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

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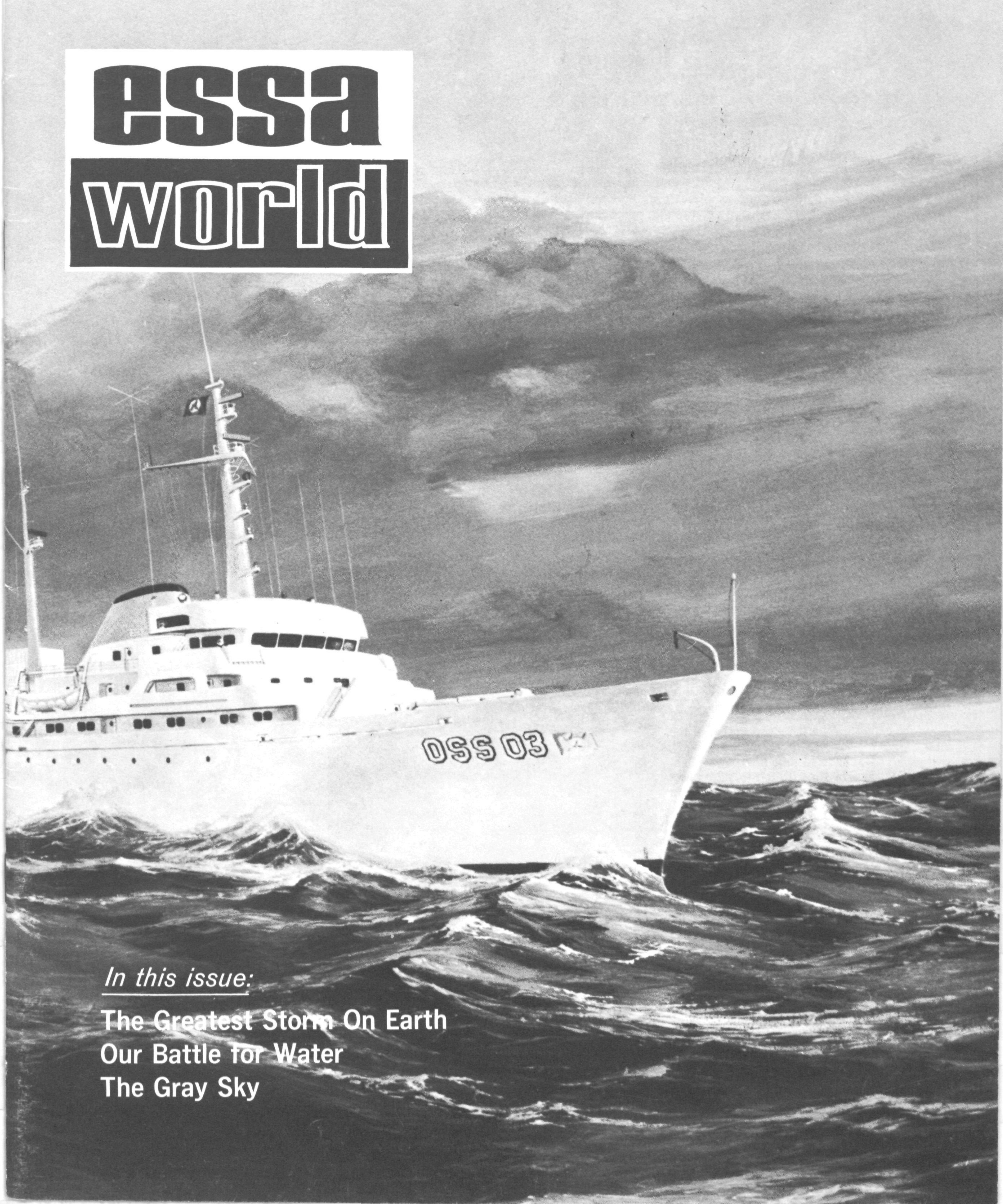

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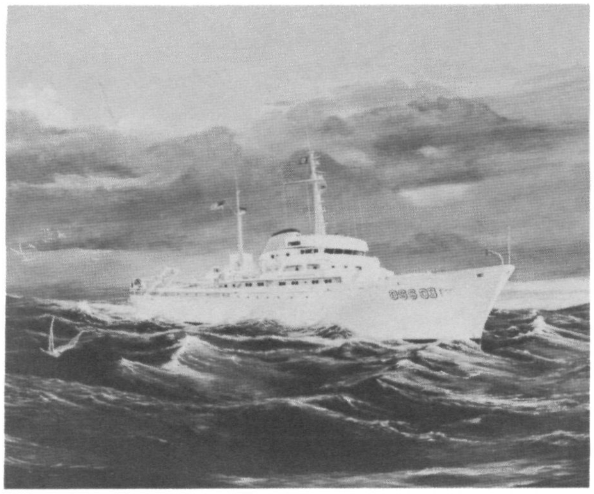

COVER
An artist's conception of the USC&GSS RESEARCHER, scheduled to join the ESSA fleet in 1969. RESEARCHER's keel was laid Sept. 5 at the American Shipbuilding Co. yard in Toledo, Ohio. She will become the first CGS vessel with facilities for handling deep-sea research submarines, will be 278 feet long, and will execute hydrographic, deep-ocean and weather research projects.

STANLEY B. EAMES
Director, Public Information

MAX M. CHESY
Art Director

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REAR ADMIRAL DON A. JONES
ASSOCIATE ADMINISTRATOR

New Look In ESSA's Commissioned Corps

An Editorial

When ESSA was formed two years ago, commissioned officers of the Coast and Geodetic Survey became commissioned officers of ESSA. At that time, there were about 210 officers on duty with the Coast and Geodetic Survey—aboard ship, as pilots of photogrammetric aircraft, on a variety of mobile field parties, in C&GS field offices and in headquarters. A professional group with training and experience in the various C&GS disciplines who could be ordered to sea or to remote or other duties as needed, they provide the flexibility demanded by the nature of C&GS responsibilities.

The mission of ESSA is global in nature. It includes the C&GS responsibilities plus many others which require that we have the capability of conducting multidisciplinary activities in many areas of the world. The commissioned corps as a professional group trained in ESSA disciplines will provide the flexibility and fast response needed to meet many of these demands. Agreement to accept assignments of this kind, often on short notice, is implicit in Commissioned Corps service. There must, however, be some opportunities for advanced professional training, and for responsible fixed shore assignments and normal family life. There must be provision for qualified individuals to specialize in one or two disciplinary fields. Career patterns, while varying with the individual, must also be acceptable to the individual.

The transition to an ESSA Corps in fact as well as in name is progressing today. Of the 300 officers on duty, 240 are assigned to the C&GS; 14 to the Institutes; 16 to the Weather Bureau; 11 to the National Environmental Satellite Center; 2 to the Environmental Data Service; and 17 to ESSA Headquarters.

Officers are assigned a wide variety of duties. Those in the Weather Bureau are in the Office of Hydrology and at River Forecast Centers; the National Meteorological Center; Systems Development Office; Engineering Division; and in regional offices.

Among others with the Institutes, two are at ITSA's Space Disturbance Laboratory, one at IAS's National Severe Storms Laboratory, two at the Research Flight Facility, and one at the Geophysical Fluid Dynamics Laboratory.

The present editor of Environmental Data Service's Mariners Weather Log is an officer; another is with Environmental Data Systems of EDS. At NESC, commissioned personnel are assigned to the Office of Research; System Engineering; and to Operations. At ESSA Headquarters officers have a variety of duties in staff offices.

We hope and expect to obtain approval to increase the numerical strength of the Corps, so that ultimately an average assignment mix will result with about nine years sea, six years mobile and remote, and 15 years fixed shore duty during a 30-year career. We are now recruiting officers with academic degrees in many ESSA disciplines. Each year several are selected for full-time graduate training. I believe it is imperative that, along with a numerical increase, we broaden and enhance overall professional scientific and technical capability to meet the growing needs of ESSA. For instance, our ships are engaged in multidisciplinary projects to an increasing degree. The commanding officer has primary responsibility for the quality and quantity of scientific work done by his ship in addition to responsibility for operation of the ship. This system certainly does not discount the contributions of the many extremely well-qualified civilian scientists who frequently serve aboard C&GS ships.

The complexity of ESSA's mission presents an exciting challenge for every one of us, officer or civilian. I firmly believe that all of us working together will successfully meet that challenge. □

ONE OF ESSA'S OUTSTANDING NATIONAL PROGRAMS IS ITS EFFORT TO WARN OF

THE GREATEST STORM ON EARTH

From a vantage point in space they seem quite small, flat spirals drifting on the sea, gentle eddies in the endless flowing of the planet's atmosphere. But where their drift takes them across shipping lanes and islands and the coasts of continents, their passage is commemorated by property destroyed, prospects diminished and death.

They are tropical children, the offspring of ocean and atmosphere, powered by heat from the sea, driven by the easterly trades and temperate westerlies, the high planetary winds, and their own fierce energy. In their cloudy arms and around their tranquil core, winds blow with lethal velocity, the ocean develops an inundating surge, and, as they move toward land, tornadoes now and then flutter down from the advancing wall of thunderclouds.

Compared to the great cyclonic storm systems of the temperate zone they are of moderate size, and their worst winds do not approach tornado velocities. Still, their broad spiral base may dominate weather over thousands of square miles, and from the earth's surface into the lower stratosphere. Their winds may reach 200 miles per hour, and their lifespan is measured in days or weeks, not minutes or hours. No other atmospheric disturbance combines duration, size, and violence more destructively.

As they occur in different oceans and hemispheres, they bear names given locally: *baguio* in the Philippines, *cyclone* in the Indian Ocean, *typhoon* in the Pacific. In our hemisphere, the name is *hurricane*—the greatest storm on earth.

Along our Atlantic and Gulf coasts, the nominal hurricane season is from June through November. Early in the season, the Caribbean and Gulf of Mexico are the principal areas of origin; in July and August, this center shifts eastward and by September spreads from the Bahamas southeastward to the Lesser Antilles, and eastward to the Cape Verde islands off the west coast of Africa. After mid-September, principal areas of origin shift back to the western Caribbean and the Gulf of Mexico. If this is an average year, there will be fewer than 10 tropical cyclones, of which about six will develop into hurricanes. These will kill 50 or 100 persons between Texas and Maine and cause property damage of more than $100 million. If it is a worse-than-average year, we will suffer several hundred deaths, and property damage will run to many more millions of dollars.

At ESSA, the tempo is increasing. Tornadoes and floods and severe storms are in season elsewhere on the continent; now, to these destructive forces must be added the hazard of the hurricane.

From the National Hurricane Center in Miami, a radar fence reaches westward to Texas, northward to New England, providing ESSA Weather Bureau stations along the coast a 200-mile look into off-shore disturbances. In Maryland, the giant computers of the National Meteorological Center digest the myriad bits of data—atmospheric pressure, temperature, surface winds and winds aloft, humidity—received from weather stations and ships monitoring the atmospheric setting hour to hour, day to day. Cloud photographs from the ESSA (*E*nvironmental *S*urvey *SA*tellite) spacecraft orbiting the earth are received at the National Environmental Satellite Center in Maryland, and studied for the telltale spiral on the warming sea. The crews of U.S. Navy, Air Force, and Coast Guard aircraft over the Gulf of Mexico, Caribbean, and Atlantic watch the sky with special emphasis—waiting for the storm that will bear a lady's name. The machinery of early warning vibrates with new urgency as the season of great storms begins.

Detection of hurricanes and timely warning against them has been the task of the Weather Bureau for nearly a century. Its success is reflected in the steady decrease in hurricane deaths at a time when population in hurricane-affected areas has doubled and tripled. The present hurricane warning system, headquartered at ESSA's National Hurricane Center in Miami, Fla., is a smoothly operating warning establishment, supported by the experience and dedication of its personnel and the broad new technology, that has become an integral feature in America's weather service.

Until the end of World War II, meteorologists lacked both the techniques and the equipment to conduct even an adequate hurricane warning operation. The development of improved detection apparatus and forecasting techniques made such a system possible. The devastating hurricane season of 1954 reminded residents of the Atlantic and Gulf coasts from Brownsville to Providence how vulnerable they were to these great storms—and made a hurricane-warning system mandatory. The capability and the impetus led, in 1955, to the warning system operating today, and to its attendant research effort.

The work goes beyond this season's warnings. Scientists from ESSA's Weather Bureau, Institute for Atmospheric Sciences, and Institute for Oceanography muster for another round of experimentation—another season's work in the laboratory of the hurricane and in the sea from which it grows. At the National Hurricane Research Laboratory in Miami, *Project Stormfury* prepares for another attempt to determine whether hurricanes can be modified beneficially. Scientists from the Sea-Air Interaction Laboratory, using research aircraft and the ships of ESSA's Coast and Geodetic Society, move toward experiments in the oceanic breeding grounds of hurricanes.

The flow of weather data through the National Hurricane Center is constant. Weather stations in the United States and through the Indies provide data on surface conditions and conditions aloft at frequent intervals. At the National Meteorological Center near Washington, D.C., weather data from ships, aircraft, and weather stations are assembled and plotted by men and computers for the Northern Hemisphere, and transmitted as facsimile maps to weather stations in this country and overseas. Photographs of cloud cover transmitted by orbiting ESSA spacecraft are received at the National Environmental Satellite Center at Suitland, Md., computer-modified by the addition of geographic coordinates and landforms, and relayed in facsimile to weather stations. In addition, Automatic Picture Transmission (APT) receivers at Miami pick up eight or nine ESSA photographs a day, when the satellite is within its 2,000-mile transmission range. The Miami facility also receives APT photos relayed from Puerto Rico. Between the 2 APT receivers and information from Maryland, the Center has photographic coverage of most of the tropical North Atlantic, Caribbean, and Gulf of Mexico.

The incipient disturbance is monitored by the flow of hemispheric weather data from the National Meteorological Center, local data from stations south of the Miami facility, reports from ships crossing the area of suspicion, satellite photographs, and hurricane reconnaissance flights deployed by the U.S. Navy and Air Force. These are the long-range eyes of the hurricane warning service; a radar fence from Brownsville to Boston, and from Miami to the Lesser Antilles, will pick up the disturbance—the tropical cyclone, if the disturbance has matured—when it moves landward.

Once generated, a hurricane tends to survive while it is over warm water, for it is the temperature difference between air and water that drives and sustains the storm system. But the forces which control its movement are destructive; they drive the storm ashore or over the colder water beyond the tropics where it will fill and die, or be resurrected as a storm of another type. This thrust away from the tropics is the clockwise curve which takes typhoons of the tropical Pacific across the coastlines of Japan and northern Asia, and the hurricanes of the tropical North Atlantic, Caribbean, and Gulf of Mexico across the eastern United States.

Even before a hurricane forms, the embryonic storm has forward motion, driven by the easterly flow in which it is embedded. While this easterly drift is small—less than 20 miles per hour—intensification is favored; greater movement generally inhibits intensification during the early stages. When the hurricane matures, greater forward motion is frequently accompanied by intensification—the intensification which often follows acceleration is usually shortlived. At temperate latitudes, few hurricanes reach forward speeds of 60 miles per hour.

Forecasting the direction this steering current will take the hurricane is complicated by several factors. The hurricane winds mask the basic current over a large area, both horizontally and vertically. Also, the steering mechanism is incompletely understood.

The tracks of hurricanes are as individual as the storms themselves. No two tracks are precisely superimposed, and only the most general trends can be established. A hurricane drifting westward past Cuba may seem poised to recurve north and east across Florida, only to dither, then spin off through the Gulf of Mexico—to Yucatan or New Orleans or Brownsville. Or a hurricane may follow a course from birth to death whose only consistency is an erratic, aimless looping across the tropics.

While a hurricane lives the transaction of energy within its circulation is immense. The condensation heat energy, released by a hurricane in one day, often is the equivalent of that released by fusion of 400 20-megaton hydrogen bombs. One day's released energy, converted to electricity, would supply the United States' electrical needs for more than six months. There is no satisfactory way of scaling down a hurricane; it is immense to us, like the ocean and atmosphere themselves.

Until the emergency begins the National Hurricane Center is the visible portion of the Hurricane Warning Service. Then, like lightning behind a tree, the warning cycle illuminates the structure of the entire system. The Center still controls the total warning apparatus; it also acts as the National Hurricane Information Center, coordinating the flow of bulletins and advisories to the public.

Local warning responsibility is dispersed, however, among the Miami center and four other ESSA Weather Bureau offices—at New Orleans, Washington, Boston, and San Juan. These Hurricane Warning Offices have assigned areas of responsibility—New Orleans covering the Gulf of Mexico west of 85° West Longitude; Washington, between the latitudes of 35° and 40° North and west of 65° West; Boston above 40° North and west of 65° West; San Juan, the eastern Caribbean and Atlantic south of 20° North and between 55° and 75° West. The National Hurricane Center at Miami has warning responsibility for the area west of 35° West and for all unassigned areas and forecast responsibility for all Atlantic and Gulf coastal areas.

The Hurricane Warning Offices and National Hurricane Center are linked by normal Weather Bureau communications and by a special Hurricane Teletypewriter Circuit—the coastal portion of the Weather Bureau's RAWARC (*RA*dar report and *WAR*ning *C*oordination) system that focuses on hurricane warning activities from June 1 through November 30, the nominal hurricane season.

These communications systems, and those of the Office of Civil Defense, Federal Aviation Administration, and the Armed Forces, tie hurricane forecasters

Continued

(Editor's note: This article is excerpted from a new ESSA brochure, "Hurricane", produced in the interest of public safety)

to local governments, law enforcement agencies, and other emergency forces (like the Coast Guard and Red Cross), and, through newspapers and radio and television stations, to the general public. As the emergency develops, the flow of information will be from the Hurricane Warning Offices outward along these rapid-communication networks, with the Miami headquarters coordinating all local efforts.

The flow is not one way. Along the coastline from Brownsville, Tex., to Portland, Me., a double fence of observers contributes its information to other data received at the Miami center. Part of this fence is the line of radar-equipped, first-order Weather Bureau offices. Part is the network of volunteer observers, called CHURN (*C*ooperative *Hu*rricane *R*eporting *N*etwork)—Coast Guard stations and private and public citizens who operate wind-measuring equipment and provide local information on tides and storm surges. Each CHURN outpost is linked to the nearest Weather Bureau office, which links it in turn to the National Hurricane Center in Miami.

Hurricanes are creatures of the sea as much as of the atmosphere. Weather Bureau offices from Brownsville to Boston supplement their radar and meteorological intelligence with telemetered information from ESSA's network of tide gages. These Coast and Geodetic Survey stations measure the gradual rise and fall of sea level caused by the astronomic tide. Under normal conditions, the tidal record, or marigram, is a gentle, continuous oscillation; the swells which precede hurricanes, storm surges during the final approach and passage of the hurricane, and wave action caused by hurricane winds are of a shorter period and appear as radical discontinuities in the tidal record. Weather Bureau offices at a score of coastal locations can thus monitor changes in local water level—an important element in forecasting the arrival and destructive potential of storm surges and hurricane-driven waves.

The hurricane's worst killer comes from the sea. Over the deep ocean, waves generated by hurricane-force winds may reach heights of 50 feet or more; beneath the storm center, the ocean surface is drawn upward (like water in a giant straw) a foot or so above normal by reduced atmospheric pressure. The hurricane's presence may be detected well in advance of its arrival on land by sea swells emanating from the storm.

