. The device was designed and built by Melpar, Inc., Falls Church, Va., veteran builder of flight simulators under contract to the U. S. Naval Training Device Center (an activity of the Office of Naval Research). This is the first time a flight trainer has been delivered before the aircraft itself has gone into operation.

During the final test period, Mr. Franklin E. Papin of Melpar, an engineer who helped design the simulator and also served as its checkout pilot, was accompanied by a qualified pilot in a flight of the HSS-2 from the Sikorsky plant at Stratford, Conn. During the flight Mr. Papin, who had never been in an actual helicopter until the day before the flight but had had some fixed-wing flight time, took over the controls. He piloted the HSS-2 at its top speed, made turns, ascended, descended, hovered at less than 50 feet above ground, and landed.



The "cockpit" of the new HSS-2 helicopter flight and weapons simulator.

The HSS-2, which can be operated day or night or during instrument flight conditions, is capable of carrying out such ASW tasks as the detection, tracking and destruction of enemy submarines as well as sea rescue services and visual reconnaissance. A high degree of skill is required of the crew (pilot, co-pilot and two sonarmen) in executing these missions. The simulator will be used to train crews for all phases of tactical missions, including communications, navigation, ASW search procedures; target tracking, detection and classification; and the delivery of weapons. The flight-control equipment, cockpit, and sonar compartment in the trainer duplicate exactly the actual helicopter. Even the forces felt by the pilot trainee on his control stick and rudder pedals during operation are the same as those in the actual aircraft.

The HSS-2 trainer simulates the behavior of twenty of the helicopter's systems, including oil and fuel, hydraulic, blade-folding, landing gear, and armament. The trainer also duplicates temperature and atmospheric pressure variations and wind force.

Mean Lifetime of the Neutral Pion

During the New York Meeting of the American Physical Society in early February, U. S. Naval Research Laboratory scientists Dr. Robert Glasser, Nathan Seeman, and Bertram Stiller announced the determination of the value of one of the universal constants of physics. This constant, which scientists have been trying to pin down for ten years, is the average life span of one of the 30 known elementary particles, the pi zero meson, commonly called the pion. It is believed that these elementary particles account for all forms of matter and energy in the universe.

Measurement of the average lifetime of the neutral pion was made possible through the use of improved detection techniques and the Bevatron accelerator in the E. O. Lawrence Radiation Laboratory of the University of California at Berkeley. Accelerated to an energy of 6 billion electron volts in the Bevatron, protons (nuclei of hydrogen atoms) were allowed to smash into a metal target. The resulting nuclear-particle collisions caused complete breakups of the nuclei, releasing most of the 30 known elementary particles. From the numerous products released, a beam of one particular type—the positive K meson—was selected, using magnets and electrostatic deflectors. The positive K mesons were then brought to rest in a block of about 100 layers of Ilford fine-grained nuclear emulsion.

(The nuclear emulsion is basically similar to the sensitive layer used in ordinary photographic film, but about 100 times thicker. A stack of these emulsions is used to record the "tracks" of charged particles as they pass through. After the emulsion is developed, these tracks are examined under a high-powered microscope.)

After the K mesons stopped, they disintegrated within one fifty-millionth of a second. Although the mesons break down in a variety of ways, only one was of value in measuring the lifetime of a pion. This one way, which occurs 20 percent of the time, happens when the K mesons break down into a charged and a neutral pion. The charged pions left a track in the emulsion just as the charged K mesons did. But the neutral pions, which were being studied, did not leave any track, their existence being known from other scientific evidence.

