U.S. DEPARTMENT OF COMMERCE ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION APRIL 1967

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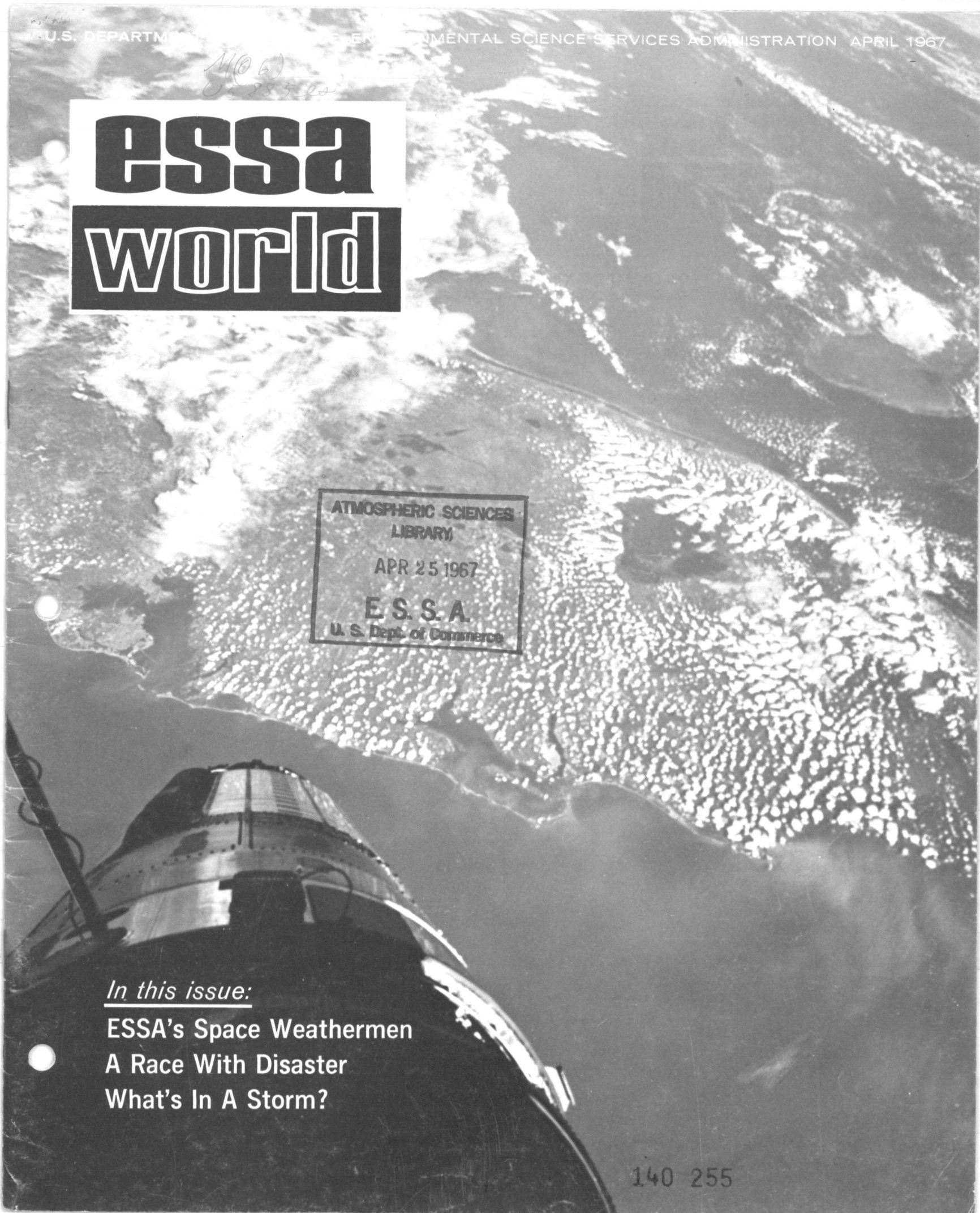

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In this issue:

ESSA's Space Weathermen
A Race With Disaster
What's In A Storm?

140 255

National Oceanic and Atmospheric Administration

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APRIL 1967 VOLUME 2 NUMBER 2

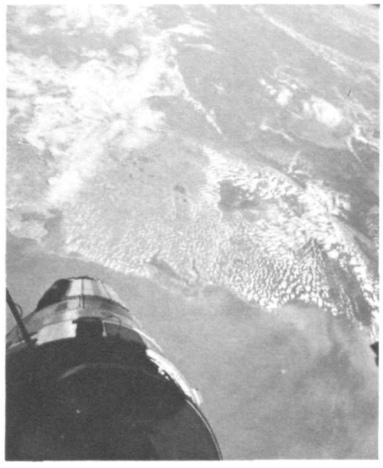
U.S. DEPARTMENT OF COMMERCE, Alexander B. Trowbridge, Acting Secretary
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION, Robert M. White, Administrator
Werner A. Baum, Deputy Administrator

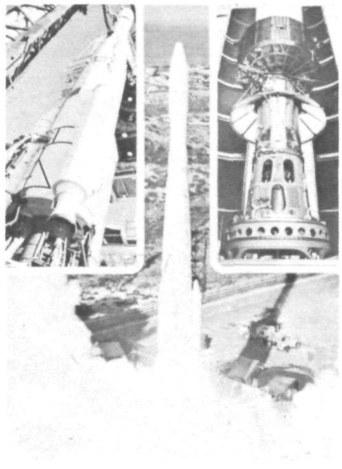
page

3. The Larger Task Ahead — An Editorial
4. ESSA Space Weathermen
9. The Biggest Watch in the World
12. Science Goes Underground
14. A Race with Disaster
18. The Day of the Data Bank
20. Meet Miss Commerce
22. Assignment — The Unknown
24. What's in a Storm?
26. NMMTC National Meteorological Training Center
28. ESSA's Globe Girdling Fleet
30. Home of Many Missions
32. The Five-Year Look
34. ESSA Newsbeat

COVERS
Two of ESSA's space activities are illustrated on the ESSA WORLD covers. On the front, clouds over Florida were photographed during the Gemini-12 mission, for which ESSA forecasters provided weather services. The pictures on the back cover show launch preparations and liftoff of ESSA 4 from NASA's Western Test Range.

All satellite photos by NASA.





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ESSA WORLD, the official employee publication of the Environmental Science Services Administration, Department of Commerce, is published quarterly by the Office of Public Information in Rockville, Md.

Articles of general interest to ESSA employees may be submitted to: Editor, **ESSA WORLD,** Environmental Science Services Administration, Bldg. 5, Room 804, Washington Science Center, Rockville, Md. 20852.

REAR ADMIRAL JAMES C. TISON, JR.
DIRECTOR, COAST AND GEODETIC SURVEY

The Larger Task Ahead

An Editorial

For 160 years, the Coast and Geodetic Survey has performed a vital service to the Nation by gathering, analyzing and disseminating knowledge in the earth sciences.

Its research and services have provided the American people with invaluable tools for the enhancement of commerce, industry and many other fields.

Traditionally, the Coast and Geodetic Survey's services have included charts and related information for marine and air navigation, basic geodetic control data in support of our national mapping program and for the construction industry, as well as seismic studies and information to protect our people against earthquakes and tsunamis.

Now the Coast and Geodetic Survey has become a major element of ESSA. What does this mean to our new parent organization — and to us?

Our mission, if anything, has grown in size and scope. Along with the services the Survey has historically offered to the Nation, its purpose now includes supporting ESSA by every possible means in achieving a more efficient and economical use of our resources in advancing environmental science programs.

The environmental sciences — be they oceanographic, geophysical, meteorological or space-oriented — are global and international in stature. Our environment now is recognized as a scientific whole, which cannot be studied piecemeal.

In ESSA's mission of understanding, describing and predicting the state of our indivisible environment, the Coast Survey's role has the benefit of an added dimension. For example, the ability to predict the changes in the state of our marine environment requires an understanding of the state of the atmosphere and of complex sea-air interaction processes. The formation of ESSA makes it possible for the Survey to make a more meaningful contribution to this vast undertaking, and others of equal importance. Just as the Coast Survey provides valuable information and services in such programs, so do ESSA's other elements. The close coordination among ESSA's varied disciplines enables each of our elements to achieve infinitely more than would have been possible by going it alone.

ESSA's mission is one of breath-taking proportions, with implications from beneath the ocean floor to the little-known world of the solar flare. The Coast Survey welcomes its share of this challenge, and pledges that the same dedicated service which has been our tradition since 1807 will be given to the larger task ahead. □

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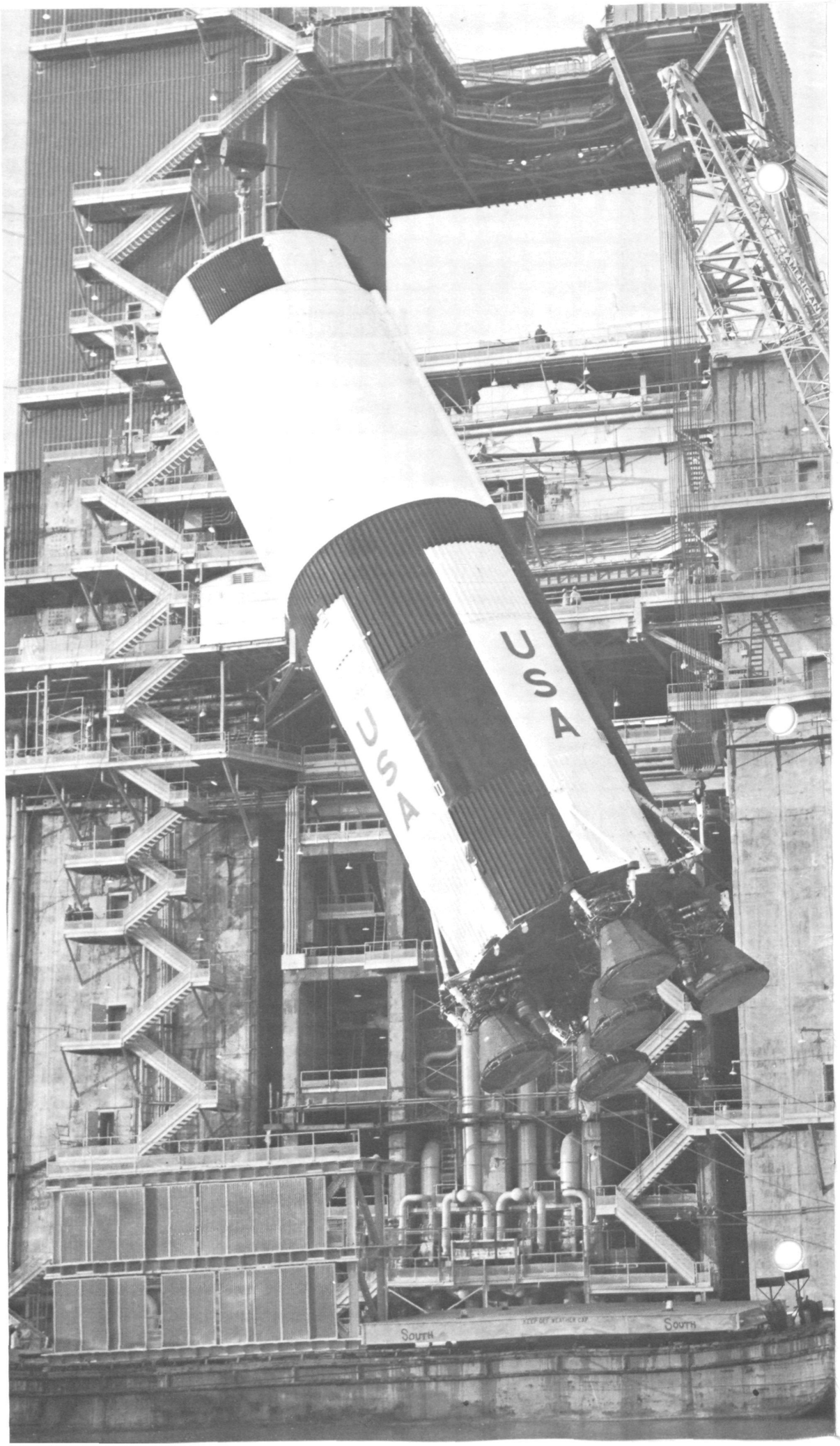

S-IC stage of the Saturn V, capable of 7½ million pounds of thrust, is hoisted into a test stand at the NASA Mississippi Test Facility. A principal meteorological concern is the selection of weather conditions which will cause minimum propagation of sound waves and noise into surrounding communities.

From blastoff to splashdown, America's astronauts depend upon

ESSA's SPACE WEATHERMEN

By KENNETH M. NAGLER,
Chief, Space Operations
Support Division,
Weather Bureau

Before the powerful Saturn V rocket roars off from Cape Kennedy, starting the first Apollo astronauts on journey to the moon and back — over half a million miles through space — the Weather Bureau will make a forecast for a much shorter leg of the rocket's trip.

It will take many hours to move the huge Saturn over the mere 3½ miles from the Vehicle Assembly Building to its launching pad, and during this critical time, heavy winds or a lightning-producing thunderstorm could prove disastrous to the multi-million dollar spacecraft.

Forecasting the weather for this touchy operation will be members of the Spaceflight Meteorology Group (SMG), a branch of the Weather Bureau's Space Operations Support Division. Originally called the Project Mercury Weather Support Group, the SMG has provided weather services for all of NASA's manned spaceflights and related tests.

From its modest entry into the "space age" in 1959 with the assignment of a team of observers to Pt. Arguello, Calif., then a part of the Navy's Pacific Missile Range, to the beginnings of the Apollo program, the Weather Bureau has provided meteorological expertise for many of the government's space-oriented programs.

At present some 130 Weather Bureau employees work on six space and missile prorams for NASA and the Department of Defense. These programs are directed through the two branches of the Space Operations Support Division—the Spaceflight Meteorology Group and the Range Support Branch.

The SMG has sections at the NASA Centers at Cape Kennedy and Houston as well as supporting offices at Weather Bureau facilities in Miami, Suitland, and Honolulu.

Chief of the SMG is Alan Sanderson, with Group headquarters at the Houston Manned Spacecraft Center. Allen Cummings is Meteorologist in Charge of the section there. Three original members of the Mercury group in 1960, Ernest Amman, J. R. Gulick, and Richard Brintzenhofe, are the MICs at Cape Kennedy, Miami, and Suitland sections respectively. O. A. Gorden, Jr., is the Honolulu representative.

Months of Planning

The SMG's support for a specific mission starts several months before the scheduled launch date with the preparation of climatological background information — often with the help of ESSA's Environmental Data Service. Studies on how best to forecast the weather which may affect the flight are also made.

Actual forecasts for a mission normally start days before the launch date, followed by a variety of forecasts and weather briefings at both of the NASA Centers before the launch, and at the Houston Center until the spacecraft has landed and been recovered.

For the launch, the principal weather concerns are strong surface winds, strong upper winds and wind sheers, low clouds or visibility, and thunderstorms and lightning. The staff at the Kennedy Center keeps NASA's launch director aware of any weather which might interfere with pre-launch or launch operations.

One specialized service just before each launch is the preparation of a weather map for the flight crew to take with them. On the map are shown the meteorological features over which the crew will pass, as well as areas expected to be unfavorable for landing and recovery operations.

Cliff-Hanging Crisis

A rather frightening personal experience related to one of these astronaut maps comes to mind. On the morning of Scott Carpenter's Mercury flight in 1962, I had his flight kit, to which we had added the weather map, and was scheduled to give the final weather briefing during the slow trip to the launch pad . . . but the van departed 20 minutes early.

Our vehicle was in use elsewhere (most of the roads were blocked anyway); there was apparently no way to get to the launch pad; there would be no launch without the flight kit; I'd be blamed for delaying the launch — all sickening thoughts.

Fortunately, two others, with some film that had to go on board the spacecraft, had also missed the van. They had a fast car and some knowledge of back roads. We got to the van just as it pulled up at the launch area. There was time for the weather briefing and, more important, time to get the flight kit to Scott Carpenter.

Since early in the Gemini program the principal forecasting and briefing effort shifts to the SMG office at Houston once a spacecraft has been launched. Activities during a mission include forecasting for many possible emergency landing points each day.

Perhaps the most critical decision made by NASA based on our weather advice was the decision to bring the Gemini V spacecraft down one revolution earlier than planned to avoid the possibility of

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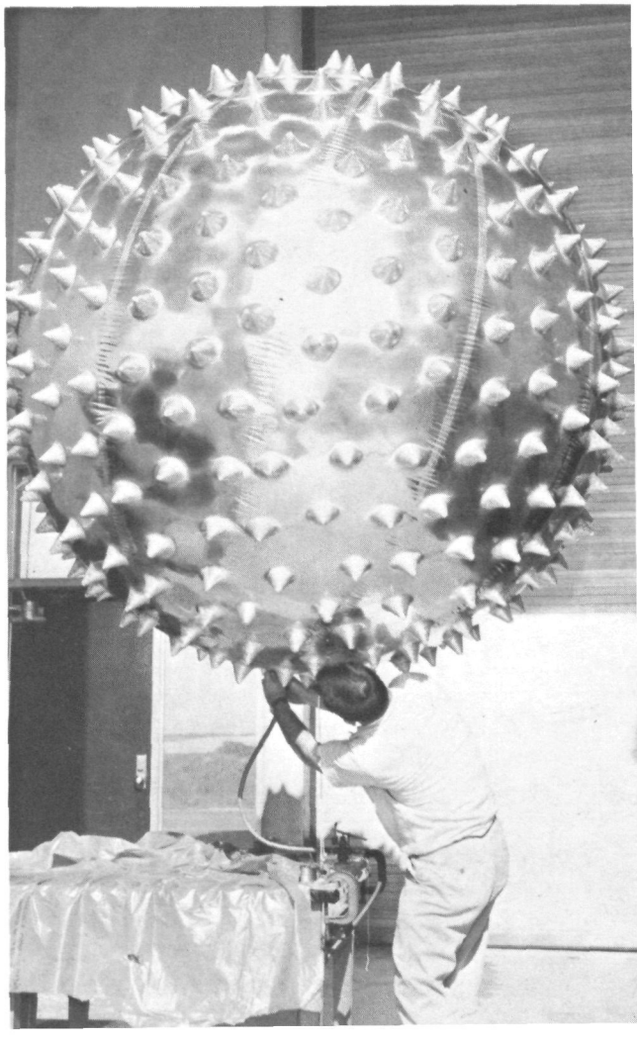
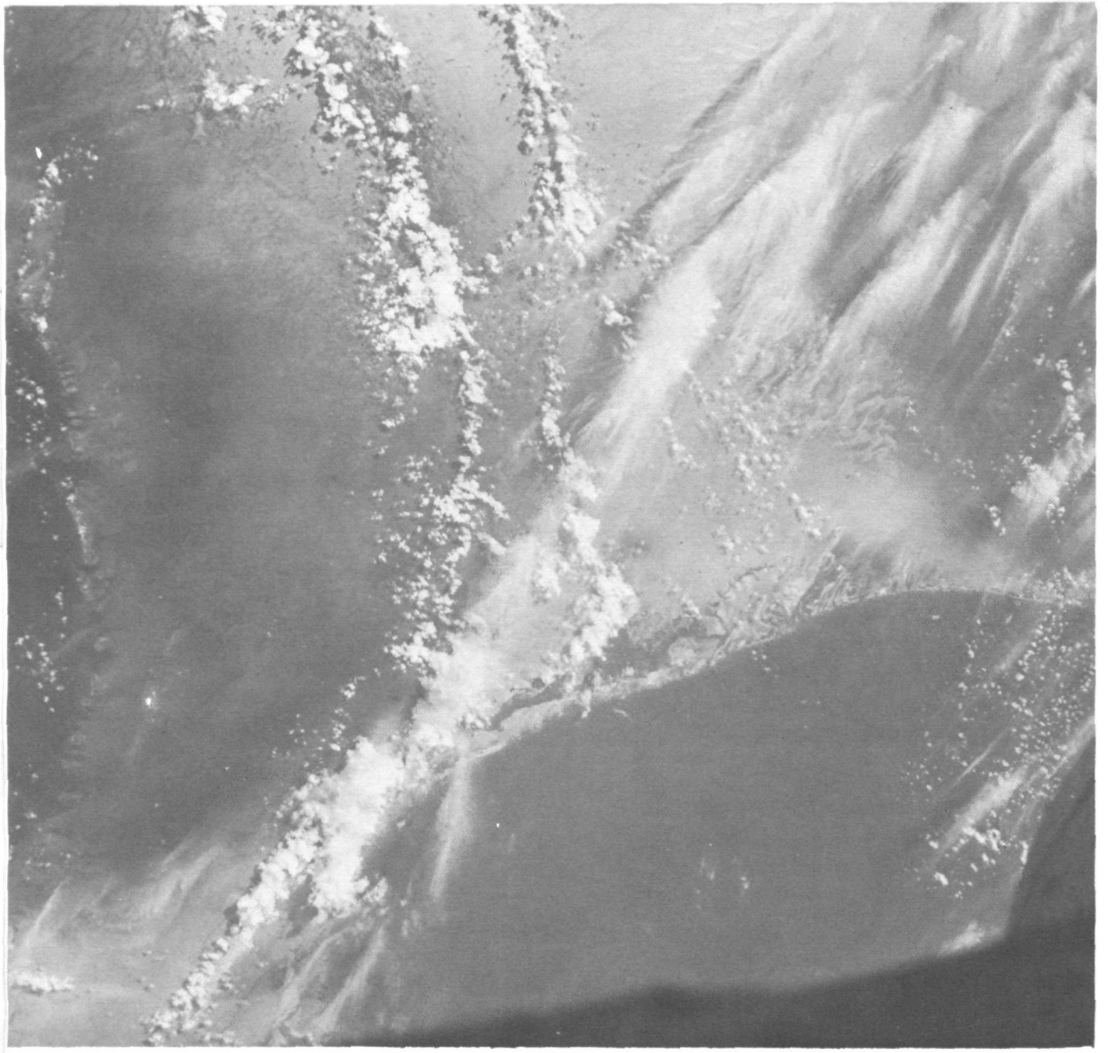
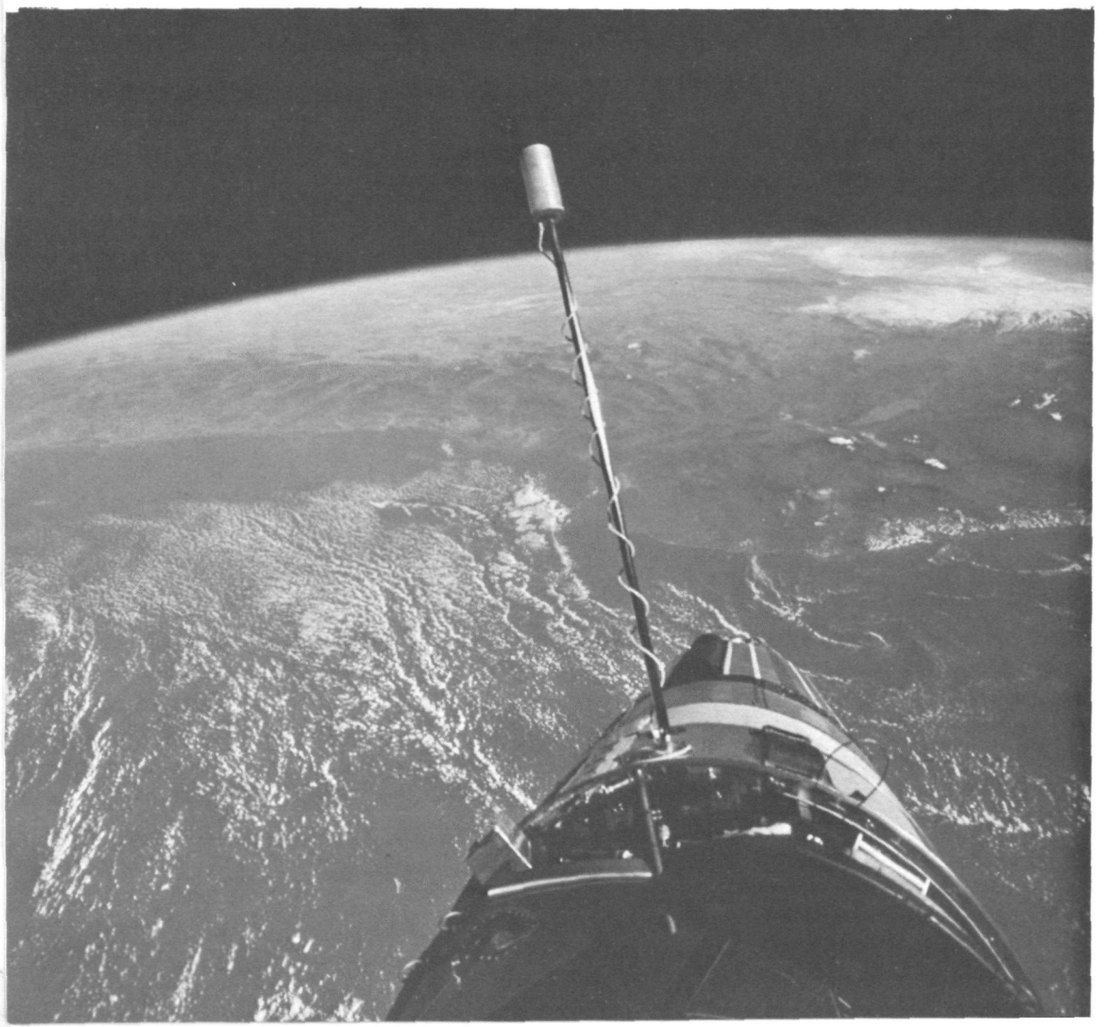


Inflation of a Jimsphere at Weather Bureau Support Facility, Wallops Station, Va.





