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NAVAL RESEARCH REVIEWS

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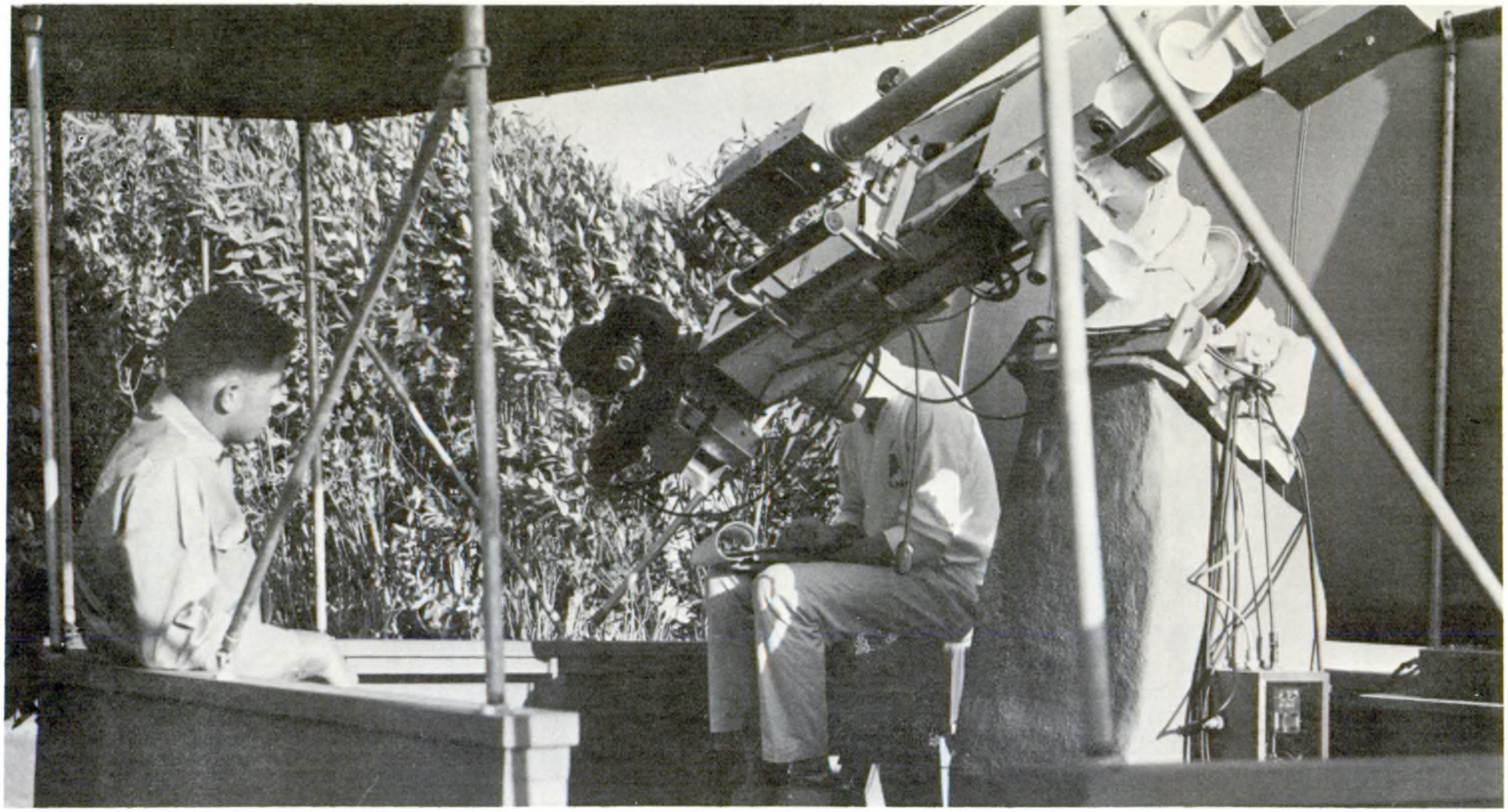

An optical flare patrol was conducted by NRL representatives at the Lockheed Solar Observatory, where the solar disc was viewed in the light of the red line of the hydrogen spectrum.

Project Sunflare II

T. A. Chubb*
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The Naval Research Laboratory recently completed by far the most successful of three series of solar flare experiments which began in July 1956 with Project Rockoon and continued in July 1957 and July-September 1959, respectively, as Project Sunflare I and Project Sunflare II. In the first series of experiments, 10 Deacon Rockoons were launched from the USS COLONIAL, 400 miles southwest of San Diego; in the second series, 12 Nike-Deacon plus 2 Nike-Asp rockets were fired from San Nicolas Island, 60 miles off the cost of California on the Point Mugu Range. In the series recently completed, 12 Nike-Asp rockets were launched from Point Arguello on the Pacific Missile Range. The objective of the experiments was to obtain new data on the physical nature of solar flares.

A solar flare, one of a group of phenomena comprising "solar activity," is a sudden, short-lived brightening of the solar surface in the neighborhood of a sunspot. Within a matter of minutes after its inception, a large solar flare expands over a hundred million to a billion square miles of the solar disc and flashes to peak brightness. It then decays more slowly, in half an hour to several hours, depending on its size. It is the cumulative action of the radiation present in solar flares which is believed to be the primary cause of radio fadeouts and geomagnetic storms.

By whatever mechanism, the effects of solar flares may be prompt or somewhat delayed. Prompt effects, such as radio fadeouts, are traceable in part to sudden disturbances in the upper atmosphere where most of the short-wavelength radiation from the sun is absorbed. Delayed effects such as geomagnetic storms, which begin about a day after a solar flare, result from the action of high-speed particles, which were blown out of the solar atmosphere at the time of a flare and arrived in the vicinity of the earth. The resulting magnetic changes in the effective field at the earth can induce large currents in power lines, telephone lines, and telegraph lines, causing distortion of communications and damage to equipment. If the mechanisms by which solar flares produce sudden ionospheric disturbances were understood well enough, it might be possible, for example, to predict the range of short-wave radio communications and perhaps eliminate the problem of untimely radio fadeouts. To improve our understanding of the physical nature of solar flares, Projects Rockoon, Sunflare I, and Sunflare II employed NRL's pioneering technique of rocket astronomy to observe directly the energetic radiations from the sun.

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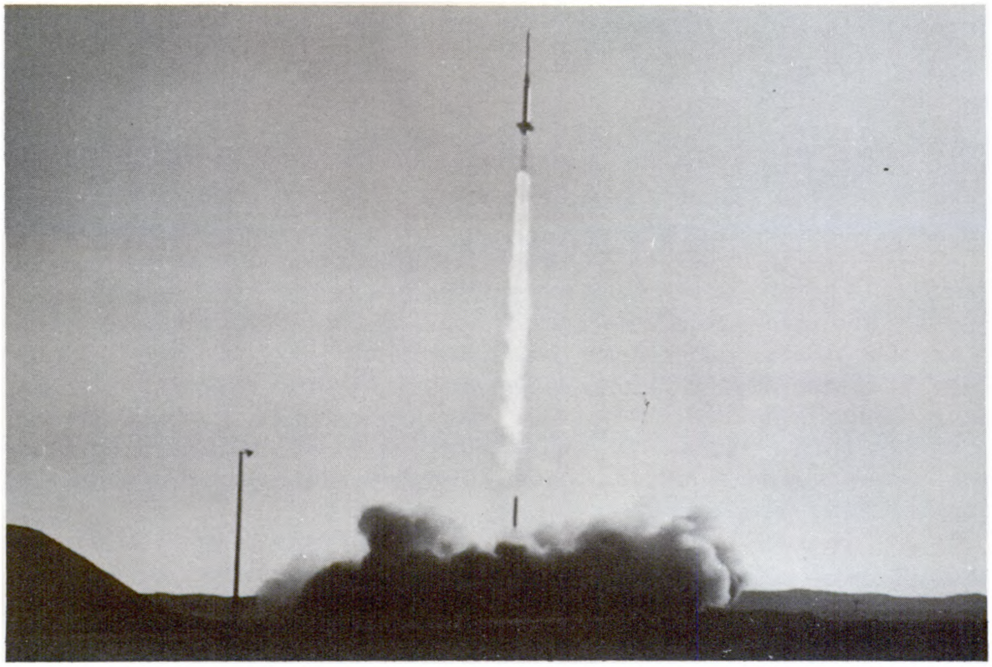


Figure 1—Nike-Asp rockets were used during NRL's Project Sunflare II to carry NRL's fact-finding instrument packages far above the absorbing atmosphere of the earth.

The Nike-Asp rockets used in the most recent experiments (Sunflare II) reached altitudes between 130 and 150 miles, far above the absorbing atmosphere of the earth. For the scientific experiments to be successful, it was necessary for a rocket to be launched as quickly as possible after the detection of a solar flare. Both optical and radio methods were employed for flare detection prior to launching operations, which were planned on a 1-minute countdown.

Optical observation of the sun's disc in the light of the red line of the hydrogen spectrum was carried out by a team of two NRL summer students, working at the Lockheed Solar Observatory in Los Angeles, who transmitted their observations and flare warnings to the firing site at Point Arguello by a private telephone line. Radio observations of ionospheric effects due to solar flares were conducted from the NRL van at Point Arguello. Observations of sudden short-wave fadeouts and sudden cosmic noise absorption at 18 Mc provided reliable indication of the occurrence of flares intense enough to cause ionospheric disturbances.

In all cases except for background measurement, an attempt was made to time the rocket firing to coincide with the expected maximum intensity of a flare. Three of the rockets were launched during flares, one reaching peak altitude during the maximum intensity of a Class 2+ flare, and five during various degrees of solar quiescence and minor activity.

