U.S. DEPARTMENT OF COMMERCE ENVIRONMENTAL SCIENCE SERVICES A TRATION JULY 1968

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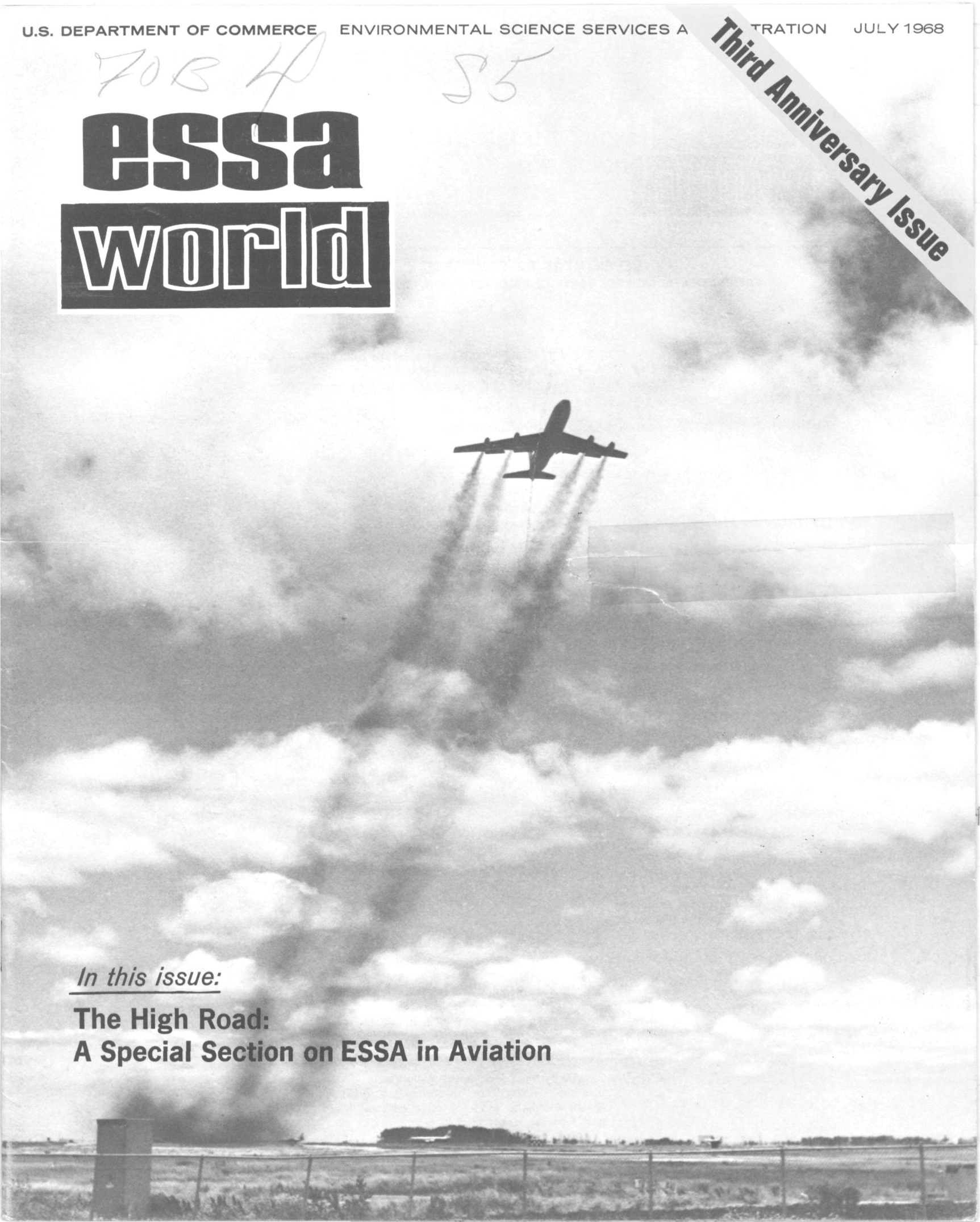
Third Anniversary Issue



In this issue:

The High Road:
A Special Section on ESSA in Aviation

National Oceanic and Atmospheric Administration

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U.S. DEPARTMENT OF COMMERCE, C. R. SMITH, Secretary
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION, Dr. Robert M. White, Administrator
Dr. Werner A. Baum, Deputy Administrator

page

3. A Message from the Assistant Secretary of Commerce For Science and Technology
4. You'll Love It, Don't Let It Kill You
7. The High Road — A Special Section
8. Winging on the Wind
11. EDS: Aviation's Planning Partner
13. Sky Taxi
16. The Airport Profile
18. The Changing Challenge
20. Twenty Million Travelers
24. They Fly for Science
27. Where Time Stands Still
31. What Makes Old Faithful Gush
32. Peary and the North Pole
36. Newsbeat

COVER
Jet takeoff from a modern airport highlights ESSA's special section on aviation, The High Road.

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ASSISTANT SECRETARY OF COMMERCE
FOR SCIENCE AND TECHNOLOGY

A Message from the Assistant Secretary of Commerce for Science and Technology

"It was the best of times; it was the worst of times . . ."
A Tale Of Two Cities.

The Environmental Science Services Administration will be three years old on July 13, 1968.

It is a genuine pleasure for me to offer anniversary congratulations to this dynamic young Commerce agency. My pleasure, however, is tempered by the knowledge that the coming year will not be without some extremely challenging problems. For ESSA, like the rest of the Federal establishment, clearly faces a time of considerable austerity.

The Environmental Science Services Administration was conceived in a spirit of boldness, imagination and high resolve to execute a major mission: to serve as the national focus for the understanding, description and prediction of the physical environment. We must call upon this imagination and resolve to the fullest extent of our capabilities in the year ahead. For an organization of dedicated men and women, impatient to get on with the job, the major danger in periods such as this is not the fact of austerity; it is the spectre of simple frustration, and the loss of momentum and will.

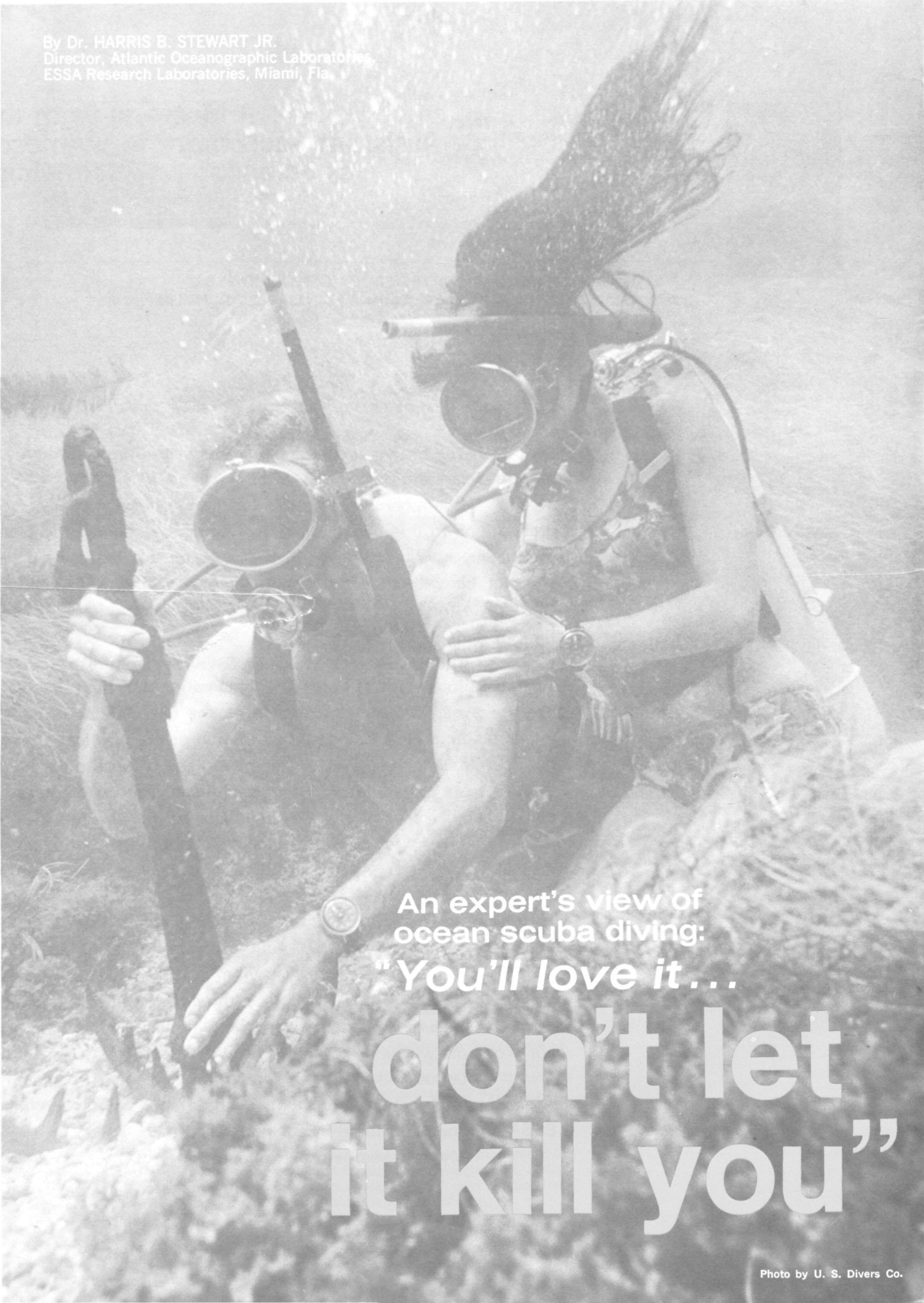
Let us remember that the worst of times often bring out the best in us, and that few really worthwhile things are easily accomplished. ESSA's mission is vital to the safety, convenience and well-being of America. Let us remember that the austerity which faces us today cannot always be with us; over the long haul, our programs will find the proper level of support.

Let us, therefore, continue in the same spirit of determination for high achievement that, in three short years, has made ESSA a compelling force in our national life.

My very best wishes to you all. □

John F. Kincaid

By Dr. HARRIS B. STEWART JR.
Director, Atlantic Oceanographic Laboratories,
ESSA Research Laboratories, Miami, Fla.



An expert's view of ocean scuba diving:

"You'll love it... don't let it kill you"

Photo by U. S. Divers Co.

THIS summer some 300,000 persons in the United States will don ducklike flippers, a cyclopian faceplate, heavy weight belt and one or more air tanks, and wade into the ocean through the surf or roll in over the gunwale of a boat somewhere off the coast.

More people than ever will learn the sheer joy of unfettered swimming, suspended above the bottom and glorying in the magnificence of the seascapes beneath. Once you have tried it, you return again and again to that quiet realm of gentle motion, graceful creatures, swaying seaweed and oceanic peace. You travel in a three-dimensional world. You are free. You are an explorer, enjoying new sights, new sounds, new sensations, new motions, new peace.

It is a good feeling and you will love it. Don't let it kill you.

Most of the Americans who go scuba diving this summer will come back, but a tragically large number will die in the ocean. Since 1960 in Florida alone, some 40 scuba divers have perished in the Atlantic — and most of these deaths could have been avoided.

The really dangerous aspect of scuba diving (and scuba is an acronym for self-contained underwater breathing apparatus) is that anyone can do it. You can don the gear with no instruction, wade into the ocean and swim underwater on a man-to-man basis with the fish who have lived there all their lives. There are no special valves to master, no dials to read, no special techniques to learn; you don't even have to be a strong swimmer. This is the great danger of scuba diving. Anyone can do it — as long as all goes well.

Many problems can arise, however, and the reactions to these problems are what sort out the living from the dead. What happens if your faceplate gets kicked off at 50 feet? If you run out of air at 100 feet? if your intake hose fills with water? What happens if you lose your weight belt and pop to the surface holding your breath? if you get stuck in a wreck and another diver comes down to help you out and offers you his mouthpiece?

These are the mechanical, the technical problems that require that you have a complete scuba indoctrination and checkout in a pool before you ever approach the ocean. This pre-ocean training is vitally important. Like learning to drive a car, you must first learn how to operate the equipment and how to react when the unexpected happens. Any person who scuba dives in the ocean — or anywhere else, for that matter — without first having a complete checkout with a qualified instructor is asking for deadly trouble. It is this group that makes up a portion of the member of divers who do not come back.

Even after you have had the full course in a pool, there is still the transition between that shallow, clean, uninhabited, tideless, currentless inclosure and the ocean. It is the many differences between the pool and the real ocean that claim another portion of the divers who do not come back. It is to this group, this summer, that this article is directed.

What, in fact, are the peculiarly oceanic things that can threaten the pool-trained scuba diver? What should he know about the ocean if he is to increase his chances of coming back from his first dive or from his fiftieth?

The ocean is a magnificently complex environment. Those who spend their lives studying it are the first to admit that we know very little about it.

Currents are a universal oceanic phenomenon. If you have trained in a pool, the concept of currents has not yet been faced. Learn them and respect them. If you are entering the ocean from a beach through the surf, you will encounter currents as soon as you leave the dry land and enter the water. With your big fins made for swimming rather than for walking, moving out through the shallows can be difficult. Some move into the water backwards so their fins do not impede their progress. Others will carry their fins until they reach swimming depth and put them on there. Longshore currents are usually present between the shoreline and the surf zone, and you should be prepared to be carried parallel to the shore as soon as you stop walking and start swimming.

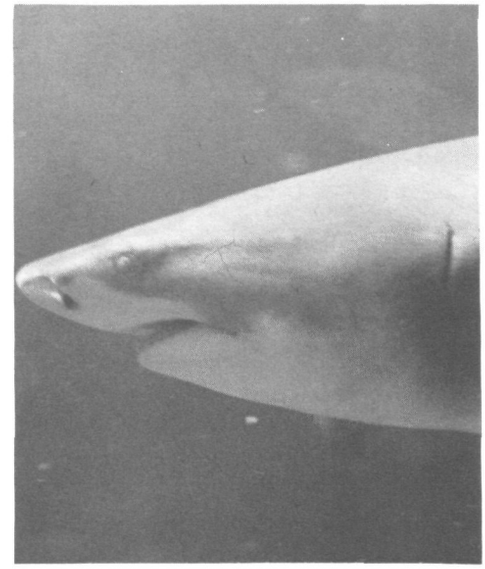
Rip currents — those narrow swift-moving currents that move seaward the water that piles up at the beach from wave action — are common along most of our long sand beaches. An experienced scuba diver might use a rip to carry him out into deeper water with less expenditure of his own energy, but an inexperienced diver might panic when he finds himself carried seaward at a fast clip. Learn about rip currents and how to spot them.

Once in your diving area, whether you have come out through the surf or rolled in off a boat, your first task on the bottom is to check the local current. Wear a compass on your wrist. They are cheap, and good ones are available. Lie motionless for a moment and see which way you move. If the water is shallow, the swell large, and the current small, you will find yourself moving back and forth as each wave crest and trough moves overhead.

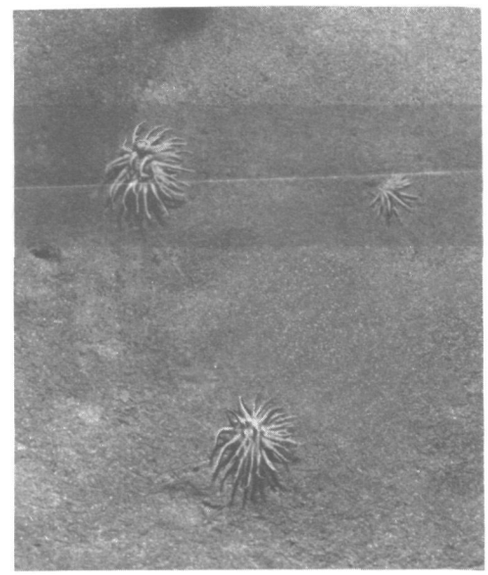
Learn to use this action, and swim harder with the surge than you do with the backsurge. If the surge is really big, you will find that the sediment on the bottom moves with the surge in what marine geologists call "sheet flow," and you will move too. You and the sand will be moving in the same direction and at the same speed, and there apepars to be no relative motion. As the forward surge stops and the sand settles to the bottom, you suddenly discover that you have been moving, and the "Einstein effect"

continued

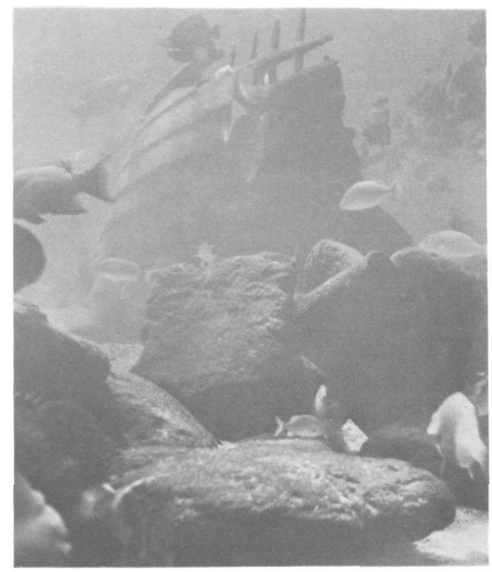
There is fun and fascination in scuba diving, but also great danger. . . .



sharks may be nearby . . .



sea urchins can puncture . . .



a wreck can be a trap . . .

Author Dr. Harris B. Stewart, Jr. in wet suit preparing for dive. (Right) Swimmer Sled capable of speeds up to 2½ knots and depths of 150 feet, carrying two divers.

Photo by North American Rockwell Corp.

can leave you confused. In some instances this totally unworldly effect has led to sheer panic. Learn of it and enjoy it. It is one of the many new sensations you will discover in ocean diving.

In most of our offshore areas within diving depth there is a current over and above the surge related to waves moving overhead. In places like the Santa Barbara Channel off California, these currents can be so strong that a diver hanging onto a rock outcrop at fifty feet finds himself waving like a flag. If you have a tending boat overhead — and it is a lot safer to have someone up there whose sole purpose in life is monitoring your and your fellow diver's bubbles — pop up and tell the man in the boat that you are encountering strong currents to the east so that he will know which way to move to follow you. It is quite probable that he is in a different regime of currents and has the additional problem of wind and that the boat is not drifting the same way that you are, some fifty feet below him. If currents in a dive are strong to the east, this is no indication that they will be the same when you go back to the same diving area the next week. Off most of our coasts, we have fairly strong tidal currents that change direction with time, so you will have to check the current direction each time you dive.

Even though the surface water may be warm as you enter it, the temperature at depth will probably be considerably colder. Most offshore areas have what oceanographers call a thermocline. This is an area where there is a relatively rapid decrease in water temperature with increasing depth. Know what the local temperature regime is, and dress accordingly. You may be perfectly comfortable with only swim trunks at the surface, but at fifty feet you may find that without a full wet suit your teeth are chattering so badly that you have trouble keeping your mouthpiece in place.

There are numerous organisms in the sea that are potentially dangerous to scuba divers. Many of these, such as sharks and the sharp-spined sea urchins, fortunately look dangerous, and obviously should be avoided. If you are heavily weighted and tend to sink, look beneath you as you settle to the bottom. The spines of the sea urchin are sharp. They can puncture the toughest of wet suits and inflict an annoying wound.

Although there are many stories about scuba divers who have driven off sharks by hitting their noses with an underwater camera or an abalone iron, there are also stories about sharks having been caught and found to have swim fins or face plates or even a leg in their stomachs. If there are sharks of any sort in the water, the really clever thing is to get back to back with your fellow diver and head for the surface as fast as you can. The best course of action — if there are sharks in your area — is to have a cup of coffee aboard and wait until they move off.