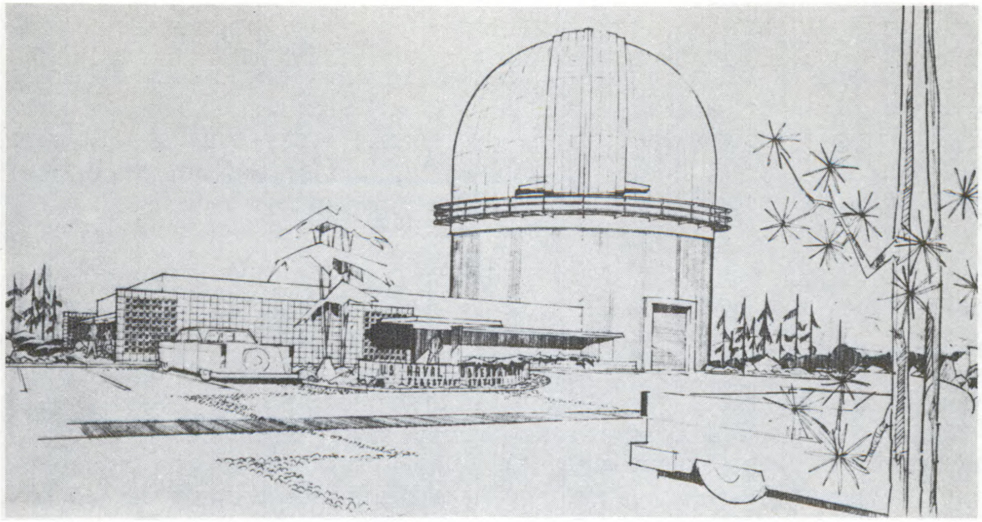
The neutral pions, which are unstable and decay rapidly, break down in two ways. The most common, which results in two gamma rays (particles of high energy electromagnetic radiation which are neutral and don't leave tracks in the emulsion), could not be used. The second way, which occurs one time in 80, provided the means by which the life span of the neutral pion was measured. In this case, the neutral pion breaks down into one gamma ray and a pair of electrons (one positive and one negative), the latter leaving visible tracks. By measuring the distance between the end of the K meson track and the point where the electron tracks started, it was possible to determine where the neutral pion began and where it broke down. It is known that the pion from the K meson decay moves at a velocity of 80 percent of the velocity of light. From the measured distance, which was three-millionths of an inch, and the velocity of the neutral pion, it was possible to obtain the time it took the particle to decay in each of the 77 cases observed. The average life span of the neutral pion was found to be two-tenths of a quadrillionth of a second (2^{-15}). This is a million times shorter than that of any other elementary particle that has been measured.

A product of basic research, the determination of this universal constant is expected to help in providing a better understanding of the forces holding together the nuclei of atoms. The charged and neutral pions appear to act as a nuclear "glue," holding nuclei together in a manner still not fully understood by science. The experiments were conducted as part of the basic research program in high nuclear physics carried on at the U.S. Naval Research Laboratory in Washington, D.C.

New Observatory Building and Telescope Planned

A new observatory building will be constructed at the U. S. Naval Observatory's Flagstaff Station near Flagstaff, Arizona. The structure is being built by the Murray J. Shiff Company of Tuscon under the supervision of the Navy's Bureau of Yards and Docks.

The eight-story building will house a new reflecting telescope of unique design. The rotating top part of the structure, shaped like a half sphere with a diameter of 65 feet, will weigh 150 tons. It will be constructed of welded steel plates and double insulated walls to shield the telescope against temperature changes. The dome, powered by a two-horsepower motor, will revolve on 40 wheels, each 18 inches in diameter. As further protection against temperature changes, the lower part of the building will be a concrete structure with an insulating surface on the outside and a shield of aluminum. Connected with the structure will be a one-story annex for laboratory and associated uses.



Architect's drawing of the proposed building at the U. S. Naval Observatory's Flagstaff Station near Flagstaff, Arizona.

The telescope was designed by Dr. K. A. Strand, Director of the Observatory's Astrometry and Astrophysics Division in Washington, especially for high-precision, photographic measurements of the positions of faint stars. Its resolving power will be such that it will be possible to measure the position of a star with an accuracy of several hundreths of a second of arc.

One project planned for the telescope is the determination of the distances of faint stars in the "neighborhood" of the sun, that is, within a 100-light-year radius, or 600 million-million miles from the earth. No telescope is able to do this at present. Information obtained will provide data on the formation of red and white dwarf stars and the energy they generate. We may also learn how our sun was formed. New engineering features to keep the optical elements aligned precisely will be incorporated in the telescope. Final engineering design is being done by C. W. Jones Engineering Co., Los Angeles. The Corning Glass Works of Corning, New York, is fabricating the telescope's 62-inch quartz mirror out of the first quartz blank of this size ever manufactured. Quartz was chose because of its insensitivity to temperature changes.