The 55-pound instrument package flown in each of the rockets included a selected grouping of short-wave solar radiation detectors

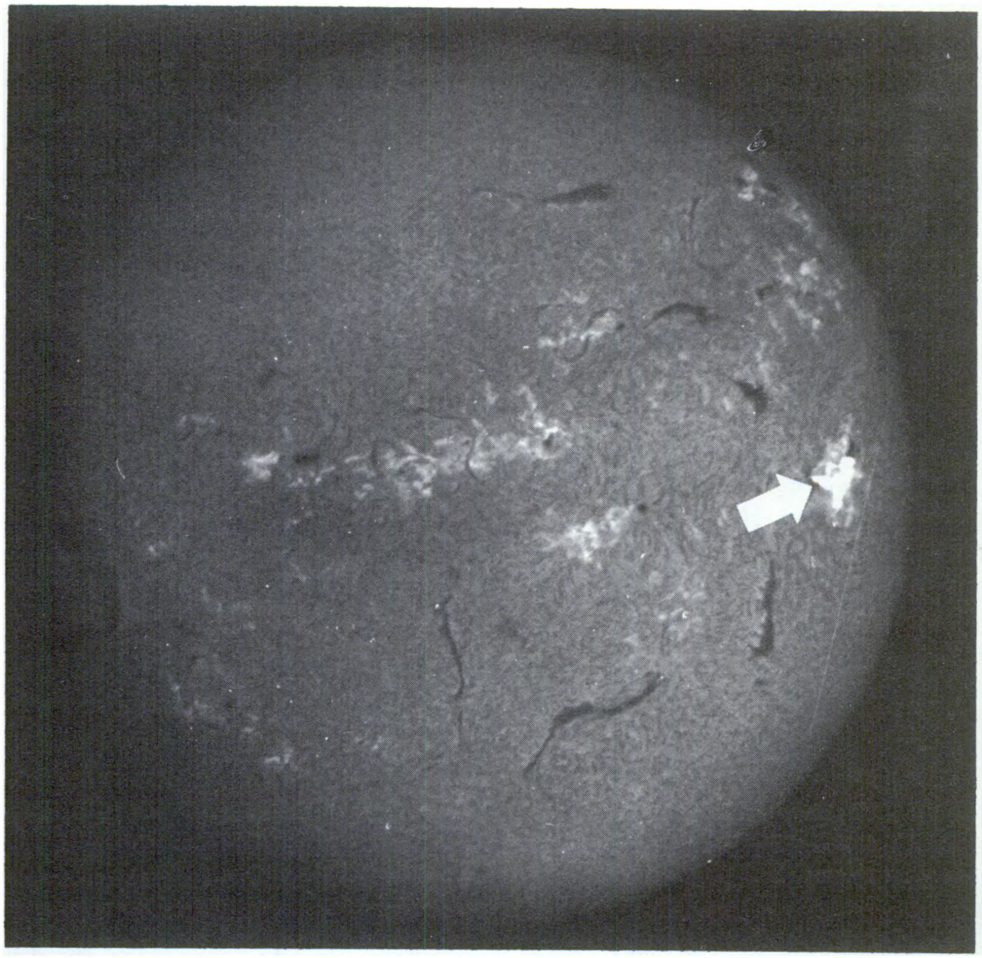


Figure 2—Arrow points to a flare on the disc of the sun which was observed September 1, 1959. The flare was photographed at NRL, in the light of H-alpha, by use of a Lyot heliograph installed at the Laboratory's "Bald Eagle" Observatory.

and two photocells, sensitive only to visible light, which were used for rocket aspect indicators. Among the detectors used for the main purposes of the experiment were one of two types of ionization chambers: either one fitted with a Mylar window and filled with dry nitrogen, designed for intensity studies of 44A-60A x-rays, or one fitted with a lithium fluoride window and filled with nitric oxide, designed for intensity studies of Lyman-alpha emitted at 1216A. Others in the grouping included two photon counters, one with a berryllium window and one with an aluminum window, designed for coverage of the 2A-8A and, 12A-18A region of the x-ray spectrum. Finally, proportional or scintillation counters, sensitive either to 2- to 20-kev or to 200-kev radiation, were employed for intensity studies of hard or penetrating x-rays.

Scientific data from each radiation detector were telemetered, continuously for about 8 minutes in the best flights, to tape and oscillographic recorders mounted in two NRL instrumentation vans especially equipped for rocket astronomy experiments at vantage points in this country or abroad.

The most important new information gained from the Sunflare II experiments was the discovery of extremely energetic x-ray quanta produced in the most active phases of large solar flares. X-rays with energies as high as 80,000 electron volts, about that of medical and dental x-rays, were detected above the absorbing atmosphere of the earth. The findings indicate that temperatures in the solar atmosphere or corona may be as high as 100,000,000° C. The most energetic solar flare radiations which had been actually detected previously were of the order of 6000 to 7000 electron volts, which correspond to temperatures in the solar atmosphere of about 10,000,000° C.

Earlier experiments performed by NRL had revealed that solar flares were accompanied by bursts of x-rays capable of penetrating to the base of the ionosphere (D-region) and producing enough ionization to cause radio fadeouts. There were indications from the first measurements made during Project Rockoon that there was a background of x-rays at high altitudes with energies extending to perhaps as high as 50,000 volts. In that series of experiments, however, the flux observed was so small that it was not possible to make directional measurements

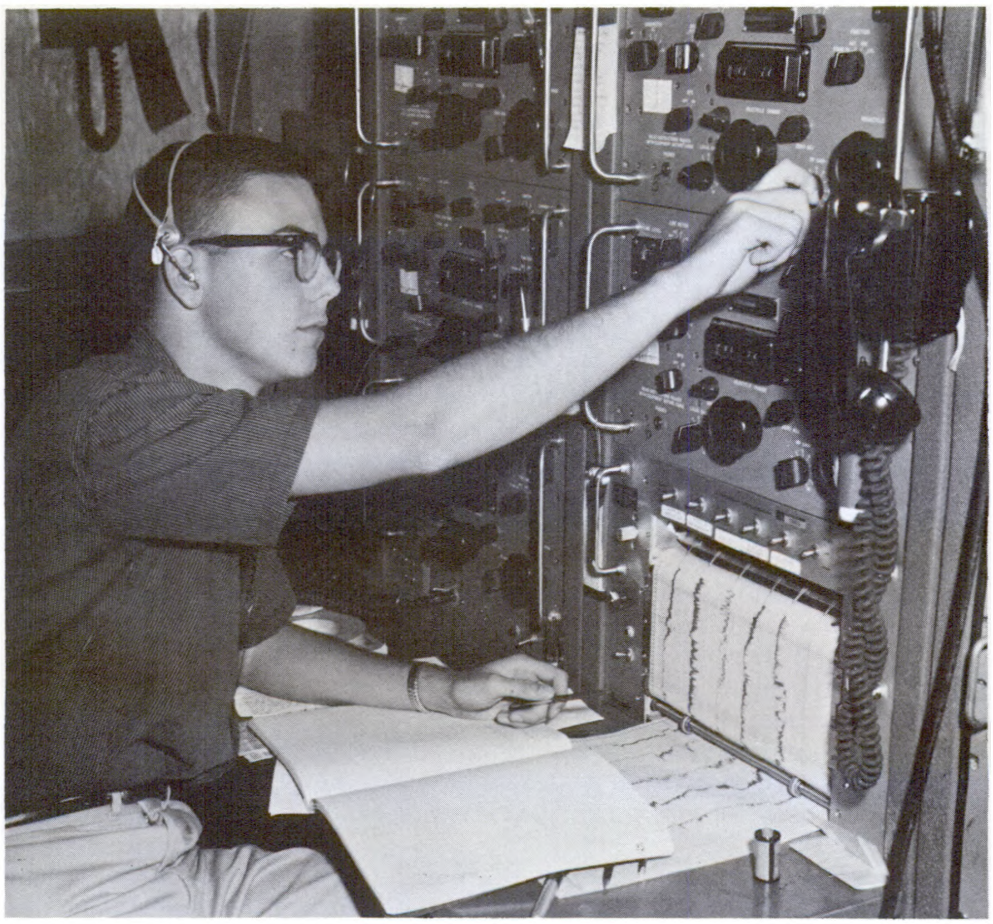
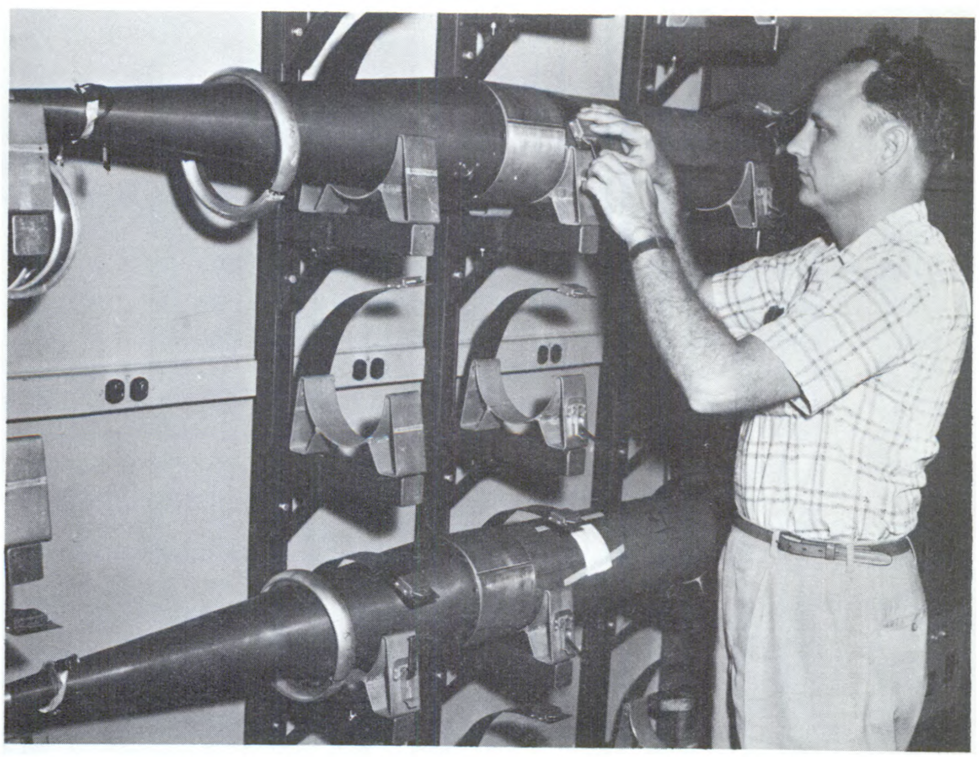


Figure 3--Radio observations of short-wave broadcasts were conducted from ground stations at Point Arguello to detect ionospheric disturbances and fadeouts which indicated the beginning and duration of solar flares.

Figure 4--Instrument packages were readied for installation (at right) and then mounted (below) where they could be checked out conveniently and easily withdrawn for quick attachment to the Nike-Asp vehicles.



which could identify the radiation with the sun. Theoretically, it was possible that such x-ray emission could originate in some celestial source or possibly as a secondary effect of the interaction of some Van Allen belt electrons with the atmosphere. The results of Project Sunflare II indicate that such x-rays are a normal solar emission. It appears, moreover, that the quiet sun emits a broad spectrum of x-rays extending to very high energies, but the flux is very low. The intense excitation that accompanies a solar flare evidently enhances the x-ray emission over the entire spectral range.

There are a number of theories on possible mechanisms for the generation of such high-energy x-rays, which are products of the interaction of high-speed electrons with the coronal gas or with magnetic fields at the surface of the sun. The connection of flares with sunspots implies that the acceleration process is associated with rapid changes of magnetic field strength. This action is similar to the induction process which produces current in an electrical generator. The higher the rate of change in the magnetic field, the greater is the induced flow of electrons, and the more energetic is the x-ray emission.

It has been proposed that the solar atmosphere contains Van Allen belts which trap energetic electrons accelerated in the vicinity of sunspots. These trapped electrons generate x-rays. According to one theory, a few hundred relativistic electrons per cubic centimeter in a coronal region with a magnetic field of only 10 gauss would produce, by the synchrotron process, x-rays strong enough to explain earlier rocket results.

Some astronomers (Russian), who have observed the strength of magnetic fields in flare regions on the sun with a resolution of a few hundred miles, have found that flares begin at null points in the regions of very high magnetic field gradients. The flare process wipes out these gradients and thereby dissipates the stored magnetic energy. This entire process resembles the magnetic pinch effect such as scientists at NRL and elsewhere are seeking in laboratory experiments to achieve controlled nuclear fusion. Only recently (August 1959), evidence was reported which indicated that NRL scientists may have already achieved a thermonuclear reaction on a laboratory scale. Nonetheless, theory indicates the possibility of producing x-rays of energies as high as several million volts by such a mechanism in the flare phenomenon.