As the storm crosses the Continental Shelf and moves coastward, mean water level may increase 15 feet or more. Behind the storm center, offshore hurricane-force winds may cause a decrease in mean water level, setting up a strong current. The advancing storm surge is superimposed on normal astronomical tides, and, in turn, wind waves are superimposed on the surge; this buildup of water level can cause severe flooding in

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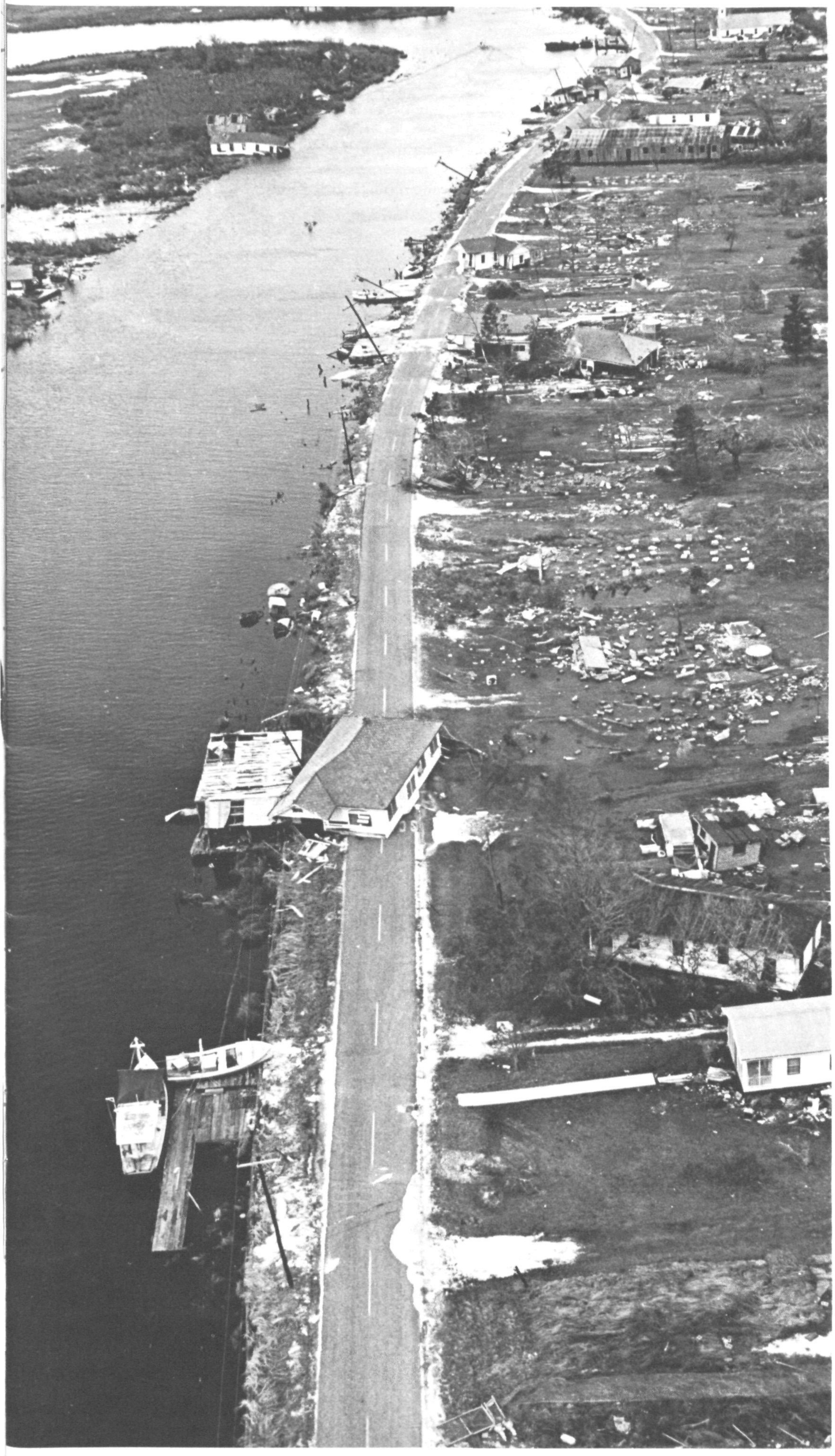
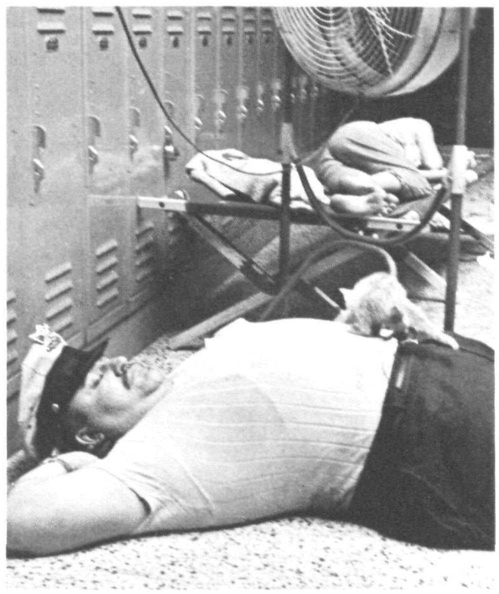




Photos are of Hurricane Betsy, New Orleans, La. 1965 coastal areas, particularly when the storm surge coincides with normal high tides. Because much of the United States' densely populated coastline along the Atlantic and Gulf coasts lies less than 10 feet above mean sea level, the danger from storm surges is great.

Surge heights along flat coasts can bring catastrophe. When the surge is forced up a narrow channel, like a river bed, the surge may appear as a wall of water—what is incorrectly called a "tidal wave."

Wave and current action associated with the surge also causes extensive damage. Water weighs some 1,700 pounds per cubic yard; extended pounding by giant waves can demolish any structures not specifically designed to withstand such forces.

The greatest loss of life associated with hurricanes is caused by flooding due to the storm surge. History is filled with such catastrophes.

When the National Hurricane Center issues the initial advisory, the hurricane warning system comes to full alert status. The emergency begins, its progress marked by the changing content of the advisories and bulletins which follow; for these messages are evolutionary, like the storm they monitor, and their emphasis shifts from the tropical cyclone to the storm's potential destructiveness as it moves landward.

Initial forecasts cover a period 24 hours into the future. In the tropics, the storms drift slowly, at some 12–15 miles per hour; but this can mean more than 300 miles of travel for the 24-hour forecast period, over a path influenced by a myriad of forces. As the storm moves landward, as its winds increase to hurricane strength, and as its recurvature into the temperate zone accelerates its forward speed, forecasting of future position and intensity becomes increasingly complicated—and increasingly an art.

The 12- and 24-hour forecasts included in tropical cyclone advisories are developed out of the close coordination of hurricane forecasters. Telephone conferences between forecasters at Miami and the Hurricane Warning Offices, ESSA units in Washington, and military meteorologists provide a pool of forecast intelligence which is distilled into the 12-, 24-, and 48-hour prognoses of hurricane progress. A 72-hour outlook is also prepared as a guide to forecasters, although it is not sufficiently accurate to be used as a public tool.

All advisories have certain information in common. They begin with a headline, which summarizes the message, and describes the tropical cyclone's location, direction of movement, intensity, and size. They also provide forecasts of storm position over the ensuing 24 hours, and give the time and source of the next advisory. But as the warning sequence develops, advisory information begins to concentrate on coastal and inland effects. While the storm is at sea, advisories are issued at 6-hour intervals, at 0400, 1000, 1600, and 2200 Greenwich Civil Time (GCT, GMT, or Z). As the tropical cyclone threatens land, these are supplemented by special bulletins issued as conditions demand.

As the tropical cyclone moves within range of the coast, advisories focus on possible dangers to specific areas. These messages are written by the cognizant Hurricane Warning Office, and released simultaneously throughout the warning system. A *hurricane watch* announcement is included in these advisories that specifies the area which might be threatened. A hurricane watch is not a hurricane warning, but a first alert for emergency forces and the general public in *prospectively* threatened areas. A hurricane watch is announced when a hurrican poses a significant but uncertain threat to a coastal area, or, when a tropical storm threatening the watch area has at least a 50–50 chance of intensifying into a hurricane. Small-craft warnings are issued as part of an advisory containing a hurricane watch.

When a tropical cyclone is expected to pass near the coast (its hurricane-force winds remaining at sea), advisories contain storm or gale warnings as well as the hurricane watch announcement. Local warning information and recommended emergency procedures are also added to the message, which still includes small-craft warnings. At this point, the hurricane is close enough for peripheral tornadoes and flooding to be an added hazard. Weather Bureau River Forecast Centers near the affected area, and the National Severe Storms Forecast Center at Kansas City, Mo., join the National Hurricane Center in assessing these new destructive possibilities.

A hurricane warning becomes part of advisories when a hurricane is expected to strike the coast within the next 24 hours. Warnings supersede the hurricane watch for a given area; however, additional watch announcements may be made for areas along the projected path of the hurricane.

Advisories containing hurricane warnings include an assessment of flood danger in coastal and inland areas, small-craft warnings, gale warnings for the storm's periphery, estimated storm effects, and recommended emergency procedures. Tornado watches from the National Severe Storms Forecast Center may also be included.

As the hurricane moves inland, it begins to fill and die; its winds diminish and its spiral form expands. Advisories

Arnold L. Sugg, Acting Chief of Hurricane Services, National Hurricane Center, Miami, Florida.

(Right) Weather Bureau offices located at University of Miami, Coral Gables, Florida.

continue at this point, but their emphasis shifts to flooding, particularly in mountainous regions. These messages assess storm effects over the land, and include gale and small-craft warnings. Tornado watches are also included.

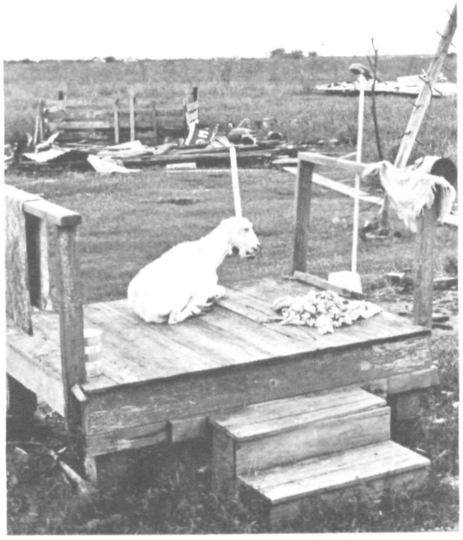
Floods produced by hurricane rainfall are more destructive than the winds. The typical hurricane brings 6 to 12 inches of rainfall to the area it crosses, and the resulting floods have caused great damage and loss of life, particularly in mountainous areas. Hurricane Diane of 1955 caused little damage as it moved onto the continent; but, long after its hurricane winds subsided, it brought floods to Pennsylvania, New York, and New England—floods that killed 200 persons and cost an estimated $700 million in damage.

Tropical cyclone advisories are interspersed with tropical cyclone bulletins—information released as often as necessary to keep the public adequately informed.

Advisories are discontinued when a tropical cyclone moves far enough inland to lose its hurricane characteristics. But as long as the disturbance retains its identity and threatens life and property, bulletins on the storm are issued at regular intervals.

The hurricane emergency may develop over a period of days or hours, and the violent storm may live for weeks, following an erratic, self-destructive path from the warm waters south of Cancer to polar ice floes. While the storm lives it will be tracked, and timely warning will go out to those living in its path.

ESSA is expanding its natural hazards warnings communications and detection networks, refining the technology and procedures to protect every American against the natural hazards which threaten him. □



Play it Safe!

How well equipped are you to make the most of ESSA's early warning? These safety rules will help you save your life, and the lives of others.

1. **Enter each hurricane season prepared.** Every June through November, recheck your supply of boards, tools, batteries, nonperishable foods, and the other equipment you will need when a hurricane strikes your town.

2. **When you hear the first tropical cyclone advisory,** listen for future messages; this will prepare you for a hurricane emergency well in advance of the issuance of watches and warnings.

3. **When your area is covered by a hurricane watch,** continue normal activities, but stay tuned to radio or television for all ESSA Weather Bureau advisories. Remember: a hurricane watch means possible danger within 24 hours; if the danger materializes, a hurricane warning will be issued. Meanwhile, keep alert. Ignore rumors.

4. **When your area receives a hurricane warning:**

Keep calm until the emergency has ended.

Plan your time before the storm arrives and avoid the last-minute hurry which might leave you marooned, or unprepared.

Leave low-lying areas that may be swept by high tides or storm waves.

Moor your boat securely before the storm arrives, or evacuate it to a designated safe area. When your boat is moored, leave it, and don't return once the wind and waves are up.

Board up windows or protect them with storm shutters or tape. Danger to small windows is mainly from wind-driven debris. Larger windows may be broken by wind pressure.

Secure outdoor objects that might be blown away or uprooted. Garbage cans, garden tools, toys, signs, porch furniture, and a number of other harmless items become missiles of destruction in hurricane winds. Anchor them or store them inside before the storm strikes.

Store drinking water in clean bathtubs, jugs, bottles, and cooking utensils; your town's water supply may be contaminated by flooding or damaged by hurricane floods.

Check your battery-powered equipment. Your radio may be your only link with the world outside the hurricane, and emergency cooking facilities, lights, and flashlights will be essential if utilities are interrupted.

Keep your car fueled. Service stations may be inoperable for several days after the storm strikes, due to flooding or interrupted electrical power.

Stay at home, if it is sturdy and on high ground. If it is not, move to a designated shelter, and stay there until the storm is over.

Remain indoors during the hurricane. Travel is extremely dangerous when winds and tides are whipping through your area.

Monitor the storm's position through ESSA Weather Bureau advisories.

Avoid the eye of the hurricane. If the calm storm center passes directly overhead, there will be a lull in the wind lasting from a few minutes to half an hour or more. Stay in a safe place unless emergency repairs are absolutely necessary. But remember, at the other side of the eye, the winds rise very rapidly to hurricane force, and come from the opposite direction.

5. **When the hurricane has passed:**

Seek necessary medical care at Red Cross disaster stations or hospitals.

Stay out of disaster areas. Unless you are qualified to help, your presence might hamper first-aid and rescue work.

Drive carefully along debris-filled streets. Roads may be undermined and may collapse under the weight of a car. Slides along cuts are also a hazard.

Avoid loose or dangling wires, and report them immediately to your power company, or the nearest law enforcement officer.

Report broken sewer or water mains to the water department.

Prevent fires. Lowered water pressure may make firefighting difficult.

Check refrigerated food for spoilage if power has been off during the storm.

Remember that hurricanes moving inland can cause severe flooding. Stay away from river banks and streams. ESSA Weather Bureau advisories will keep you informed on river flood stages.

WHY MOTHER EARTH WOBBLES

BY RAYMOND WILCOVE — Coast and Geodetic Survey

Scientists of four nations scan the heavens each night, seeking the answer to an age-old riddle:

Why does the earth wobble on its axis?

There are various theories: some believe it is due to the melting of the icecaps, others to the unevenness of the earth's land masses, still others to the movements of the seas.

The earth wobbles on its North-South axis at a maximum range of 72 feet over a 14-month period. Its axis zigs and zags around the geographical North Pole in a generally circular motion. Coast and Geodetic Survey scientists are trying to determine whether there is any uniformity to this shimmy.

Why? Some feel the knowledge may help answer questions concerning the geophysical makeup of the earth, the ice ages, the direction in which the universe is drifting. Others seek the answer simply because man is always searching for the truth.

In 1900 the United States, Russia, Japan, and Italy decided to work together on the problem. They have continued to do so through war and peace.

Each night throughout the year, astronomers at five stations—Gaithersburg, Maryland, and Ukiah, California; Kitab, near Samarkand, in the Soviet Union; Carloforte, Sardinia, Italy; and Mizusawa, Iwate-ken, Japan—train their telescopes on the heavens. For the answer, if it is ever to be found, will be discovered in the stars. To obtain uniform computations, the five observatories are near the parallel of 39° 08′ north latitude. They are spaced as evenly as possible around the Northern Hemisphere. The program is known as the International Polar Motion Service. The Coast Survey operates the U.S. stations.

The irregular daily motion of the axis is extremely small, but its extent can be determined by precise measurements of the stars.

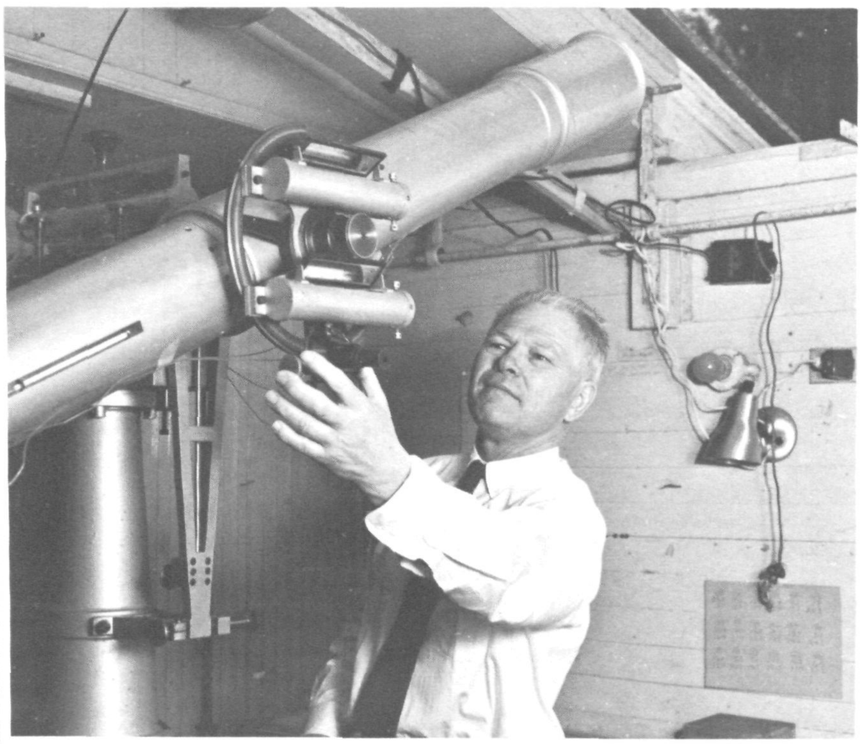
Each astronomer focuses a six-foot telescope on 18 pairs of stars previously agreed upon by the participating nations. Exact measurement of the stars' movement over an imaginary extension of the earth's axis (or meridian), called the celestial pole, tells how much the earth has wobbled. The data is transmitted to a central bureau at Mizusawa where it is processed.

A. W. Helm is the astronomer at the Gaithersburg Observatory. He has been in charge since 1957. His assistant is Mac G. Currin. Normally, each works every other night.

The 18 pairs of stars are checked nightly for about six hours. "We work on star time," explains Helm. "During spring, we worked for a time from 11 p.m. to 5 a.m. But star time gains about two hours a month on solar time (Greenwich time). So about a month later we worked from 9 p.m. to 3 a.m."

This is how it is done:

"We know the exact time that each star will cross the meridian," Helm says. "The telescope is trained on the meridian. As each star crosses the meridian, we make four sightings of each star.



Astronomer A. W. Helm scans the heavens for observations to determine the earth's wobble.

Helm and his assistant, Mac G. Currin at the Gaithersburg Observatory. Building dates back to 1900.

"To determine the extent of the wobbling of the axis, we measure the angular distance between a pair of stars. That indicates the extent the earth has wobbled on its axis."

His telescope magnifies the stars 105 times. To aid in accurate pointings, the stars selected must be neither too bright nor too dim. Generally the 18 pairs range in magnitude from 5 to 7.4.

Helm's telescope is as old as the small building in which it is housed, both dating to 1900. The telescopes used by the four nations are all of the same type. To change them might upset the uniformity of the calculations made for 67 years.

The work at the Gaithersburg Observatory demands intense concentration and dedication. Since the telescopic instrumentation is extremely delicate, it must be shielded from heat, including the warmth given off by artificial lighting. As a result, the astronomers work in very dim light and with only their body heat to keep them warm. To be sure that doesn't generate too much heat, the windows in the observatories are kept open, as is the aperture in the roof through which the telescope is pointed.

"It gets pretty cold here at times," Helm says. "The temperature last winter fell to seven degrees above zero. It was about two to four degrees warmer in the observatory with the windows and roof open."

To protect himself against the cold, Helm wears electrically-heated socks, thermal underwear, and thin gloves, with the fingers cut away. When it snows, he clears off the roof.

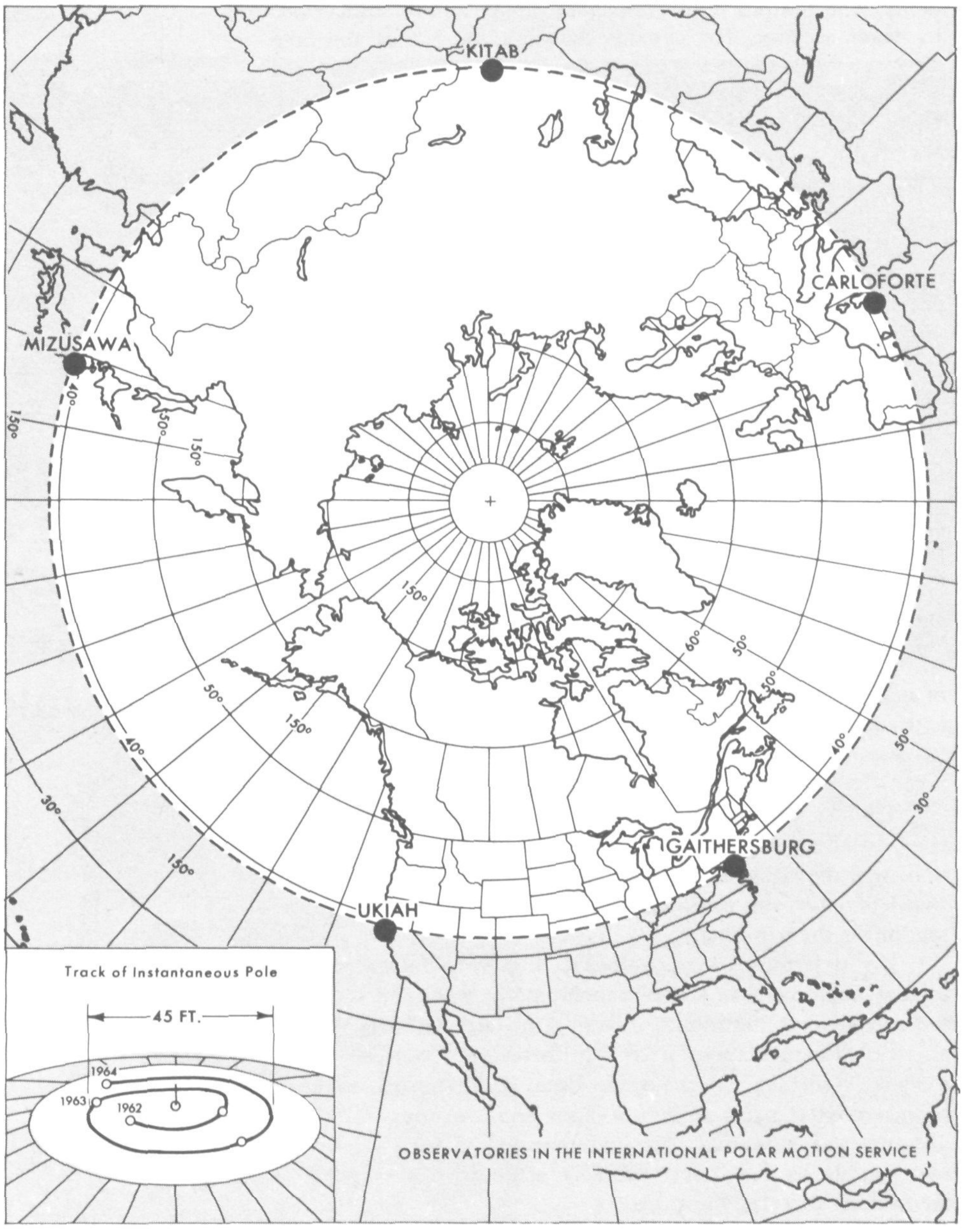
"Its comfortable in the summer," he comments. "There's usually a nice breeze, and the nights are balmy."