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landing near a tropical storm (which later became notorious hurricane Betsy). At the same time, the landing was moved eastward from the planned aiming point on the new revolution in order to avoid the expected effects of a cold front and squall line. The actual landing occurred under ideal weather conditions.

Photographs From Space

Another of the tasks of the SMG during spaceflight missions is forecasting for scientific experiments conducted by the astronauts. Some experiments (e.g. terrain photography, astronaut visual acuity, tests of laser communications) require relatively clear skies. Clouds are required for other experiments, notably for the weather photography effort for which Stanley Soules, of the National Environmental Satellite Center, and I are the co-experimenters. Through this experiment, the Gemini pilots took several hundred pictures which show selected cloud systems in color and in great detail — on a scale between that obtainable from aircraft and that normally obtained from weather satellites.

The role of the other three SMG offices is to provide the forecasts and special meteorological charts needed at the Spaceflight Centers. Weather data for the launch area and for the potential Atlantic Ocean recovery areas come from the Miami Section which uses the resources at the ESSA complex there. From Honolulu, where extensive help is received from the Weather Bureau Airport Station staff, come the specialized forecasts for much of the Pacific Ocean area. The Suitland staff prepares the nearly global analyses and prognoses needed for the missions, using products of the National Meteorological Center, weather satellite information, and the inputs from Miami and Honolulu.

As its name implies, the Range Support Branch of the Space Operations Support Division arranges for weather services for a number of missile range activities of the Army, Navy, Air Force, and NASA. Headed by Graden Harger, this branch is responsible of the overall conduct of the programs while the Weather Bureau regions manage the teams carrying out the work.

For the Air Force Western Test Range a Weather Bureau support group headed by Norman Asbridge provides forecasts, observations, and other services at several locations.

Upper left, view of Great Exuma Islands in the Bahamas. Clouds are of both cirrus and cumulus types.

Lower left, view of stratocumulus clouds off the west coast of Mexico, from the Gemini XII flight. The spacecraft is docked to the Agena target vehicle.

The Vandenberg Air Force Base Upper Air Unit provides daily scheduled rawinsondes plus frequent specials for launch operations. Other observations include frequent low-level rawinsondes from remote sites using mobile equipment; wiresonde observations from fixed and mobile sites using blimps or kites as lifting vehicles; miscellaneous low-level soundings using free balloons and small rockets; specialized surface observations at launch sites; ballistics calculations for launcher settings and impact predictions; and meteorological rocket observations.

Assignment for Bachelors

At the Eniwetok Weather Station, where living facilities dictate bachelor status for the 10-man staff, specialized forecasts and observations for missile operations are made as well as more conventional forecasting for flight clearance, base support, and severe weather warnings.

The Weather Bureau-Western Test Range Support Group also has teams on two ships: the USNS LONGVIEW, based in Honolulu, and the USNS RANGE TRACKER based in Port Hueneme, Calif.

For the Navy's Pacific Missile Range, the Weather Bureau does not provide the forecasting service, but handles a variety of observations at three land sites and one range ship.

Surface and upper-air observations are made at two California sites — Pacific Missile Range Headquarters at Pt. Mugu and San Nicolas Island. Rocketsonde observations are made at Pt. Mugu. Since most of the men alternate working at the two stations, they are treated as a unit, with Donald Fleming as the Technician-in-Charge. At the PMR Barking Sands site on the island of Kauai, Hawaii, Weather Bureau men take surface and upper-air observations, including rocket soundings.

The USNS WHEELING, operating out of Port Hueneme, Calif., has a team of four Weather Bureau observers on board. The shipboard program includes special oceanographic observations, as well as upper-air and marine surface observations.

For the Army, specifically for the NIKE-X Project Office, the Weather Bureau operates the Kwajalein Test Site weather station. The staff under MIC Hubert Boyd provides a variety of specialized forecasts and observations, primarily in support of the anti-missile development and testing activity on the

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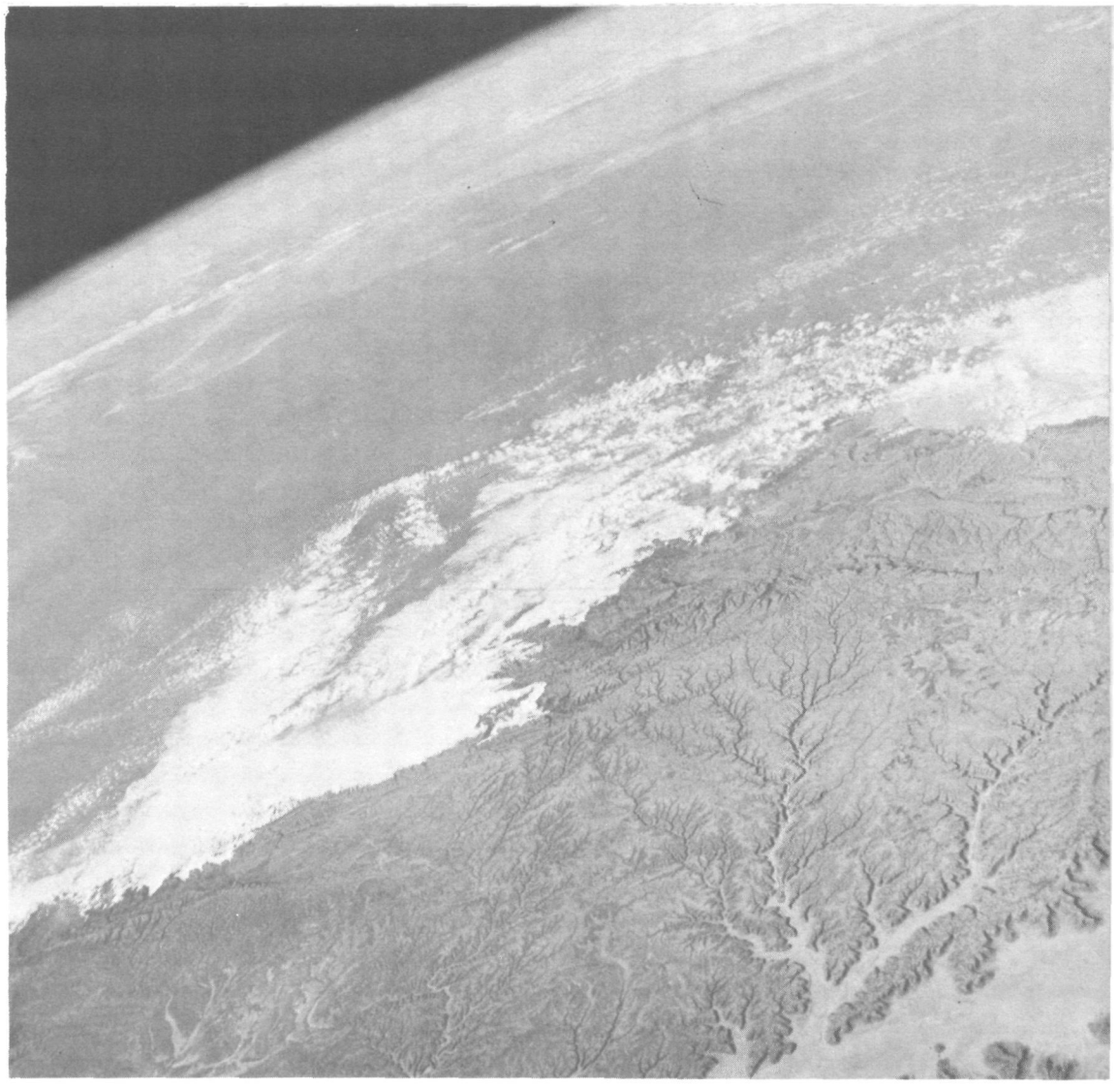

Upper right, Gemini IV view of Southern Arabia, Gulf of Aden and Somalia.

Lower right, Gemini XI view of India and Ceylon from an altitude of about 450 miles showing cloud-free band around the sub-continent.

Vandenberg AFB Upper Air Unit Meteorological Technicians John Collins and Glenn Taylor and Special Projects Chief, Paul Moore, retrieve air-foil kite on completion of a low-level sounding in support of a major ballistic missile launch.

Prior to a Gemini flight, Nagler discusses weather map with Astronauts John Young, Donald Slayton, and the late "Gus" Grissom.

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atoll. The station operates and maintains weather surveillance radar, ozone measuring ground equipment, and automatic weather stations on Wotje and Jaluit Atolls. The meteorological rocket activities there are also conducted by the Weather Bureau personnel.

The two Range Support Branch programs for NASA are those at the Wallops Station and the Mississippi Test Facility.

The missions of the NASA Wallops Station involve the testing of rocket vehicles and payloads and the acquisition of atmospheric and space data by sounding rockets, space probes, and satellites. The Weather Bureau support includes specialized forecasting; atmospheric measurements for a variety of applications; and climatological and other staff services. Various upper-air sounding systems are employed. Modified MPS-19 radars are used in weather surveillance and for target tracking. The Wallops staff also assists in the training of foreign personnel in rocket range meteorological procedures. Lloyd Chamberlain has been the MIC of the Weather Bureau team at Wallops since its beginning in 1960. Periodically, men are detailed to Pt. Barrow and Anchorage, Alaska, to support rocket grenade experiments conducted at Pt. Barrow. The staffs of WBAS, Pt. Barrow, and WBFC, Anchorage, assist the Wallops team in these activities. In the rocket grenade program, grenades are exploded at a number of altitudes up to 400,000 feet. The arrival times of the sound at several sites are analyzed to yield measurements of the very high-level winds and temperatures.

More popular than the Alaskan trips are the temporary assignments in Bermuda, where the group provides the forecasting and special observational support, including launching of meteorological rockets, for studies of atmospheric reentry phenomena.

Mississippi's Loudest Sound

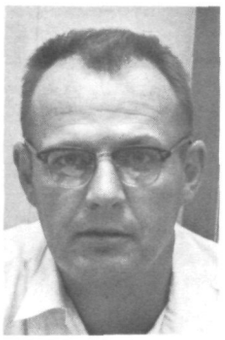
In the fall of 1962 when Technician-in-Charge John Rhyne and other Weather Bureau men started work at the NASA Mississippi Test Facility, they were among the first employees in the sparsely populated area between Picayune and Bay St. Louis, which was chosen to be the site for testing the Saturn rocket engines. The reason for the early establishment of the weather station there was to get a background of surface and upper-air observations for the site prior to the testing. A major concern was the propagation of sound from the rocket engines. To simulate such sound, a loud horn — one of the world's loudest — was sounded regularly, and the resulting sound intensity distribution was correlated by the NASA staff with the radiosonde and upper-wind data — in order to learn just what meteorological conditions might have to be avoided in the actual engine tests. At the same time, forecasting techniques for anticipating critical situations were and are being developed.

The growth of missile range and space-oriented programs in the past few years has been fantastic. Many in the Weather Bureau have played a part in that growth and will continue to contribute to some of the remarkable developments likely in the years to come. One expectation for the future is that Weather Bureau men will help select a smooth landing site for the first astronauts returning from a successful voyage to the moon. □

Shown on right are Alan Sanderson, chief of SMG, and three original members of the Mercury group in 1960

Alan Sanderson
Houston, Texas

J. R. Gulick
Miami MIC



E. Amman
Cape Kennedy MIC

R. A. Brintzenhofe
Suitland MIC

The hope of a brighter future for millions may rest with

THE BIGGEST WATCH IN THE WORLD

By RICHARD E. HALLGREN and DON M. HANSON*

Our lives are inextricably involved with the weather. It affects our convenience, our prosperity, and sometimes even our safety. One of mankind's fondest hopes is to reap its benefits and avoid its malevolence.

This is why the World Weather Program is one of the most exciting concepts imaginable — because it seeks to bring a brighter future for millions of persons around the world.

It is a global meteorological program with two major goals: development and operation of a World Weather Watch — an international system to observe the atmosphere and to communicate, process, and analyze global weather data; and a comprehensive research program to accomplish long-range weather prediction and for the theoretical study and evaluation of the feasibility of large-scale weather climate modification.

The concept of a World Weather Watch has emerged from the work of the World Meteorological Organization. The International Council of Scientific Unions is presently moving forward with the formulation of a detailed, cooperative research program to crystalize the scientific problem to be solved and to develop the requirements for information to pursue this research.

Success of the World Weather Program will bring vastly improved meteorological services for all the world. It will permit long-range weather prediction, allow for a systematic exploration of the scientific possibilities of large-scale weather and climate modification, and contribute to the technological and economic development of developing nations. It will require an unparalleled degree of international cooperation among the nations of the world. It will serve as another building block for establishing world order and peace. It will permit meteorology to broaden its knowledge of the globe's atmosphere. It will furnish earlier and better warnings of severe storms and other weather hazards. It will further the industry, commerce, and agriculture within the borders of each nation cooperating in the program. It will permit better land and water management — not only for the United States and those nations that are technologically advanced, but to less developed lands as well.

The research program includes broad theoretical studies leading to proved mathematical physical models that will accurately simulate the physical processes of the atmosphere.

Major effort needed

It will require a coordinated effort by the world scientific community with the help of more trained scientists. The research program also includes a series of projects to collect the data required to verify and refine the efforts of the theoreticians.

The largest and most complex of these data-gathering envisaged projects is the Global Meteorological Experiment (GLOMEX), an experiment extending over a period of up to a year intended to acquire the most comprehensive set of global atmospheric data ever compiled.

Continued progress in meteorology depends not only upon advances in the understanding of the general circulation of the atmosphere but also upon technological development. Both areas have progressed with extraordinary speed in recent years. The development of the electronic computer has made it possible to study the problems of the complex workings of the atmosphere.

More data sought

As a result, scientists have confidence that the ability to make reliable long-range weather predictions of periods of up to two weeks and the ability to determine the feasibility of large-scale climate modification and control are within reach. The largest remaining obstacle to the achievement of these capabilities is the lack of adequate global atmospheric data. Currently, adequate weather data is obtained over less than 20 per cent of the earth. The remaining percentage consists largely of the oceans and the less

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*Dr. Hallgren is Director of ESSA's Office of World Weather Systems. Mr. Hanson is Weather Bureau Coordinator for World Weather Systems.

Continued

developed nations. The development of new observational tools, such as the satellite, horizontal sounding balloons, and automatic observing stations, now offer the research scientists and weather service of the nations of the world the opportunity to obtain these fundamental data.

Both the World Weather Watch and the Global Meteorological Experiment are vast and complex undertakings beyond the reach of any single nation. In fact, the World Weather Program is probably the largest and most complex scientific program ever attempted internationally.

The year 1967 is a crucial period for the World Weather Program. Hopefully, it will be a historic year. Major decisions regarding the World Weather Watch will be taken at the Fifth Quadrennial Congress of the WMO. And, at the Assembly of the International Union of Geodesy and Geophysics, equally important decisions will be taken in regard to the general circulation research effort.

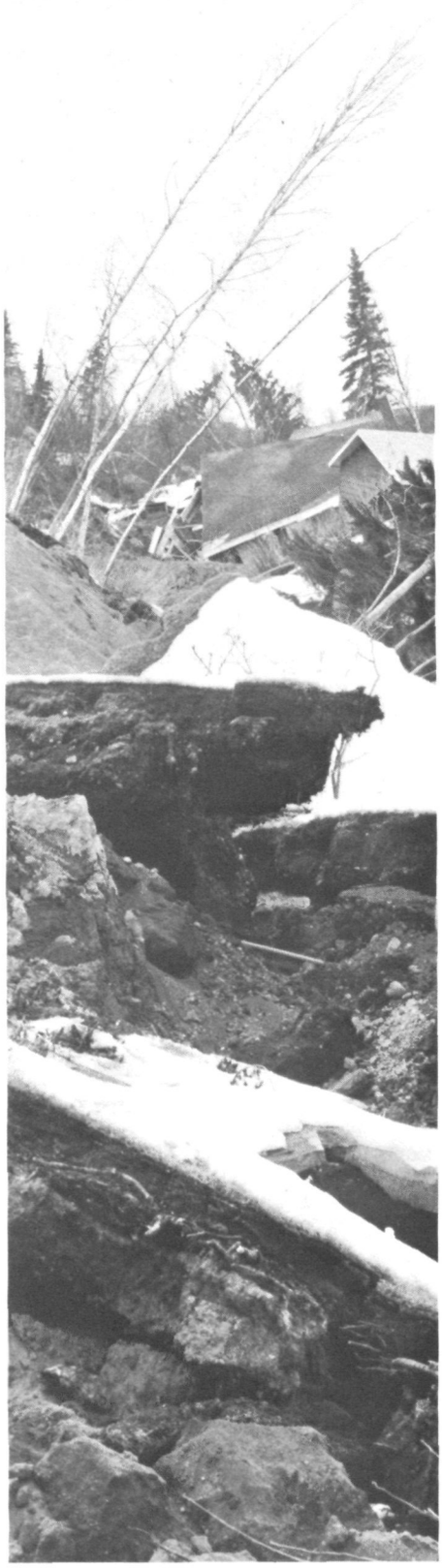
The WMO Congress will decide on a plan of activities in 1968-71 for using proved technology to remedy the most critical deficiencies in the existing international system. At the same time, the nature of new technological developments that must be undertaken by its members will be discussed.

Plan proposal expected

A general plan prepared under the leadership of the Secretary General for early improvements during the period 1968-71 in global observing, communications, and processing will be proposed to the WMO Congress. Washington, Moscow, and Melbourne have already been established as world meteorological centers. New steps will be taken in 1967 to distribute products from these centers to the national weather services of member states. By the end of the planning period (1971), global products prepared automatically are expected to be available. In addition, a number of regional meteorological centers will be established to perform functions similar to those of national meteorological centers, but serving a group of nations.

The United States has offered to establish late in 1967, a regional meteorological center at Miami to serve the countries of the Caribbean and Latin America.

Improvements in the Global Observing System are aimed at achieving a minimum network spacing of 600 nautical miles for surface and upper air stations over continental regions and ocean regions having suitably distributed islands; over open ocean areas the average network will be increased to approximately 1000 nautical miles. This will be done by upgrading or establishing new stations at 130 locations, and the equipping of some 100 merchant ships to take rawin-



sonde observations.

Some of the most far-reaching improvements planned for 1968-71 are in telecommunications. The members will jointly install a global main trunk circuit which will interconnect all regions with sufficient capacity to exchange the meteorological data and products required by members. In January 1967, the United States, with the Federal Republic of Germany, set up a high-speed link between Washington and Offenbach as part of the main trunk circuit.

In principle, the large-scale circulations — the major low and high-pressure systems — can be predicted in time and space for periods of up to two weeks and useful statistical predictions of certain meteorological parameters can be made for longer periods.

The lack of observations is not the only limitation to forecast accuracy. Inadequate representation of certain physical mechanisms in models such as the release of latent heat, diabatic heating, and internal and boundary layer exchange of heat, momentum, and moisture, automatically limits the forecast period to three or four days.

