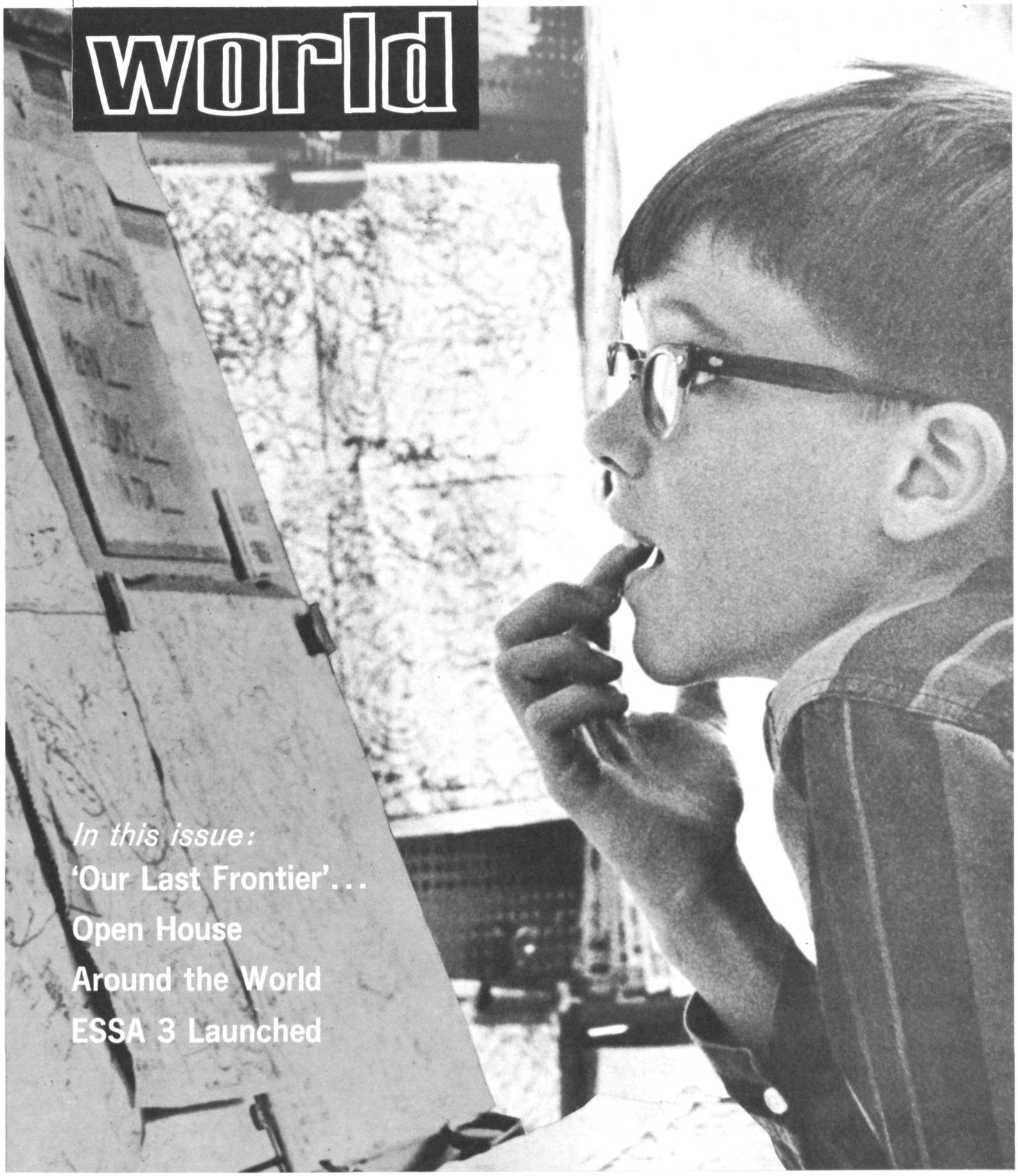
U.S. DEPARTMENT OF COMMERCE ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION OCTOBER 1966

essa world



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'Our Last Frontier'...

Open House

Around the World

ESSA 3 Launched

National Oceanic and Atmospheric Administration

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July 23, 2010

DEPARTMENT
OF COMMERCE
FEDERAL CREDIT UNION

newsletter

• BORROW FOR TODAY AND SAVE FOR TOMORROW •

October - November 1966

Christmas Loans 1966

For the sixth consecutive year, your Credit Union will again offer to qualified borrowers our special Christmas Loan Program.

A new feature this year will be loans up to $200.00 for a time period of 4 months. The rate remains the same, ½ per cent per month on unpaid balances.

Schedule of Payments

$ 50.00	4 @	$12.66
100.00	4 @	25.32
150.00	4 @	37.97
200.00	4 @	50.63

SHOP WISE - SPEND WISE - BORROW WISE

Christmas will be more enjoyable.

CHRISTMAS LOANS AVAILABLE NOV. 21 THRU DEC. 23, 1966

TIGHT MONEY — HIGH INTEREST

In the past several months commercial banks have found it necessary to tighten up considerably on extending credit to their borrowing customers at acceptable rates of interest. The "prime interest rate," which is the rate banks charge their preferred or "blue-chip" customers, is now 6-1/4% per annum.

As the preferred customers' demand for money at this growing prime interest rate diminishes, banks have more money available to lend to "regular borrowers" who of course must pay a rate of interest higher than the prime rate.

Your Credit Union is not faced with the problems of more expensive money versus less expensive money. The Credit Union has capital available and our interest rates are fixed by type of loan, not by type of borrower. Every member in good standing is considered a BLUE CHIP CUSTOMER. Every member who borrows to finance an automobile pays exactly the same low rate of interest. Every member who borrows to finance home improvements or to consolidate debts pays exactly the same low rate of interest. Every member who establishes an Estate Loan pays exactly the same low rate of interest.

For details on how to become a BLUE CHIP CUSTOMER — for saving and borrowing — call or visit your nearest Credit Union office or representative:

	ROOM	PHONE
Main Commerce	2032	112-2034
Bldg. #1, ESSA Rockville	423	146-8770
Gramax, 8060 13th St., N.W.	414	179-2260
Eugene Brown, FOB-4, Suitland	3301-B	157-7245
Lloyd Decker, 1201 E St., N.W.	1119	112-3287

AUTO CREDIT SAFETY

Your Credit Union continues to set new records in the Auto Credit Safety field!

Over 250 members have selected Credit Union financing for their automobile purchases during the first nine months of 1966. This represents almost one half million dollars in loans to members who shopped as carefully for credit as they did for the automobiles they purchased.

These borrowers found that borrowing from their Credit Union for auto purchases is both economical and convenient. They found that there are no "extras" added on for loan insurance in a Credit Union loan. They found that there are no prepayment penalties hidden in the fine print of the loan agreement.

When you shop for your new or used, don't be stampeded into accepting the dealer's "package price per month" figure without knowing exactly what the "package" includes. And don't sign the dealer's handy contract until you have compared his itemized terms with the terms your Credit Union can offer.

We can finance your new car purchase up to three-quarters of the selling price, with maximum terms of 36 months at a cost of 3/4 of one percent a month on the unpaid balance — and no "hidden extras."

Guard the safety of your transportation budget dollars by investigating Credit Union terms when you get ready to close the deal on that new or used car.

"AND NOW, A BRIEF COMMERCIAL ANNOUNCEMENT FROM YOUR INSURANCE COMPANY"

Cuna Mutual Insurance Society is your insurance company if you are a member of this Credit Union. You are insured by Cuna Mutual as a depositor or borrower in this Credit Union. You are qualified to participate in the individual insurance program offered by Cuna Mutual.

Is your personal insurance program adequate to cover your present and future obligations? Have you considered these facts and figures?

> It costs a minimum of 18,000 dollars to raise one child to the age of 18 years.
>
> It costs approximately 10,000 dollars to give each child a college education.
>
> If you died today, it would cost approximately 2,000 to 6,000 dollars for medical and burial expenses.
>
> If your widow outlives you by 20 or 30 years, she would need a minimum of 35,000 to 50,000 dollars just to live modestly.

In considering your personal and family insurance program, consider Cuna Mutual. For complete details, write to:

Cuna Mutual Insurance Society
P.O. Box 391
Madison, Wisconsin 53701

DO UNTO OTHERS #2

In the April-May issue of the newsletter, we asked members cashing pay checks at the Main Office on paydays to use the teller's window specially designated for that purpose, to speed service to all our members. We asked that the other receiving-teller windows be used on paydays only for making loan payments or share deposits in cash and to cash personal checks. For all the membership, we extend thanks for your prompt and cheerful cooperation.

Prompted by the success of that suggestion, other members have suggested another way to improve service on paydays. In order to expedite movement at the check cashing window, please refrain from cashing more than 2 checks per member. We don't know why, but one member cashing 4 checks seems to take twice as long as two members each cashing 2 checks.

CHECK NSF-CHECK RISE:

The Credit Union Board of Directors has found it necessary to increase the handling charge for checks returned by banks marked "NSF," which means "not sufficient funds." As indicated on notices posted at all Credit Union offices, the charge is now $4.00 per check returned. The Board's decision was prompted by a sharp increase in the number of personal checks being returned.

The handling charge applies to the individual who cashes the check, regardless of whether it is his own personal check, another person's personal check, or a company check.

LEAVING THE DEPARTMENT?

If you are planning the leave Government service, transfer to another department or agency, or to another bureau of the Department, you will want to be sure you have satisfied your obligations to your fellow members of the Credit Union before you leave.

The Department of Commerce Federal Credit Union is chartered to serve employees of certain bureaus and offices, as identified at the bottom of this page. Any member leaving this "field of membership" is restricted to borrowing only up to the limit of his shares on deposit.

Satisfactory arrangements for orderly settlement of a departing employee's account can be made quickly by calling or visiting the Credit Union office.

The Department of Commerce Federal Credit Union, chartered under Federal law, is an employee-owned and operated activity authorized to make financial services available to member employees of the Department of Commerce and their families. Membership is open to all regular employees of the Department except those in Patent Office, Bureau of Public Roads, Census Bureau, National Bureau of Standards (except those in Springfield, Va.), and Maritime Administration, which have their own Federal Credit Unions.

essa world

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U.S. DEPARTMENT OF COMMERCE, John T. Connor, Secretary
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION, Robert M. White, Administrator
Vice Admiral H. Arnold Karo, Deputy Administrator

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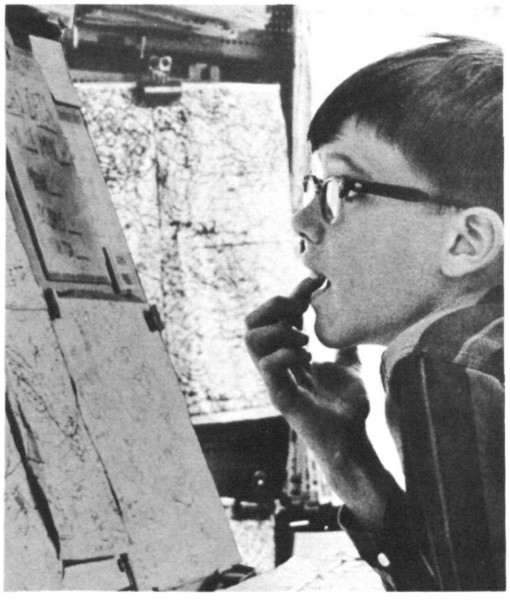

COVER
Young Stephen Allison of Niskayuna, N. Y., is intrigued by the weather maps on display at the Weather Bureau Airport Station in Albany, N. Y. He was one of several thousand who visited ESSA's facilities around the world during the July 13th Open House.
(Albany Times-Union photo)

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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.

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DIRECTOR, IER

An Editorial

ESSA . . . a focal point

When ESSA was organized, the central concept to which it was dedicated was the unity of the environmental sciences—the belief that a focal point was necessary for man's effort to understand, predict, and control his physical environment. In the past several decades, many substantial advances have been made in our ability to observe and predict natural phenomena. The environmental sciences, which seek to harvest the fruits of these capabilities, have a central role to play in ESSA's continued growth.

The key to our future, however, may well lie in our ability to improve our fundamental understanding of the physical world about us: our atmosphere, our oceans, the earth beneath us, and the limitless universe above. Must mankind explore the solar system huddled behind the radiation shield provided by his armored space vehicle, or can he aspire to walk freely on the moon and the planets far beyond the safety of the earth's magnetic field? Must man always *react* to the disasters of storm or flood, or can he eventually eliminate such natural catastrophies or redirect these natural forces for his own progress? Must civilization continue to be bound to the Continents, or can it extend its way over the oceans of the globe, taking full advantage of the biological and mineralogical resources of the oceans? These and many other crucial questions are ours to answer. To exploit our environment fully, we must understand it, know what causes its vagaries, and be able to predict, modify, and eventually control its complex structure and evolution.

It is toward these aims that the Institute for Environmental Research, the research arm of ESSA, are dedicated. We are one of the smaller of the five major line components of ESSA, but we take pride in our organization and its mission. Our objectives can be stated simply: to be the best major environmental research organization in the world, one which will place the United States in a firm position of leadership in the international effort to modify and exploit the physical world in which all of us live. Of primary importance is the creation of a cadre of scientists who are dedicated to the proposition that there are no boundaries to man's intellect, and no legitimate limits to his curiosity. What is "visionary research" today may be the foundation of tomorrow's operational facility.

Fortunately, with the formation of ESSA, the Institutes for Environmental Research have inherited a nucleus of scientists to assist us towards our goal. The Institute for Telecommunication Sciences and Aeronomy, formerly the Central Radio Propagation Laboratory of the National Bureau of Standards, constitutes the world's foremost group of experts on the uses of the electromagnetic spectrum for telecommunications and for the study of the higher atmosphere. A comparatively new activity is the experimental forecasting of natural radiation in space—forecasts which will ultimately require a far deeper understanding of solar dynamics and space physics than we now possess. The Institute for Atmospheric Sciences, formerly the Office of Meteorological Research of the Weather Bureau, has provided world leadership in such fields as large scale numerical weather prediction and the diffusion of atmospheric contaminants. A small group of dedicated scientists from the Coast and Geodetic Survey have formed a nucleus around which the Institute for Earth Sciences and the Institute for Oceanography have been organized.

We in the Institutes for Environmental Research know that our environment must be examined from a variety of perspectives. The scientist working in the quiet of his study complements the laboratory experimentalist or the numerical analyst. Often, to understand nature, we must seek out and examine certain physical processes wherever they can be found. Although the Institutes for Environmental Research are headquartered at Boulder, Colorado, we have laboratories scattered throughout the United States, and indeed throughout the world. Our staff includes the Space Disturbances Monitoring Station at Fairbanks, Alaska; Jicamarca Observatory near Lima, Peru, designed to study the structure of the ionosphere in the tropics; and the Mauna Loa Observatory in Hawaii, which is part of our effort to understand the physics and chemistry of atmospheric processes. Other scientists are centered at the National Hurricane Research Laboratory in Miami, Florida, at the Earthquake Prediction Laboratory in San Francisco, and at many other key locations. We have no wish—nor would there be any reason—to try to concentrate all of our activities at a single location. The world is our laboratory, and we must take maximum advantage of the opportunities it offers us.

Much remains to be accomplished. There are many fields of environmental physics in which we are deplorably weak. In addition, an essential strength of our organization should lie in the unity of the attack on our problems. Scientific boundaries should not rise at the margins of the atmosphere, the oceans, or the continents, but rather at the ill-defined limits of human knowledge. We have much to learn about how to work together to exploit our capabilities and overcome our deficiencies in our efforts to extend these limits.

One example of the unity of the environmental sciences is the exciting field known as *remote probing* of space, the atmosphere, the oceans, and the solid earth. This rapidly developing field focuses on our physical environment new scientific and technical achievements in our understanding and use of wave phenomena. For example, it will soon be possible to use optical and radio frequencies of the electromagnetic spectrum to determine routinely, with considerable accuracy, such atmospheric parameters as air density, temperature, and water vapor content averaged over path lengths of several miles. Perhaps the standard instrument and radiosonde will soon be anachronisms. Perhaps we do not really want to know the values of meteorological parameters at an arbitrary point, but should be more concerned with representative values of these quantities averaged over characteristic intervals in space or time. It is difficult to estimate the full potentialities of our growing capability to measure and to probe our environment without disturbing it by the insertion of artificial platforms and physical instruments. However, in the development of remote probing as a tool of the environmental sciences, the physicist, the solid earth geophysicist, the meteorologist, and the oceanographer all have a vital role to play.

As the first Director of IER, I have the privilege of helping to provide leadership for ESSA in its exploration of the unknown. We welcome the advice and assistance of all scientists with vision and imagination. The challenge is great; the opportunities are unlimited. We do not know how fast and how far we can go. We do know that in making the effort to excel, we will be advancing the causes of mankind and of our country.

Hurricane Betsy (1965) as seen by high-flying U. S. Air Force reconnaissance aircraft.