There were six observatories when the program was launched in 1900, at Ukiah, Gaithersburg, Carloforte, and Mizusawa, and at the University of Cincinnati and Charjui in Russian Turkestan. Of these, Ukiah, Carloforte, and Mizusawa, constituting a bare minimum of the stations necessary to determine the pole's displacement, have continued to function.

As an economy measure, Cincinnati and Gaithersburg were discontinued in 1914 and 1915. During World War I, all trace was lost of Charjui, but it was found that it had functioned until 1919. Once the station had to be moved because a river several miles distant changed its course and threatened it. Kitab was finally substituted for Charjui and in 1932 the Gaithersburg station reopened.

No one knows if the heavens will ultimately divulge the answer to the riddle of the earth's wobble—but science, steadfast in its pursuit of knowledge, will keep on trying. □

WHY IS EARTH WOBBLING ON ITS AXIS? — Since 1900 the United States, Russia, Japan, and Italy have been participating in a joint effort to determine why the earth wobbles on its axis. Astronomers at five stations cited on map — Ukiah, California; Gaithersburg, Maryland; Carloforte, Italy; Kitab, USSR; and Mizusawa, Japan — keep tabs on the movement of stars over the meridian for clues to the phenomenon. Over a 14-month period the earth has been known to wobble as much as 72 feet. Inset shows a 45-foot wobble during the 1962-64 period or a 22½ foot deviation of the earth's axis to each side of the mean pole, or geographic North Pole (indicated by center dot). The track of the "Instantaneous Pole" shows the actual location of the pole at various times.



ESSA experiments on an Oklahoma lake help in Our Battle for Water

BY
DR. BRADFORD R. BEAN
Institutes for Environmental Research

There is no shortage of water in the world. Water, man's most plentiful resource, covers 71 per cent of the earth. The trouble is that usable water often appears in the wrong place, at the wrong time, in the wrong amount for human convenience.

Along with other water control problems, the Bureau of Reclamation has been attacking water scarcity through conservation for more than a half century, particularly in the 17 western states officially declared arid and semi-arid. These states cover 60 per cent of the land area of the contiguous United States, yet possess just 25 per cent of the fresh water supply. As a consequence, the region is unable to take advantage of the potential productivity of its arable land.

During the past two years the Bureau of Reclamation, assisted by scientists from ESSA's Boulder research headquarters, has been performing conservation experiments at Lake Hefner, part of Oklahoma City's water supply system.

Lake Hefner is hydrologically famous because of its suitability for such experiments. The size of the lake—two by three miles in diameter—is convenient for evaporation experiments. The bottom is of Hennessey shale, almost impervious to water seepage. No streams flow into or out of the lake. The lake is filled from a canal where inflow is easily metered. The experiments have dealt primarily with evaporation retardation by spreading a monomolecular film on the surface.

ESSA scientists measured evaporation in the presence and absence of the film, at various time intervals during day and night, under differing conditions.

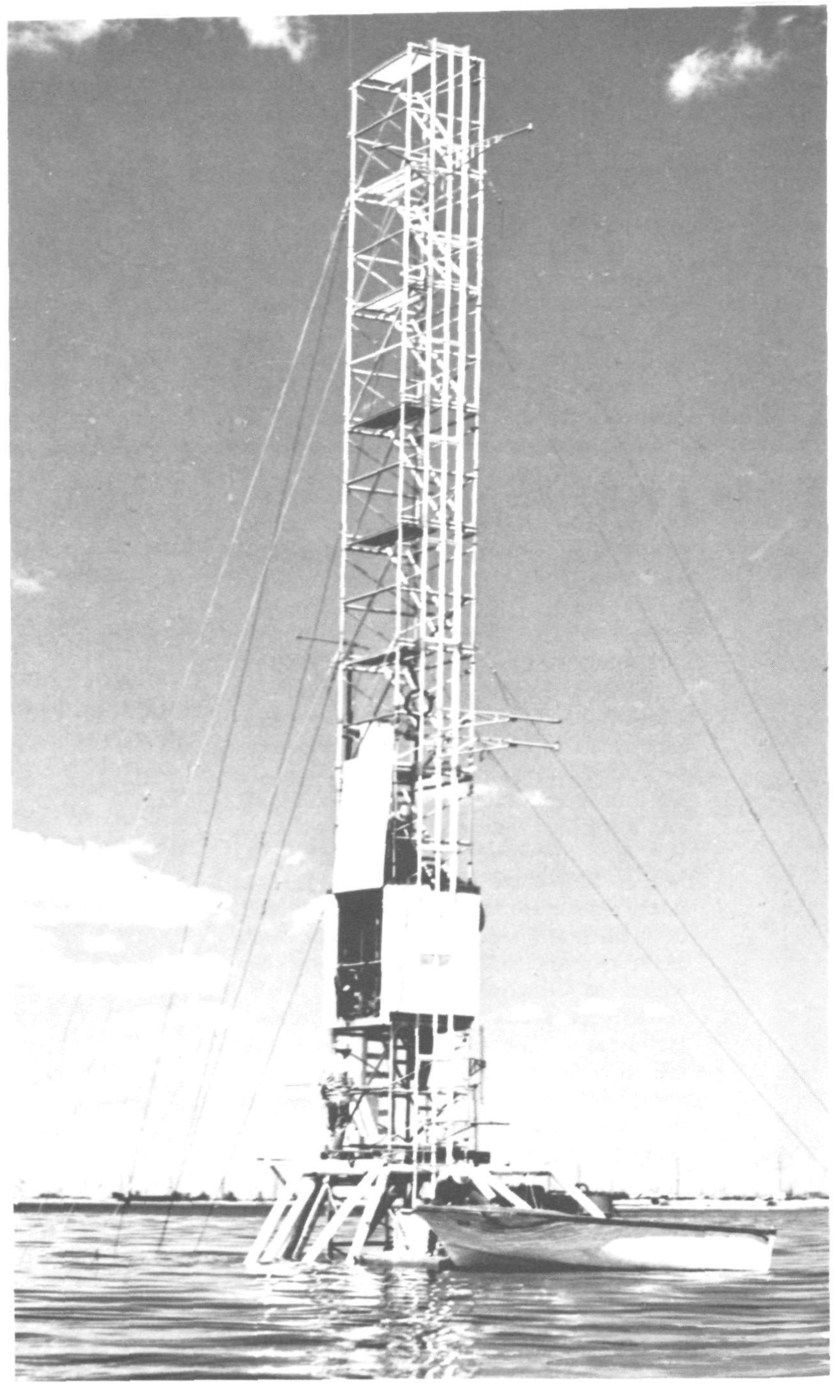
Previous measurement methods required seven to ten days; when it rained the experiment had to be rerun. These previous techniques required measurement of water balance, temperature, and wind as well as solar radiation.

ESSA's scientists cut down the measurement time from days to minutes. They used temperature sensors, humidity sensors, solar radiation sensors, infrared and optical lasers, wind and sound meters, and radio wave meters. With these instruments they analyzed the complex relationships of humidity, temperature, wind velocity, and similar related factors to discover the amount of water evaporating from the lake.

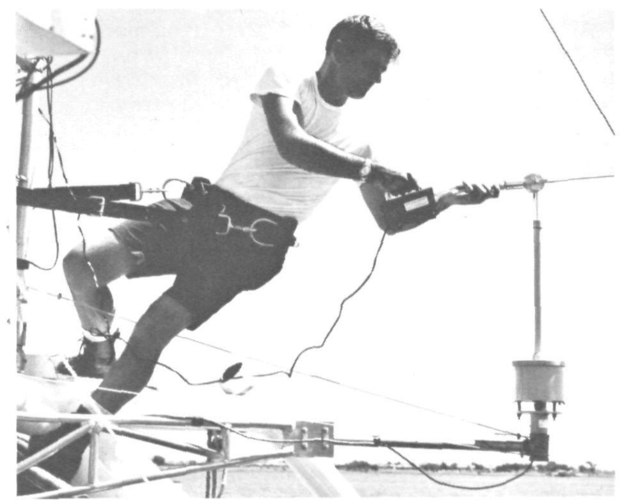
As an example of measurement technique, the Boulder scientists sent infrared laser beams across Lake Hefner. The amount of energy received was measured against the amount of energy sent. The difference indicated the energy absorbed and scattered by the water vapor and enabled the scientists to compute the percentage of humidity in the air over the lake.

Optical laser and radio beams were also sent across the lake. In these experiments time, rather than energy absorption, was the determining factor. Water molecules reduce the speed of laser and radio beams; thus, the more water vapor, the longer the trip time.

To determine wind velocity, ESSA scientists used a regular anemometer. A sonic anemometer was used to determine vertical wind. Sound, traveling upward with the moving air, was measured along a 20 centimeter path vertically from the lake's surface. At the same time, a downward traveling sound moving against the air flow and traveling the same distance was measured. The difference in travel time of the two sounds (a few microseconds) established the speed of the updraft carrying moisture.



(Left) Tower near center of Lake Hefner has highly sophisticated instruments for measuring humidity, temperature, atmospheric pressure, wind velocity and the refractive index of air over water.



(Below) Raymond E. McGavin, assistant chief, Radio Meteorology, calibrates a three-dimensional bivane wind sensor used in the turbulence and evaporation studies at Lake Hefner.

Another instrument the ESSA men used to measure humidity was a barium fluoride element whose electrical resistance goes down when the humidity goes up.

Measurement data fed into a computer revealed that evaporation on a typical summer day drew off enough water from Lake Hefner to fulfill the needs of a city of 25,000.

When the monomolecular film was applied, ESSA tests showed it to be 60 per cent effective: monomolecular films on the surface of the lake could save enough water under ideal conditions to provide for 15,000 persons on the average summer day.

These conclusions established the importance of pursuing a solution of the evaporation problem.

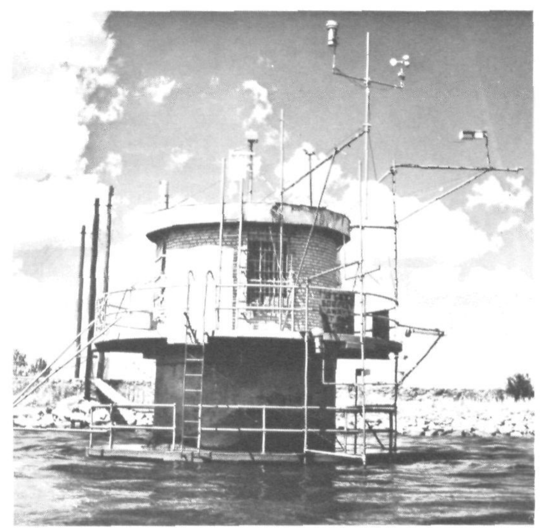
There are still questions to be answered in the use of evaporation retardants. How can their efficiency be increased? How can the chemical film on the water's surface be maintained? Waves break up the film. Winds over 15 miles per hour tear it; and it tends to pile up on the shore away from the wind. Nevertheless, chemical retardants show real promise as weapons in the water conservation war.

The Lake Hefner experiments marked a new approach by ESSA scientists to the measurement problem. Instead of using the cumbersome and indirect inflow-outflow method or the energy balance method to determine the amount of water lost into the air, the Boulder men measured evaporation itself. The techniques represent a considerable advance in the efficiency of water vapor measurements with consequent time savings.

ESSA scientists at Lake Hefner represented the program areas of radio meteorology, infrared propagation, and optical propagation from the Institutes for Environmental Research in Boulder. Chief scientist for the experiment was the author, assisted by Raymond E. McGavin, radio meteorology; Norman Abshire, infrared; and Dr. James Owens, optics.

Many other groups were affiliated directly or indirectly with this scientific effort. Included were Cornell Aeronautical Laboratory, Oklahoma State University, Colorado State University, North Texas State University, the Advanced Research Projects Agency, the National Bureau of Standards, and ESSA's Sea-Air Interaction Laboratory. □

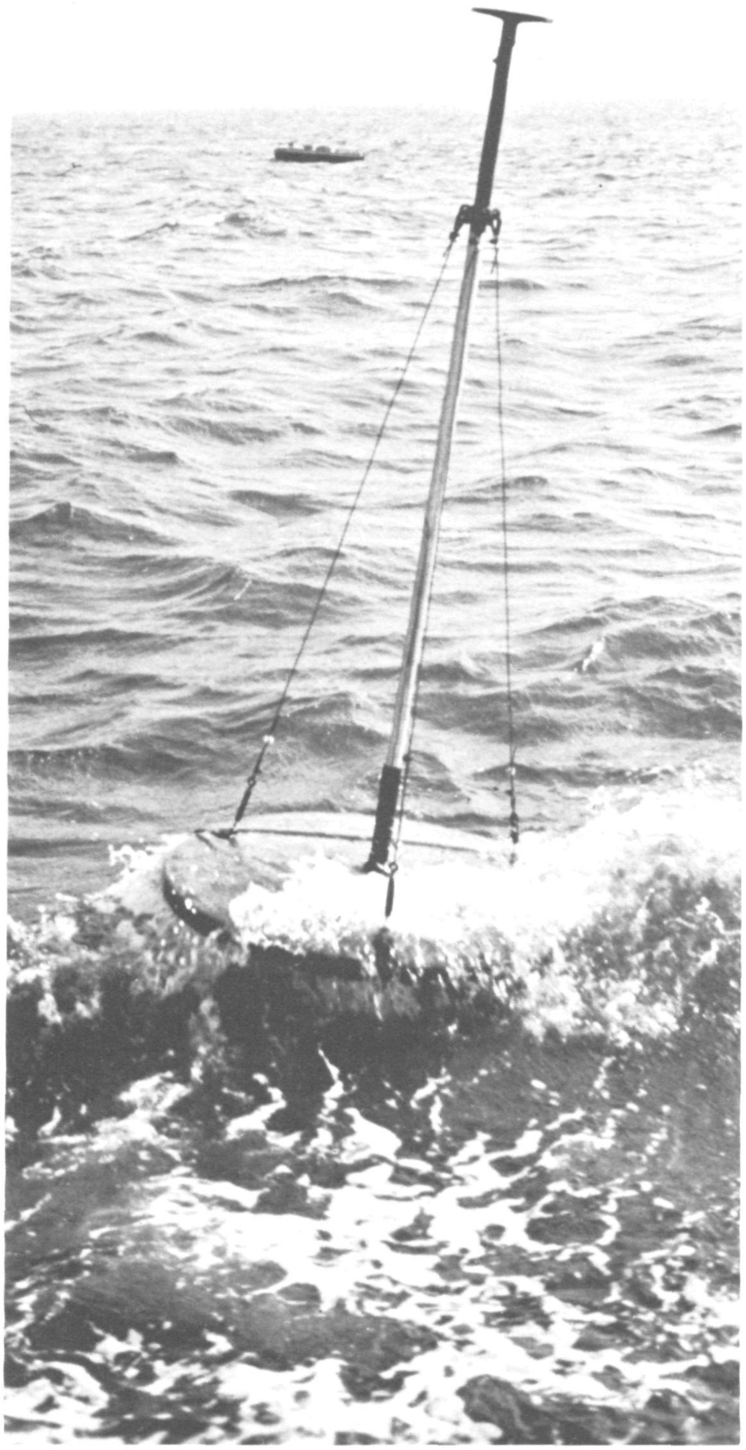
Aerial view of Lake Hefner and part of Oklahoma City. Lake Hefner is famous world-wide for hydrology experiments. The lighter streaks on the water are caused by the experimental monomolecular film on the surface estimated to be 60% effective in preventing evaporation.



(Left) The scientific equipment on the north intake tower of the Oklahoma City Water System demonstrates the inter-facility activities at Lake Hefner this summer. Represented are ESSA, the Bureau of Reclamation, Colorado State University, Cornell University and Oklahoma State University.

Filling the weather information gap in the oceans is a

big job for a small buoy



In tomorrow's global weather programs a tiny object, bobbing on the trackless oceans, may play a role far out of proportion to its size.

It is the satellite-interrogated buoy, expected to help fill the gigantic information gaps which today plague all weathermen.

But achievement of this significant advance toward better understanding of weather and sea conditions is somewhat like the concocting of a rabbit stew: first catch the rabbit.

To be successful, the buoy must be inexpensive, able to survive the ocean environment, and to respond immediately to demands for oceanographic and meteorological information. Mooring a buoy in deep-ocean areas for extended and unattended periods is extremely difficult. Numerous problems surround every part of what, at first glance, might seem a relatively uncomplicated operation.

At the National Environmental Satellite Center in Suitland, Md., the problem has been under scrutiny since October 1964, when the Advanced Systems Groups began reviewing the meager literature then available.

Today, with a half-size model which has tested spectacularly well, a full-size prototype well under construction, and two others slated to follow, NESC can claim initial success.

Between the first, hard look in 1964 and the encouraging performance of the first model, the ESSA agency has logged three years of intensive research and development.

First indications from research reviews were pessimistic. Cdr. Roger Lanier, USESSA, who conducted a study of mooring systems, found that none which would endure for as long as six months were available. Existing buoys were big and costly; many also showed poor dynamic characteristics in the ocean. NESC's Charles Cushman, pursuing another portion of the problem, found difficulty in locating sensors which were lightweight and still reliable in a sea environment. There was little evidence of research and development of communications systems adaptable for buoys; this facet was tackled by Jack Puerner and Nelson Seese.

Development of an economical system which could withstand the rigors of the sea was, plainly, no small task.

Buoy hull shapes were conceived—spar shapes, spheres, hula hoops, boat hulls, discs, catamarans, toroids, and many others. Models from three inches to four feet were built and tested in bathtubs, lakes, and in the Chesapeake. Mooring line materials, from 1/8" diameter to 5/16", containing a variety of materials—glass, steel, copper, aluminum, and synthetic fibers were tested on a test device built by NESC personnel.

Sensors were also subjected to close scrutiny and one strain gage anemometer was built to determine feasibility of a new approach. Various communication, data processing and antenna configurations were also examined in an effort to keep costs down and obtain reliable and durable equipment designs.

Included in the early studies were studies of the dynamic forces of the ocean, which turns out to be one huge broiling chemical vat ready to destroy or corrode any object placed in its environs. Despite the difficulties apparent, a solution seemed possible and NESC decided to develop three prototype buoys. The first buoy will be used to fully test its deep-sea mooring characteristics, the second and third will test their respective capability for communicating with a synchronous satellite. The design concept features a very small buoy just large enough to carry the equipment necessary for unattended operation over extended periods.

Why a small buoy? In an ocean powerful enough to destroy huge ships, equipment destined for ocean use is usually designed as massive and strong as a ship. Yet a fragile lightbulb can drift halfway around the world and wash ashore at some distant beach, unbroken. Meeting the ocean's brute force by equipment design of brute strength makes impossible an inexpensive large-scale investigation of the world's ocean areas. A design philosophy of using a shape which is compatible, and like a lightbulb, moves with the dynamics of the ocean's force has attractive economic and survivability features. Thus, a small buoy concept, one which would offer a reasonable chance for survivability and still carry the necessary equipment, came into being.