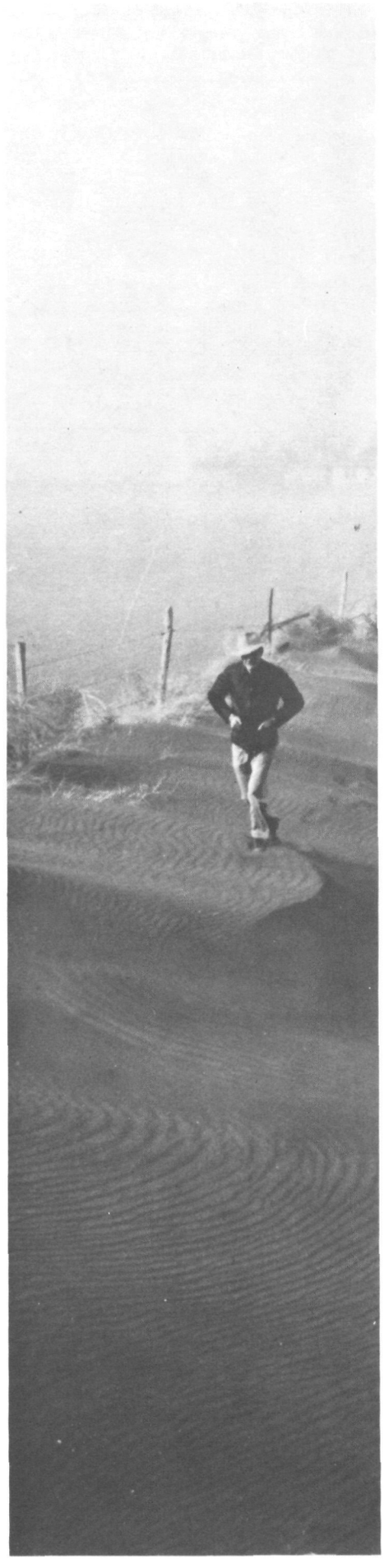
Model program expansion

Therefore, the general circulation research program will include an expanded effort to establish models that simulate the atmosphere with higher fidelity. ESSA's research effort is led by Dr. Joseph Smagorinsky and his co-workers at the General Fluid Dynamics Laboratory. This program will be expanded during 1967. Two important experiments to collect data for the research program will be undertaken in 1967.

The National Center for Atmospheric Research, with the support of numerous Governmental agencies and universities including ESSA, will study the tropical circulations in the vicinity of Line Islands to the southwest of Hawaii. Through the addition of a number of upper-air stations on these islands, the use of the USC&GSS SURVEYOR, radars, and the Advanced Technological Satellite, will bring this area under close observation and gain further insight into the nature of the tropical circulation.

ESSA's sea-air interaction laboratory under the direction of Feodor Ostapoff is undertaking preliminary experiments to test new techniques of measuring boundary exchanges in the vicinity of Wallops Island. This is an important first step in ESSA's essential effort to define and incorporate the smaller processes into long-range prediction models.

Next summer, ICSU/IUGG is considering a conference in Stockholm, Sweden, involving scientists from many nations. This conference will discuss important questions in regard to the general circulation research program — the assessment of data requirements, the time table, the studies that must be undertaken prior to any major experiments.



In September, the Assembly of the IUGG will tackle the questions of the establishment of international study groups in areas such as tropical circulation, sea/air/land interactions, development of dynamical models and technical developments, and at that time will probably designate the period that the nations of the world will join in bringing the atmosphere under intensive observation— The Global Meteorological Experiment.

Many factors involved

Establishment of a full World Weather Watch and the conduct of a Global Meteorological Experiment depend heavily upon the success of research, development, test and experimentation with new observation and communication techniques. Although present technology is capable of providing the observations and communications required, the new technology, as yet not fully developed, offers strong possibilities for significant reductions in the annual costs of operation of the WWW and conduct of GLOMEX.

Many of the new concepts center around the environmental satellite. Its enormous potential has already been demonstrated but the satellite is still in its infancy. We must fully exploit its capability to sense remotely the atmosphere, to provide global communications capability, and to collect observations from remote and automatic platforms on the surface or in the atmosphere. During 1967, initial tests will be made with the flight of the Nimbus B satellite of the new, advanced sensors. The satellite infrared spectrometer developed by Dave Wark and Don Killary of ESSA's National Environmntal Satellite Center will be one of the sensors to be tested on the Nimbus B spacecraft. This instrument measures the vertical distribution of temperature and an advanced model, presently under development, will measure the vertical distribution of moisture in addition to temperature.

The ATS-C satellite which will be orbited in mid-1967 will test the OPLE system for location and interrogation of balloons, buoys, and other remote stations. The horizontal sounding balloon is another area of new technology that offers great promise for both the WWW and GLOMEX.

These are only examples of some of the exciting new techniques that can be brought to an operational status in the near future. It will probably take as long as a decade to establish the WWW, and perhaps two decades to achieve the objectives of the research effort. The difficulties are many, but ESSA believes none is insuperable. □

Dr. George S. Benton, Director of the IER, observes a dramatic display of "creep" on the famed San Andreas Fault. The row of vines originally was straight, but movement of the earth has caused an obvious effect.

North shore of Hebgen Lake in Montana where highway was dumped into lake by earthquake.

Dr. Leroy Alldredge, Director, IES, studies the effect of earth creep on a concrete-lined ditch.

SCIENCE GOES UNDERGROUND

at a new laboratory where ESSA spies on earthquakes.

In Greek mythology, when the earth cracked and trembled, Poseidon, god of the sea, was expressing his displeasure. Descendants of the god, according to some legends, could predict earthquakes. Since the Greeks did not understand why the solid earth should shake and tremble, they attributed this, as they did other powerful forces of nature, to the vagaries of the immortals.

With the growth of scientific knowledge, man's understanding of the forces of nature has improved to the point where these phenomena are explained as the result of basic physical laws. The Environmental Science Services Administration was created for this purpose, to study and understand the actions and reactions which occur in the total physical environment. In addition, as the ESSA studies perfect the necessary knowledge of mechanisms involved, programs to warn of natural disasters and to modify and control the environment are instituted.

Earthquakes, among the most powerful and destructive forces of nature, are an area where much basic research remains to be done. We know what an earthquake is, but the mechanisms which cause it are not completely understood and the prediction capability for the occurrence of earthquakes is even less developed.

Integrated Program Planned

The Earthquake Mechanisms Laboratory, a major unit of the Institute for Earth Sciences of the Institutes for Environmental Research, is conducting research programs designed to supply some of the answers to earthquake phenomena. Under the leadership of Dr. Don Tocher, Director, a staff of sixteen scientific, engineering, and support personnel has been assembled to carry out an integrated program of pure and applied research to increase our understanding of earthquakes.

The Laboratory was created two years ago as part of the Coast and Geodetic Survey and was transferred to IER following the formation of ESSA. The major emphasis during this period has been centered on the development of instrumentation for data collection and analysis and the installation of equipment at field sites along the San Andreas Fault. Close working relationships have been maintained with the U.S. Geological Survey and with colleges and universities working in the field of seismology. The Advanced Research Projects Agency assisted the Laboratory in the development of instrumentation for remote field sites.

Laboratory Is Dedicated

Formal dedication of the Laboratory, at 390 Main St., San Francisco, California, and its Data Acquisition and Analysis Facility (DACAN) was held on January 17. Dr. George S. Benton, Director of IER, was principal speaker at the

BY RUSSELL B. STONER
Institutes for
Environmental Research

ceremony attended by more than 100 representatives of universities, industry, government agencies, and news media. Dr. Leroy Alldredge, Director of the Institute for Earth Sciences, was master of ceremonies and Dr. Tocher explained the activities of the Laboratory and the DACAN system. An open house was held preceding and following the ceremony. Extensive coverage of the dedication by television and press indicated a high interest in the activities of the Laboratory by the general public in the Bay area.

The DACAN system, now operational, will give the Laboratory staff an unusually flexible tool for the study of the various mechanisms associated with earthquakes. Data from the field sites are recorded on tape and in some cases telemetered directly to the Laboratory. The analysis center for the system can then present these data for study in a variety of ways: audio, visual, and, after conversion from analog, in binary form. Visual presentation of selected data are available in real time in the Analysis Center.

Rapid Scan System Used

Since much of the data are recorded at field locations when no one is present to monitor the records at the time an event occurs, some method of rapid tape scanning is necessary to identify the needed data and present it in usable form. The DACAN system provides for tape search and playback for this purpose. After the correct portion of the tape is located, an audio presentation is made. When the scientist hears the event begin, he can punch a button instructing the equipment to present that portion of the tape as a visual readout which can be studied, scaled, and compared to other records of the same event obtained from other observing sites.

Installation and maintenance of the DACAN system were accomplished by the Engineering Group under the direction of Edgar C. Sparks, Jr. Dr. John H. Pfluke, Chief of the Analysis Group, is responsible for operation of the Analysis Center. The applied research is then augmented by the Theoretical Studies Group under the leadership of Dr. Dean S. Carder.

Geophysical sensing stations for the recording of earth movement are presently being maintained by the Laboratory at five locations: Plantation and Bear Valley, northwest of San Francisco, and Castle Rock, Mount Madonna, and Stone Canyon to the southeast. The Stone Canyon Geophysical Observatory which lies directly on the San Andreas Fault south of Hollister, is the most extensive and heavily instrumented of the five. The site, located on the 101 Ranch, uses seismometers, tilt meters, strain meters, and magnetometers to measure and record crustal movements in an active seismic region. The installation of three shallow-well (up to 500 feet) seismometers is planned in the immediate future to reduce surface noise so micro-earthquakes can be studied in greater detail.

Laboratory's Projects Outlined

What is the Earthquake Mechanism Laboratory intended to accomplish? In broad outline, the Laboratory has four major projects, two in basic research and two with more immediate applicability.

The projects to investigate earthquake mechanism and the physics of the interior of the earth fall primarily within the "study and understand" portion of the total ESSA mission. Only as our understanding of the physical laws governing the forces within the earth which generate earthquakes increases can we devise ways to reduce the loss of life and property resulting from them.

The other two projects, investigations of earthquake hazards and earthquake warnings, fall within the "modifying and predicting" portion of the ESSA mission. The earthquake hazard project will investigate the behavior of the ground and of man-made structures during damaging earthquakes. With a clearer understanding of the effects of an earthquake on different ground surface formations and how those effects will act upon structures erected upon the ground formations, it will be possible for engineers and architects to modify their structural designs in active seismic regions to minimize the damage caused by major earth movements.

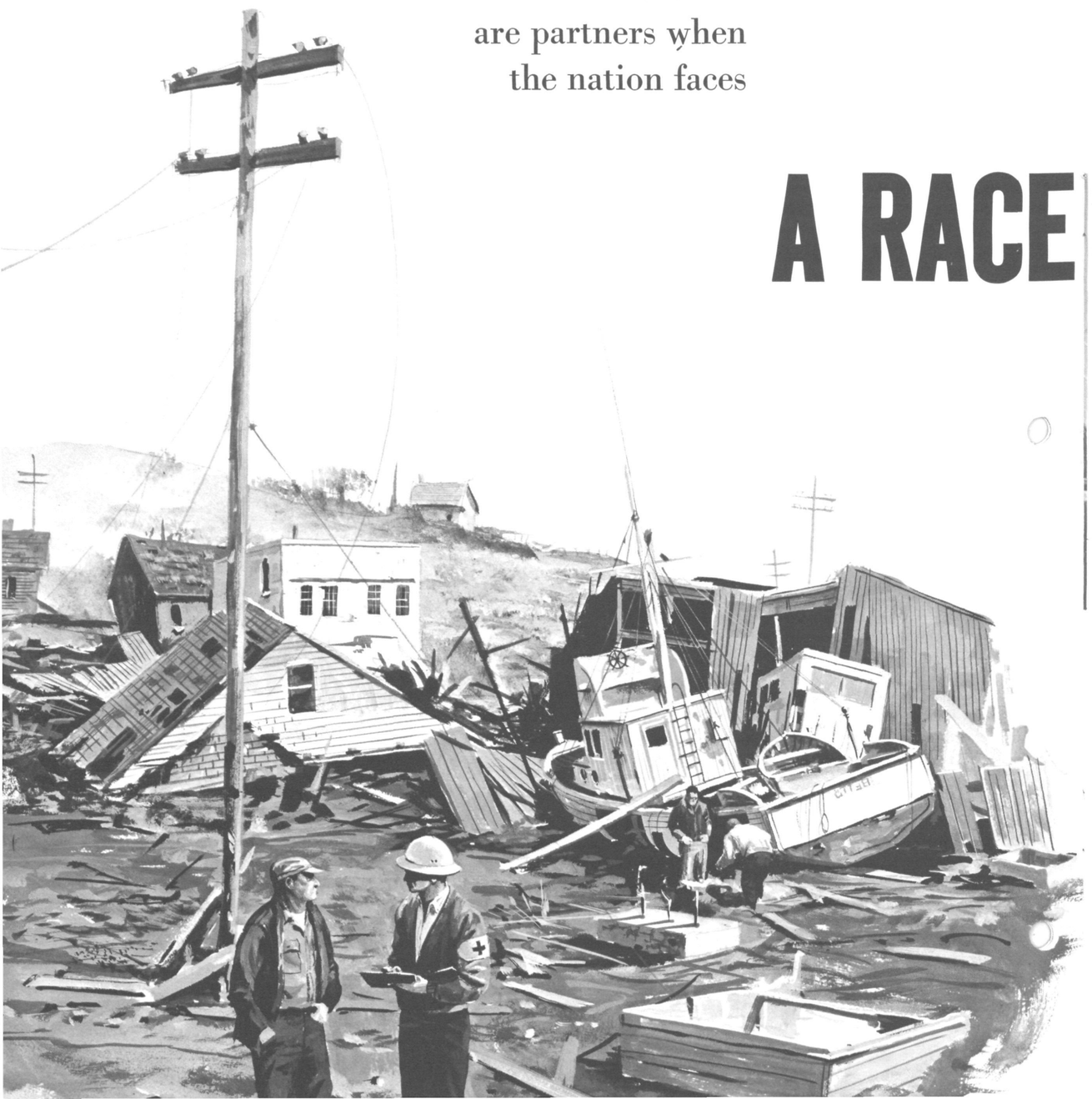
Ultimate Goal: Warning

Earthquake warning capability would be the ultimate goal of the fourth project. At the present time this capability is limited to saying that the probability of future quakes is greater in areas of known seismic activity than in areas that are seismically quiet. For a useful prediction system, it would be necessary to be able to predict an earthquake in a specific area with less than a week lead time. This would allow for evacuation of people, alerting emergency personnel and services, and the suspension of such services as gas and electricity which might present potential hazards. Such specific predictions are not now possible. There is some question whether they will ever be possible. The project will search for possible predictors that might be used to create such a warning system. Areas of study will include micro-earthquakes, rate of creep along the fault, changes in the rate of strain or tilt, changes in the magnetic field, and changes in the velocity of seismic waves. □

BY ROY S. POPKIN
Assistant to the National Director,
American Red Cross Disaster Services

ESSA and the American Red Cross are partners when the nation faces

A RACE WITH DISASTER



At approximately 8:40 a.m. on April 4, last year, the American Red Cross chapter in St. Petersburg, Florida, learned from the police and the Weather Bureau that a tornado had struck the community. Within fifteen minutes, the chapter later reported, "Directors of Nursing and Safety Services immediately sent to scene . . . Chapter sent trailer to scene and began serving coffee and sandwiches to disaster workers . . . First aiders and two nurses, canteen volunteers responded immediately, as well as Citizens Band members of Emergency Service . . . Were on scene thirty-two hours."

There is nothing unusual about this report, but it does underscore the important relationship between the warning services of the Environmental Science Services Administration and the effectiveness of the American Red Cross Disaster Services program.

When the first National Weather Service was formed in the Army Signal Service in 1871, one of the primary responsibilities assigned to the nation's first weathermen was the issuance of storm warnings for the Atlantic and Gulf Coasts and the Great Lakes. Implicit, too, in Congressional action to establish the Survey of the Coast in 1807 was the protection of life and property. The American Red Cross did not enter the field of disaster relief until the Michigan forest fires of 1881, but by 1905 its status as the nation's official voluntary disaster relief agency was recognized by the Congress which that year formally chartered the Red Cross to . . . "continue and carry on a system of national and international relief in time of peace and apply the same in mitigating the sufferings caused by pestilence, famine, fire, floods, and other great national calamities, and to devise and carry on measures for preventing same."

Since that time, the Red Cross has spent hundreds of millions of dollars contributed by the American people to carry out this responsibility. Although subsequent legislation has over the years broadened the disaster relief responsibilities of various federal agencies, the traditional responsibilities of the American Red Cross — to meet the needs of individuals and families affected by natural disaster — have never been duplicated by any agencies of the United States government. In disaster relief operations today, the Red Cross works in close coordination with the Office of Emergency Planning, the United States Public Health Service, the Department of Agriculture, the Coast Guard, the Small Business Administration, armed forces (under military regulations the Red Cross may request assistance from the armed forces and reimburses them for out-of-pocket costs when this happens), the Farmers Home Administration, the Bureau of Indian Affairs and other federal, state and local agencies.

ESSA's Role Outstanding

But no agencies, perhaps, play so important a role in Red Cross plans and operations as those of ESSA.

For it is the flood, tornado, hurricane, blizzard and tsunami warnings provided by the Weather Bureau and the Coast and Geodetic Survey that make it possible for the Red Cross to go into action in advance of a disaster's impact, or immediately after one has occurred. During the almost three weeks in which ESSA aircraft, satellites and radar-meteorologists and forecasters followed Hurricane Inez's erratic path, the Red Cross moved disaster staff and equipment to likely impact points from the Carolinas to Texas, always ready to provide emergency assistance should the storm actually strike.

The key to the effectiveness of the Red Cross disaster program is preparedness planning, and a major factor in carrying out these plans is advance information of an impending disaster when such information is available.

Improved hurricane, flood, tornado and tsunami forecasting services have greatly enhanced the ability of the Red Cross to alert its local chapters and mobilize its relief personnel and equipment in time to help emergency workers and evacuees even before a disaster occurs. Even the

Continued

Continued

relatively short time sometimes provided by urgent tornado warnings provides enough lead time to alert volunteers to be ready for a tornado strike. On Palm Sunday, 1965, sixty-eight Red Cross chapters were involved in tornado relief activities. The average time it took for them to go into action — after the tornadoes struck — was less than forty-five minutes. The extensive Weather Bureau alerts and warnings helped make this possible.

Watch-Warning System Vital

The Red Cross disaster relief program involves both emergency assistance prior to and at the time of impact and recovery aid designed to assist families in getting back on their feet and resuming normal living. In advance of a flood, the Red Cross will open shelters, assist families with the evacuation and storage of household possessions. The same is true in advance of a hurricane or a tsunami. The Red Cross Hurricane Disaster Action program is keyed to the Weather Bureau's hurricane watch and warning system. A comparable flood action program is being developed in cooperation with the Weather Bureau's River and Flood Forecast Service. On the West Coast, a tsunami watch triggers comparable Red Cross action.

As part of this kind of planning, the Red Cross surveys potential damage which might be caused by storm tides or floods reaching various heights, so that shelters — in schools, churches, union halls, etc. — can be located in safe areas and so that preparations can be geared to the potential number of evacuees who might require food, clothing, shelter and emergency first aid or medical care. The number of people sheltered and fed by the Red Cross may reach the hundreds of thousands, as it did after hurricanes Carla and Betsy (during and after Betsy, the Red Cross spent approximately $17,500,000 on relief operations), or it may be just a handful following a local flash flood or isolated tornado hit. The Red Cross does not require a Presidential Disaster Declaration to go into action; there are about 25 Presidential declarations annually, yet local Red Cross chapters are active in more than 12,000 disaster relief efforts a year.

Because the Red Cross program is designed to provide the most extensive emergency assistance possible, the organization is looking forward to the development and expansion of the NADWARN system throughout the nation. At present, ESSA teleprinters provide weather, tsunami and earthquake information to the Red Cross national headquarters and several regional offices. Other regional offices and major local chapters depend on telephone contact with appropriate Weather Bureau or Coast and Geodetic Survey offices. With the extension of the NADWARN system to other communities throughout the nation, it is expected that ESSA teleprinters will be installed in many more key Red Cross locations.

Close Cooperation The Rule

In advance of this development, the Red Cross will continue to work closely with ESSA to make the maximum use of warning information provided by teleprinter and by direct contact, as provided for in ESSA operational directives. This spring, should the rivers rise in the Ohio Valley, a new system of transmitting river and flood forecasts from the Cincinnati River Forecast Center will speed up-to-the-minute information about river stages to the Red Cross regional offices and local chapters concerned, just as hurricane information is now transmitted through Red Cross channels to Hurricane District offices and local chapters as part of the Hurricane Disaster Action plan which was tested first during Hurricane Donna in 1960.

At the time, the Weather Bureau's Gordon Dunn said, "The small loss of life in Hurricane Donna was truly remarkable . . . A considerable portion of the credit for this small loss of life must go to the public and semi-public agencies,

such as the American Red Cross, which did so much to encourage evacuation of the inundated areas and provide refuges for the evacuation. In community after community on the Florida Keys and at Collier County, 90 to 95 percent of the population either evacuated to Miami or Key West or went to designated places of refuge."

In May, 1957, Walt Bodine, former news editor of WDAF in Kansas City, talked of the weatherman's role in predicting the tornado which hit that city. After citing the advance warnings, he said, in his series, "Diary of a Disaster," that the weatherman's job was done after the tornado struck. All the forecaster could do then was to wait to find out what happened.