The mechanisms proposed by different theories predict widely different values of the x-rays emissions accompanying a solar flare. The information obtained from Project Sunflare II may provide enough data on the spectral energy distribution of the x-ray emission to furnish a clearer understanding of solar flares than heretofore possible.

The experiments conducted under Project Sunflare II were supported by a grant of $250,000,000 from the National Science Foundation as part of the United States effort in the International Geophysical Cooperation, 1959. The Laboratory is proud of the results of Project Sunflare II.

Ed. Note: The information contained in the foregoing is of timely interest in conjunction with an article in last month's issue, "Threat to Manned Space Flight," by Malcolm D. Ross, ONR's Harmon Trophy and DFC balloonist.

Yankee Ingenuity

Ralph G. Eldridge
and
CDR Edward F. Leonard, USN

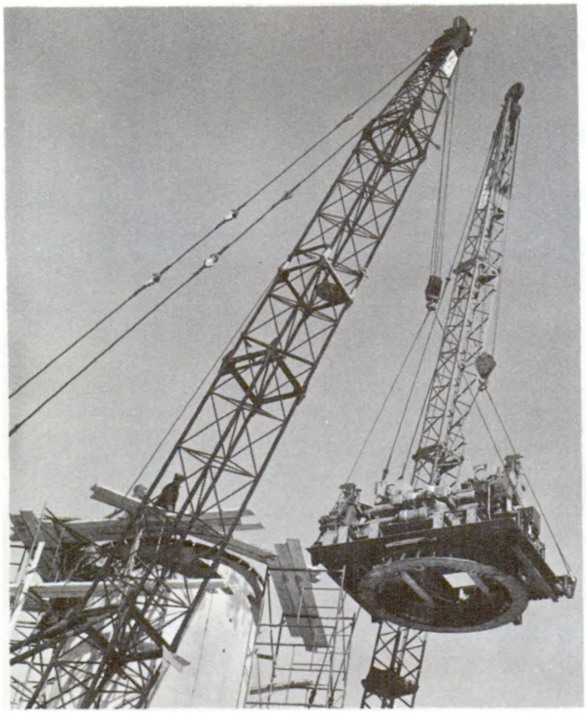
Navy Representative's Office, M.I.T. Lincoln Laboratory
Lexington, Massachusetts

Although the staff of M.I.T.'s Lincoln Laboratory hail from many parts of the United States and corners of the world, working in historic Lexington and living in old New England must have influenced some members to think in terms of Yankee frugality and ingenuity. Ingenuity may be defined as "inventiveness; skill in devising or combining; cleverness of design or contrivance." Certainly the transformation of World War II gun mounts into superior steering mechanisms for radar antennas may be termed ingenuity. This is the story of how potential junk was revitalized to become a part of our scientific assets in this embryonic space age.

It all began last summer when an urgent need developed for an improved antenna steering system to support research being carried out by the communications staff at Lincoln Laboratory. What was needed was an accurate steering system fast enough for use in tracking a missile at a launching site and yet slow enough for use by the communications staff in following the sun. Because time was important, potential use of available commercial antenna control systems was investigated. In the course of the study a former shipyard employee commented that during World War II he had worked on a system which might do the job. He was referring to a 5-inch Mk-2 gun mount. At first there was some skepticism, but a feasibility study indicated that these old mechanisms were worthy of consideration. Their extraordinary pointing accuracy had been demonstrated earlier at the Naval Research Laboratory, where a 5-inch gun mount was used for mounting a 50-foot radio telescope, but in this case high-speed steering capabilities were not essential so they were not exploited.

When the first four gun mounts—stripped of all bulk and weight not essential to their new use—arrived at Lincoln Laboratory, a small company of specialists, called ORD/ONICS, set them up and ran them through a complete "sea-going" type of test to determine their operating characteristics. These findings were then used by Lincoln engineers to plan the necessary modifications for converting the gun mounts into antenna control systems. The modifications were varied, of course, to meet the specifications dictated by the individual research programs.

The principle of operation for these gun mounts is a mechanical servo-loop which actuates a hydraulic drive system. After the mounts had been stripped down and modified for automatic control, some of the advantages of this hydraulic system became apparent. One advantage is the low inertial forces involved; the antenna system can be pointed

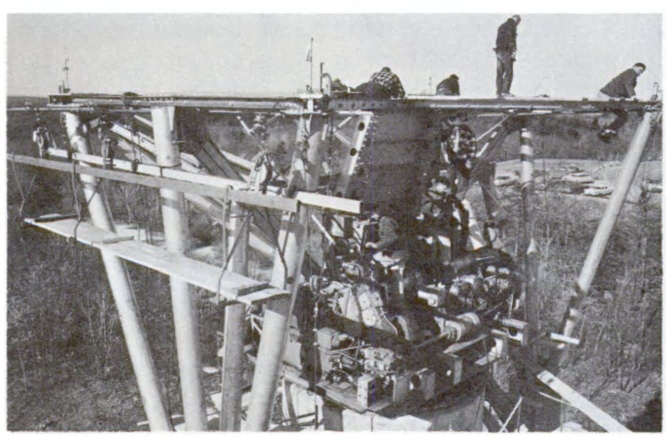


A modified 5-inch gun mount is being hoisted up to the top of the 35-foot reinforced-cement pedestal at Millstone Hill Radar Site, Westford, Mass. An inverted gun-mount stand secured to the top of the tower serves as a mating flange.

quickly and accurately with very little backlash or overshoot. The gun-mount servomechanism is capable of a maximum change of 15° per second in elevation and 25° per second in azimuth. Even modification and addition of the antenna, feed horn, and other structures reduced this performance only slightly so that their present capabilities still exceed the most rigorous requirement placed on tracking radar for following missiles (6° to 8° per second). Slow speeds, necessary for following the sun, were accomplished by the selection of the proper gear system.

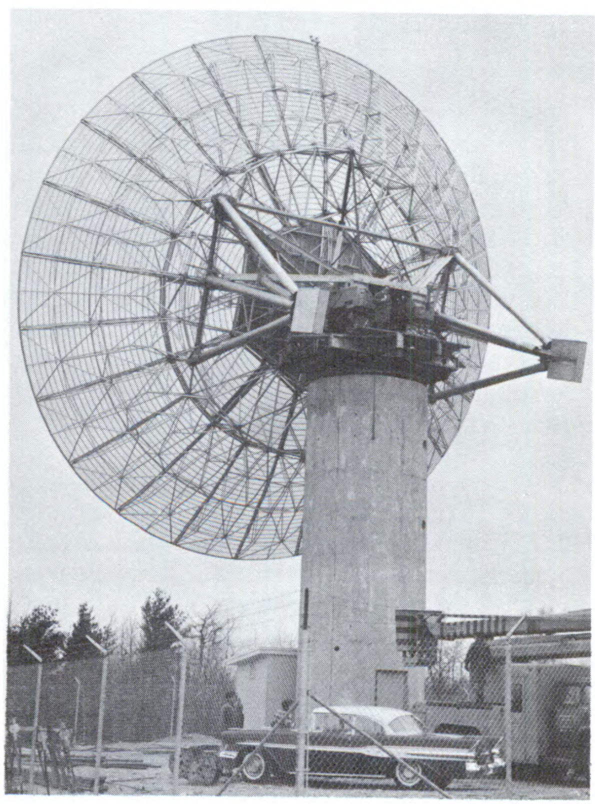
In addition to the increased capabilities in tracking, use of the gun mounts resulted in a considerable saving in money and scientific man power. These old gun mounts can be put into operating condition in only two to four weeks and at about one-twentieth the cost of available control systems—depending, of course, upon the degree of sophistication in auxiliary apparatus necessary for the particular application. Furthermore, the modified gun mount appears to be as equally adaptable as other radar control mechanisms.

The accompanying photographs show the integration of a 5-inch gun mount into the radar system at Millstone Hill Radar Site, Westford, Massachusetts. The modified mount is secured to the top of a 35-foot



Prefabricated counterbalance arms and antenna mounting structure are secured to the reinforced gun slides.

After the support structure is in place, the 60-foot dish is positioned prior to final mounting of the antenna structure.



Rear view of the 60-foot antenna, counter balance arms, and mounting structure on the gun mount.

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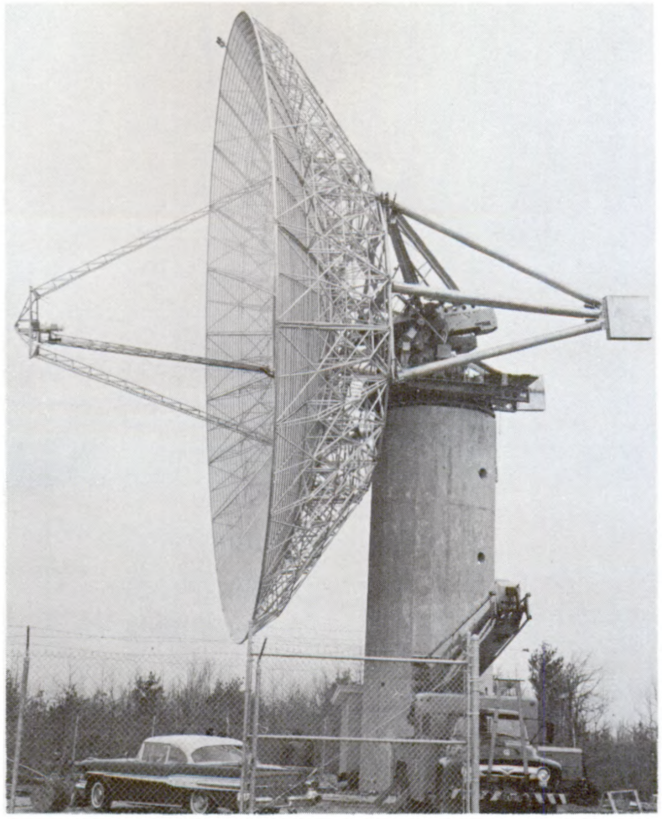


Side view of the 60-foot antenna, showing the final assemblage of the feed horn, counter-balance arms, the Navy gun mount.

reinforced-cement pedestal. The ring-gear track, an inverted gun-mount stand secured to the top of the tower, furnishes an excellent mating flange for the active gun mount. Much of the prefabrication of antenna back-up structure, mounting assemblies, and other parts was made on the gun mount in the Lincoln Laboratory yard adjacent to the engineering facilities, prior to assembly at Millstone Hill. During tests of the tracking platform and the auxiliary apparatus, personnel from Mobile Ordnance Service Unit Number Two were particularly helpful in "ironing out the bugs" peculiar to the gun mounts. This procedure afforded a good opportunity for evaluating assembly techniques and gun-mount performance before shipment to a more remote radar site.