Simulated Periscope View

The Submarine Fleet Ballistic Missile Training Facility at the U. S. Navy Submarine School, New London, Conn., is getting a new periscope-view simulator. This new device, featuring an unprogrammed approach recently developed by the Naval Training Device Center, provides for the direct viewing of periscope target images by using a unique method of TV blanking of the sky-sea background in the area of the targets. Colored film strips of target models are projected onto a screen, which can be seen through the periscope. The film strip, prepared by photographing target models on a jet black background, contains a series of transparent frames showing one ship in different degrees of aspect angle. (A change in target size can be accomplished by moving the zoom lens on the projector.) A sky-seascape, a color transparency for a complete 360^{o} angle, is inserted into the optical path of the periscope by utilizing a beam-splitting method.

The unique feature of this simulation is the method of inserting the target into the background. This is accomplished as follows: A TV camera is used to pick up the light of the targets from the screen. This signal produces a blanking pulse to generate a target silhouette on the face of the TV tube. The TV tube is then used as a projector lamp to illuminate the sky-seascape transparency. Thus, the seascape is illuminated in all areas except where the silhouette is formed. Every movement of the target in range and aspect angle is picked up by the closed-circuit TV and the background illumination is changed accordingly.

New Conical Shock Tube

The Navy has constructed a 180-foot conical shock tube in which five-pound explosive charges have produced blast waves as powerful as those generated by simultaneously firing six of the most destructive blockbusters ever dropped during World War II. And it's practically noiseless, too.

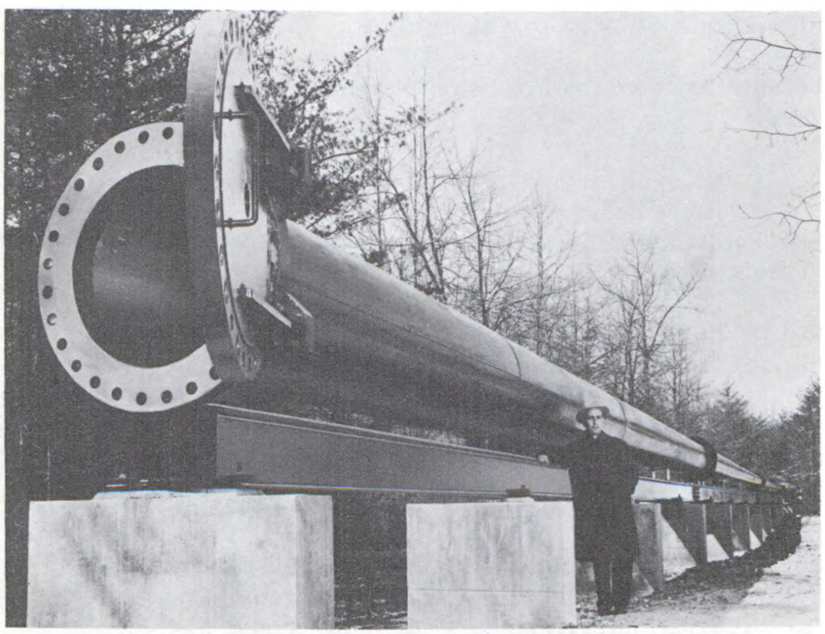
Installed at the Naval Ordnance Laboratory in Silver Spring, Maryland, the device was conceived and developed by physicist William S. Filler of NOL's Explosions Research Department. It is a scale model designed to predict the performance and aid in the design of a 2000-foot shock tube in which a blast wave from a 1000-pound charge can be effectively amplified to simulate that of a nuclear explosion of many kilotons. Such a large-scale shock tube will give the Navy a facility capable of economically creating, "inside the laboratory," repeated radiation-free blast waves of nuclear size at relatively short intervals.

In light of the nuclear test ban which has been in existence for the past two and a half years, the shock tube program has particular significance. It was undertaken as an economical means of performing ship-structure damage tests of nuclear proportion by the Ship's Protection Section of the Preliminary Design Branch, BuShips. Nuclear-blast simulators would be equally valuable for testing Army and Air Force vehicles and structures above and below ground, as well as bomb shelters for Civil Defense purposes.

Tests can be performed over a wide range of blast pressures and durations by simply locating test materials at various points along the inside of the tube, just as one would locate test materials closer or farther from an open explosive in order to subject them to stronger or weaker blast forces. In a large-scale nuclear blast simulator, for example, shock pressures ranging from low values up to hundreds of pounds-per-square-inch and lasting up to as long as seconds would be available on any single shot.