Technically, this may be so, but from the point of view of a disaster relief agency such as the Red Cross, the forecaster has played a far larger role. For the warning information he provided made it possible for relief activities to be initiated — gave adequate lead time ahead of a tornado, blizzard or flood, or at the very least indicated that local officials and Red Cross chapters should be alert to a possible need for their emergency services. In this respect, the forecaster's job goes right on . . . for the information he provided set the wheels of mercy in motion. □

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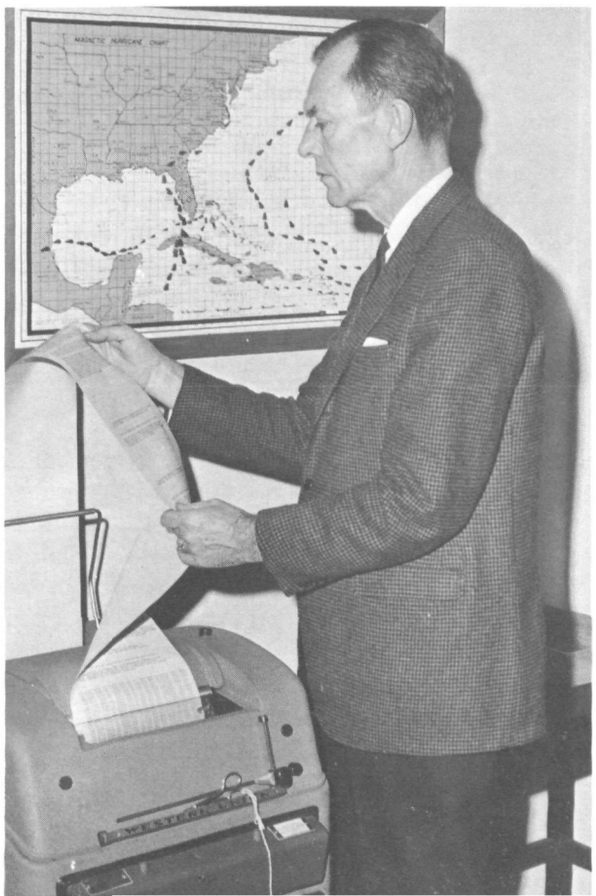


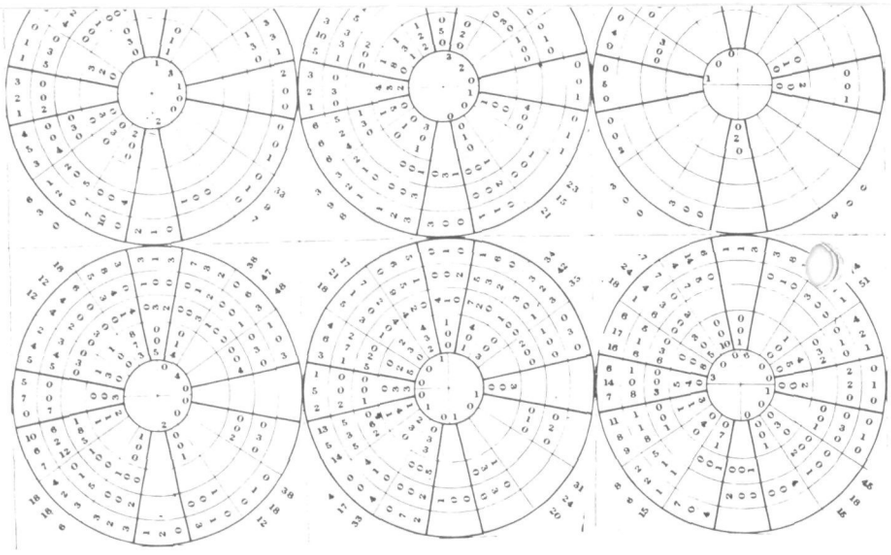
4 ▼

1. *Red Cross assistance moves, flags flying, across a forbidding landscape in the wake of a North Carolina snow disaster, using Army vehicle for transportation.*

2. *Whenever natural disaster threatens, Robert M. Pierpont, National Director, American Red Cross Disaster Service, is often found at the organization's weather machine.*

3. *A Red Cross volunteer, one of an army of thousands across the nation, feeds baby in a refugee shelter in aftermath of Hurricane Betsy, a historic disaster.*

4. *Kindly reassurance and comfort are offered by a Red Cross nurse to a bewildered, elderly patient. This scene occurred in wake of Hurricane Betsy.*



MATTHEW FONTAINE MAURY

A runaway stagecoach, 127 years ago, led to . . .

THE DAY OF THE DATA BANK

By PATRICK HUGHES
Environmental Data Service

In 1839 a young man broke his leg in a stagecoach accident and thus assured the future of oceanography. For the Environmental Data Service his story is both parable and preamble.

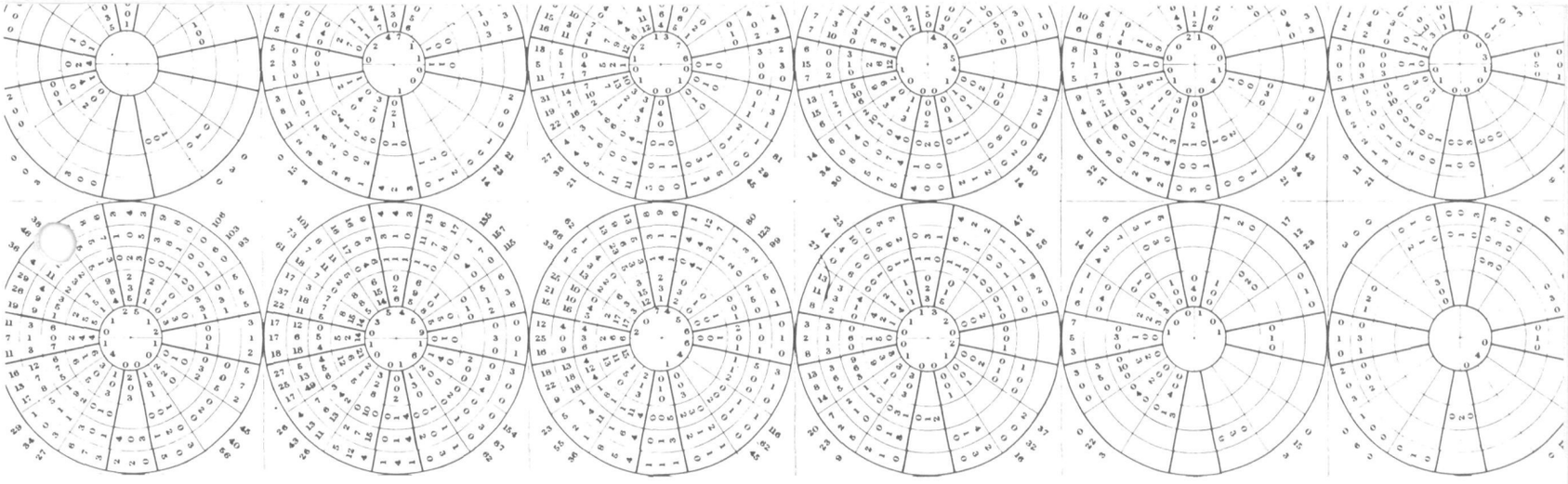
Lt. Matthew Fontaine Maury, left with a permanent limp and barred from the active life of a sea-going Naval officer, was appointed Superintendent of the Depot of Charts and Instruments (now the Naval Oceanographic Office).

The Depot was used as a dead storage for old ship's logs, and Maury was soon studying the records of countless men-of-war and merchant vessels. He was amazed at the wealth of data on winds and ocean currents that they contained. By the simple but tedious process of extracting and analyzing these apparently unwanted observations, he was able to determine the general surface circulation of the world's oceans and to establish the relationship between wind and current. His data collections, and the charts based on their analysis, remain one of the great contributions to modern environmental science, the direct result of the study and synthesis of environmental observations routinely taken, logged, stored, and ignored — by all but Maury.

Ironically, despite the universal acclaim for Maury's achievements, many seem to have missed the moral of his story.

A curious but popular misconception — found even today — is that data processing, archiving, publication, etc., are secondary activities, mere byproducts of the practical world of operational science. According to this theory, data centers are full of "dead" ancient history deservedly relegated to dusty shelves, dark corridors, and eventual disintegration. Nothing could be further from the truth.

Courtesy of Kaiser Aluminum News



"Wind Roses" above were taken from Lieutenant Maury's original wind charts of the Cape Town area. Maury obtained the figures by painstaking exploration in thousands of logbooks in the course of his search for a history of the past behavior of the winds in this area.

Data Volume Increases

Contrary to popular opinion, archived scientific data become more valuable as time passes, and the collection grows. Our environmental data heritage will again, as it has in the past, inspire new and revolutionary concepts — concepts that will largely determine the success or failure of ESSA's accelerating efforts to understand, describe, cope with, and perhaps someday, to control our environment.

Man has long struggled to establish systematic programs of data collection and archiving. In recent years, the explosive growth and staggering diversity of environmental data collection activities, both national and international, have threatened to overwhelm the assimilation capabilities of individual scientists, laboratories, agencies, and even governments. The demonstrated need has been for centralized "data banks" where environmental information can be systematically processed and archived, and whose data, analyses, studies, publications, and services are available to all. This need led to ESSA's creation of the Environmental Data Service (EDS).

ESSA's multi-discipline environmental data are processed and archived at one of EDS' three major data centers: the National Weather Records Center (NWRC) and the National Geophysical Data Center, at Asheville, N.C., and the Aeronomy and Space Data Center, at Boulder, Colo.

Centuries of Weather

NWRC is primarily responsible for climatic data and for a fast-growing file of international weather records. This includes everything recorded about the weather — from the contents of 18th century weather journals to the observations now being taken at upwards of 12,000 ESSA observation posts in the United States alone.

The National Geophysical Data Center is composed of the Seismological and Geodetic Centers. The first is the archives and dissemination point for the seismographs recorded by the 125 stations of the Worldwide Standardized Seismograph Network, strategically located around the globe to monitor earthquakes. It also receives data from other seismological activities.

The Geodetic Data Center is responsible for the maintenance and distribution of adjusted geodetic control data, diagrams, indexes, and publication to those interested in surveying, mapping, exploration, etc.

The Aeronomy and Space Data Center, at Boulder, collects, archives, and makes available data relating to the ionosphere, airglow, space disturbances, solar activity, and geomagnetic fluctuations. A significant portion of these data consists of ionospheric soundings made several times an hour at 150 stations around the world.

The International Geophysical Year (IGY) 1957/58 was the great stimulus for the international data bank concept. World data centers for both the East and West were established in the various geophysical disciplines, and have since become permanent data banks, providing for the international exchange of environmental data under the supervision of the Comité International de Géophysique, a special committee of the International Council of Scientific Unions.

A number of these international centers — the World Data Centers A (WDC-A) for seismology, geodesy, geomagnetism, meteorology, nuclear radiation, the ionosphere, and airglow — were originally established in the Coast and Geodetic Survey, the Weather Bureau, or the Central Radio Propagation Laboratory. With the advent of ESSA, EDS assumed responsibility for these, and, since that time, for several others (cosmic rays, auroras, and solar observations). Each international data center is currently co-located at one of EDS' three national data centers, according to discipline.

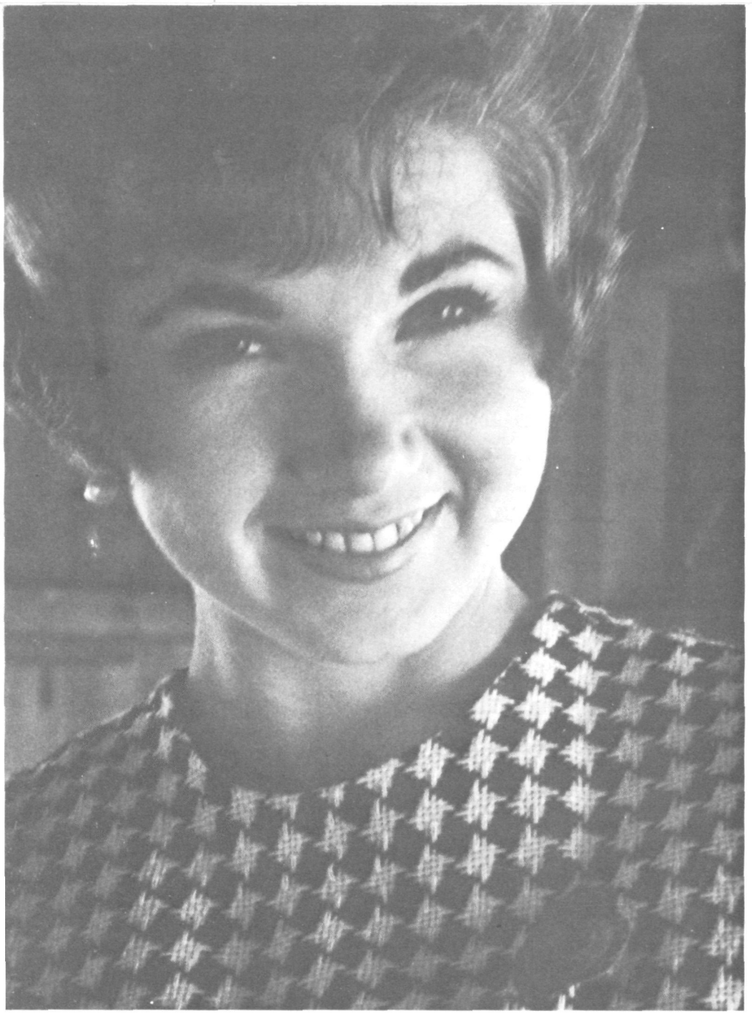
Many Customers for ESSA

ESSA's data clients include other Government agencies, the scientific community, the military, practically every area of the national economy, and the private citizen. To meet broad user requirements, environmental data are summarized in routine publications. These are global, national, or local in focus, and are available in synoptic, graphic, narrative, and tabular form. Besides its publications, EDS makes available microfilm, punched cards, magnetic tapes, radar and satellite film, original records or duplicate copies, autographic traces, etc. It provides and interprets data analysis tools, and searches for new methods of analysis, new applications of archived data to environmental problems, and technological advances in the mechanical processing, storage, and retrieval of data.

For today, when 90% of all the scientists who have ever lived are active and technical information is doubling every decade, the hand-extraction and tabulation of environmental data performed by Maury have, of absolute necessity, given way to the lightning reflexes of electronic computers.

The single most significant scientific development since World War II has been the data explosion. The collection, quality control, communication, analysis, processing, storage, and retrieval of information, on a scale that numbs the imagination, is one of the central concerns of our time. Since the environmental sciences are observational sciences, data and their use are both the backbone and substance of these disciplines.

ESSA's success in meeting the critical challenges of our environment will largely depend upon its development of the mechanisms and systems necessary to absorb the rising flood of raw data, and then to rapidly, efficiently, and economically screen and disseminate them, in their most useable forms, to support ESSA's operations and research. To date we have done little more than define the problem. This is indeed a beginning, but we still have a long way to go. □



Meet Miss Commerce...

Queen of ESSA and Commerce and Miss 'LorSta Sitkinak' of the Coast Guard

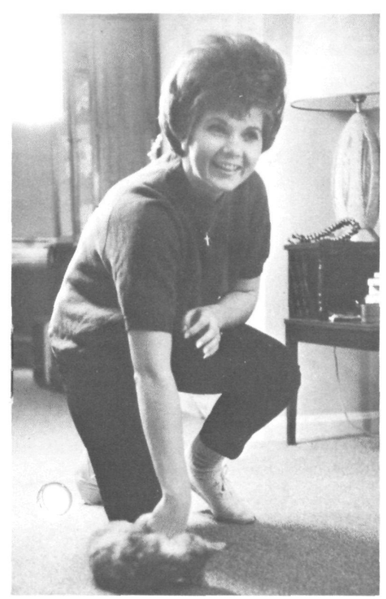
Gwendolyn Fulcher is a bright, pretty 20-year-old who last October, somewhat to her own surprise, was crowned first Miss ESSA and then Miss Commerce. In these pages, **ESSA World** visits the queen of our own and our parent agency.

She lives in Beltsville, Maryland, and is an administrative aide in ESSA's travel and tort claims section at the Rockville headquarters. Off the job, she is perpetually in motion, although her new eminence has not excused her from sharing in the household's duties. Her father, William, is a government employee by day, a jazz trumpeter by night; she shares his enthusiasm for such giants as Brubeck, Kenton and Ferguson. When he plays, she often goes to hear him. She also sings in the choir of Beltsville's United Presbyterian Church.

Her reign so far has brought its share of ceremonial functions, which she thoroughly enjoys. It has also brought her the collateral honor of becoming Miss *LorSta Sitkinak,* in which she succeeded TV actress Mary Tyler Moore. A king-sized photo of the Fulcher smile looks benignly upon the Coast Guardsmen who operate the Loran station on that small and isolated Alaskan island.

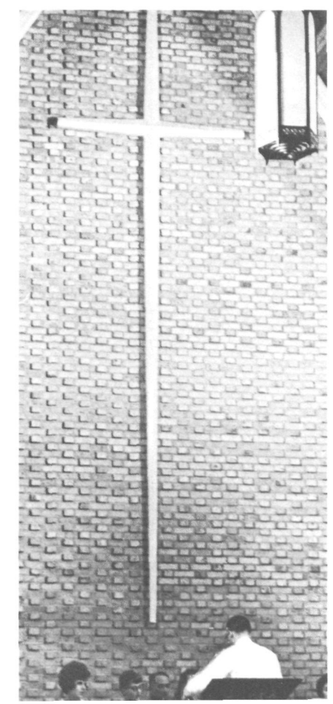
At home, however, she shares the honors. She was almost as pleased as she was at her own coronation to learn that her 19-year-old sister, Linda, a freshman at the University of Maryland, was named Pershing Rifles Sweetheart this year.

. . . researching a claim at work

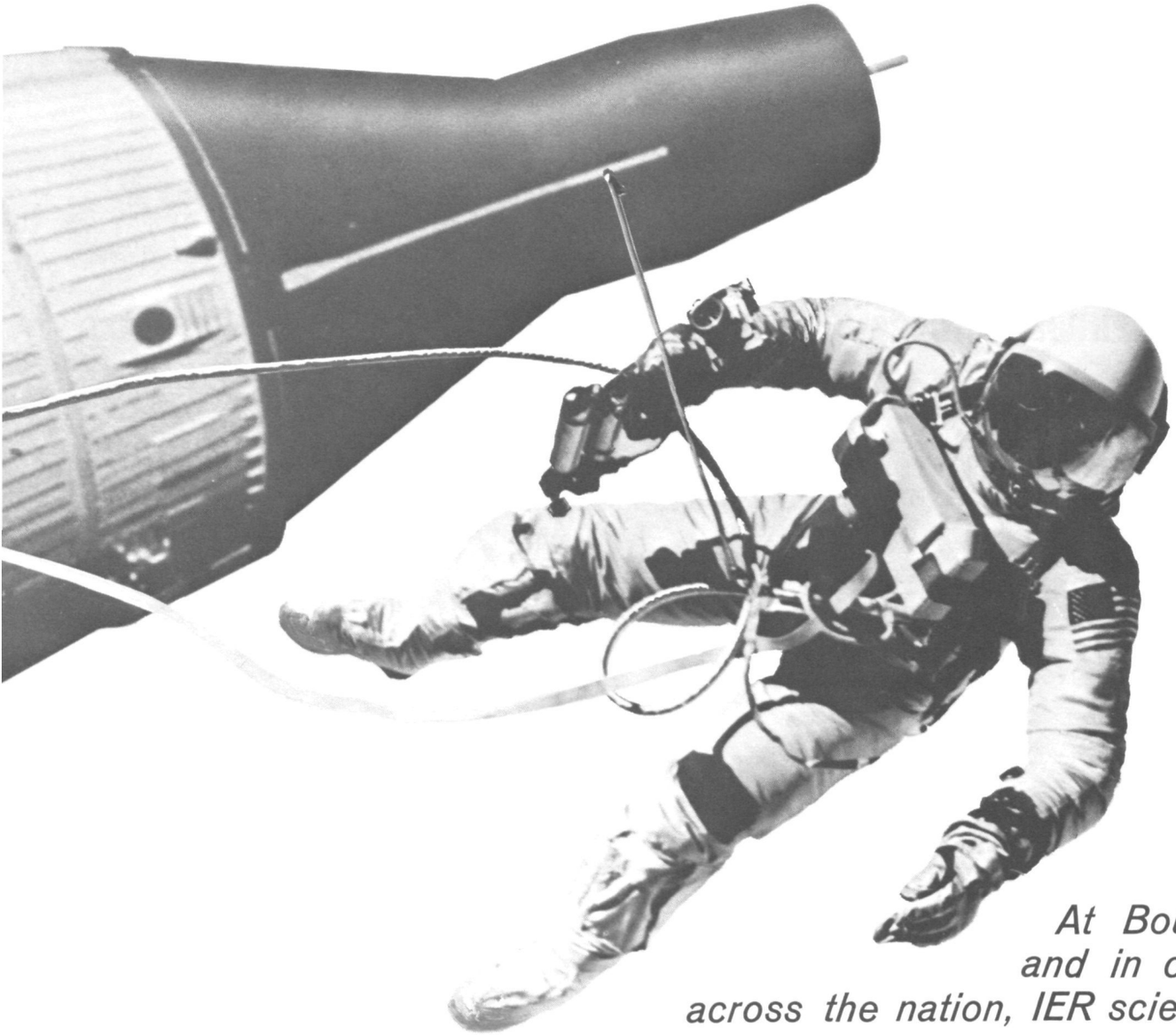


Top left, at home with father. Top right, enjoying mild winter weather. Lower left, relaxing with pet.

Below and right, practicing with church choir



Photos by John Roseborough



At Boulder, Colo., and in other centers across the nation, IER scientists pursue an awesome **ASSIGNMENT—**

THE UNKNOWN

THE SNOW-TIPPED ROCKIES look down protectively like a grey-haired family elder keeping watch over his active brood. This is Boulder, seat of the nation's leading center of study into man's expanding world.

The great mountain is the back doorstep of the Boulder Laboratories where Environmental Science Services Administration has established its Institutes for Environmental Research. Here, some 30 miles northwest of Denver, Colo., scientists are unlocking secrets of the earth — its atmospheres, oceans, total behavior — to make known what is in the unknown of new and great exploration.

The mission is clear cut — to supply the human race with the information it must have to descend safely deep into the oceans or soar high into space, to free the people from the fear of the hazards of storms, to protect them from the seismic convulsions within this planet, to assure uninterrupted communication with our man on the moon or wherever he may be.

This is a big order for science, one of unprecedented magnitude. Not too long ago, airplanes flew at ground-hugging altitudes and the ceiling was considered unlimited when clouds were above 10,000 feet. Now flight at 30,000 feet is routine and a supersonic transport will one day fly at 60,000 to 80,000 feet. Passengers will have to be safe, not only from the conventional weather disturbances on takeoff and landing, but also from the radiation that exists above the thin protective envelope of our atmosphere.

ESSA's Institutes for Environmental Research have the challenge to acquire the knowledge to make this possible.

Venture into the sea has been limited to the surface and a few hundred feet below, but the potential resources of what has been called the last frontier beckon man down to the ocean floor. Davy Jones must be persuaded to divulge his secrets of the deep.

ESSA's Institutes for Environmental Research have the challenge to make him talk.

Regulating Nature's Fury

The human and physical sacrifice that nature demands of mankind each year with its punishing hurricanes, tornadoes, earthquakes, tsunamis, has aroused an increasing compassion for the suffering. Our civilization pleads for protection against this violence. No less is the concern when nature takes the other extreme and withdraws its rain to deprive the people of the water they need for survival. ESSA's Institutes for Environmental Research have the challenge to evolve methods that will regulate the fury and achieve a favorable balance.