One of the best ways to attrack sharks if there are none in the dive area is to spear a few fish and have them dangling on a line at your belt. What you are doing is setting yourself up as bait. If you are spearfishing, get the fish in the boat as soon as possible unless you are interested in attracting sharks. They are mean, regardless of species. Have infinite respect for them. If you must have photographs of sharks to impress your friends with your bravery, invest in a simple shark cage. This is merely a small cage to contain not the sharks but you. Take your pictures through the bars, and your friends will never know. You will be just as heroic, and the chances of your getting back with all your arms and legs are considerably enhanced.

Be aware of restricted underwater visibility. In murky waters, things can come upon you undetected faster than they can in clear water. If you are being towed on a line behind a boat or are using one of the several underwater sleds now on the market, don't move so fast that you are unable to stop within the distance you can see. It is the old problem of overdriving your headlights on the road at night. Restricted underwater visibility can come from a heavy overcast sky, from sediment thrown into suspension by storm waves, or by a heavy plankton bloom that causes a "snowfall" of organic material. Unless you know the area and the potential hazards in it, avoid diving if the visibility is less than six or eight feet. The fun of diving is drastically curtailed if the visibility is low, so unless you are in the business commercially, come to the surface and wait until next weekend. It is safer.

Night diving for the experienced diver can be a totally different and exciting experience, but the hazards are multiplied manyfold. Any night dive must be very carefully planned in advance with particular care taken to insure good communication between the divers and the tending boat. Although the visibility underwater at night is nil, there is in most waters and particularly in the tropical waters a phenomenon that is totally undetected during daylight hours. The oceanographers give it the complex name of "bioluminescense." Actually, it is the living light given off by various marine organisms when they are agitated. If there are in the water suspended small organisms that luminesce, any motion of a diver at night will agitate them into giving off light, and the experience is indescribable. Diving, for example, on a bottom mounted oil rig, you may find that the entire structure is outlined in the subdued neon lighting of bioluminescense. This is due to the turbulence which the rig causes as the current rushes past it. This turbulence is enough to agitate the organisms in the water to the extent that they give off their bioluminescense, and your first exposure to his can be quite startling. In the same environment, you can flick your swim fin and find that great galaxies of swirling light are cast off into the dark reaches of space. A night dive in tropical waters can be very exciting, but it must be planned with sufficient care that when you come up from your experience you have a boat wating for you.

Finally, be it scuba diving, navigating, fishing, swimming on the surface, boating in your power boat, sailing in your dinghy or your cruising sloop, or just body surfing or swimming, the real secret of getting back safely is based to a large degree on understanding the ocean as a dynamic entity. Probably this is most important while scuba diving. Here you as an individual are completely immersed in the alien world. If you are going into the ocean, learn about it, and your chances of coming back alive will be increased. It is an utterly fascinating environment, but like any alien environment, it can kill you if you don't know about it and respect it. □

THE HIGH ROAD

A Special Section on ESSA in Aviation

Compiled by ANN K. COOK

"Flight 802 now ready for departure at Gate 26."

Whether 802 is a long or short flight — whether the plane is a jet, turboprop, or piston-engined aircraft — ESSA products and services will be with it all the way, as they are with each flight arriving or leaving United States airports every day.

Information available from the Environmental Data Service on factors affecting flight was of paramount importance in the aircraft's design. The layout of the airport's runways was determined by records of prevailing winds at the site. Flight obstructions at the airport were mapped by the Coast and Geodetic Survey. The communications channels used by the crew to talk to ground controllers were selected on the basis of ESSA Research Laboratories predictions of potential radio interference.

Coast Survey aeronautical charts guide the pilot through the nation's maze of airways and into the approach pattern for landing at the next stop. Magnetic observations made by the Survey provide information on the deviation of the aircraft's compass from true North, a vital bit of knowledge for the navigator.

When the pilot leaves the terminal, he is concerned with the weather here and now, the weather as it is and will be over his flight route, and predicted weather conditions at his destination, as well as at possible alternate landing fields. To provide this information, the Weather Bureau operates 22 Flight Advisory Weather Service Centers, and provides aviation services at 259 offices. The Bureau's aviation weather service includes an aviation safety and quality control program which supports aviation safety investigations and seeks to improve the quality of weather services to aviation.

While ESSA serves aviation in a variety of ways, it also uses the capabilities of aircraft to expand man's knowledge of the environment.

"The airplane has revealed to us the true face of the earth," wrote pilot-author Antoine de Saint-Exupery, but the Coast Survey's aerial photography and photogrammetric techniques, under development since 1928, have multiplied the airplane's revelations. Aerial photography is used today for mapping all coastlines for nautical charts. Landmarks and aids to navigation shown in aeronautical charts are located by photogrammetric techniques.

The instrumented aircraft of the Research Flight Facility take the laboratory into the atmosphere, to gather data on hurricanes, severe storms, air-sea interaction, snowstorms, and hail, and to participate in weather modification experiments.

ESSA scientists are engaged in research and development efforts to solve some of the major meteorological problems facing aviation — detecting and forecasting turbulence in thunderstorms and clear air (CAT), accurate measurement of changing winds on runways, and in runway approaches, measurement and prediction of short-term weather changes at airports, and dissipation of fog at air terminals.

Over the years, ESSA components have continually expanded their services to keep pace with an industry in which aircraft fly faster, higher, and farther with every passing decade. Today, we are on the threshold of another era of flight, when supersonic aircraft will be flying at speeds up to Mach 3, 16 miles high, nonstop over distances of 5,000 miles.

Such flights will require a continuous weather watch over the entire globe, from the earth's surface to heights of at least 100,000 feet. The World Weather Watch will make such global weather forecasting a reality, enabling ESSA to serve supersonic aviation as it serves today's air transport.

Supersonic flight may pose an entirely new environmental problem. Dangerous cosmic rays and proton particles from sudden solar flares may penetrate to the cruising altitudes of these aircraft. ESSA's Research Laboratories are studying the possibility of predicting solar flares and are examining the extent of the hazards they will create.

Ten years from now, there will be twice as many planes in the air as there are today. With such an increase, new airports will be built, and older ones will be enlarged to handle greater traffic volume and larger aircraft. The aviation industry will require more aeronautical charts, more weather information, more service — and the role of ESSA in aviation will continue to grow.

Weather provides the power when sailplanes go

WINGING *on the* WIND

WHILE jets streak across the continent and around the world, a growing band of enthusiasts is turning back the clock to the era before powered flight.

In a time of hurry, tension, and mechanization, these aficionados find peace and relaxation in soaring above the earth in an unpowered craft, drifting lazily on the wind, climbing on invisible currents of air.

To stay aloft, the pilot of the heavier-than-air sailplane spirals upward in rising currents of warm air, soars on waves of air rising to the lee of mountain ranges, flies along the windward side of ridges, or soars in updrafts caused by a coastal sea breeze front. He is totally dependent on the weather and on his knowledge of it.

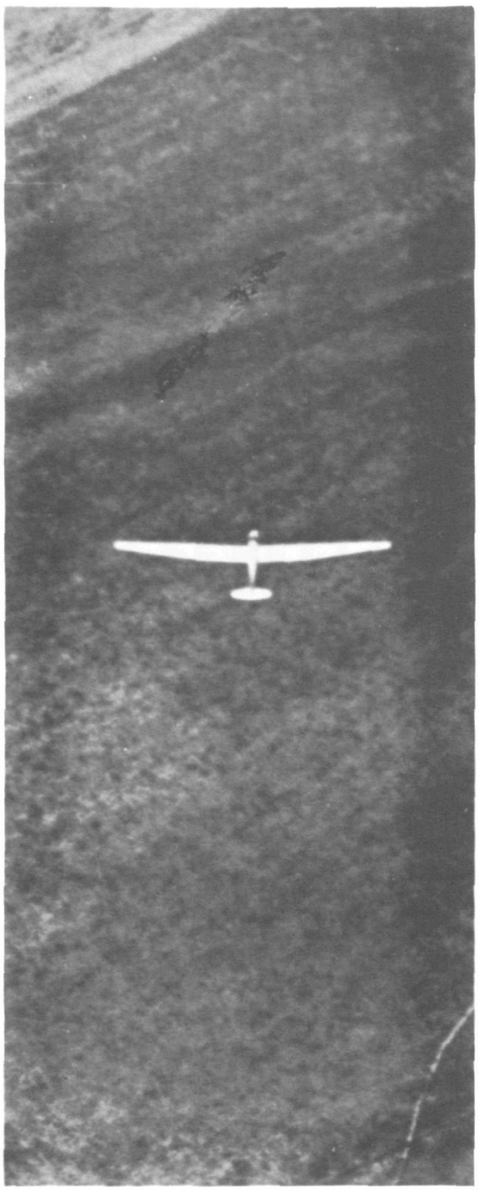
So, it is not surprising that a number of ESSA men are either sailplane pilots or specialize in forecasting for soaring.

Among the pilots are Dr. Joachim P. Kuettner of the ESSA Research Laboratories; Billy Thomas of the Weather Bureau's Sounding Systems Branch; and Graden S. Harger of the Bureau's Space Operations Support Division.

The Weather Bureau provides forecasters for sanctioned regional and national soaring contests, and aviation forecasters in many areas are called upon by soaring sportsmen for weather services.

Weather Bureau meteorologists who have made a speciality of forecasting for the needs of sailplane pilots include Charles V. Lindsay of the Washington, D.C., Forecast Center; John Marsh, Reno, Nevada, Airport Station; John H. Aldrich of the Los Angeles Forecast Center; and Ted Lange of the Fort Worth, Texas, Forecast Center.

"Soaring meteorology," says Lange, "has offered some of the most challenging and rewarding moments in my years with the Weather Bureau. When I was selected to serve as meteorologist to the National Soaring Contest in 1947 at Wichita Falls, Texas, I was not aware of the fascinating life on soaring that I was to become part of . . . It was easy to become engrossed in this sport and my job of forecasting lapse rates seemed to make me part of each flight." He since has served as meteorologist for six national contests and a number of regional meets.



"Acting as meteorologist at a soaring contest," Lange explains, "means rising about 5 a.m., to analyze adiabatic charts, weather maps, and plot other information for over-eager pilots. What they want to know is where the rising currents will be, what time they will start rising, and how high and fast they will rise; also, the direction and speed of the winds aloft.

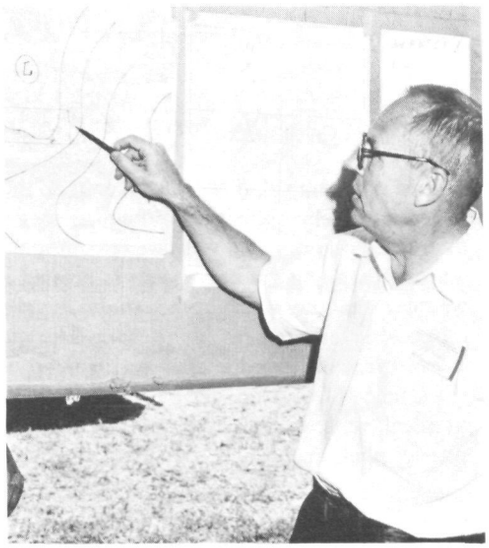
"There is nothing like a fat cumulus cloud to gladden the heart of a soaring pilot; like signposts in the sky, beckoning him on."

"I usually manage to make a few flights at these contests," Lange continues. "There is something about that first upward surge of warm musty air and tight spiraling that causes a touch of nausea. But this is the price for the exhilarating experience of a lazy, peaceful, and silent cruise, all at the cost of not one ounce of fuel."

Soaring, although primarily a sport, has made many contributions to the science of meteorology. The mountain wave phenomenon — in which wind flowing over mountains, like water flowing over rocks, rises and falls downstream — was first discovered by sailplane pilots. Sailplane pilots have reported weather patterns unsuspected by meteorologists. And because of their special abilities, sailplanes have been used in a num-

Los Angeles forecaster John Aldrich (center) discusses the weather situation with Polish meteorologists of the 1958 world soaring meet.

Sailplane pilot Dr. Joachim P. Kuettner of the ESSA Research Laboratories, has set several world soaring records.



Meteorologist Ted Lange of the Fort Worth, Texas Weather Bureau has made a specialty of forecasting for sailplane pilots.

ber of meteorological research projects, most recently in the Colorado mountain wave study.

Los Angeles forecaster John J. Aldrich alludes to this link between soaring and meteorology. "My first exposure to the science of soaring occurred in 1947 when a veteran soaring pilot visited the office seeking steady onshore winds that would help him to win a duration record," Aldrich recalls. "He was unusually weatherwise and began telling tales about air currents that we had not seen in textbooks. I felt that I was learning more than my visitor and his enthusiasm was infectious.

"In 1954, the annual U.S. national contest was held at Elsinore in Southern California, and I learned much more by the two-week assignment to the contest. I also felt a growing respect for the strong technical curiosity and love of challenge that seems characteristic of soaring people."

Mr. Aldrich later served as meteorologist for the United States team at the 1958 World Contest in Poland and at two other national contests. He has written several articles on soaring meteorology and is chairman of the meteorology committee of the Soaring Society of America's technical board. He also is the author of "Weather Services for Soaring Activities," a guide for weather offices serving sailplane pilots.

Another forecaster who emphasizes the mutual contributions of soaring and meteorology is Charles V. Lindsay. Writing in the January issue of *Soaring* magazine, Mr. Lindsay said: "During the past five years, soaring pilots have added significant data to the dimensions of mountain waves over the United States . . . Their flights have given us more knowledge of the altitudes waves

John Marsh, of the Reno Weather Bureau, checks wind conditions, while serving as forecaster for the 1966 national contest in Nevada.

extend to, and more has been learned of the vertical motions experienced in waves. Over the Appalachian area, waves were thought to be very small compared to the great waves of the Rockies, but to the lee of the Appalachians pilots have now soared to over 24,000 feet."

Mr. Lindsay has served as forecaster for two regional soaring meets and as meteorologist for the United States team at the World Meet in England in 1965. While in England, he presented a paper, "Satellite Wave Observations as an Aid to Wave Soaring," which was judged by the International Scientific and Technical Organization for Soaring Flight to be the best meteorological paper presented at the meet's scientific sessions. Mr. Lindsay received his award at the World Soaring Meet held in June at Leszno, Poland, where he again served as meteorologist for the United States team. After forecasting for the sport for ten years, Mr. Lindsay has decided to take to the air and is learning to fly a sailplane.

Among the research programs which made use of sailplanes to learn about the atmosphere was the 1946 thunderstorm project, conducted by the Weather Bureau, the Army, the Navy, and the National Advisory Committee on Aeronautics. Flying the unpowered aircraft into thunderstorms, volunteer pilots located the strongest updrafts and were tossed thousands of feet skyward, a procedure not recommended for recreation.

From 1952 to 1955, sailplanes participated in the Air Force Sierra wave research project in California. The study was led by Dr. Joachim P. Kuettner, then of the Air Force Cambridge Research Center, and now Director of Advanced Research Projects at ESSA's Research Laboratories. *continued*

Dr. Kuettner, himself a celebrated sailplane pilot, has set several world soaring records. He was the first pilot in Germany to win the diamond badge — soaring's highest award — and the twenty-third in the world.

It was soaring that led Dr. Kuettner into the atmospheric sciences. When he began flying sailplanes, he was a law student. Through soaring, he became so interested in weather that he went on to study meteorology after earning his law degree. His meteorological knowledge has contributed to the science of soaring, and he sees sailplanes as ideal vehicles for study of some atmospheric phenomena. Dr. Kuettner is chairman of the scientific section of the International Scientific and Technical Organization for Soaring Flight, known as OSTIV, and in this capacity attended the recent world meet in Poland.

The Weather Bureau's two sailplane pilots, Billy Thomas and Graden Harger, are instructors at the Capital Area Soaring School in Leesburg, Va. Mr. Thomas has a missionary zeal for the sport. "It gives me great satisfaction to introduce it to others," he says. "This is why I enjoy being an instructor. But, in addition to teaching, I never miss a chance to demonstrate the quiet beauty of soaring to others for the first time.

"The most meaningful aspect of soaring to me," Thomas continues, "is cross-country flying. The first few times you turn your back on the home airport and set off for a distant goal are, in each case, a profound experience."

Forecaster Lange, too, emphasizes the problems that may await the pilot who heads away from home. "Soaring pilots can make very few mistakes or they will find themselves landing in some field or backyard, dismantling their plane and hauling it out by trailer. As a result, pilots have found themselves avoiding buckshot, jumping fences ahead of charging bulls, or explaining that they did not just arrive from Mars." □

Billy Thomas and Charles Lindsay push the sailplane onto the field.

Ground crew attaches tow rope to sailplane as Thomas dons parachute.

Entering cockpit, pilot Thomas discusses flight plan with Lindsay.

Thomas settles into cockpit, ready for tow by small conventional plane.

Lindsay holds craft's wings level as Thomas' plane is towed down the field.

Up, up, and away! Sailplane weighs 400 pounds and has a wingspan of 49.2 feet.

EDS: Aviation's Planning Partner

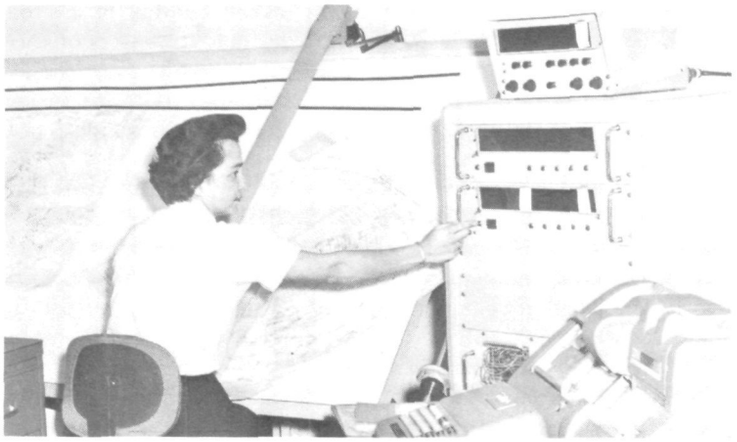
By WILLIAM P. NASH and DICK M. WHITING
National Weather Records Center, Environmental Data Service

THE pilot taxiing his plane to his takeoff runway in a strong breeze may give little thought to why that runway is oriented in one direction rather than another. In part at least, the airport designer's decision was based on climatology — on the surface wind history of the location, including prevailing directions, peak gusts, and crosswind components.

Environmental elements summarized over a period of years have been of great value in airport and airsraft design, placement of electronic aids to navigation, scheduling of air traffic, aircraft route selection, aerial photogrpahy, and in many other aviation applications. The aviation community, in fact, is one of the principal and most knowledgeable users of ESSA's multi-discipline environmental data, both for operations and planning.

ESSA's Environmental Data Service makes its greatest contribution to aviation in the area of planning, although its data quality control program helps to maintain the high standards of weather observations recorded for operational aviation use. EDS' primary mission is to make environmental data available in its most useful form to all who must make decisions involving safety, strategy, time, or money — and these decisions must be made every hour of every day by people who consider, weigh, and respect the effects of environmental factors on their operations. *continued*

Dulles International Airport and some of its runway patterns.



Wanda Ross operating the NWRC's Large Area Record Reader (LARR-V). This machine produces digitized grid point data from analyzed weather maps. One of the uses of these data is in the checking of meteorological consistency between the various levels of mean upper air analyses used in flight planning and research. (Right) Transmissometer used to determine visibility in a specified direction, usually along an airport runway.

Information collected by ESSA is processed at one of four data banks. The largest is EDS' National Weather Records Center in Asheville, N.C. Collocated with the NWRC is EDSs Geophysical Data Center with two branches, Seismological and Geodetic. The third principal data center of the Environmental Data Service is the Geomagnetic Data Center, at ESSA headquarters in Washington D.C. High atmosphere, radio propagation, and space information are the responsibility of ESSA's Space and Aeronomy Data Center in Boulder, Colorado.

The first comprehensive effort to use statistical summaries of environmental data in aviation planning was made just before World War II. Weather observations that had been taken along the airways at about 400 stations during the period 1928 to 1941 were summarized and published. The airlines made numerous applications of this work, and planners were soon voicing their requirements for more summaries and special studies.