PROJECT STORMFURY

BY HERBERT LIEB

CLOUD PHOTOS from a weather satellite indicate a tropical depression at 15°N and 45°W—a tiny point in the Atlantic between Africa and South America more than 1000 miles from any land area. Of no concern to most people. Just a suspicious area now. Later, possibly a hurricane. No one can tell yet.

At ESSA's National Hurricane Center in Miami, Florida, the world's best trained hurricane eyes keep a constant vigil from this moment on. Ships, satellites, planes, and radars will track, measure, and report on the storm's progress. When a land mass is threatened, the public is warned. It's almost routine now.

But other eyes are also watching this low pressure area. They include atmospheric physicists, meteorologists, engineers, technicians and flight crews of instrument-crammed aircraft. They are on 72-hour alert to "stage" from Roosevelt Roads Naval Station in Puerto Rico. From there they will fly into the hurricane—if it's the right kind of hurricane . . . and in the right place.

They come from Jacksonville and Miami, Florida; from Edwards Air Force Base and China Lake, California; from Norfolk, Va.; and from Washington, D. C. They wear the ensignia of ESSA, or U. S. Navy, or Air Force, but at Roosevelt Roads, they are one team. On any one operation, as many as 200 scientists, technicians, and flight crews will fly into the storm. This is Project Stormfury.

Stormfury scientists hope to find ways for man to reduce the destructive forces of the giant storms. The hurricane is driven by heat. Seeding the clouds in the strongest part of the storm surrounding the eye releases latent heat and may trigger a chain of events leading to changes in the storm circulation and structure.

Project Stormfury is an inter-agency program of the Department of Commerce (ESSA) and Department of Defense (NAVY). It was established in 1962 as a program of scientific experiments designed to explore the structure and dynamics of hurricanes. The Project's objectives are to achieve better understanding, improve prediction, and investigate the possibility of modifying some aspects of these destructive storms.

The Director of Project Stormfury is Dr. Joanne Simpson, Chief of the Experimental Meteorology Branch of ESSA's Institute for Atmospheric Sciences.

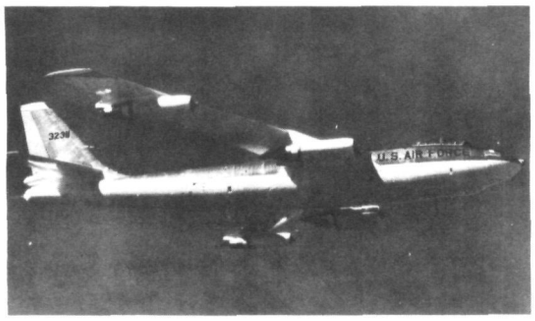
Commander J. W. Kidd, Officer in Charge of the U. S. Navy Fleet Weather Facility at Jacksonville, (Fla.) Naval Air Station is Assistant Director Operations Officer. Dr. R. C. Gentry, Director of ESSA's National Hurricane Research Laboratory, is the Alternate Director of the Project. Dr. J. R. Stinson, Chief of the Research Division, U. S. Navy Weather Research Facility, Norfolk, Va., is the scientific advisor to the Assistant Director.

The seeding materials have been developed under the supervision of Dr. Pierre St. Amand. He and other scientists of the Naval Ordnance Test Station at China Lake, California have perfected the generator used to disperse the silver iodide crystals and have participated extensively in the field programs, with their research aircraft as one of the seeding planes.

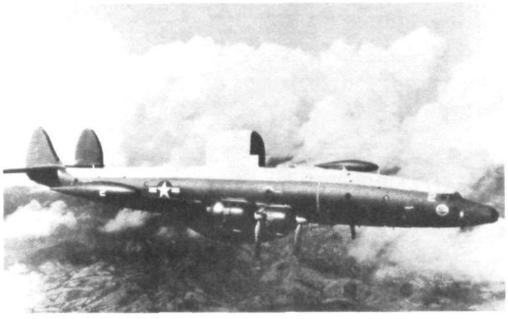
The originator and former Director of the Project, Dr. Robert H. Simpson, is currently the senior ESSA consultant. Dr. Simpson is also Associate Director of the Weather Bureau for Meteorological Operations.

In addition to its full and part-time staff, the Project has an advisory panel of five distinguished scientists who meet with the group several times annually to review progress,

U. S. Navy Photo



B-47 jet aircraft used by U. S. Air Force for hurricane research.



U.S. Navy Super Constellation used by Airborne Early Warning Squadron Four (VW-4).

ESSA's Research Flight Facility's DC-6, known as 40 Charlie.

discuss design and results, and assist in planning. Members are: Dr. Noel E. LaSeur, Panel Chairman, Florida State University; Dr. Edward Lorenz, Massachusetts Institute of Technology; Dr. Daniel F. Rex, National Center for Atmospheric Research; Dr. James E. McDonald, University of Arizona; and Dr. Jerome Spar, New York University.

Until the 1966 hurricane season, only two hurricane eyewalls (clouds surrounding the storm center) had been seeded. They were Esther in 1961 and Beulah in 1963. Tropical cumulus cloud seeding experiments were conducted in the eastern Caribbean Sea area in 1963 and again last year.

Since then, the seeding experiments have been intensified. The eyewall is bombarded repeatedly with silver iodide over an 8-hour period in an attempt to produce more pronounced, long-lasting effects than those in previous tests. Aircraft now are also better equipped to measure and record the results of the seeding.

In addition to the hurricane-eyewall experiments, the Project investigates the effects of seeding hurricane rainbands —narrow, curved strips of heavy precipitation found at some distance from the hurricane eye. Silver iodide generators are dropped across a section of the rainband, and changes in cloud structure and precipitation patterns are observed and recorded.

As many as 17 aircraft—provided by the Navy, the Environmental Science Services Administration, and the Air Force—are used in Stormfury operations.

Four instrumented aircraft of ESSA's Research Flight Facility (RFF) participate in the seeding experiments. Two DC-6's, one C-54, and one WB-57, all based at Miami, Florida, monitor the operations by recording numerous meterological observations from 1,500 feet to 35,000 feet. The Director of the Research Flight Facility is Howard Mason.

WC-121N (Super Constellation type) aircraft from the Navy's Hurricane Hunter Squadron AEWRON FOUR, based at NAS Jacksonville, provide airborne control of all aircraft in the operations and measure numerous meteorological parameters. Within the past two years, one of the squadron's prototype aircraft has been used continuously in developing new and more efficient types of instrumentation. This plane now carries a system for launching and tracking rockets which can gather data as far as 25,000 feet above the aircraft. Other environmental sensors applicable to various aspects of hurricane reconnaissance are being evaluated. Improved Doppler radars, navigational computers, and radar altimeters have been installed on all Squadron aircraft. Commander R. V. Himelick, USN, is the Squadron's Commanding Officer.

Silver iodide canisters for all experiments and photographic reconnaissance are provided by RA3B's (Skywarriors) of Heavy Photo Reconnaissance Squadron 62, also based at Jacksonville. Commander H. F. Bryant, USN, is the Squadron's Commanding Officer. One Skywarrior from the Naval Ordnance Test Station at China Lake, California, participates in the seeding, monitoring, and photographic reconnaissance. This aircraft is specially outfitted to drop a large number of silver iodide canisters, if needed.

The Air Force supports the Project by providing C-130 (Hercules) aircraft for dropsonde measurements, a specially modified B-47 jet for additional high level wind observations and a U-2 for high-level photography in the hurricane experiments.

Project Stormfury has a staff of about five full-time senior scientists and about five others who devote about half their time to the program. The data acquired by the aircraft are largely processed by the computer facility at the National Hurricane Center in Miami.

Project Stormfury is indeed an ambitious program. Writing in the Bulletin of the American Meteorological Society (June 1965), Dr. Robert M. White, ESSA Administrator, who along with Capt. E. T. Harding, Director of the Naval Weather Service has overall responsibility for the joint program, says:

"Hurricane experimentation presents enormous potential rewards for the Nation. On the other hand, such experimentation is confronted by formidable obstacles, both scientific and logistic. Like anything related either to weather modification or to hurricanes, public and scientific interest runs high and controversy is a normal accompaniment. We feel that every reasonable effort to surmount the obstacles should be made, that we must avoid exaggerated promises of practical benefits and false claims. Above all, we must strive to design and carry out experiments which are scientifically sound. This is, we believe, a major avenue for advancing the science of meteorology and the only way that modification of the atmosphere will progress from the Sunday supplement stage to a reality." □

DO YOU FEAR THE WIND?

'Do you fear the force of the wind,
The slash of the rain?
Go face them and fight them,
Be savage again.'

Harlin Garland

DC-6 Interior looking forward.

IT MAY be a hurricane in the Caribbean, Atlantic, or Gulf of Mexico; or a tornado-breeding thunderstorm in Oklahoma; or a cyclone in the Bay of Bengal.

Most people will steer away—especially aircraft. But not the men and planes of ESSA's Research Flight Facility (RFF).

The RFF has only 24 men. Organizationally they are part of ESSA's Institute for Atmospheric Sciences.

Small as their numbers may be, their job is one of ESSA's most important.

While their efforts in Project Stormfury seem to monopolize the headlines, flying in support of Stormfury represents only a small part of their mission to support general atmospheric research.

The RFF was originally part of the Weather Bureau's National Hurricane Research Projects established in 1956. It became a separate unit in 1960 and the scope of its activities was broadened to include other atmospheric research studies.

In 1960, the RFF acquired two DC-6's, and a B-57. In 1965, a C-54. They have used two other aircraft, a B-26 now retired from service, and an F-11 which has been returned to the U. S. Navy.

Since 1962, RFF crews have flown about 7,000 hours. Of these, about half have been in support of the hurricane research effort. Another several hundred hours have been flown in support of the National Severe Storms Laboratory at Norman, Okla.

The RFF has in the last year also flown hailstorm study missions for the Atmospheric Physics and Chemistry Laboratory, comparability studies for the Sea Air Interaction Laboratory, and air mass studies for the Air Resources Laboratory of the Institute for Atmospheric Science. In addition, it has conducted cloud photography studies for the National Environmental Satellite Center.

During 1963 and 1964, the RFF made two trips in support of the International Indian Ocean Expedition. The facility's planes flew 115 missions, more than 100,000 miles, and collected almost one million observations in connection with the studies of monsoons and general weather patterns in the Arabian Sea, the Indian Ocean, and the Bay of Bengal.

Howard J. Mason, Jr. heads the RFF staff. William S. Callahan is chief of Flight Operations. Harlan W. Davis is chief meteorologist, and Gerald Conrad heads the Instrument Development Branch for the RFF.

Mason, a physicist and certified professional engineer, also has an airline transport rating. He flies as co-pilot on all research missions involving the DC-6 known as *39 Charlie.*

An eight man crew including two ESSA meteorologists and two electronics specialists operate the DC-6's. The B-57 has a pilot station forward and an observer station located in the fuselage compartment. The observer doubles as meteorologist and navigator. The C-54 operates with a crew of six and often carries visiting scientists.

Two pilots from the Coast and Geodetic Survey have joined the RFF since ESSA's formation.

A private contractor, Air International, provides for flight operations and general maintenance of the aircraft furnishing five pilots, five flight engineers, two navigators, and a crew chief for the B-57.

The two DC-6's fly below 20,000 feet and generally at levels between 1,000 feet and 14,000 feet. The B-57 has a practical operational altitude of 35-45,000 feet. and the C-54 operates at 10,000 feet or lower.

Based in Miami, the crews of the RFF leave their homes and families for weeks and months at a time. During peak storm activity, no matter if they are in Puerto Rico or Oklahoma, they work 'round the clock several days a week.

During Stormfury operations, one of the DC-6 aircraft flying at 12,000 feet makes two trips into the storm and may be out as long as 22 hours during a 24-hour day. The C-54 flies at 1,000 feet and the B-57 monitors the storm for two hours at the beginning of the operation and again toward the end.

ESSA's Research Flight Facility Crews.

JOANNE SIMPSON. Joanne Gerould's fascination with clouds came very early when she learned to fly as a young girl in Boston. Her interest in aviation led to studies in meteorology and eventually to her being known as one of the world's foremost atmospheric physicists.

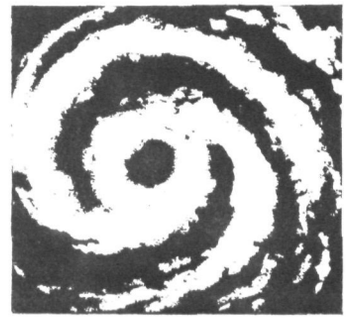
Today Dr. Joanne Simpson heads one of the most complex and vital projects known to science—Project Stormfury.

She was born in Boston on March 23, 1923. She obtained her B.S., M.S., and Ph. D. from the University of Chicago. She has taught meteorology at the University of Chicago, New York University, Illinois Institute of Technology, Woods Hole Oceanographic Institution, and the University of California at Los Angeles.

Dr. Simpson has served on numerous industrial, national, and international panels and is an associate editor of the American Geophysical Union's Review of Geophysics.

She has received many awards, honors, and fellowships, including the Guggenheim Fellowship in 1954, the Melsinger Award from the American Meteorological Society in 1962 and in 1963 was selected by the Los Angeles Times as "Woman of the Year" in science.

Dr. Simpson has been associated with Project Stormfury from its inception in 1962. She was one of the prominent university scientists on the Project Stormfury Advisory Panel. When her husband, Dr. Robert H. Simpson, the director of the Project, became associate director of the Weather Bureau in 1965, she assumed the reins as project director and also heads the Experimental Meteorology Branch in ESSA's Institute for Atmospheric Sciences. (H. L.)



U.S. NAVY

Hurricane Hunters

Their official title is Airborne Early Warning Squadron FOUR, or in naval jargon, VW-4. But the world knows them as the famous Navy Hurricane Hunters. While they have taken a vital and active part in Project Stormfury, their prime mission is reconnaissance—early warning of the approach of tropical storms.

The Navy has performed aerial reconnaissance in support of the joint U. S. hurricane warning service since 1943. VW-4, the seventh naval aircraft squadron assigned this mission, has been in operation since 1953. Hurricane reconnaissance techniques have improved greatly during recent years. The aircraft perform at altitudes of 500 to 1000 feet including hurricane eye penetrations. This is thought by many to be the most dangerous type of flying in the world, but time tested procedures and highly trained flight crews have reduced the danger to a minimum. In more than 23 years of Navy hurricane flights in the Atlantic, Caribbean, and Gulf of Mexico, only one plane has been lost. That occured in 1955 when a VW-4 aircraft, a P2V Neptune, was lost with all hands in the Carribbean while penetrating the eye of Hurricane Janet.

With the advent of powerful long-range airborne radars, a new aircraft was added to the long list of planes making storm flights. In 1955 the Navy Hurricane Hunters received the first of the WC-121N Lockheed Super Constellations. New techniques were devised and weather reconnaissance underwent a radical change. Weather information which once took days to acquire can now be gathered on one meteorological flight. Conditions in an area of 200,000 square miles can be observed with one sweep of the powerful airborne radar. One Navy weather flight can provide information of an area encompassing 1,500,000 square miles.

Based at Naval Air Station, Jacksonville, Fla., the squadron also maintains a detachment in Puerto Rico to provide better year-round weather reconnaissance in the Caribbean and Atlantic waters.

Since aerial hurricane reconnaissance began, more than 350 hurricanes and tropical storms have been probed by Navy Hurricane Hunters. They have a record of 50,000 accident free flying hours with 10,000 of these in actual hurricane reconnaissance. They have made about 800 penetrations into the "eye" of the hurricanes. Experts at the low-level penetration technique, the Hurricane Hunters, in their 70-ton "Connies", encounter winds as high as 150 miles per hour.

The men of VW-4 can be justly proud of the traditions and accomplishments of the Navy Hurricane Hunters. The Nation is. □

Dr. Joanne Simpson, Director of Stormfury Project and Commander Ronald V. Himelick, Commanding Officer VW-4 study weather data aboard aircraft.

Cdr. J. W. Kidd is Assistant Director of Project Stormfury and also serves as the project's operation officer.

WHEN THE EARTH QUAKES

BY R. J. BRAZEE
Technical Assistant,
Seismology Division

New system furnishes ESSA's seismologists with more precise information on location, time, size and effects of earthquakes.

SCIENTISTS WERE SURPRISED recently at Cholome, Calif., when close-up earthquake measurements made there showed even a small quake exerted a force on a building half as great as the building's weight. The strongest measured force had been a third of the weight. ESSA's scientists now believe that a big quake may actually push against walls and girders with a force at least as great as the weight of the building itself.

Today, whenever the earth gets the shakes, the public will know about it quicker than ever because of the August 15th establishment of ESSA's National Earthquake Information Center at the Coast and Geodetic in Rockville, Md.

The center's National Earthquake Early Reporting System (NEERS) reports quakes of medium magnitude (6.5 on the Richter Scale) or larger, as quickly as their indications are analyzed, to news services and Government agencies with public safety responsibilities.