Earth's inhabitants are poisoning themselves by polluting the very air that keeps them alive. Uncontrolled combustion, nuclear explosions, undisciplined incineration are contaminants of torment that have reached a critical mass.

ESSA's Institutes for Environmental Research have the challenge to contribute toward a reduction of this evil through scientific investigations.

This only touches upon the responsibilities assigned to the Institutes for Environmental Research (IER). ESSA has a mandate to develop a coordinated system of predictions and warnings of natural hazards. Better understanding of the environment is an obvious requisite toward that goal. IER has been fashioned to ferret out that understanding.

IER has close to 400 projects on its schedule for this fiscal year, sponsored not only by ESSA but also other governmental agencies.

Recently the National Aeronautics and Space Administration transferred to the Space Disturbances Laboratory full responsibility for the prediction of solar flares and the radiational effects on outer space. NASA phased itself out of this operation and turned four of its telescopes over to the IER department.

Probing Space Secrets

This is significant recognition for the Space Disturbance Forecast Center, which only last year established an operational, real-time prediction program under which scheduled advisories of solar flares are transmitted as a means of determining the degree of dangerous proton activity in space. A buildup of excessive proton particles could be a hazard to astronauts as well as to satellite instrumentation.

With a network of optical and radio observatories around the world, the forecast center has introduced a high-speed teletype communications network that permits warnings to be issued as quickly as 15 minutes after it receives a report of unusual solar display.

IER, under the overall direction of Dr. George S. Benton, breaks down into the following major subdivisions:

1. Institute for Earth Sciences.
2. Institute for Oceanography.
3. Institute for Atmospheric Sciences.
4. Institute for Telecommunications Sciences and Aeronomy (formerly the Central Radio Propagation Laboratory).

Programs Across The Nation

Although Boulder is the headquarters for IER operations, laboratories are spread throughout the country. Of the total IER personnel of 1300, only half are assigned to Boulder.

The programs of all are vast, impressive and sometimes breathtaking, as is the climb to Fritz Peak, 9000 feet above sea level, the site of the observatory for the Optical Aeronomy Laboratory headed by Dr. Michael Gadsden. Here optical observations supplement radio research into the upper atmosphere.

The Institute for Earth Sciences, directed by Dr. Leroy Alldredge, is focusing attention on 2 major activities: satellite geodesy and earthquake research.

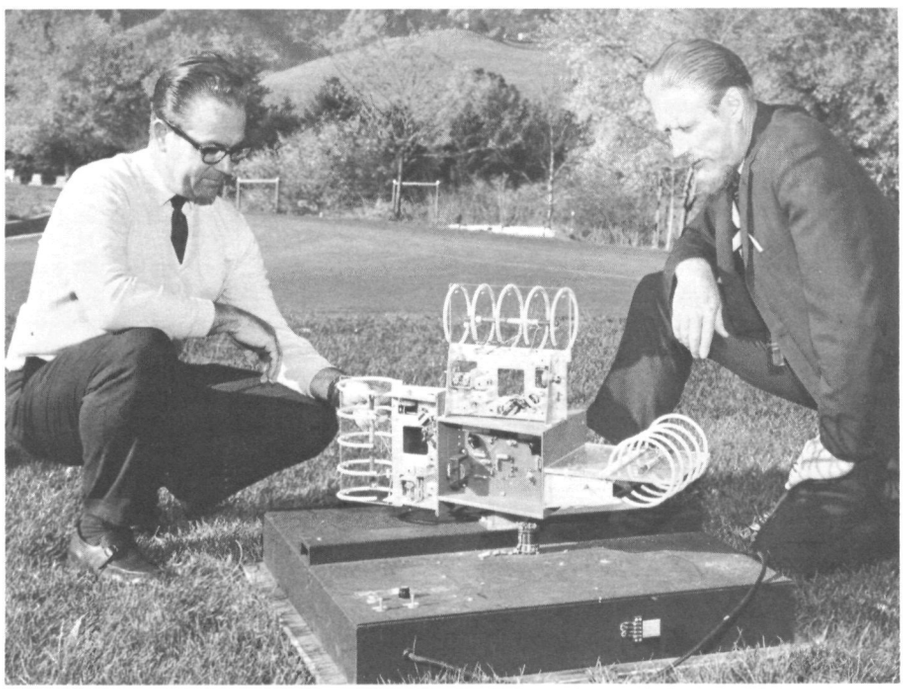
The Atmospheric Sciences laboratories are far flung, each oriented toward its prescribed responsibility.

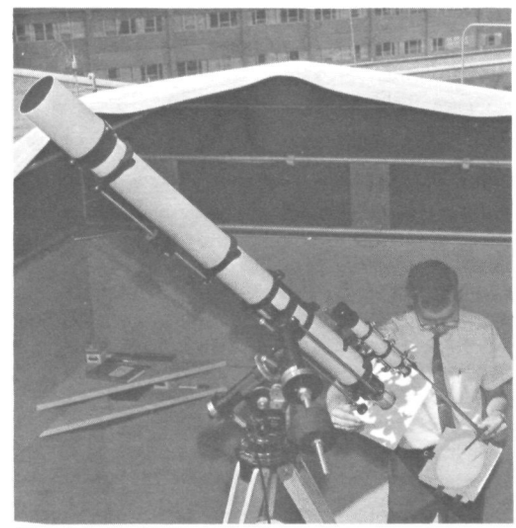
The Atmospheric Physics and Chemistry Laboratory, directed by Dr. Helmut K. Weickmann, is moving deeper into weather modification research with such projects as Stormfury and Hailswath. Lester Machta's Air Resources Laboratory has its home in the Gramax Building in Silver Spring, Md., while Dr. Cecil Gentry's Hurricane Research Laboratory operates, logically, out of Miami and Dr. Edwin Kessler has his National Severe Storm Laboratory in Norman, Okla.

The Gramax Building also is headquarters for the Institute of Oceanography headed by Dr. Harris B. Stewart Jr. but the IER returns to Boulder with the Institute for Telecommunication Sciences and Aeronomy under the direction of Dr. C. Gordon Little.

On and on the list could go, but it is obvious that the four IER divisions are designed to embrace the entire environmental picture, from earthquake and geomagnetic studies to weather modification, from radio propagation to oceanography, from ionospheric research to air pollution.

The world, all of it, is IER's test tube. □

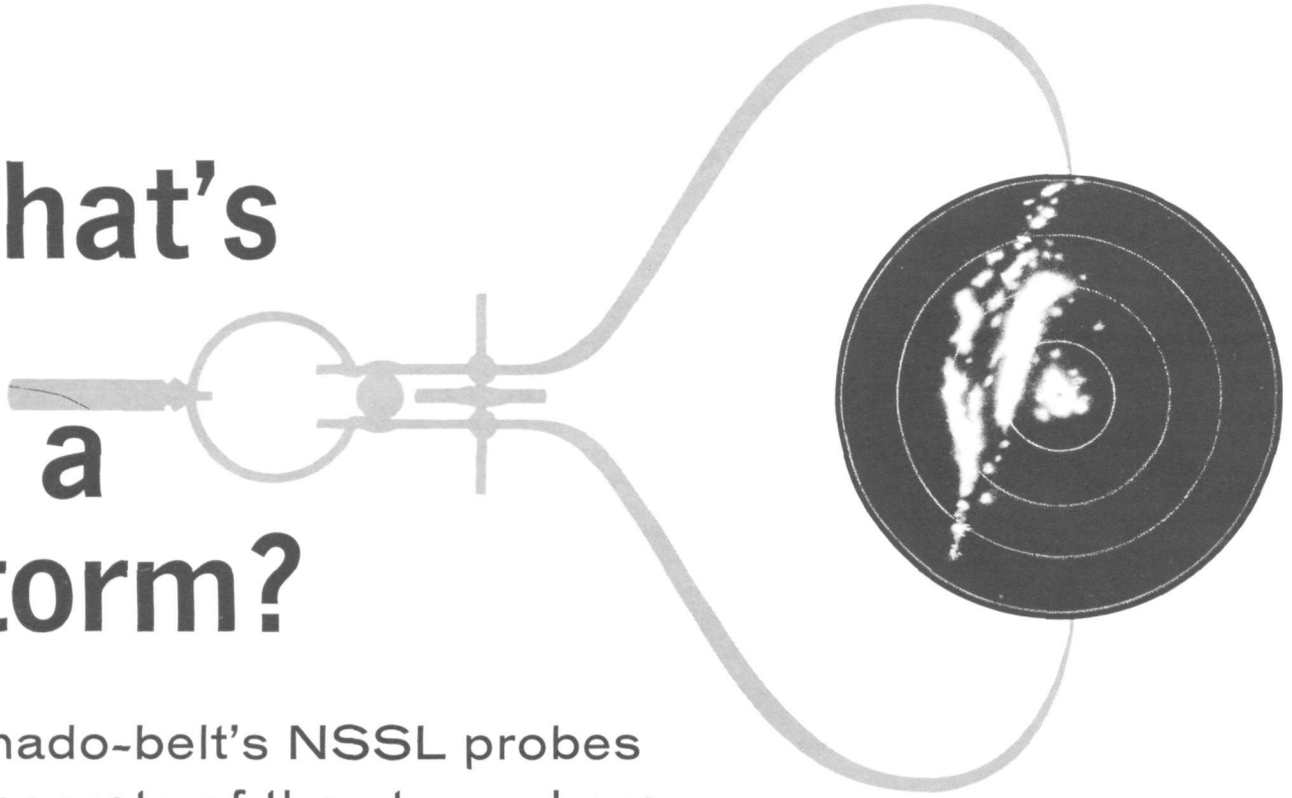




Patrick S. McIntosh observes sunspot from Boulder Laboratories' Radio Building.

B. R. Caldwell (l) and R. B. Stoner inspect a lightning discharge direction detector.

What's in a Storm?



Tornado-belt's NSSL probes the secrets of the atmosphere

BY SUMNER BARTON

Take a piece of the atmosphere roughly 100 miles wide, 100 miles long and 15 miles high, measure and analyze it, and the chances are good that the secrets of its behavior will be unlocked.

When that volume of air is in the heart of the mid-plains severe storm belt, any newly-acquired information should be expected to help meteorologists understand what makes disastrous storms tick.

Once understood, even the tornado may be exposed, vulnerable to improved forecasting techniques that will contribute toward the saving of lives and property.

That is the premise behind the establishment of the National Severe Storms Laboratory in Norman, Okla.

Saturation Search

Airplanes zig-zag through the atmospheric sample before, during, and after storms, collecting new information. Specially-developed radars search the air for clues. A dense network of instruments at the surface and at various heights on towers bring in data on winds, temperature, and humidity.

After two years, the National Severe Storms Laboratory has made encouraging inroads into its difficult problems. Research projects have been blueprinted. Computer techniques have been evolved to digest the growing accumulation of data and spew forth some answers. These are beginning to find application in the forecasting area, at least experimentally, with promising results.

As an example, radar readings were digitized and transmitted via teletype to a computer where they were converted to equivalent rainfall amounts and retransmitted to stations that could use the information. The advantage of this program is that it can provide a real-time, or current appraisal of the amount of rainfall over a watershed to aid in rapid predictions of run-off and potential floods.

The benefit of such a relay is obvious, especially where heavy precipitation imposes a demand for the issuance of warnings.

Success at Ft. Worth

The system was tested with the river forecasting center at Fort Worth, Tex., where a teletype radar data message was fed into a receiving computer and unscrambled for operational use.

The Fort Worth center commented: "This study has demonstrated the practicality of using current field radar and computer equipment to operationally analyze radar data for rainfall amounts."

Here is a new tool making an important contribution toward a life-saving function. River forecasting centers have the responsibility of alerting the public to the dangers of flooding. An immediate evaluation rainfall intensity would permit quicker, more precise warnings.

The advance by NSSL, which is under the direction of Dr. Edwin Kessler, was made possible by the development of a new type of radar data presentation, a vital link in the chain of progress that has its roots in basic research.

This is an integrated radar, in which the echo power is averaged to provide a clear signal that adapts itself to computer treatment. The radar scope image is as clear as a finely delineated picture, displaying contour lines of precipitation intensity, and making possible quantitative estimates of rainfall from a storm. This was designed by one of the world's foremost radar analysts, Dr. Roger M. Lhermitte, formerly of France, and now on the staff of NSSL.

Dr. Lhermitte, who prefers to be known as a mesoscale physicist rather than a radar meteorologist (meso referring to the center area of study between the small and large scales), has been a dominant figure in the construction of radar systems oriented toward weather analysis.

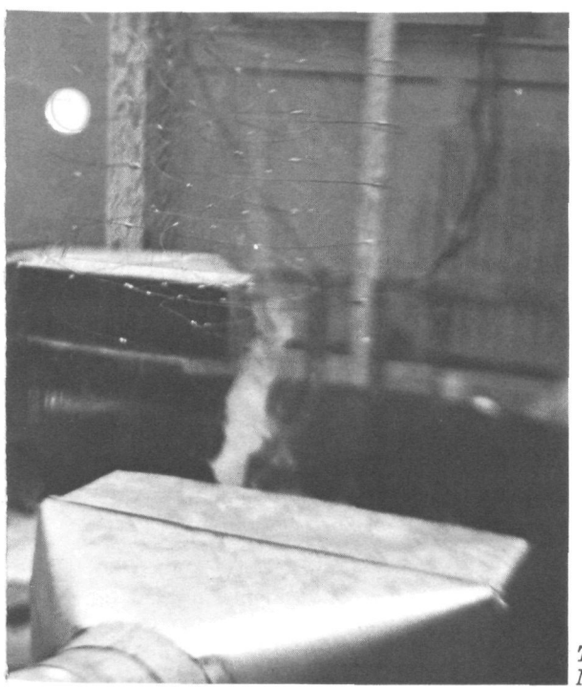
Radar's Promise

His present efforts are dealing with the applicability of Doppler radar techniques —which are capable of sensing the storm particle's velocity—to the analysis of the storm's severity. For instance, such radar techniques may offer means to positively identify tornado storms associated with the narrow, rotating funnel that drops out from some intense thunderstorm systems and, with its high velocity winds, cuts a destructive swath in its brief ballet performance.

Also included in Dr. Lhermitte's activities is the analysis of low-level turbulence from the radar echoes resulting from the presence of insects and dust particles in the atmosphere. This has enhanced research in this field and is leading him in new directions.

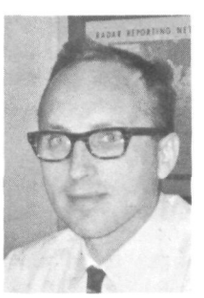
Insects are good targets in the summer

Actual tornado.



The tobacco smoke model built by Neil Ward to study vorticity flow.

Radars at the Weather Bureau's NSSL probe the atmosphere in an attack on the riddles of thunderstorms and tornadoes.



DR. EDWIN KESSLER
Director of National Severe Storms Laboratory

and spring about 20 per cent of the time up to 10,000 feet and as much as 50 per cent of the time at lower levels. But in winter, *poof*, no insects.

Since such observations are important to study the turbulent diffusion process in the atmosphere, Dr. Lhermitte is devising a program in which aluminized Fiberglas chaff would be lifted aloft and released as a target of year-round reliability.

Research meteorologist Neil Ward, intent on studying the vorticity flow (rotational circulation causes) within a tornado, has filled a room at NSSL with a model he constructed to help him take at least a laboratory look at the reactions within. When tracer smoke pours onto the floor of the model, heated filaments and controlled drafts of air set the smoke into a rotating motion that is fascinating to observe.

NSSL research is attracting new concepts, some that are uttered with a hard swallow. One advances speculation that tornado generating clouds might have anticyclonic as well as cyclonic rotation, which means they would turn clockwise in defiance of classical storm circulation definitions. James C. Fankhauser, a synoptic meteorologist engaged in upper air studies, is attempting to evaluate that projection.

Animation Study

Jean T. Lee, NSSL program coordinator, is absorbed in studies of thunderstorm effects upon aviation, a program of increasing concern as aircraft reach critical speeds. Hail, that would do little more than make an irritating rat-a-tat noise upon slow-moving aircraft, becomes an agent of destruction upon high-velocity jets and Lee has pieces of torn wing sections to prove it.

Leslie D. Sanders is supervisor of mesonetwork operations, which means that he has the responsibility for instrumenting, staffing, and developing the vast area of observing stations in the area of research activity.

An important cog in the NSSL operations is Mrs. Katherine Gray, supervisory computer specialist who is a wizard at translating data into the electronic gobbledygook that makes everything useful. Here is a living contradiction to ordinary man's condescending view of women as mathematical nonentities.

A new program under discussion takes a page out of Mohammed's precept: if the thunderstorm will not come to NSSL, let NSSL go to the thunderstorm.

Dr. Lhermitte said several storms have skirted to one side or the other of the observing network, out of research range. Proposed is a Doppled radar-equipped mobile van that could be rushed to a potential tornado breeder for investigation. This might be known as house-call research. □

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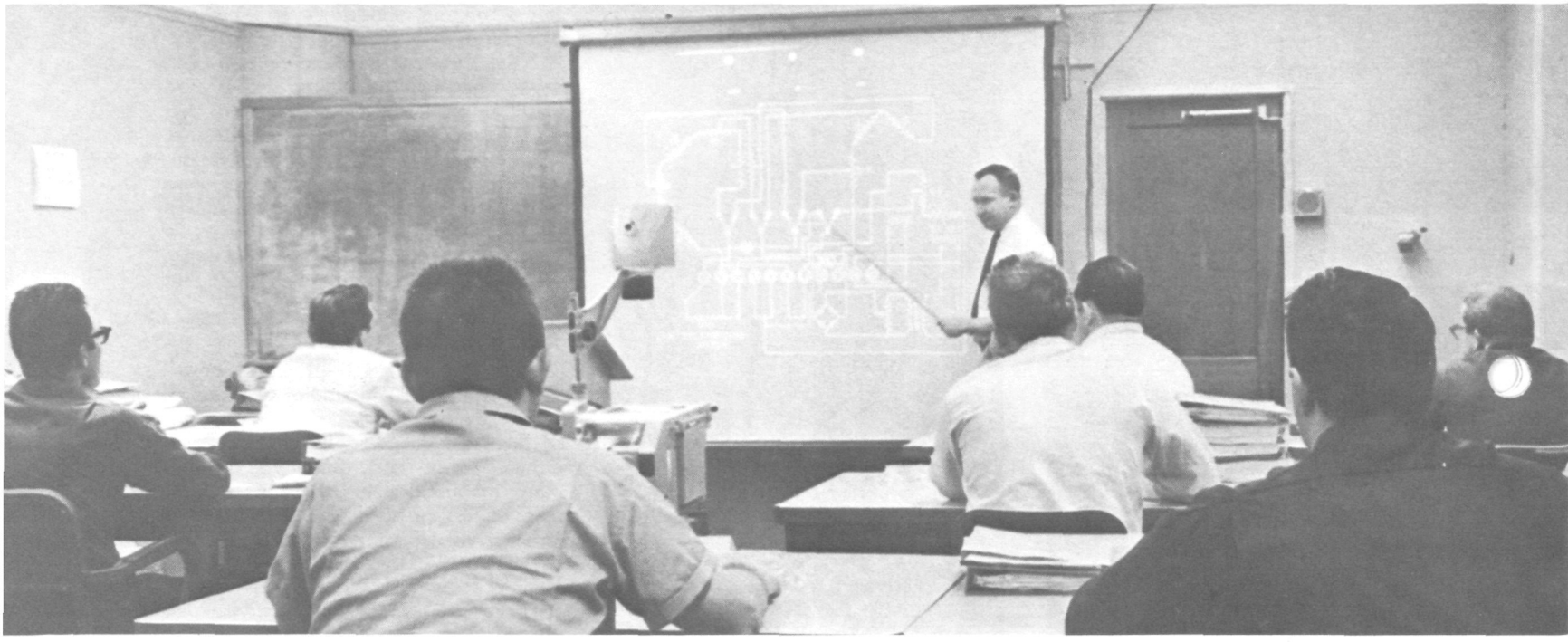
NMMTC

The WEATHER BUREAU'S graduate school for electronics technicians . . .



On the third floor of a converted warehouse in Kansas City a Weather Bureau electronic technician chews on his pencil eraser.

"IF NO ECHOES APPEAR ON THE RADAR DURING SEVERE WEATHER AND CHECKS INDICATE THAT ALL VOLTAGES ARE NORMAL, WHAT IS YOUR NEXT STEP?"

This is his final examination at the National Meteorological Maintenance Training Center (NMMTC), the Weather Bureau's graduate school for electronic technicians.

He and his fellow students shouldn't have much trouble with this question and others equally difficult. They are all experienced 'Eltecs" who must understand electronic theory before they even enroll in the school, and they have just completed an intensive seven-week course on the maintenance of a complex weather radar system.

This radar course is a typical one in the 23-subject curriculum offered by the NMMTC — covering everything from anemometers to automatic meteorological observing stations — to help Weather Bureau technicians sharpen their skills with current equipment, keep abreast of new techniques, and become familiar with new systems.

The school is operated throughout the year with courses scheduled to fit the demands created by new equipment acquisitions and the need for highly-trained maintenance personnel in the regions, cooperating agencies, and foreign governments.

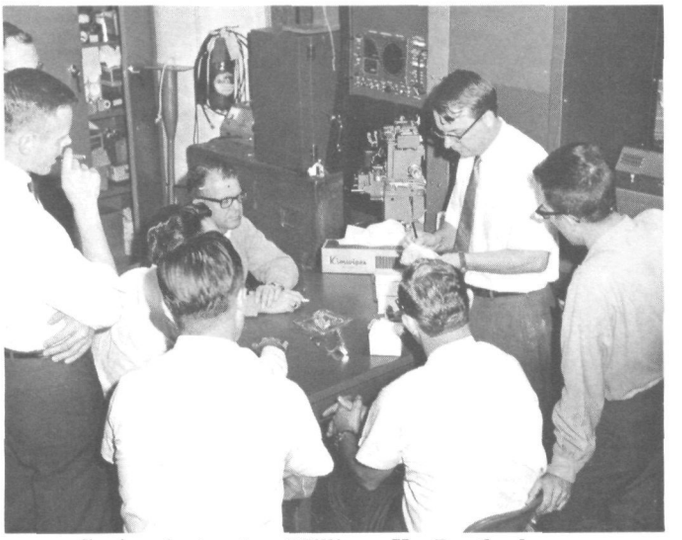
The number of courses and the number of trainees has grown steadily since the program's modest beginning in 1955 when nine technicians attended the first (and only) course offered.