Meeting the requirements was indeed a technical challenge. Briefly the major requirements are that the buoy:

Be capable of survival through a wide range of wind and sea conditions;

Possess a meaningful lifetime of at least six months;

Operate long enough and reliably enough without servicing or maintenance to make its deployment worthwhile;

Present no hazard to shipping;

Operate and communicate as reliably as possible in the ocean environment and under the effects of salt-spray caking, corrosion and icing;

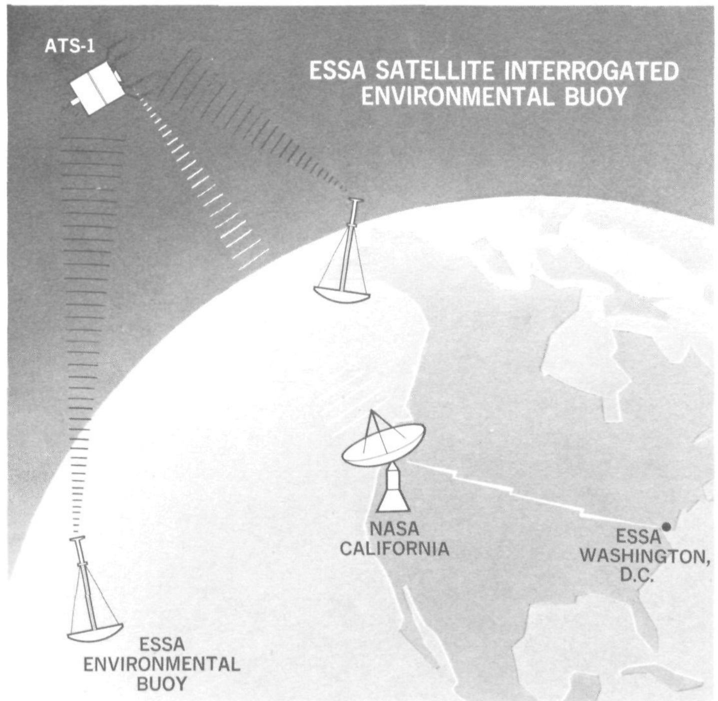
Be economically producible and deployable.

Success in meeting these requirements makes possible large scale environmental observations from remote ocean areas.

Buoy Systems

The three prototype buoys will be used to test survivability in the ocean, and communication capability with a satellite. They will be built of foam filled Fiberglas over a monocoque metal frame and a taut mooring line will hold them in place.

The taut mooring, coupled with the disc-shape of the buoy, will maximize its chances to withstand the great and never ceasing ocean forces. With this design, the buoy is expected to maintain sufficient stability to avoid capsizing. The design is also intended to prevent the buoy from riding out of the tops of very high waves and crashing; instead it will tend to cut through the upper portions of such waves and settle softly. Buoy motions and their timing, as embodied in the design, are intended to be compatible with the ever-changing movements and timing of the sea. Mooring in depths up to eighteen thousand feet is no simple task. The mooring, consisting of approximately three thousand feet of wire, to prevent severance by fish bite, and fifteen thousand feet of synthetic line to provide elasticity, must have a small diameter, yet be strong and durable enough to hold for extended periods of at least six months. Once in place, the buoy will be able to begin sending its information to a satellite when commanded to do so. Prototype buoys #2 and #3, now under construction, will be fully instrumented to test this capability.



The ESSA-NESC buoy has been designed to sense environmental data and transmit these data upon command from the NASA ATS-ground station at Mojave, California. The Applications Technology Satellite will provide the data relay link between the ground station and the buoys. The data collected will be processed by the Environmental Science Services Administration in Washington, D.C.

The first, half-size model was tested after repeated computer calculations of its probable stability, both moored and under tow. The little buoy performed far better than the computer had indicated it might. The full-size model is expected to be delivered to NESC in the near future.

Unmanned ocean-based buoys constructed thus far, in general, have had to communicate their observations in the High Frequency Radio band or store their data on board.

The use of HF has required substantial amounts of power—in one case well over a thousand watts—and is highly dependent upon the varying state of the ionosphere. These are popular frequencies, crowded and much in demand. They are, therefore, frequencies carrying heavy radio traffic with the consequent communication interference.

On the other hand, by working in collaboration with a satellite and transmitting its weather and oceanographic observations via direct line-of-sight communication to a spacecraft overhead (figure 2), the buoy can operate with a greatly reduced power output on the Very High Frequency or lower Ultra High Frequency bands. To be specific: an ocean buoy can radio its data skyward to a synchronous satellite at 137 mc/s or 400 mc/s, using simple antennas, and with a power output of only 10–50 watts. High frequency transmission usually requires two or more frequency ranges and transmitters to insure reliable transmission over the day-night 24-hour periods.

Thus far, no satellite communication with buoys has been tested—although a land-to-satellite-and-return communications test has been held on the West Coast to determine feasibility.

NESC plans to test the prototype buoys in conjunction with the National Aeronautics and Space Administration on NASA's ATS–C synchronous satellite, probably around the end of the year. The NESC prototype will be tested near Bermuda and in the Gulf Stream to determine the problems associated with position location of drifting buoys.

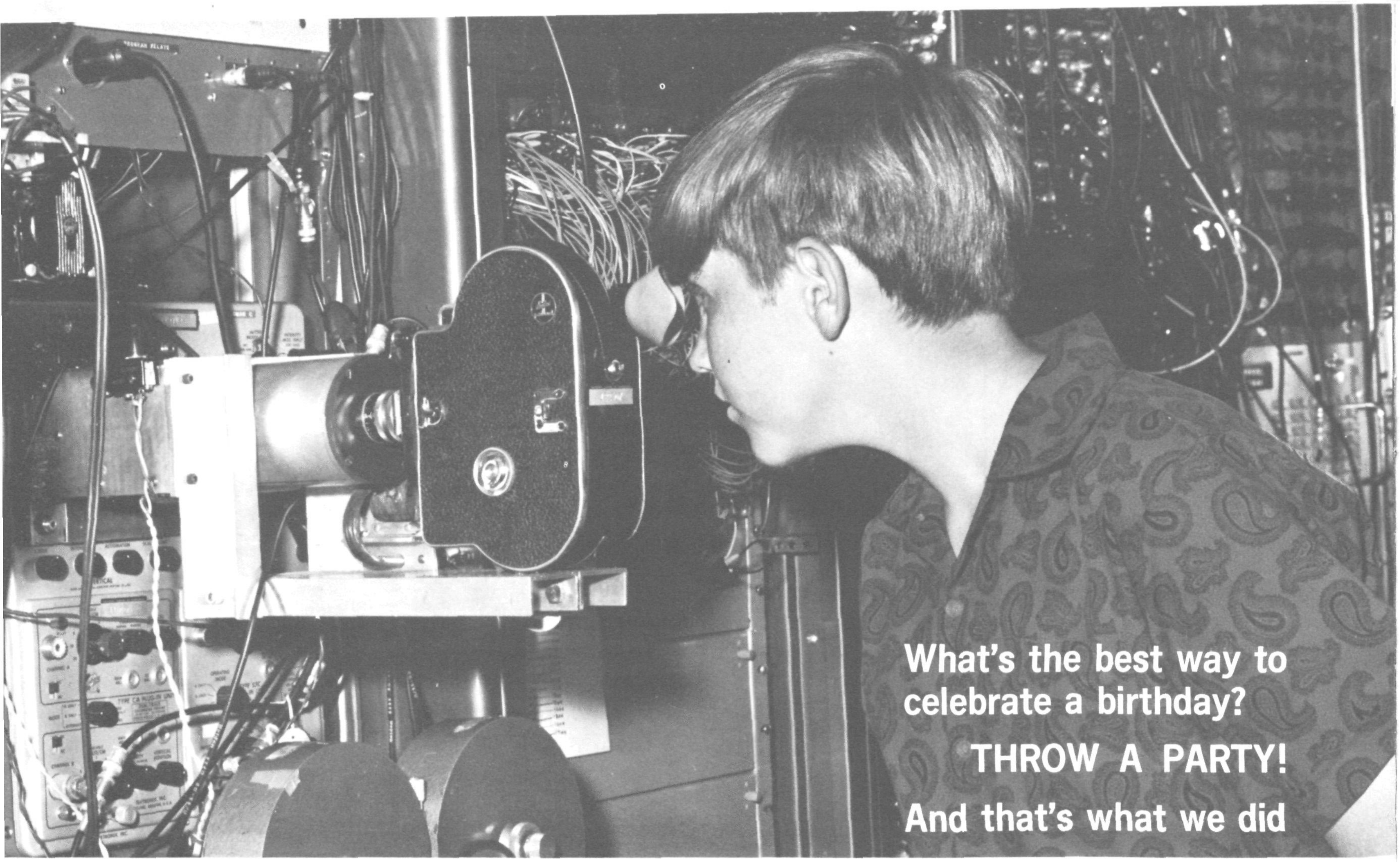
The reason for using the satellite, of course, is to have it assume the burden of the communication load which the buoy would otherwise have to undertake itself. Because a single earth-synchronous satellite stationed 22,300 miles above the equator has within its communication range a circular area of roughly 60°N to 60°S and an equal longitudinal distance, it will be able to collect data from buoys spread across an immense area of the earth's surface. Just as important, it can relay or retransmit those buoy messages almost instantaneously to interested meteorological activities distributed through that same immense segment of the globe.

The 24-hour period, earth-synchronous satellite, because it stays "fixed" in the sky, will have its network of buoys continually within radio sight. It can query or interrogate each—and do so rapidly—at conventional synoptic meteorological times. Furthermore, it can interrogate buoys at more frequent intervals—such as every hour—if the presence of storms or unsettled conditions warrant. Thus, the satellite, needing no network of ground stations, which are in themselves vulnerable to storms, can help to provide global observation of our environment.

Many ESSA personnel have contributed to the progress of this program. Miss Mary Ann Ruzecki, for example, prepared the detailed buoy and sensor-requirements study and is now developing the mooring technique and sea-test plan. Lt. (j.g.) Gordon Dodge, USESSA, developed the initial communication test plan and a complete study of power sources. From other ESSA components, Yates Holloman and Al Kornmann of the Weather Bureau, Charles Kearse and Richard Ross of the Coast and Geodetic Survey gave assistance from their experience with buoy systems and emplacement.

One part of the job, however, remains incomplete—and a part which is virtually unthinkable in government: the buoy has no acronym.

In view of the program's performance thus far, however, one might be suggested. BOB—for buoy, oh buoy. □



When ESSA Turned Two

Thousands of people across the Nation and as far away as Adak, Majuro, and Pago Pago saw ESSA in action . . . most for the first time.

They came to see how earthquakes are recorded, weather forecasts made. They saw the pride of ESSA's oceanographic fleet. They visited a geophysical observatory, a world weather center, a national weather and geophysical records center, 2 marine centers, a severe storm laboratory. They saw a multitude of research activities related to man's environment and visited about 200 Weather Bureau.

This was ESSA's second birthday and it was celebrated by inviting the public, Congressmen, Boy Scouts and international visitors, press, radio and TV, to open houses and tours at ESSA facilities.

Approximately 300 people toured the National Meteorological Center and the National Environmental Satellite Center in Suitland, Maryland.

Honolulu extended a gala welcome to the new hydrographic survey ship McARTHUR. It was the first C&GS ship in 35 years to make Honolulu her home port. The Royal Hawaiian Band and a hula troupe entertained at the ship docks and the public poured through the ship. In Boston, an open house was held aboard the DISCOVERER.

At Asheville, North Carolina, the NWRC-NGDC open house was attended by many visitors from Maine, Indiana, Florida, and points in between.

The Weather Bureau's Central Region Headquarters in Kansas City combined forces with the Coast and Geodetic Survey's Mid-Continent Field office for an open house there.

In Seattle, Washington, the second anniversary observance featured ESSA's activities at the C&GS Pacific Marine Center, the IER Pacific Oceanographic Laboratory and the Seattle Weather Bureau Office.

The Newport Geophysical Observatory, Washington, and the San Juan Geophysical Observatory in Puerto Rico explained and demonstrated their equipment to students and the general public.

Despite rainy weather, more than 300 persons visited the Atlantic Marine Center in Norfolk, Virginia, to see exhibits on photogrammetry, hydrography, mark maintenance, tides and currents, and land and sea interaction.

ESSA's research hub at Boulder, Colorado, initiated about two hundred people into ESSA's scientific endeavors through talks by Boulder scientists, film showings and tours of activities related to space disturbance, radio noise, weather modification, infrasonics, and radio meteorology.

The Adak (Alaska) Observatory showed visitors seismograms produced on visible recorders and explained procedures used to determine where and how earthquakes occur.

And so it went from July 8 through July 16 and particularly on July 13. The response was excellent, the results indeed gratifying. □

From left to right Hervey G. Machen, Maryland Congressman, Dr. Frederick G. Shuman and Dr. Robert White at the National Meteorological Center, Suitland, Md.

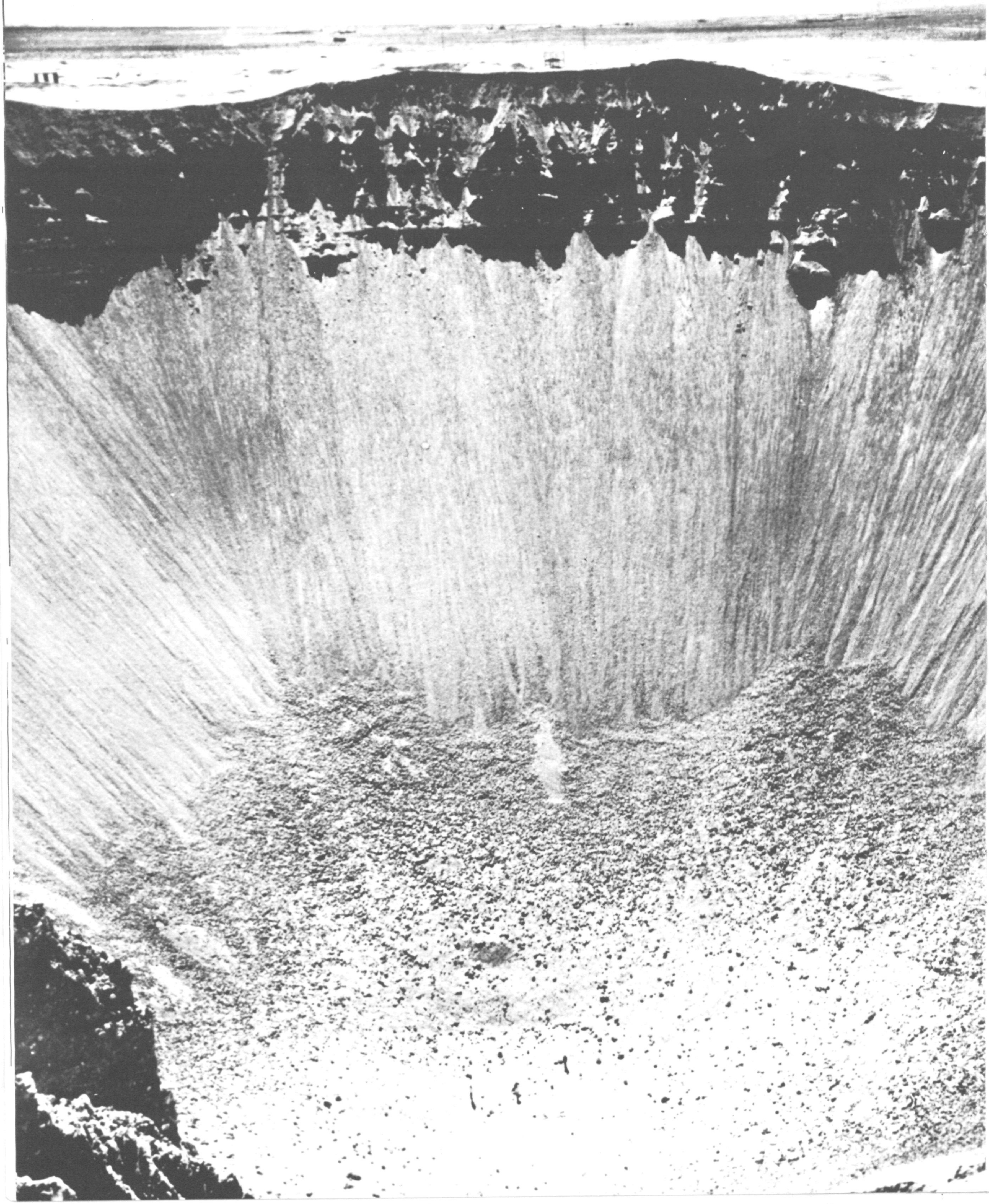
(Above) Open House is observed in Majuro, Pacific Trust Territory. Standing on the left with a group of visitors, are Micronesian observers Noboru Girshi and Paul Peter.

Congressman Donald G. Brotzman of Colorado joined the celebration and showed keen interest in the equipment at the Atmospheric Collision Processes Laboratory.

(Left) A guest examines an oscilloscope at the high frequency radar installation atop Table Mountain, in Boulder, Colorado.

(Right) younger Boulder participants get a new perspective on the world.

(Below) Mrs. Janice Rosander with a group of visitors awaiting their turn to view the slide show in the WB Central Region.



An ESSA project in South America is vital to the

Big Ditch of Tomorrow

Supersize ship barely squeezes through the Panama Canal. Larger ships must go around South America.

BY CHARLES G. THOMAS
Weather Bureau

The "Big Ditch" just isn't big enough any more.

When the Panama Canal's locks were designed more than a half-century ago, engineers provided ample lock capacity for the largest ships ever to be constructed. The locks' overall dimensions—1,000 feet x 110 feet x 41½ feet deep—seemed quite adequate.

But today more than 300 ships built or being built are too big to go through the canal with full loads. Many of them—like our modern, canted deck aircraft carriers—cannot go through at all.

Traveling from this country's east coast to the west coast, a ship too large for the 40.27-mile Panama Canal has to make an 8,000-mile trip around Cape Horn.

The answer? On December 18, 1964, President Johnson said, ". . . I think it is time to plan in earnest for a sea level canal. Such a canal will be more modern, more economical, and will be far easier to defend. It will be free of complex, costly, vulnerable locks and seaways. It will serve the future as the Panama Canal we know has served the past and the present."

The earth-moving capabilities of a nuclear detonation were demonstrated in 1962 at the AEC Nevada Test Site with the explosion of a 100 kiloton device as part of the "Plowshare Program." This experiment left a crater 1,200 feet in diameter and 320 feet deep. The largest nuclear devices foreseen for the isthmian project fall within the 35 megaton range.

With Congressional authority, the Atlantic-Pacific Interoceanic Canal Study Commission came into being to coordinate investigations of the needs, possible routes, excavation methods, and other aspects of a new isthmian canal. The Environmental Science Services Administration became involved in the studies almost immediately.

Project scientists, engineers, and economists were intrigued by the idea that nuclear energy could help them carve out a new canal. Two routes, one across Panama and the other across northwest Colombia, seem the most likely candidates for nuclear excavation.

To the layman the idea is simplicity itself. To build a deep, broad, sea level canal across the American Isthmus, plant a string of nuclear devices along the proposed route and blast a trench from the Atlantic to the Pacific. All that remains is to clean up the trench, put in a couple of toll booths, and await the shipping traffic which is bound to come.

Of course, it's not that simple. Within the overall engineering feasibility study, the Atomic Energy Commission's Nevada Operations Office has been assigned the task of conducting safety studies involving radioactivity, ground shock, and air blast.

As part of the Atomic Energy Commission's safety studies, the ESSA Interoceanic Canal Project was formed to carry out the meteorological observations and technical studies needed to predict the transport and deposition of radio-

Continued

activity from the proposed nuclear blasts. The Air Resources Laboratory (ARL) of the ESSA Institute for Atmospheric Sciences is providing the scientific direction and technical studies while the Weather Bureau's Overseas Operations Division (OOPS) is conducting the field observations program. Robert J. List (ARL) is directing ESSA's effort with the aid of a small staff in Silver Spring headed by Gilbert J. Ferber, Scientific Director (ARL) and Arthur W. Youmans, Operations Manager (OOPS).

The ESSA studies will help to determine the areas which would have to be evacuated to insure the safety of the surrounding populations. Since the ditch would be dug in sections, with 20 or more separate explosions, the frequency of occurrence of favorable weather conditions for the blasts may be an important factor in determining the time and cost involved in digging a canal with nuclear explosives.

After site surveys by Philip W. Allen, in charge of the Air Resources Field Research Office in Las Vegas; Vaughn D. Rockney, Chief of Overseas Operations; and Stuart G. Bigler and Billy D. Thomas of the Radiation Systems Section of the Weather Bureau's Data Acquisition Division, four project weather stations were put into operation and now are making surface observations and upper air soundings at both ends of the proposed Sasardi-Morti route in the Darien region of Panama and the Atrato-Truando route in Colombia.

At all four stations, M–33 track radars are used for radar wind soundings to at least 60,000 feet four times a day. The stations at the Pacific end of each route also use surveillance radar to study precipitation patterns.

Razorback ridge leading to the ESSA isthmian weather station on Pidiaque Hill overlooking the jungle.

Low-level wind flow across the isthmus is being studied with the aid of radar-tracked constant-volume balloons (tetroons) and instrumented towers at strategic points along the routes. Rain gages are also spotted along both routes.