As aviation's need for climatological data services have grown since World War II, so has the capability to satisfy these requirements. Climatological information has become available on a worldwide basis, and periods of record have lengthened. Improved sounding techniques and the use of satellites have increased the total portion of the atmosphere under observation. During this period, the electronic computer has developed into an irreplaceable tool in the processing and treatment of the growing flood of data collected.

Manufacturers use climatological documentation in designing aircraft. Examination of maximum wind shear at the surface and aloft, for example, helps to determine the stress that various components of the aircraft must be capable of withstanding. In a recent inquiry, EDS was asked for wind shear data at high levels as an aid in the development of an experimental aircraft with a folding wing.

The number of runways an airport needs depends on two things: the expected volume of air traffic and the climatological variability of surface winds. A single runway (offering two possible takeoff or landing directions) may suffice for an airport in the doldrum belt, or in a valley where the wind usually blows from either of two opposing directions. At least three runways with different orientations are usually desirable in open country in the temperate zone.

One of the more important climatological summaries that the Environmental Data Service provides the airport designer is the ceiling-visibility-wind tabulation needed to plan the placement of electronic aids to navigation, such as the FAA's Instrument Landing System. Incidence of flow ceilings and visibilities, together with the wind pattern and volume of air traffic, largely determine if a particular airport needs an ILS. Such a summary also helps to determine if a second system is needed at an airport with very heavy traffic.

Radar information provides important timely data to the pilot on a real-time basis, and, when summarized and analyzed for many stations over a long period of time, can be useful in establishing air routes. Certain geographical areas have a much higher frequency of thunderstorms and towering cumulus clouds than others. Although this has been known for years, ESSA's weather radar network has now made it possible to furnish more useful and specific data. One summary shows the frequency of radar echoes at heights above 50,000 feet at three hourly intervals on a monthly basis, while another gives the distribution of heights of echoes as a function of distance (in miles) from the station.

The distribution of cloud heights, amounts, and types is of great interest to those engaged in aerial photography and mapping. This information has been tabulated for numerous locations around the world and probabilities (by season) of obtaining a clear line of sight for high intensity, high contrast optical targets from altitudes to five kilometers have been furnished.

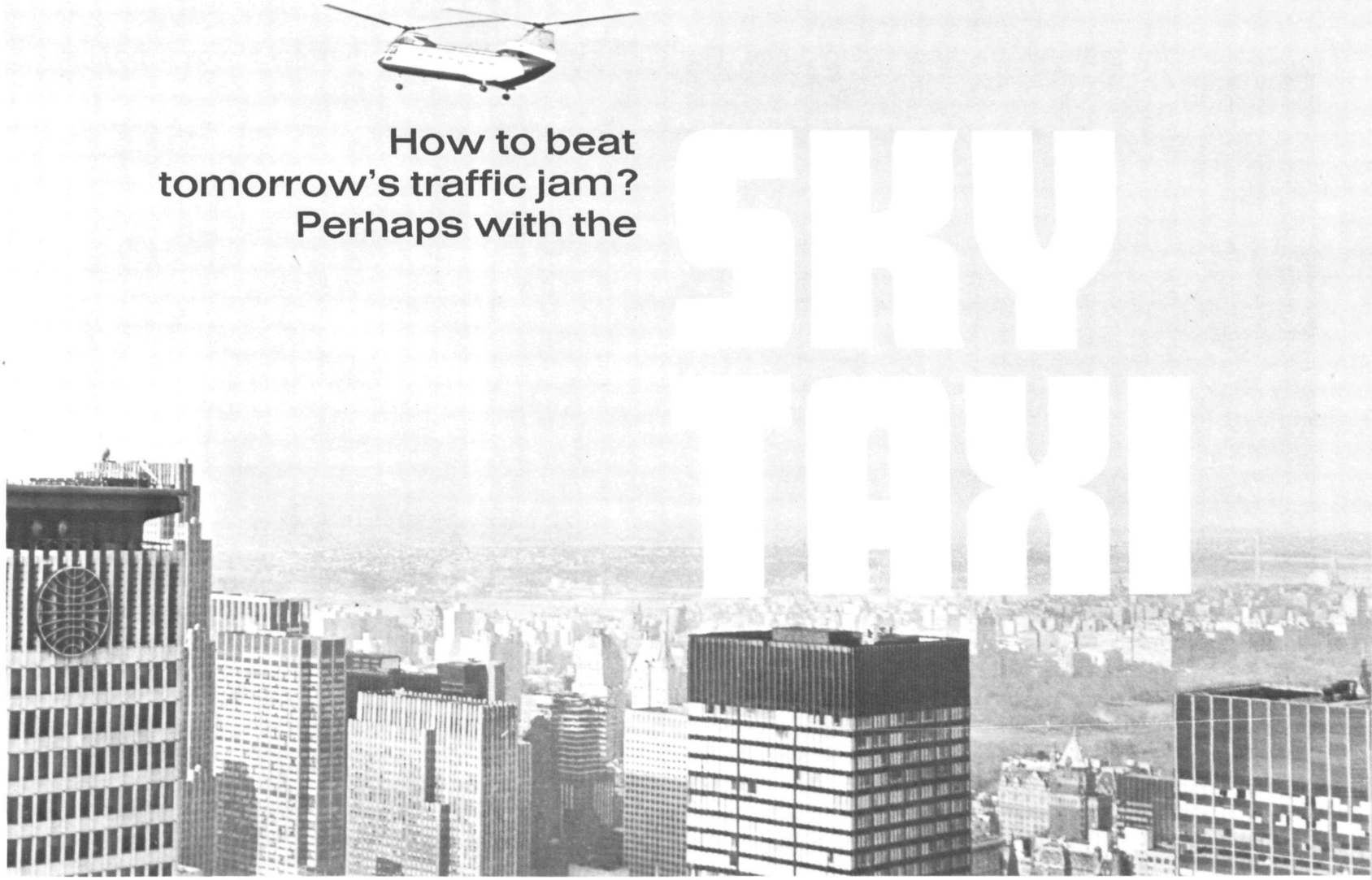
These are only a few of the applications of climatological data summaries and studies to the problems of the aviation planner. The Environmental Data Service makes other important contributions to aviation.

Geodetic information collected by the Coast and Geodetic Survey is published by EDS and distributed to a large variety of users. The latitude and longitude of marked points and prominent natural and manmade objects — as well as benchmark locations of adjusted elevations — are essential in the preparation of various aeronautical charts and in establishing flight safety standards. These control data are also used extensively in airport planning.

Air navigation still depends on the magnetic compass, which may read several degrees off due to variations in the earth's magnetic field. Worldwide geomagnetic data, archived and disseminated by EDS' Geomagnetic Data Center, are used by ESSA's Coast and Geodetic Survey to construct charts of magnetic variation. Compass deviation data are also included on C&GS' Aeronautical Charts. Without it, the compass would be an impractical instrument for aircraft navigation.

EDS is even concerned with the noise problem associated with supersonic flight. The transmission of sound waves is a function of atmospheric refractivity. When the index of refraction (determined from radiosonde flights) is within a certain critical range, sound waves are focused in a relatively shallow layer, rather than spreading normally. This is known as "ducting". If the probability of ducting were known to be greater during certain periods and at certain altitudes, supersonic flights could be routed above these levels. The ducting layer would then act as a noise trap or filter and the decibel level on the street below would be considerably reduced — to say nothing of the breakage that might be caused by these sound shock waves. □

Photo by Pan American Airlines



How to beat tomorrow's traffic jam? Perhaps with the SKY TAXI

BY NEWTON A. LIEURANCE, Director, Aviation Affairs

THE transportation outlook for America's cities is almost uniformly bleak. While the automobile proliferates, the superhighway obsolesces before it is built. Virtually every transportation facility is overcrowded, and the rush hour has become a nightmare for millions. Severe storms paralyze entire metropolitan areas for days at a time.

More and more, the need for expanded urban transport emerges — and more and more, the need for less weather sensitive systems for intercity travel is vital for the future. Fortunately, there is an ideal vehicle for this need — that relatively new workhorse of the skies, the helicopter.

The heavy snows that paralyze ground systems do not hamper the helicopter; in fact, they tend to bring it into its own. Floods have no effect upon them. And any motorist who has cursed the five o'clock traffic jam listens with envy to that friendly voice from the sky, the traffic chopper.

By and large, the helicopter is far less weather-sensitive than most of our sophisticated ground systems. It can be operated in visibility which would render ground movement nearly impossible. When you can see only a few yards ahead, driving your car becomes a risky business; even on foot you can become disoriented. But the perspective of looking down from a few feet above the ground can be an improvement over looking straight ahead, and a helicopter in hover flight, moving slowly as necessary, can be visually navigated by landmarks imperceptible at ground level.

In fact, weather restrictions for tomorrow's intracity helicopter service will, in all probability, be minimal — far less than those governing the conventional airplane flight.

The helicopter has forged a formidable record of foul-weather operation. An example is the Chicago snowstorm of January 1967, when the city was shackled by drifts.

continued

Photo courtesy Red Cross

The heavy snows that paralyze ground systems do not hamper helicopter operations and floods have little effect upon them.

Larger scheduled helicopter operations have shown that the promise greatly exceeds the problems.
Photo by Pan American Airlines

The performance of the choppers won this accolade from John Smith, a Chicago Weather Bureau forecaster:

". . . the metropolitan area of over seven million residents was all but paralyzed . . . fortunately, the city was blessed with one method of transportation that operates come war or blizzards — the helicopter. All private, public and military 'copters were pressed into service. A dozen or so proved their worth many times . . . with hundreds of emergency trips. They flew blood, insulin, delicate heart instruments, oxygen, drugs, medical supplies of all types, and several emergency medical cases to hospitals . . . these 'copters landed everywhere . . . on streets, river banks, parking lots, yards next to hospitals, power plants, and anywhere they were asked to go . . ."

Several large metropolitan areas now have scheduled helicopter service, among them New York, San Francisco and Los Angeles. For the most part, they operate in and out of established airports. Their restrictions are conventional and their minimum operating conditions, to some extent, a carryover from fixed-wing operations. As helicopter tech-

Tomorrow's intracity helicopter operations will face highly localized weather problems

A wind condition that poses no airport problem can produce severe turbulence on the lee side of a tall downtown building.

Cities are warmer than their surrounding areas and this can cause hazardous freezing rain in suburbia to be a mere drizzle in city.

Localized thunderstorms can be widely scattered, affecting individual heliports, one at a time, for brief periods.

nology advances, the minimums may be expected to diminish.

Among the larger scheduled operations is the New York Airways, which has demonstrated that the promise greatly exceeds the problems associated with its efforts.

New York Airways operates on instrument flight rules into Kennedy and LaGuardia Airports, but is limited to visual flying in the city dock area and atop the Pan American Building. Wind is no barrier to its operations; the line flies in winds up to 60 knots unless approaching the lee side of a building. Summer storms, winter icing, low visibility and static-electricity buildup in the smoky city atmosphere are problems which it faces. New York Airways compensates for turbulence in the approach and landing on the Pan Am Building by the use of double wind systems, socks and anemometers on its city landing pad. Standard telephone and radio communications are employed to get and distribute weather data.

In general, the industry has found that the smaller machines, up to five places, are difficult to handle on the ground in wind over 25 knots. The larger machines can be damaged when starting up or shutting down in wind velocities over 40 knots, or gusts of more than 15 knots' variation in speed. In low visibilities, today's operations are restricted by the lack of navigation facilities and full instrument capabilities.

Even now, however, the visibility bugaboo is not a serious one. A study of conditions at terminals in Boston, Chicago, New York, Philadelphia, Washington, Los Angeles and San Francisco has established that visibility would warrant restriction of operation no more than two percent of the time; and that the frequency of winds over 35 knots is rather low.

It seems entirely reasonable to suppose that, given a substantial market for intracity operation, the helicopter industry will strive to make its product attain its potential. This will mean that the machine must become a stable platform with fully operational all-weather capability. Engineering advances will be required to increase the payload-thrust ratio.

Given these conditions, there seems little doubt that current visibility restrictions can be greatly eased in the coming years, at least for the larger machines. Under such circumstances, perhaps the only conditions under which operations would close down would be those of ice storms, squall lines and heavy turbulence. Clearly, this development will bring with it a different kind of weather service requirement.

First, some system more sophisticated than a gentleman's agreement must be fashioned to separate the aircraft of an urban air transport system. Our present aviation weather system, providing service for only 1 or 2 airports in a major metropolitan area, probably will not suffice any more.

A wind condition that poses no runway problem at one airport can produce severe turbulence on the lee side of a tall downtown building. Smoke and haze can cause wide visibility variance between city and suburb. Cities are warmer than their surrounding areas and this can cause hazardous freezing rain in suburbia to be a mere drizzle downtown. Localized thunderstorms can be widely scattered, affecting individual heliports one at a time for brief periods. These variations must be continuously known for dispatch, aircraft and crew scheduling. Observing, tracking and forecasting of highly variable conditions of turbulence, winds, icing and visibility between areas in a large city complex will be a new requirement.

The present aviation weather system, in short, must be extended to account for highly localized weather. All heliports or short-runway facilities must be served. An essential part of the system will be a discrete communications system to collect observations and give them to a central processing facility. Heliport observations would be made automatically and fed into the communications system with rapid cycling — a five-minute update rather than an hourly system.

The observing system for the heliport and its associated communications and processing centers would require a link with the national aviation weather system supporting major terminals, and would prove a valuable augmentation. Weather watch would be maintained for severe storms, with radar the major tool and special attention paid to conditions producing turbulence, heavy snow, floods and ice storms.

This growth from a random to an extensive, highly organized kind of transport service will be neither quick nor inexpensive. But it will come; when it comes it will radically change the face of urban travel; and when it comes, we in the weather service must be ready for it. □

The Airport Profile

At nearly 600 locations, the Coast and Geodetic Survey provides Airport Obstruction Charts for your safety

"You are cleared for takeoff."

Behind these words, crackling in an airline pilot's earphones, lies a wealth of ESSA effort.

Before being cleared for takeoff, flights are armed with significant safety information: the elevation of the airport, the length and gradient of the runway, the obstacles to be cleared with a given load.

This information is contained in airport obstruction charts, a major contribution to aviation safety by the Coast and Geodetic Survey.

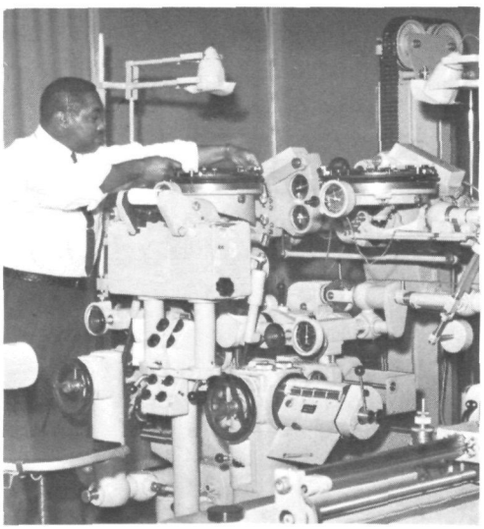
Nearly 60 employees in the Photogrammetry Division devote their talents to the preparation of these charts which are a key factor in computing safe takeoff and landing gross weights for commercial air carriers. The program was started in 1942 and initially provided instrument approach and landing charts for pilots.

At the close of World War II, the commercial aviation industry was booming. Special obstruction charts were essential for regulating air safety. The Coast and Geodetic Survey met this unique challenge for piston-type aircraft and by 1960, when the big jets were rumbling down the runways, had again updated its procedures to meet the rigid safety standards of the FAA. Today, nearly 600 different airport obstruction charts are available for distribution. Most of these are in the conterminous United States but there is also excellent coverage in Alaska, Hawaii, Puerto Rico and as far as Wake Island and American Samoa in the South Pacific. This year well over 150 original and revision surveys will be completed.

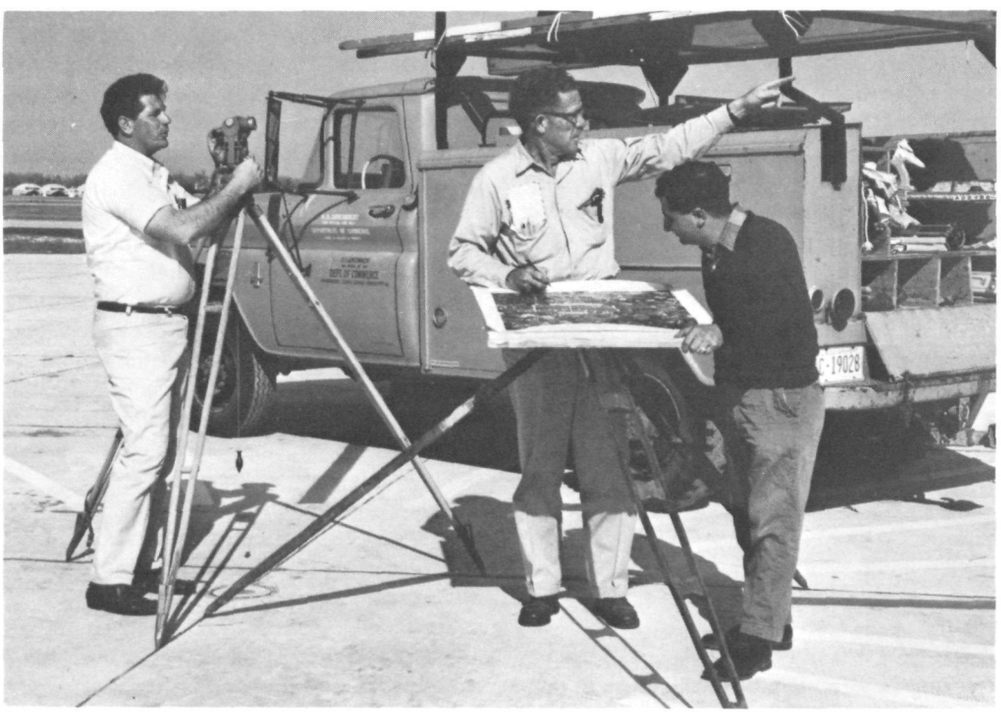
The airport obstruction chart is a 1:12,000 scale special-purpose chart of an airport and its immediate vicinity. Part of the details shown by each chart are the limits of elevated imaginary surfaces that define obstructions to air traffic, a plan and profile view of the flight paths off the runway ends, and the locations and elevations of the most critical obstructions to air traffic.

The production of airport obstruction charts is a streamlined business. Each year the program gets underway with a request from the FAA for about 150 surveys. Hammond Rau, the Bureau's top obstruction chart specialist, works out the final requirements with the FAA and programs the work in the Photogrammetry Division. The first step is planning; it involves flight maps for the Air Photo Mission and the survey specifications which are handled at the Rockville headquarters under the direction of Willard A. Kuncis. Aerial photography follows, then field surveys, office compilation, reproduction and finally distribution.

The Air Photo Mission commenced its operations this season in March and had scheduled completion of 50 photography assignments by the end of June.



Paul Hawkins at the Rockville headquarters places an airport aerial diapositive on the Zeiss Stereoplanigraph to connect photogrammetric locations of airport and navigation facilities to National Datum.



Early each spring, aerial cameras and related gear are loaded aboard the aircraft and secured in proper mounts. This Grand Commander photographed airports in Alaska. (Left) William Reynolds directs a field survey at Andrews Air Force Base and is assisted by Donald Rexrode using the T-2 theodolite and Gerard Trosino on right.