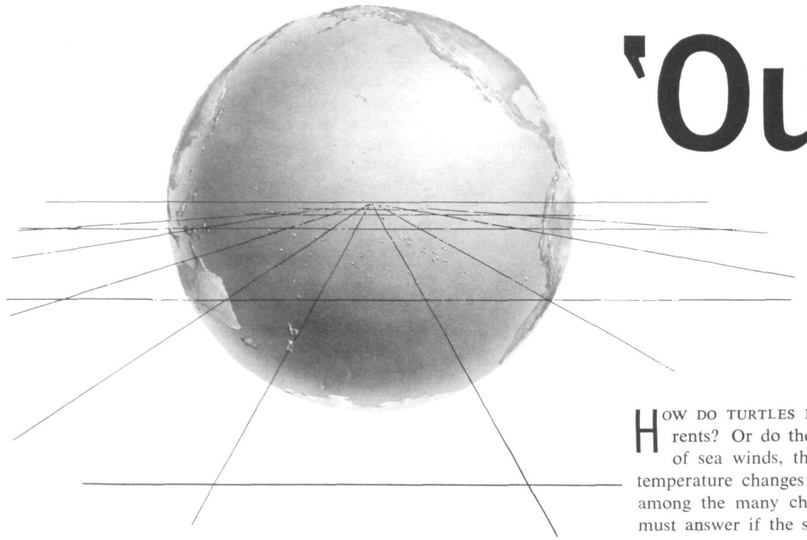
Since 1925, C&GS's Seismology Division has had the job of locating and cataloging every earthquake for which sufficient information could be gathered. Through voluntary cooperation of seismologists around the world, a network of participating stations and rapid communication gradually evolved. During the 1940's and early 50's, this information was assembled and the location of each large earthquake was determined as quickly as possible. Within three days on the average, a Preliminary Determination of Epicenter card containing the pertinent data was distributed to all contributors and interested organizations.

By 1960, electronic computer methods had been developed and improved so that the number of earthquakes located annually gradually rose from 1,500 to 6,000. The capacity of the computer was so great that more rapid and extensive station and communication networks evolved. The threshold of magnitude for earthquakes located dropped from about 5½ to 3½. This automation increased the amount and accuracy of data available for scientific study many times, but the locating process became increasingly mechanical so that individual quakes received less critical attention and the degree of urgency was not so apparent.

Division seismologists welcomed the NEERS since it lent a sense of immediacy to their work. Five seismologists at the Washington Science Center, Rockville, Md., were given the responsibility of locating, as quickly as possible, any earthquake of magnitude 6.5 or greater. At least one of these scientists is on duty at all times which requires him to be able to furnish this information regardless of the hour.

To do this, five seismograph stations at Tucson, Ariz.; Newport, Wash.; College, Alaska; Honolulu and Guam were put on the same schedule. When an earthquake of the requisite magnitude occurs, an alarm will ring at one or more of these stations alerting the resident seismologist. He then will scale the seismograms immediately for the arrival of primary and secondary waves and the amplitudes needed for magnitude determination. This information will be telephoned to the National Meteorological Center (NMC), Suitland, Md., and confirmed by teletype. The duty officer at NMC will report the advent of the shock by phone to the seismologist on duty and will relay all subsequent information pertinent to the shock via teletype to the Washington Science Center. The Seismologist will take these data and analyze them to establish an origin time and then by converting the transit times to distances he will swing intersecting arcs on a large and extremely accurate world globe. By making suitable adjustments to the origin time, scientists will pinpoint an accurate quake location. The information, plus any other pertinent material, will be reported to the NMC which in turn will disseminate it to the public and news media through its radar reporting and warning coordination net. It is expected that the NEERS will help make the Nation safer from earthquakes even if they can't be prevented. Mainly this means gauging the force of quakes and designing buildings to withstand them. "An earthquake," said ESSA Administrator Dr. Robert M. White, "is like a chain. You pull on it and it will snap, but nobody knows where."

Just why they do occur, scientists do not know. Hundreds of miles beneath the surface of the earth, layers of rock shift and ooze, sometimes placing terrific strains on the rock above and on the surface. Because the key to earthquakes is locked beneath 250 to 400 miles of rock, scientists have small hope of being able to stop them. □



'Our Last Frontier on Earth

...this is the sea around us'

(from remarks by President Lyndon B. Johnson at the commissioning of the USC&GSS OCEANOGRAPHER, July 13, 1966)

BY DR. HARRIS B. STEWART, JR.
Acting Director
Institute of Oceanography

How do turtles navigate? Do they follow certain currents? Or do they have a special sense for the direction of sea winds, the movements of the sun and stars, the temperature changes between salt water and air? These are among the many challenging questions that oceanographers must answer if the sea and its depths are ever to be understood.

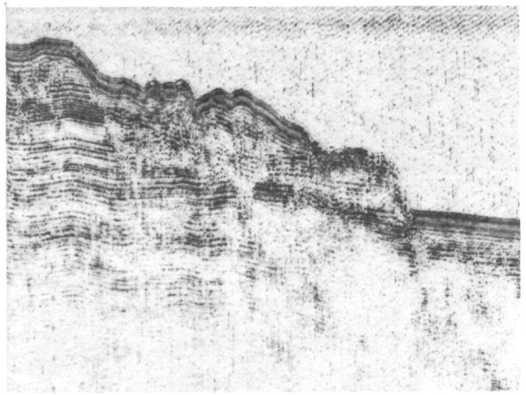
Take, for example, the case of small green sea turtles which apparently can navigate thousands of miles over the open ocean with fantastic accuracy. In one experiment, 206 baby green turtles were tagged at Ascension Island in the South Atlantic off the coast of West Africa. All of the turtles left their island home in 1960. Some of them were later discovered on the beaches of Brazil. By 1963, a number of them had returned to Ascension Island, only to disappear again for Brazil. In 1964, after apparently two round trips to Brazil, all but one of the green turtles were found back on Ascension Island at exactly the same site on the beach where they had been tagged! The missing one was found on an adjacent beach that had been created by the action of waves.

In ESSA, the Institute for Oceanography deals with the special problems, the characteristic processes, of the oceans. Of all the environmental sciences, oceanography can perhaps be most ideally integrated into the ESSA concept of a total program dealing with a single, interacting composite environment.

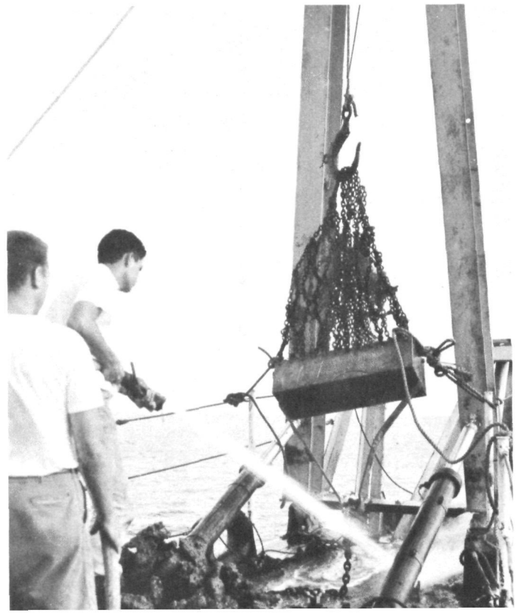
The Institute for Oceanography pursues a research program concerned with describing and, especially, understanding and predicting the nature and behavior of the oceanic environment.

The science of oceanography had its beginnings when chemists began to analyze sea water samples; when geologists extended their studies beyond the continental margins and began to use the ocean basins as a proving ground for hypotheses on the genesis of the earth; and when physicists and astronomers first applied their knowledge to studies of oceanic phenomena such as tides or prevailing current systems.

The direct contribution of meteorology to advances in physical oceanography deserves special emphasis. The fluid ocean obeys the same physical laws as does the fluid air. Advances in fluid dynamics gained by meteorologists have, when modified and applied to the oceans, resulted in significant progress in oceanography. Notable examples of this can be found in the work of Rossby and Sverdrup in the 1920's and 30's as well as in the work of many present-day oceanographers.



Record from a continuous seismic profile illustrating structure beneath seafloor.



Washing up after a successful rock-dredge recovery.

The recent report of the President's Science Advisory Committee's Panel on Oceanography, "Effective Use of the Sea," stressed another aspect of the desirability of considering the environment as a total, integrated system: Techniques of data processing, correlation, and analysis, the concepts developed in one branch of geophysics often prove useful in other branches. The ESSA concept gives researchers in one environmental science ready access to ideas, methods and techniques in many other fields.

Interactions and exchanges at earth-ocean and ocean-air boundaries are processes of special interest and importance. And efforts to describe and understand these boundary processes again illustrate the advantage of integrated programs in environmental research. Land-sea interaction processes are of interest to the geologist because they affect marine sediments, beaches, and undersea features.

These interactions are vital to the physical oceanographer because they modify circulation patterns and are a significant factor in the ocean energy budget. Both meteorologists and oceanographers recognize the importance of air-sea interactions. Mass, momentum, and heat energy can pass either from the ocean to the atmosphere or from the atmosphere to the ocean. An understanding of the mechanisms and amounts of these transfers is essential to the solution of critical problems in both meteorology and oceanography.

These factors that support the ESSA concept of a unified solid earth-ocean-atmosphere environment dictate the Institute for Oceanography's organizational structure and program content. The Institute is made up of six laboratories or research groups engaged in oceanographic research in four sub-programs: physical oceanography, land-sea interaction, marine geology and geophysics, and sea-air interaction.

The Physical Oceanography Laboratory, under the direction of B. D. Zetler, is located in Silver Spring, Md. The Laboratory is engaged in research into the physical and dynamic properties of the oceans with special efforts toward: describing ocean circulation both by the traditional methods of inference and by the application of dynamic theories and models; investigation of wave phenomena including tides, tsunamis (seismic sea waves), wind waves, and internal waves; investigation of medium-scale hydrodynamics in the estuarine, nearshore, and oceanic environments to gain knowledge about phenomena such as ocean turbulence, estuarine circulation, energy transfer mechanisms and boundary currents. Important efforts now under way include tidal research that has recently resulted in a much-improved method for predicting tides in shallow water, and has produced an objective comparison of various techniques for tidal analysis.

Beginning in August, 1965, extensive studies have been made of the Gulf Stream. Under Institute for Oceanography and Coast and Geodetic Survey leadership, a cooperative effort has been developed that includes participation by a large number of Federal agencies and private oceanographic groups. As a significant part of the study, ships of the C&GS have monitored the strength and position of the Gulf Stream. Analysis of the resulting data is expected to provide an observational basis on which interpretive models can be formulated.

The Land Sea Interaction Laboratory (LASIL), located in Norfolk, Va. LASIL, under the direction of Dr. P. Wyman Harrison, carries out research into the responses of beaches and estuarine and continental shelf sediments to environmental and man-made forces or influences. As a part of this research investigations are made into the gas-fluid-solid sea floor system. Present efforts at LASIL include the development of techniques for measuring the bearing strength of estuarine sediments, preliminary efforts to establish predictor equations for the response of beach and nearshore sediments to oceanic and atmospheric forces, and a project to collect pertinent environmental data in a selected near-shore environment.

The Marine Geology and Geophysics Laboratory, under the direction of Dr. George H. Keller, is located in Silver Spring, Md. In studies of the ocean floors, continental margins, and the crust and mantle of ocean basins, the goal is to develop an understanding of the solid earth environment.

Geomorphological studies are one important part of the geological effort. In these studies the shape and form of marine features are considered, and are used as keys to the origin, permanence, and predicted change in these features. Research in marine geophysics is aimed at gaining knowledge of the structure, nature and evolution of ocean basins. This is accomplished through the analysis of gravity, geomagnetic, heat flow and seismic data collected on systematic surveys.

Each of the variables listed can yield information on the structure of the earth's crust. Deep sea floor research is directed toward developing an understanding of the processes and mechanisms important in the origin of ocean basins and the deep sea floor structure. This effort includes the generation and testing of theoretical models. Efforts in sedimentology are directed toward describing the nature and composition of sea floor sediments, and from this description inferring the source and mechanisms for transport of the sediments.

By applying standard sedimentological and geochemical techniques of analysis to samples, insight is gained into sea-floor processes. Existing efforts in the Marine Geology and Geophysics Laboratory have led to: a set of six bathymetric maps showing the Aleutian Island Arc area at a scale of 1:400,000; the discovery of a new fracture zone in the North Pacific Ocean (this discovery resulted from analysis of magnetic data from the SEAMAP project and revealed horizontal displacements in the earth's crust of about 800 kilometers); and the discovery of an undersea rift valley in the eastern part of the Indian Ocean that may have significance in considering the origin of ocean basins.

The Pacific Oceanographic Laboratory, Seattle, Wash., is under the direction of T. V. Ryan. This Laboratory conducts research in physical oceanography, marine geology, and geophysics in the Pacific Ocean. Efforts are currently underway in analyzing and presenting geological and geophysical data from the SEAMAP surveys in the North Pacific; in a cooperative investigation into the mechanisms of formation of the intermediate-depth water in the North Pacific Ocean; and in studies of heat flow through the ocean floor off California.

The Sea Air Interaction Laboratory, (SAIL) under Feodor Ostapoff, is located in Silver Spring, Md. SAIL's main objectives are to develop methods of obtaining data on the exchange of mass, momentum, and heat between the atmosphere and the ocean and to develop an advanced theoretical understanding of the exchange processes. Present efforts are in the development of theoretical models of storm surges and the ocean-atmospheric boundary layer; and in developing sensor systems and observational techniques suitable for measuring the properties important in studies of the lowest layers of the atmosphere and the mixed layer in the ocean.

The Joint Oceanographic Research Group (JORG), under Dr. Robert E. Burns, is located on the campus of the University of Washington in Seattle. JORG carries out substantive programs in physical, geological and geophysical oceanography, jointly with the Department of Oceanography, University of Washington. Because of the vast mission of the Institute for Oceanography and the finite limit on in-house resources it is desirable to extend our capability by using capabilities outside of the Government.

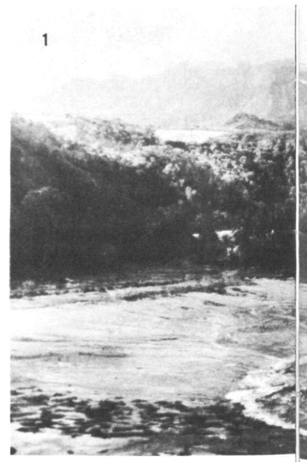
An important effort at JORG is to devise and promote projects that are of direct aid in carrying out the ESSA research mission and at the same time are of interest to and utilize the competence of the Department of Oceanography. Joint projects now under way include Puget Sound tide investigations that consider meteorological influences; and sedimentological studies based on samples from the USC&GSS *Pioneer's* Indian Ocean Expedition.

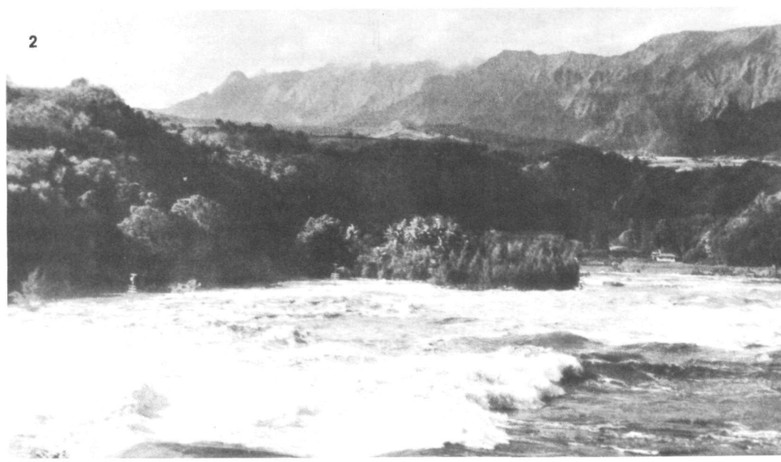
As with any healthy new organization, the Institute for Oceanography's projected programs far overshadow present ones. These plans include the acquisition of a coastal facility to house the East Coast laboratories and the Institute Director's Office. Because the research work in the Institute is more concerned with the real than with the theoretical ocean, ready access to the sea and to research ships is important. Future efforts in physical oceanography will include projects in deep sea tide measurements and modeling; synoptic studies of ocean regions aimed at describing energy budgets, fluxes, and transfer mechanisms; and ultimately sufficient knowledge of the ocean environment to allow accurate prediction of the distribution of ocean properties, currents, and waves.

The Joint Tsunami Research Effort, under Dr. Gaylord Miller, has plans to develop instrumentation and techniques for studies of the origin, propagation, modification and effects of seismic sea waves. In the field of land-sea interaction, efforts will be made to develop models to aid in the prediction of beach and sediment responses to environmental forces.