From the modest beginning of supporting and training a 28-foot "dish" for communications research to that of steering a 60-foot antenna to track missiles for the radar group, the modification of twin gun mounts has proved to be a fruitful expenditure of effort. Not only has there been a considerable financial savings (their relegation to the junk pile would have yielded only the current price for scrap), but there has been no sacrifice in performance. The modified gun mounts have met the rather stringent requirements imposed by the scientific staff of Lincoln Laboratory; yet, at the time of this writing, their possibilities have not been fully exploited. Even more ambitious ideas are undergoing speculation; only further study will determine their feasibility.

Also, gun mounts of smaller size appear to have desirable characteristics as precision optical-tracking platforms.

The utilization of surplus property can be a profitable endeavor for our national economy. Moreover, there is a certain emotional satisfaction derived from seeing retired relics of war called to active duty in this era of sensational new advances in science.

ACKNOWLEDGEMENTS

Because this short dissertation encompasses the efforts of many, the authors wish to acknowledge the cooperation of the Lincoln Laboratory staff in making this information and the photographs available. On the other side of the ledger, many people in the Naval Establishment contributed their share in helping to procure the Navy gun mounts.

New Radio Telescope at the University of Michigan

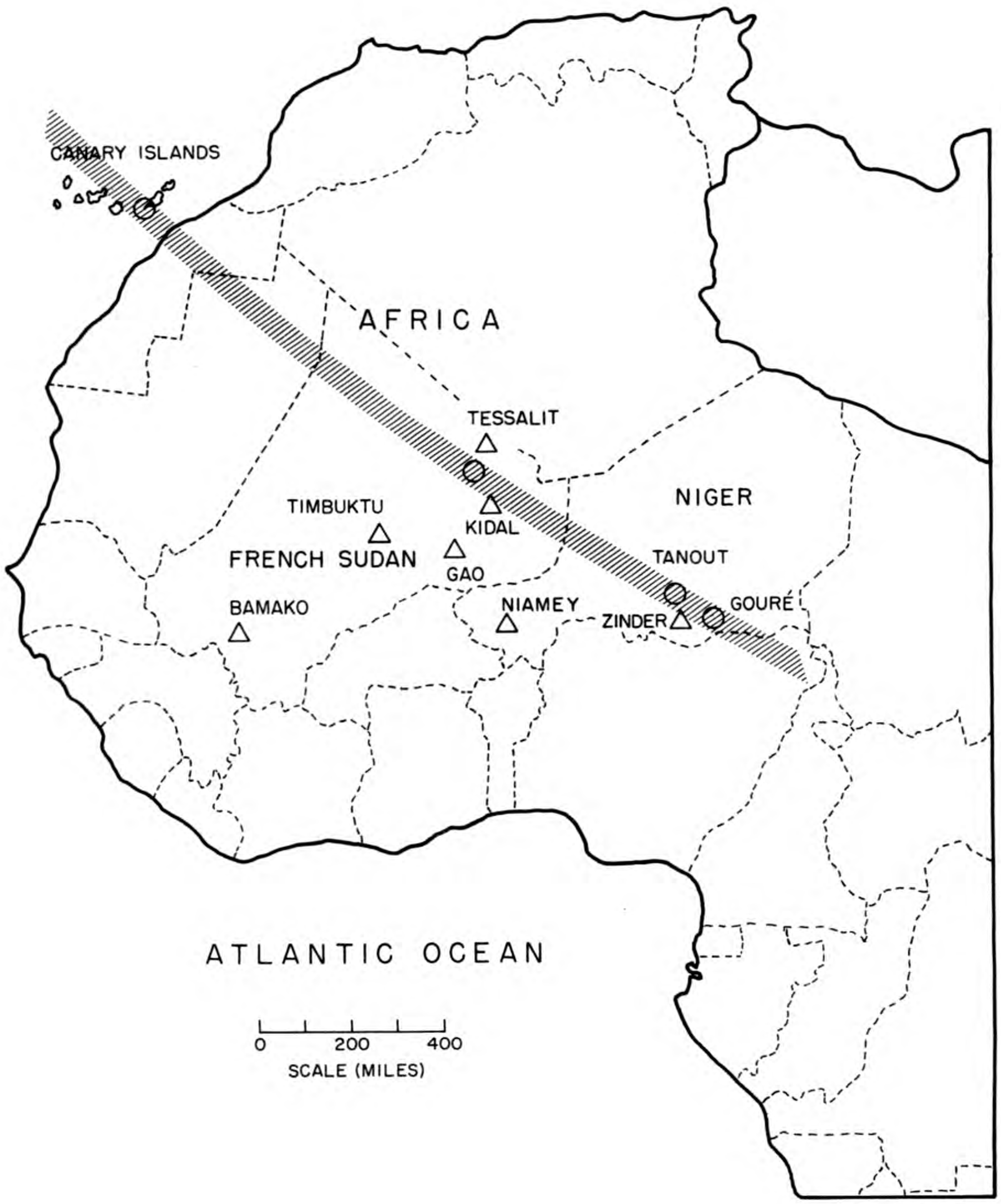
The first large radio telescope in this country designed specifically for solar research was dedicated on October 7 by the University of Michigan. The new instrument, which is among the larger steerable radio telescopes in the world, was built with the support of the Office of Naval Research.

The 85-foot parabolic radio telescope is part of the University's Peach Mountain radio astronomy facility, located about 16 miles northwest of Ann Arbor. The facility, begun 4 years ago, includes a 28-foot parabolic antenna which has been in operation since August 1957. Research is conducted under contract with the Office of Naval Research as part of ONR's broad program in radio astronomy.

The new dish on top of Peach Mountain will permit comprehensive studies of radio emissions from the sun, particularly the bursts of radio-frequency noise that often accompany solar flares. Studies will be made in collaboration with optical observations by the University's McMath-Hulbert Observatory, where investigation of solar flares has been a major field of research for the past twenty years.

The large antenna, weighing over 155 tons, is equatorially mounted. By being fully steerable, it can track the sun from sunrise to sunset. This is an important factor, since solar activity is constantly changing, and no two solar events are exactly alike. Solar effects lasting for hours can be observed. The radio telescope can track the sun during poor weather, which frequently bars optical observations.

The versatile 85-foot antenna will also be used for the studies of galaxies and extra-galactic radio sources, including those at 21 centimeters. Incorporated in the large dish is a newly developed broad-band, traveling-wave-tube radiometer with a proven performance 10 times better than that in other similar receivers. This receiver will make it possible to detect and study a much greater number of celestial radio sources, including radio emission from ionized hydrogen nebulae, planetary nebulae, and nonthermal radio sources. It will also permit operation of the dish at the shorter 3-centimeter wavelength. Another feature of the new telescope is its radiometer, incorporating a ruby maser (a solid-state device for microwave amplification by stimulated emission of radiation), developed by the University of Michigan. This device will increase the normal range of the instrument by about three times.



Map of French West Africa, showing the path of the solar eclipse. Although scientists from the University of Minnesota never reached Timbuktu, that renowned spot of story and song, they did have equipment at three nearby sites—Gouré, Tanout, and Kidal-Tessalit—with which they made measurements on the light from the sun's corona.

Navy Eclipse Expedition to West Africa

LTJG Paul D. Maycock
Office of Naval Research

Burdened with nearly ten thousand pounds of complicated scientific equipment, nine physicists visited French West Africa to conduct measurements on the polarization of the sun's corona during the total eclipse on the second of October. Dr. Edward P. Ney, of the University of Minnesota,* led the expedition to three remote sites on the edge of the scorching Sahara Desert in the Niger and Sudan Republics. At all three sites the scientists were able to make their delicate measurements on the light from the sun's corona.

It will take a month or more to analyze the data completely, but hopes are high that enough information was obtained to aid in the evaluation of a new theory of the solar corona recently proposed by Professor Ney and his associate, Dr. Paul Kellog. The Ney-Kellog theory predicts that the solar corona consists of trapped charged particles moving in the magnetic fields of the sun, much like the recently discovered Van Allen radiation belts of trapped charged particles surrounding the earth. This concept is different from the current model of the corona, which predicts a mixture of electrons, protons, and heavy elements, at a temperature of a million degrees Kelvin, in hydrostatic equilibrium in the gravitational field of the sun. The data taken on the eclipse may make it possible to determine which of the theories is more nearly correct. The information is especially important in our present stage of space probe and satellite research.

The first phase of this exciting adventure began on July 12, when Professor Ney and William Huch, of the University of Minnesota, Professor Jacques Blamont, of the Ecole Normale Superieure, Paris, and LTJG Paul D. Maycock, of the Office of Naval Research, visited Africa to make preliminary arrangements with the local officials. At that time they established prospective sites and reserved trucks, gas, food, and other essentials for the actual expedition. Three interesting sites were chosen, all lying in the path of totality (see map). They were Gouré and Tanout, in Niger, and another between Kidal and Tessalit, in Sudan. Arrangements for the exploratory visit had been made in advance by Professor Blamont. Earlier, he had exchanged cablegrams with the presidents of the two republics, establishing the mission and alerting the local officials. Undoubtedly these preparations were responsible for the success of the expedition, because complete cooperation was received from the Presidents of Niger and Sudan, their countrymen, and the French Military.

*The expedition was sponsored jointly by the Office of Naval Research, the National Aeronautics and Space Administration, and the National Science Foundation.

The first site visited was the small village of Gouré, 110 miles from the nearest airport at Zinder, where six thousand natives, living in clusters of thatched huts, raise peanuts, sheep, cattle, and camels. Dr. Ney and his crew arrived at Gouré on the 16th of July, after several hours of kidney-bruising driving, and were met by the local officials and a group of very excited natives. Evidently one of the cables had either contained the wrong information or been misunderstood, because the villagers were expecting the eclipse to occur on the very next day, just as soon as the equipment was ready. This called for a hurried discussion, during which the chief of the village came up with a brilliant suggestion. Since this was the first week of the rainy season, which normally lasts until September 30, the natives would be told that, in order not to interrupt the crop planting, the eclipse would be delayed; then after the labors of the wet season were over, they would be rewarded with the eclipse. This met with their approval, and that night the drums relayed the story to the outlying huts that the eclipse was off!

The second site established was at Tanout, also located about 110 miles from the city of Zinder. Mr. Huch and LTJG Maycock took charge of arrangements here, while Professors Ney and Blamont went on to the Kidal-Tessalit site. To reach Tanout required more bouncing over a rain-soaked strip of gravel road rutted with corduroy-like bumps. Here, in a village much like Gouré, a Frenchman living in an adobe set of buildings graciously consented to the placement of telescopes on his unused tennis court.

The third site was not located in a city but on a patch of sand on the desert floor, exactly on the centerline of the eclipse, about midway between Tessalit and Kidal. While traveling to the desert site, Dr. Ney was injured in a truck accident, breaking a leg, seven ribs, and a collar bone. Prof. Blamont arranged for the private plane of the President of Niger to move him to a French military hospital in Niamey. Two days later, when he was able to travel, he returned to Minneapolis to recuperate.