BY HARLAND R. CRAVAT, Coast and Geodetic Survey

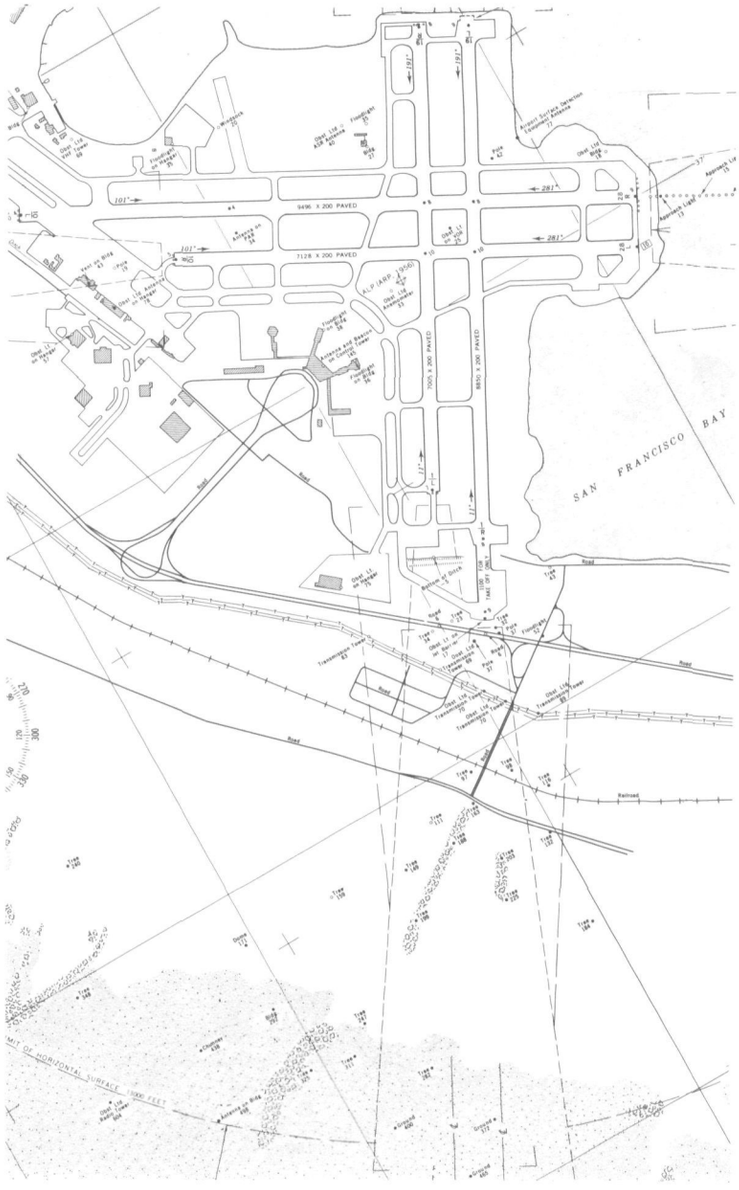
Aerial photo and Airport Obstruction Chart (below) of the San Francisco International Airport.

The Air Photo Mission, which operates with a leased aircraft, normally flies 8,000 to 10,000 linear miles of flight lines annually, covering about 35,000 square miles of airports, approaches and surrounding terrain. This season, Lt. Cdr. Frederick H. Gramling is first pilot and is assisted by Lt. Walter S. Simmons, who serves as co-pilot and navigator, while Charles Ferguson operates the aerial camera. Both ESSA Commissioned Corps Officers are graduates of the Army Fixed Wing Flight School, Fort Rucker, Alabama. The film is developed and prints are processed in the Photogrammetry Division's Laboratory in the Commerce Building.

Field surveys using the aerial photographs are made at each airport. These field surveys are directed by Rear Admiral John C. Bull, the East Coast Field Director. His principal assistants in the program are William A. Rasure and Elgan T. Jenkins who operate from headquarters in Portsmouth, Virginia. They direct the operations of nine two- or three-man field parties that are scattered across the United States. Those parties work in the north during the summer months and south in the winter. For work outside conterminous United States, Mr. Rasure organizes special parties. Last year, for example, he directed the field operation on 10 airport surveys in Alaska in addition to work in the United States.

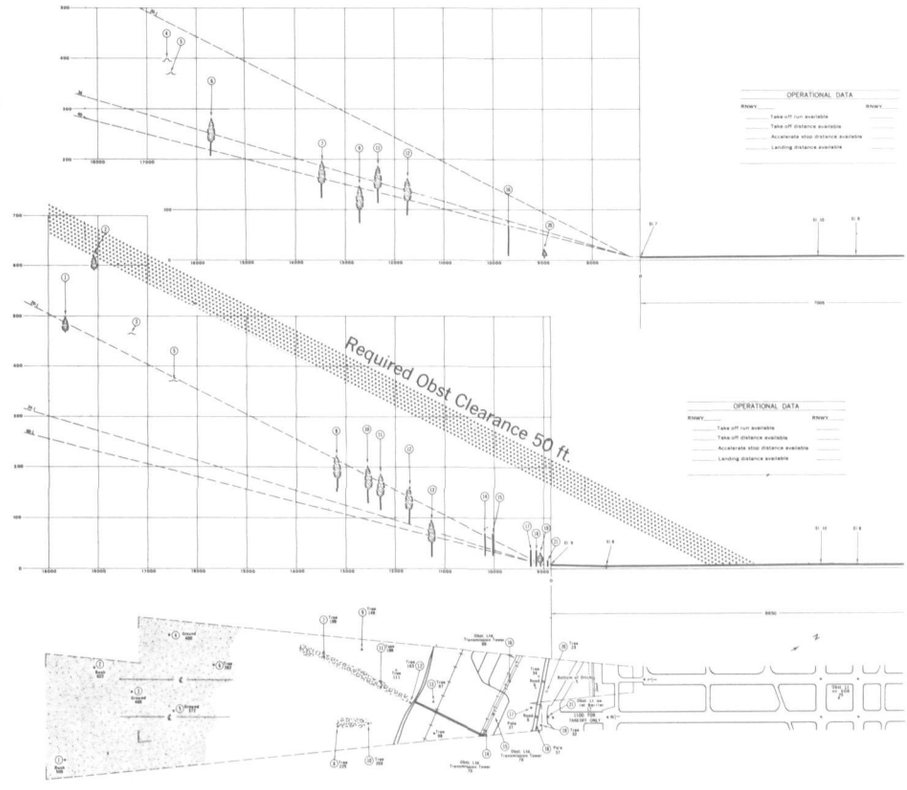
Airport survey field personnel live a nomadic life; many are married and home is a house trailer. It is seldom that they remain in one location longer than three weeks. A typical survey of Andrews Air Force Base was completed by William M. Reynolds and his party in April. The field records were forwarded to Mr. Jenkins' group in Portsmouth, Virginia, for verification and computations.

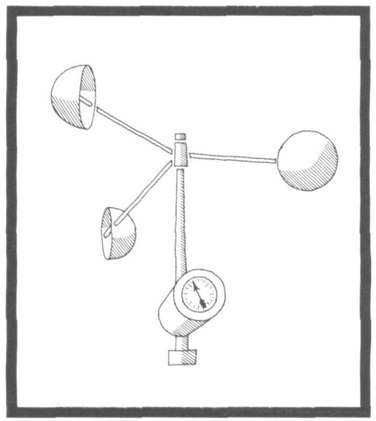
The records and data requiring specialized aerotriangulation instruments for photogrammetric reduction are forwarded to Rockville, Maryland. At this point, Mr. Rau checks on both progress and work backlogs and channels reasonable compilation work flows to the airport obstruction chart compilers in both Norfolk and Rockville. Scribing and reproduction follows immediately in the Reproduction Division. The final product is distributed in ozalid form by the Photogrammetry Division on an approximate five-month start to finish schedule. □



AIRPORT OBSTRUCTION CHART

These large scale charts are used in determining airport instrument approach and landing procedures, and to provide data for engineering plans relative to clearing of obstructions and improvement of airport facilities.





"The records of the Government Weather Bureau at Kitty Hawk gave the velocity of the wind between the hours of 10:30 and 12 o'clock, the time during which the four flights were made, as averaging 27 miles at the time of the first flight and 24 miles at the time of the last . . . After these years of experience I look with amazement upon our audacity in attempting flights with a new and untried machine under such circumstances." — Orville Wright, 1913

The beginning of their Air Age in 1903 quite literally opened a new dimension for the weatherman.

Wright's concern about the weather for his first flight of a little over 120 feet at a maximum altitude of 10 feet is shared today by pilots who are flying from one continent to another at near-sonic speeds — six miles up.

The higher and faster we fly, the more important it becomes that weather observing and forecasting techniques keep pace with the technology which will produce the SST in this country within the next five years.

To this end, the Weather Bureau's Systems Development Office is immersed in several aviation-related programs.

From SDO's Systems, Plans and Design Division has come a plan for reorganizing the Weather Bureau's forecast structure. The plan, developed jointly with the Weather Bureau's Office of Meteorological Operations and Office of Hydrology, is the result of four years of information gathering and study.

The new forecast structure, to be put into effect over the next five years, is designed to improve the quality of weather forecasts and warnings.

The new structure is a story in itself, but its most outstanding feature, perhaps, will be the establishment of 50 Weather Forecast Offices. These facilities will receive guidance material directly from the National Meteorological Center and other special centers with computer capabilities. The area covered by each of these Weather Forecast Offices will be smaller than that covered by each of the present 24 forecast offices, thus enabling meteorologists at the new stations to concentrate more intensively on forecast problems.

Working out the thousands of details involved in a total reorganization such as this one is hard work with little glamour, but the benefits to the aviation world as well as to all other users of Weather Bureau forecasts and warnings should be substantial.

With the advent of the use of computers in forecast work, the Weather Bureau has learned a new language. Computers "speak" with numbers and must be questioned in a like manner.

Following the lead of the National Severe Storms Laboratory where original development work was done, another SDO organization, the Equipment Development Laboratory, is working on a program wherein the weather radar data, so important in aviation forecasting, can be digitized and fed into a computer. The computer may be able to analyze this information swiftly and accurately and, perhaps, help the forecaster plot the future movement of local weather systems. Often severe storms such as tornadoes seem to have a definite radar "signature" which a computer might identify, giving the meteorologist an invaluable jump on these storms.

Success with such a project could lead to the digitizing of all forms of meteorological data, relieving forecasters of many of the time-consuming calculations now needed to produce any weather prediction.

Members of the Equipment Development Laboratory envision that, with some modification of present equipment such as the Automatic Meteorological Observing System (AMOS), the production of some new hardware and further development of computer forecast processes, aviation terminal weather observations could be fed into a central computer complex and be returned in a form suitable for flight planning.

From this, it is not difficult to imagine the pilot of the future pushing a button or two and receiving weather conditions along his proposed route and at his destination, automatically kept up-to-the-minute by a computer.

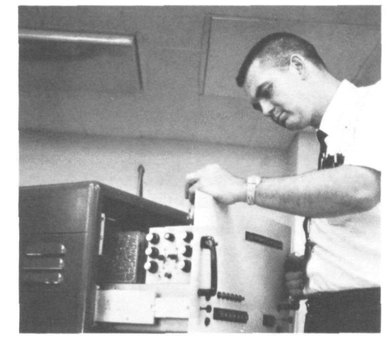
Another Systems Development Office project in the field of aviation concerns Clear Air Turbulence (CAT). In SDO's Techniques Development Laboratory the possibility of improving the forecasting of this always uncomfortable, sometimes dangerous phenomenon is being studied.

Effective medium and long range jet operations start at about 25,000 feet — so does CAT.

Weathermen know there is an association between CAT and upper-level troughs (elongated areas of low pressure) and areas of wind shear. Air rushing up over mountainous terrain is also a factor. But CAT is invisible, and all they really have to go on is reports from pilots and, more recently, a special study of rawinsonde balloon ascents.

The Techniques Development Laboratory is compiling a climatology of CAT reports from pilots over North America, the North Atlantic, the Caribbean, and Central America. These reports, telling not only of clear air turbulence, but also of the lack of it (negative reports have not been received routinely before this climatology was undertaken) will form a basis for a number of future studies into the nature and possible prediction of CAT.

The vertical dimension added to weather forecasting in the 65 years since Orville Wright looked askance at his hand-held anemometer on the windy outer banks of North Carolina has climbed higher and higher. Keeping up with such a fast moving age is not enough. The Weather Bureau has had to get ahead and stay ahead by streamlining its techniques and technology. This is the job of the Systems Development Office. □



Donald M. Edmonds adjusts a Video Integrator Processor which produces contour-mapped radar pictures prior to digitizing.

As flight goes higher and faster, a Weather Bureau office works to meet

The Changing Challenge

By CHARLES THOMAS
Weather Bureau

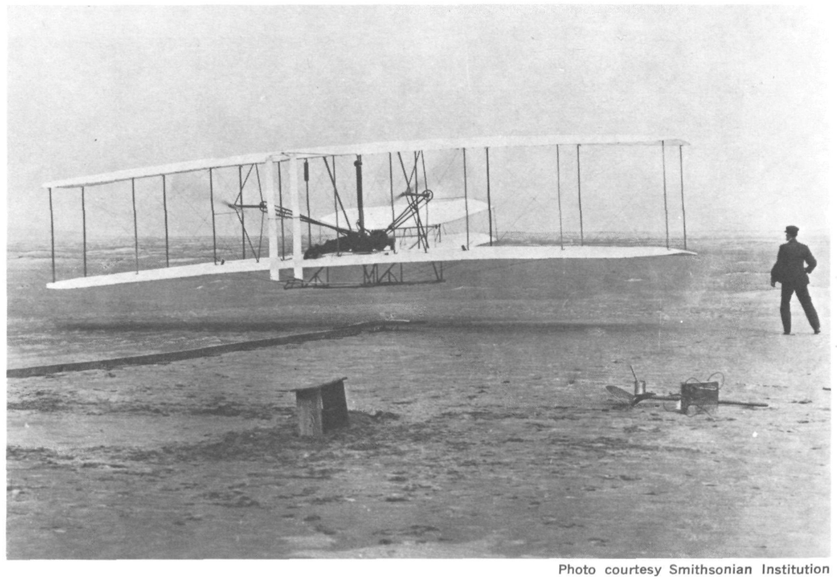
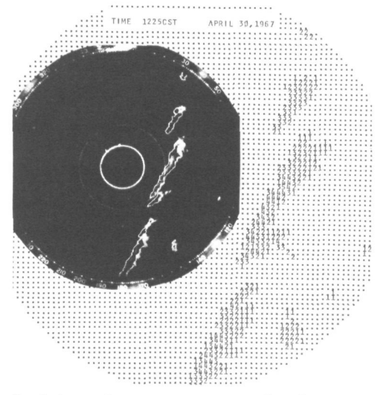


Photo courtesy Smithsonian Institution



Dark inset is a contour-mapped radar scope photograph of cloud "echoes" in a 100-mile circle around radar site, over a numerical code of the same information. (Left) Flight into the future from the windy North Carolina coast in 1903 gave the Wrights weather problems. (Right) The technology which will produce the supersonic transports in the early 70's, will bring with it new weather related problems.

Boeing Company

Weathermen at New York's Aviation City make the skies safer for

TWENTY MILLION TRAVELERS

BY ANN K. COOK

New York's John F. Kennedy International Airport is a city in itself . . . a city where more than 40,000 people work for the safety and comfort of aviation and of the nearly 20 million air travelers arriving or departing every year.

Among the 40,000 are 61 ESSA employees who staff this Aviation City's two Weather Bureau offices — the Weather Bureau Airport Station and its Flight Briefing Unit.

They work in one of the nation's busiest airports. Through Kennedy pass about three-quarters of all air passengers traveling between the United States and Europe and more than one quarter of those journeying between this country and Latin America. The world's largest air cargo center, Kennedy handles more than half of all goods shipped by air to and from the United States. It is aptly called "the aerial gateway to the United States."

A hub of activity in this 4900-acre super-airport is the International Arrivals Building, where the planes of United States and foreign carriers taxi up to discharge their passengers for clearance through Customs. On the second floor, with windows overlooking the colorful craft of many nations, is the Weather Bureau Airport Station's Flight Briefing Unit, headed by Chief Airport Meteorologist Milton N. Werbin.

Werbin and a staff of seven forecasters provide round-the-clock weather briefing and flight documentation service for international air crews heading for Europe, South America, the Caribbean, or west over the United States to destinations in the Pacific.

The second major function of this unit is observation of ceiling, visibility, and other weather conditions affecting aviation at Kennedy. Weather measurements, made by instruments far out on the airport's 30 miles of runways and taxiways, appear on a console in the briefing unit. Many flight crews make a practice of visiting the unit to pick up the weather documentation and receive a personal briefing from Werbin's staff.

In the flight forecast folders, under procedures established by the International Civil Aviation Organization, are prognostic constant pressure charts for at least two levels of the atmosphere; a significant weather chart showing predicted positions of fronts, centers of high and low pressure, areas of clear air turbulence, clouds, and other vital meteorological information; and terminal forecasts — predicted weather conditions at a number of airports in the United States, Canada, the Caribbean, and Europe. The charts — prepared at the National Meteorological Center, the main Kennedy airport station and other Bureau forecast centers — come in on the unit's facsimile recorders.

The same charts are available to airlines if they have receivers on the facsimile circuits carrying high-altitude weather information. Using them, airline meteorologists and flight dispatchers prepare a flight plan, several hours in advance, designed to achieve either the least time, least distance, or the smoothest flight. Based on this weather information, the dispatcher determines the amount of fuel needed and the maximum aircraft load.

After receiving the flight forecast folder with the latest available weather information, the pilot may review the flight plan with the dispatcher and perhaps request a revision. When he is airborne over the ocean, the pilot will refer to his weather folder before making any in-flight decisions on changes in altitude or course.

John F. Kennedy International Airport from the FAA control towever, eleven stories above the field. ***(Below)*** *The Weather Bureau's APT antenna at JFK airport station.*

Fifty thousand flight folders are assembled by the Kennedy briefing unit in a year — with an all-time peak thus far of 200 in one day. By the end of 1968, they will have prepared a half-million since the airport opened in 1948.

Annotated satellite photographs showing cloud coverage over Atlantic air routes are a special feature of the flight documentation provided at Kennedy.

The satellite pictures are received through the APT antenna near the main office of the Kennedy Weather Bureau Airport Station, which is located in the North Passenger Terminal, three and a half miles by road from the International Arrivals Building.

By a technique developed at WBAS Kennedy, APT photographs received from ESSA and Nimbus satellites are pieced together, their major features are outlined and annotated, and the pictures are printed and available to pilots within 2½ to 3 hours after picture-taking time. These photographs are a welcome addition to the flight documentation for pilots flying over trans-ocean routes where little conventional weather information is available.

The WBAS, led by MIC Louis Harmantas, furnishes weather information for flights over an area that fans east across the Atlantic from New York to eastern Europe and includes northern and western Africa.

The greater part of this information is received by facsimile from the National Meteorological Center at Suitland,

continued

(Above) Forecaster Melvin Rosen records weather measurements as they appear on the console in the Flight Briefing Unit. (Right) Outlining major features appearing in the APT satellite photographs. (Below) Howard Bookman, a meteorologist at the Weather Bureau Flight Briefing Unit, JFK International Airport, discusses weather conditions over the Atlantic with BOAC flight crew. Captain Anthony Frish is in center and First Officer John D'Arcy on right.

Maryland, where it has been prepared by computers. The staff in the Airport Station's International Aviation Unit monitors the NMC products and adds later information provided by the APT satellite photographs and by reports received from pilots and surface vessels. Occasionally, developing weather conditions may require a reanalysis of the NMC products, but this occurs less and less frequently.

The Kennedy staff is enthusiastic about the quality of today's computer products. "We have seen dramatic improvements in recent years," says MIC Harmantas. "It certainly makes our job easier."

The International Unit prepares significant weather charts, showing the features of special concern to the international flight crews, for its area of responsibility.

It issues SIGMETS — significant meteorological advisories — whenever certain conditions of special concern to aviation safety, such as severe turbulence, squall lines, or icing, are known to exist or expected to develop within two hours.

Providing weather information for international flights is only one facet of the activity at the Kennedy Weather Bureau Airport Station. As a FAWS (Flight Advisory Weather Service) Center, it monitors aviation weather over southern New York, western Connecticut, New Jersey, and eastern Pennsylvania, an area of high aviation activity. Kennedy MIC Harmantas also is responsible for supervision of operations at the LaGuardia Field Weather Bureau Airport Station.