Last year seven full-time instructors taught 316 engineers and technicians in specialized areas such as radar, microwave, and communications systems; upper-air systems; surface systems; and data logger and computer systems.

Students at the Center attend classes eight hours a day studying courses which last from one to eleven weeks. Classes include lecture and laboratory sections.

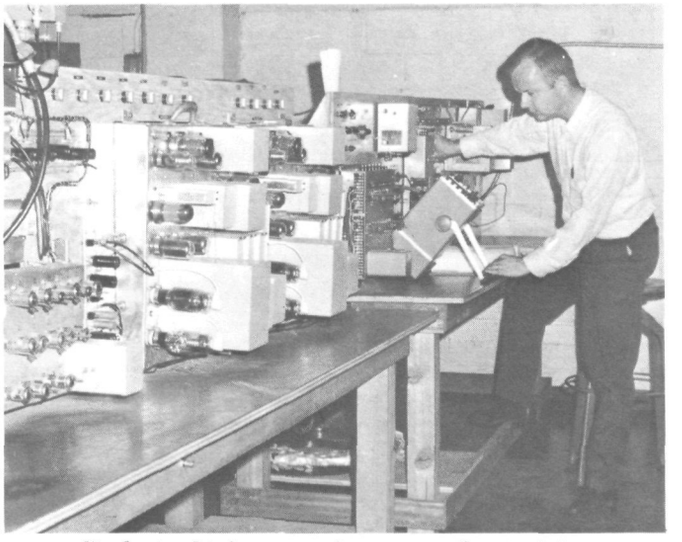
The National Meteorological Maintenance Training Center is under the direction of an Instructor-in-Charge, a one-of-a-kind designation in the Weather Bureau currently held by Lawrence K. Eide. Technical guidance for the development of training programs is provided by the Weather Bureau Engineering Division in coordination with ESSA's Career Development Branch. □

Parmelino Casorso and George J. Bradstream search for the trouble in a radar and telephone transmission system (WB/RATTS-65).

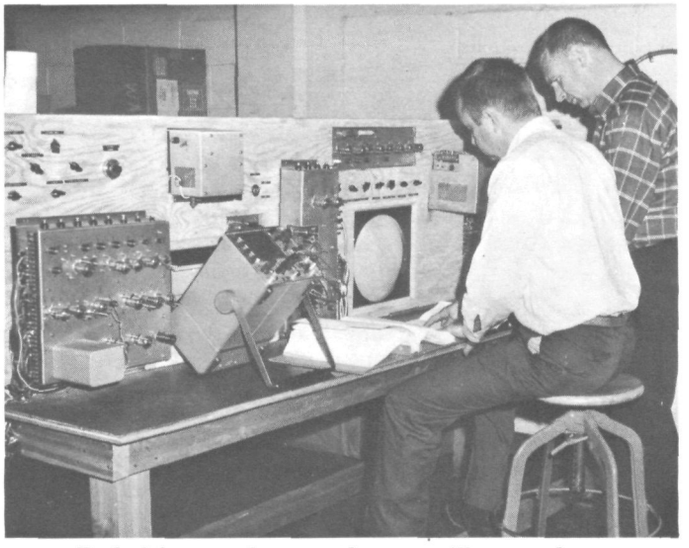


Senior instructor William H. Barth demonstrates care of upper-air equipment to an attentive class at the Kansas City school.

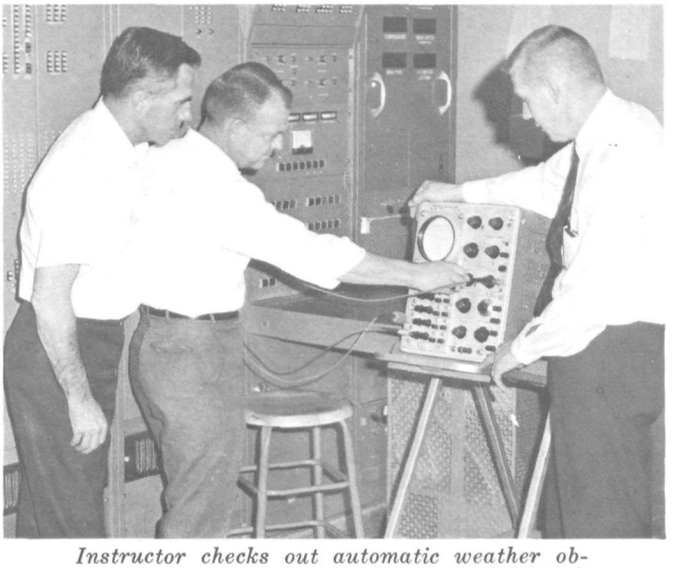
Rows of rain gages and other surface weather observing instruments serve as guinea pigs for maintenance training center students.



Student obtains waveforms on the training center's model of WSR-57 radar.



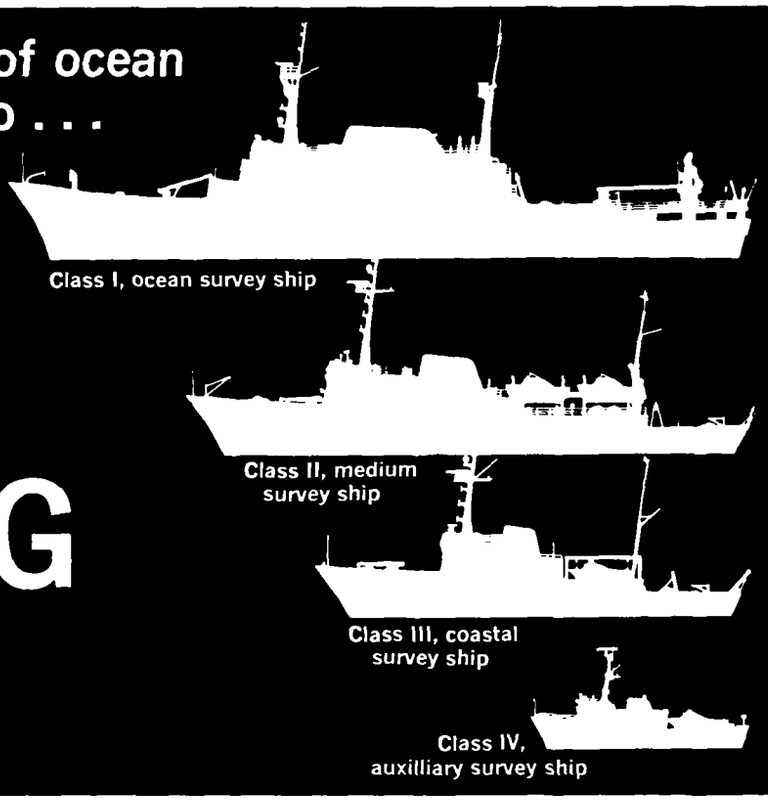
Technicians study a weather surveillance radar mockup used in classroom instruction.



Instructor checks out automatic weather observing system as students Clyde R. Welch (left) and Charles E. Mays (right) watch.

200,000 square miles of ocean will be home in 1967 to . . .

ESSA'S GLOBE-GIRDLING FLEET



BY RAYMOND WILCOVE, Coast and Geodetic Survey

This will be a big year for ESSA's "little navy."

Eight new ships (replacing obsolescent vessels) will enter the fleet of 14 ocean research, hydrographic, and wire drag vessels operated by the Coast and Geodetic Survey.

Their oceanographic and hydrographic activities will take them far and wide, from the frigid wastes of Alaska to the palm-studded islands of the South Pacific, from the sunny shores of Puerto Rico to the teeming harbors of Bombay and Penang, to England, Ethiopia, Australia, South America and places in-between.

The USC&GS Ship OCEANOGRAPHER, commissioned by President Johnson last year on the first anniversary of the establishment of ESSA, will make the first round-the-world cruise to be undertaken by a Survey vessel.

Now on the seas from Jacksonville, Fla., it will visit England, Monaco, Ethiopia, India, Malaysia, Australia, New Zealand, Chile and Peru, en route to its home base at the Survey's Pacific Marine Center in Seattle, Wash.

During the 37,000 mile trip, which will end in December, American and foreign scientists will conduct numerous oceanographic research projects in the Atlantic, Mediterranean, the Arabian Basin, Andaman Sea, and the South Pacific.

Scores of Projects

But while the OCEANOGRAPHER global expedition will highlight the year's activities, its sister ship, the DISCOVERER, and the rest of the Survey fleet will be engaging in scores of other projects, ranging from deep sea research and soundings off the coasts of the United States to upper air and surface meteorological observations in the South Pacific.

It is estimated that during the year the fleet will cruise 125,000 nautical miles, equal to five circumnavigations of the globe at the equator, and conduct Survey operations over 200,000 square miles of ocean.

The Survey fleet will have added to its ranks this year, if all schedules are met, the following new ships:

Ship	Displacement Tonnage	Length	Cost
USC&GSS Discoverer	3800	303 feet	$9,500,000
USC&GSS Fairweather USC&GSS Rainier USC&GSS Mt. Mitchell	1627	231 feet	$4,000,000
USC&GSS McArthur USC&GSS Davidson	995	175 feet	$2,500,000
USC&GSS Rude USC&GSS Heck	190	90 feet	$870,000

The DISCOVERER is an ocean survey ship, the RUDE and HECK are wire drag vessels, and the remainder combine hydrographic and limited oceanographic capabilities.

Other new ships are under contract or in the planning stage. They include the RESEARCHER, whose keel is scheduled to be laid later this year. This vessel will be an ocean survey ship similar to the OCEANOGRAPHER and DISCOVERER, but somewhat smaller. Scheduled for completion in 1969, the 2750-ton vessel will be 278 feet long and cost approximately $8,400,000.

The ships being replaced by the new vessels are the wire drag ships WAINWRIGHT and HILGARD (already decommissioned) and the hydrographic survey ships HYDROGRAPHER (decommissioned), BOWIE, HODGSON, PATTON and LESTER JONES. An ocean survey vessel, the PIONEER, was decommissioned last year.

The new ships are being based as follows: at the Survey's Atlantic Marine Center, Norfolk, Va., RUDE, HECK, and possibly the DISCOVERER; at the Pacific Marine Center, Seattle, Wash., the FAIRWEATHER, RAINIER and DAVIDSON; in addition to the OCEANOGRAPHER; at Honolulu, Hawaii, the MCARTHUR. The MT. MITCHELL will probably be based on the East Coast or Gulf of Mexico.

Surveyor Roams the Seas

While the OCEANOGRAPHER is making the year's longest trip, other vessels in the fleet will also be ranging far and wide across the oceans. The SURVEYOR's assignments will take it to Christmas and Palmyra Islands, to Baja, California, to Alaska, and to Hawaii.

Both the 49th and 50th states will see more than one Survey vessel during the course of the year. The MCARTHUR will journey from the East Coast to Honolulu,

its new home base, via the Panama Canal, probably in July, and will then conduct hydrographic surveys in the Hawaiian waters. To Alaska will go the ships PATHFINDER, LESTER JONES and PATTON, in addition to the SURVEYOR.

The Virgin Islands and Puerto Rico will receive visits from the WHITING and DAVIDSON. The former will also touch at the Dominican Republic.

The EXPLORER and the PEIRCE will do limited observations of the Gulf Stream off the East Coast and then begin hydrographic operations off the Massachusetts and Florida coasts. The RUDE and HECK will operate off North and South Carolina, New York, and Gulf of Mexico; the MARMER and the WHITING in Long Island Sound; the FAIRWEATHER off New England and in the Gulf of Mexico, before she goes to her home base of Seattle, now scheduled for mid-February 1968; and the MT. MITCHELL on the East Coast and Gulf of Mexico. The RAINIER will conduct hydrographic operations in the Gulf of Mexico and off the east coast of Florida before her scheduled trip to Seattle in mid-April 1968.

Hydrographic survey work will also be conducted in the Puget Sound area near Seattle by the HODGSON, prior to its scheduled decommissioning in mid-year.

Pacific Assignments

A wide variety of oceanographic research and surveys will be conducted in the far reaches of the Pacific by the seven ships that will operate there this year. These include observations of the ocean's depths, the intensity and variation in the earth's magnetic and gravity fields, the temperature and salt content of the water, cloud photography and sea bottom photography, bottom dredging, mapping of the sea's bottom topography, tide and current observations, shoreline mapping, and tidal current studies.

Of the 12 ships which will operate in the Atlantic, one may make a study of the distribution of the manganese nodule, the strange mineral growth at the bottom of the sea, in the vicinity of the submerged Blake Plateau, off South Carolina and Georgia, and beneath the Gulf Stream. This study would be conducted by the DISCOVERER.

Operations conducted by the other vessels will include work on the submerged Mid-Atlantic Ridge, current surveys, bottom probes, the planting and retrieval of deep sea tide gages and current meters, gravity observations, and wire drag searches for underwater navigational hazards. □

USC&GSS PATHFINDER . . . to Alaska

USC&GSS OCEANOGRAPHER . . . around the world

USC&GSS MARMER . . . Long Island Sound

USC&GSS PEIRCE . . . the East Coast

The York Street Base of Atlantic Marine Center.

HOME OF MANY MISSIONS

The shoreline is only a beginning for the operations of the Atlantic Marine Center, Norfolk's

By REAR ADMIRAL JOHN C. BULL
Director, Atlantic Marine Center and
East Coast Field Director

Land, sea, air.

The Atlantic Marine Center, which looks down the Elizabeth River to Hampton Roads, has as its scientific and service province all these areas of our indivisible environment. Its work is reflected in the lives of the pilot aiming for a runway in the Carolinas, the utilities expert studying water supplies in Philadelphia, the bridge-builder in Delaware, the fisherman off the East Coast, and thousands of others across the Nation.

As urban sprawl along the East Coast increases almost before our eyes, taller buildings rise, broader roads are built, old airports are expanded; and all of this change brings added responsibility to the Coast and Geodetic Survey.

Growing maritime commerce in ships of ever-deepening draught depends for safety of navigation, and the Center's responsibility in this area extends to the Gulf Coast and Puerto Rico. The development of electronic measurement, recording and transmitting devices helps the Center assume a major responsibility in property loss from high tides and in support of the Nation's hurricane warning system. The Center's tidal program supervisor is responsible for installation and maintenance of tide stations from Maine to Mexico. Tidal studies produce information needed to reduce hydrographic soundings to a common basis. The determination of heights above sea level, used for construction purposes, starts at the water's edge; builders of bridges and tunnels consult the Center for information concerning the elevation of benchmarks long before construction begins. And, of course, the rise and fall of tides affects the daily lives, and sometimes the safety, of countless thousands.

Firefighters Aided

The city of Philadelphia uses Delaware River water for firefighting. It needs continual tidal measurements and predictions to be sure of its emergency water reserves. That information is supplied by tide gauges maintained and operated by the Center. Power companies supplying city water, which tie their pipelines into tidal rivers, are informed by the tidal warning system when it may be necessary to protect equipment by sandbagging or other measures.

The airport has been called a national problem, and it is. It is a problem with which the Center is deeply involved. Airport survey parties, photogrammetrists and cartographers are hard at work (on a reimbursable basis) for the Federal Aviation Agency.

Airport obsolescence increases apace; airports built for piston aircraft now must accommodate turbojets, with the supersonic transport perhaps only a matter of a few years away. AMC field parties may be found anywhere in the Nation making basic surveys for new airports and doing the groundwork for mapping obstructions at older facilities. The Center does the field work and processing for aeronautical charts; the Coast Survey charts the aerial path of the pilot down to the runway from 20 miles out, so that he sees obstructions on his chart as a mariner sees shoals on his.

The Center is a prime example of the way in which hydrography, oceanography and land-sea interaction flow together in research. It supports many projects designed to lead to discovery in our last frontier, the sea. It is the home base of five hydrographic and oceanographic survey ships.

Charts by Thousands

The making of nautical charts has been a prime mission of the Survey since its inception in 1807. Deep-water surveys are made by vessels of the fleet; surveying in shallow coastal waters is done by launch parties from the ships or in small boats by shore parties. In either case, fathometers measure the depth of the water electronically. The "boat sheets" come to this Center for preparation of the "smooth sheets" from which nautical charts are made.

Voyage of Discovery

The Center-based ships make substantial contributions to the Nation's accumulation of oceanographic knowledge. For example, the USC&GSS EXPLORER, tracking the Gulf Stream from off Cape Hatteras to 300 miles southeast of Newfoundland found a huge body of warm and wayward water just north of the main stream. Large "split-offs" of water from the meandering Gulf Stream were not previously known; EXPLORER added to our lore of this fantastic body of water with its great influence on wind and weather and land-life. There is little doubt that the pride of the ESSA fleet, the USC&GSS OCEANOGRAPHER, will contribute much to the annals of oceanography on its global expedition.

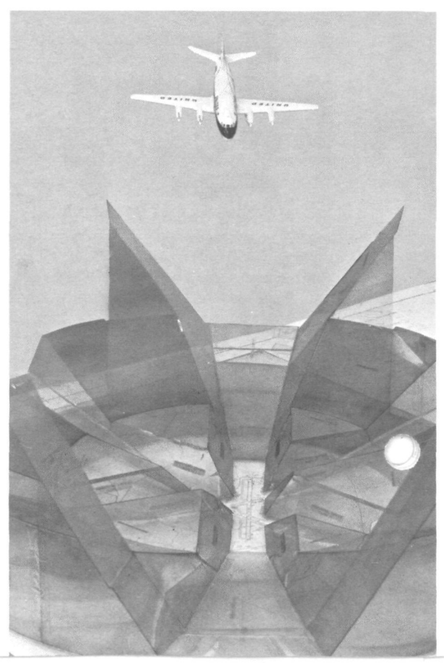
Unique Studies

The Institutes for Environmental Research's Land-Air-Sea Interaction Laboratory, with headquarters here, has been studying with its loading devices the bearing capacity of the surface of the Continental Shelf, a virtually untapped national resource. From its studies will come information of potentially great value for seafloor engineering projects; from its studies of particle transport by bottom currents may come vital knowledge in the farming of the sea.

(Ed. Note: ESSA *World* will feature a major article on this Laboratory in a forthcoming issue.)

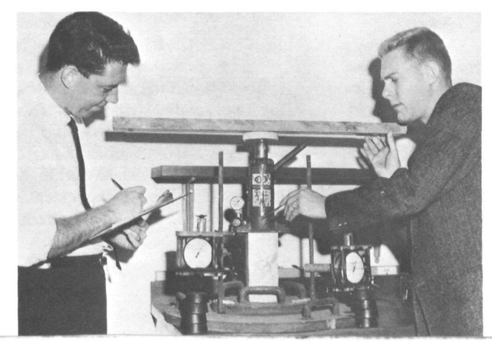
Three major divisions — administration, operations and processing — do the Center's work. Administration is a general housekeeping enterprise with property acquisition and maintenance, budgeting and personnel management among its duties. New officers of the ESSA Commissioned Corps, along with civilian technicians and other civil service employees, are trained here. There are more than 100 uniformed officers under this command; total personnel numbers about 700, although only about 60 persons are stationed at the base itself.

The Center's work — widespread, embracing numerous disciplines — touches the lives of people everywhere, in an almost bewildering variety of ways. In its scope and its skills, it is symbolic of ESSA itself in its mission of helping man to live in harmony with his environment. □

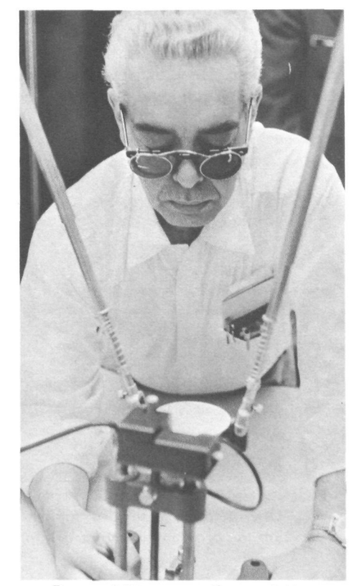


Left, model aircraft flies toward compilation of airport devised at Atlantic Marine Center.

Top right, Rear Admiral John C. Bull and Captain Emerson Jones study a map of the EXPLORER's tracking of the Gulf Stream.



Lower right, Dr. P. W. Harrison (r) and Earl Rayfield discuss modifications in LASIL's plate-load apparatus used in studying the response of continental shelf sands to natural and artificial loads.



Bernard Kurs operating a plotter, orienting a model to a chart.

THE 5 YEAR LOOK *is all in the day's work at ESSA's Office of Planning and Program Evaluation*

For the past year and a half, the civilian Federal Government has been involved with a new approach to planning. The Planning-Programming-Budgeting System (PPBS for short) was instituted to provide a unified planning system within the Executive Branch. It is intended to provide greater efficiency in allocating resources and increased benefits to the public. It will provide information needed by management to aid in making rational choices among alternatives.

What is PPBS? It is a system that helps the Administrator manage ESSA. The approach to PPBS is from a market, or service, point of view. Who wants our services? What results do the public and our customers expect to get from our services? Can these results be provided in some other way? Plans are made for what ESSA feels should be done for the next five years. These plans are for the products and services that the public and other users want — reduced loss of lives and property from tornadoes, safer pleasure boating, better radio reception, to name a new. Various ways of meeting these needs are proposed and evaluated. Will small craft nautical charts or marine weather forecasts make pleasure boating safer? Perhaps some combination of the two will do the best job. Each portion of the plan is evaluated for the benefits that it will provide the user. Then, when the Administrator or higher echelons have to make decisions as to what part of the plan will be implemented because of budget, time, people or technological limitations, they will have some idea of what activity will do the most good for people with what resources are available.

The central effort for PPBS in ESSA is in the Office of Planning and Program Evaluation. OP&PE was formed by merging the earlier work of the Program Planning and Coordination Group in C&GS, headed by Captain Harley Nygren, and that in the Weather Bureau's Office of Policy Planning, headed by Walter Hahn. Both of these groups were engaged in efforts that today would be labeled "PPBS". The current activities include aiding the formulation and approval of service requirements of the public and other users that will be met by ESSA. This office serves as the focus for ESSA program planning which is done mainly through the line components. The group performs cost/benefit studies, systems and socio-economic analyses, and prepares the PPBS documentation for the Department and Bureau of the Budget.

MANY SKILLS REQUIRED

PPBS requires a wide variety of skills. Within ESSA's Office of Planning and Program Evaluation are people whose backgrounds range from meteorology to economics to physics to operations research to civil engineering to oceanography to sociology. Such a collection of talents leads to some lively discussions and many interpretations of the problems at hand, which are also a part of PPBS.