Efforts in marine geology and geophysics will be designed to develop understanding of phenomena and processes that vary in scale from oceanic to regional. SAIL plans to mount major field experiments to determine ocean-atmosphere exchanges on scales sufficiently large to be significant in atmospheric and oceanic circulation models. These findings could dramatically improve ESSA's ability to make accurate predictions of weather and oceanic conditions. In the Pacific, investigations into estuarine dynamics, atmospheric and oceanic conditions utilizing an offshore installation will lead to insights valuable in ocean and estuarine predictions.

With whole oceans to study and the total environment to consider in these studies there will always be new problems to solve, problems which will demand cooperative efforts among the various laboratories within the Institute for Oceanography as well as among the various other components of ESSA. In the solution of these problems it is hoped to add to man's ability to understand and utilize his overall environment. □





1. Shore area of Kalihiwai Bay, Hawaii, before arrival of a tsunami. 2. The great wave begins to rise. 3. Tsunami at crest of second wave. 4. Second wave all out. In all, nine waves will strike. The third and fourth are the worst and the seventh does some damage.

Photo by Rev. S. M. McCain, Jr.

WEATHER FACTS

A BUSINESSMAN who wanted to open a lumber yard in Memphis, Tenn., recently wrote the National Weather Records Center (NWRC) in Asheville for information about wind directions, an important factor in drying lumber.

A consulting engineer, helping to plan sewer installations in Anchorage, Alaska, asked for data on the frequency and extent of heavy rainfall.

A Baltimore company, desiring to put air conditioning in some of its salesmen's cars, requested temperature and humidity data for various parts of the country.

These inquiries, just three of hundreds which come into the center each month, reflect an increasing use of weather information by business and industry in planning major moves.

An ever broader range of applications for weather data also is being found by various branches of the Federal Government. Long-range forecasting, based on past observations, is used by space shot planners and for designing aircraft of the future.

There is rising interest too on the part of universities, researchers, and private citizens.

The records center, one of several closely related agencies in the Federal Building, is the national depository of vast

One of the NWRC operations is a "clean room" for processing and duplicating FOSDIC film satellite photography, and microfilm of weather records. All who enter must don garb like this to keep the operation free of dust and dirt.

find EVER-EXPANDING MARKET

By LUTHER THIGPEN **Asheville Citizen-Times**
(Reprinted by Permission)

numbers of observations of temperatures, humidity, winds, pressures, and other factors that tell man about his environment and enable him to deal with it intelligently.

But it is more than a depository. It is a giant space-age "merchandising mart" that neatly packages this mass of raw material into usable form and sends it out to thousands of regular customers and to thousands of others who need such information only occasionally.

Periodic climatological publications produced in the NWRC printing plant, are mailed to 40,000 subscribers, and to anyone else—241,892 in 1965—who requests them and pays the nominal fees charged for them. If these don't offer the information needed, the NWRC will put staff specialists to work and set its computers to whirring among the millions of punched cards, microfilm rolls and magnetic tape and come up with what you want, for a price.

Many jobs done for government agencies are major projects requiring months of research. One of these was a complex study of winds and temperatures between 50,000 and 80,000 feet altitude for the San Francisco-to-Thule-to-Stockholm supersonic aircraft route. The information is being used in the design of the SST and later will be used in its operation. Similar studies were made for the New York-Paris and New York-San Francisco routes on behalf of the Federal Agency.

The National Weather Records Center, under Acting Director William H. Haggard, is a major operating division of the Environmental Data Service.

Since the formation of ESSA and EDS, the National Geophysical Data Center has moved into the Federal Building. It has two branches, one which keeps seismological data, or records of earthquakes throughout the world, another the bank for geodetic data, which is used primarily for navigation, map-making and development of natural resources. Tom Modgling is acting director of the seismological branch, and Gayle Tompkins heads the Geodetic Data Center.

The building, constructed in the late 1920s as the Arcade Building and purchased by the government in 1942, also houses the Data Processing Division of the Air Weather Service, under James R. DeCoster, as director, and a small environmental detachment of the Naval Weather Service, headed by Lt. William H. McIntosh Jr.

In all, more than 600 persons are involved here in record-keeping and processing involving the environmental sciences, a job which pumps about $6 million a year into the area economy.

Their tasks are becoming more and more complicated as modern technology speeds the flow of information. Meteorological observations from the thousands of weather stations in this country and those in other countries are continually being refined. Rocketry and electronics enable scientists to take closer looks at the upper atmosphere. Satellites feed streams of weather pictures back to earth.

Raw weather data pouring into the NWRC and the Air Weather Service unit from around the world just about doubles each year.

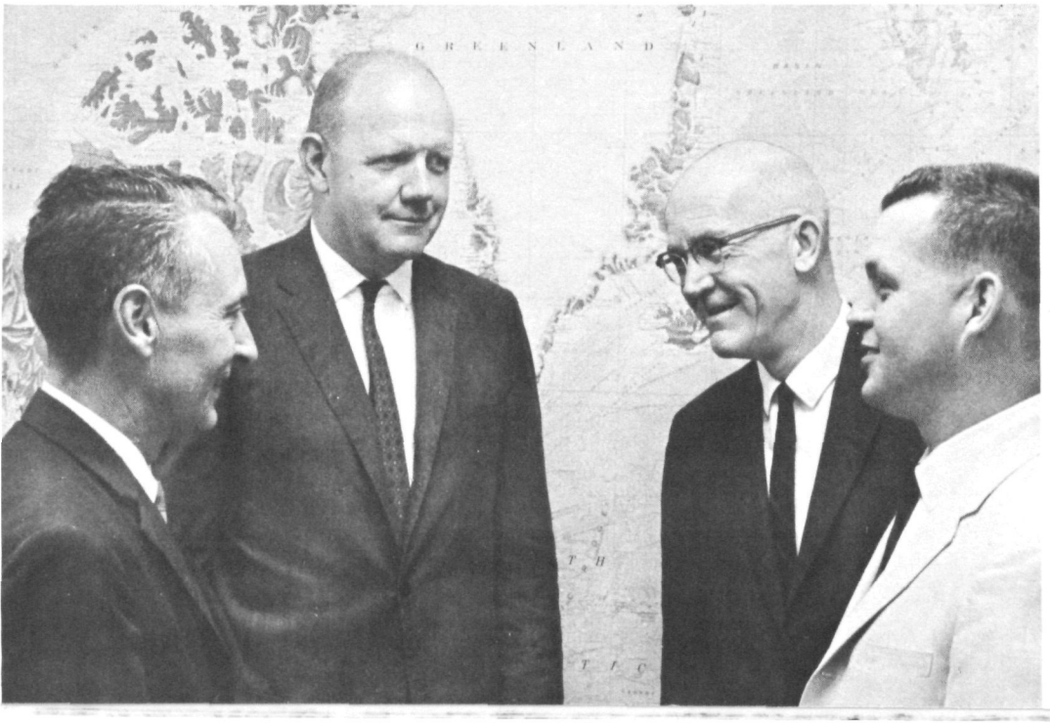
Their methods of handling it therefore must be constantly changing. They are always behind; much of the information goes unprocessed because science has not developed ways to cope with the full flood. Between 25 and 30 million punch cards are added each year, and something has to be done with that many old ones to make way for them.

"There is a perpetual struggle to keep up," Haggard said. "But I don't want to give the impression that we are hopelessly behind. We feel we can keep our heads above water." Recent innovations have made the records center a far more sophisticated operation than it was when it was moved to Asheville in 1951 from New Orleans, where it was established 17 years earlier.

The NWRC has two computers which it leases for a total of about $24,000 monthly, and the Air Weather Service unit has a $2¾ million machine which it "bought" as a surplus

Among the department heads who deal with the environmental sciences in Asheville are (from left) Gayle Thompkins, Director of the Geodetic Data Center; William H. Haggard, Acting Director of the National Weather Records Center; James R. DeCoster, Director of the Air Weather Service's data processing division and Lieutenant William H. McIntosh Jr., of the Naval Weather Service.

Staff photos by E. M. Ball



Tom Modgling, chief of the Seismological Data Branch, checks on the duplication of earthquake records with Joe Granat, who is operating the photo duplicator.

item for another government agency, plus a smaller computer which it leases.

These are second generation computers. Already planned is a third generation complex which will combine the NWRC and Air Weather Service operations by about 1968. It will give both agencies greater flexibility and enable both to do bigger projects than is possible at present, Haggard said. Yet, because of the constant advancement in computers, the cost to the government according to present estimates will only be $25,000 to $30,000 a month, less than the total now being paid.

Further into the future is a computer operation which will permit control centers in other cities such as Washington to reach into the memory back here via direct microwave relay connections and pull out big chunks of raw data, or even specialized data.

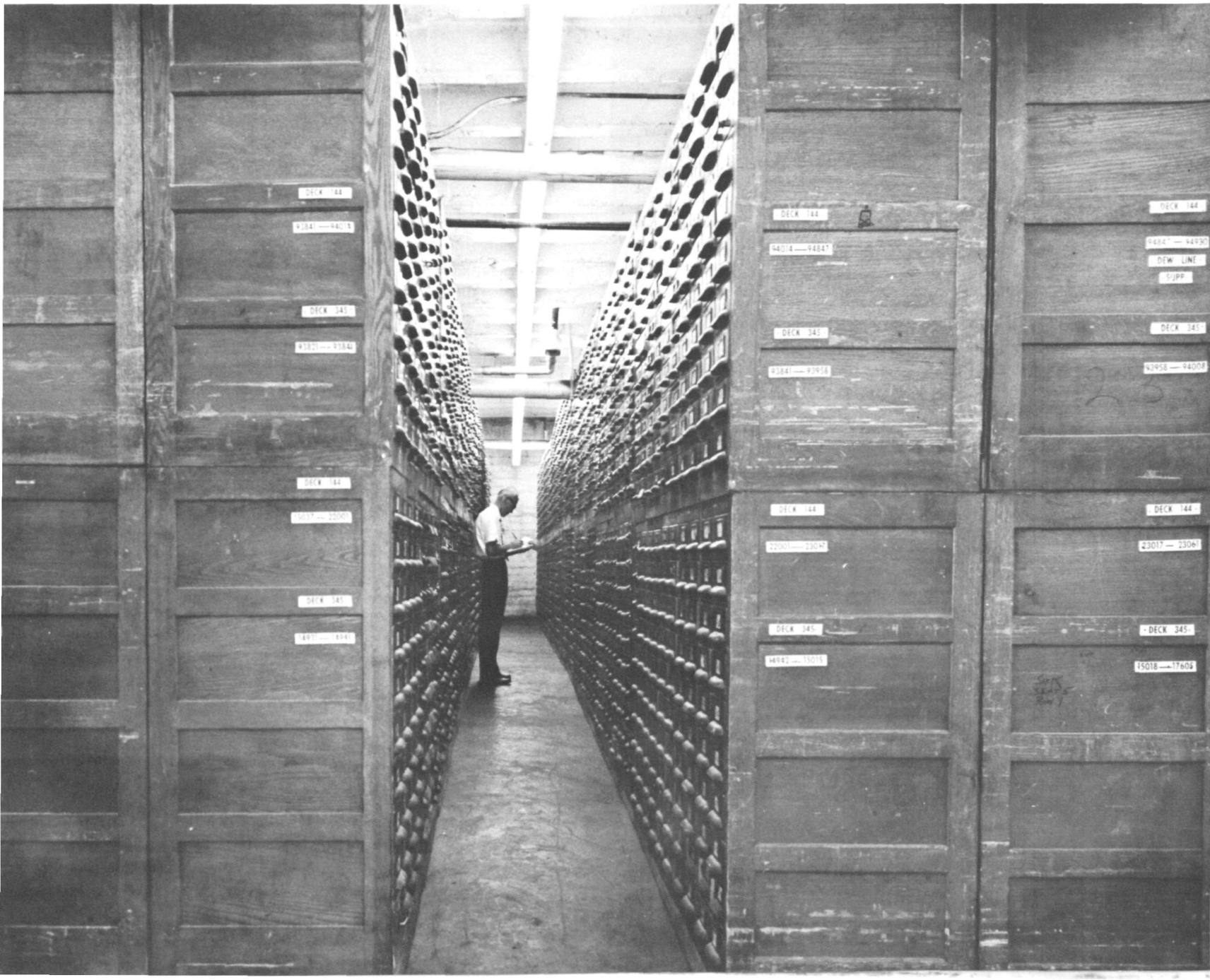
Other developments, in keeping with the age of space exploration, are in the works.

One is a faster, more compact method of storing information, involving a laser beam process. The laser beam will write bits of data as photographic spots around the edge of a paper-thin disc about the size of a phonograph record. One such disc will store twice as much information as one 2,000-foot roll of magnetic tape and about 7,500 times as much as a cabinet holding 25,000 to 30,000 file cards.

"What we have on two floors of the building," DeCoster said, "can be put in a space about twice the size of a large refrigerator."

This process, which will also make the data more easily accessible than present methods, is expected to be put into use here within five years.

Upgrading and modernizing of "garden variety" equip-



ment such as that used in microfilm photography, in printing and in other phases of the operation are being done constantly." Planning for the future is an inherent part of our function," DeCoster said.

The NWRC, according to Haggard, has six senior staff members who are "thinkers," men who are one step or several steps ahead of the daily grind, studying new methods, visiting manufacturers to examine new equipment which might be adapted to NWRC needs, reading technological literature, dreaming up ideas.

"Our investment in their salaries is an investment in our future," Haggard said.

Such planning in the past apparently has paid off in today's accomplishments. DeCoster said the Air Weather Service unit is achieving five or six times what it did 15 years ago without an increase in manpower. The same is probably true of the NWRC, Haggard said.

DeCoster's division is closely coordinated with the National Weather Records Center though it is a separate agency answerable to the Air Force.

The National Weather Records Center serves a wide range of customers who use weather data for an equally wide variety of purposes.

An umbrella manufacturer, for example, needs to know, that he probably will sell more umbrellas in Asheville, with an average of 128 days a year with rainfall of .01 inch or more, than in Topeka, Kan., with only 95 days, or even in Charlotte, where the average is 110 days.

Gilbert Stegall, chief of the Climatic Operations Branch, which deals with such requests from business and industry recalls the case of an insecticide manufacturer whose sales in Beaumont, Texas, were double what they were in Corpus Christi. Since both are Gulf Coast cities, he assumed sales should be about the same. He was about to fire his Corpus Christi sales manager but decided first to check on the weather situation. The explanation turned out to be simple. Beaumont, with almost twice as much annual rainfall, naturally had far more bugs than Corpus Christi.

Open air warehousing of cotton has been changed by availability of accurate rainfall records. Shipments now go first from those areas where rain might damage the cotton. It stays in the dry sections until the latter part of the shipping season which lasts for several months. Losses from rain damage thus have been sharply reduced.

The University of Chicago's Department of Geophysical Sciences is doing research for the U. S. Weather Bureau on severe storms in the Plains states, the object being to learn more about how to forecast tornadoes. From data about atmospheric pressures, temperatures, humidity, and other conditions, they are learning what conditions spawn twisters and when they occur.

The Florida State University Department of Meteorology has asked rainfall records for South Georgia and Florida in connection with studies being made for the Forest Service at Macon, Ga.

A Colorado State University professor bought $6 worth of microfilmed records of upper air observations in Hawaii for use in his course in tropical meteorology.

Special studies are conducted under the supervision of William M. McMurray, chief of the Applied Climatology Branch. Results of these studies are in the public domain once completed and are available to others for the cost of reproducing them, normally just a few cents a page.

Raymond Joiner (front), digital systems advisor, and Grady McKay, data reduction section chief, check on operation of the computer complex.

A consultant meteorologist, acting for an attorney, paid $832 for a weather study to be used in a court case. A consultant got the same information for $4, the cost of reproducing the results. Because of the similarity of the requests, an NWRC staff member as a courtesy telephoned the originating attorney who said he had no objection. "I'd have given him a copy if he'd asked for it," he said.

Addition of the Geophysical Data Center in January of this year has added a new dimension to the record-keeping task carried on in the Federal Building.

The Seismological Data Branch microfilms seismological readings from about 115 stations throughout the world, files, and catalogues them, and in turn sends copies out to institutes, universities, and individuals who use them primarily in research on how to predict earthquakes.

The Geodetic Data Center answers 25,000 to 30,000 requests a year for data used for everything from settling boundary disputes to determining the proper elevation for television transmitting towers.

About 2 million sheets of control data have been stored in the Federal Building here since the move from the Washington Science Center in Rockville, Md. About that many sheets will be printed in the NWRC printing plant during the current year to keep the supply replenished as publications are mailed out to answer requests. □

An unusual view of a couple of the many stacks of file cabinets containing climatological data from around the world.

About to board the USC&GSS **OCEANOGRAPHER**, President and Mrs. Johnson greet guests. To the President's rear are (from left) Mrs. John T. Connor, Hawaii Gov. John A. Burns, Secretary Connor, and Presidential Science Advisor Donald F. Henning.