Meteorologist Philip Stone of the FAWS or Domestic Aviation Unit listed, in weatherman's terminology, the products of this branch:

FT 1, 12-hour terminal forecasts, which the Kennedy unit prepares every six hours for 20 airports in its FAWS area. These include heights and amounts of sky cover, ceiling, visibility, weather, and surface wind.

FT 2, 24-hour terminal forecasts for major airports. For advance planning by airline and airport interest, the Kennedy

office also prepares 30- and 36-hour forecasts for terminals in the New York City area.

Terminal forecasts for seven airports in the northeast are coded for transmission to Europe, to aid pilots flying toward the United States.

Forecast amendments. All forecasts, including the terminal forecasts prepared at Kennedy and the area forecasts and winds aloft forecasts issued by the National Meteorological Center, are monitored closely and adjusted or amended when necessary.

SIGMETs, as well as **AIRMETs,** the small-aircraft equivalent of the **SIGMET,** are issued.

Jet take-off forecasts of runway winds and temperatures for the next 12 hours are prepared every three hours to assist operations at Kennedy and LaGuardia airports.

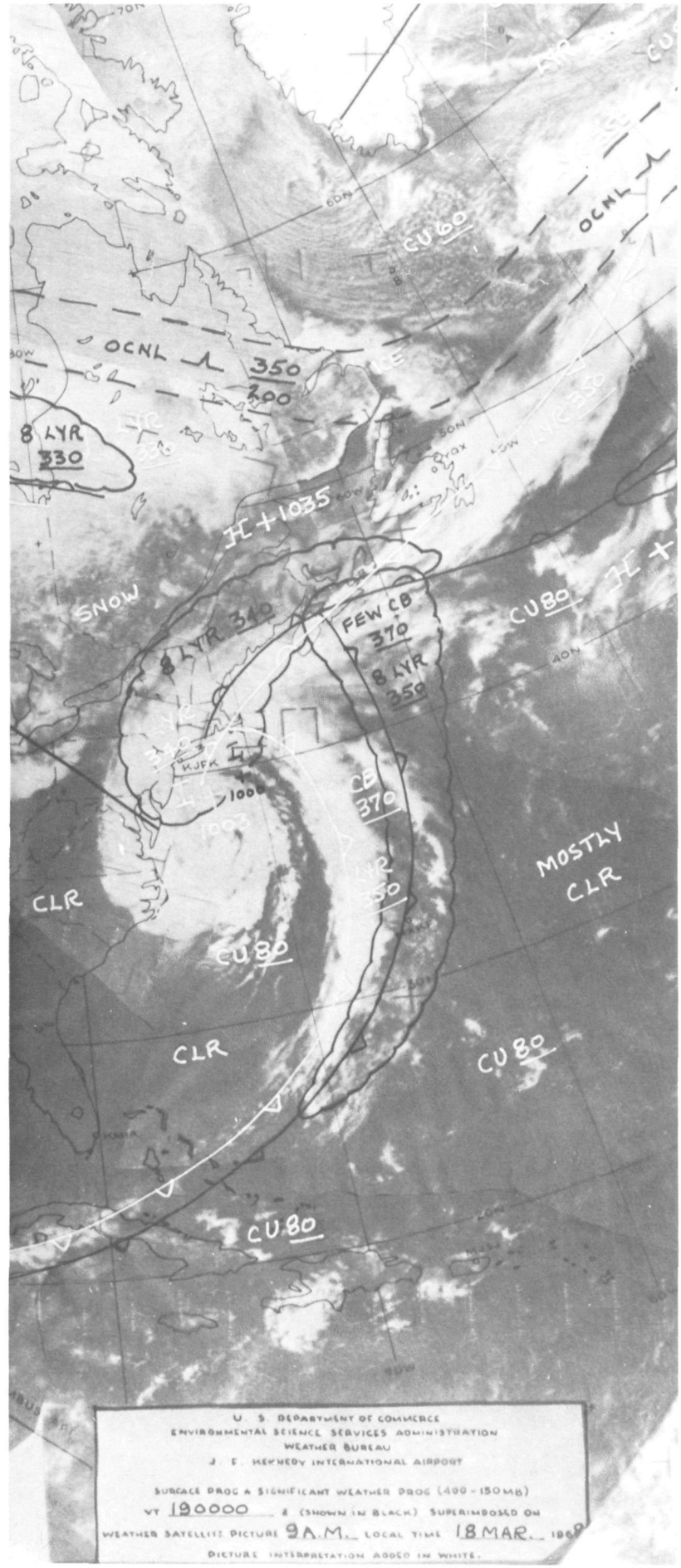
TWEB's, Transcribed Weather Broadcast texts are prepared for continuous aviation weather broadcast by FAA Flight Service Stations from Elmira, N.Y., and from Newark, N.J.

PATWAS, Pilots Automatic Telephone Weather Answering Service texts are prepared and recorded, and are available by telephone in the New York City area.

At the Domestic Aviation Unit's briefing display the telephones ring 200 times in an average day, with calls for weather information from pilots flying out of Kennedy or LaGuardia. For the most part, these calls are from private or charter-plane pilots or from the pilots of the numerous air taxis operating in the metropolitan area.

The products of the Kennedy staff are used by airline meteorologists, flight dispatchers, air traffic controllers — by all those concerned with safe and efficient flight.

Most of all, they are welcomed by the pilot. The atmosphere is his element, his environment, and he depends on accurate weather information to bring his passengers and his craft safely to their destination. □



Edward J. Maree of the International Aviation Unit at the JFK Weather Bureau Station, interprets pictures received from APT spacecraft. (Right) Assembled APT photographs from ESSA and Nimbus satellites with major features outlined and annotated. Copies are given to pilots departing on trans-oceanic flights.

Buffeted by storms, struck by lightning,

THEY FLY FOR SCIENCE

By RALPH SEGMAN
ESSA Research Laboratories

"Oh-oh, here I go into a hurricane."

James D. McFadden, a research meteorologist with the Sea-Air Interaction Laboratory (Atlantic Oceanographic Laboratories),* was aboard a Research Flight Facility DC-6A, named 39-Charley, collecting data in advance of Hurricane Inez west of Cuba. The job was nearly done when Pilot Don George received an urgent radio message from the National Hurricane Warning Center. Would George take 39-Charley into the storm? McFadden braced for the worst flying in his life, as the plane headed toward the hurricane and climbed for an 8,000-foot penetration.

Looking back, McFadden says nothing terrible happened. There were short periods of turbulence and smooth flying between rainbands and in the eye. Flying over the small lakes region of Canada on a clear winter day, he says, is a much rougher experience.

Does McFadden's report strip away the glamour surrounding ESSA's hurricane hunters? It depends on who's doing the reporting. Dr. Helmut K. Weickmann, Director of the Atmospheric Physics and Chemistry Laboratory, has considerable flying experience, ranging from C-119 Flying Boxcars to open cockpit two-seaters. He made his first hurricane penetration through Inez in late September 1966, a few days before McFadden. The aircraft entered the storm at 2,000 feet south of Puerto Rico and measured winds of 197 miles per hour, a record for Caribbean hurricanes. Dr. Weickmann has put his feelings into writing, concluding that it takes "sheer human courage" to penetrate hurricanes, exceptional flying skill, and "continuous concentration under conditions almost unbearable."

Hilary Whitaker reported in the *Kiwanis* Magazine that his spirits lifted when 39-Charley emerged from Hurricane Dora in 1964. He described how they met unexpected turbulence and, without the restraint of a seatbelt, he bounced about the interior like an ice cube in a shaker.

If Howard J. Mason, Jr., Chief of RFF, were the author of this article, he probably would not emphasize flying in hurricanes because his team has developed techniques that minimize the danger. Hurricane penetrations have become routine. The hazards are there, but with their experience, the RFF crews regard the flights as little more than a day's work.

RFF was conceived as a tool for hurricane research. Following a series of devastating storms along the east coast of the United States, the Congress in 1955 made the Weather Bureau responsible for setting up a severe storm research effort. The U.S. Air Force provided and operated aircraft and the Weather Bureau installed and operated meteorological instruments. This arrangement continued until 1958 when Air Force support ended. The Weather Bureau entered the 1950 hurricane season with three of its own newly acquired aircraft. In 1961, the flight group of the then National Hurricane Research Project became part of the Weather Bureau's Office of Meteorological Research.

It had become clear by that time that instrumented aircraft could contribute broadly to atmospheric science. The Research Flight Facility began to diversify, and presently a large percentage of its missions are in non-hurricane areas. In 1963, for example, all RFF aircraft and crews flew for three months out of Bombay on research missions during the International Indian Ocean Expedition. They carried out a similar mission the next year.

RFF was one of the variety of environmental research organizations melded in the formation of ESSA in 1965. It is now one of the 13 major components of the ESSA Research Laboratories.

Over the past eight years, this aerial team has served and cooperated with the Atomic Energy Commission, National Severe Storms Laboratory, Atlantic Oceanographic Laboratories, Air Resources Laboratories, Atmospheric Physics and Chemistry Laboratory, and National Hurricane Research Laboratory; and with several other Federal agencies, universities, and private research institutes.

RFF crews have participated in research projects covering such areas as thunderstorms, tornadoes, hurricanes, lightning, hail, the formation and physics of clouds, the nature of precipitation, sea-air interaction, jet stream, air pollution, and weather modification.

RFF is a small organization — 47 people and four aircraft. One of the reasons they can operate efficiently and extensively and hold to schedules is that the aircraft crews have dual skills. Mason, for example, besides having administrative duties, is an instrumentation specialist and co-pilot of 39-Charley. Operations Officer William S. Callahan is also a navigator for the C-54A. Marshall Hatch is meteorologist and navigator aboard the B-57 jet.

RFF aircraft include the two DC-6A's, which are generally flown between 1,000 and 20,000 feet; a B-57A jet, used from 35,000 up to 45,000 feet; and a C-54A, usually held below 10,000 feet. Sometimes several, or even all, of the aircraft fly simultaneously. The DC-6A's are operated by eight-man crews — two pilots, navigator, flight engineer, two meteorologists, and two electronics specialists. Because of tight accommodations, only a pilot and a meteorologist-navigator man the B-57A. The C-54A crew consists of two pilots, navigator, flight engineer, meteorologist and an electronics specialist plus additional personnel as may be needed to operate any special equipment used for a specific mission.

Despite its large amount of flying in rough weather, particularly in thunderstorm and hurricane areas, RFF has never had a serious accident. This can be attributed not only to personal skills and training, but also to maintenance and flying techniques.

Normal procedure for flying into a hurricane calls for the following:

Penetrate the storm in a crabbed position, that is, with the nose pointed 45-50 degrees into the wind, which flows counterclockwise around the center. This helps the aircraft fly a reasonably straight track into the eye.

Fly most of the way on autopilot. This reduces the strain on the controls and the pilot and maintains a more precise flight path. Small adjustments in airspeed are made by varying the pitch, or bite, of the propellers, and not by throttling.

In leaving the storm, the aircraft is again crabbed into the wind, which is now coming from the opposite direction. The winds now tend to carry the aircraft away from the storm center.

Hurricane winds are basically horizontal in flow, and penetrating aircraft usually encounter a washboard kind of turbulence. Thunderstorms are more violent. An aircraft penetrating a thundercloud could, for example, meet an updraft rising at 3,000 feet to 4,000 feet per minute, then abruptly enter an equally powerful downdraft. Such wind shear could tear an aircraft apart. RFF pilots generally try to stay out of thunderstorms.

Another area of RFF competence, not so well known but critical to the facility's performance, is the development of instrumentation and other equipment. Much of the work involves the modification of existing instruments; it also includes cooperating with ESSA and other laboratories on highly specialized equipment. For example, the Instrument Development Branch is working closely with Heinz Grote of the Atmospheric Physics and Chemistry Laboratory on a small computer to display wind speed and direction, superimposed over the storm picture on the aircraft radar screen, allowing airborne scientists to make decisions on the spot.

RFF personnel are constantly on the alert for ways to improve their scientific instruments and other equipment. This is a considerable job in itself. The aircraft are crammed with such devices as

continued

* *Now with the Research Flight Facility.*

ESSA's RFF "Forty Charlie" in the eye of a hurricane. This is one of a pair of heavily instrumented DC-6 aircraft used by the Research Laboratories and performs research tasks as well as hurricane duty. (Below) Howard Mason, Chief of Research Facility, in his working gear aboard the plane.

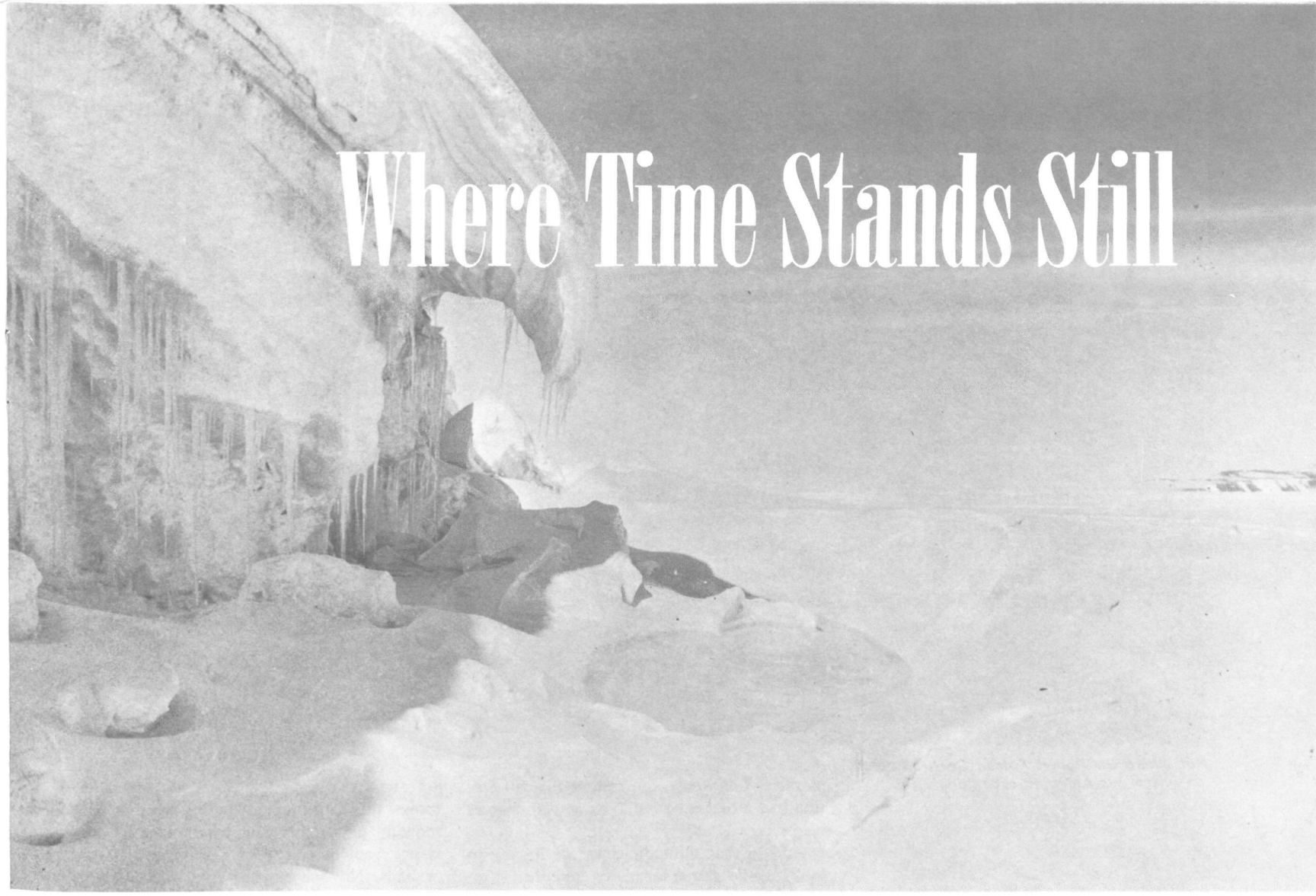
differential pressure transducers, dropsondes, vortex probes, icing detectors, infrared hygrometers, water content meters, and gust probes. There are three kinds of radar, magnetic tapes for recording digital data, and oscillographs and cameras for visual records. A typical mission could produce millions of data bits and thousands of photographs.

Much of science is conducted at stationary observatories; on unmanned mobile platforms, such as spacecraft; in laboratories; and in the brains of theoreticians. RFF is one of the relatively few scientific groups that seek out extreme conditions and physically plunge into them in order to gain new knowledge.

Mason tells of the time he was flying near Flagstaff, Arizona, on an atmospheric electricity mission for Dr. Heinz W. Kasemir of the Atmospheric Physics and Chemistry Laboratory. The crew made 24 flights in 12 days, and their DC-6A was struck by lightning 28 times. When you are in the pilot's seat, Mason says, the control column feels as if it has been whacked on the other end by a baseball bat. There is a loud crack, and a blinding flash fills the windows. Under these conditions, Mason keeps the interior lights on and his eyes on the instruments to prevent temporary flash blindness. As a result of the lightning strikes on these sorties the aircraft skin was marked with burns and holes up to the size of a half-dollar.

Mason, who was trained as a physicist at Adelphi University, has experience in measurements and instrumentation, is a certified professional engineer, and holds a transport pilot's rating, views the mission of RFF as an exciting challenge. He likes to fly, but not the Miami-to-Chicago run. To him the real challenge is to utilize the aircraft to their maximum for research.

"We fly lower and higher than usual," he says, "almost to the surface at times and occasionally at maximum altitude. We often fly under considerable turbulence. Our jobs require a large amount of skill, on the ground as well as in the air. It gives us great satisfaction to be able to meet the demanding needs of the scientists with whom we work." □



Where Time Stands Still

Here's one way to go South for the winter—

By RAYMOND WILCOVE
Coast and Geodetic Survey

LIFE on the Great Frozen Continent can be beautiful. There are no traffic jams and no smog. There are no flies, mosquitoes, or other insects. Colds are virtually unknown. You don't have to hurry because there's little to be late for.

You're not bothered with visitors during the long winter months. When they do come, during the summer, their stay is sometimes for only an hour or two. Otherwise, the motors of their planes might freeze and they could be stuck all night — four to six months of it.

You can save practically all your money, since there's little to spend it on and no bills to pay (although bills do manage to arrive intermittently from Stateside creditors). In addition to a year's salary, you get a 25 per cent pay differential, eight hours a week overtime pay, all your winter gear, and free board and lodging, as well as a stopover in sunny Hawaii and a chance (at your own expense) to see Australia and New Zealand. Transportation is also free.

If you enjoy movies, there's a different one every night for some six months. After that, you can enjoy the best of the reruns.

And there are all kinds of conveniences in Antarctica, such as steam baths at the South Pole and automatic washers and dryers at all stations. And beer and pizza parties every Friday evening at the South Pole.

Of course, there are a few inconveniences. The temperature never goes above zero at the South Pole (it has fallen to 115 below) and your beard and eyelashes freeze outdoors and have to be thawed out. At Plateau Station, 121 degrees below zero have been recorded, but you get accustomed to that. To celebrate the sun's return after six

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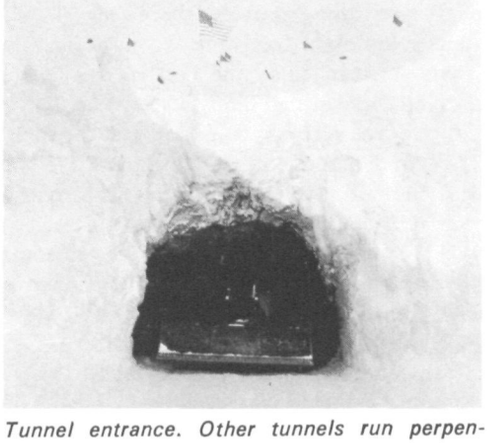
Hut where Sir Robert Falcon Scott wintered on one of his Antarctic expeditions.