Room at Gouré, where members of the expedition spent their first night in Africa

Expedition visits local market on route to Tanout

On September 18 Professor Ney and his colleagues boarded a chartered DC-4, once again headed for Africa and, this time, an eclipse. Prof. Ney, Dean Athelstan Spilhaus, of the University of Minnesota Institute of Technology, Professor Blamont, and James Stoddard manned the Kidal-Tessalit site; Dr. Kellog, Raymond Maas, and Charles Reinert were at Tanout, and William Huch and Rudolph Thorness operated the telescopes at Gouré. Amid swarms of scorpions, 130-degree temperatures, pelting sand storms, and curious natives, the scientists set up their equipment for the measurements on the long-awaited eclipse.

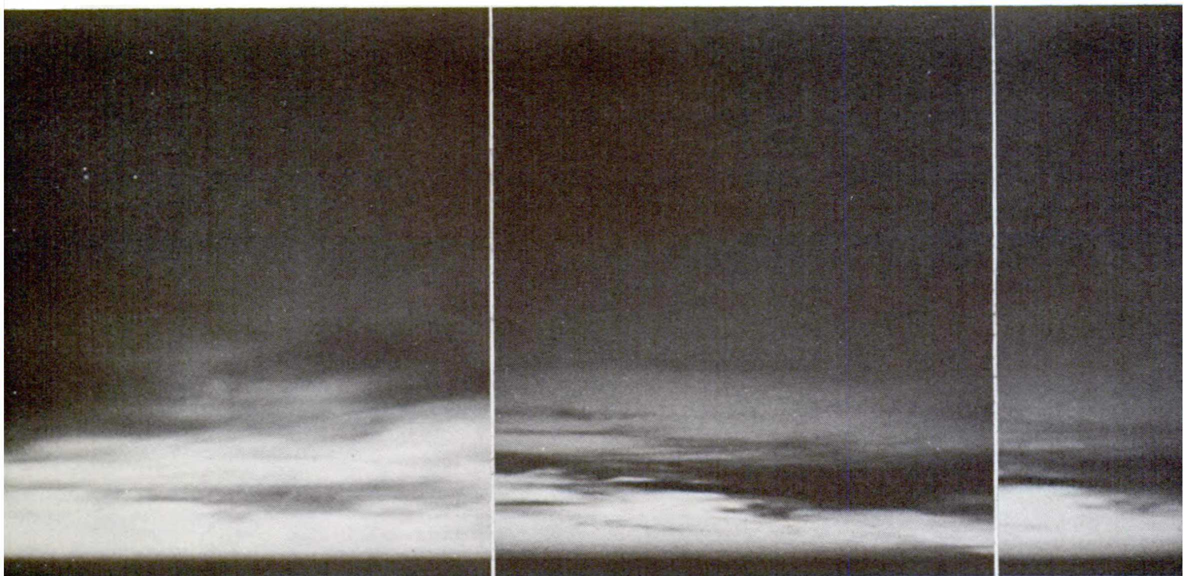
The problems of setting up the complicated scientific equipment were formidable. At each site provisions had to be made for refrigerating and processing 2000 feet of film as soon as possible after the eclipse and for cooling photomultiplers with dry ice. Even air-conditioned tents were shipped from America.

At about noon on the second of October a black shadow crept over the Canary Islands onto the African mainland and over the three sites. Uninformed nomads frantically sought refuge in the bushes and ditches as the sun was slowly and awesomely blotted out and the day turned to night. While masses of people prayed, children screamed with glee, drums rattled, and camels ran amok, the American scientists worked feverishly to get three minutes of scientific data with their electronic telescopes. Then it was all over. Films were stored, tents broken down, and equipment packed; and the scientists boarded their DC-4 for the return flight to America.

The African people of Gouré, Tanout, Kidal, and Tessalit will perhaps never forget the day that the American physicists visited their cities. Needness to say, neither will the physicists!

Native huts in the city of Goure

Site at Boure was built on foundation of unfinished building. Here crew inspects with local officials.



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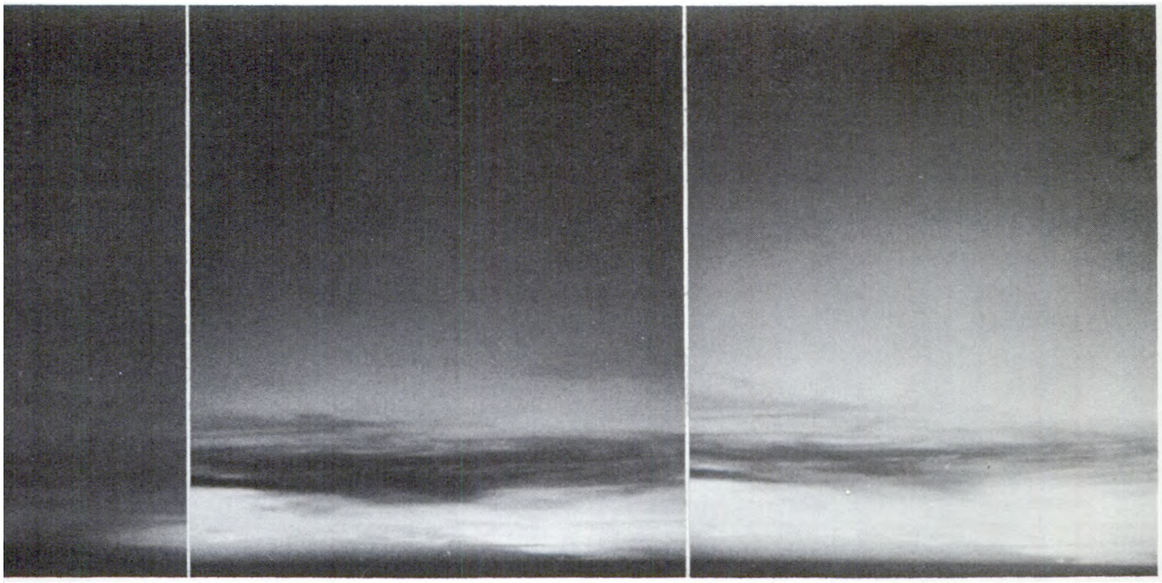
Photographs of the sky before sunrise, during the solar eclipse of October 2, 1959. Thin clouds precluded the possibility of detecting the zodiacal light during totality. The first frame shows the sky in early dawn, about one-half hour before sunrise and 10 minutes after totality, illuminated by the sun in partial eclipse. In the second the sky has darkened, because the reduction in sunlight produced by the advancing eclipse much more than offset the brightening caused by the approach of sunrise. The third

The Dawn Sky During the Solar Eclipse

Richard Tousey
Naval Research Laboratory

Many expeditions to study effects produced during a total eclipse of the sun have gone forth from the Naval Research Laboratory. To reach the path of totality, scientists and photographic teams have travelled over much of the globe, to the Aleutians, to Kartoum on the Upper Nile, to the Baltic Coast of Sweden, to Colorado, and, in 1958, to the South Pacific close to the Danger Islands. In 1959 they chose Ontario, a point near home, and this time the objectives were the zodiacal light and the airglow. In hopes of cloud-free skies, observations were made from NRL's new Flying Laboratory, a WV-2 super-Constellation. The base of operations would have been NAS, Patuxent River, but warnings of hurricane Gracie sent the plane and its crew scurrying to NAS, Glenview, Illinois, where scientists and photographers finished the job of installing and checking out the equipment.

The faint and elusive zodiacal light is thought to be produced partly by sunlight shining on dust in interplanetary space and partly by matter in the outer reaches of our atmosphere. Clouds of electrons that propagate the form of radio static known as whistlers may contribute another portion. The zodiacal light is usually seen low in the sky in the plane of the ecliptic just before the sky commences to brighten at dawn. At-



10:53 10:57 Zebra

hows the actual shadow, 38 miles in diameter, cast in the sky by the moon during otality. To those who watched, it appeared as a spectacular dark-brown pillar which eemed to fan out upward in accordance with a perspective view from below of the early cylindrical shadow. The fourth frame was exposed just after third contact, hen the total phase was over. Thereafter the waning of the eclipse and the approach f sunrise combined to brighten the sky with great rapidity.

tempts to study it close to the sun, where its brightness should increase as it merges into the corona, have always been foiled by the light of the sky, even during a solar eclipse. In the attempt on October 2, by choosing the flight plane so that the eclipse would occur when the sun was 6° below the horizon, it was hoped that the sky would be nearly free from veiling light. With the darkness created both by the eclipse and by the earth's shadow itself, the zodiacal light might well be exposed to view.

In the second experiment it was planned to measure the green (5577Å) and red 6300Å) airglow lines of atomic oxygen, emitted by the upper atmosphere itself. In the night sky the green line is excited chemically by the collision of three oxygen atoms, but the process by which the red line is produced is not completely understood. During twilight, then the sun illuminates the upper atmosphere, photochemical reactions take place, enhancing the red line, but not, so far as is known, the green. A further understanding of these reactions was expected to result from measurements of the changes in airglow emission intensity when the shadow cast by the moon came down through the atmosphere, bringing to a sudden halt the reactions produced by sunlight.

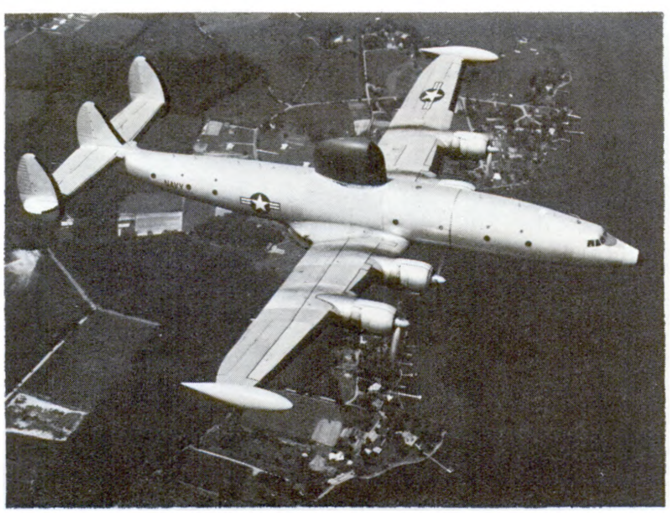
Shortly after midnight on eclipse day, October 2, the "Connie" left Glenview for several predawn runs to determine ground speed, wind velocity, and drift angle, so that the final run during the eclipse could be made with the greatest possible precision. LCDR B. R. McClelland flew the aircraft, while copilot CDR Mark D. Montgomery manned the navigator's station. The writer enjoying the luxury of the copilot's chair, watched the progress of twilight and the paradox of dawn going into reverse, as totality approached, looked for the zodiacal light, and tape-recorded what he saw. Crouching in the little space remaining in the cockpit was an NRL photographer, making sure that his 35-mm robot camera, photographing the sky dead ahead, was operating as it should.

Farther back in the aircraft, Dr. D. M. Packer and his assistants watched over the airglow photometers. These were built around two Lyot birefringent filters, similar to those used for the study of solar flares, but designed to isolate the oxygen lines rather than the red line of hydrogen that is the characteristic emission of a flare. The telescopic photometers were mounted looking up nearly vertically through a pressure-tight window, into the sky over the plane, and awaiting the descent of the moon's shadow into their fields of view. Surrounding them was a maze of amplifiers and recorders, under the watchful eyes of two scientists from New Mexico State University who had prepared the electronic part of the instrumentation.