One of the first steps in implementing PPBS has been to develop the program structure to support the basic mission of ESSA. Leadership of this effort has been the responsibility of Walter Hahn, Director of P&PE, aided principally by Harlan Pickering, operations research and management science analyst, and Dr. Fred Brown, physicist and planning analyst. The problem is to decide what our services are and to devise a program structure that expresses those services. This is not necessarily the same as the organization structure that is needed to carry out the program. ESSA's program structure is shown below.

WEATHER FORECASTS AND WARNING SERVICES:
Public Weather and Warning, Special and Basic Weather

EARTH DESCRIPTION, MAPPING AND CHARTING SERVICES:
Geophysical, Aeronautical Charting

HYDROGRAPHIC AND OCEANOGRAPHIC SERVICES:
Hydrographic, Oceanographic

RIVER AND FLOOD PREDICTION AND WARNING SERVICES:
Forecasting and Warning, Water Information

TELECOMMUNICATIONS AND SPACE SERVICES:
Tropospheric, Ionospheric, Space "Weather" Forecasting

ENVIRONMENTAL SATELLITE SERVICES:
Environmental Satellite

ENVIRONMENTAL DATA SERVICES:
Climatology, Aeronomy and Space, Geophysical

RESEARCH:
Earth Sciences, Oceanography, Meteorology, Aeronomy

EXECUTIVE DIRECTION AND ADMINISTRATION.

The analyses and studies necessary to support the planning decisions are under the direction of Dr. James R. Hibbs, economist and deputy director for planning. With his guidance, a recent conference on "Man and His Physical Environment" in Boulder, a joint University of Colorado and ESSA venture, produced discussion among physical and social scientists that should lead to better understanding on how each set of disciplines can contribute effectively to ESSA decision processes. Dr. Milton Johnson, an economist, is working with the Battelle Memorial Institute of Columbus, Ohio, in carrying out economic research to enlarge the understanding and information base relevant to the relationship between resource systems and man within his environment for the Gulf of Mexico region.

MODELS UNDER DEVELOPMENT

Harvard University in a joint ESSA — Commerce Office of Regional Economic Development project is developing mathematical models to aid in achieving economic development consistent with the wide use of continental shelf resources. Dr. William Dorfman, a mathematician and sociologist, just finished working with a group of management interns in analyzing the extent of obsolescence of ESSA's equipment and developing alternatives as to what should be

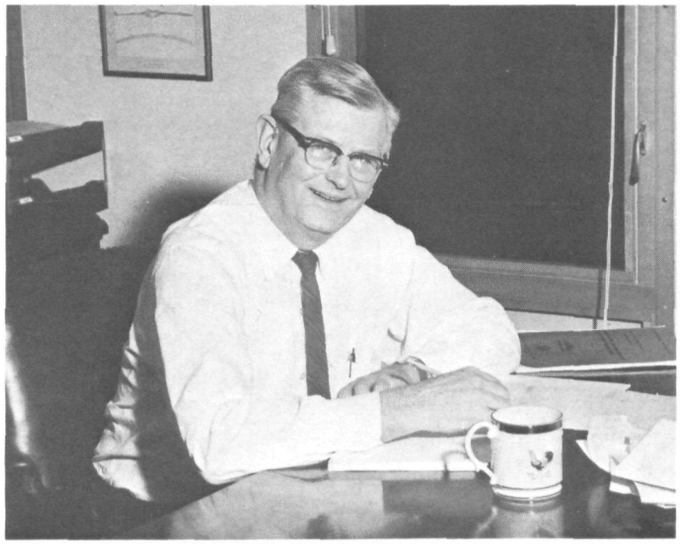
done to improve the situation. Studies for determining objectives, benefits and effectiveness of the annual PPBS "Program Memorandum" have been carried out jointly by Betty Clark, a program analyst, and Robert D. Harrington, a Department of Commerce Science Fellow on assignment to P&PE. Dale Sellheim, applied mathematician, participated in a study to determine the socio-economic benefits associated with the implementation of the proposed Nationalwide Natural Disaster Warning System (NADWARN). These are just samples of the studies that are constantly going on and which will give the Administrator additional tools to aid his decision making.

Through the leadership of Donald House, deputy director for programming and former meteorologist-in-charge of the Kansas City forecast center, the procedure for documenting and approving customer requests for ESSA services (Management Order No. 6) is being carried out. These approved "identified needs" will provide documented evidence of decisions made to provide specific services and why the service was needed. These decisions are the basis for the preparation of ESSA's annual 5-Year Program and Financial Plan submitted through the Department to the Bureau of the Budget. The budget which goes to Congress is now derived from the first year of the five-year plan. Commander A. R. Benton, oceanographer, and Arthur Sweet, geodesist, have been documenting requirements and analyzing plans for C&GS present and future services. Tillman Gladney, aviation meteorologist, has been assisting with Weather Bureau requirements and in developing methods for handling the large volumes of information involved in these program planning activities.

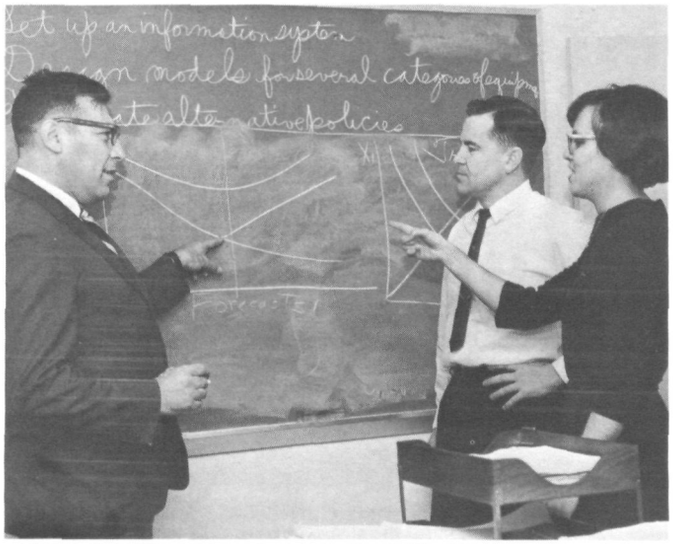
There are many indications of a growing trend to view man in relation to his physical environment in a much broader context than previously. Through the efforts of the P&PE staff and the application of PPBS concepts throughout ESSA, it is hoped that an increasing, sound basis will develop for managing the affairs of ESSA. This in turn will permit maximum contribution to meet the needs of the public and other users of ESSA's products and services. □

From left, Walter A. Hahn, Director of Planning and Program Evaluation, confers with Dr. Frederick W. Brown, chief planning analyst, and Arthur J. Sweet, program planner.

From left, Tillman F. Gladney, technical planning analyst, Donald C. House, Deputy Director for Program Planning, and Harlan D. Pickering, operations research analyst, consider a problem.



Dr. James R. Hibbs is Deputy Director for Program Evaluation.



At the blackboard are, from left, Dr. William Dorfman, operations research analyst, H. Dale Sellheim, technical planning analyst, and Elizabeth Clark, program analyst.

essa news beat

Department's Highest Honors

23 Medals Awarded to ESSA Employees

The Department of Commerce has presented three Gold Medal and 20 Silver Medal Awards to ESSA employees.

The Gold Medal, highest honor within the Department's gift, was presented to Charles L. Bristor, chief of the National Environmental Satellite Center's data processing and analysis division; Dr. Donald T. Farley, director of the Jicamarca Radar Observatory, Lima, Peru; and Dr. Frederick G. Shuman, director of the National Meteorological Center.

Mr. Bristor was honored for development of an automated data processing system for weather satellite observations. Dr. Farley was recognized for authorship of scientific publications of extraordinary importance to the field of upper atmosphere physics. Dr. Shuman was cited for the development of a numerical prediction model which marks a major advance in the Nation's weather services.

The following received Silver Medals, in a ceremony at which Acting Secretary of Commerce Alexander B. Trowbridge gave the principal address:

David P. Beatty, technical assistant to the chief, Aeronautical Chart Division.

Harold A. Bedient, acting chief, Data Automation Division, National Meteorological Center.

Lloyd E. Brotzman, regional administrator, Weather Bureau, New York (presented Jan. 7 at a retirement dinner).

Richard A. Garrett, Meteorologist-in-Charge, Topeka, Kansas, Weather Bureau.

Robert D. Goodrich, technical assistant, Distribution Division, Coast and Geodetic Survey.

Christos Harmantas, chief, upper air equipment section, Equipment Development Laboratory, Weather Bureau.

Raymond L. Joiner, digital computer systems administrator, National Weather Records Center, Environmental Data Service.

Donald L. Jorgensen, chief, test and evaluation section, Techniques Development Laboratory, Weather Bureau.

Dee E. Kimbell, chief, support and maintenance branch, office of geodesy and photogrammetry, Coast and Geodetic Survey.

Arthur R. Kneer, chief, programming branch, National Meteorological Center.

Wilbert R. Krumm, western fire-weather coordinator, Weather Bureau.

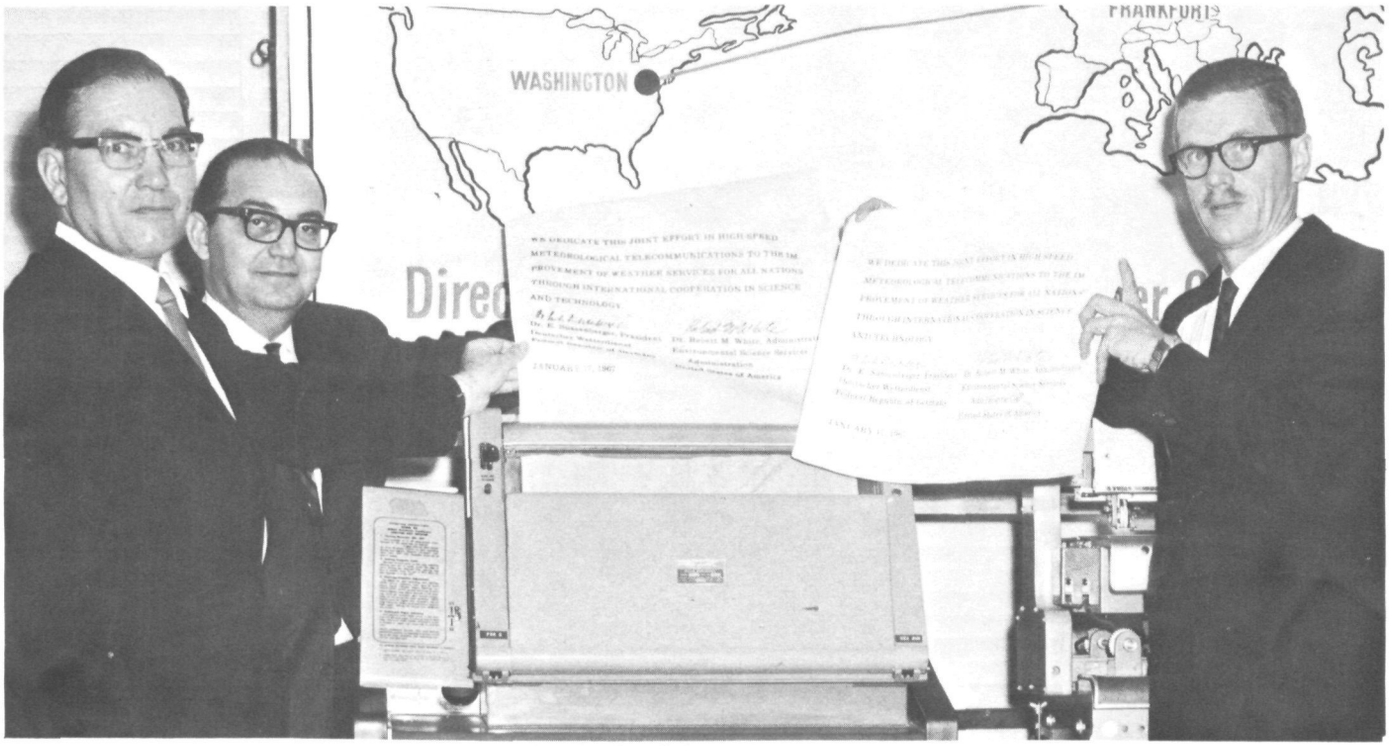
Clarence E. Lamoureux, Meteorologist-In-Charge, Des Moines, Iowa, Weather Bureau.

Continued

Left to right, back row: Curtis J. Smith; Richard A. Brintzenhofe; Wilbert R. Krumm; Kenneth A. Norton, Donald L. Jorgensen; Lt. Dee E. Kimbell; Harold Q. Van Dyke; Ernest A. Amman; Harold A. Bedient; Richard A. Garrett; David P. Beatty; Robert D. Goodrich; Lorne G. Taylor; Raymond L. Joiner; and Arthur R. Kneer.

Left to right, front row: Clarence E. Lamoureux; Jesse R. Gulick; Charles L. Bristor; Robert M. White, ESSA Administrator; Frederick G. Shuman; Joanne Simpson; Christos Harmantas.

CEREMONY MARKS OPENING OF WEATHER CIRCUIT



Left to right, Dr. Erich Sussenberger, Dr. Robert M. White and Dr. George P. Cressman.

In a Jan. 17 ceremony at the National Meteorological Center (NMC), Dr. Robert M. White, ESSA Administrator, and Dr. Erich Sussenberger, director of the weather service of the Federal Republic of Germany, opened a new high-speed weather communications circuit linking North America and Europe. Also participating in the ceremony were Dr. Ernst Lingelbach, chief of meteorology for the Federal Ministry of Transport, and Dr. Julius Brinkmann, head of the West German weather service's forecast division. ESSA representatives, in addition to Dr. White, were Dr. George P. Cressman, WB Director; Dr. Frederick G. Shuman, NMC Director; Harold A. Bedient, chief of NMC's Data Automation Division; and John C. Straiton, chief of the WB's Communications Division. The circuit between Washington and Offenbach (Frankfurt), Germany, is expected to revolutionize the exchange of weather information between Europe and North America. Capable of voice, teletypewriter or pictorial transmission, it replaces an older line that carried only teletypewriter messages at a relatively slow speed of 100 words per minute. The new circuit is 10 times faster.

Continued

Dr. Joanne Simpson, chief, experimental meteorology branch, Atmospheric Physics and Chemistry Laboratory, Institutes for Environmental Research.

Curtis J. Smith, field aide, state climatologist's office, Lincoln, Nebraska, Weather Bureau.

Michael Sunray, physical science technician, Mexico City, Weather Bureau.

Capt. Lorne G. Taylor, chief, marine chart division, Coast and Geodetic Survey.

Lloyd W. Tourville, supervisory general physical scientist, National Environmental Satellite Center.

Harold Q. Van Dyke, manager, command and data acquisition station, Wallops, Va.

Communications Systems Design Group, Institute for Telecommunication Sciences and Aeronomy (Philip L. Rice, Mrs. Anita G. Longley, Kenneth A. Norton, Albrecht P. Barsis).

Space Flight Meteorology Group, Weather Bureau (Richard A. Brintzenhofe, Jesse R. Gulick, Ernest A. Amman).

ESSA Commissioned Corps Observes 50th Anniversary

The ESSA Commissioned Corps will observe its 50th anniversary on May 19, with a dinner and ball in the Commissioned Officers' Club at Washington Navy Yard.

In May, 1917, the Coast and Geodetic Survey's personnel structure was realigned to include a uniformed service, with officers commissioned by the President, and subject to transfer to the War or Navy Departments.

The contributions of this group to the Nation's security and to its commercial life have been many and varied. Today, as an ESSA corps, the group of nearly 300 officers looks forward to even greater service in numerous scientific disciplines.

A full report on the anniversary celebration will be featured in the next issue of ESSA *World*.

ROBERT T. FROST, former administrative officer for the Institute for Telecommunication Sciences and Aeronomy, has been appointed executive officer for the Institutes for Environmental Research.

Frost will serve as an advisor to the director on management policies and organizational development, assist in planning research programs, and serve as a consultant on the use and control of IER resources.

Three ESSA Employees Honored for Achievement

Carl A. Posey

John J. Smiles

John B. Townshend

Three ESSA employees were honored Feb. 8 by Acting Secretary of Commerce Alexander B. Trowbridge for their achievements in service to the public or in effective communications.

John B. Townshend, observer-in-charge of the College Magnetic and Seismological Observatory, Alaska, received a Superior Service to the Public Award "for outstanding efforts to increase understanding of ESSA's earthquake warning and other services by the scientific community and the general public in Alaska."

John J. Smiles, chief of ESSA's Graphics Branch, and Carl A. Posey of the ESSA Office of Public Information, won Creative Communication Awards. Mr. Smiles was cited "for resourceful leadership in creating dynamic design in visual presentations of the Environmental Science Services Administration," and Mr. Posey "for exceptional endeavor in planning and developing publications to promote public understanding of the scientific services of the Department of Commerce." Mrs. Ann K. Cook of the ESSA Public Information Office, a Creative Communication award-winner last year, attended this year's presentation to see her husband, Robert T. Cook of the National Bureau of Standards, receive a similar honor.

New Director of Environmental Data Service

ESSA ANNOUNCES NEW ASSIGNMENTS

Dr. W. C. Jacobs

Dr. Woodrow C. Jacobs, nationally known climatologist, author, and lecturer, has been named Director of ESSA's Environmental Data Service, succeeding Dr. Helmut Landsberg who retired on December 30. Dr. Jacobs has been Director of the U.S. Navy's National Oceanographic Data Center since 1961. He was graduated from the University of California at Los Angeles in 1930, received his master's degree at the University of Southern California at Los Angeles in 1935, and his Ph.D. from the University of California (Scripps Institute) in 1941. From 1957 to 1960 he was Director of Climatology at Headquarters, Air Weather Service, leaving in 1960 to accept a post as physical scientist in the Science and Technology Division, Library of Congress. Dr. Jacobs began his career in meteorology in 1931 with the Weather Bureau, and in 1946 was Assistant Chief of the Climatology and Hydrologic Service Division.

In another major appointment, **Dr. Robert H. Simpson,** Associate Director of the Weather Bureau, has been named to succeed Dr. Gordon E. Dunn as director of the National Hurricane Center in Miami. Dr. Dunn will retire at the end of 1967.

Dr. R. B. Simpson

Although the official transfer is set for January 1968, Dr. Simpson, a noted specialist in hurricane research, will join the center this month to effect a smooth transition into one of the Weather Bureau's most sensitive positions. He will serve with Dr. Dunn through the 1967 hurricane season.

K. R. Johannessen

Dr. Simpson will be succeeded as Associate Director of the Weather Bureau by **Karl R. Johannessen,** director of the ESSA - Weather Bureau's Eastern Region, which is headquartered in New York City.

Captain Raymond M. Stone has been named Acting Associate Director of C&GS for Hydrography and Oceanography, succeeding Rear Admiral Don A. Jones, who is now ESSA Associate Administrator. Captain Stone joined the Survey in 1940, and has served on 12 USC&GS vessels, commanding the HYDROGRAPHER and MARMER. He has directed the Survey's office in San Francisco, conducted land surveys in various parts of the United States, served as liaison officer with the Federal Aviation Agency, and most recently was Assistant Chief of Operations for Oceanography and Project Planning Officer in the Office of Hydrography and Oceanography.

Roy M. Sylar is the new chief of C&GS' Los Angeles field office, succeeding Captain Philip A. Weber who has retired. Mr. Sylar has been with C&GS since 1931 and for the past six years was a program coordinator at Survey headquarters.

James A. Cunningham has been appointed chief of the Weather Bureau's Engineering Division. Mr. Cunningham has been with the National Bureau of Standards as an electronic scientist and engineer since 1950.

Holbrook Landers, a former member of Florida State University's Department of Meteorology, has been appointed South Carolina's State Climatologist.

Lt. Donald J. Florwick has been named Commanding Officer of the USC&GS Ships RUDE and HECK. The new 90-foot, 16-ton sister ships replace the WAINWRIGHT and HILGARD, which have been decommissioned. *Continued*

Ernest L. Kvam, Chief Administrative Operations, Dies

Ernest L. Kvam, Chief of ESSA's Administrative Operations Division, died suddenly March 14, at his home in Falls Church, Va.

Mr. Kvam, 49, headed administrative and office services for ESSA since its creation in 1965. Previously, he was Manager of the Weather Bureau's Administrative Operations Division, a post he held since 1958.

Mr. Kvam began his career with the Weather Bureau as a junior observer in 1941. From 1942 to 1946, he served with the Army Air Corps. He returned to the Weather Bureau at Seattle in 1947, moving to the Weather Bureau's Regional Office at Salt Lake City in 1949, and to the Weather Bureau Central Office in 1951.

In February 1965, Mr. Kvam received the Department of Commerce Silver Medal for meritorious service in recognition of his valuable contributions to administration and management in the Weather Bureau and the Department of Commerce.

He was born in Bellingham, Washington, on June 14, 1917. He is survived by his wife, Genevieve; and a daughter, Linda, 20, a student at Randolph-Macon College in Lynchburg, Va.

Continued

Lt. Ralph J. Land is the new commanding officer of the USC&GSS MARMER, a 220-ton hydrographic survey vessel.

Lt. Commander Lavon L. Posey, former operations officer of the USC&GSS SURVEYOR, is the new executive officer of the USC&GSS PATHFINDER. He succeeds Commander Dewey G. Rushford who is now chief, Operations Division, at C&GS' Mid-Continent Field Office in Kansas City, Mo., the post vacated by the transfer of Commander Kenneth A. MacDonald to Jacksonville, Fla.

TORNADO, a new edition of the 16-page brochure first published in 1966, is available now and is being distributed to field stations before the tornado season begins. The new brochure is supplemented by a booklet entitled "Tornado Statistics" and a poster on Tornado Safety Rules. A leaflet called "Tornado Watch" also is part of the 1967 tornado information package.

Swearing-in of Dr. Werner A. Baum as ESSA Deputy Administrator by Secretary of Commerce John T. Connor on January 4, 1967, is witnessed by his wife Shirley, daughter Sandra, mother Mrs. Theodor Baum and daughter Janice.

UNMANNED SURVEY LAUNCHES MAY SPEED EXPLORATION OF CONTINENTAL SHELF

Successful initial tests of an automated system which could speed exploration of the Nation's rich continental shelf have been announced by ESSA.

Maneuverability tests of remotely controlled hydrographic survey launches, which sound the ocean floor, have been held in the Chesapeake Bay by ESSA's Coast and Geodetic Survey. "Acceptable responsiveness" was established at a range of one to two miles from a mother craft.