The accuracy of simulation, simplicity of operation, and flexibility in its blast-pressure and duration range are unique features of the conical shock-tube technique. The first of its kind ever built, NOL's 180-foot conical shock tube is a result of NOL-originated research studies which recently found that such devices can make it possible to create and study large-scale blast waves under controlled conditions without actually firing nuclear charges.

A blast wave from a five-pound explosive charge fired at the small end of the new shock tube is amplified 25,000 times. Such a wave represents a sector of a spherical shock wave generated by about 75 tons of explosives fired in the open. In effect, the small-charge shock wave expands within the confines of the cone in the same manner that it would if it were part of the full 75-ton spherical blast pattern. The 180-foot metal cone is six inches in diameter at the small end and five times this size at the mouth. Coupled with the small end of the cone is a "retired" 6-inch naval gun which serves as a firing block for explosive charges. Almost all the noise from these charges can be muffled in the cone by bolting a heavy metal cap over the cone's mouth. Pressure gages placed along the interior of the cone are used to obtain blast-wave measurements.



It's a shock tube, not a weapon! This 180-foot scale model of larger ones to come can amplify the blast wave of a five-pound explosive charge 25,000 times. Mr. William Filler, Naval Ordnance Laboratory (Silver Spring, Md.) physicist who conceived and developed the device, is shown beside it.

DTMB Gets LARC

New research techniques in nuclear reactor and ship design were announced recently during ceremonies dedicating the LARC (Large Automatic Research Calculator) system at the Applied Mathematics Laboratory of the Navy's David Taylor Model Basin, Carderock, Md.

Up until now, detailed mathematical models could not be studied efficiently in three dimensions. LARC makes feasible the simulation of the lifetime behavior of mathematical models and the calculation in hours of the performance of the various components during the power-producing life of the reactor core. Different reactor designs can be studied by the LARC, and the most efficient design for a specific purpose selected. This reduces the need for pilot-model construction which sometimes takes years.

Another computer technique—that of calculating ship forms—promises to have far-reaching effects on naval architecture, ship design, and construction. Designers will be able to determine ship lines on the computer rather than laying them out full-scale in a builder's loft, as is done at present. Some of the other problems being considered for solution on the LARC system are:

- The development of a digital method for spectrum analysis of ocean wave patterns

- Calculations related to the design of large arrays of transducers

- The automatic control of heavy machine tools used to fabricate ship components

- The analysis of magnetic fields for minesweeping operations

- The development of a method of underwater sound analysis based on ray tracing

Built by Remington Rand UNIVAC, Division of Sperry Rand Corporation, the LARC is many times faster than existing computer systems in operation today. This system is capable of performing 250,000 additions and subtractions in a second. In just one hour the LARC can perform computations which would require the effort of 40 men, working 100 years at the rate of 40 hours a week to complete with desk calculators.

The giant, solid-state electronic computer is almost completely transistorized. LARC contains over 80,000 transistors and 600 vacuum tubes in the two interconnected computers and associated auxiliary devices which make up the system. The high-speed, magnetic-core memory of the Model-Basin LARC system stores 30,000 words. An additional six million words may be stored on twelve high-speed memory drums which process information at speeds up to 360,000 characters per second on each drum. Supplementing the high-speed drums are sixteen magnetic-tape units which are also used to put data into, and take data out of, the system. Results are produced by the high-speed printer at the rate of 600 lines per minute.

The Applied Mathematics Laboratory established at the David Taylor Model Basin in December 1952 is one of the most complete computer facilities in the world. In addition to the LARC system, two UNIVAC I computers, an IBM 7090, and specialized computer auxiliary devices are used. The Laboratory performs computations and analyses for the Bureau of Ships and its laboratories and other agencies of the federal government.

Navy Gets New Atomic Clocks

Development of two light-weight, portable, atomic-frequency standards (atomic clocks) has been completed and delivery made to the U.S. Navy by ITT Federal Laboratories at Nutley, New Jersey. Known to have an accuracy of less than one second's variation in 300 years, they may prove to be accurate to less than one second's variation in 1500 years, according to their developers. The clock is the result of experimental research conducted by ITT's senior scientist, Dr. Maurice Arditi, for which he has been granted two patents and has three more pending.