On the final run the aircraft was flown at 15,500 feet from Windsor, Ontario, towards Niagara. The schedule took it directly under the shadow cone, with a heading toward the point on the horizon over which the sun would rise. At 10 hours 49 minutes Zebra, the position was directly over Waterford, Ontario. This was the time when the center of the moon's shadow cone reached the 100-km level in the upper atmosphere, and Waterford was at the longitude to place the sun 6° below the horizon.

The sun in eclipse could not be seen, of course, but the sky presented a strikingly beautiful spectacle, which is hardly done justice by monotone photographs. The sequence of shots shown here were printed from negatives in full color.

Unfortunately, the zodiacal light could not be seen. Thin clouds far to the east, left over from Gracie, brightened the sky and obscured the light from outer space. Perhaps only from a rocket or satellite will it be possible to map completely the luminescence of this forbidden region close to the sun.



NRL's Flying Laboratory, normally employed in wave-propagation research, from which scientists studied the predawn zodiacal light and airglow associated with a solar eclipse.

A Successful Marriage of Documentation and Research*

When a scientific investigator embarks on a new project he is frequently haunted by the suspicion that much of the background research may already have been done, and that others may already have stumbled into the developmental pitfalls and found their way out. But where is it published? Who has the Report? Faced with the staggering volume and wide dispersion of existing and cumulative technical information, the investigator has to do one of two things. He may put a man or a team on a "literature search" that can last for many months. Or he may ignore prior research and push ahead on his own. Either way involves a waste of a priceless national asset—scientific manpower.

Recognizing this major shortcoming of American science, the Office of Naval Research has encouraged the establishment of information "clearing houses," whether general ones such as ASTIA, or ones devoted to specific fields, such as the Thermophysical Properties Research Center described in the following article.

ESTABLISHMENT AT PURDUE

The plan for a center on the thermophysical properties of matter was conceived in early 1955 within the School of Mechanical Engineering at Purdue University. It was developed into its present form as a result of close consultations and the cooperation of some 30 organizations representing nonprofit research foundations, governmental research agencies, industrial organizations, national technical societies, and educational institutions of higher learning. Upon the unanimous concurrence of all the people consulted, and with the financial support of a number of farsighted organizations, the Center was established on January 1, 1957. The following four points set forth TPRC's over-all position and outlook:

- The program undertaken by TPRC is most timely and indispensable because, as everyone knows, the present limitations in many technical developments are often a direct result of the scant knowledge of the properties of materials. Engineering developments in the years just ahead must be closely linked to the research that is done today if they are to contribute to a better understanding of the properties and behavior of materials.

- The best and least expensive way of meeting the present and future needs for adequate information on thermophysical properties is through a continuous, systematic program cooperatively financed by a large number of industrial organizations and governmental research agencies.

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*Taken from a report of the Thermophysical Properties Research Center prepared by its Director, Dr. Y. S. Touloukian.

- For most effective operation, such an organization should maintain a degree of specialization and should embody the functions of both research and documentation. Neither of these by itself is adequate to serve the complete needs of science and technology.

- Organized thus, TPRC hopes to become a world center for the collection, analysis, correlation, and dissemination of thermophysical properties information.

THE TASK AT HAND

TPRC's over-all activities fall into two distinct and separate categories: documentation and research. These two facets of TPRC's work have already taken form; and while their conduct and end products remain clearly different, the close relationship between physical research and research in documentation is well recognized.

After 2 years of operational experience, consultations, and careful consideration of the total task at hand, it was decided that TPRC will concern itself with 30 thermophysical (transport and thermodynamic) properties for all matter. Typical properties of interest are: (1) thermal conductivity, (2) specific heat, (3) viscosity, (4) emissivity, absorptivity, reflectivity (total and spectral), (5) diffusion coefficient, (6) thermal diffusivity, and (7) Prandtl number.

It should be made perfectly clear at this point that while TPRC attempts to keep abreast on all the available world knowledge concerning these 30 properties for all matter, in no way does this imply that TPRC's scope of research and study will at any one time encompass either all 30 properties or all matter. In other words, it would be completely unwarranted to interpret the statement of declared sphere of interest with the scope of current or planned research activities. To date TPRC's efforts have been concentrated on the seven properties listed in the preceding paragraph.

The first year of activity concerned itself primarily with the development of the tools necessary to carry out the work ahead. It was clear from the very outset that in view of the very large volume of material involved, some kind of mechanized information storage and retrieval system had to be developed. Furthermore, it was also clear that since the Center was not in a financial position to acquire the optimum computer facilities, it had to design its operations around the facilities already available at Purdue University.

RESEARCH ON DOCUMENTATION

The first order of business was the development of a system of substance classification which would be adequate for the storage and retrieval of information on thermophysical properties. Existing systems, some old and some new, were carefully studied, and it was decided that none of them was adequate for the Center's needs. We had to develop our own.

To accomplish its function, the TPRC classification schedule departed entirely from the concepts of commonly accepted substance classification procedures which are based on association of substances either by their chemical or physical similarity or by the similarities in their uses or applications. The system classifies individual substances by formula and name, and yet it is capable of handling information which may not specify any specific name of a substance. For the past year the system has been used in coding information for mechanized processing. It has a potential capacity for handling 10 million different substances.

Procedures used for machine processing of thermophysical properties information are dependent, to a large degree, on the classification system used for the organization of information. The Datatron digital computer, with two additional magnetic tape units, is used by TPRC for its mechanized operations.

The code system for mechanized storage and retrieval utilizes 13 fields of information and possesses the following characteristics: (1) accommodates 100 million individual substances; (2) differentiates between 8 languages; (3) identifies 9 conditions of physical state of a substance (i.e., solid, liquid, gas, powder, sintered, etc.); (4) differentiates between 7 areas of subject interest (i.e., theory, experimental techniques, data, etc.); (5) accommodates the coding of up to 99 properties (TPRC will concern itself with only 30 properties); (6) specifies journal name, volume, number, series, pages and year; and (7) uniquely identifies each entry by a TPRC serial number which has a capacity of 10 million individual scientific and technical documents. The system's over-all features and the procedures used in mechanized storage and retrieval are discussed in detail in TPRC Report 6, July 1958.

THE SEARCH FOR INFORMATION

Parallel with the activities just outlines, early in 1957 TRPC initiated the search for and collection of thermophysical properties information. Information comes to TPRC primarily through the following five channels:

1. The open literature (scientific journals, monographs, books, etc.).

2. Reports sponsored by governmental research organizations (ONR, OSR, OOR, AEC, etc.).

3. University search (reports, disserations, etc., including masters' theses).

4. Reports of industrial research organizations and research institutes

5. Information received from cooperating major research centers outside of the United States.

Item 5 deserved special attention, as it is believed that potentially this channel of information will constitute the most effective procedure for securing up-to-date information on thermophysical properties research through the world. Arrangements are already underway with major centers in France, England, and Germany.

To date, the major part of the information has come through Channels 1 and 2. The open literature is searched through the 25 abstracting journals selected for identification of reference sources of interest. As a result of this initial search effort, approximately 22,400 items of literature, from 1300 scientific and technical journals, have been located pertinent to the seven thermophysical properties currently considered.

In its early efforts of searching through abstracting journals, TPRC recognized the tremendous task it faced to cover the back years of all 25 selected abstracting journals while constantly keeping abreast of current issues. This problem was studied in detail, and a technique was developed for the effective and rapid search of major abstracting journals. The findings of this research were presented at the International Conference on Scientific Information, NAS-NRC, November 17-28, 1958, in Washington, D. C.

DISSEMINATION OF INFORMATION

Since the effective dissemination of scientific information is one of the primary concerns of TPRC, considerable thought was given to this problem. A unique procedure was developed whereby the bibliographic source information comes to the ultimate user in the form of a three-volume book entitled Search and Retrieval Guide to Thermophysical Properties Information. The three volumes of this book, referred to as Parts A, B, and C, respectively, carry the following descriptive subtitles:

Part A - Guide to Substance Classification and Code Descriptions

Part B - Classified Search Index

Part C - Master Bibliography and Author Index

Through a simple procedure involving coordinated use of these three parts, an individual can make any query within the scope of TPRC's activities, and he will receive the specific answers to his query in a matter of minutes.

This book will be issued approximately once a year. Each subsequent issue will update all of the information contained in the preceding year's volumes, and thus will become the most comprehensive and authoritative work of its kind ever published or contemplated. Work on this publication is 50 percent completed and the first volume is anticipated to be ready sometime by midsummer 1959. This completely original work has combined one of the oldest mediums of communication, the printed page, with one of the most recent tools of cybernetics, the electronic computer.

SERVICES RENDERED

TPRC's accomplishments in the form of direct services rendered to date have been expectedly modest in volume but nevertheless important in their consequences and significant in their implication of what can be expected in the years to come.

During the second year of its operation, TPRC had already received and responded to over 30 specific queries on thermophysical properties information. Most of these queries came from Sponsors. A number of these queries have been received from governmental research organizations either in the form of direct questions or requests for proposals for experimental work. TPRC has satisfied a number of these requests by supplying the desired information from its files, thus saving these agencies large sums of money which can be vested into other much needed research. More important, of course, is the conservation of time and manpower.

RESEARCH

The first research program was initiated in February 1958 and the following research activities are currently underway:

Project C 1. Tables project on thermal conductivity of pure metals and their alloys. This project covers ferrous as well as nonferrous metals over the temperature range from cryogenic temperatures to the melting point of the materials; the resulting tables will be published late in 1959.

Project C 2. Tables project on the thermal conductivity and viscosity of gases and gas mixtures. This project covers both the pressure and temperature dependence of a number of major gases and gas mixtures and undoubtedly will involve an appreciable amount of computational work for the preparation of internally consistent tables of the properties.

Project B 1. Theoretical prediction of thermal conductivity of pure metals and their alloys. This is a project running parallel with Project C 1. The area of investigation falls within the domain of solid state physics. This difficult problem was undertaken for the simple reason that no data correlation effort can be very meaningful until one has as good an understanding as possible of the fundamentals involved in the mechanism of thermal conductivity.

Project B 2. Thermoelectric phenomena at high temperatures. The available scientific literature is being studied with a view to a better understanding of the fundamental mechanisms and to establish better correlation between thermoelectric constants and other transport properties of materials.

As the year 1959 draws to a close, the first volume (in three parts) of the "Search and Retrieval Guide to Thermophysical Properties Information" is about to be published. By the end of the year the search of the open literature should be completed for the first seven properties presently considered, for all the 25 abstracting journals back to the year 1940. It is anticipated that by the end of 1959 TPRC's magnetic tapes will contain upwards of 25,000 items of literature, for instant, mechanized search and retrieval. Also virtually complete is an up-to-date listing of English translations of all available Russian scientific and technical articles on thermophysical properties.

On the agenda for 1960 is the activation of the experimental research program. The initial problems in this connection will be those of the procurement of qualified senior staff and the finances necessary for the establishment of a small but well equipped and instrumented laboratory.

IN CONCLUSION

The significance of the successful establishment of TPRC goes far beyond the immediate functions and activities it performs. This activity demonstrates that: (1) industry is ready to recognize and willing to accept the responsibilities of supporting well-conceived basic and applied research in institutions of higher learning; (2) partial governmental support of such centers whose work is of national importance is both necessary and desirable; (3) the performance of TPRC is watched closely by responsible quarters as a possible model for the establishment of similar specialized centers to cover important scientific and technological fields presently unattended.