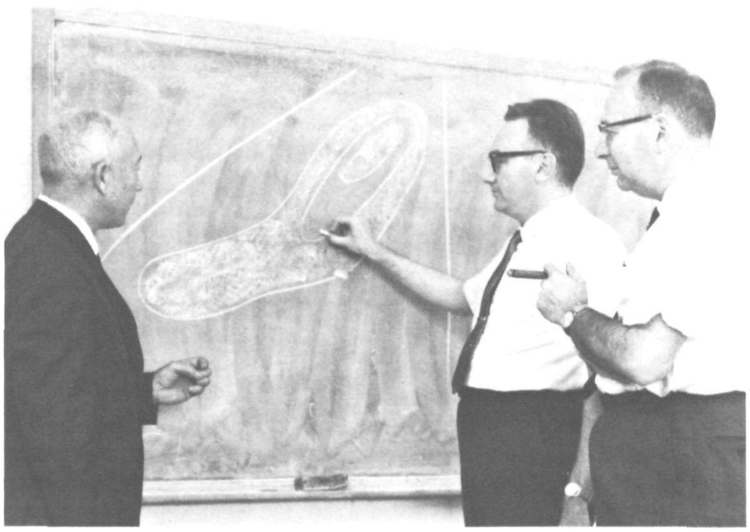
ESSA field personnel sign on for two years (the length of the program at each station) and are assigned to the Canal Zone in Panama. Directing site operations and data gathering from offices in the Canal Zone are Glenn Stallard, Field Director (OOPS), and A. B. Arnett, Field Scientist (ARL).

Under Observers-in-Charge Richard S. Baker, Jack L. Dielkey, Benjamin L. Brown, and Albert Hinkle, 20 observers man the Soskatupu and Pidiaque sites in Panama and the Loma Teguerre and Alto Curiche sites in Colombia. Four of these observers are local meteorological trainees—two from Panama and two from Colombia.

After eight weeks of duty at these remote jungle stations the men are given a week's duty in the Canal Zone office before returning to the wilds. The OIC's and observers work on a rotating schedule—spending time at all four stations.

While the mission of all four stations is to gather meteorological data and their equipment is similar, the stations differ considerably according to their location.

On the Panama route, Soskatupu, a small island just off the coast in the Caribbean, presents a typical paradise appearance with breaking surf, sun-drenched beaches, and tall palm trees. Soskatupu belongs to the San Blas Indians who are frequent and colorfully costumed visitors although none of them actually live on the island. Men and supplies are flown in to the island's small landing strip.



The other Panama station, on Pidiaque Hill in the midst of a jungle near the Pacific end of the route, has an entirely different environment.

Linking the Pidiaque station with the outside world is the Sabana River. Through the Gulf of San Miguel and up the Sabana, heavy equipment and supplies are shipped by small "coasters" or Canal-Zone-based LCMs (military-type landing craft). Personnel and lighter supplies which can be flown in are brought from the Santa Fe base camp and airstrip four miles upstream.

From the river, a 2½-mile road winds to the top of Pidiaque Hill which rises like an island above the thick green jungle treetops.

Near the top of the hill a bulldozed area holds the living facilities for the station's crew. Prefabricated, trailer-like buildings serve as sleeping, dining, and storage rooms. Air conditioning is a must in this hot, humid climate. At this level are the electric power generator and the balloon inflation shelter.

Further up the road, at the top of Pidiaque, two trailers house the weather station itself. The trailers are packed with electronic instruments geared to the station's radars and communications equipment.

On the Colombia route, Loma Teguerre is on the top of a small hill jutting up out of a swamp and is the only solid ground for miles around. Access is by boat up the Atrato River from Turbo, Colombia. The other Colombian station, at Alto Curiche, is on top of a mountain in the jungle area on the Pacific end of the route. It is about seven miles from the beach where the main base is located. Alto Curiche is in the tropical rain forest and the so-called dry season here simply means that they have slightly less rain than during the wet season. The station is reached by a slippery-wet jungle trail or by helicopter from the beach. A few of the more hardy have walked up the trail—once!

In the coming months and years the data from these weather stations will form a basic element in what could become the greatest earth-moving feat in man's history.

In addition to participation by the ESSA Interoceanic Canal Project, a number of prominent ESSA scientists have been named to technical working groups formed to advise the AEC in various study areas. Serving in this capacity are Robert J. List; Philip W. Allen; Dr. Edwin Kessler, Director of the National Severe Storms Laboratory in Norman, Okla.; and Dr. James K. Angell of the Air Resources Laboratory.

The transition from the lush tropical jungle setting now found along the proposed isthmian routes to a broad sea level channel cut with nuclear explosives through which the world's largest ships can steam between the Atlantic and Pacific is mind-boggling, but for ESSA's meteorological team it presents a rare challenge and opportunity. □

(Top left) ESSA Interoceanic Canal Project Director Robert J. List (right) discusses wind currents and possible radioactivity fallout with Arthur W. Youmans, Operations Manager, and Gilbert J. Ferber, Scientific Director.

(Left) At a recent Canal Zone meeting were standing (from left to right) Albert J. Hinkle, Field Director Glenn Stallard, and Benjamin L. Brown. Seated are Jack L. Dielkey, Richard S. Baker, and A. B. Arnett.

THE GRAY SKY

ESSA's role in a national crisis

BY ANN K. COOK

Ever since man learned to use flame for his own purposes, he has been adding the products of combustion to the atmosphere. Until recently, the pollution that resulted was harmless and lasted only a short time, because the atmosphere has a huge capacity to absorb particles and gases without changes in quality.

"It is quite reasonable to use the atmosphere to dispose of wastes," says Donald H. Pack, Acting Director of ESSA's Air Resources Laboratory, "if we know the limits and the effects of such use."

Now we are beginning to reach these limits. Our industrial society is pouring forth pollutants in quantities that severely strain the ability of the atmosphere to dilute them. More and more frequently, the air is so overloaded with impurities that human and animal life, vegetation, and property are endangered or damaged.

During the autumn, air pollution episodes reach their

Aerial photograph of an industrial complex illustrating how individual sources combine to create a single volume of polluted air.

peak. For four days of Thanksgiving week last fall, New Yorkers inhaled huge amounts of carbon dioxide, chemical fumes, and assorted airborne junk from a mass of heavily polluted air trapped over their city. Eighty persons died. Millions were made uncomfortable.

Alarming as such episodes may be, they are relatively minor, Mr. Pack says, when compared to the major disaster that could occur if the pollution lasted as long as a week.

In a message to Congress in January 1967, President Johnson warned: "Ten years from now, when industrial production and waste disposal have increased and the number of automobiles on our streets and highways exceed 110 million, we shall have lost the battle for clean air — unless we strengthen our regulatory and research efforts now."

In the national effort to combat air pollution, ESSA provides services to Federal, State, and local agencies responsible for setting standards of air quality and for controlling pollution. To aid these agencies, ESSA describes and predicts the capacity of air to dilute and disperse pollutants.

At the Institute for Atmospheric Sciences, a staff of specialists in the Air Resources Laboratory studies various aspects of air pollution in a program that began almost 20 years ago. The first studies, sponsored by the Atomic Energy Commission, were the true beginnings of air pollution meteorology in the United States. For it was in tracking debris from nuclear explosions that meteorologists discovered much about the large-scale distribution of pollutants over the globe.

ESSA scientists have since learned many of the details on how radioactive materials — and other impurities such as smoke and soot — are carried off by the winds and dispersed throughout an envelope of air, 5 to 11 miles deep, that covers the earth.

They know that serious pollution buildup is least likely to occur on a sunny summer afternoon. This is because pollution particles are carried upward most easily at times when the air temperature decreases with altitude. In the morning, when the sun rises and heats the ground, the air near the earth's surface is warmed. This warm air rises and is replaced by cooler air, which warms and rises in its turn, carrying impurities with it.

At night, as the ground and the lower layers of air cool, the situation is reversed — the temperature increases with height, preventing air from rising and dispersing pollution particles. This condition — called an inversion — occurs more frequently in fall when there are fewer daylight hours than in summer and before the winter storms bring the higher speed winds. An inversion can also form when a warm air mass moves over cooler air below.

Several years ago, the meteorologists found that air pollution is especially apt to occur when slow-moving high-pressure weather systems create inversions and light winds over large areas. Under these conditions, pollutants can accumulate near their source until the weather changes. This set of weather conditions has been designated as "high pollution potential."

In 1960, ESSA's Air Resources Field Office at Cincinnati began issuing forecasts of air pollution potential for the United States east of the Rockies. Three years later, the service was extended to the Pacific coast. ESSA's National Meteorological Center assisted the Cincinnati forecasters by providing computer analysis and predictions of mean wind speeds and mixing depths, based on upper-air observations taken throughout the United States.

PROTECTING OUR NATURAL HERITAGE

"There is much to be done. And we are losing ground. The air and water grow heavier with the debris of our spectacular civilization. The domain of nature shrinks before the demands of commerce.

"We can build, for a time, a rich nation surrounded and permeated by poisoned elements. By ignoring the poisons, or by treating them in a casual, piecemeal way, we can endure in their midst for decades.

"But here in America, we started out to do more than simply endure. We intended to live as men should live, working hard, raising families, learning, building — and breathing clean air, swimming in clear streams, finding a part of the forest or the shore where nobody else was.

"If we are to have that America, we shall have to master the consequences of our own prosperity — and the time to begin is now."

LYNDON B. JOHNSON

In July 1967, after a year of practice forecasting in close collaboration with the research office, NMC assumed the job of predicting pollution potential. The forecasts, designating areas susceptible to pollution, are prepared every day and transmitted to Bureau stations, which release them to interested groups.

At present, forecasts of air pollution potential provide an opportunity for specialists to conduct meteorological and medical studies during periods of high pollution. Eventually, they may contribute to reduction of pollution, by enabling local officials to order cutbacks in the release of impurities when pollution potential is high.

ESSA's air pollution meteorologists have launched and tracked constant-level balloons in recent field experiments at Los Angeles, Atlantic City, New York, to gather detailed information on the erratic patterns of low-level winds over urban areas. These studies have revealed that the warmth over cities actually helps get rid of pollutants by allowing them to rise to greater heights. "Without this so-called urban heat island," Mr. Pack says, "our cities might literally be choked with smog."

The scientists have also developed mathematical models for predicting where — under various weather conditions — pollution will gather over cities. They are now preparing and testing such models in New York, Philadelphia, Cincinnati, and St. Louis.

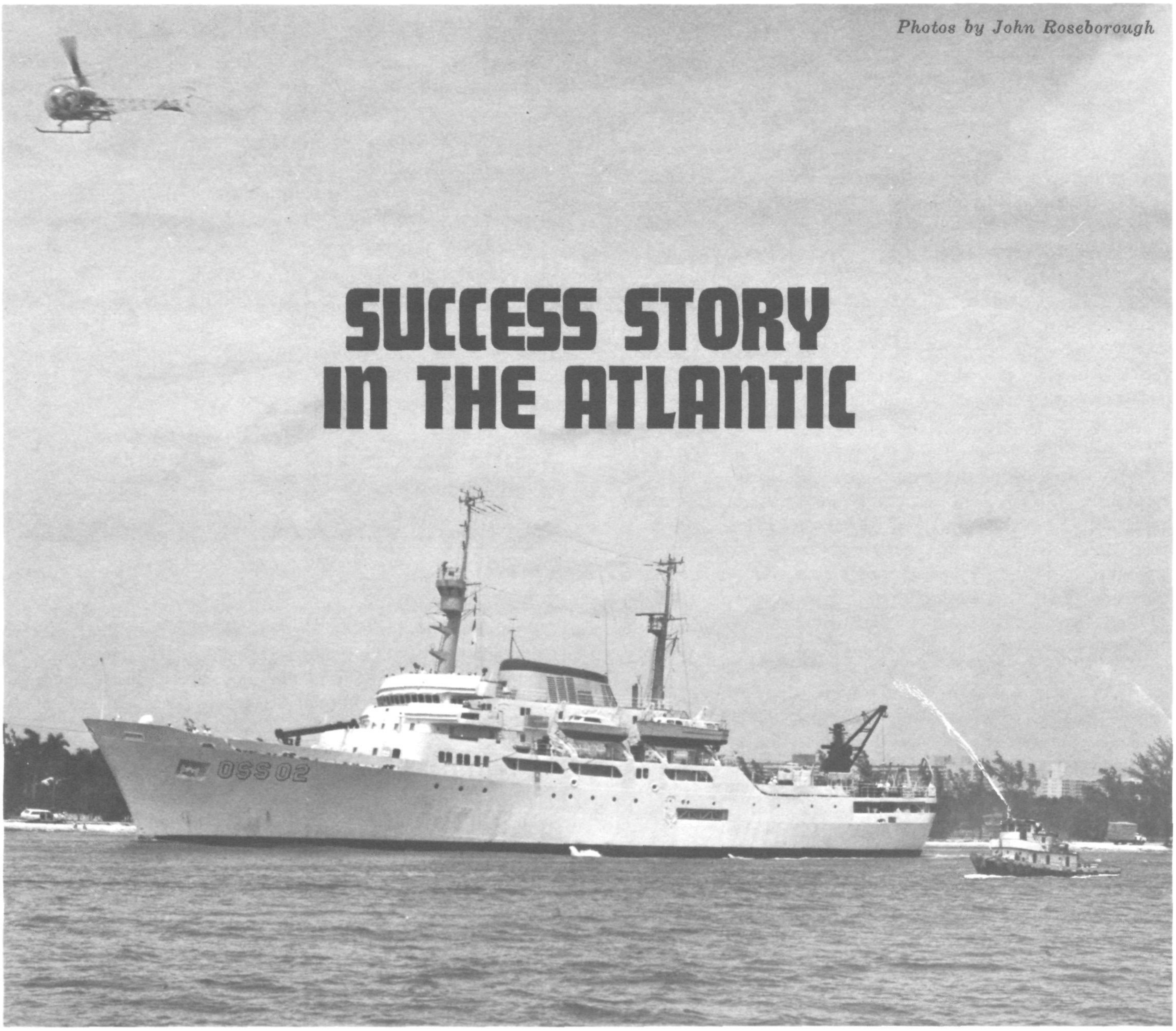
"Before long," according to Mr. Pack, "we hope to be able to predict expected pollution concentrations routinely, taking into account the different patterns caused by changing sources. Auto exhaust pollution, for example, would be different on Sunday than during weekday rush hours."

"The most important problem, however," he says, "is to arrive at better understanding of the long-range effects of pollution. Otherwise, we may unknowingly cause an irreversible change in our weather and climate."

"We must increase our understanding and the relationship between air pollution and climate — and of the ways in which the atmosphere cleans itself," Mr. Pack concludes, "if we are to safeguard the air reservoir in which we live and breathe." □

Photos by John Roseborough

SUCCESS STORY IN THE ATLANTIC



New ESSA ship probes mysteries of seamount

The newest addition to the ESSA fleet—the USC&GSS DISCOVERER—received a royal reception in its home port of Miami after a successful first working expedition.

More than 3000 Floridians visited "DISCO," as the new ship has come to be known by its crew, after welcoming ceremonies at Miami.

She came into port accompanied by fireboats and helicopters after a 10-day expedition from Boston, during which scientific experiments were conducted by the Coast and Geodetic Survey over the Gregg Seamount, midway between Bermuda and the Grand Banks.

Dr. Werner A. Baum, ESSA Deputy Administrator, who accompanied the 303-foot, 3800-ton vessel, described the expedition as having achieved most of its originally planned objectives.

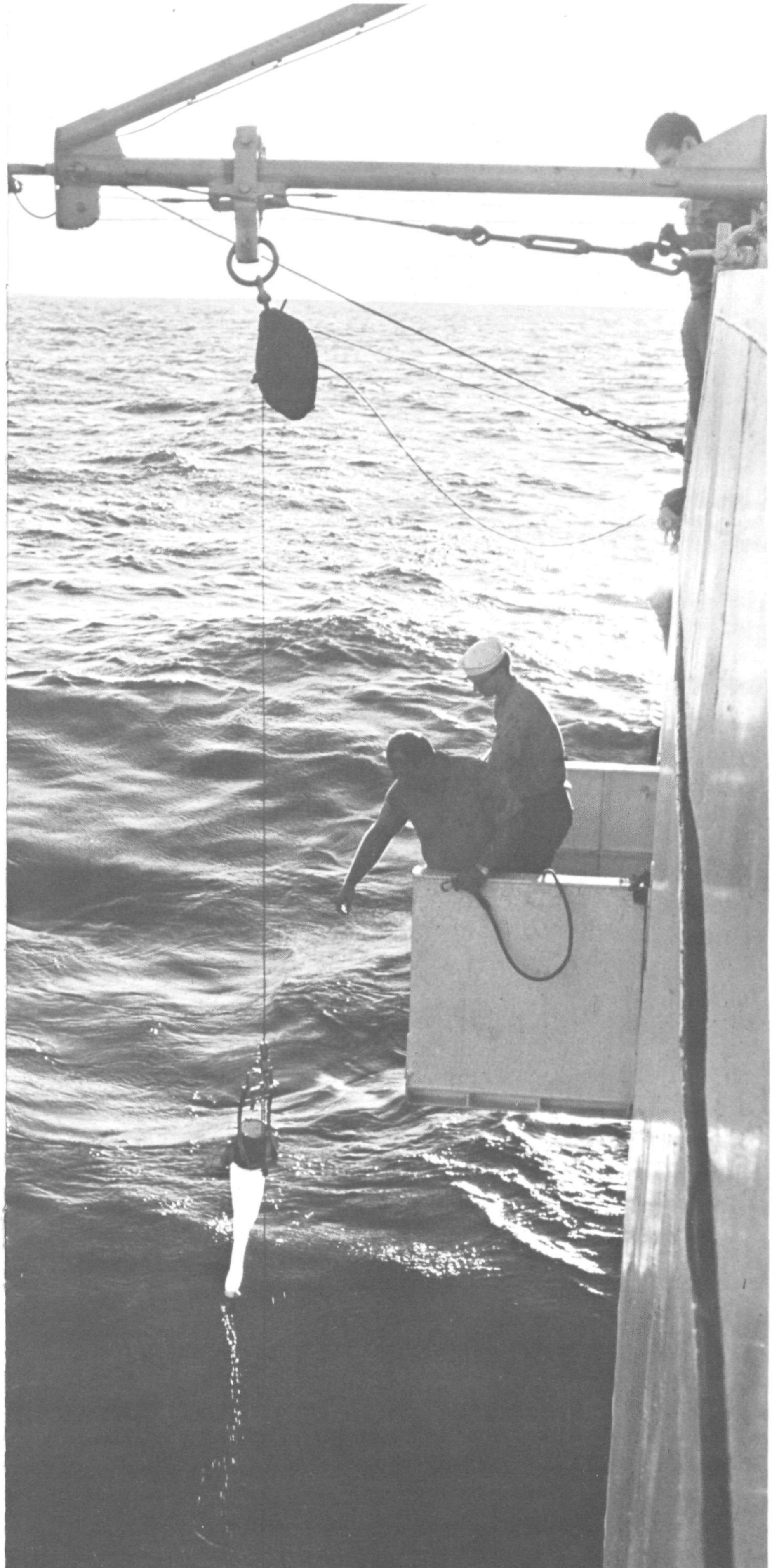
Gregg Seamount rises more than 13,000 feet and comes to within 2,880 feet of the Atlantic's surface. The expedition's major accomplishment was obtaining detailed measurements of the vertical temperature and salinity structure down to 11,500 feet at four locations around the seamount. These measurements will let ESSA oceanographers evaluate the speed and direction of the Gulf Stream in and around the seamount. They will be helpful in obtaining theoretical determinations of the effects of seamount barriers in deflecting ocean currents. The measurements were made with a new data acquisition system, with a continuous graph of temperature and salinity against depth automatically plotted and displayed in the ship's oceanographic laboratory during the lowering.

Collections of microscopic organisms were made simultaneously at 33 and 330 feet below the surface at three locations. Success was also achieved in obtaining a 38-inch bottom sediment core at 6,180 feet. It will be analyzed by the Institute for Oceanography, which has just begun operation of its East Coast Laboratories in Miami under the direction of Dr. Harris B. Stewart, Jr.

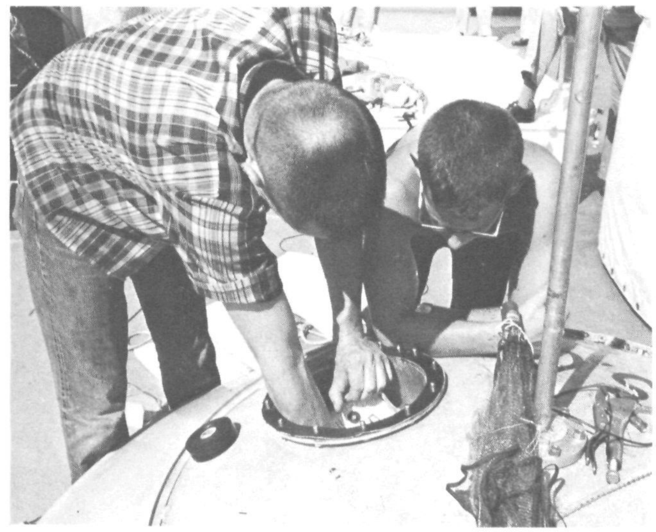
Visual observations of marine life were made from DISCOVERER's unique bow viewing ports, and 250 drift bottles were released to assist in general-circulation studies. Finally, detailed depth charting was obtained of the entire area covered, more clearly defining the seamount's topography and the ship successfully anchored in 3,000 feet over the summit.