"So to Captain Wardwell and his distinguished officers and men of **OCEANOGRAPHER**, we say today: Yours is a most worthwhile mission. May you bring back much for the benefit of all humanity." (President Johnson, July 13, 1966).

These Cub Scouts visiting the Pacific Marine Center, Seattle, received drift bottle souvenirs.

Chief observer Willis S. Jacobs (left) shows visible seismograph recorder to Civil Defense Chief Jerry Perez (center) and assistant Frank Lizama at Guam Magnetic and Seismological Observatory.

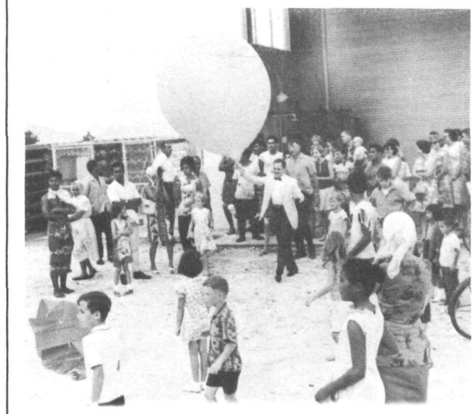
When ESSA Opened its Doors

They came from far and wide—by twos, threes, in droves and occasionally alone. They came in outriggers, in chauffeured limousines, on bicycles, on sleds, in kayaks, afoot, on horseback, in cars, buses and trucks.

What was the attraction? Where were these thousands of people going?

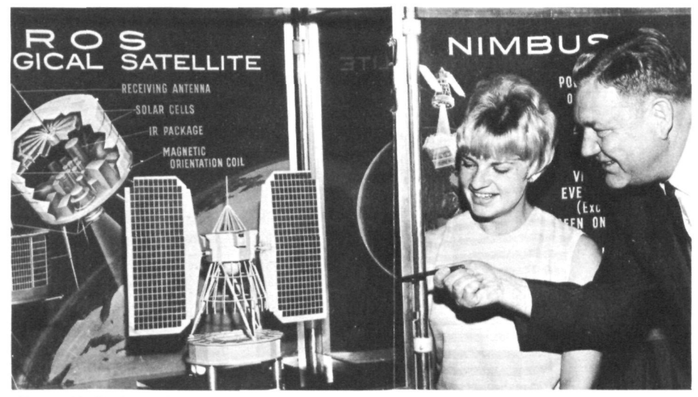
They were on their way to inspect the USC&GSS **EXPLORER** at Norfolk, Va. . . . to visit the San Juan Geophysical Observatory in Puerto Rico . . . to see President Johnson at the commissioning of the USC&GSS **OCEANOGRAPHER** in Washington, D.C. . . . or to view dozens of other ESSA exhibits around the world.

The occasion? It was ESSA's first birthday on July 13th and "open house" was the keynote of the day from Pago Pago, American Samoa, to Point Barrow, Alaska.



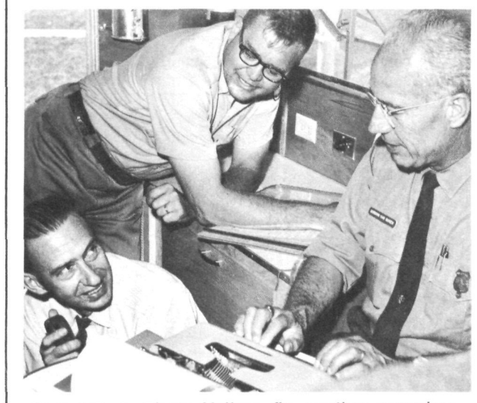
At Pago Pago, American Samoa, some of the 200 visitors watch as Acting Governor Owen S. Aspinall releases a radiosonde balloon.

Some 500 sightseers toured the many exhibits at the Atlantic Marine Center and Ship Base in Norfolk, Va.



Hazen H. Bedke, Director, Weather Bureau Western Region, explains a weather satellite display to Miss Joan Klenke of Salt Lake City, Utah.

(Salt Lake Tribune photo)



From left: L. Pierce Mallory, fire weather supervisor; Paul Sjoblom, State forester and Gordon Van Buren operate fire-weather unit at Salt Lake (Utah) Airport.

(Photo Salt Lake Tribune)

Eskimo visitors Edna Ahgeak (left) and Margaret Leavitt visit Point Barrow Alaska Weather Bureau office.

High point of the day was the commissioning of the USC&GSS **OCEANOGRAPHER** at colorful ceremonies in Washington (D.C.) Navy Yard where President Johnson addressed several hundreds of visitors. "We meet here today," said the President, "at the beginning of a new age of exploration. To some, this might mean our adventures in outer space. But I am speaking of exploring an unknown world at our doorstep. It is really our last frontier here on earth. I am speaking of mountain chains that are yet to be discovered, or natural resources that are yet to be tapped, of a vast wilderness that is yet to be chartered. This is the sea around us."

ESSA's organizations across the Nation opened their doors so the public could see how weather forecasts were made, how earthquakes were recorded, how ESSA measures the size and shape of the earth, and how communication disturbances are predicted, to mention a few of the activities.

On these pages you will see just how far and wide ESSA's doors were opened.

The oceanographic ship **EXPLORER**, operated by the Coast and Geodetic Survey, also was opened to the public at the Atlantic Marine Center, Norfolk, Va.

At the Weather Bureau Airport Station, McNary Field, Salem, Ore., meteorologist-in-charge Robert Kirkpatrick decodes the latest weather reports for guests.

Natives of Pago Pago, American Samoa, are shown weather instruments by John Hertel at Tafuna.

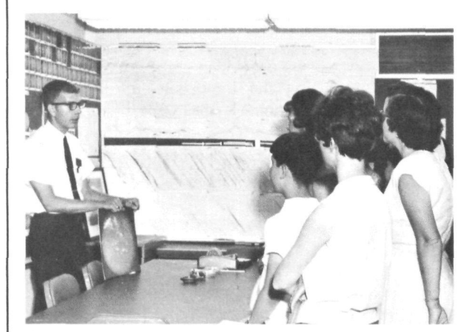
An electronic engineer, Dr. Hiroshi Akima took his family on a tour of ESSA's laboratories in Boulder, Colo.

Joseph Vederman, meteorologist-in-charge of Honolulu's WBAS, shows satellite weather picture to visitors.

Augusto Bonet and family from Rio Piedras, Puerto Rico, watch a visible recording seismograph at the San Juan Geophysical Observatory.

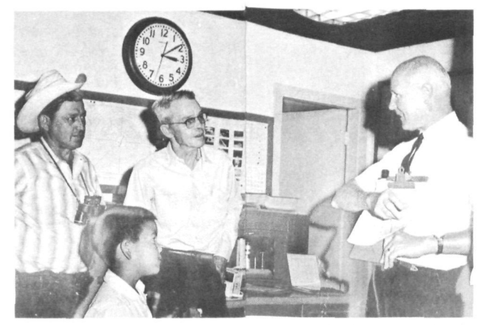
Earl Bates, meteorologist-in-charge of Mahlon Sweet Airport Weather Station, Eugene, Ore., sets his sights on a weather balloon with a theodolite.
(Staff photo by Paul Petersen, Eugene Register-Guard)

Robert Ingram, left, meteorologist-in-charge of the Phoenix, Ariz., WBAS, shows Ben Hablutsel (center) and Harry Keets how temperatures are recorded.



At the Institute for Telecommunication Sciences and Aeronomy's Space Disturbance Laboratory, Patrick McIntosh greets visitors.

Ed Schiffmacher of IER demonstrates data conversion in Boulder, Colo. At Schiffmacher's right are Mrs. George S. Benton, wife of IER's Director, and two of their daughters.



In Flagstaff's (Ariz.), WBAS meteorologist-in-charge Paul W. Sorenson briefs visitors on operation.
(Arizona Daily Sun photo)

Visitors at the Port Arthur (Tex.) WBAS inspect teletype equipment.
(Beaumont Journal photo)

More than 12,000 visited Central Region WB facilities. Joe Crites, at regional headquarters, explains radar use.

CROSS TRAINING

A space age necessity

Secretary of Commerce John T. Connor discussed major programs of the Department in one session with the Fellows.

THE PERIOD OF HUMAN DEVELOPMENT between the time of King Solomon and the American Revolution covers almost 3,000 years. Generations of man, during all of that time, traveled by horse-drawn vehicles, used oil for light, wood for heat and wore homespun clothing.

The difference between the Revolutionary days and today is only some 200 years—but what a contrast in the progress of mankind! The enormous strides during this period can be attributed in large part to science and technology. Organizations such as the Coast and Geodetic Survey and the Weather Bureau, now under the ESSA banner, have added extensively to this progress.

Today, the science and technology of the space age are contributing even more rapidly to the advancement of man's welfare and to the knowledge of his environment. Through ESSA's endeavors, many of man's environmental needs for tomorrow will be developed and human conditions improved.

Recognizing the importance of coordinated efforts in science and technology, the Department of Commerce initiated a Science and Technology Fellowship Program under the leadership of Dr. J. Herbert Hollomon, Assistant Secretary for Science and Technology. In the second year of the program, scientists, technicians and others who occupy positions with management responsibilities, have been brought together for the study of issues involving science, technology, and related matters. The Commerce Fellows are exposed to new job experiences to enhance their professional competence and broaden their scientific, technical and managerial abilities.

In addition, the program seeks to build a clearer understanding between the operating Bureaus of the Department of Commerce, the structure of the Department, the Federal Government as a whole, and the major segments of industrial and technological society. The program endeavors to:

■ provide an opportunity for individuals who have displayed breadth and understanding and who have shown traits of leadership in the technically oriented Bureaus to gain first-hand knowledge and experience in the overall functions of the Federal government. ■ foster an awareness of the technical activities and problems which exist in similar agencies of the government at the national and international level, thereby providing motivation and encouragement for development of cooperative endeavors and programs. ■ promote improved communications between the Bureaus of the Department, to encourage collaboration and cooperation among them to improve the Department's effectiveness. ■ provide the opportunity to work at broad, challenging problems within a similar agency in activities allied to the individual's specialty or interest, with the intent of defining or developing opportunities for joint cooperation and collaborative efforts. ■ develop individuals who at some future date, may be considered for key positions within the Department or in related activities of the Federal establishment.

The most important part of the 1965-66 program was the work assignment in a Bureau or Institute other than the one in which the participant was permanently assigned. During some eight or nine months, the Fellows took part in intensive experiences in positions related to the individual's specialty, competence, or interest. These assignments involved *decision-making and policy-making activities at a high level* of Bureau or Institute operation.

During the year, seminars and luncheon programs were held, featuring leaders from education, government, business, labor, and the professions, exploring in depth the major policy problems of the Federal government. Selected field trips provided on-site study and first-hand observations of scientific and technical institutions.

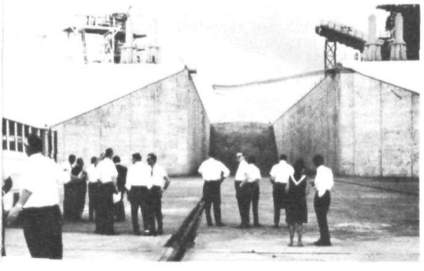
Dr. J. Herbert Hollomon, Assistant Secretary of Commerce for Science and Technology, addresses members of the 1965-66 Fellowship Program.

The Federal government orientation phase of the program was arranged by the Brookings Institution and consisted of seminars and informal discussions with high officials of the legislative, executive, and judicial branches of Government, as well as visits to major Federal agencies. The interplay of government with related activities sponsored by industry and educational institutions, at both Federal and State levels, was stressed. The orientation was designed to provide an overall view of governmental structure and operations, a broad understanding of Federal problems and activities including significant interactions between these activities and the industrial and academic communities, and an opportunity to meet with key government, industry, and academic representatives.

In the Department of Commerce orientation phase, participants attended conferences and informal discussions with officials from all of the Department's operating elements, including the Secretarial officers. The objective was to promote a clearer understanding of the mission of the Department of Commerce. Specific attention was directed to those aspects of the Department's mission which are related to private industrial technology, and the role of science and technology in economic development.

Dr. Glenn T. Seaborg, Chairman of the U. S. Atomic Energy Commission, addressed the Fellows on their visit to AEC headquarters at Germantown, Maryland. Dr. Holloman and Mr. Pomerantz, AEC officials, and several Fellows are shown during one session.

On their visit to the Boulder Laboratories, the Fellows were greeted by this welcome sign.



At Cape Kennedy, Florida, the Fellows visited the firing platform at the Apollo Moonport.

Another part of the program was a Congressional orientation, which was designed to provide an opportunity to obtain, through direct contacts with the Congressional community, a more realistic and thorough understanding of the overall legislative process. Emphasis was directed toward the relationship of the Congress to matters dealing with science and technology, particularly the impact of science and technology on industry and commerce.

Seven participating Fellows from ESSA represented the Coast and Geodetic Survey, the Weather Bureau and the Institute for Telecommunications Sciences and Aeronomy in the 1966 program.

ESAAites selected to attend the 1966-67 program are: Philip A. Calabrese, staff assistant, meteorologist, Meterological Operations of the Weather Bureau; Dr. Robert F. Dale, Regional Climatologist, Ames, Iowa, WB; Walter R. Hinchman, acting chief, Systems Group, Institute for Telecommunication Sciences and Aeronomy, Boulder, Colo.; Wesley V. Hull, Lieutenant Commander, USESSA, Office of Geodesy and Photogrammetry, C&GS; Bernard Zavos, meteorologist, National Environmental Satellite Center, Suitland, Md., and James K. Huntoon, executive assistant to the Director of Aviation Affairs, ESSA. □

1. **Stuart C. Bigler,** Head, Radiation Section, Weather Bureau, Environmental Science Services Administration.

2. **Frederick F. Ceely, Jr.,** Supervisory Mathematician, Coast and Geodetic Survey, Environmental Science Services Administration.

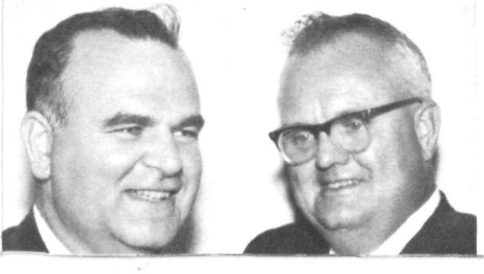
3. **Wilbur H. Eskite, Jr.,** Scientist, Coast and Geodetic Survey, Environmental Science Services Administration.

4. **Charles R. Hosler,** Meteorologist, Weather Bureau, Environmental Science Services Administration.

5. **Walter E. Johnson,** Electronic Engineer, Institute for Telecommunication Sciences and Aeronomy, Environmental Science Services Administration.

6. **Richard C. Kirby,** Division Chief, Institute for Telecommunication Sciences and Aeronomy, Environmental Science Services Administration.

7. **Herbert R. Lippold, Jr.,** Assistant Chief, Geodesy Division, Coast and Geodetic Survey, Environmental Science Services Administration.



BIG BLIZZARD OF '66

...how Weather Bureau's Central Region personnel worked together to save life and property in the Northern Plains

By ROBERT C. BASKIN, Chief, Weather Analysis and Prediction, Central Region

WILL THERE BE any big blizzards in the United States in 1967?

Of course there'll be plenty of snow, but where or how much no one knows. It is known, however, that the Weather Bureau's snow forecasts and warnings will be timely and will minimize loss of lives and property.

Witness, for example, the great blizzard of last March. One of the most severe snowstorms of the century developed the night of March 2 over the western portions of the Dakotas and northwest Nebraska. By the late evening hours of the following day the storm had spread eastward through North Dakota into northwest Minnesota, central South Dakota and north-central Nebraska. The blizzard howled unabated through the night of the 4th before releasing its grip on the hard-hit northern plains during the late morning and afternoon hours of the 5th.

The big blizzard of '66 had created a smothering white blanket of snow and bitter cold that covered much of the northern plains for three days and nights. Heavy snowfall driven by 70 to 80 miles an hour winds, which occasionally gusted to over 100, reduced visibility to zero as it whipped into drifts of from 25 to 40 feet high.

As the storm moved eastward, relief finally came to the battered northern plains where people and animals alike had suffered through the devastating three-day seige. Observers reported miles of almost bare ground in barren areas and tremendous drifts in towns and around farmsteads. In many places the high winds also had stirred up dust and sand which resulted in huge mounds—snow mixed with dirt.

Private citizens, city, county, state, and federal employees and agencies joined together in the battle, as the blizzard abated, and handled the gigantic snow removal job. They gave unselfishly of their time to help reduce human suffering, lessen livestock losses and dozens of other tasks that had to be done.

ESSA's Weather Bureau mobilized its forces to provide vital forecasts and warnings. Weather stations throughout the area maintained surface and upper air observations and informed public service radio and television programs without interruption during the storm. Many employees remained on continuous duty from 40 to 48 hours.

Heavy public service loads and difficult surface and upper air observation problems kept ESSAites busy fulltime, allowing only occasional rest during the extended tours of duty.