The basic element of the atomic clock is a small cell filled with cesium, an alkali metal vapor. The atoms of this vapor exhibit certain natural resonances to induced radio waves, an unvarying characteristic of all gases. Under controlled conditions, these resonances can be detected and made the basis for a very precise determination of frequency. The present models each weigh 55 pounds. Models now in the design stage, however, will weigh approximately 30 pounds.

Practical uses for such devices are many. One foreseeable application is in long-range, space-navigational control systems where, over great distances and at high speeds, small errors in time result in large errors in position. The Navy's far-ranging nuclear submarine fleet would put to good use a time standard that would need virtually no resetting or checking, an important factor to consider in view of the craft's long at-sea and underwater endurance. Such an exact time piece might also test Einstein's relativity theory. Two atomic clocks would be synchronized and one placed in a speeding satellite orbiting within the earth's gravitational field. Should a difference in time appear, Einstein's general theory that time, as we know it, is changed by gravitational effects, would be confirmed.

Some other applications would be as an international time standard, and as a means of greatly improving the accuracy of present-day, missile-guidance gear, as well as celestial and satellite navigation methods. The precision position-locating aid provided by such a clock would also have major use in air traffic-control systems.

Magnetic Fields Laboratory

The formal dedication of the Navy's newest research facility, the Magnetic Fields Laboratory of the U. S. Naval Engineering Experiment Station, Annapolis, Maryland, took place on 16 June.

Recent advances in undersea warfare have caused the Navy to give increased emphasis to the measurement and reduction of even the very low-level DC magnetic fields which her ships may produce. Thus the need for a laboratory of this type has become increasingly urgent.

The principal mission of this facility is to aid in the research and development of magnetic counter-measure devices and low-magnetic-field shipboard equipment and to provide a means for rapidly testing and analyzing prototype equipment under actual running conditions.

NRL Research Reactor Power Raised

The nuclear reactor of the U. S. Naval Research Laboratory—the most powerful research reactor in the Washington, D. C. area and the first to be built in a Department of Defense installation—was recently modified from a 100-kilowatt to a 1-megawatt power level.

Operated successfully and safely since 1956 under Atomic Energy Commission license, the NRL reactor was shut down briefly during the installation of required engineering modifications. Following completion of the modifications, the facility was inspected by the AEC, and a license amendment authorizing the higher power operation was obtained. The reactor was first operated at the 1-megawatt power level on 12 June, 1961.

This increase in power will provide an approximate ten-fold increase in neutron flux. This will accelerate data-taking in existing nuclear and solid-state physics programs as well as permit additional experiments to be undertaken which have not previously been feasible.

Advanced Science Student Receives PhD

CDR D. A. Paolucci, USN, who is in OpNav (Op31) has fulfilled the requirements for his PhD Degree in Mathematics from Indiana University. CDR Paolucci graduated from the Naval Academy in 1943 and under the Advanced Science Program received his Master's Degree in Mathematics from the University of Indiana in 1952. He re-entered the Advanced Science Program to obtain his PhD degree.

The first guided missiles ever launched by the United States in wartime and against an enemy were Navy weapons. They were small drone airplanes, each carrying a 2000-pound bomb, which were used in the Pacific in 1943-44.

On The Naval Research Reserve

ONR Seminar

The Thirteenth Annual Naval Reserve Research Seminar—sponsored by the Office of Naval Research and conducted by Naval Reserve Research Company 5-8—convened for two weeks in Washington, D. C., on 4 June 1961. Ninety-nine reserve officers of all three services were given presentations and tours to bring them up to date on research and development in the Navy. The program was under the general direction of CAPT J. W. Jockusch, Jr., USNR, Special Assistant to the Chief of Naval Research (Research Reserve) and CDR R. N. Jennings, USNR, Training Officer. Technical direction of the program was provided by Dr. F. J. Weyl, Research Director, ONR. CDR J. R. Patton, Jr., USNR, the Commanding Officer of NRRC 5-8, served as chairman of the Seminar.