Al Beaunagel with tractor toboggan for snow traveling.



Tunnel entrance. Other tunnels run perpendicular to this one.

months of darkness, the men at Plateau Station had a barbecue outdoors at 110 degrees below.

Add to that the tediousness of having to look at the same faces for months. You can't be choosy about your friends.

Yes, life in Antarctica can be beautiful, and awesome, adventuresome and exhilarating — if you don't stay too long, according to Robert R. Mallis and Robert H. Geissel, geophysicists of the Coast and Geodetic Survey. Both men spent a winter there, Mallis at the South Pole and Geissel at Plateau Station. The latter is perhaps the coldest inhabited place on earth, located about 600 miles from the Pole in the direction of the Indian Ocean. Vostok holds the record of 128 below, but Plateau is expected to establish a new record.

The two had some interesting things to tell about the frozen continent — the driest, highest, coldest continent on earth.

Did you know, for example, that the South Pole is one of the quietest places anywhere? Even the wind is quiet, because there's nothing to howl about. Practically all the buildings are buried beneath the snow.

Did you know that it snows very little at the South Pole, even though the U.S. station at the Pole is sitting on top of almost two miles of ice and snow? The average snow accumulation at the Pole is about seven inches a year! No weather reports predicting snow are ever issued. Even when it snows, there's no way of telling whether it's snowing or it's just the wind blowing the snow. And, of course, it never rains, sleets or hails. No one catches cold, except perhaps from visitors who bring the bug with them. The flu and pneumonia are unknown.

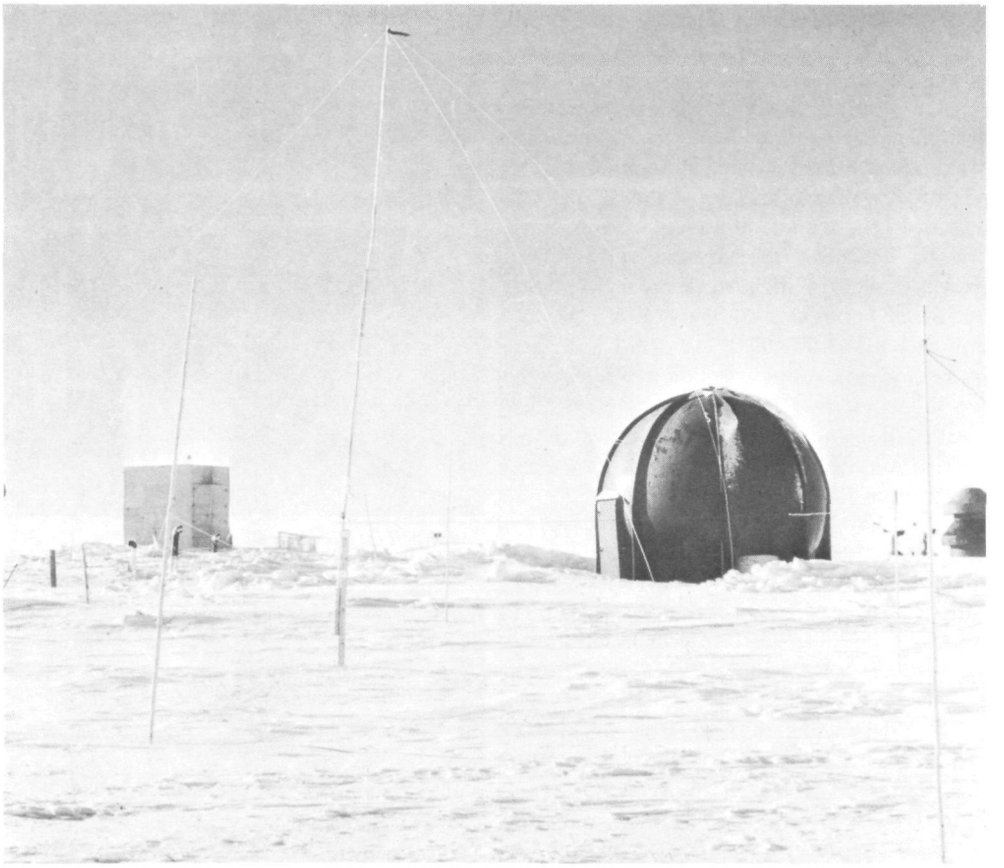
The air is so dry and wholesome that when men go from one building to another at the South Pole through the connecting tunnels, they rarely bother to put on a coat, even though the temperature is 15 below zero. "Too much trouble," explained Mallis.

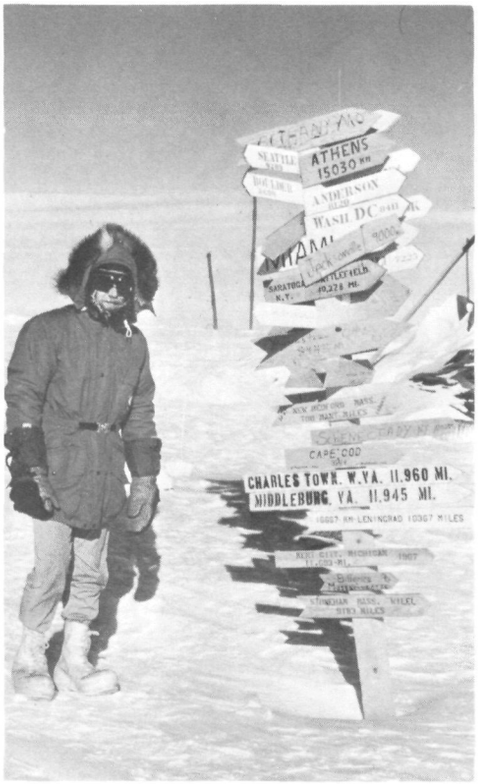
But after all is said and done, Antarctica is essentially a challenge to the hardihood and ingenuity of man. It is not to be trifled with. The white continent has exacted its toll over the years.

Mallis and Geissel said it took months to become acclimated to the weather and dry air. They found it difficult to breathe because the extreme cold, together with the high altitude, irritated their lungs. When they came out of the cold, they would cough and cough.

Mallis' mission was to operate the magnetic and seismological observatory at the South Pole; Geissel was in charge of the magnetic program at the Plateau Station.

Fire is the biggest bugaboo in the Antarctic. Just as the Ancient Mariner was surrounded by "water, water everywhere, nor any drop to drink," so the hardy sojourners





The South Pole where every direction is North. (Left) Radar installation for tracking weather balloons.

in Antarctica are surrounded by miles and miles of water, but none to fight a fire, because it's all frozen. Extinguishers could put out a small fire at the South Pole, but the buildings there are made of wood and are extremely dry, because they've been there so long in the dry atmosphere. In the event of a major disaster, there are emergency quarters in which the personnel could survive.

Recreation facilities at the South Pole are excellent, possibly as good as at some military facilities in the States. They include a darkroom for developing film, a billiard table, a fine selection of classical and popular records, a library well equipped with technical and fiction books, and ham radio facilities. Mallis talked regularly with his parents in Alexandria, Va. Chess is a popular pastime at the South Pole. A tournament is held regularly by radio with personnel at other stations.

Beer is available at all times. The biggest party is held June 21, the shortest day of the year in the Southern Hemisphere.

Star-gazing is a popular pastime among the men. Even without the sun, there is considerable light and the moon is so bright it is possible to take pictures. In March, when the sun is rising and setting a little and there is some twilight, the planets Saturn, Venus, and Mercury can be viewed at about 8 or 9 a.m. At the Plateau Station, star-gazing takes place from the comfort of indoors, through a plexiglas dome in the ceiling of the station.

Life in Antarctica at times gets lonely. Probably the loneliest time for the men comes when the plane arrives with the last airdrop of mail and supplies in late February. That is their last contact with civilization, except by radio, until the following October.

Although the food at the bases is excellent (except for the absence of fresh eggs, milk and produce), most men with excess weight lose it because so much energy has to be expended in doing things. In order to supply water at Plateau Station, sleds have to be loaded with snow and pulled up an incline to be dumped into a melting tank. At Plateau, this is an arduous task because of the high altitude and the failure of the sleds to slide over the snow. Geissel lost 20 pounds.

For those accustomed to more temperate climates, the sun, when it is present, is always interesting to observe. There are two twilight periods a year when the sun shines dimly for a short time each day — for about five hours — from mid-March to mid-May and from mid-August to mid-October. From May through August is one long night, though at noon there is still some light in the north.

Because the usual hours of daylight in the more temperate zones are absent, the

continued

Snow tractor for use in mountain climbing.

Dick O'Connell, C&GS geomagnetic seismology observer at the South Pole.

Robert H. Geissel, C&GS geophysicist wintered at the Plateau Station.

Fresh fish, but not hooked through the one-mile thick ice at Byrd Station.

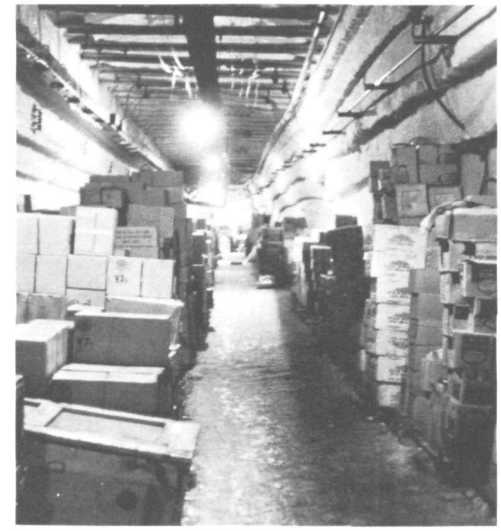
time routine sometimes gets scrambled. In the summer, when the sun shines continuously, an attempt is made to maintain the regular schedule to which the men were accustomed before they went to Antarctica: breakfast at 8 a.m., dinner at noon, and supper at 6 p.m., followed by the 7 o'clock movie. In the winter, however, with its continuous darkness, the routine varies. The men do much of their work when it would ordinarily be night and they would be sleeping. The most difficult thing of all is to get up at 8 a.m. Geissel found himself stretching the days into 25 and 26 hours. Mallis said he didn't think he'd ever spent another year of his life when he would be so aware of the time.

Both men had one major regret when they left Antarctica: they never got a chance to do any sightseeing. Rarely did either man travel more than a half-mile from his station. The only penguins and seals they saw were those they visited at the zoo back home.

The assignments in Antarctica of Mallis and Geissel were part of the continuing U.S. Antarctic Research Program financed by the National Science Foundation, with logistical suport by the Navy. Hundreds of U.S. and foreign scientists participate in the program each year.

Many are ESSA scientists. During the 1967-68 program, now underway, 24 scientists represent such ESSA components as the Coast and Geodetic Survey, the Research Laboratories, and the Weather Bureau, including 14 who will winter over. The previous year, 22 ESSA scientists participated in the program. Of these, 15 wintered over. □

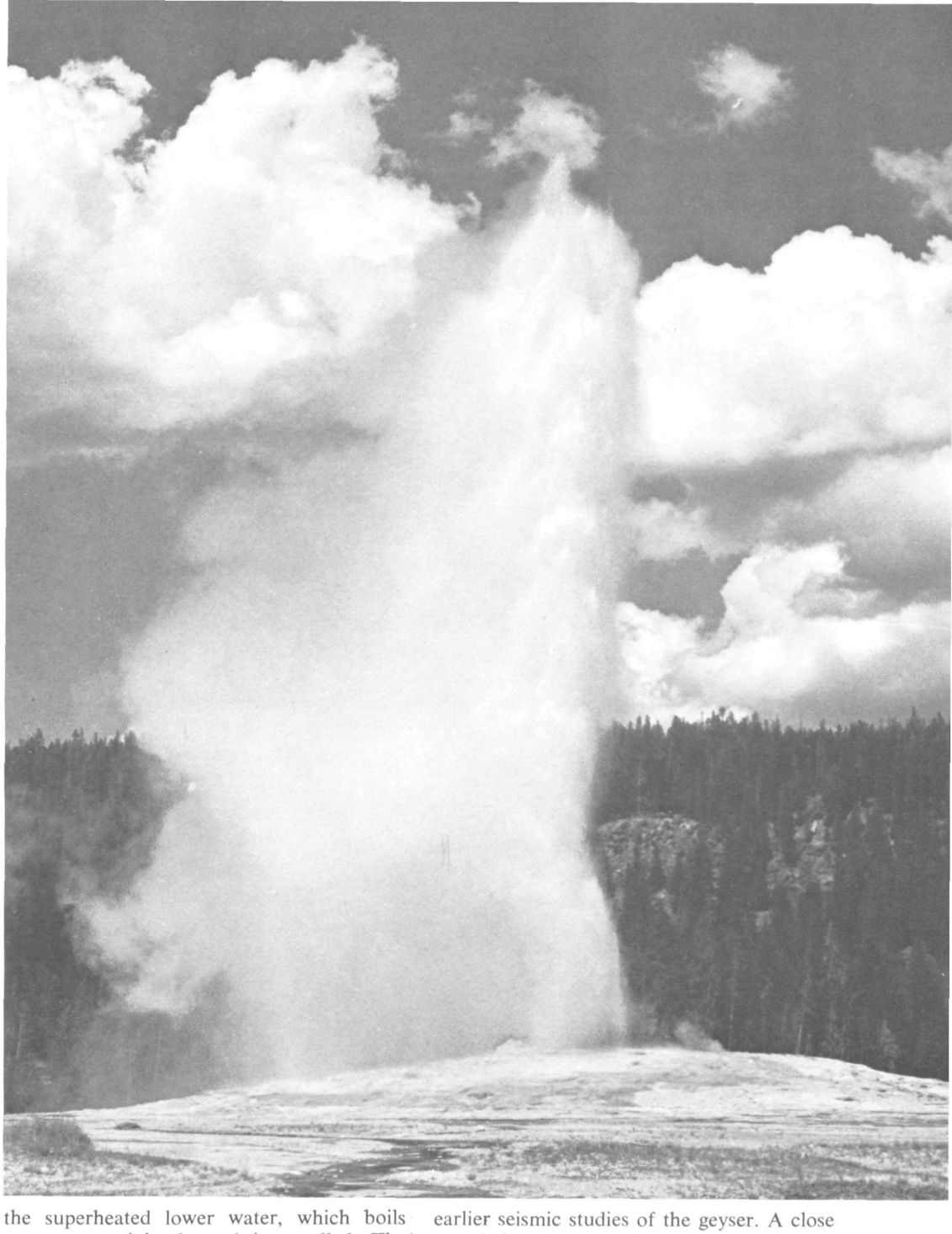
Geophysicist Robert R. Mallis of the C&GS spent the winter at the South Pole.



Main tunnel and food storage at Byrd Station in Marie Byrd Land.

Vostok Station (USSR). U.S. visitors are made welcome with caviar, cognac, wine hors d'oeuvres and Russian pin-ups. (Left) Men enjoy books with their beer in their Antarctic library.

What Makes Old Faithful Gush?



HAVE you ever tried to take a rebellious child's temperature? Bow low, then, in the direction of Dr. John S. Rinehart, a senior research fellow at the ESSA Research Laboratories in Boulder, Colorado.

He took Old Faithful's temperature. Not once, but often.

Five times during Dr. Rinehart's quest for an explanation of the famed geyser's eruptions, his thermometer was blown out of the hole. But he succeeded, nevertheless, in recording temperatures at various levels during 34 eruptions.

The temperatures were recorded at depths from 50 to 585 feet, believed to be more than three times below the level of the deepest previous probe — and the bottom has not yet been reached.

The Old Faithful water temperature measurements ranged from 199.4 degrees F. to 284 degrees F. Based on these findings, Dr. Rinehart explains its eruptions thus:

The geyser hole is filled to within about 35 feet of ground level with hot (280 degrees F.) water, probably siphoning in from the nearby Firehole River. This part of Yellowstone National Park was volcanically active in recent geological time and contains a "reservoir" of hot rock that provides energy for the recurring gusher.

Boiling immediately reduces the surface water to the boiling point, which at Old Faithful's 7400-foot altitude is 199.4 degrees F. A certain amount of vertical heat circulation maintains the boiling and reduces the temperature of the upper part of the water column for some 20 minutes.

Simultaneously, deep within the geyser, the water becomes heated to as high as 240 degrees F. because the pressure of the water above prevents boiling. Rising gradually in the column, the heat eventually causes the upper level water to boil so violently that it is expelled from the geyser in a 16-foot high fountain. (Dr. Rinehart was intrigued by the rising hot fronts and descending cold fronts in the water column that carried temperature changes of about five degrees F. every minute or two before the eruption.)

The initial gush relieves the pressure on the superheated lower water, which boils even more violently and is expelled. The downward sequence of boiling action continues until as many as 12,000 gallons of water are thrown out, lowering the water level several hundred feet.

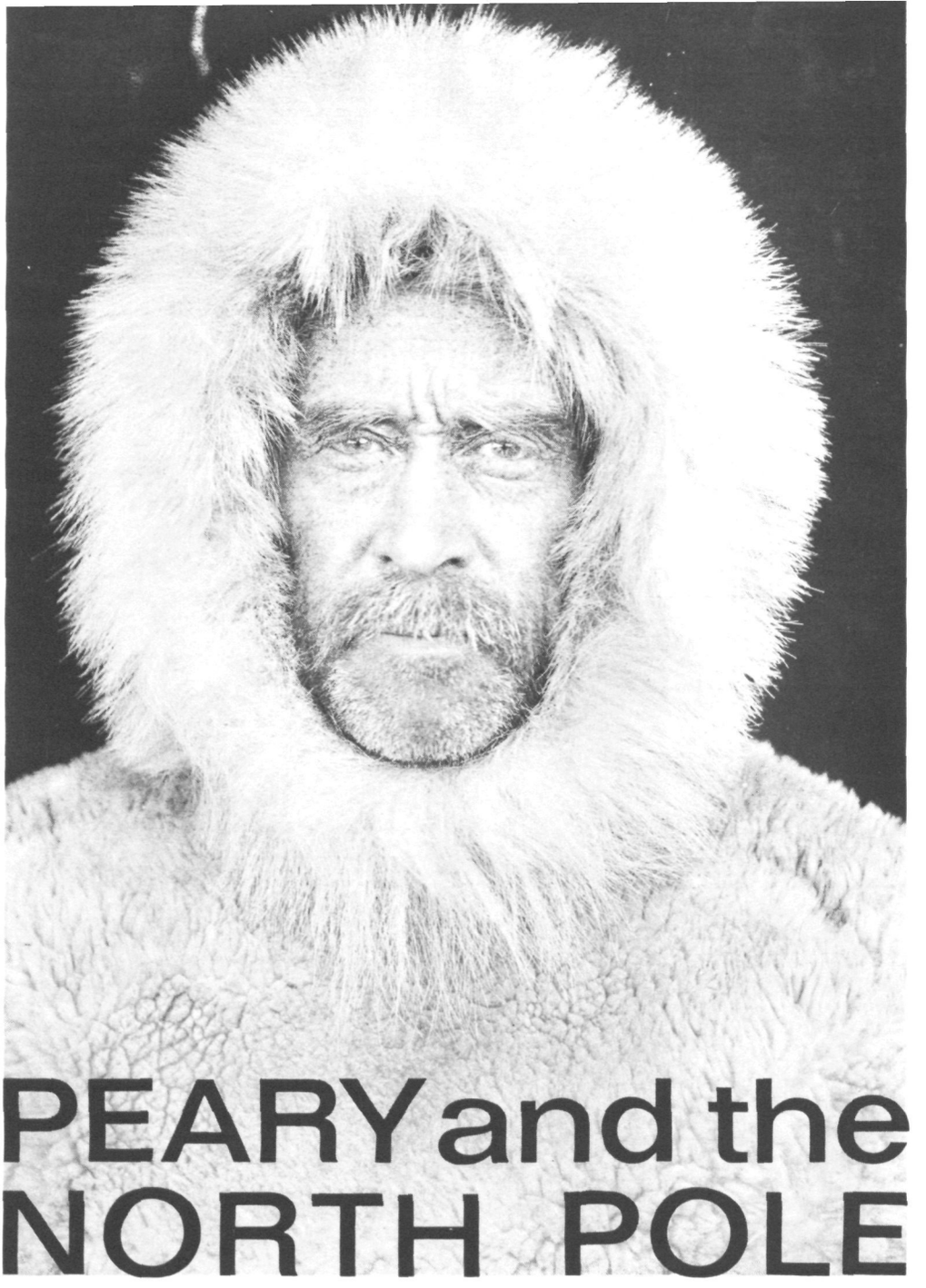
Eruptions from Old Faithful vary in duration, between two and five minutes. After a long eruption, the standpipe remains empty to a depth of several hundred feet for 20 to 30 minutes. A rush of very hot water (208 degrees F.) fills the geyser in about one minute, considerably faster than the eruption empties it.