The expedition was headed by Capt. William F. Deane, USESSA, the ship's commanding officer. Steacy D. Hicks,

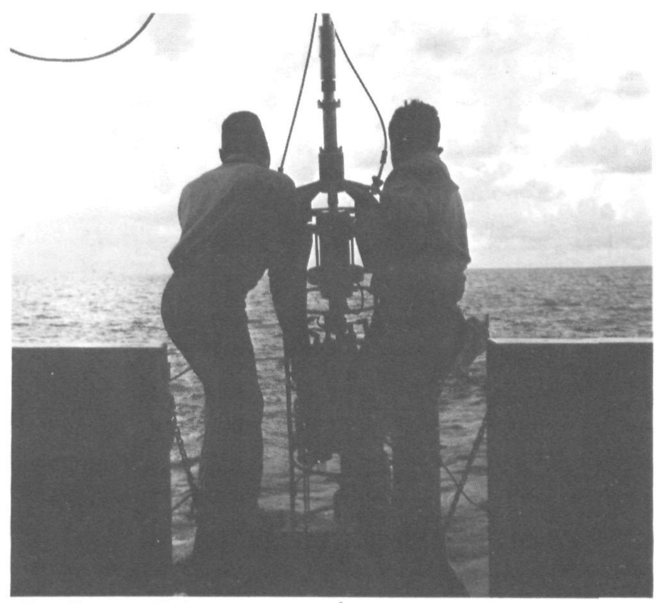
Continued



Tossing flotation bottles adrift for sea current observations.



Readying "flying saucer" buoy to mark deep-sea tide gage on Gregg Seamount.



Sending salinity, temperature, depth (STD) multi-sensor package over the side.

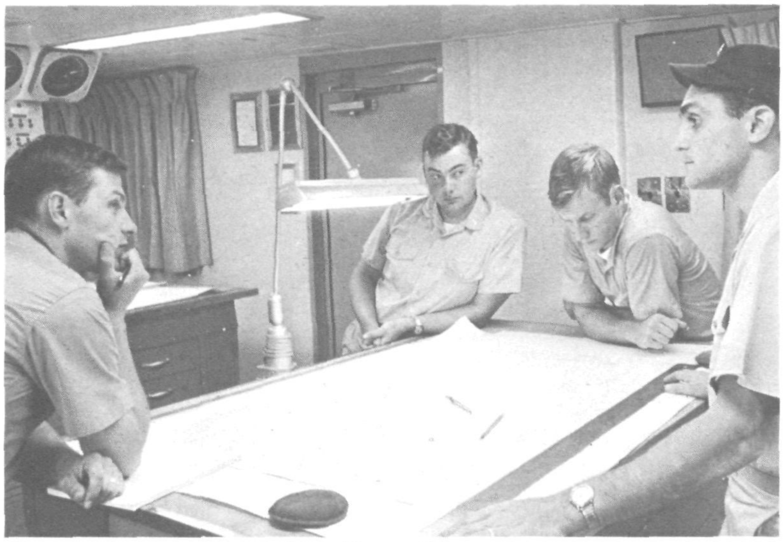
(Left) Lowering plankton net.

Coast and Geodetic Survey, was responsible for on-the-scene changes in the scientific program. Execution of the program was done by Lt.-Comdr. George A. Maul and Lt. Rodger K. Woodruff, USESSA, of the ship's crew. Dr. Ola M. Johannesen of McGill University, Montreal, was aboard as guest scientist.

The gleaming new vessel, which shares with her sister ship, USC&GSS OCEANOGRAPHER, the distinction of being the most modern and most highly automated of its kind in the Nation, plunged into a busy career after its triumphant homecoming.

After minor overhaul at Jacksonville, she was scheduled for working expeditions in the Gulf of Maine and over the Atlantic's Blake Plateau, where she is to investigate the status of manganese nodules on the ocean floor. □

(Right) Chief Storekeeper Daniel V. Casino and Commanding Officer, Captain William F. Deane watching deep-sea anchoring operations.



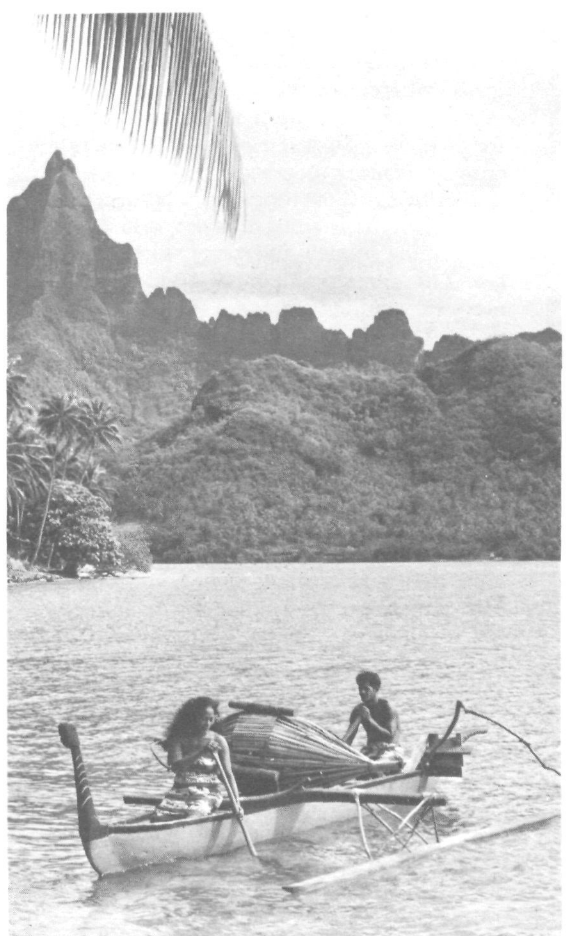
Lt. Roger K. Woodruff, Ens. Terry Bryan, Lt. Theodore Wyzewski, and LCDR George A. Maul discussing the navigational trackline to Miami from the Gregg Seamount.

Preparing a piston corer sample for storage.

(Left) Technicians Richard A. Kloker and James McGovern studying the bathymetric profile of the Gregg Seamount.

By helicopter and mule, amid palms and on snow-capped mountains, Pacific weathermen serve the

World of the Islands



Woleai, 4000 miles east-southeast of Hawaii, is an atoll of 22 palm islets, populated by 400 or so Micronesians who live in thatched huts. One of its most modern edifices is the Weather Bureau station, a small concrete-block building with a 50-foot radio tower.

Every six hours, day and night, Observer Kengzio Morimats reads his instruments and transmits his findings by radio to District Headquarters at Yap, 500 miles west. In turn, Yap relays the information by key transmitter to Trust Territory headquarters at Saipan.

Morimats' weather data then goes by radioteletype to Guam's Joint Typhoon Warning Center, and to Hawaii by marine cable for relays to Tokyo, New Zealand, Australia, San Francisco and Washington.

There ESSA's National Meteorological Center computes and uses the information—and, after a 15,000-mile trip, it returns to the Pacific as part of a facsimile weather map.

Nothing could illustrate more strikingly the fact that the Weather Bureau's Pacific Region is a unique operation, one which walks with Kengzio Morimats before it flies with ESSA's satellites, and is, in fact, a vivid combination of make-do and the Space Age.

Major Forecast Responsibility

Its forecast responsibility is the largest of all Weather Bureau Regions. Its programs include agriculture, aviation, marine, special and general public service.

Its aviation weather effort is a formidable one. Briefers at the Honolulu Forecast Center and the airport station at Wake Island brief flight crews for the world's longest over-water nonstop flights; Wake briefs more crews flying in tropical-storm areas than any other Weather Bureau station.

Surface and upper-air observations collected in this Region are vital to the total Weather Bureau effort. Every day, in addition to surface and rawinsonde observations, nearly 200 ship and 1000 aircraft reports cross the Pacific to the National Meteorological Center.

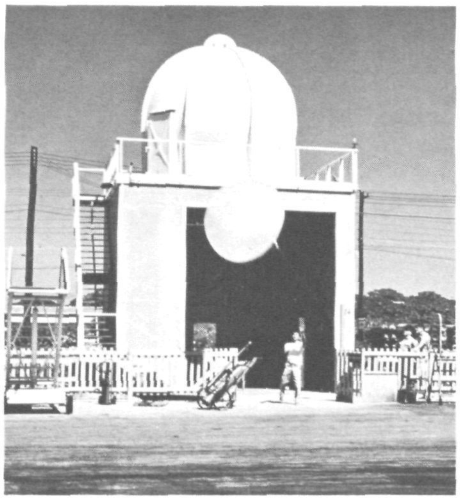
The Honolulu Forecast Center does most of the data processing for all Pacific stations. Through cooperative arrangements with the Air Force and Navy weather services, it produces com-

Photos courtesy Pan American Airways

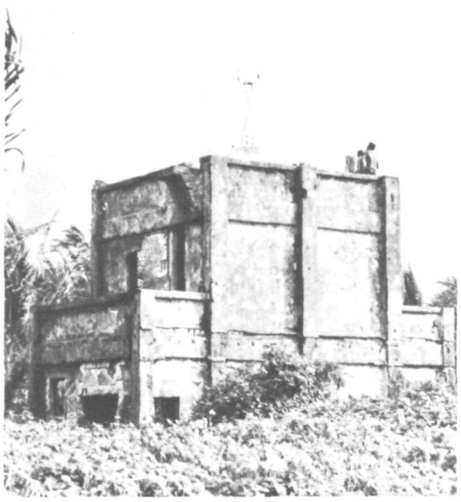
Photo courtesy of Dole Company

Bill Taliaferro and Carl Peterson of the Weather Bureau, en route to the dormant Haleakala Crater on Maui Island, Hawaii.

(Left) Mt. Kaala, 4,025 feet, highest point on Oahu, Hawaii, and transmitter site of ESSA's radio station KBA-99.



Taking upper air sounding by rawinsonde on Wake Island.



Remote weather station on Jaluit, one of the Marshall Islands. It was also used by the Japanese as a weather station before the war.

puter-derived weather predictions. More, and smaller-scale, weather and oceanographic problems are being attacked, and the near future is expected to bring automatic reduction of terminal forecasts, automated surface and subsurface analyses in the tropics, orographic rain models, and automatic upper-air sounding analyses.

Weatherwise, the Pacific Region is something of a law unto itself. Enough snow falls on three Hawaiian mountains to cause formation of a ski club, and Weather Bureau forecasts, which pay close attention to the thriving recreation industry, deal with snow as well as surf. Marine forecasts for an area three to four times the size of the continental United States are issued daily by the Honolulu Forecast Center.

Waialeale—World's Wettest

The Hawaiian island of Kauai has the world's heaviest rainfall—at Mt. Waialeale, where precipitation averages 486 inches a year. It is not at all uncommon for Weather Bureau stations to undergo damage from typhoons.

In this far-flung domain, where urban sophistication is only a plane ride away from stone money and grass skirts, there are 330 climatologic and flood control network stations, most of them in Hawaii. There are, of course, numerous smaller stations scattered over thousands of miles.

Visits to substations by Regional Office inspectors can be gruelling affairs. A report from Regional headquarters says:

"The inspector drives to the Hawaii Volcanoes National Park headquarters in a comfortable sedan . . . jeeps to Ahua Umi over a rough lava flow . . . ascends Mt. Waialeale via helicopter . . . hikes for seven hours to and from Mt. Kukui through muck and mire . . . visits Mokil via the district field trip ship . . . and sits astride a mule to inspect the gages strewn along the Kohala Ditch trails. . . ."

The Weather Bureau's housekeeping in such an area is of necessity a complicated affair. Procurement and supply specialists fight a running battle with irregular transportation, one of their major headaches being the moving of helium to stations in the Trust Territory.

The round trip from the Regional office to Marcus Island, the most distant point, is more than 11,000 miles. At one location, landing barges are required to put men ashore; at another, a special vehicle is used to carry men from sea level to the top of a snow-capped mountain. A great deal of Weather Bureau service in the Pacific is isolated duty, and many of the meteorological technicians are Micronesians who have been trained by Region personnel.

James W. Osmun is Regional director. Others of the Region team include R.F. Shaw, user services representative; S. Price, Regional climatologist; E. M. Carlstead, chief of the scientific services division; R. L. Belknap, chief of the operations division; R. E. Rush, chief of the weather analysis and prediction branch; M. H. Kerner, communications specialist; J. P. Lee, chief of the data acquisition branch; C. M. Peterson, chief of the observations section; J. P. Pentecost, upper-air specialist; W. J. Taliaferro, chief of the substation management section; J. R. Nunan, oceanic specialist.

Also B. L. Johnson, chief of the administration and technical services division; R. W. Gray, budget analyst; S. K. Kaneshiro, chief of the fiscal branch; J. G. Norris, chief of the personnel branch; S. J. Oborski, chief of the procurement and supply branch; D. D. Conte, chief of the facilites branch; and F. M. Keyes, chief of the electronics branch. □

(An article on the Coast and Geodetic Survey's activities in the Pacific will appear in a forthcoming issue of ESSA World.)

OPERATION PCV

How Peace Corps volunteers aid the Weather Bureau in Micronesia

Native child of Pago Pago in all that was left of his home after a tropical storm in March 1966.

BY WILLIAM J. TALIAFERRO
Chief, Substation Management Section
Pacific Region, Weather Bureau

Peace Corps volunteers have become weather observers in isolated Pacific outposts where weather information never before has been available.

The operation is part of a new cooperative program in which the Corps, the Weather Bureau, and the U.S. Trust Territory of the Pacific Administration are partners. Within a span of only five weeks in the spring of 1967, eight PCV synoptic reporting stations materialized in some very unlikely places—minute, isolated patches of coral and volcanic ash stretching from the "high" island of Pagan in the northern Marianas to the "low" island of Mili in the southeastern Marshalls. Additional stations are programmed for FY 68 in a dramatic expansion of the synoptic network in this data-sparse area of the western Pacific known as Micronesia.

Until this year, surface observational coverage over the three million square miles of the Trust Territory—an area extending more than 2,700 miles from east to west and 1,200 miles from north to south—was provided by stations on 12 islands. Five of these, staffed by the Weather Bureau, are located in the District Centers on Koror, Yap, Truk, Ponape, and Majuro. Also available are reports from Guam and from Weather Bureau stations on Kwajalein and Eniwetok. Completing the network are three "fee" stations, employing Micronesian observers, on the islands of Kusaie, Ulithi, and Woleai, and the Coast Guard station on Saipan.

Until the advent of the Peace Corps program, there was but scant hope for obtaining weather reports—from any of the myriad atolls dotting the oceanic expanse of Micronesia. Nearly all of them, many hundreds of miles from the nearest District Center, lacked facilities for radio communications; and, for the great majority, their only contact with "civilization"—by ship—has often been both infrequent and erratic.

First to visualize the potential value to the Weather Bureau of a tie-in with the new Peace Corps program in the Trust Territory was Paul Woolard, technician-in-charge of the Weather Bureau office on Guam. Woolard explored the possibilities with the top local PCV representative and passed the word to the Weather Bureau's Pacific Region Headquarters that the PCV would cooperate fully in serving as observers on any island which the PCV had been or expected to be assigned. The Operations Division of the PRH studied Woolard's proposal, and decided such a program was meteorologically sound and economically feasible and should be implemented as quickly as possible.

In late 1966 the Pacific Region Headquarters in Honolulu embarked on a crash program, enlisting the support of the Central Office, field stations in the Trust Territory, and nearly every segment of the PRH. Eight sites (seven coral atolls and the volcanic island of Pagan) were selected for the initial "wave" of installations. The program was outlined to the Trust Territory High Commissioner, Hon. William Norwood, who gave his endorsement. Approval for recruiting the PCV as weather observers was granted by John Pincetich, Director of the Peace Corps for Micronesia.

Now the chances of detecting unusual weather situations and predicting such things as typhoons will be greatly increased with the addition of Peace Corps weathermen at Ebon, Mili and Utirik atolls in the Marshall Islands, Kapingamarangi and Nukuoro atolls in Ponape District; Satawal in Yap District and Satawan in Truk; and eventually, Sonsorol Atoll in the Palau District.

The Peace Corps Volunteers will make two to four observations daily, at the same time weather bureau observers around the world are recording their observations of such things as wind, rainfall, temperature, humidity, air pressure

Continued

PCV weather observers, Mr. and Mrs. Wayne Waldrip on Pagan Island of the Marianas. The wind mast can be seen in the background.

(Left) chief's house on Tobi in the Palau district, where a PCV station is planned. It was once used by the Japanese also as a weather station.

and other meteorological elements. They will radio their observations to district centers which will relay them to weather bureau forecasters in Guam and Hawaii.

The Peace Corps Volunteers, who are stationed in the various islands as teachers and health workers, will receive no pay for their work for the Weather Bureau. But part of their job will be to train Micronesian observers who will be paid for each observation reported.

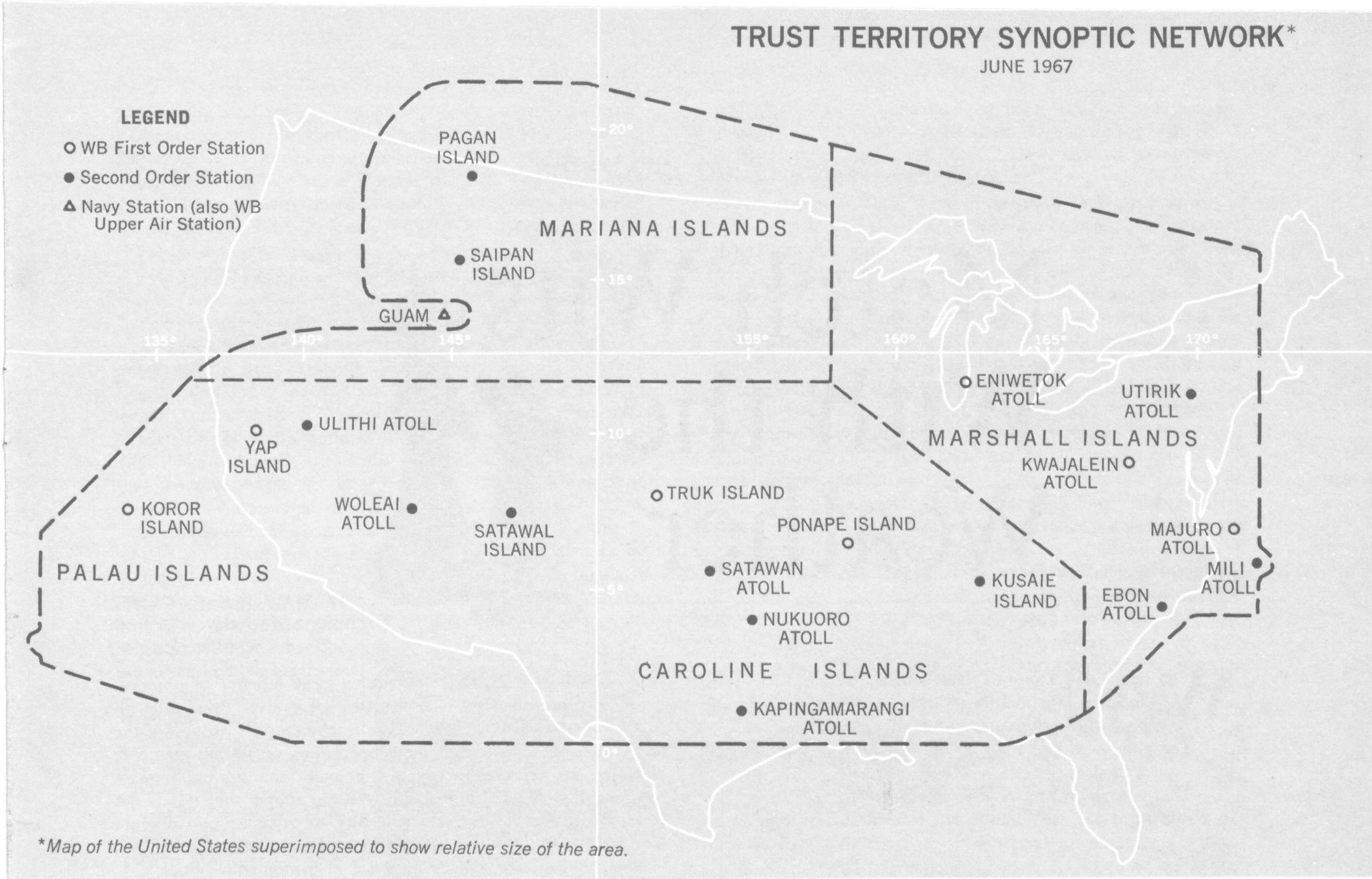
They will train two observers on each island, from two different families, so there will always be someone on the island at all times who can do the job.