The Seminar opened with two days of general meetings followed by six days devoted to meetings covering specialized activities. Two more days of general meetings were held, one on the second Monday and the final one on the last Friday. The welcoming and keynote address was given by RADM L. D. Coates, USN, Chief of Naval Research. He was followed by VADM J. T. Hayward, USN, Deputy Chief of Naval Operations (Development), who discussed research and development concepts in OPNAV. RADM J. A. Tyree, Jr., USN, Assistant Chief of Naval Operations (Naval Reserve), covered the subject "Today's Naval Reserve." Also speaking on the first day were Mr. James M. Bridges, Director, Office of Electronics, Office of the Director of Defense (Research and Engineering); CAPT H. E. Ruble, USN, Deputy and Assistant Chief of Naval Research; and Mr. A. H. Helvestine, Deputy Chief for Patents and Patent Administration for ONR. The second day of general discussions featured talks by representatives of the Office of the Chief of Naval Operations: RADM E. R. Eastwold, USN, Director, Strike Warfare Division; CAPT M. A. Shellabarger, USN, Head, Amphibious Strike Warfare; RADM I. J. Galatin, USN, Director, Anti-submarine/Submarine Warfare Division; and CAPT D. L. Harris, USN, Head, ASW Readiness Branch. Other speakers on this day were Dr. Hugh L. Dryden, Deputy Administrator, NASA; VADM W. F. Raborn, USN, Director, Special Projects, Bureau of Naval Weapons and CAPT A. E. Krapf, USN, Director, Naval Research Laboratory.

The Seminar was divided into four working groups each under a group chairman: Undersea Science and Technology, (Mr. J. W. Smith); Operations and System Analysis, (Mr. J. R. Marvin); Navy Research in Material Sciences, (Dr. E. I. Salkovitz); and Naval Problems in the Life Sciences, (CAPT J. P. Pollard, MC, USN). These groups were each addressed by leading authorities in their fields. The presentations were supplemented by tours to the Naval Research Laboratory, the David Taylor Model Basin, the Naval Ordnance Laboratory at White Oak, Maryland, the Naval Weapons Laboratory at Dahlgren, Virginia, and the National Naval Medical Center.

The third day of general sessions brought all groups together to hear two representatives from the Office of the Chief of Naval Operations, CAPT F. H. Brumby, Jr., USN, Director of the Atomic Energy Division and CAPT F. P. Anderson, USN, Director of the Astronautics Operations Division. One of the highlights of this day's presentations was the famous "Muscles to Missiles" talk by Mr. J. Lewis Powell, Office of Planning and Requirements Policy, Office of the Assistant Secretary of Defense (Installations and Logistics). Other speakers on this day were Dr. A. K. Brewer, Chief Scientist in the Scientific Division of the Scientific and Technical Intelligence Center, Office of Naval Intelligence; CAPT E. C. Callahan, USN, Commanding Officer and Director, U. S. Naval Training Device Center, Port Washington, New York; Dr. F. Joachim Weyl, Research Director, Office of Naval Research; and CAPT W. T. Sutherland, USN, Executive Assistant for Leadership, Bureau of Naval Personnel. On the final day the Seminar was first split up into separate Army, Navy, and Air-Force groups for reserve presentations. After this, the groups reunited for a final summary of the Seminar by CDR J. R. Patton, Jr., USNR.

New Research Reserve Company Planned for Kansas City

At a meeting held 17 April at the University of Kansas City, fifteen Reservists expressed an enthusiastic desire to associate with a proposed Research Reserve Company: NRRC 9-9. Subsequently, the Bureau of Naval Personnel approved the request for the establishment of the company in Kansas City.

CAPT Loren V. Burns, USNR (Ret.) who, prior to his recent retirement, was a member of Naval Reserve Research Company 9-20, Lawrence, Kansas, is primarily responsible for the forthcoming establishment of the new unit. In March of this year CAPT Burns obtained a list of non-participating reserve officers in the Kansas City area and sent each a letter describing the Research Reserve program and extended an invitation to these officers to attend a meeting at which CDR L. P. Hoskins, USNR, Reserve Assistant, ONR Chicago, would discuss the program in detail and explain how a company could be formed.

CDR Alonzo C. Hare, USNR, is the prospective Commanding Officer. He has completed a tour of active duty for training at ONR-Chicago, during which he was briefed on Research Company operations, organization of company files, and the preparation of a drill schedule for the first quarter of Fiscal Year 1962. Formal activation of the company is planned for 1 July 1961.

Seminar at ONR Boston

Twenty-five Naval Reserve officers of the First Naval District participated in a two-week Seminar at the ONR Branch Office, Boston commencing 11 June 1961. The Seminar was under the direction of CAPT W. C. Hilgedick, USN, Executive Officer and Assistant for Research Reserve, ONR Boston.