Several risked the dangers of the storm and walked to work, roping themselves together to keep from straying. Others received aid from highway crews and law enforcement officers. One rode a city Sno-cat to work. Added complications developed when electrical power kept communication systems operating, but the loss of power shut down heating systems and dropped office temperatures into the low 40's.

Inevitably, a storm of this magnitude calls for comparison with others of the past. Thus, the big blizzard of '66 may be compared with the killer blizzard of March 1941, the great blizzard of 1949, and with the "big snow" winters of 1888 and 1896.

The odds are against another blizzard of this magnitude during the coming winter—but the Weather Bureau never dares count on anything but the worst.

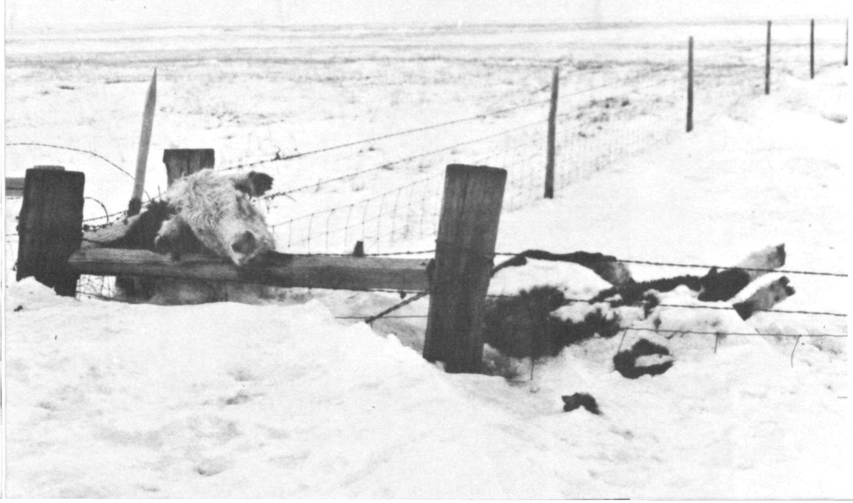
And if the Northern Plains get another Big Snow, the Weather Bureau personnel's galoshes will be at the ready. □

Hen house buried in snow drift on farm near Driscoll, North Dakota.

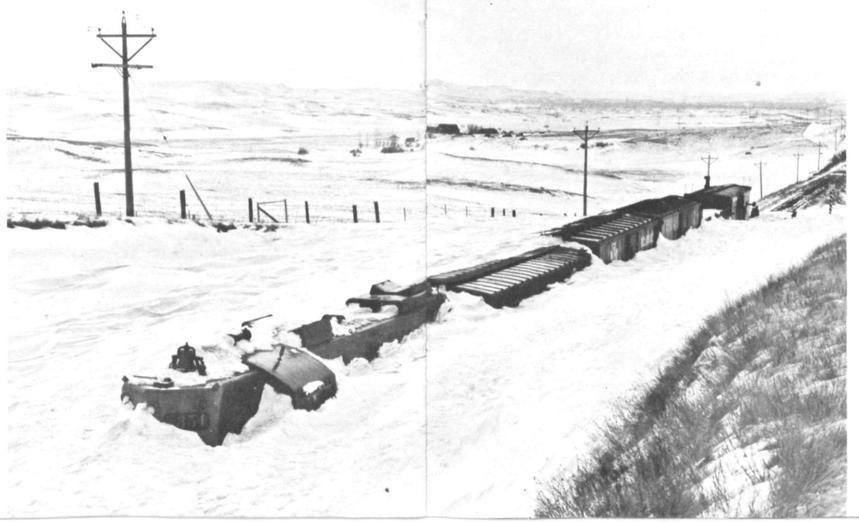
Clearing a farmyard 13 miles east of Hague, North Dakota. Owner had to crawl out of attic window.

North Dakota State Highway Dept. photos

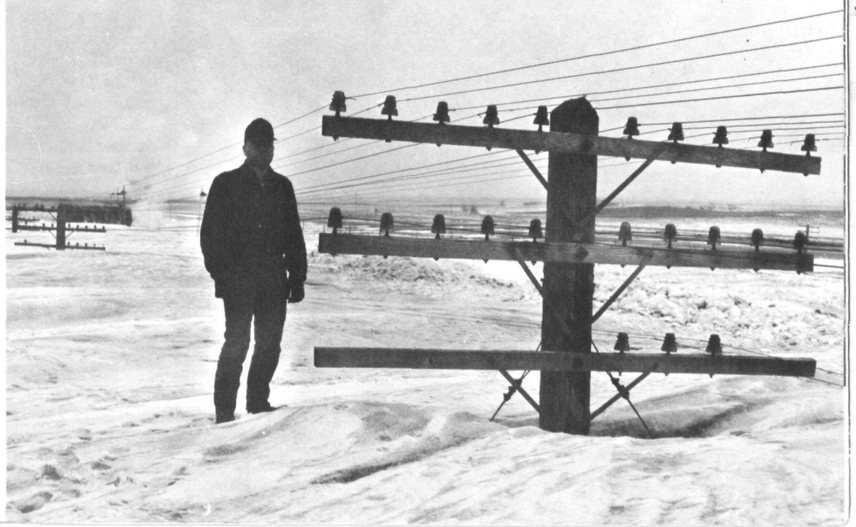
Seven cattle who perished in the storm east of Sterling, North Dakota.

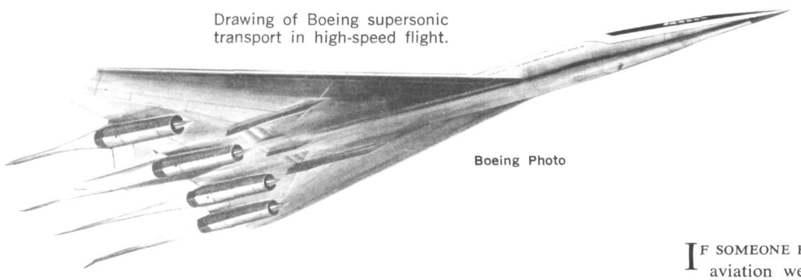


This train was stalled two miles north of Lincoln, North Dakota.



Snow drifts covering a train six miles west of Jamestown, North Dakota.





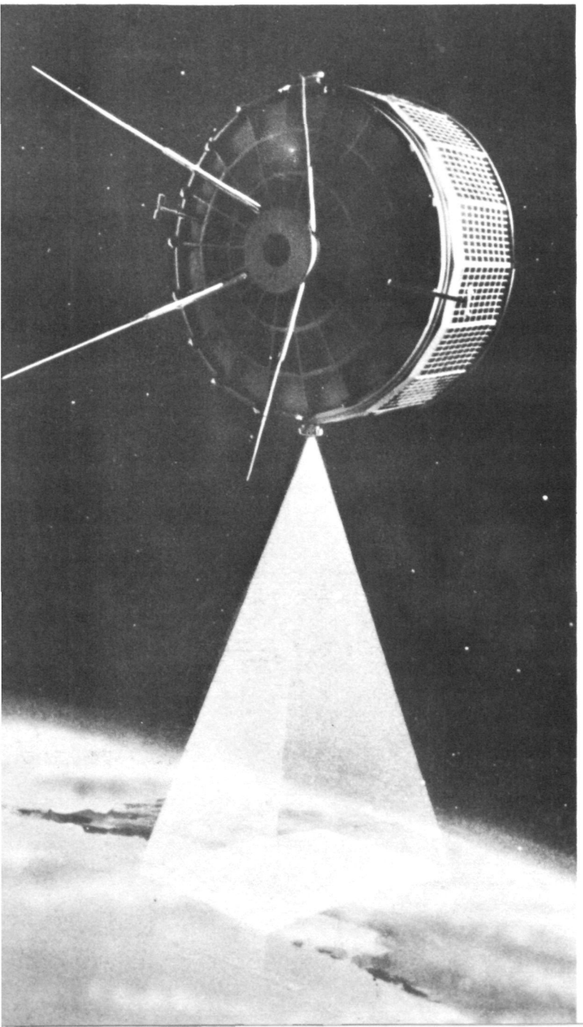
Drawing of Boeing supersonic transport in high-speed flight.

Boeing Photo

High Up Lowdown

Satellites and Aviation Weather

BY NEWTON A. LIEURANCE
Director of Aviation Affairs



A space-eye view of cloud formations over earth is photographed in 1700-mile segments by weather satellites using TV-type camera.

IF SOMEONE HAD TOLD ME when I was just getting started in aviation weather that within relatively few years earth-orbiting satellites would routinely supply us with meteorological data directly applicable to aircraft operations, I would have questioned his sanity.

Also at that time, just prior to World War II, I wouldn't have guessed that my work would later involve me in preparations for supersonic transport aircraft (SST) operations.

The timing of these two great events was fortunate in that the science and technology of the one supports the industrial development of the other. This is true not only of the SST, but of other segments of aviation as well, where in our country the air is almost saturated with general aviation and air carrier traffic, and where intercontinental air travel is commonplace.

Early in 1966 the first two ESSA satellites and NIMBUS II were launched, giving the world an operational weather satellite system so designed that storms over the earth would be viewed three to five times daily and located within an accuracy of one degree of latitude.

Also, these satellites make it possible to locate those jet streams which are associated with clouds, large frontal systems, the inter-tropical convergence zone, waves in the easterlies and tropical disturbances and hurricanes. On a smaller scale, satellite pictures may reveal areas of mountain waves, coastal fogs, valley fogs, and continuity of cloud type and distribution. In the tropics we are able to determine from the appearance of thunderstorms the direction of the high-level wind shear and, more important, wind velocity in tropical hurricanes.

We are able to do all these things now, and all are important to aviation. In the early days of the Television and Infrared Observation Satellite (TIROS) we were fascinated by the new capability for determining the general weather picture over the oceans and other areas of sparse data.

New skills have been developed which enable us to sharpen, and in some cases to correct, analyses over water and land areas having substantial data coverage.

Over half of the Flight Advisory Weather Service centers have (or soon will have) capability to receive automatic picture transmissions in facsimile readout form, enabling the ground station to acquire directly a sequential set of satellite pictures showing cloud cover over the surrounding region. With three to five such pictures daily a greatly improved watch can be maintained on standing wave cloud development, lee effects on cloud patterns and snow cover, cloud forms and patterns over adjacent ocean and other sparse data areas. These situations have already been experienced and have demonstrated clearly the great potential of this new observational tool.

So far this article has been about things that can be determined from the present television satellites. Newer satellites, such as NIMBUS II, have instrumentation that not only produces cloud pictures, but also measures the temperature of cloud tops, at the earth's surface and at the surface of the ocean.

From the cloud top temperature the height can be estimated within about 2,000 feet. A more exact height determination is possible when the temperature profile is known from other observational methods. This and the temperature profiles themselves are useful elements for flight planning and operation. And, by determining the heights to which various cloud layers extend, it may be possible to do a better job of identifying the location and extent of turbulence in cirrus decks.

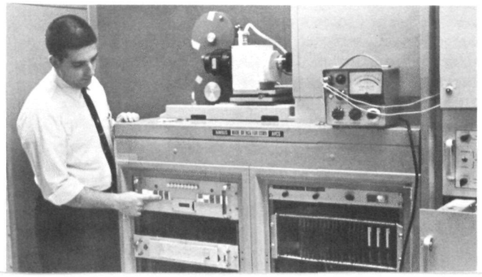
Another type of cloud information which will be of particular importance to aviation will come from the future synchronous altitude satellites. These satellites will be positioned at about 22,000 miles above the earth over the equator, remaining stationary over a given spot on the earth. From this height each of these satellites will be able to observe continually about one third of the earth's surface. This will allow a continuous view of storm systems, giving us the ability not only to locate all large storms but to measure their movement and watch their growth and decay with an accuracy far beyond what we are now able to do. The value of such information to flight operators and pilot weather briefers is obvious.

Looking ahead to the SST era, it is easy to visualize that for the en route phase the overall schematic weather picture would be based to a large extent on the products of the synchronous satellite, while the data collected by satellites equipped with infrared radiometers would assist in the determination and prediction of temperature, winds, and turbulence distribution in the stratosphere.

These are just a few of the highlights of what is being done with meteorological satellites and what can be expected in the foreseeable future. It is clear that these satellites offer an observational tool of fantastic potential—adding to, not replacing, usual methods of weather observations.

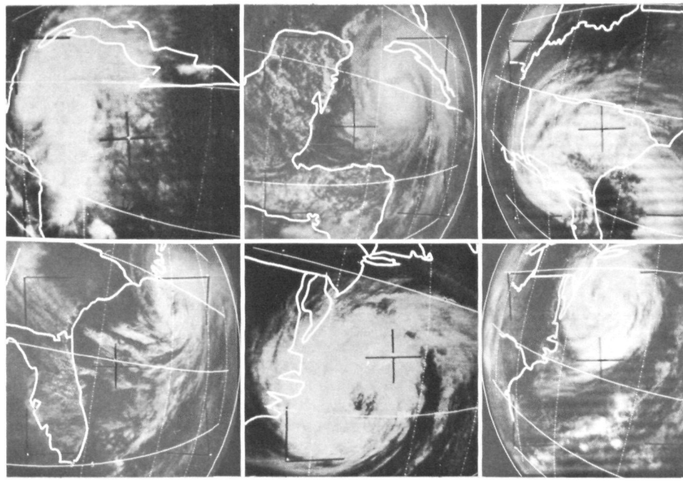
Much has yet to be done to integrate this tool with day-to-day operational procedures. The accomplishments up to this time leave little room for doubt that weather satellite operations will prove as directly beneficial to aviation as they will to the science of meteorology. □

Arthur Johnson, director of operations at National Environmental Satellite Center, examines photomosaic of pictures made by satellite, showing global weather conditions.

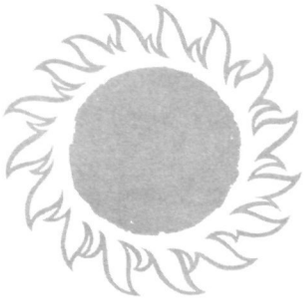


Weather technician Jose O. Martinez at the National Environmental Satellite Center in Suitland, Md., starts camera that will photograph TV-like picture of cloud formations.
Western Electric Photo

Life story of "Alma."



THE SUN IN THE MORNING ... HOW SOLAR ACTIVITY IS FORECAST



ON SUNDAY MORNING at 9:27 last Aug. 28, an active region near the center of the sun erupted in a major flare which lasted four hours. The onset of the flare was noted immediately by the duty member of the Space Disturbance Forecast Center's forecasting and monitoring team, from instruments at the Table Mountain field site north of Boulder, Colo., and from the equipment at Boulder Laboratories.

Contact with the National Aeronautical and Space Administration (NASA) control center for Lunar Orbiter (NASA's moon satellite) was the first step in the reporting procedure which saw all users of the center's service notified within fifteen minutes of the event.

For two days preceding the solar flare, the daily messages from the center had begun with the warning that a major flare was anticipated. The forecast proved correct. Using experimental techniques developed within the Space Disturbances Laboratory of the Institute for Telecommunication Sciences and Aeronomy (ITSA), the forecasting team had predicted the "solar weather" for three weeks without a major error.

This accomplishment of ITSA's scientists began Aug. 9 with the issuance of a 14-day forecast of solar activity provided for the Lunar Orbiter shot. Although no sunspot regions were present on the visible solar disc when the forecast was made, they correctly predicted minor activity to start on Aug. 13 with a major increase between Aug. 20-23 in the general area where the flare occurred. Both forecasts proved correct, and then came the warning of the major flare in the Aug. 6-27 forecasts, followed by the Class 3 bright flare on Aug. 28, the largest of the present solar cycle. Minor Class 1 flares had been forecast for the earlier part of the period and several did occur.

The predictions by the forecast center are based on observations from participating observatories around the globe, local and remote monitoring of the upper atmosphere and ionosphere using radio techniques by the Space Disturbances Laboratory, readings from the Naval Research Laboratories' solar radiation monitoring satellite, and visual observations of the sun by the forecast center staff.

The need for research on the effects of solar and space disturbances and how to predict them is of relatively recent origin. While man confined his activities to the surface of the earth and the lower atmosphere, the higher layers of the atmosphere together with the ionosphere acted as a protecting blanket, shielding him from the harmful effects of solar particles and rays. As man's interests and activities expanded to regions above the protected earth and lower atmosphere, his need to understand and predict the effects of solar disturbances has become important.

Predictions like those prepared by ITSA for NASA satellite and man-in-space programs will become even more important as manned spacecraft leave the protection of the earth's magnetic and atmospheric environment. The research conducted by ITSA's Space Disturbances Laboratory is looking to that day. The laboratory is investigating whether man can distinguish between a flare accompanied by a potentially dangerous solar proton emission and one which is not.

In addition to reports from cooperating observatories, staff members at the Center use a small telescope to make sunspot drawings on days when seeing conditions are favorable. As in the above picture, Pat McIntosh usually performs this chore.