If the eruption has been short, the geyser remains partially filled and then suddenly refills after about ten minutes.

Dr. Rinehart conducted his temperature probes as a member of the Yellowstone Research Field Expedition-8, sponsored by the National Science Foundation. His interest in the famous tourist attraction has included earlier seismic studies of the geyser. A close correlation between the seismic and temperature records is evident.

The most puzzling thing about the mechanism, acording to Dr. Rinehart, is how the hundreds of feet of empty geyser can fill so suddenly. Possibly water from the river fills a nearby subsurface reservoir over a period of about one hour. When the reservoir is full enough to force water over the high point of the channel to the geyser, a strong siphon is created which sucks the reservoir water into the standpipe. Seismic records indicate ground motions accompany the inrush of water.

At the depth of 585 feet, another unusual feature was observed. Short surges of extremely hot water, at 284 degrees F. were observed. These occurred 40 minutes before an eruption took place, and the ultra-hot water quickly mixed with the bulk of the superheated water. □



Robert E. Peary after discovering the North Pole.

Photo courtesy of William E. Peary Jr., and Marie Stafford, National Geographic Magazine

PEARY and the NORTH POLE

A Navy explorer's work for the Coast and Geodetic Survey solved a historic dispute

THE name of Rear Admiral Robert E. Peary, USN, means one thing to most Americans: on April 6, 1909, he became the first man ever to reach the North Pole overland.

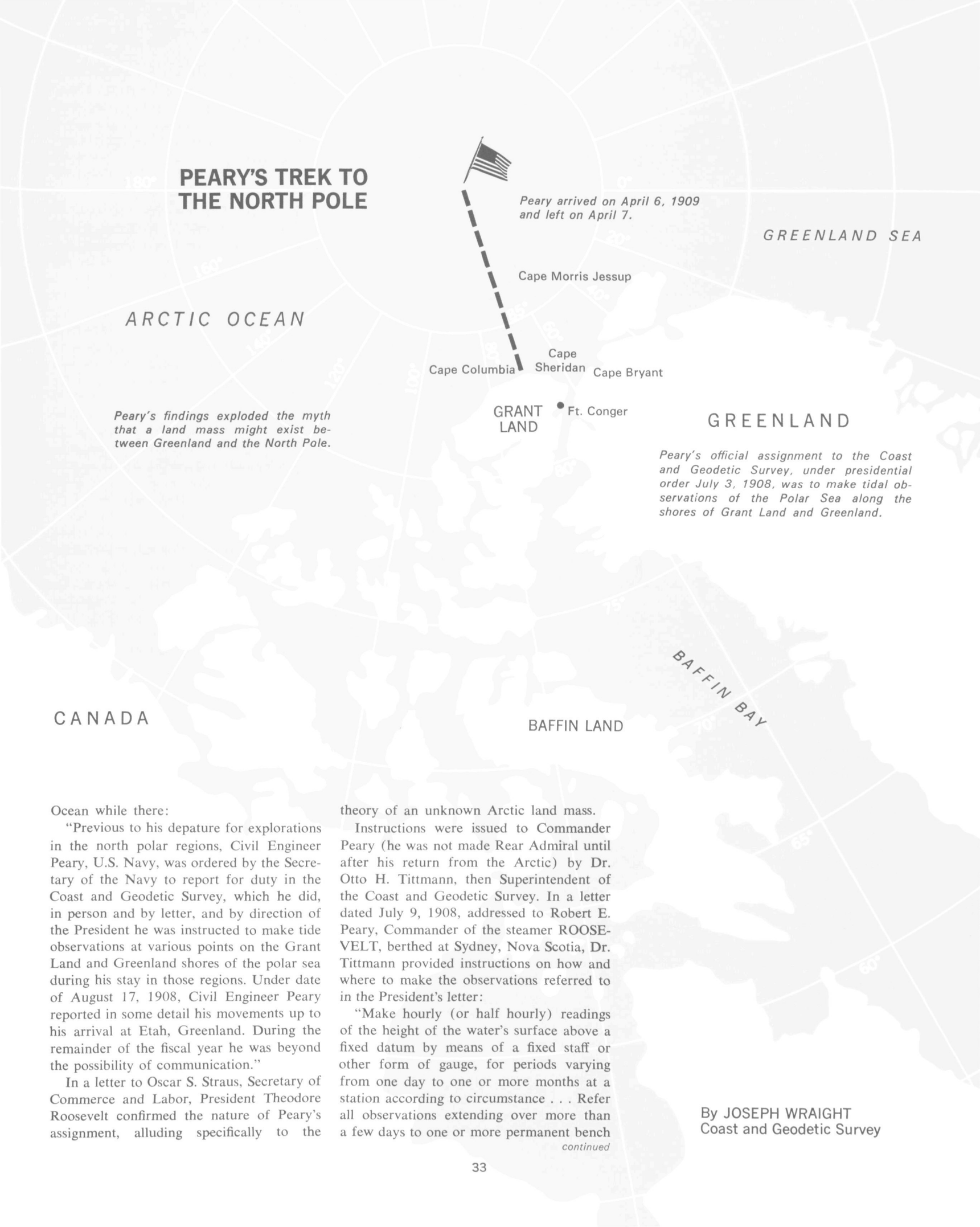
There is, however, a story-behind-the-story of his gallant Polar trek. His observations for the Coast and Geodetic Survey not only added significantly to our store of Arctic knowledge but assured his own place in history.

Acting on a Presidential directive, Peary made various findings of scientific importance for the Survey, one of which exploded the myth that a land mass might exist between Greenland and the North Pole. And after his return, a Coast Survey analysis of his records proved to a skeptical Congress that he did, indeed, reach the Pole — for his observations could have been taken nowhere else.

Even had he not reached the North Pole, Peary would still have won a place in history for the excellence of his scientific work. In addition to exacting tidal and bathymetric recordings, he made meaningful meteorological and astronomic observations, and sent them in small lockers to the Survey.

The 1909 *Annual Report of the Superintendent of the Coast and Geodetic Survey* noted that Peary, by direction of the President, was instructed by the Coast Survey in 1909, before his departure for the Arctic, to make tide observations in the Arctic

PEARY'S TREK TO THE NORTH POLE



Ocean while there:

"Previous to his depature for explorations in the north polar regions, Civil Engineer Peary, U.S. Navy, was ordered by the Secretary of the Navy to report for duty in the Coast and Geodetic Survey, which he did, in person and by letter, and by direction of the President he was instructed to make tide observations at various points on the Grant Land and Greenland shores of the polar sea during his stay in those regions. Under date of August 17, 1908, Civil Engineer Peary reported in some detail his movements up to his arrival at Etah, Greenland. During the remainder of the fiscal year he was beyond the possibility of communication."

In a letter to Oscar S. Straus, Secretary of Commerce and Labor, President Theodore Roosevelt confirmed the nature of Peary's assignment, alluding specifically to the theory of an unknown Arctic land mass.

Instructions were issued to Commander Peary (he was not made Rear Admiral until after his return from the Arctic) by Dr. Otto H. Tittmann, then Superintendent of the Coast and Geodetic Survey. In a letter dated July 9, 1908, addressed to Robert E. Peary, Commander of the steamer ROOSEVELT, berthed at Sydney, Nova Scotia, Dr. Tittmann provided instructions on how and where to make the observations referred to in the President's letter:

"Make hourly (or half hourly) readings of the height of the water's surface above a fixed datum by means of a fixed staff or other form of gauge, for periods varying from one day to one or more months at a station according to circumstance . . . Refer all observations extending over more than a few days to one or more permanent bench

continued

By JOSEPH WRAIGHT
Coast and Geodetic Survey

Oyster Bay, N.Y.,
July 3, 1908.

Sir:

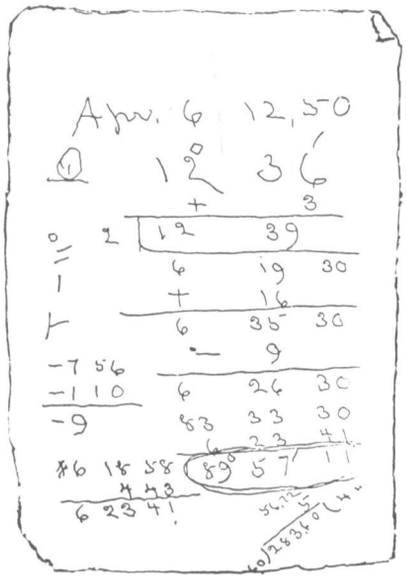
Civil Engineer R. E. Peary, U.S.Navy, has been directed by the Navy Department to report by letter to the Superintendent of the U.S. Coast and Geodetic Survey, and you are requested to direct this official to order him to make tidal observations along the Grant Land and Greenland Shore of the Polar Sea, during his projected cruise in the "Roosevelt."

It is believed that such observations will throw light upon the Coast Survey theory of the existence of a considerable land mass in the unknown area of the Arctic Ocean.

Respectfully,

Theodore Roosevelt

Hon. Oscar S. Straus,
Secretary of Commerce and Labor.



Page from notebook showing Peary's observations made in the vicinity of the Pole. (Left) Some of the original expedition records.

marks upon the shore . . . Wherever practicable the observations should extend through all twenty-four hours of the day."

He also specified some of the places where observations were especially desired, such as points as far northward, westward, and eastward as possible; Cape Columbia; Cape Sheridan; and Cape Bryant.

A memorandum provided additional instructions for Donald B. McMillan, one of Peary's assistants on the expedition. Attached were the results of some meager previous observations made by earlier expeditions at places such as Cape Sheridan and Fort Conger. The other instructional material enclosed with the Superintendent's letter dealt in detail with the preparation and care of the tidal staffs, exact type sites for locating them, the establishment of further bench marks, and precise details of observational procedure.

The instructions were by no means casual, nor was Peary's attitude toward them. He even sought additional advice from Rollin A. Harris, a pioneer personality in the Coast and Geodetic Survey and one of the greatest tidal scientists of all time. Harris forwarded to Peary additional instructions as well as memoranda about the probable condition of the Polar Basin.

Considerable additional documentation dealt with the uncertainty that existed at that time as to the true nature of the basin of the Arctic Ocean and with the necessity of taking soundings in that ocean and making some meteorological records at sites where other observations were being taken. Instructions on the taking of soundings by the lead-line method were included, and directions were enclosed on the procedures used in making thermograms and barograms.

The lead-line sounding method was used for obtaining ocean depth figures then, as the modern method of echo sounding had not yet been invented. This was accomplished by reeling off lengths of piano wire under the weight of lead sinking to the bottom. From this alone it can be seen that Peary did not travel as lightly as he could have on his northward dash, for he took a sounding very near the Pole.

In addition to making the requested tidal observations at the places suggested, Peary also took the recommended meteorological observations at these sites, and, as instructed, a number of depth soundings in the Arctic Ocean. As indicated by this notation in the *1910 Annual Report of the Superintendent of the Coast and Geodetic Survey,* some of the soundings were made on the polar trek, along a line from Cape Columbia to within a few miles of the Pole.

In that report, the Superintendent said:

"In accordance with the instructions issued to Civil Engineer Peary, U.S. Navy, as stated in the previous annual report, tide observations were made in the Arctic regions at Cape Sheridan, Cape Columbia, Cape Bryant; were made day and night at hourly intervals covering periods varying from 231 days at Cape Sheridan to 10 days at Cape Morris Jesup, and valuable information in regard to the tides was obtained. Meteorological observations were also made in connection with the tide observations, and soundings were made on the meridian of Cape Columbia, 9 in all, extending from Cape Columbia to latitude 89°55′."

Naturally, in the vicinity of the Pole Peary made astronomical observations, of which he kept careful record.

The profile of the soundings made on the polar trek, signed by Peary himself, tended to present a picture of the floor of the Arctic Ocean as a basin, deepening toward the center, and exhibiting normal oceanic features such as a continental shelf. The theory of a land mass near the Pole was permanently exploded. The assistants who were with Peary part of the way to the Pole made many of the soundings, all under Peary's supervision, and with the same precision that characterized work done directly by him. In accounts too detailed to reiterate here, Peary later described the care with which they made the soundings and some of the difficulties under which they were taken.

In addition to the bathymetric sounding records and the astronomical records, detailed tidal records were included for five different sites. Also included were meteorological records taken at the same sites as the tidal observations. From the tidal records and the thermograms and barograms, as well as other data, much of the mystery about the Arctic Ocean was removed. Some of the records have been lost in the intervening years, but much data still remains.

An appraisal of the tidal records was made by Dr. Harris in a report to Superintendent Tittmann, dated March 16, 1910, in whilch he lists the record lengths at the five major sites. The observations were taken day and night; and besides the regular hourly readings, numerous additional readings were generally taken near the times of the high and low waters.

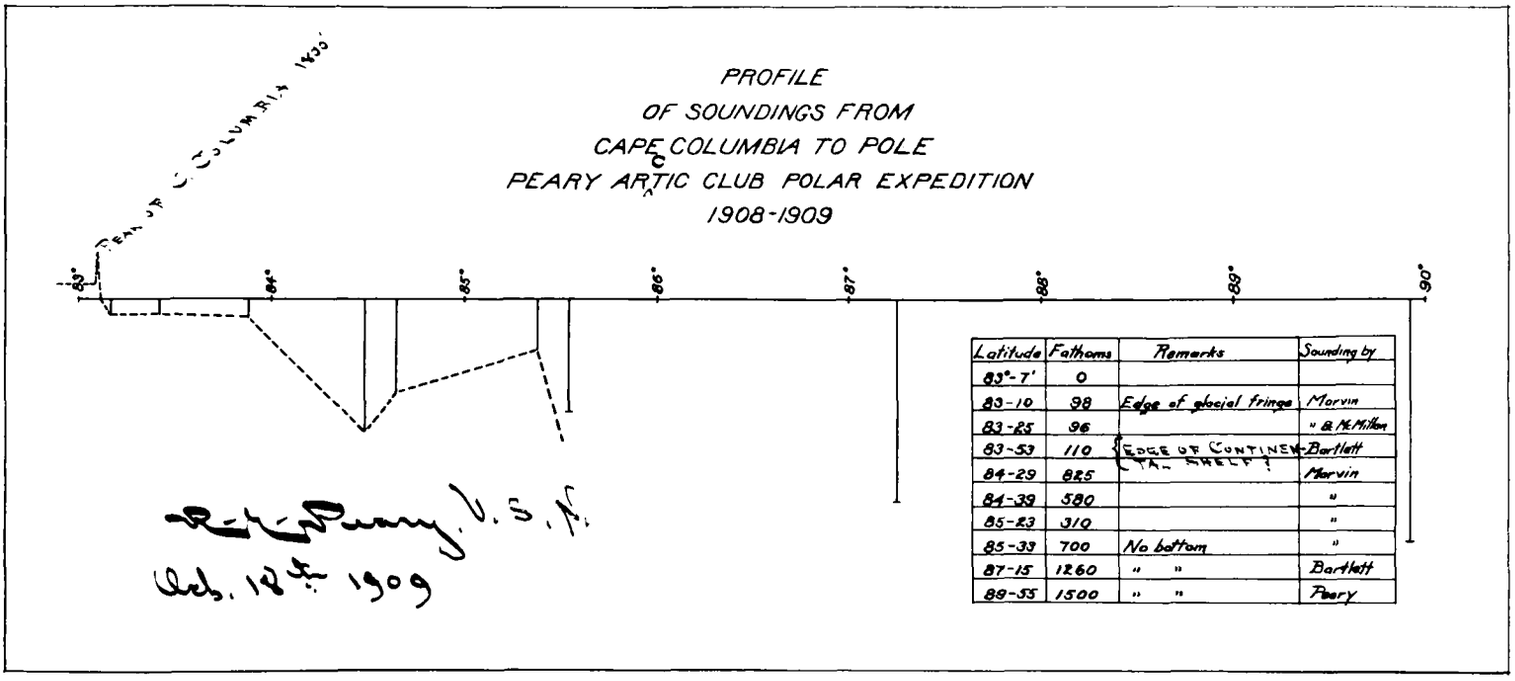
From the records themselves and from plottings constructed from them, it appears that the observations were taken with great care and thoroughness. In order to show the full geographical value of the results, the data were considered in connection with all other tidal results relating to the Arctic Ocean. The results obtained from Peary's records showed that the tides along the northern coasts of Grant Land and Greenland were quite different in many respects from what had been supposed.

For example, his records prove that the tide occurs eight hours earlier at Cape Columbia than at Cape Sheridan, and not later, as had been generally assumed. The full significance of these observations in respect to Arctic geography was revealed in due time.

The meteorological records consisted of thermograms covering about 180 days, and barograms covering about 260 days. The soundings that Peary made in the Arctic Ocean were added to maps and charts and conrtibuted greatly to the understanding of that ocean at that time. The meteorological observations added significantly also to the understanding of the polar air mass at the time. The astronomical observations were examined carefully by Coast and Geodetic Survey mathematicians Hugh C. Mitchell and Charles Duval, whose findings were presented as testimony at the Congressional hearing that came later to prove that Peary had indeed been to the Pole. Coast and Geodetic Survey engineers analyzed the records and testified that his observations could only have been made there. The 61st Congress, accepting the authenticity of the records of the Peary expedition, passed House Joint Resolution No. 169 in March 1910, based on the report of an elite committee of scientific leaders which heaped high praise on Peary and his work. The report of the Congressional subcommittee is quoted in part:

"Commander Peary has submitted to this subcommittee his original journal and records of his observations, together with all his instruments and apparatus and certain of the most important of this scientific results of his expedition. These have been carefully examined by your subcommittee, and they are unanimously of the opinion that Commander Peary reached the North Pole on April sixth, nineteen hundred and nine." □

Profile made by Peary of the bathymetric soundings on his polar trek.



essa NEWS BEAT

U.S. DEPARTMENT OF COMMERCE ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION

Three win coveted Commerce Awards

WEATHER BUREAU METEOROLOGISTS HONORED

Numerous other members of the ESSA family have been honored in recent months:

Dr. Robert M. White, Administrator, has been elected to the National Academy of Engineering, for leadership in development of weather forecasting methods and in the evolution of the World Weather Watch System.

The officers, scientists and crew of the USC&GSS OCEANOGRAPHER received the Karo Plaque given by the Society of American Military Engineers for its global scientific expedition, which contributed "not only to the knowledge of the oceans but also to international scientific cooperation."

USC&GSS Cdr. Hubert W. Keith Jr., commander of the Miami ships base, received the SAME's Colbert Medal for his development of a "singular and reliable 'Simplified Azimuth of Polaris.'" This is an easy method of determining North, using the star Polaris. His method has achieved wide international use.

Raymond G. Busniewski, Official-in-Charge at Hilo, Hawaii, was named the Outstanding Male Federal Employee for the Pacific, topping nominees from among more than 25,000 civilian employees.