CAPT G. K. Williams, USN, Commanding Officer, ONR Boston, opened the Seminar with a welcoming address. He was followed by Dr. A. L. Powell, Chief Scientist, who discussed the Office of Naval Research history, mission, function and role in a scientific community. Members of the Branch Office staff made presentations in their particular departments: Administrative, Contract, Patent, Scientific, and Technical Information.

Field trips to local activities lent interest to the Seminar. These trips included the following: Chelsea Naval Hospital, A. D. Little Co., M.I.T., Harvard University, Millstone Radar Site, Woods Hole Oceanographic Institution, Naval Air Development Unit, and Boston Naval Shipyard, where a visit was made to the USS LUCE (DLG-7).

CAPT J. W. Jockusch, Jr., USNR, Special Assistant to the Chief of Naval Research (Research Reserve) discussed the Research Reserve Program. He was joined in further discussions of the Naval Reserve by CAPT Hilgedick and CAPT P. Broderick, USN, Assistant Chief of Staff for Naval Reserve and Training, First Naval District.

CAPT Ayres Receives Grant

CAPT. Gilbert H. Ayres, USNR member of NRRC 8-5, Austin, Texas, has received a three-year grant from the National Science Foundation to support his research on the analytical chemistry of the platinum elements. Since 1948 Dr. Ayres, Professor of Chemistry at The University of Texas, has been conducting research on the platinum elements (platinum, palladum, ruthenium, rhodium, osmium, and iridium), with emphasis on spectrophotometric methods of analysis.

Active in the establishment of NRRC 8-5, CAPT. Ayres served as its first Commanding Officer (1949-1952). Currently he is ONR Mobilization Liaison Officer for the Eighth Naval District.

Research Reserve Officers Selected for Advancement in Rank

Sixty-seven officers of the Research Reserve Program were among 4425 Reserve officers selected for promotion to the grade of Lieutenant by the selection board which convened 11 April 1961. The names of those selected are as follows:

Anderson, Thomas A.	12-2	Kriz, Thomas A.	9-4
Baldwin, Robert C.	4-4	Krueckeberg, Harry F.	4-4
Barber, John W.	9-11	Kubik, James C.	1-1
Beard, Donald S.	6-3	Lederman, Peter B.	9-3
Bibbins, Gareth L.	1-5	Longerbeam, Gordon T.	12-2
Biehler, Wayne E.	12-4	Martin, Albert J.	5-9
Buch, Walter E.	3-13	May, Howard M.	8-8
Busharis, John G.	3-2	Maycock, Paul D.	9-5
Bussard, Robert H.	9-20	McLaughlin, Thomas M.	1-1
Chandler, Russell J., Jr.	9-10	McNeill, Dane A.	6-8
Chew, Jong M.	8-4	McWhorter, William C.	6-3
Clark, Harold W.	11-9	Murray, John A., Jr.	6-3
Conti, Peter S.	12-5	Palmer, Richard A.	9-2
Denning, Anthony J.	3-13	Peck, Wallace C.	1-1
Donnely, Thomas H.	9-23	Phillips, Lawrence D.	9-3
Duderstadt, Douglas W.	8-5	Poltenson, Arnold	3-6
Dyer, Richard H.	12-5	Prather, James G.	12-2
Figg, Charles E.	12-5	Rambo, Nathan H. III	11-8
Gergen, Kenneth J.	6-6	Raphael, David E.	12-2
Gerling, Francis W.	8-5	Reper, Ronald R.	8-4
Gilman, Walter L.	3-14	Rislove, Seth E.	13-6
Goings, Hilda C.	13-5	Rohricht, Thomas E.	6-6
Graf, Donald V.	4-2	Rutledge, Delbert L.	8-13
Gribble, Robert F.	8-5	Schmidt, Herbert C.	11-4
Hagen, Gunter	11-3	Scorpio, Ralph M.	1-2
Hamilton, William M.	6-15	Smith, Sheldon M.	12-6
Hammett, Robert E.	6-2	Stanford, Leland B.	4-11
Hansen, Melvin C.	9-7	Sturges, Wilton III	5-4
Henshaw, Richard C., Jr.	9-16	Thompson, Howard D.	9-7
Howard, Henry T.	12-3	Thornton, Manly P.	9-22
Igo, Robert V., Jr.	4-4	Whitaker, Gilbert R., Jr.	9-10
Jeffers, Martin C.	11-3	Williams, James M.	8-9
Jones, Raymond N.	9-17	Woodcock, Richard W.	13-5
Kontje, David F.	3-2		