The purpose of the program is to develop unmanned launches which can operate in fleets sounding the sea floor and telemetering information to a mother ship.

Such a system would advance significantly the now-laborious task of mapping the floor of the 850,000-square-mile continental shelf, whose mineral, petroleum, and food resources are largely untapped.

The second stage of the experiment, to be conducted in the spring, will involve telemetering of sounding and position information from the remotely controlled launches back to a mother vessel.

At present, sea-bottom information is obtained by sending three or four launches from a mother ship. Each launch is usually staffed by a crew of four or more, and remains away from the ship throughout the day.

Full exploration of continental shelf resources constitutes a tremendous and time-consuming task. Fleets of 10 to 20 launches, operating as drones, could increase materially vitally needed data output.

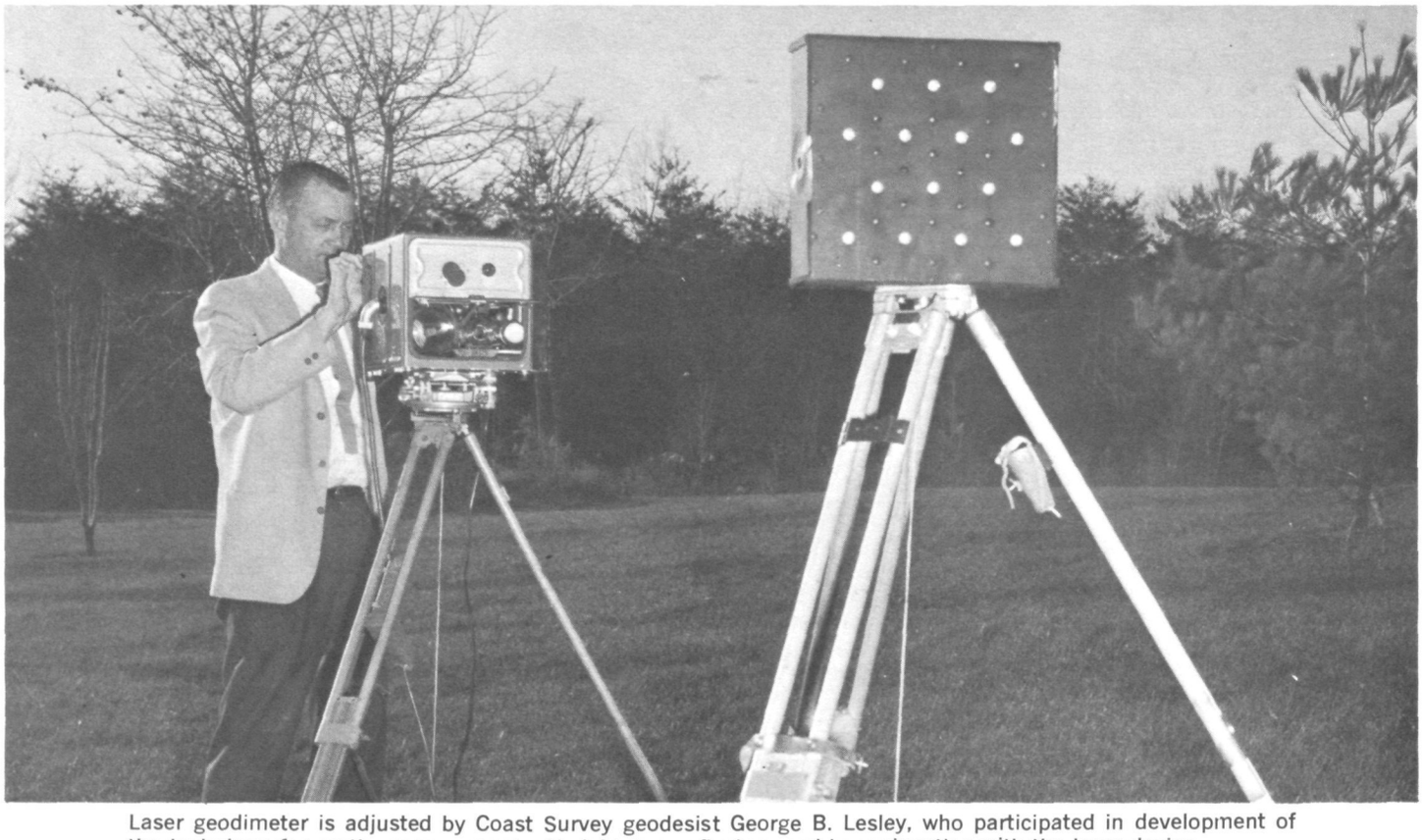
As presently contemplated, each launch would be equipped with a receiving package, radar reflector, and automatic pilot which would respond to the mother ship's command unit.

The first experiments were conducted by Lt. (j.g.) Clifford Wells of the ESSA commissioned corps and Angelo Ferrara of the Survey's engineering division.

Wells said there were no insurmountable technical problems involved in establishing the system, with most of the required equipment already available. "We are presently working out a system for attaining required positioning accuracy," he explained. "We have been able so far to operate within one to two miles from the mother ship with acceptable accuracies and are striving for similar accuracy at distances of 10 to 15 miles, in water over 100 fathoms (600 feet) deep."

It is believed the system could be used close to shore or farther to sea, although near-shore use would be more limited.

Use of Lasers Improves C&GS Precision Measurements



Laser geodimeter is adjusted by Coast Survey geodesist George B. Lesley, who participated in development of the technique for earth measurement. At right is a reflector used in conjunction with the laser device.

The use of lasers has made possible a significant advance in the Coast and Geodetic Survey's precise long-line measurements.

The development of the laser technique was conducted by the Survey's Geodesy Division, with the cooperation of the National Bureau of Standards.

Use of the laser as a light source for geodetic measurement will increase substantially the pace of the Survey's program in that field.

It will make possible distance measurements whenever weather will permit optical observations. Because the atmosphere is more stable at night, most geodetic measurement is done nocturnally. The laser is capable of daylight operations, but will require evaluation.

It will enable geodetic crews to measure long distances in one "step" instead of two.

Ultimately, as more powerful laser beams are employed and techniques are refined, it will make possible greater service to the Nation's satellite program and even to "shoot the moon" for accurate distances from points on the earth.

The technique was developed by George B. Lesley and Raymond W. Tomlinson, both Coast Survey geodetic technicians, Geodesy Division; Spurgeon E. Smathers, former Coast Survey physicist, Office of Research and Development: and Dr. Harold S. Boyne, physicist and Chief of the Atomic Physics Section in the National Bureau of Standards' Atomic Physics Division. The Survey sought NBS cooperation because of that agency's preeminence in optics and electronics and its experience in the development and use of laser techniques.

Developmental work is being continued by Dr. Harold V. Straub, physical scientist of the Engineering Division.

The device has been tested in the area of ESSA headquarters at the Washington Science Center, Rockville, in Beltsville, and in Aurora, Nebraska, where transcontinental traverse measurements are underway.

In the Nebraska tests, where reliability under operational conditions was the criterion, technicians were able to measure with undiminished precision a single 30,000-meter line, nearly twice the length of previous measurements. Readings over this distance produced accuracy exceeding one part in a million.

During field testing over 10-mile distances, it was determined that the laser light source measured through haze and marginal weather with at least 50 per cent more light return than was obtained from a conventional Geodimeter. Survey experts believe the limit of operational capability in the future will be set, not by the instrument, but by the state of the atmosphere itself.

A project of the Survey's Geodesy Division, headed by Captain John O. Phillips, is the transcontinental traverse which will provide the basis for a more accurate geodetic network in the United States and supply a scale by which satellite triangulation can link the world together in one composite geodetic survey.

I.A.S. Experimental Meteorology Branch To Move To Florida

A move of the Experimental Meteorology Branch, Institute for Atmospheric Sciences, from Silver Spring, Md., to Miami, Fla., is planned for this spring.

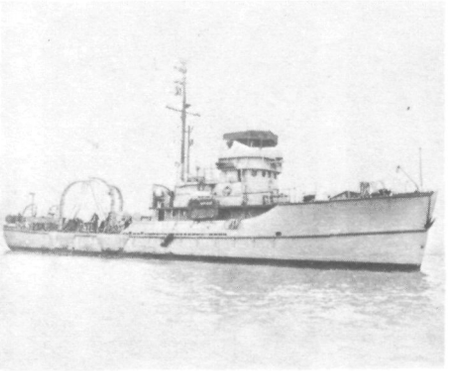
At Miami the branch, headed by Dr. Joanne Simpson, will be located near the National Hurricane Center and the National Hurricane Research Laboratory. The branch is engaged in an extensive program of research into the dynamics and possible modification of tropical cumulus clouds — work which requires extensive aircraft support from ESSA's Miami-based Research Flight Facility.

MAC EMERSON RETIRES

Mac A. Emerson, Director of the Weather Bureau Alaskan Region, retired Dec. 30, after more than 41 years of Federal service.

Mr. Emerson's Weather Bureau career began in 1927, when he entered the Bureau as an observer at St. Paul, Minn. In less than a year, he was promoted to the position of Meteorologist-in-Charge. Ten years later, he transferred to Chicago where he held the position of airways inspector with headquarters at the Municipal Airport.

In 1941, he was promoted to the newly created position of chief liaison officer established in connection with the organization of Weather Bureau administrative regions. In 1945, the Bureau transferred him to Alaska where he served as Assistant Regional Administrative Officer until 1958 when he took full charge of the region.



USC&GSS BOWIE Decommissioned

The Coast and Geodetic Survey Ship BOWIE was decommissioned on February 1st. The vessel will be declared excess and turned over to the General Services Administration for disposal.

The BOWIE was built by the Navy during World War II and designated PCS-1405. In 1946, she was transferred to the Coast and Geodetic Survey, together with her sister ship, the HODGSON, and the PIONEER (formerly the Navy AVP USS Mobjack). Since that time she has conducted hydrographic and current surveys in San Francisco Bay, the Columbia River, Puget Sound and adjacent waters, and various parts of Alaska. Her most recent assignment was a three-year comprehensive study of tidal currents in the San Juan Islands and the Strait of Juan de Fuca.

The officers and crew have been transferred to other survey vessels. The BOWIE's replacement is the new 220-ft. survey ship FAIRWEATHER, which is due to arrive in Seattle in 1968.

ESSA 4 Launched Successfully January 26

ESSA 4 was successfully launched at 9:32 a.m. PST, January 26, from the Western Test Range in California. Its orbit has an apogee of 894 statute miles and a perigee of 822 statute miles. The satellite crosses the Equator, southbound, at 9:19 a.m. local sun time. ESSA 4 has two automatic picture transmission cameras, one of which failed on Jan. 28. The other camera is operating well, and pictures have been received.

Since the beginning of the TOS system, the ESSA 1 and 3 satellites have returned more than 110,000 useful pictures. ESSA 2 has broadcast over 32,000 pictures for reception by APT ground stations. From the pictures, ESSA's National Environmental Satellite Center has prepared more than 10,000 analyses for transmission to United States weather stations and foreign meteorological services, and has sent more than 700 warnings to areas in the paths of potentially dangerous storms.

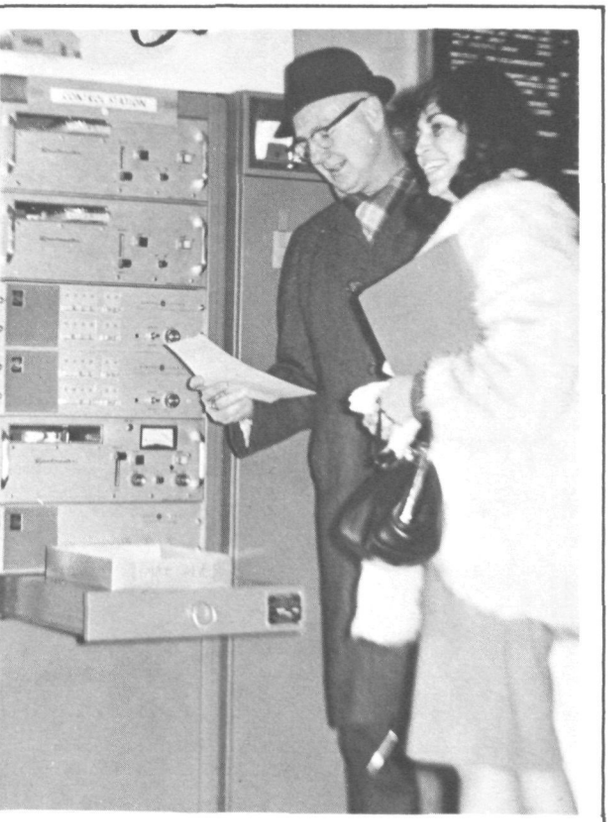
President Praises ESSA for Service and Economy

Before leaving office, Secretary of Commerce John T. Connor submitted a report to the President on ESSA's progress since its formation in 1965. President Johnson, commenting on the report in a letter to the Secretary, said in part:

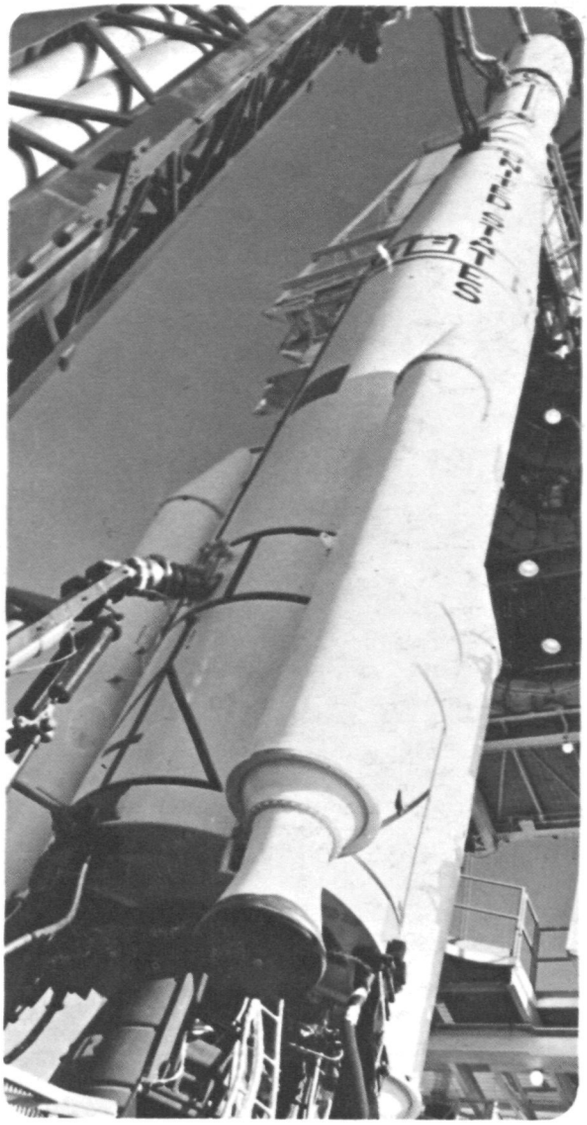
"Your report indicates that the reorganization has resulted in specific economies, improved management of programs, and better services to the public. This combination of achievements is basic to this Administration's concepts of how the public's business can and must be conducted. You stated in your letter that there is further progress to be made in the future. I am confident that this progress will be made.

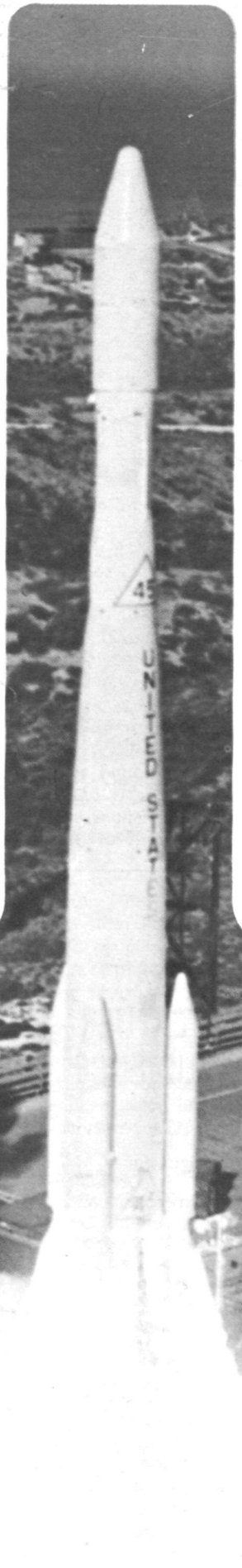
"I want to commend you, ESSA management, and all ESSA employees for the efficiency and sensitivity which have contributed to carrying out this reorganization. These accomplishments will benefit substantially the public and other agencies of the Government."

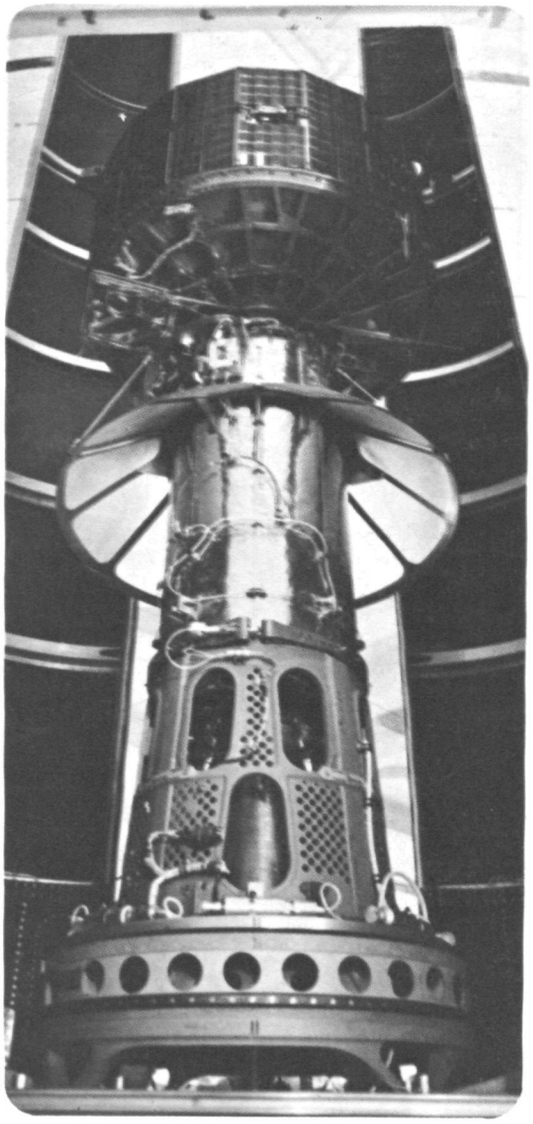
INSTANT WEATHER AUDIENCE

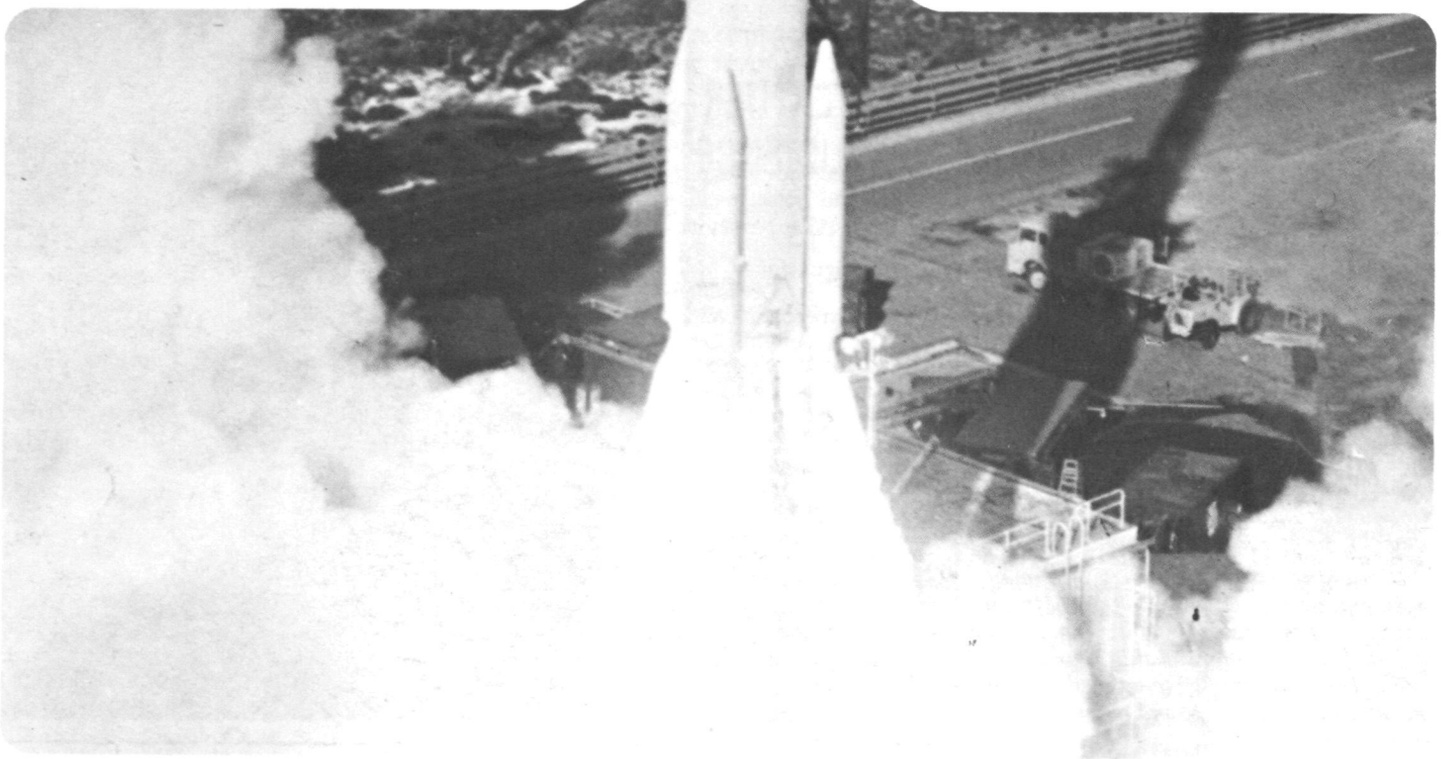


Patricia Jones of Dr. George P. Cressman's office staff and William E. Hardy of the Experimental Meteorology Branch pause to listen to the test transcription of the VHF Weather Bureau forecast in the lobby of the Gramax Building. The equipment was set up under the direction of Claude A. Kettering and Woodford W. Schafer of the Weather Bureau's Engineering Division.









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