Drawing on their knowledge of current solar conditions, the trend of the present solar cycle, and past activity in previous cycles, a forecast team prepares the daily prediction to send to users of the Forecast Center's services. Members of the team are (left to right) Pat McIntosh, Roger Olsen, and project leader Dale Bucknam.

First indication of the August 28 flare was received on equipment at the HANDS station on Table Mountain. The information was displayed simultaneously on recorders in the forecast center at the Boulder Laboratories which is connected to the HANDS sensors by direct wire.

A flare is seen as a sudden brightening of the sun's surface in or near an active region which contains sunspots and other visible forms of activity. A large flare may extend over an area of the sun's surface ranging from 100-million to 1-billion square miles. During the course of these flares, large amounts of additional solar radiation in the form of high energy particles and solar X-rays are often emitted into interplanetary space. These radiations present a potential hazard to man's use of the space environment and, in addition, cause a wide variety of effects in the earth's upper and lower atmosphere and magnetic field.

When a solar flare occurs, it is too late to warn unprotected space travelers against its immediate effects. Those effects will be felt by men in space at essentially the same time as the flare is seen from earth. However, warnings can be provided of the more dangerous delayed effects, especially the emission of energetic solar protons.

There are certain clues to when a flare is likely to occur and whether it will be accompanied by solar proton emission. For example, before a flare occurs, the magnetic fields in the area of activity on the sun may display strong, opposite polarities at relatively close distances, creating a steep gradient in the magnetic field. This may be one clue of an impending flare. When the flare occurs, if it is accompanied by a Type IV burst or particular structures are evident in the magnetic fields where the flare occurs, the likelihood of solar proton emission is increased. Until the nature of these phenomena is more clearly understood, however, predicting solar events and their consequences will continue to be an inexact science.

At present, the occurrence of a specific solar flare event cannot be predicted with consistent accuracy. Based on observations of solar activities, however, an estimate can be made of the probability of such an event occurring. ITSA, through its research, hopes to improve the accuracy of these predictions. The forecasts issued by the center are intended to test the effectiveness of ITSA's present prediction techniques.

Some examples of the types of activities that will benefit from improved understanding and prediction of solar disturbances follow.

To an increasing extent, earth satellites are being used for such practical purposes as communications, navigation, geodesy, and for making weather observations to improve forecasting. These space vehicle designers need information on the environment in which they will operate and on the effect of solar radiation and other performance factors. An over-protected payload would result in an unnecessarily heavy satellite considerably increasing the expense of the system. Under-protection could easily result in an early performance failure, with much of the cost being wasted. Thus, there is a definite economic benefit to such practical satellite programs in improved environmental predictions.

As manned vehicles travel higher and higher above the shelter of the atmosphere, problems of protecting the human cargo from radiation effects become important. This will be true of programs designed to orbit manned laboratory satellites in the upper atmosphere and near space for relatively long periods or to transport people in planes operating at the altitudes planned for the supersonic transport aircraft above the protection of the lower atmosphere.

Other activities requiring services in the area of solar disturbance predictions include radio communications involving ionospheric reflection and certain types of research programs that need to be conducted during short-lived disturbance events.

The term "space weather" has been used to characterize the class of phenomena which are important in space disturbance research and space environment forecasting. In the same sense that tornadoes, hurricanes, damaging hail storms and floods are important meteorological events, so large solar flares, energetic solar particle streams, and ionospheric and magnetic storms are important events in the space environment. The meteorological phenomena already mentioned, when combined with these space disturbance phenomena and such other types of geophysical disturbances as tsunami and earthquakes, form a family of disturbances that can be characterized as "environmental hazards."

The Space Disturbance Forecast Center operates 24-hours a day, seven days a week, to observe the sun and to forecast activity on the solar disc. Prediction techniques are studied and revised to increase the accuracy of the forecasts issued to the center's customers. Past records of solar activities are studied and research on the basic physics of the sun is conducted by IER scientists to increase man's knowledge of this vital star around which earth revolves and the ways in which it affects man's lives. □

ESSA news beat

PRESIDENT JOHNSON TO NOMINATE NEW ESSA DEPUTY ADMINISTRATOR

President Johnson announced on Sept. 16 his intention to nominate Dr. Werner A. Baum as Deputy Administrator of ESSA to succeed Vice Admiral H. Arnold Karo who will retire Jan. 1, 1967.

Dr. Baum is vice president for Scientific Affairs of New York University, and is widely known in the field of meteorology and as an administrator of scientific affairs.

Born in Germany, Dr. Baum was naturalized a United States citizen in 1934. He graduated from the University of Chicago with a B.S. degree in mathematics in 1943; received an M.S. in meteorology in 1944 and a Ph.D. in meteorology in 1948, also from the University of Chicago.

His professional career began at the University of Chicago's Department of Meteorology as a graduate assistant in 1943. In 1947 he joined the University of Maryland as a research associate and assistant professor in the Department of Geography. Dr. Baum went to Florida State University in 1949 as associate professor and head of the Department of Meteorology. He became a full professor in 1951 and served in that capacity until 1958. He was named Director of University Research in 1957 and Dean of the Graduate School and Director of Research in 1958. He was appointed Dean of the Faculties in 1960 and vice president for Academic Affairs in July 1963.

In Sept. 1963, he was appointed vice president for Academic Affairs, Dean of the Faculties, and Professor of Meteorology at the University of Miami. He went to New York University in Aug. 1965. (see back cover)

SPECIAL SCHOOL TEACHES FIRE FIGHTING

"Unique" is the word used by a Duke University professor in describing a special school held annually at an old World War II Air Force Base near Kinston, N. C.

Dr. L. E. Chaiken of Duke's School of Forestry was talking about the summer school conducted by the North Carolina Department of Conservation and Development's Division of Forestry for forestry students.

In the forest, students learned of the problems that must be solved if forest fires are to be suppressed with a minimum of damage.

One of the instructors was Charles Carney, meteorologist in charge of the WBAS at the Raleight-Durham Airport. Carney taught the students the Weather Bureau's latest techniques in keeping track of capricious winds which can and do play important roles in fighting forest fires. Here Carney (right) explains use of balloons to John Carr and Don Varner of the U. S. Forest Service.

(N C. Forest Service photo)

Three Promoted to Admiral

Sec. Connor Announces ESSA Associate Administrator Post

Secretary of Commerce John T. Connor announced on Sept. 16 the establishment of the new position of Associate Administrator in ESSA.

The post will be filled by Captain Don A. Jones, Associate Director, Office of Hydrography and Oceanography in the Coast and Geodetic Survey. Captain Jones will be promoted to the rank of Rear Admiral effective Jan. 1, 1967.

The new Associate Administrator will report to Dr. Robert M. White, Administrator, will supervise ESSA's commissioned corps and act as the focus for policy matters involving marine and charting operations.

At the same time, the Secretary announced that the Directors of the C&GS's Atlantic and Pacific Marine Centers in Norfolk, Va., and Seattle also will carry the rank of Rear Admiral.

The posts are held by Captain John C. Bull, Director of the Atlantic Marine Center and East Coast Field Director of the C&GS, and Captain Harold J. Seaborg, Director of the Pacific Marine Center. Both appointments also will become effective Jan. 1, 1967. (see back cover)

New High-Powered Radar Begins Weather Surveillance

A new high-powered weather surveillance radar began operation in Athens, Ga., last month. Called a WSR-57(M), the Athens radar is the most modern and reliable instrument in the Weather Bureau's network of about 100 radars strategically located throughout the Nation.

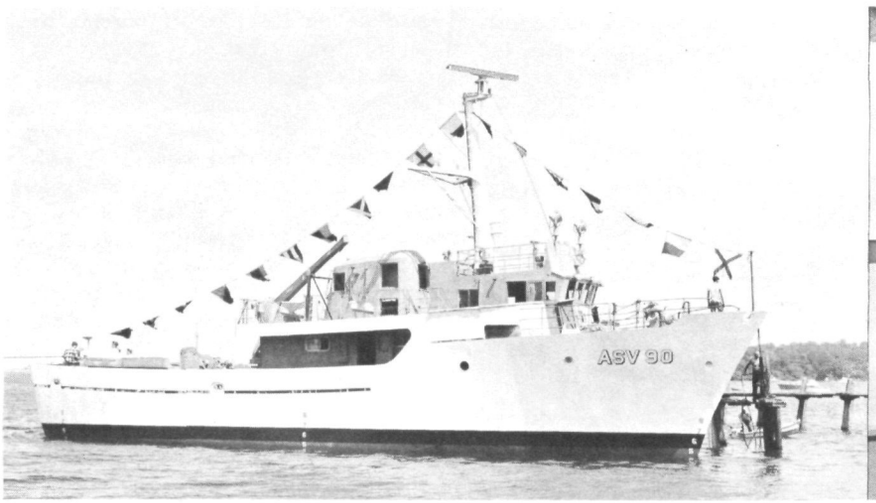
The new weather eye can "see" storms and precipitation within 250 nautical miles enabling the Athens WB to issue early storm warnings.

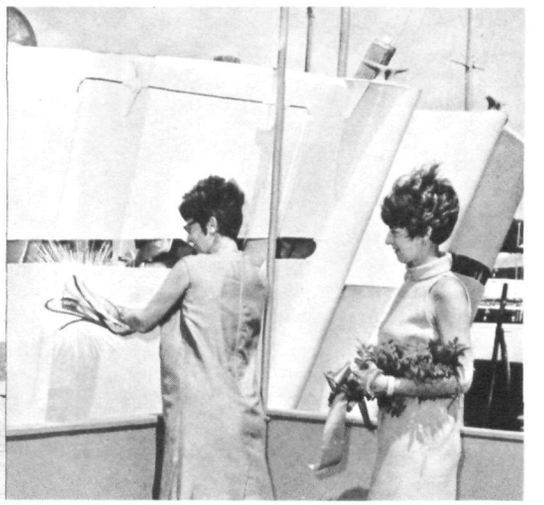
According to John D. Watson, meteorologist in charge of the WBAS at Clarke County Airport, "The new radar will give us a much clearer picture of local weather patterns and we will be better able to judge the intensity of storms."

The radar's 14-foot dish-shaped antenna is enclosed in a fiberglass dome 18 feet in diameter and set atop a 50-foot tower at the airport.

Weather information gathered by the new unit will be used to brief pilots, to issue warnings of severe storms and flash floods, and to provide a number of other weather services.

NEW WIRE-DRAG SHIP LAUNCHED





The first of two new wire-drag ships, the USC&GSS **RUDE,** was launched at Oyster Bay, N. Y., on August 17.

Dr. Robert M. White, Administrator, delivered the principal address at the launching. Mrs. James O. Thomas (right), granddaughter of the late Captain Gilbert T. Rude, after whom the vessel is named, christened the 90-foot, 176-ton ship with the traditional bottle of champagne. Mrs. Thomas' matron of honor was her sister-in-law, Mrs. Gilbert E. Rude.

Also attending the ceremony was Rear Admiral James C. Tison Jr., Director of the Coast and Geodetic Survey. The C&GS will operate the vessel and its sister ship the USC&GSS **HECK** which is currently under construction.

The new steel vessels will replace two small wooden craft, the USC&GSS **HILGARD** and **WAINWRIGHT** and will be the only ships of their kind in operation. Working together, they will locate underwater obstructions by towing a wire between them, normally at a depth of from 35 to 50 feet, suspended from surface bouys.

Accommodating two officers and eight crew members each, the ships are scheduled for completion later this year, at the Jakolison Shipyard.

VOLUNTEER WEATHER OBSERVER HONORED

Wisconsin's Governor Warner P. Knowles and state weathermen honored Oconomowoc (Wis.) volunteer weather observer C. W. Aeppler by presenting him the Weather Bureau's Holm award for many years of superior service as a cooperative weather observer. From left: Bill Harms, Milwaukee WB; ESSA State Climatologist Hans Rosendal; Mr. and Mrs. Aeppler; Howard Thompson, Milwaukee (WB retired) and Bill Carlson, Milwaukee TV weatherman. Also present was Stephen J. Regney, meteorologist in charge at the WBAS Truax Field.

(Capital Times photo)

Weather Bureau Saves $3 Million

Engineer-in-charge Glenn M. Miller of the Weather Bureau Reconditioning Center, Joliet, Ill., reports that a $3 million savings milestone was passed last month.

Since establishing the Center in 1945, more than 365,000 radiosondes have been provided for use in the WB's upper air program.

During FY-1966 the Center delivered 24,000 radiosondes to the program. Approximately 30,000 recovered radiosondes are returned annually with some units having been reconditioned and returned as many as 11 times.

The $3 million savings is the difference between reconditioning costs and the price of new radiosondes.

The Center has on several occasions provided services by increasing its production on a crash basis to prevent closing of upper air stations when contractors were unable to deliver radiosondes in sufficient quantities.

Radiosondes are sent aloft by balloons and consist of radio gear and miniature weather observing equipment which furnishes such information as temperature, humidity, pressure and wind.

OPERATION SHOWCASE

Since 1961 the Federal Government has been quietly building a showcase to display the value of our most under-utilized natural resource—womanpower.

The first efforts in this direction began in 1961 with the establishment of the Commission on the Status of Women. The five years that have passed since the Commission's inception have been years of progress. Among the major goals achieved during this period have been the elimination of legal barriers to job opportunities for women, a change in employers' thinking and attitudes toward women as employees, and a continuing and wide-spread search for talented womanpower.

When President Kennedy created the Commission on the Status of Women, he made a special point of his intention that the Federal service should become a showcase of equal employment opportunity for women. This intention has been restated with renewed and increased vigor by President Johnson.

While "Operation Showcase" has made great strides, much remains to be done. The biggest remaining obstacle encountered is that too few women have sufficient preparation for professional careers. The doors of opportunity have been closed so long that many talented women still lack incentive to gain the education and make the effort needed to develop their full potential.

"Operation Showcase", which has helped remove barriers to employment, now needs to deal with the barriers to preparation for employment. This next step is truly a difficult one, for it deals with incentive and motivation—uniquely personal, individual matters. It is not something that the government can accomplish alone, but requires the efforts of educators, private employers, and women themselves.

How much hinges on the success of truly equal employment opportunity for women is contained in the following remarks made recently by President Johnson:

"The under-utilization of American women continues to be the most tragic and the most senseless waste of this century. It is a waste that we can no longer afford. Our economy is crying out for their services. In the next decade alone we will need 900,000 additional school teachers and college instructors; one million additional specialists in the health services; 800,000 additional science and engineering technicians; 700,000 additional scientists and engineers; and 4½ million State and local Government employees, exclusive of teachers.

"The requirements in these fields alone will be 110,000 additional trained specialists every month for the next 10 years. That requirement cannot be met by men alone; and unless we begin now to open more and more professions to our women, and unless we begin now to train our women to enter those professions, then the needs of our Nation just are not going to be met."

The barrier of motivation is a complex one made up of many interrelated factors. The following are just a few of these factors:

While relatively more girls than boys finish high school with more than their share of honors, a smaller proportion go on to college. As we proceed up the educational ladder into the graduate level the girls fall farther behind. This "educational fallout" is due not only to a lack of motivation, but also to a negative attitude on the part of parents toward college for their daughters.

Another current attitude toward employment of women may be called the "cake-winner" fallacy. This says in effect that "if women work, it is only because they want to add to the family income, so it is essentially a temporary situation, and they don't want careers or aspire to responsible positions." The facts are these: There are 26 million working women in the United States today. More than 36 percent of our total work force are women. More than one-third of all married women work. Five million women are heads of households. With an increasing life expectancy more women will have more years to devote to careers.

Still another attitude affecting motivation is the masculine-feminine occupational concept. This concept is based upon the erroneous assumption that certain abilities, aptitudes, and interests are inherent in each sex and that certain occupations should be labeled "his" or "hers".

Changing people's thinking is always a difficult job. In the area of environmental science it may be exceedingly difficult, for the physical sciences have been an area which has traditionally attracted men. We at ESSA need to reexamine our attitudes and prejudices toward women. Are we guilty of these misconceptions? If we are, then we are limiting our effectiveness and ability to meet ESSA's needs. Excellence must include equal recognition for women and maximum opportunity for their participation in achieveing ESSA's mission. □

ESSA RECEIVES SAVINGS BOND AWARD

ESSA was among the Department of Commerce bureaus whose records of participation in the annual Savings Bonds campaign recently won official recognition. ESSA was honored for achieving a 25 per cent increase.

ESSA Administrator Dr. Robert M. White accepted the agency's award from Secretary of Commerce John T. Connor at a presentation ceremony in the Secretary's office, shortly after the conclusion of a major ESSA-wide drive for widespread participation.

Pathfinder Fetes Alaskan Children

It's a red letter day for the kids at the Alaskan Christian Children's Home, an orphanage in Homer, Alaska, when the USC&GSS *Pathfinder* comes to port.

Last June, before departing from her Seattle base for Alaska, the ship's personnel collected a fund of $140 for the orphanage. Part of this was used to buy eight cases of fresh fruit which were immediately flown to the orphanage by Pacific Northern Airlines.