TPRC's modest accomplishments have already received both national and international recognition and approval by many major and responsible quarters. In turn it has offered its fullest cooperation to such organizations as the Thermodynamics Section of the National Bureau of Standards and the recently organized Office of Critical Tables of the NAS-NRC. In this respect it is indeed most heartening that in the press release of December 7, 1958, from The White House, the report of the President's Science Advisory Committee under the chairmanship of Dr. James R. Killian, Jr., cites TPRC as an example of active centers which offer a solution to the acute problem of data organization.

Research Notes

Crash-Injury Research on Survivor of 150-Foot Fall

Cases of free falls of human beings, in which the velocity and stopping distances can be accurately measured, provide valuable evidence on the ability of the human body to tolerate severe impact loads. The following details of a particularly valuable case of a free fall were investigated by Aviation Crash Injury Research, a Cornell University project partially supported by ONR.

A workman survived a fall from a scaffolding which was about 25 feet below the top of a 175-foot smokestack. He impacted on his left side in loose rubble near the base of the stack. He fell a total distance of 145 to 150 feet. At the point where the man hit, the ground sloped away from the stack at about a 30-degree angle toward a concrete retaining wall; his body made a depression approximately 8 inches deep. After initial impact he bounced (or rolled) over the wall and fell another 10 feet to a lower level where he was found by several witnesses.

Investigation showed that his fall was completely "free." Although the stack tapered outward at the base, the scaffolding from which he fell projected far enough outward to prevent his scraping along the side of the stack as he fell.

The survivor of this accident was conscious and coherent when nearby witnesses reached him. He was taken to a hospital close by, where he was examined and given treatment for shock.

His injuries were largely confined to the left side of his body; he sustained fractures of the left ankle, a chip fracture of the right ankle and a linear fracture of the left side of the lower jaw. The only other visible injuries were a black eye, a split nostril, numerous scratches and bruises. He also evidenced rigidity of the abdomen, however, which suggested the possibility of either spinal injury or injury of the abdominal viscera; but this rigidity subsided eventfully in a short time. There were also a few red blood cells in his urine and he coughed up a little blood and complained of pain in the chest for about a day and a half. His recovery from all these injuries was rapid.

From analysis of his injuries, it was apparent that he had struck the ground face downward, on his left side, with his left arm outstretched. The absence of greater skeletal damage and the lack of more severe injury of the abdominal viscera are extremely interesting in view of the fact that the impact force was applied primarily to the left shoulder, side of the chest, and a portion of the abdomen.

A fall of 145 feet, if calculated without allowance for air resistance, will result in a velocity of approximately 96 feet per second. If an arbitrary deduction of 6 feet per second is made, to allow for air resistance during the fall, a minimum impact velocity of 90 feet per second was sustained. Reducing this velocity to zero through a distance of 8 inches results in a mean deceleration of approximately 195 g.

The depression in the ground, the softness of the ground and the final resting point of the survivor indicated that almost all of the impact force was absorbed at the initial point of impact. There was little evidence of any glancing effect due to the slope of the ground; the amount of rubble displaced toward the lower side of the depression approximately equalled the rubble displaced in other directions.

If it is arbitrarily assumed that 85 percent of the force acted at the point of initial impact, a mean deceleration in the order of 162 g was sustained—and survived. Since the victim weighed 155 pounds, the force acting on his body during the deceleration was in excess of 25,000 pounds ($155 \times 162 = 25,110$). The peak force was probably far in excess of 162 g—perhaps close to 300 g. Calculations on the duration of the impact and the rate of onset of deceleration indicate that the deceleration lasted approximately 0.014 second and the rate of onset was in excess of 22,000 g per second.

It is important to note that this enormous deceleration did not result in fracture of the skull, serious injury of the brain, or retrograde amnesia. The survivor stated after the accident that when he found himself falling he "figured this is it" and closed his eyes and relaxed. However, there was some evidence of shock since he did not remember hitting the ground and had only a hazy recollection of events between the time of impact and the time of his arrival at the hospital.

The fact that a person can survive a mean deceleration of 162 g—resulting in a force of 25,000 pounds—may be difficult to believe. Investigations, however, of 14 similar falls show beyond any reasonable doubt that decelerations in the order of 100 to 200 g can be survived with little or no injury when the force is applied during a brief period of time and is reasonably well distributed over large areas of the body. From the evidence of these free falls, as well as from data from aircraft accidents, it is now recognized that the ability of the human body to tolerate crash force has been grossly underestimated. With reasonable—engineered—protection and proper support, it is probable that the human body can easily tolerate forces that will completely demolish most aircraft now in use.

Certainly, to design accurately for impact protection, engineers need precise information on the limits of pressure, duration and rate of onset which the human body can tolerate without serious and/or incapacitating results. Such data would be of inestimable value in the design of crash helmets, seat cushions, seats, restraining devices (belts, harness, vests, etc.), and delethalized structure.

It is, of course, recognized that such research presents a major problem—the need for human subjects. Initially, the use of fresh human cadavers would certainly provide the means for obtaining some useful data. Volunteers could also be used for less rigorous studies.

Barring the deliberate approach, the only remaining avenue is that of detailed analyses of related accident and injury data, the latter to be obtained from thorough autopsies of all accident victims, coupled with similar analyses of accident-injury data involving survivors.

A Noisy Solution to the Noise Problem

Using cats as his "guinea pigs," Dr. E. G. Wever of Princeton University established that man has some natural protection afforded him when the ear is subjected to noise of high intensity. Dr. Wever, working under ONR contract, found that the tensor tympani and stapedius muscles in the ear tense as a reflex to noise, resulting in a change in the tension of the ear drum and a subsequent change in the nature of energy transmitted into the receiving mechanisms of the ear. This reaction Dr. Wever called acoustic reflex (AR). The threshold for the protection thus given the ear was shown to be a function of the frequency of the sound.

Doctors at the U. S. Army Medical Research Laboratory were quick to appreciate the potential of such a natural system for combating noise problems, particularly in military situations where man controls the time of firing such weapons as machine guns or even larger field pieces. Experiments have now established that if a noise is given to the ear just prior to the firing of these weapons, the acoustic reflex is activated and thus affords some protection against the greater noise impact that occurs when the weapons are actually fired. The usual short-term deafness following 100 rounds of machine gun fire was found to be 10 decibels less when the acoustic reflex was brought into play than it was without such protection. Further, this natural defense actually provided better protection up to 1000 cps than a V-51R ear plug.

X-Ray Experiment in Satellite 1958 Eta

NRL's Dr. Herbert Friedman was a frustrated man. Four times he had carefully packed his x-ray measuring instruments into a Vanguard satellite, and each time some minor malfunction had led to failure in one of the launching vehicles. But the fifth time, he made it. When Vanguard III went into orbit as 1959 Eta on September 18, Dr. Friedman's instruments were aboard the 50-pound satellite and working perfectly. Their purpose is to measure the x-radiation from the sun and its effects in the earth's atmosphere.

The instrumentation measures the solar x-ray flux and records the solar-flare peak intensity throughout the daylight part of each orbit. Previous solar x-ray studies using rockets were available to record only a few minutes of the development of a flare, usually after the flare had already begun. Satellite instrumentation, on the other hand, can follow the entire life history of a flare from growth to decay.

Two identical ionization chambers sensitive to wavelengths of 1 to 10 Angstroms (x-rays in this range are produced in solar flares) are the main components of the x-ray instrumentation. The ionization chambers, which record the ionic charge produced by the x-rays, are oriented about 120 degrees apart on the satellite's equatorial plane. The maximum signal occurs when an ion-chamber tube "looks" in the direction of the sun.

The x-ray instrumentation also includes an electrometer circuit for amplifying currents generated in the ionization chambers and a peak-reading memory device. The memory device retains the maximum x-ray signal received during an orbit. This memory core is the controlling element in an audio oscillator that modulates (alters the frequency or amplitude of) the Minitrack signal with the ion-chamber signals. Actually, two cores are used in an orbital switching arrangement: While the core containing the maximum signal from the preceding orbit is modulating the transmitter, the second core is storing data from the current orbit. The roles are reversed as the satellite passes from the night to the day portion of the orbit, and when the satellite is interrogated, by a switching arrangement using a light-sensitive solar cell. Analysis of the modulated signal provides information on the intensity variations and energies of x-rays entering the chamber. A third core transmits instantaneous values of radiation.—IGY Bulletin.

Touring Naval Medics Visit TDC

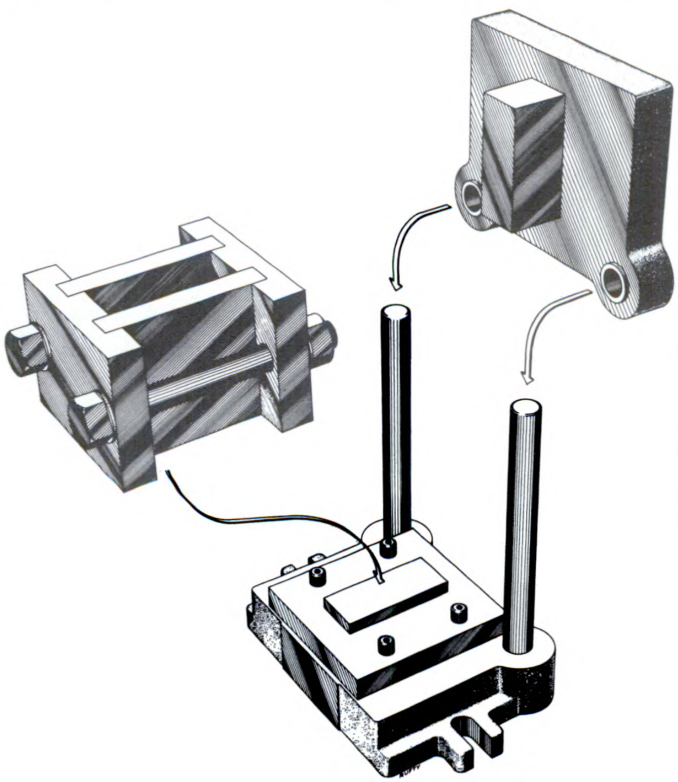
A group of 24 visiting Naval Medical Officers from the Far and Middle East and Central and South America is shown following their special tour of the U. S. Naval Training Device Center, Port Washington, N.Y. During their visit to the Center, the foreign medical officers saw various weapons simulators and training devices related to their particular fields of interest. CDR Dred W. Poole, USN, Executive Officer at the Center (first row, far right) acted as host to the group. CAPT L. J. Pope, USN, Naval Medical Center, Bethesda, Md. (first row, far left), was in charge of the group.

Neutron-Absorbing Bricks

To carry out delicate experiments involving the detection or absorption of neutrons, nuclear physicists frequently have to shield their detectors or absorbers from stray scattered neutrons. There are many different materials used for this purpose, but those materials which are efficient for absorbing neutrons in the kev region or Mev region are either very expensive or very bulky. Small bricks made of boron carbide are commercially available, and are relatively efficient but are very expensive. Gold, gadolinium, and europium are also efficient, but just as costly. Water and borax are very bulky for effective shielding. The cheapest source of boron (of at least 50-percent purity) available commercially is calcium boride powder.