In getting the PCV weather program off the ground, there were exasperating delays—equipment shortages, errant shipments, district field trip schedules that appeared to change from hour to hour, often the unavailability of the PCV for training at the District Centers—all compounded by the chronic problem of staff shortages at the Weather Bureau stations in the Trust Territory.

April was the "breakthrough" month. Two Micronesian observers from the Majuro station, Yoshio Samuel and Principal Assistant Tony Mamis, boarded a field trip ship for the atoll of Utirik in the northeastern section of the sprawling Marshall district. At 0600 on April 11 the first synoptic observation was transmitted to the district radio station on Majuro, then relayed over Trust Territory, military, and FAA circuits to the Guam and Honolulu forecast centers. On the following day, the first report went out by radio from Kapingamarangi, southernmost island in Micronesia. Then, within a month, six more stations joined the ranks—Nukuoro, Satawal, Mili, Satawan, Ebon, and Pagan—with twice-a-day observations. The first phase of Operation PCV was completed.

District vessels on field trips are usually expected to discharge their cargo of largely rice, canned fish, sugar, fish hooks, and bolts of cloth—simultaneously hauling aboard sacks of copra—in a very few hours before setting sail for the next port of call. In this respect, Akira Suzuki, the Principal Assistant, and Electronics Technician Marvin Walsh, both from the Weather Bureau station on Ponape, were a bit more fortunate on their trip to Nukuoro and Kapingamarangi. During the roughly 48 hours available to them on "Kapingi", they had only to meet the local population; dicker with the Chief Magistrate for suitable space for the station (atoll "real estate" is privately owned); erect the wind mast, instrument shelter, and gage support; install the anemometer and vane (including orientation), rain gage, extreme thermometers, psychrometer, and aneroid barometer; instruct the PCV in taking, encoding, and transmitting synoptic observations and in preventive maintenance; make diagrams of the installation and visibility charts; and supervise the first observation.

An economic factor underlies one of the most vexing problems of the PCV weather operation in Micronesia. The principal cash crop on all of the islands is copra, dried coconut meat that can be processed for a number of commercial uses. The area of a typical Micronesian island is less than two square miles. Except for a small number unfortunate enough to have been decimated by a typhoon or ravaged by the destructive coconut beetle, most of the productive islands are nearly covered with coconut palms—frequently sixty feet or more in height. But what is good for the local economy is by no means good for a suitable exposure for wind equipment. Coconut trees represent wealth and the island chiefs are understandably reluctant to cut down a money-making proposition for the whims of science. Frequently, they are adamant in their refusal to part with a single tree. On the island of Tobi in



Map of the United States superimposed to show relative size of the area.

the Palau District, where a PCV weather station is planned, the technician-in-charge of the Koror Weather Bureau Office reports "a request from the Chief that he be paid ten dollars for each coconut palm that is cut down. Fortunately, the spots picked out would require no more than two palms being cut down and possibly none."

The difficulties encountered in establishing weather programs on the outer islands of Micronesia have been legion. Some of the problems were anticipated, many were inconsequential, a few were bizarre. Most important of all, solutions have somehow been forthcoming, thanks to the ingenuity and good faith of a good many individuals of highly varied backgrounds.

In his endorsement of the PCV program, High Commissioner Norwood commented: "We do suggest that observational training include training of Micronesian alternates at all locations." Similar action has been recommended by several of the technicians-in-charge of Weather Bureau stations in the Trust Territory. Although there are a number of unknown quantities that must be considered—continuation of radio links, recruiting Micronesians who are interested in and capable of taking the observations, etc.—there is an excellent precedent for Micronesian weather training. Over 12 years ago the first Weather Bureau course of instruction in surface and upper air observations was completed successfully by a student body composed of Palauans, Yapese, Ponapenas, and Trukese. The second training class included Marshallese as well. Nearly all of the graduates of three classes are still employed by the Weather Bureau, many of them in supervisory positions.

No one can be certain just how long the Peace Corps Volunteers will be assigned to the Trust Territory. Even if their tenure is a long one, there are substantial and valid reasons for training Micronesian observers as soon as possible. The basic reason is that Micronesia is their land. The Pacific Region Headquarters has asked all supervision field stations to encourage the PCV observers in every way possible to provide on-the-job training of Micronesians in the operation of synoptic stations.

It is hoped that the eventual take-over by indigenous observers, who will receive a small payment for each observation transmitted, will ensure a long life for this valuable supplementary synoptic network in the Pacific. □

Technician-in-charge, Paul Woolard of the Guam Weather Bureau Office, visualizes the potential value to the Weather Bureau of a tie-in with new Peace Corps program in the Trust Territory.

Ingenious, small-scale programs help MIC's

Match Wits With the Weather

BY MAURICE E. PAUTZ
Technical Procedures Branch
Weather Bureau

When Eliza Doolittle was taught to say, "The rain in Spain falls mainly on the plain," she was making a weather observation, even if not intended.

The point was that the rain did not fall everywhere, but mostly on a small area.

That is true in the United States, as well. Anyone caught in a rainstorm can see nothing but falling water around him and is unable to appreciate how restricted the area of precipitation really is.

It has been estimated that as much as 40 percent of the rain or snow that falls in most localities of this country occurs in weather systems measuring less than 150 miles.

Some of the most violent weather systems occur on scales of less than 50 miles in extent and, sometimes, just a few yards.

This is small scale, but this is where the action is. Of necessity, this is where the Weather Bureau is directing its greatest attention.

In order to emphasize the need for greater detail in short-range forecasts, a Bureau-wide program for Small Scale Analysis and Short-Range Prediction has been established and all stations encouraged to participate as fully as their resources allow.

The intent is to encourage field forecast offices to develop operational techniques for analysis and prognosis of weather systems which complement the guidance products provided by the National Meteorological Center. The primary goal is to improve the capability of field offices to adapt and augment the large scale analyses and prognoses to local conditions, adding the detail necessary to account for the time and spatial variations that characterize the weather.

In an effort to stimulate field participation in the program, an awards contest has been established to recognize superior accomplishments at field stations in the development of small scale analysis and forecast techniques.

One of the ESSA-Weather Bureau field stations judged to have an excellent small-scale program was developed under the leadership of Glen Sachse, Meteorologist-in-Charge at Norfolk, Virginia.

The small scale network for the Weather Bureau Airport Station at Norfolk includes a large number of observational sources spread over a rather large area. Practically all the small scale observers are members of groups using weather information in their operations or whose members would be expected to have a greater than normal interest in weather. Experience at Norfolk has shown that this is the most satisfactory and efficient way to organize and operate a small scale network from which observations of a reasonably high quality can be obtained at a moment's notice.

The Small Scale Program at Norfolk has a variety of data sources. About eight different types of facilities can furnish a maximum of 69 reports from as many locations with an additional potential of 85 reports from Virginia and North Carolina state highway patrol cars.

An example of how the program operates can be seen from this severe local storm situation:

On the day in question, a severe weather watch was issued by the Severe Local Storms Unit of the National Severe Storms Forecast Center at Kansas City, Missouri, at 10:40 EST calling for a few tornadoes between 11:00 A.M. and 5:00 P.M. over much of the Norfolk area of forecast responsibility. At the time of issuance of the watch, the weather associated with the approaching cold front was over the Appalachian Mountains and no squall line had yet developed.

The Norfolk Weather Bureau office made its first call to a radio station in the extreme western portion of its area of responsibility, since that area would probably be affected first. Afterwards the Norfolk office called radio outlets progressively eastward—always giving them watch information and requesting them to make collect calls to the Bureau should any severe weather occur or be reported to them. Shortly after noon, the radio station called and reported that a funnel cloud had been observed nearby at noon and that shortly afterwards the sky had cleared rapidly. By use of radar and spot checks with other local observers and reports from state police units, the Norfolk office followed the severe squall line as it moved rapidly eastward, crossing the local area and moving out into the Atlantic at 1:30 P.M. Although no more tornadoes were reported, the office learned from the various local reports that all significant activity was concentrated in the fast moving squall line with rapid clearing following at all locations afterwards. Because of this knowledge, the Norfolk Weather Bureau was able to issue an "all clear" statement to a metropolitan area of a million concerned people at 1:30 P.M. instead of 5:00 P.M. as was called for in the tornado watch.

A second example of the usefulness of the small scale network, (illustrated on the following pages), is shown in the technique used in following the progress of the leading edge of precipitation. This technique has been used many times to "sharpen" the local forecasts. The nearest regularly-reporting weather stations to the west and south of the Norfolk area are over 100 miles distant; therefore the importance of small scale reports can be easily seen. In this type of situation, the Norfolk office frequently uses radio stations, since they routinely call for forecasts at six hour intervals. These stations send observations to, as well as receive forecasts from, the Norfolk office. These local observations usually enable the office to obtain a much more accurate indication of the advance of precipitation than is possible with the widely-spaced regularly reporting network.

The small scale network is utilized also for situations involving stationary fronts, fog moving in from the ocean, on-shore gale warnings and the problem of occurrence of rain and snow.

The use of the small scale network reports has proven useful in the Norfolk area, which has a complicated land mass-water distribution with its night and day, as well as seasonal, variations. Through these reports, forecasters are able to determine local effects operating at any given time and to allow for these effects in the issuance of local forecasts. The on-call capability of many of the small scale reporting points permits the office to issue more timely and detailed information resulting in better weather service to the users in the area.

A — Smoke plume from cement plant with the Elkhorn Mountain ridge above in the distant background. Plume has flattened in typical under-inversion fashion.

B — Meteorologist using a clinometer to measure the angle of the top of the plume.

Another excellent small scale program is that developed by the ESSA-Weather Bureau Airport Station at Helena, Montana, under the leadership of Richard Dightman, Meteorologist-in-Charge.

While large scale weather analyses present most features of significance in varying degrees of detail, many aspects of the day-to-day weather are modified considerably by small-scale features generated by the mountain-valley topography common in the Northern Rockies. The Helena Valley is nearly surrounded by mountains. A natural exit is through the narrow canyon of the Missouri River some 15 to 20 miles north of the community. The valley weather regime is inter-mountain, and small-scale modifications at times produce weather apparently almost totally unrelated to large-scale patterns. Small scale analysis and prediction techniques, particularly for periods up to 12 hours, are essential.

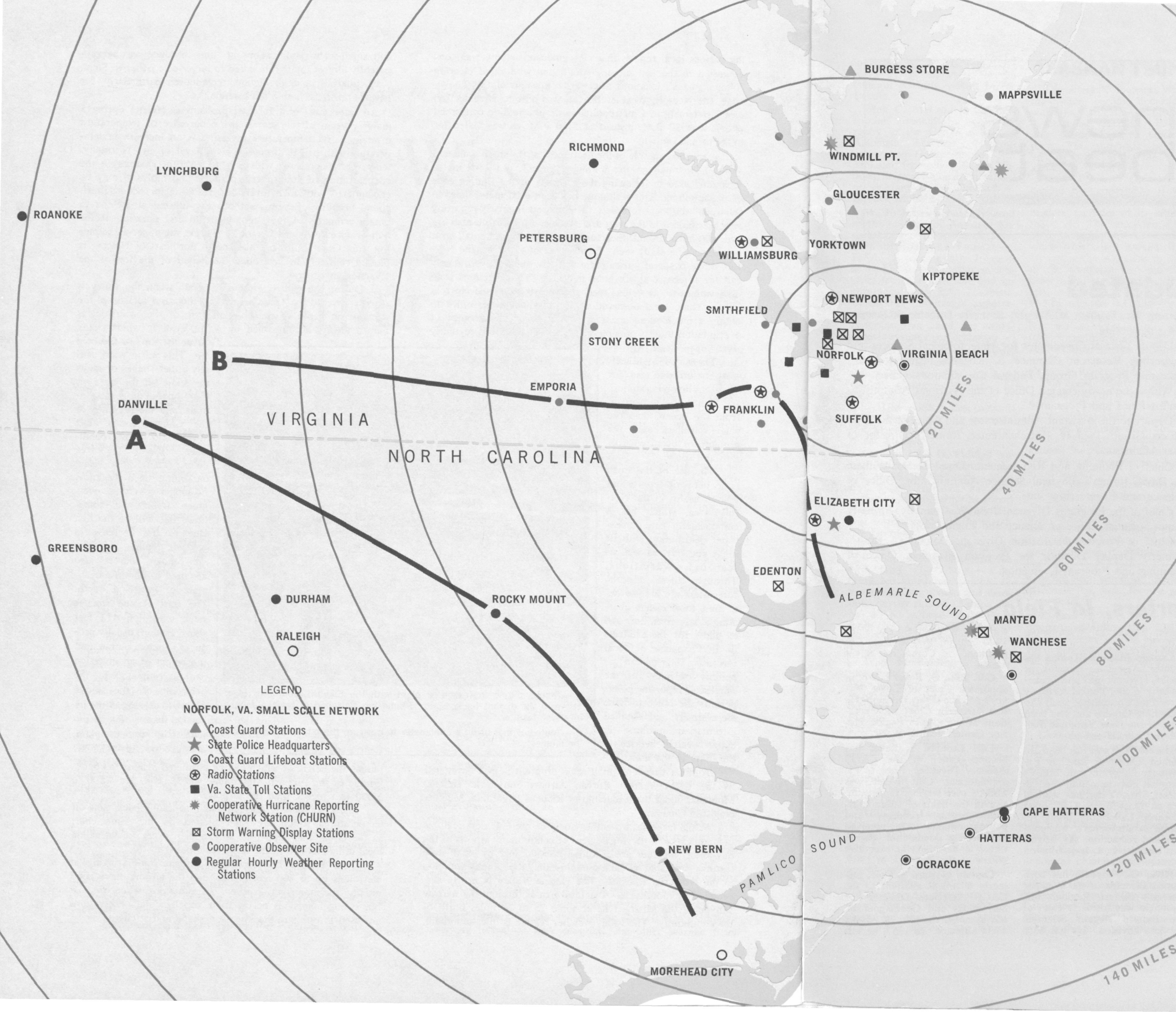
An important local forecast problem at Helena during a major portion of the year is the occurrence of temperature inversions. (A temperature inversion is an increase in temperature with height through a given layer of air. Normally, temperature decreases with height.) Abrupt changes in the concentration of atmospheric particles and moisture may be encountered with such inversions, resulting in reduced horizontal visibility. Several methods are utilized at Helena to obtain estimates of the strength, depth and duration of the temperature inversion. On the large scale, the upper-air sounding from Great Falls, 60 miles north northeast of Helena, is plotted routinely to determine the height of the top of the inversion in general.

During the winter, after a snowfall, when the valley is usually covered by Arctic air several thousand feet deep, the decrease in depth of the cold air (top of the inversion) is almost always accompanied by warm westerly winds riding "over the top" of the cold air. This warm wind usually either shakes or melts the snow off the trees on the surrounding mountains, and the presence of the "Chinook winds" aloft always (in snow conditions) reveals the tree color. There is a visual darkening since the snow no longer covers the evergreen trees, and sometimes this will be the first clue to the decrease in cold air depth.

Smoke sources also are used to obtain an estimate of inversion depth. The East Helena smelter stack (elevation 412 feet above ground) usually produces a smoke plume, and the height of an inversion can be estimated by the behavior of the smoke plume (flattening at the inversion base). The Montana City cement plant, also produces a "reliable" plume, the height of which can be estimated against the background of the Elkhorn Mountains, whose peaks are 4,500 to 5,000 feet higher than the airport.

Pilots sometimes are requested to radio back take-off temperatures which are then plotted on the same chart as the Great Falls upper-air sounding in order to determine local differences from the large scale pattern.

Several Helena ESSA-Weather Bureau staffers living at elevations up to 400 feet higher than the airport have good quality thermometers exposed. In situations when shallow but strong inversions occur, these supplemental observations are used to estimate the inversion shape and strength.



SMALL SCALE ANALYSIS AND SHORT RANGE PREDICTION

On the day this technique was used, the afternoon guidance forecast indicated a 50 percent probability of precipitation for the area for the period from 7:00 P. M. Before the Norfolk late afternoon local forecast was released, the forecaster on duty determined from the small scale network reports that the leading edge of the rain was moving significantly northeastward and had almost reached the Norfolk area. The line "A" on the map indicates the leading edge of the precipitation at 4:00 P. M. EST as deduced from the routine hourly observations at that time. Line "B" indicates the leading edge of the precipitation as reported by the Norfolk small scale network at the same time. As a result, the Norfolk local forecast called for rain with a probability of near 100 percent. The rain actually began about 5:30 P. M. and the local forecast verified completely.

Another technique in Helena is the use of local surface winds. For example, the Helena wind direction might be from the northeast while the large scale flow pattern would indicate the wind should be from the southeast. Such a variation in direction suggests the existence of an inversion when other indicators are indefinite. Conversely, if the local surface wind agrees well with the large scale flow, the existence of an inversion should be questioned. It can be present, but other confirmation is sought.

An objective method developed for forecasting maximum temperature is another Helena technique. A chart was developed using the 8:00 A.M. Helena temperature, the 10,000-foot temperature from the 5:00 A.M. upper-air sounding at Great Falls, and the surface temperature difference between 8:00 A.M. and 5:00 A.M. at Helena as parameters. Maximum temperatures for many days for May through September are easily forecast by the use of this objective chart. Certain average corrections are applied according to the forecast of sky condition and weather for the day.

An example is shown by the maximum temperature forecast for June 28, 1966. Using the 5:00 A.M. temperature of 55 degrees F, the 8:00 A.M. temperature of 67 degrees F, and the 10,000-foot temperature of 9 degrees Centigrade from the Great Falls upper-air sounding, a temperature of 96 degrees F was indicated on the chart. By applying the correction for the Helena local forecast of partly cloudy and a trace of precipitation, (—3.0 degrees), a temperature of 93 was indicated, and this temperature was in the official forecast at 9 A.M.

The actual maximum temperature recorded that afternoon at Helena was 93 degrees. This exceeded the all-time record for that date since records were started in 1880. The previous record for June 28 was 88 degrees.

The Norfolk and Helena efforts are but two of many excellent small scale programs in the ESSA-Weather Bureau. Other award-winning stations with such programs are: Brownsville, Texas; Denver, Colorado; Savannah, Georgia; Worcester, Massachusetts; Salem, Oregon; North Platte, Nebraska; Huntsville, Alabama; St. Louis, Missouri; Chicago, Illinois; and Mobile, Alabama. □

essa news beat

Moore Named to New Post

ESSA Offices Consolidated

ESSA's Offices of Planning and Program Evaluation, Science and Engineering and User Affairs have been consolidated into one office under the direction of an Assistant Administrator for Plans and Programs. Pending permanent assignments, the following officials have been designated by Dr. Robert M. White, Administrator, to serve in these positions:


Donald F. Moore

Assistant Administrator for Plans & Programs: Donald F. Moore, formerly Deputy Federal Coordinator for Meteorological Services and Supporting Research.

Assistant Deputy Administrator for Policy Development, within the Office of the Administrator: Walter A. Hahn, formerly Director of Planning and Program Evaluation.

Special Assistant to the Administrator for Science and Engineering: Dr. William V. Wright, formerly Director of Science and Engineering.

Deputy Federal Coordinator for Meteorological Services and Supporting Research: Clarence E. Roache, formerly Chief, Operating Program Group, Federal Coordinator's Office.

Within the newly-created Office of the Assistant Administrator for Plans and Programs:

Deputy to the Assistant Administrator and Chief of the User Affairs Group: Paul H. Kutschenreuter, formerly Director of User Affairs.

Chief of Planning and Requirements Division: Dr. William O. Davis, formerly Physical Science Administrator, Office of Science and Engineering.

Chief of the Programs Division: John W. Connolly, formerly Senior Scientist, Office of Science and Engineering.

Chief of Program Evaluation Division: Donald C. House, formerly Deputy Director for Program Planning, Office of Planning and Program Evaluation.

Personnel Changes At Headquarters, In Field

Numerous personnel changes have been made throughout ESSA in recent weeks. Among them are the following:

Brigadier General Benjamin G. Holzman, USAF (Ret.), was sworn in September 6 as Deputy Director of the Environmental Data Service.


Gen. Benjamin G. Holzman

General Holzman was Commander of the Air Force's Cambridge Research Laboratories from 1960 until his military retirement in 1964 when he joined the National Aeronautics and Space Administration as Special Assistant to the Associate Administrator for Advanced Research and Technology.

He has served as Vice President of the AMS, Vice President of the AGU, and President of the AGU Meteorology Section. He is currently an Associate Fellow of the American Institute of Aeronautics and Astronautics.

Col. Frederick O. Diercks, retired Army officer, has been named Associate Director of C&GS for Aeronautical Charting and Cartography. Col. Diercks' most recent assignment was as Director of the U.S. Army Coastal Engineering Research Center in Washington, D. C.

Captain Miller J. Tonkel has become Associate Director of C&GS, Hydrography and Oceanography. Capt. Tonkel formerly headed the Continental Shelf Coordinating Group, and has been chief of the New York and Baltimore Field Offices.