Last Labor Day weekend, the *Pathfinder* moored in Homer and one afternoon was devoted to the children. Twenty-three of them were taken on a guided tour of the ship, shown movies and were given refreshments. It was a big day for the kids—and the crew.

HAWAII'S NEWEST RADIO STATION IS ESSA'S WX KBA-99

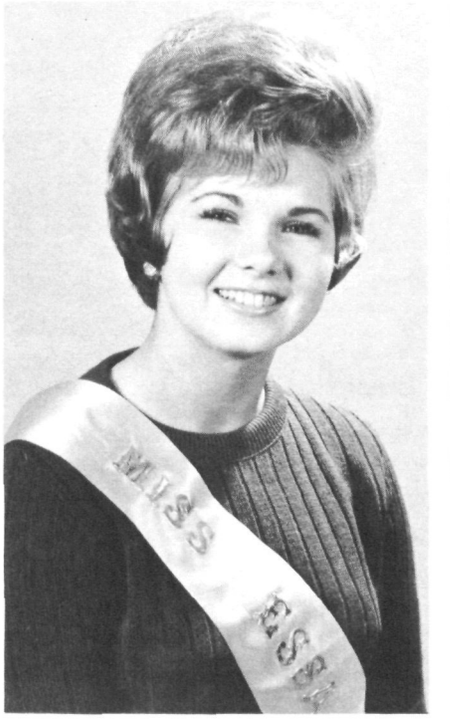
James W. Osmun, Weather Bureau Pacific Region Director, and Miss Hawaii, Loretta Ann Perreira, recently inaugurated the WB's new FM radio station KBA-99. The ceremony was held at ESSA's exhibit at the 50th State Fair.

Hawaii's newest radio station is ESSA's KBA-99. The new FM radio station is on the air daily from 5:00 a.m. to 6:00 p.m. broadcasting current weather conditions, bulletins and warnings on a frequency of 162.55 megacycles.

The continuous weather broadcasts originate at the Weather Bureau Forecast Center at the Honolulu International Airport. They are relayed to the transmitter installed atop Mt. Kaala which is operated with the cooperation of the Federal Aviation Agency.

A typical broadcast sequence runs approximately six minutes and is repeated continuously via automatic tape. All or part of the sequence may be updated as often as changing conditions require so that the listener receives the latest reports.

GWEN FULCHER NAMED MISS ESSA WINNER



The weatherman—who wouldn't have dared do otherwise—cooperated beautifully as hundreds of ESSAites, their families and friends gathered on Sunday, Oct. 9 at Fort Hunt, Va., for the ESSA Club's annual picnic.

Highlight of an eventful day was the crowning of pretty, blonde Gwen Fulcher, 20, of Beltsville, Md., as Miss ESSA. Miss Fulcher, employed in the travel and tort claims in ESSA headquarters at Rockville, will represent the agency in the annual Miss Commerce contest.

A 1964 graduate of Beltsville High Point High School, she joined the Coast and Geodetic Survey staff immediately on graduation, transferring to headquarters last February. She sings in the choir and teaches Sunday School at the United Presbyterian Church in Beltsville.

First runner-up in the contest was Laura Smith, of the National Environmental Satellite Center at Suitland. Second runner-up was Betty Thompson of the Coast and Geodetic Survey's ship construction office in Rockville.

The committee in charge of the event was headed by Jim Schick of the Graphics Branch, AOD.

Essaites spent the day enjoying volleyball, races (for children of all ages), badminton and other outdoor games. A bountiful lunch was served in mid-afternoon, and the picnic ended with a spirited auction of the few comestibles which somehow escaped ESSA plates.

C&GS Starts Its 22nd Training Class

The Coast and Geodetic Survey started its 22nd officers' training class last month at the Atlantic Marine Center in Norfolk.

The 13-week course began for 32 college graduates holding science and engineering degrees. Twenty-eight of them will be commissioned ensign upon graduation, four having been commissioned earlier this year.

The indoctrination course will be conducted by Lieutenant Commander Ronald M. Buffington who succeeded Commander Edwin K. McCaffrey as officer-in-charge of the training section.

The course covers the work done by ESSA in tides, currents, geodesy, oceanography, photogrammetry, seismology, geomagnetism, cartography, meteorology and aeronomy.

Made A Move Lately? Hold On To All Receipts

The Bureau of the Budget is now drafting regulations to carry out the provisions of Public Law 89-516, the so-called Moving Allowance Bill. Regulations are expected to be published by Oct. 21.

Meantime, the Budget Bureau has issued interim guidelines to Federal personnel officers.

While exact answers to many questions being asked by employees cannot be given until the regulations are issued, employees who reported to a new job on or after July 21 are being advised to keep exact records of all expenses related to their moves, including receipts or other proof of expenses and payments.

When detailed regulations are issued they will be retroactive to July 21, 1966, the date the law was signed.

ADMINISTRATOR FOR A DAY

In the absence of Administrator Dr. Robert M. White, Deputy Administrator Vice Admiral H. Arnold Karo welcomes Miss Shirley Peterson of Girls' Nation who acted as ESSA's Administrator for the day. Acting Assistant Administrator for Administration and Technical Services T. P. Gleiter showed Miss Peterson around the headquarters. When not acting as Girls' Nation ESSA Administrator, Miss Peterson may be located in Cody, Wyo.

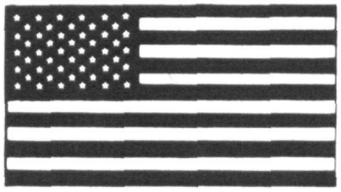
Special Tours of Duty Authorized

An amendment to the Federal Employees Salary Act of 1966 permits a variation in the workweek to allow employees to attend nearby colleges, universities, or other educational institutions.

Agency heads may now establish special tours of duty (of not less than 40 hours) to enable employees to take courses which will equip them for more effective work in their agency. Premium compensation, e.g., night or Sunday differentials, cannot be paid, however, even though the special tour of duty involves working at times for which premium compensation is otherwise authorized.

Requests for special tours of duty for education purposes should be submitted to the appropriate personnel office.

Grow with America



with U.S. SAVINGS BONDS

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Weather Bureau Engineers Work South of the Border

In an effort to expedite the transmission of observations from seven Mexican upper air weather stations, engineers Harold R. McBirney and Littleton R. Stewart of the Weather Bureau's Engineering Division recently supervised and assisted in the installation and activation of single sideband radio stations at the Mexico City and Monterrey offices of the Mexican Meteorological Service.

The procedures, specifications and experienced gained from these two initial installations will form the basis for ESSA's Weather Bureau technicians in Mexico and Mexican Meteorological Service personnel to complete the remaining five installations to be installed at Chihuahua, Guaymas, Vera Cruz, Merida and Mazatlan.

In the near future, a representative from the Weather Bureau's Engineering Division will again visit Mexico City to supervise the installation of a new high-power radio teletype transmitter for more efficient transmission of Mexican reports to Mexico City and from there to Miami for international distribution.

On Sept. 2, Ing. MasSinta, Director of the Mexican Meterological Service, was able to talk directly with his Monterrey staff and inaugurate the new transmission system of upper air observations.

DR. WHITE RECEIVES CABOT AWARD

Administrator Dr. Robert M. White was presented the Godfrey L. Cabot Award from the Aero Club of New England in ceremonies at Boston. The award is bestowed on a native New Englander or a current resident who has made a major contribution to the advancement of the aviation sciences. From left: Oscar Tenenbaum, meteorologist in charge, Boston, and Ann Wood, president of the Aero Club.

(Boston Globe photo)

LITTLE APPOINTED DEPUTY DIRECTOR OF IER

Dr. George S. Benton (left), Director of the Institutes for Environmental Research (IER), congratulates Dr. C. Gordon Little on his appointment as Deputy Director of IER. Dr. Little will continue as Director of the Institute for Telecommunication Sciences and Aeronomy in addition to his new duties.

Six Essaites Win Prizes At Commerce Art Show

Prizes to the winners of the 1966 Commerce Art Show were presented by Mrs. John T. Connor, wife of the Secretary of Commerce, on Sept. 28 in the Commerce Department Building Lobby. This was the fourth annual Art Show sponsored by the Department's Welfare and Recreation Council.

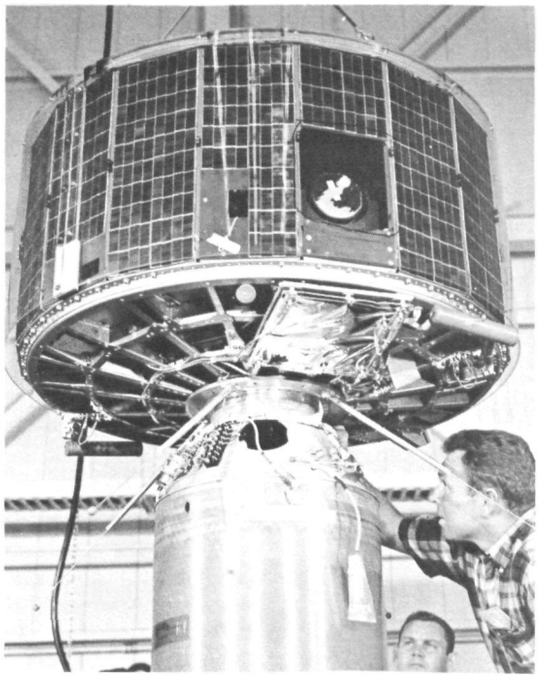
Seventy-five employees and their spouses entered 215 contributions which were on view through Sept. 30.

David H. Slade, a research meteorologist of the Institute of Atmospheric Sciences, placed first in the water color-pastel division with "Jersey City."

Robert G. Hall, a finishing worker in C&GS's Office of Cartography, won first place in the graphics division with a woodcut, "Primitive."

Other ESSA winners were: Edward E. Edstrom, program assistant in WB's Space Operations Support Division, who placed third with "Orchids" in water color-pastels; Wendell P. Taylor, a cartographic technician in C&GS's Division of Photogrammetry, was honorably mentioned in water color-pastels for his "Pittsburgh Winter"; Mrs. Gail Hussey, wife of W. John Hussey, a satellite system controller, NESC, took second prize with her "Center Street" in drawings and graphics, and John T. Smith, equipment specialist in C&GS's Photogrammetry Division, placed second in ceramics with his "Sun."

ESSA 3 is being readied for launch by technicians at the Western Test Range, Vandenberg Air Force Base, Lompoc, Calif.



It's a snap for ESSA 3

from 865 miles high

A hat-box shaped, 320 pound weather eye in the sky, ESSA 3, was hurled into a near polar and sun synchronous orbit from atop a NASA Three-Stage, Thrust-Augmented Improved Delta rocket which blasted off from Vandenberg Air Force Base at Lompoc, Calif., Oct. 2.

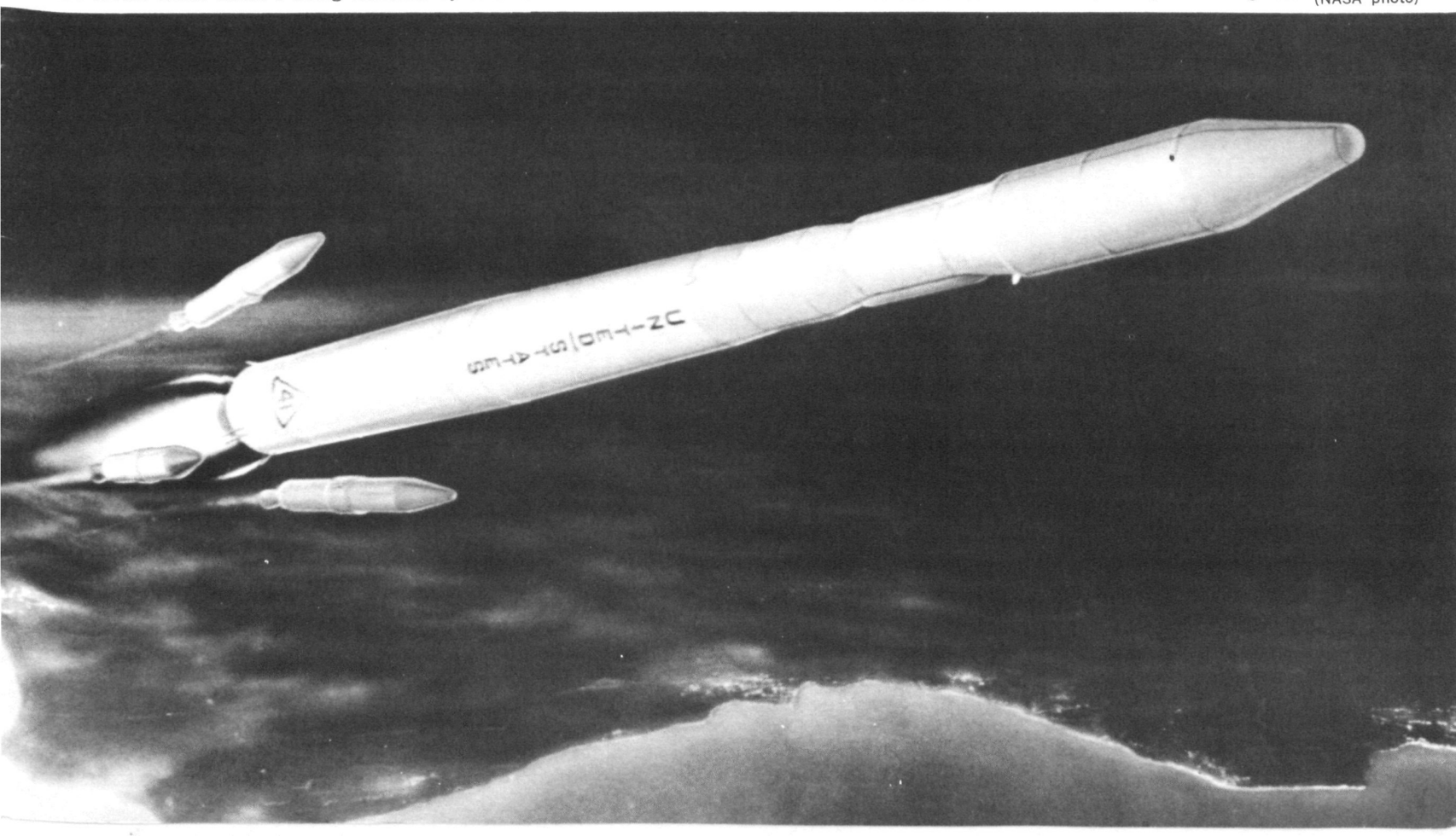
This third ESSA satellite in the TIROS Operational Satellite System (TOS), replaces ESSA 1 which suffered a one camera failure July 25 which limits its usefulness to the operational system.

The new aerial weather-watcher will be the first to carry two Advanced Vidicon Camera Systems (AVCS)—each capable of complete daily photo coverage of the earth's weather—and an array of solar and terrestrial radiation sensors.

Each AVCS photograph from ESSA 3's 865 mile circular orbit will cover an area of some 4 million square miles. One camera provides the global coverage while the other is a reserve unit in the event of camera failure.

ESSA 3's photos are stored on magnetic tape for readout by the Command and Data Acquisition (CDA) stations at Fairbanks, Alaska, or Wallops Station, Va. From the CDA stations they are transmitted immediately to the National Environmental Satellite Center at Suitland, Md., where cloud maps are produced pinpointing existing world weather systems. These maps are relayed to weather stations throughout the United States and to weather services and to weather services of other nations.

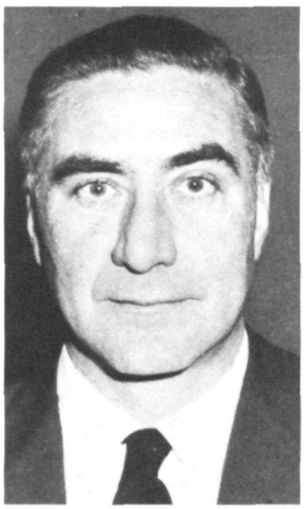
Artist's sketch shows ESSA 3 being launched by NASA's Delta rocket. California coastline can be seen from Santa Maria, Calif., to Los Angeles. (NASA photo)



Dr. WERNER A. BAUM, to be nominated as ESSA's new Deputy Administrator . . . vice president for Scientific Affairs of New York University and widely known in the field of meteorology and as an administrator of scientific affairs.

Stories see page 30

Vice Admiral H. ARNOLD KARO . . . will have completed more than 43 years of continuous active duty in ESSA and its predecessors.



Captain DON A. JONES . . . to become ESSA's new associate administrator and a Rear Admiral on January 1, 1967.

Captain JOHN C. BULL . . . holds the Bronze Star and the Croix de Guerre avec Etoile de Vermeil . . . will become a Rear Admiral January 1, 1967.

Captain HAROLD J. SEABORG . . . promoted to Rear Admiral effective January 1, 1967 . . . 16 years aboard USC&GS ships and served as commander of five.