Also during April, six medicos currently serving with RRC's received notice of promotion:

To LCDR in the Medical Corps:

Medearis, Don N.	5-4	Standaert, Frank G.	3-8
Schlossberg, Victor E.	9-19		

To LCDR in the Medical Service Corps:

Jensen, Roderick E.	4-12	Jones, Morris T.	5-10

To LCDR in the Dental Corps:

Ferguson, William W.	9-12

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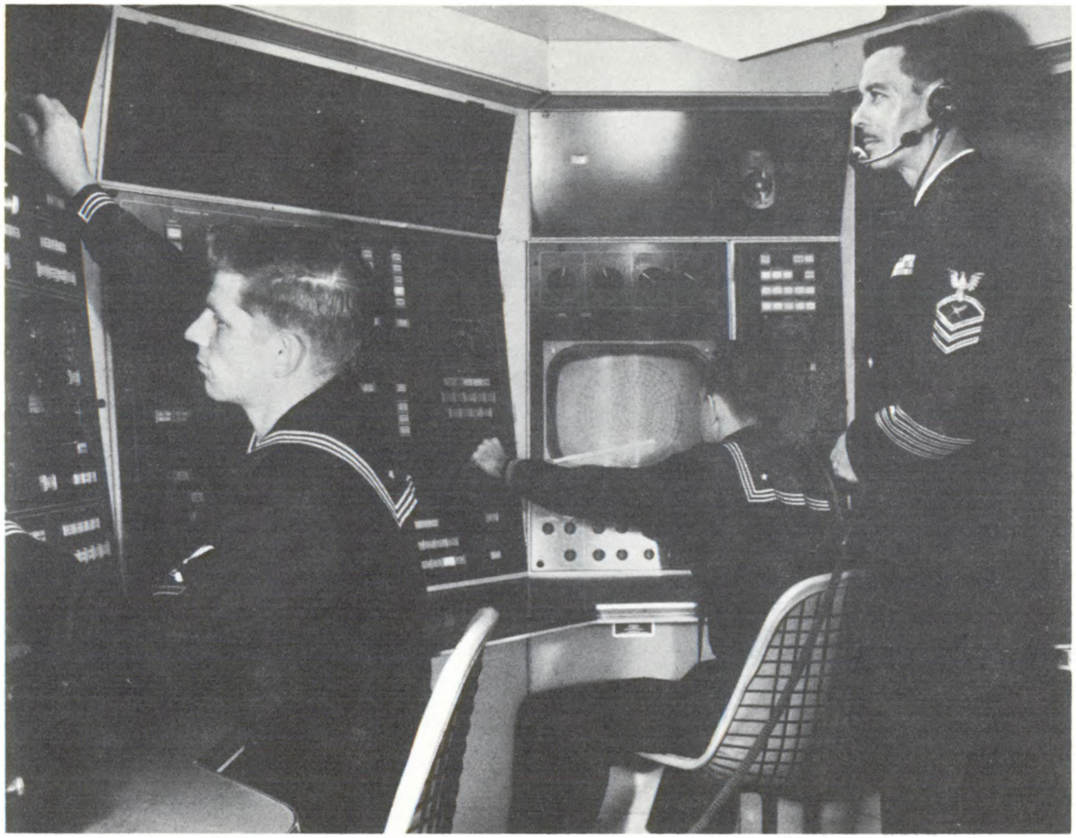

A console in the Navy's new HSS-2 helicopter flight and weapons simulator where crews are trained. See story on pp. 16 and 17.

IN THIS ISSUE

NAVAL RESEARCH reports highlights of technical progress in research by Navy laboratories and contractors and the development of important naval research facilities. The magazine is listed for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. Subscription price: $1.50 per year in U. S. and Canada; $2.00 per year, foreign; $0.15 per individual copy. Changes of address should be sent to Code 740, Office of Naval Research, Washington, D. C. The issuance of this publication approved by the Secretary of the Navy on 1 March 1961.

Artist's concept of the forthcoming Stratoscope-II telescope taking pictures of a planet. Story on pp. 1 to 11. (Drawing courtesy of Princeton University).