Harold W. Yates has been appointed Director, Satellite Experiment Laboratory of ESSA's National Environmental Satellite Center. Mr. Yates has worked as a physicist for the U.S. Naval Research Laboratory doing research in atmospheric transmission and refraction, sky brightness measurement, and radiation detector evaluation.

Silvio G. Simplicio has been named Director of the Weather Bureau's Eastern Region. Mr. Simplicio was formerly chief of the Eastern Region Scientific Services Division. He has been with the Weather Bureau since 1946, and in 1960 won the Department of Commerce Silver Medal.

Cdr. John O. Boyer has been appointed Chief of Coast Survey's Marine Chart Division. He was formerly Chief of Operations at the C&GS Pacific Marine Center, Seattle, Wash.

Cdr. Leonard S. Baker has become Chief of the C&GS Geodesy Division. Prior to his appointment, Cdr. Baker was ESSA's user services representative in the fields of seismology, geomagnetism, geodesy, and photogrammetry. He received the Bronze Medal for exceptional management as executive officer of the PIONEER in 1965.

Captain Howard S. Cole, formerly technical assistant to the C&GS Associate Director for Seismology and Geomagnetism, has assumed the post of Alaska Field Director. In 1957, he was in charge of the Honolulu Observatory, headquarters for the tsunami warning system in the Pacific.

Max C. McLean is the new special assistant for oceanography in the C&GS Office of Associate Director, Hydrography and Oceanography, Mr. McLean, formerly with the National Science Foundation, served as assistant to the Director of Project Mohole.

W. E. Johnson has advanced to the position of Assistant Director of the Tropospheric Telecommunications Laboratory, ITSA. Replacing Mr. Johnson as the Laboratory's program area chief for data reduction and instrumentation is R.W. Hubbard. In another Laboratory appointment, D.R. Macken was named program area chief for tropospheric systems performance.

Captain Lorne G. Taylor, formerly chief of the Marine Chart Division, C&GS, has succeeded Captain William F. Deane as commanding officer of the USC&GSS DISCOVERER. Capt. Taylor recently received the Department of Commerce Silver Medal.

Captain John O. Phillips has been appointed Captain of the USC&GSS PATHFINDER. Phillips, a civil engineer, has seen extensive sea duty since he joined the Coast Survey in 1942. He was formerly chief of the Geodesy Division.

Cdr. Pentti A. Stark is the new commanding officer of the USC&GSS EXPLORER. Cdr. Stark has spent most of his 17 years with the Coast and Geodetic Survey aboard 12 ships. He has served as head of the Portland, Ore., C&GS office, and as assistant operations officer at the Atlantic Marine Center.

Arlin E. Snider, a former meteorological officer in the Air Weather Service, has been selected to fill the State Climatologist position at the North Dakota State University at Fargo, North Dakota.

Paul B. Holcomb is the new meteorologist-in-charge of the Sioux City, Iowa, WB airport station. For the last three years, he has been principal assistant at the Duluth airport station.

William R. Long is meteorologist-in-charge of the Weather Bureau Office at Trenton, N.J., and User Services Representative for New Jersey. He has served at Topeka, Cincinnati, Nashville, and Memphis.

Clarence A. Wardman has been named meteorologist-in-charge of the Alpena, Mich., WB airport station. Mr. Wardman has been principal assistant at Evansville, Ind., for the past four years.

Richard E. Moll, former Administrative Officer for C&GS' Pacific Marine Center, has been appointed Administrative Officer for the Institute for Atmospheric Sciences (IER) at Boulder.

Alan H. Shapley has been named Assistant Director of ITSA for Program Planning and Liaison.

Commander Harley D. Nygren has taken command of the USC&GSS SURVEYOR. Cdr. Nygren is a veteran of 20 years' service with C&GS. He has served as chief of the C&GS Program Planning staff, and Deputy Director of the ESSA Office of Planning and Program Evaluation.

Dr. Eugene L. Peck has been appointed chief of the Research Branch in the Weather Bureau Office of Hydrology's Hydrologic Research and Development Laboratory. Mr. Peck worked at Western Region headquarters prior to his new assignment.

Captain Emerson E. Jones, formerly commanding officer of the USC&GSS EXPLORER, has joined the Environmental Data Service as head of its planning group.

Dr. Gilbert C. Jacobs has joined the staff of the C&GS Director's office. He has served as chief of personnel and training branch with the U.S. Army, as Administrator of the Digital Computer System in the Office of the Special Assistant to the Chief of Staff, Army, and professor and research director at George Washington University.

Robert D. Goodrich is the new chief of the Distribution Division of the C&GS Office of Aeronautical Charting and Cartography.

Samuel O. Grimm, Jr., has been named to head the Emergency Warnings Branch of the Weather Bureau's Weather Analysis and Prediction Division. Mr. Grimm has been with the Emergency Warnings Branch for two of his 25 years service with the Weather Bureau.

ALASKAN TSUNAMI WARNING SYSTEM IN OPERATION

The Alaskan Tsunami Warning System became operational with the dedication September 2, of its nerve center, the Palmer Seismological Observatory. The statewide network will be operated by the Coast and Geodetic Survey.

The Palmer Observatory, headed by geophysicist Howell M. Butler, is one of the most modern facilities of its kind in the world. The observatory will serve as headquarters for a network which will extend from far out in the Aleutians to Sitka in the southeast and north to College, with a direct tie-in via teletypewriter with the overall Pacific tsunami warning system and the International Tsunami Information Center in Honolulu. Vital information will also be furnished to the ESSA National Earthquake Information Center in Rockville, Md.

Aftermath of a tsunami is a major toll in destruction and often a loss of life.

The new regional tsunami warning system is part of ESSA's nationwide Natural Disaster Warning system, designed to improve warnings of a host of natural hazards including tornadoes, hurricanes, floods, severe winter storms, and solar disturbances.

The Alaskan system will permit more rapid warning of impending seismic sea waves. It will consist of the Palmer Observatory and two seismic auxiliary stations located 25 miles south and west of Palmer; seismological observatories at Sitka, College and Adak; and tide stations at Shemya, Adak, Unalaska, Cold Bay, Kodiak, Seward and Sitka.

A complex communication and telemetry network will connect all facilities in the Alaskan system. Arranged by the Defense Communications Agency and installed by the Air Force's Alaska Communications System, the communications network will enable the observatories and tide stations to provide timely seismic and tidal data to the Palmer Observatory.

The observatory will operate 24 hours a day. It is one of a large network of earthquake detection stations operated by the Coast and Geodetic Survey. The Palmer Observatory is equipped with the most modern and reliable instruments available to assist in the accurate determination of the location of earthquakes throughout the world and to provide vital information related to the various aspects of engineering seismology.

Documentary Film Produced By Survey

A new documentary motion picture film covering the history and development of the science of determining geographic positions on earth has been produced by the Coast and Geodetic Survey. The 16-mm, 48-minute film is in sound and color.

"Pathfinders From the Stars" depicts man's efforts from early exploration to the space age to determine more accurate positions over the earth's surface—on land, on sea, and in the air, and precise distances over the earth on which he lives.

The film is available on a free loan basis to schools, colleges and other educational institutions, educational television, professional societies and organizations, service groups and clubs. Requests for the film should be submitted to Exhibits Section (ESSA), Room 47, Bldg. #2, Washington Science Center, Rockville, Md., 20852.

Earthquake Center Marks First Year

ESSA's National Earthquake Information Center celebrated its first anniversary on August 15, after an action-packed year.

The first new service initiated by the NEIC was the Earthquake Early Reporting Service, designed to provide accurate information within a few hours on the location, magnitude, and significance of larger earthquakes. Formerly, this information was available only after several weeks, long after it had lost all value for scientists planning to study the effects in the epicentral areas and the aftershocks, for disaster relief agencies attempting to locate the probable center and extent of a disastrous shock, and for public information agencies troubled by conflicting reports.

The new service tied together ESSA seismological observatories at Tucson, Ariz.; Newport, Wash.; College, Alaska; Honolulu, Hawaii; Guam, Marianna Islands; and a three-station net in the Washington, D.C. area. These stations are equipped with alarms which are triggered whenever a large earthquake occurs anywhere in the world. The seismologists call in their observations to the NEIC where accurate locations are made. Reports from the tsunami warning system are also used, as well as the effects noted by Weather Bureau observers throughout the country.

The second new service was the Earthquake Information Bulletin. With this publication the ESSA National Earthquake Information Center is attempting to present a broad range of information—articles of general interest, announcements and notes of activities of interest to seismologists, references and discussions for students and others. The response has been gratifying, thanks largely to the cooperation of the seismologists who have attempted to put some complex ideas in everyday terms, without loss of accuracy.

The Center has provided a focus for direct inquiries from the whole spectra of groups needing earthquake information, including engineers, actuaries, teachers, architects, students, and many others.

The next year should bring many changes. The Earthquake Early Reporting Service will add more reporting stations, some foreign, and some recording in Washington, D.C., from distant sensing units. The number of earthquakes located, their accuracy, and the lapsed time will all be improved.

Continuous weather forecasts and warnings for Washington area via VHF transmission were inaugurated by Dr. George P. Cressman, Weather Bureau Director, in ceremony at Suitland, Md., on August 10. Washington is the Nation's seventh city to have this service, of special interest to boatsmen.

47 Bronze Medal Winners Named

Bronze Medals have been awarded to 47 ESSA employees for exemplary accomplishments. The medal is the highest award a Commerce agency can give an employee. Recipients were:

ESSA—Shirley Edwards and Raymond P. Hogan.

Coast and Geodetic Survey—Isaiah Y. Fitzgerald, Fred B. Engelbrecht, Robert E. Glacken, Byron P. Roberts, James Smith, Charles R. Wittmann, John R. Schmitz, Gilbert F. Lee, Dudley Doe, Frank H. Werner, Frederick L. Larsen, Elgan Jenkins, and Woodrow W. Feazel.

Weather Bureau—Henry L. Jacobson, Francis D. Beers, Ray E. Hall, Archie Bloom, Robert Kirkpatrick, Jr., Harry Weirauch, Philip Williams, Jr., Richard A. Dightman, Halbert E. Root, Gilbert L. Sternes, Harold C. McComb, Dwight A. Rigney, John C. Purvis, Edward G. Jacob, Alex J. Kish, Fred L. Horton, John W. Zimmerman, John P. McCallister, Oliver H. Newton, Vance P. Barich, Jr., Harold Alexander, Donald S. Foster, Stanley J. Lacy, Charles G. Reeves, and Charles F. Roberts.

Environmental Data Service—John L. Baldwin, Milton G. Johnson, Marcus Snelson, Gilbert E. Stegall, and Theodore R. Farmer.

Institutes for Environmental Research—Dean Smith and Paul I. Wells.

ESSA and Air Force To Share Computer

A third-generation computer facility will be installed at Asheville, N.C., for use by ESSA and the Department of the Air Force. It will be installed by the Radio Corporation of America.

Agreement to rely on a joint computer facility was reached on the basis of system feasibility studies and interdepartmental coordination.

ESSA's National Weather Records Center in Asheville maintains the records that flow in daily from thousands of weather observing stations in the United States and from other countries. These are processed and checked by specialists to ensure scientific accuracy and rapid availability to Government agencies, industry, and the scientific community.

The Air Force Environmental Technical Applications Center's Data Processing Division is responsible for preparing specialized aerospace studies for both the U.S. Air Force and U.S. Army. The resources of ESSA's National Weather Records Center are frequently used in preparing these studies.

Both agencies have common and increasing computer needs, some of which could not be met with their existing systems operating at full capacity.

The computer will meet the needs of both agencies in one integrated system, and will provide room for expansion as the flow of data increases in future years.

More efficient services to civil and military customers will be available through faster data processing speeds, common-use programs, and more efficient access to stored data.

A Joint Management Activity has been established at Asheville, with the local managers of both agencies responsible for operation of the joint-use facility. The U.S. Navy will have an observer assigned to the Joint Management Activity.

Hurricane Hunters May Overfly Cuba

A United States request for permission to fly over Cuba to make observations of tropical storms has been granted by the Cuban Ministry of Foreign Affairs.

The letter allowing permission, sent through the Swiss Embassy, says that Cuban authorities "find no objection to authorizing flights over Cuban territory by official United States airplanes that are conducting observations of tropical storms."

It also stated that flight schedules of such aircraft must be submitted to Cuba's Air Transit Control Service, and the airplanes must remain in radio communication with that service when they are in the area under its control, in compliance with international air transit regulations.

In the past, hurricane-tracking U.S. aircraft have turned away 50 miles from the Cuban shore and, to track storms south of the island, have taken a circuitous route.

Smagorinsky Lab To Move North

The Institute for Atmospheric Sciences' Geophysical Fluid Dynamics Laboratory, headed by Dr. Joseph Smagorinsky, will move next summer from Washington to Princeton University.

Princeton is constructing a building for the IAS laboratory on its Forrestal campus. The laboratory will engage in cooperative research with faculty members and graduate students.

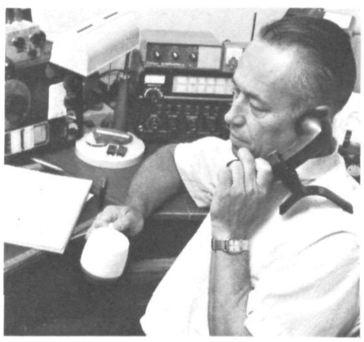
Dr. Smagorinsky's research laboratory has made significant contributions to the sophisticated science of atmospheric modeling.

IER Radio Ham Gives Aid in Alaskan Flood

August 15 started as a routine day for Stephen S. Barnes, Assistant Chief of the Administrative Services Division, IER. Before he had time to finish his breakfast coffee, however, he was serving as a communications link between a radio operator in flooded Fairbanks, Alaska, and Congressmen, Federal emergency officials, and newsmen in the states.

Barnes is a ham radio operator. From his shack in the basement of his home, he communicates with other operators around the world before work in the morning and after dinner most evenings. This morning, he was trying to contact James Wells of the Institutes for Atmospheric Sciences aboard the USC&GSS OCEANOGRAPHER in the Indian Ocean.

James McGuire, the radio operator in Fairbanks, heard Barnes' call and asked for help in contacting Representatives Donald Brotzman of Colorado and Howard Pollock of Alaska. All communications from Fairbanks were out of order except for one amateur radio station and one telephone circuit, and residents feared that the seriousness of their problem would not be recognized outside. McGuire was isolated on a non-floating boat in the Alaskan Centennial celebration area.



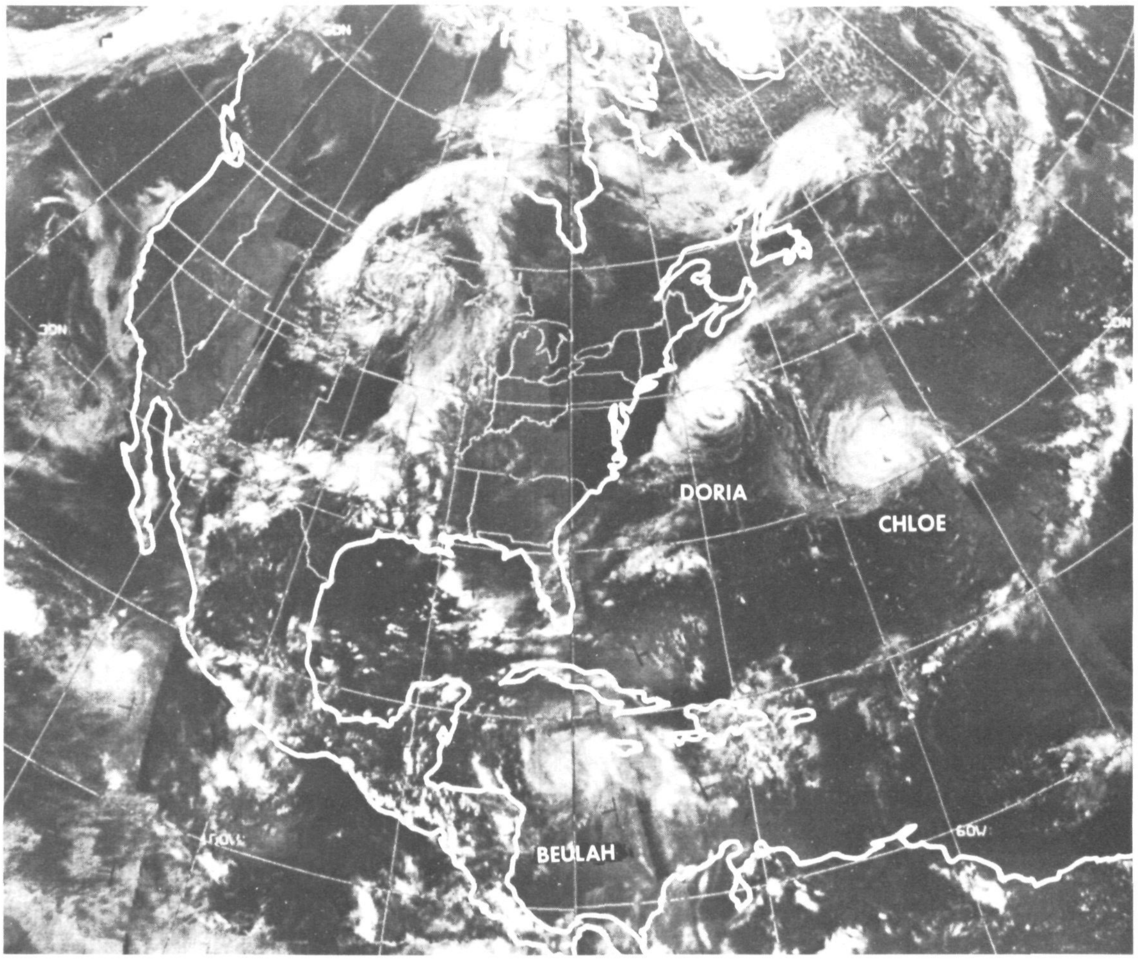
Station KØYKJ, with Barnes at the mike, responded to the appeal in the best tradition of ham radio. He contacted Congressman Brotzman, who sent for his Alaskan colleague. Congressmen Pollock and Brotzman were then connected to McGuire by phone patch. McGuire reported on flood conditions to his congressman, who immediately contacted the Office of Emergency Planning.

For the balance of the day, Barnes stayed at his radio, monitoring traffic to and from Fairbanks, providing a contact for messages between Fairbanks and the Boulder area. As emergency traffic subsided on the following days, he forwarded health and welfare messages from the flood area to friends and relatives in the western states.

KØYKJ is a familiar station to many IER staff members far from Boulder. Barnes contacts staff members in the Antarctic and provides phone patches so they can talk to their families regularly. Having spent a year at Byrd Station during the International Geophysical Year, he knows what a few words from home mean to isolated men. Jack Herbstreit, formerly Deputy Director of the Institute for Telecommunication Sciences and Aeronomy, and now Director of the International Radio Consultative Committee (C.C.I.R.), is another regular visitor from Switzerland via the ham station.

Barnes' station is a ham radio operator's dream. With two kilowatts of peak power, dual receivers, a sophisticated steerable antenna, and numerous special modifications, it provides worldwide, high-quality transmission and reception.

Hurricanes Beulah, Chloe and Doria, Viewed from the Sky



Hurricanes Beulah, Chloe and Doria as they appeared from ESSA 5 photos. During the hurricane season, digitized mosaics of ESSA 5 photographs, prepared at the Satellite Center, are being sped to the National Hurricane Center in Miami through the weather facsimile experiment aboard NASA's ATS-1 spacecraft. The mosaic transmitted on the evening of September 14 showed the positions of the hurricanes.

Coast Survey Gages Aid Weather Bureau

Twenty-three Weather Bureau stations on the east and gulf coasts now receive continuous reports on tide conditions from Coast and Geodetic Survey tide gages.

Readings taken by the gages, transmitted directly into Weather Bureau offices, enable ESSA weathermen to warn coastal residents more quickly of potentially dangerous conditions.

Although hurricane winds cause extensive destruction, the greatest single cause of death in hurricanes is drowning. As a storm moves across the coastline, it piles up great quantities of water against the shore. Water levels may be more than 15 feet above normal, often rising six feet or more within minutes. These storm surges flood low-lying areas and cut off escape routes.

The most destructive storm surges, however, are associated with winter storms. In March 1962, strong winds and high water pounded the entire east coast, causing 30 deaths and several hundred million dollars' damage.

Weather Bureau stations equipped with remoted tide recorders are Boston, Providence, New York (both the city office and the station at LaGuardia Airport), Atlantic City, Philadelphia, Baltimore, Washington, D.C., Norfolk, Charleston, S.C., Jacksonville, Daytona Beach, Miami, Key West, Tampa, Apalachicola, Pensacola, Mobile, New Orleans, Brownsville, Corpus Christi, Galveston, and Port Arthur. In addition, readings from nonremoting tide gages are available to these and other coastal Weather Bureau stations upon request.

The Weather Bureau, in cooperation with the Coast and Geodetic Survey, plans eventually to attach the new remoted tide recorders to C&GS tide gages at 90-mile intervals along the east and gulf coasts.

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