A technique was developed at NRL for using commercially available calcium boride for making reasonably sized, fairly high-density, long-lived bricks which can be used in building a neutron shield or sink in much the same way that lead bricks are used for gamma-ray shielding. The procedure is to make a thick, dry mud with the powder and water, followed by compression in a mold at pressures of about 2000 psi or more. The bricks are then baked for 2 hours or longer at a temperature of about 750° C.

The bricks, each 2 by 3 by 5 inches, are strong enough to withstand normal handling and they last indefinitely. The ones made at NRL by this process are now 7 years old, and they have been used and stored under normal room temperatures and humidities.



Disassembled view of mold for making calcium boride neutron-absorbing bricks. The mold was made from special hardened steel. The inside surfaces were ground flat; approximately 0.003-inch clearance around the plunger allows for seepage of excess water from the clay.

Automatic Weather Buoy

A U. S. Navy experimental weather buoy, designed to provide faster, more adequate weather information during fall and winter when severe winter storms are more likely to occur, is anchored in the Gulf of Mexico.

Fifth in a program of experimental floating weather stations initiated by the Bureau of Aeronautics in August 1958, the buoy is located about 300 miles south of the mouth of the Mississippi River. It is anchored in about 11,000 feet of water in an area where shipping is relatively scarce, to minimize hazards to Gulf vessels.

The experimental buoy is equipped to transmit reports by radio at six-hour intervals. These reports are received and evaluated by Navy weather forecast stations and weather bureaus in the Gulf of Mexico area.

Developed by BuAer, the buoy was put to work recently, when tropical storm "Irene" developed off the Gulf Coast.

Navy Uses Underwater TV to Study Ocean Bottom

Underwater television equipment for deep-water surveys has been successfully employed by the Navy. The television system, built for the Navy's Bureau of Ships, was used recently in ocean-bottom surveys at depths of more than 600 feet. This is the first time that a continuous, remotely controlled, visual survey has been achieved at such depths.

Primarily designed for salvage and search operations, the vehicle is equipped with a closed-circuit television system, an underwater lighting system, and a movable camera-housing capable of training 70 degrees in any direction. The camera and its self-propelled unit are remotely controlled by means of a multiconductor cable from a control vessel. The propulsion system enables the underwater vehicle to hover at any desired depth in currents and tides of several knots, assuring optimum use under varying conditions.

If fitted with suitable appendages, the vehicle could collect samples and specimens from the ocean floor and retrieve sunken objects. Vare Industries of Roselle, New Jersey, produced the unit for Navy use, but it could be used for many nonmilitary projects, such as commercial salvage work or surveys of transocean cables.

Navy Scientists Win Photographic Award

A Navy research team of four men, who recently developed a unique spectroscopic camera for use in outer space, was recently presented the Photographic Society of America's highest award.

The Society's Progress Medal and Scroll was presented to Dr. Richard Tousey, Dr. Donald M. Packer, Mr. William Hunter, and Mr. James DeWitt Purcell, all of the U. S. Naval Research Laboratory. This was the first time that the Photographic Society has presented its annual award to more than one individual.

On The Naval Research Reserve

Seminar at Brookhaven National Laboratory

Thirty-nine reservists attended the Seventh Annual Naval Reserve Nuclear Sciences Seminar at Brookhaven National Laboratory, Upton, New York, September 13 through 26, 1959. Thirty were from the Navy, seven from the Army and two from the Air Force. The subject of the seminar this year was "The Management of Radiation Accidents." Because of the general interest in the subject, a number of civilian scientists also attended portions of the seminar.

CDR J. S. Austin, USNR, the Commanding Officer of Naval Reserve Research Company 3-9, welcomed the group on behalf of his staff who organized and conducted the seminar.

Highlights of the opening session included a welcoming address by the Commandant of the Third Naval District, VADM Thomas S. Combs, USN; a talk on "Research and the Future Navy" by RADM Rawson Bennett, USN, Chief of Naval Research; a description of "Naval Medical Research" by RADM C. B. Galloway, USN, Head Research Division of the Bureau of Medicine and Surgery; a discussion on "The Role of the AEC in the Navy's Transition to Nuclear Power" by CAPT C. W. Shilling, MC, USN (Ret.), Deputy Director of the AEC Division of Biology and Medicine; and a review of the "Programs of the Research Reserve" by CAPT J. P. Aymond, USN, Special Assistant to the Chief of Naval Research for Research Reserve.

The Nuclear Sciences Seminars at Brookhaven National Laboratory are sponsored jointly by the Office of Naval Research and the Atomic Energy Commission. The subject for this year's seminar, "The Management of Radiation Accidents," was chosen because of its increasing importance in both civilian and military life.

One day of the seminar program was devoted to discussions of basic concepts of Nuclear Physics and Dosimetry and to tours of the laboratory facilities at Brookhaven. The main part of the program was concerned with descriptions of accidents that have happened in the past. For the most part, these discussions were led by people who were involved in some aspect of the management of the accident. Lectures

Participants at Research Reserve Seminar at Brookhaven were given on the clinical management of exposed persons, the management of high and low-level exposure situations and on the problems of radioactive fallout. The controversial question of whether bone marrow transplants should be used in the therapy of heavily irradiated patients was discussed, both pro and con. Dr. G. Mathe, of Paris, France, who was in charge of the care of victims of the 1958 Yugoslavian accident, presented the affirmative side. There were also discussions of the legal aspects of radiation exposure and the Public Health aspect of the radiation problem.

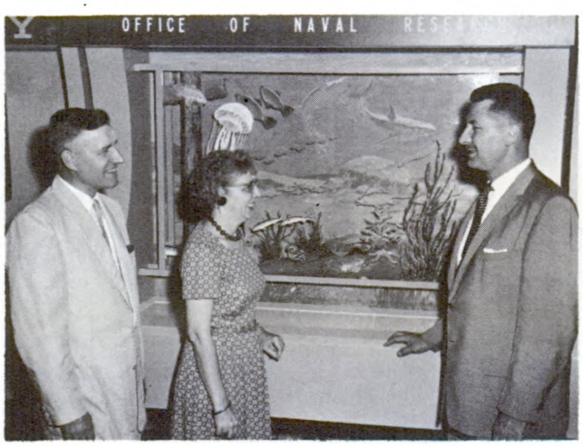
Three panels of experts discussed the following subjects: "The Clinical Management of the Heavily Irradiated Individual," "The Dose-Effect Relationships in Man," and "The Management of Contaminating Events."

To begin the seminar, participants were divided into teams and were assigned a theoretical radiation accident problem. At the end of the two-week session, one day was spent in writing up solutions to the problems. The last half-day was spent in presenting their solutions to the group. Experts in various fields were in attendance and took part in the discussions that followed.

The organization and conduct of the program was handled by LCDR Victor P. Bond, MC, USNR, and LCDR James S. Robertson, MC, USNR, assisted by LCDR Otho D. Easterday, USNR. Administrative assistance to the Commanding Officer was provided by CDR Leonard A. Baker, Jr., USNR and LT S. J. Tassinari, USNR.

Research Reserve Company At University Park, Pennsylvania Assists in Exhibit

Members of Naval Reserve Research Company 4-4, University Park, Pennsylvania, took an active part in the arrangements for an exhibit at Pennsylvania State University by the Officer of Naval Research at the meetings of the American Institute of Biological Sciences which were held early in September.



Discussing the ONR exhibit at Pennsylvania State University are LCDR Robert E. Clark, USNR, Commanding Officer, NRRC 4-4; Miss Elizabeth Appelton of ONR; and CDR Henry H. Chisman, USNR, who arranged for the exhibit.

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The exhibit was arranged between ONR and CDR Henry H. Chisman, USNR, former commanding officer and presently a member of NRRC 4-4. In charge of the exhibits was Miss Elizabeth Appelton, Assistant Technical Information Officer for ONR. Officers of NRRC 4-4 assisted in the display of the exhibit which featured hydrobiology.

Commanding Officer of NRRC 6-3, Oak Ridge, Tennessee, Receives New Appointment

CDR Richard B. Martin, USNR, Commanding Officer of NRRC 6-3, Oak Ridge, Tennessee, has been appointed Deputy Director of the Research and Development Division in the Atomic Energy Commission's Oak Ridge Operations. Dr. Martin joined the Oak Ridge Operations staff in 1953 as a chemist in the Research Branch, and in 1957 he was named chief of that Branch.

CDR Martin has been active in the Research Reserve program for many years. In addition to serving as Commanding Officer, he has contributed greatly to the success of the Annual Nuclear Sciences Seminar at Oak Ridge by his services as Seminar Chairman.

Trieste to Deeper Waters Off Marianas

The Navy will send its deep-sea diving sphere, TRIESTE (Research Reviews, April 1957), on a 3-month series of explorations off the Marianas Islands in early November, Pacific Fleet Headquarters has announced.

A team of civilian scientists and naval personnel from the Naval Electronics Laboratory, San Diego, will use the bathyscaph TRIESTE for tests to gather scientific data in waters deeper than those available near the continental shelf adjacent to the United States.

The tests will be conducted under the joint sponsorship of the Naval Electronics Laboratory and the Office of Naval Research. The explorations will be part of the global long-term oceanographic and marine research program pursued by the Navy. Headquarters for the project will be at the Naval Station on Guam.

The bathyscaph is capable of operating under its own power and of descending 20,000 feet. The craft designed and built by Aguste and Jacques Piccard, Swiss-born father-and-son team, and was delivered to the Navy in August 1958.

IN THIS ISSUE

Project Sunflare II ...... T. A. Chubb, R. W. Keplin, D. P. McNutt, and H. Friedman 1

Project Sunflare II, by far the most successful of the three series of solar flare experiments, was recently completed by NRL. Objective: to obtain new data on the physical nature of solar flares.

Yankee Ingenuity .... R. G. Eldridge and CDR E. F. Leonard 7

Because of their superior steering mechanisms, World II gun mounts—potential junk—prove to be valuable for radar antennas.

Navy Eclipse Expedition to West Africa .... LTJG P. D. Maycock 13

Scientists from the University of Minnesota made an ONR-sponsored expedition to the scorching Sahara Desert in French West Africa to take measurements on the solar eclipse of October 2. Some of their experiences in setting up the three observation sites are described.

The Dawn Sky During the Solar Eclipse .... Richard Tousey 16

While other observers viewed the eclipse from ground sites, NRL scientists flew into the direction of the rising sun to obtain photographs of the sky in early dawn, just before the solar eclipse.

Successful Marriage of Documentation and Research 19

The Thermophysical Properties Research Center, now in its third year of operation at Purdue, is serving as a model for other specialized information-processing and research centers.

Research Notes 25

On the Naval Research Reserve 31

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 salė 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. Use of funds for printing this publication was approved by the Director of the Bureau of the Budget, February 12, 1958.

One of the specially designed telescopes—jocosely called camels because of their size and shape—used in the recent solar-eclipse expedition to French West Africa. (See story on page 13.)