Six ESSA scientists were elected to office at the 49th annual meeting of the American Geophysical Union. Beginning two-year terms of office on July 1, 1968, are: Charles A. Whitten (C&GS)—AGU Secretary; Hyman Orlin (C&GS)—Vice President, Section of Geodesy; Buford K. Meade (C&GS)—Secretary, Section of Geodesy; Woodrow C. Jacobs (EDS)—Secretary, Section of Meteorology; Kendall L. Svendsen (C&GS)—Secretary, Section of Geomagnetism and Aeronomy; and Max A. Hohler (WB)—President, Section of Hydrology.

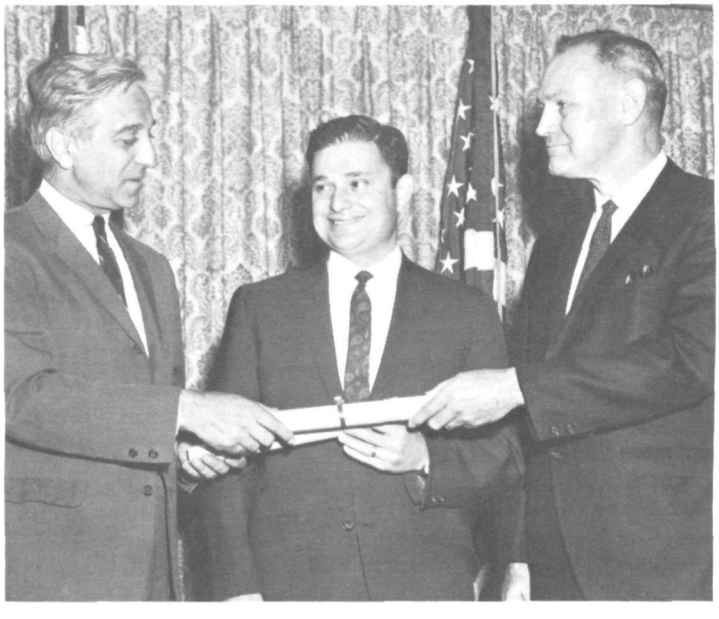
Three Weather Bureau meteorologists have been honored by Under Secretary of Commerce Howard J. Samuels with Superior Service to the Public Awards for outstanding achievement in their posts.

Robert S. Ingram, Meteorologist-in-Charge at the Airport Station in Phoenix, Arizona, and David L. Coveney and Stanley E. Wasserman of New York were among seven men and one field office within the Department of Commerce so recognized.

Ingram was cited for "significant improvement in the coverage and quality of weather forecasts and flood warnings for the entire State of Arizona." Among his achievements is a plan dividing Arizona forecasts into three topographic zones. He also developed an arrangement with state highway officials whereby rain gages were placed at numerous highway installations. Highway personnel were trained in measurement and reporting; these reports were critically valuable in the issuance of timely flood warnings during intense December 1967 storms in Arizona, and in supporting rescue efforts for Navaho Indians trapped by unprecedented snows.

Coveney and Wasserman were credited with developing an involved procedure for providing aircraft crews with annotated ESSA weather satellite photos of cloud cover over the Atlantic Ocean, within three hours of picture-taking time. In 1967, approximately 15,000 crews of internationally operated aircraft received these pictures, adding substantially to the safety of flight.

At the time of the awards ceremony, the Department of Commerce issued "Better Service to the Public," a quarterly report of recent steps to improve services. Of 19 advances cited, seven originated within ESSA.



Receiving award for Superior Service to the Public from Under Secretary of Commerce Howard J. Samuels are (top) Robert S. Ingram, Stanley E. Wasserman (left, center) and David L. Coveney.

all in the family PERSONNEL NOTES

A new Office of Systems Development has been established in the Coast and Geodetic Survey to develop improved technological systems and extend the use of automated data processing. The office will be directed by **Edward M. MacCutcheon,** who joined the Survey in 1966. **Thomas J. Hickley,** chief of the Engineering Division since 1959, will head the office's Engineering Development Laboratory. **Dr. Gilbert C. Jacobus** will be in charge of Systems Plans and Analysis. **Dr. Harold W. Straub** will be Acting Scientific Advisor to the Director of Systems Development.

Lt. Cdr. Donald R. Tibbit, 31, of Texarkana, Ark., has been appointed director of the C&GS National Tsunami Warning Center in Honolulu. The National Tsunami Warning Center alerts U.S. areas, including Hawaii, California, Oregon, Washington, Alaska, Guam and American Samoa, to the danger of tsunamis. It works closely with the International Tsunami Information Center in alerting national tsunami services in Japan, Chile, the Soviet Union, Great Britain, Canada, and other participants in the tsunami warning network. The detection of tsunamis is carried out by the Honolulu Observatory, which maintains a 24-hour watch.

Lt. Cdr. Ralph J. Land has been appointed commanding officer of the USC&GSS FERREL, a new vessel which replaces the USC&GSS MARMER. Lt. Cdr. Land joined the Coast Survey in 1960. He has served in Norfolk, at the Fredericksburg Geomagnetic Center, Corbin, Va.; and aboard the USC&GS Ships WAINWRIGHT, HILGARD, MARMER, and WHITING.

Allen H. Travis, C&GS geophysicist, has become head of the Newport (Wash.) Geophysical Observatory. Prior to his appointment, he served as the Observatory's acting chief.

Jack L. Teague has been selected as Regional Radar Meteorologist at the WB Southern Regional Headquarters. Mr. Teague holds a bachelor's degree in physics and mathematics from Central State College in Oklahoma.

Cdr. Alfred C. Holmes has succeeded Capt. John O. Phillips as commanding officer of the USC&GSS Ship PATHFINDER, and **Lt. Cdr. James S. Midgley** has been named the ship's executive officer. Cdr. Holmes joined the Coast Survey in 1949 following graduation from Oregon State University. He was formerly the executive officer on the SURVEYOR. Lt. Cdr. Midgley joined the Coast Survey in 1959 after receiving a civil engineering degree from the University of Massachusetts.

Glenn V. Sachse has assumed the post of meteorologist-in-charge at the WBAS, Indianapolis, Ind. Mr. Sachse, a 1958 Department of Commerce silver medal winner, has been MIC at Norfolk since 1953.

Willard L. Broussard, principal assistant at Columbus, Ga., since 1949, is the new meteorologist-in-charge at the Savannah, Ga., WB airport station.

Clyde H. Downes has been appointed meteorologist-in-charge of the Weather Bureau airport station at Evansville, Ind. Mr. Downes has been MIC at Fort Wayne, Ind., for almost 10 years.

Glenn Stallard, former field director for the ESSA Interoceanic Canal Project, has been named meteorologist-in-charge of the Memphis, Tenn., WB airport station.

Kelly F. Anderson has replaced Carl G. Peterson as Official-in-Charge of the WB station at La Crosse, Wisc. Mr. Anderson is a 19-year Weather Bureau veteran.

Warren O. Eckert has succeeded Laurence G. Shaffer as Official-in-Charge of the Goodland, Kans., WB airport station. Mr. Eckert has been principal assistant at the station for 11 years.

Samuel C. Davis, former principal assistant at WBAS, Savannah Ga., is the Official-in-Charge at the WB airport station in Macon, Ga. A Navy veteran, Mr. Davis has been with the Weather Bureau for nearly 21 years.

Joseph B. Pentecost, former Official-in-Charge of the Johnston Island WB airport station, now heads the Pacific Missile Range Weather Unit at Barking Sands, Kauai, Hawaii.

Robert Theisen, hydrologist at the Kansas City River Forecast Center, has been selected for the principal assistant post at the Fort Worth River Forecast Center.

Robert F. Shaw, formerly Regional User Services Representative at the WB's Pacific Region Headquarters in Honolulu, is now chief of the Region's Data Acquisition Branch.

Lt. Roger H. Kerley, USESSA, has replaced Lt. (j.g.) Frank Rossi as editor of EDS's *Mariners Weather Log.* Lt. Rossi has been reassigned to the USC&GS Ship OCEANOGRAPHER. □

LT. CDR. DONALD R. TIBBIT

EDWARD M. MacCUTCHEON

DR. GILBERT C. JACOBUS

DR. HAROLD W. STAUB

CDR. ALFRED C. HOLMES

LT. ROGER H. KERLEY

GLENN V. SACHSE

CLYDE H. DOWNES

C&GSS Mt Mitchell Commissioned in Jacksonville

The Coast and Geodetic Survey ship MT MITCHELL, a hydrographic survey vessel, was commissioned March 23, at Jacksonville, Florida. Principal speaker was U.S. Rep. Alton Lennon of North Carolina, chairman of the Subcommittee on Oceanography of the House Committee on Merchant and Fisheries.

The ship, named after Mt. Mitchell in North Carolina, will be based at the Atlantic Marine Center, Norfolk, Virginia.

The MT MITCHELL is the first of three sister ships constructed at Jacksonville to be commissioned for the ESSA fleet of ocean and hydrographic survey vessels. The others are the USC&GSS FAIRWEATHER and RAINIER. Preceding the MT MITCHELL were two larger vessels, the USC&GSS OCEANOGRAPHER and DISCOVERER, built in Jacksonville for ocean surveys in the Pacific and Atlantic.

The 4.3-million-dollar MT MITCHELL will participate in the Coast Survey's long-range program of marine charting and scientific exploration in the Atlantic. Cdr. Kenneth A. MacDonald, 37, of Hessel, Mich., a 16-year veteran of ESSA's Commissioned Corps, commands the 231-foot, 1660-ton vessel. The executive officer is Lt. Cdr. Charles A. Burroughs, 32, of Bristol, Conn.

The white-hulled ship has a cruising range of 8000 miles and accommodations for 79 officers, crew, and scientists. Her primary function will be carrying out hydrographic surveys in coastal waters in the Atlantic and the Gulf of Mexico. She is also equipped, to a limited extent, for oceanographic surveying.

MacDonald has had extensive experience on six Coast Survey ships, including command of the USC&GSS WAINWRIGHT, HILGARD, and GILBERT. Prior to being assigned to the MT MITCHELL, he was chief of the Operational Division of the Mid-Continent Regional Office at Kansas City, Mo., the Coast Survey's largest administrative unit in the field. He also served with field parties throughout the U.S. and in Ethiopia on a survey of the Blue Nile River Drainage basin. He joined the Coast Survey in 1952, after graduating the previous year from Michigan Technological University with a civil engineering degree.

DR. JOHN W. TOWNSEND APPOINTED NEW DEPUTY ADMINISTRATOR OF ESSA

The Senate confirmed on June 20 the nomination of Dr. John W. Townsend, Jr., as ESSA's Deputy Administrator. He will succeed Dr. Werner A. Baum, who has accepted the presidency of the University of Rhode Island.

Dr. Townsend, Deputy Director of the National Aeronautics and Space Agency's Goddard Space Flight Center at Greenbelt, Maryland, is widely known as a scientific administrator and ionospheric physicist, whose contribution to the Nation's satellite program has been a notable one.

He was born on March 19, 1924, in Washington, D.C. During World War II, he served 3½ years as an Air Force officer, with overseas duty at Guam, Tinian, and in the Philippine Islands.

He was graduated from Williams College in 1947, cum laude and with highest honors in physics. He received his master's degree in physics from Williams in 1949, and an honorary degree of Sc.D. from that institution in 1961.

Dr. Townsend joined the Naval Research Laboratory's Radio Division in 1949. He became head of the Rocketsonde Branch and Deputy Science Program Coordinator of Project Vanguard in 1955.

Dr. John W. Townsend, Jr.

During his service with the Naval Research Laboratory, he participated in programs of basic research in the very high atmosphere. He developed a radio frequency mass spectrometer for use in rockets, and obtained the first mass spectra of the upper atmosphere above 90 kilometers. He was the scientific officer for the Navy's development of the Aerobee-Hi rocket. As Deputy Science Program Coordinator for Project Vanguard, he directed preparation of scientific instrumentation for two of the four approved original earth satellites.

Dr. Townsend transferred to NASA in 1958 and was appointed Chief, Space Sciences Division. The following year he became Assistant Director of Goddard Space Flight Center, and was appointed Deputy Director in July 1965.

He was a member of the team that created Goddard Space Flight Center through the transfer of several agencies to the new NASA.

At Goddard, he planned, directed, and conducted a broad program of space research. He has been responsible for the day-to-day management of most of NASA's scientific and applications satellites, operation of its global tracking and data acquisition network for unmanned satellites, and the manned Gemini and Apollo spacecraft.

He received the Arthur S. Flemming Award as one of the Ten Outstanding Young Men in the Federal Service in 1963.

Historic Moment Is Recreated by ESSA Vessel

More than a century after British sea captain measured the deep ocean for the first time, an ESSA oceanographic vessel has revisited the scene and scientifically gauged the depth.

The new sounding was made early this year, 128 years after Captain Sir James Clark Ross, commander of HMS EREBUS, proved that the sea was not bottomless, as had generally been believed.

Using modern electronic equipment, the Coast and Geodetic Survey Ship DISCOVERER resurveyed the site in the South Atlantic where Ross in 1840 measured a depth of 2425 fathoms (14,550 feet) using a specially constructed line attached to a 76-pound weight. This depth is still shown on modern small-scale charts of the South Atlantic.

The DISCOVERER found a depth of 2312 fathoms (13,872 feet), or 678 feet less than that recorded by Ross. The ship determined the depth with an echo sounder, an electronic device which records depth by measuring the time it takes for a sound to travel to the bottom and return. The sounding was made while the ship was enroute to Africa.

ESSA-Air Force Dedicate Data Processing System

The Federal Government's first environmental data processing system to be jointly managed by a civilian and military agency—ESSA and the Air Force—was dedicated May 20 at the Federal Building in Asheville, North Carolina.

The twin Spectra 70/45 RCA computers will be jointly operated by the Environmental Data Service's National Weather Records Center and the Air Force's Data Processing Division. The new computer center will use large - scale, third - generation hardware and software techniques in the preparation of environmental studies and the collection and processing of worldwide weather observations.

The NWRC gathers thousands of hourly and daily reports from worldwide weather observation stations.

The Data Processing Division of the Air Force's Environmental Technical Applications Center (ETAC) is an element of the Air Weather Service of the Military Airlift Command. ETAC's mission is to gather raw weather and other environmental data from worldwide sources, to prepare studies, for the Air Force and Army, and to fill a variety of defense security and intelligence needs for such data.

This information, in addition to standard meteorological data, includes such exotic factors as variations in the earth's magnetic field, solar activity, atmospheric density, and wind direction and speed at extremely high altitudes.

The NWRC's Information Bank includes a collection of manuscript observational forms and autographic traces of measurements occupying more than 10 miles of shelf length. It also contains records reduced to microfilm, magnetic tape, and punched cards; radar and satellite films; climatological publications and unpublished tabulations and analyses.

Secretary of Commerce C. R. Smith recently visited National Environmental Satellite Center, National Meteorological Center and Washington Forecast Center at Suitland, Maryland. From left: David Johnson, NESC Director; Dr. George P. Cressman, Weather Bureau Director; Secretary Smith; Dr. Fred Shuman, NMC Director; and Dr. Robert M. White, ESSA Administrator.

Tornado Preparedness Program On in Twenty Four States

The onset of the 1968 tornado season saw a major program of public education and community preparedness launched by the Weather Bureau to help the people of America protect themselves against these deadly storms.

Early this year the new ESSA film, "Tornado!" was released, receiving national distribution and thousands of showings. Simultaneously a 28-page Tornado Preparedness Planning pamphlet was developed by the Weather Bureau, in cooperation with the Office of Emergency Planning, the Office of Civil Defense, and the American National Red Cross.

In April Dr. George P. Cressman, Weather Bureau Director, sought the cooperation of Governors in 24 states where tornadoes are most prevalent in putting the plan into practice.

Meetings now have been held in all 24 states with Governors or their representatives, public safety, regional and state civil defense and Red Cross leaders, generated by Weather Bureau officials from the Eastern, Southern and Central Regions. Many states already have initiated community programs of education and preparedness, and the program is expected to continue annually.

The Plan offers practical suggestions for planning and organizing to minimize tornado and severe thunderstorm deaths and injuries. Copies may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402, at 25 cents each.

Wisconsin Gov. Warren P. Knowles studies ESSA tornado publication at meeting in his office with State CD Administrator Bruce Bishop (left) and Joe Rigney, MIS of Madison Weather Bureau office. Meeting was one of many being held by heads of state to further tornado preparedness planning.

USC&GS TO MAKE A STUDY OF MANMADE TREMORS ON THE "GREAT STONE FACE"

The Coast and Geodetic Survey plans to check the "Old Man of the Mountains" in New Hampshire to see what effect manmade tremors might have on the Great Stone Face.

The granite rock feature is located on a shoulder of Cannon Mountain at Franconia Notch. Proposed Interstate Highway 93 will require extensive excavation nearby by dynamite, and concern has been expressed about the effects the blasting could have on the stability of the rock formations which comprise the famed "Old Man."

A team from the Coast Survey's Seismology Division will conduct a seismic monitoring project on the "Old Man of the Mountains," at the request of the New Hampshire Department of Public Works and Highways and the U.S. Department of Transportation, Bureau of Public Roads.

The project's first task will be to determine how well the granite profile is tolerating everyday stresses, such as distant earthquakes, sonic booms, and high winds. After this, the team will analyze the possible effects of blasting on its rock formations.

The "Old Man" is located 800 below the top of the mountain and about one mile from the blasting area. The Coast Survey seismology team will place and observe for one week 12 seismometers which will record earth movements. Eleven instruments will be placed on the profile and the twelfth on more stable rock 200 to 1000 feet away.

The seismologists hope to determine, by the end of the three-year survey, the degree of stability of each of the five rock ledges which comprise the granite face, under various conditions, natural and manmade; and to establish limits on the amount of explosives that can be used safely without damage to this famous promontory.

National Open House Planned —

ESSA TURNS THREE ON JULY 13

ESSA will be three years old on July 13.

To commemorate its first 36 months of service as the nation's focus for the understanding, description and prediction of the physical environment, the agency will welcome the public at many installations during the week of July 8-13.

The Washington observance will be held at FOB 4, Suitland, Maryland, where the National Environmental Satellite Center, National Meteorological Center and the Washington Forecast Center will hold Open House.

If the previous two years are an indicator, the third annual ESSA National Open House is destined for success. On ESSA's first birthday President Johnson commissioned the USC&GS OCEANOGRAPHER, one of the world's first ocean survey vessels. Last year, many thousands attended observances on ESSA ships and ashore. Some were large—more than 8000 attended in the Weather Bureau's Central Region—and some were small. At Las Vegas, more than 100 persons braved 105-degree weather; at Majuro, bilingual publicity brought more than 200 to the Weather Bureau.

They see how weather is forecast, how satellite photos are obtained, how the laboratory seeks answers to the secrets of the environment, how the Coast and Geodetic Survey goes about its work on land and at sea.

ESSA's Open House observances are notable for one thing in particular: visitors are treated, not to elaborate displays nor expensive trappings, but to a good look at the way ESSA agencies serve America.

U.S., Russia, Japan In Seismic Wave Data Exchange Pact

The United States, Russia, and Japan have agreed to step up the exchange of seismic sea wave data in a move to enhance the effectiveness of the Pacific Tsunami Warning System.

The agreement was reached at the closing session of the International Coordinating Group on the Tsunami Warning System, at the University of Hawaii. The three nations agreed to exchange tsunami information with Japan as the relay point for data originating within the Soviet Union.

James M. Klaasse, Associate Director, Seismology and Geomagnetism, Coast and Geodetic Survey, was the United States representative to the conference. He was elected to a two-year chairmanship of the International Coordinating Group.

'Employ the Handicapped' Award to ESSAites

National and state American Legion Employ The Handicapped Awards were made to Environmental Data Service's National Weather Records Center, Asheville, N.C., recently. Center previously received Governor's Employer of The Year Award; 23 per cent of personnel are physically handicapped. Above, from left: Leroy Lakey, American Legion National Committee member; Robert Tart, Department Commander, and Milton G. Johnson, WRC administrative officer.

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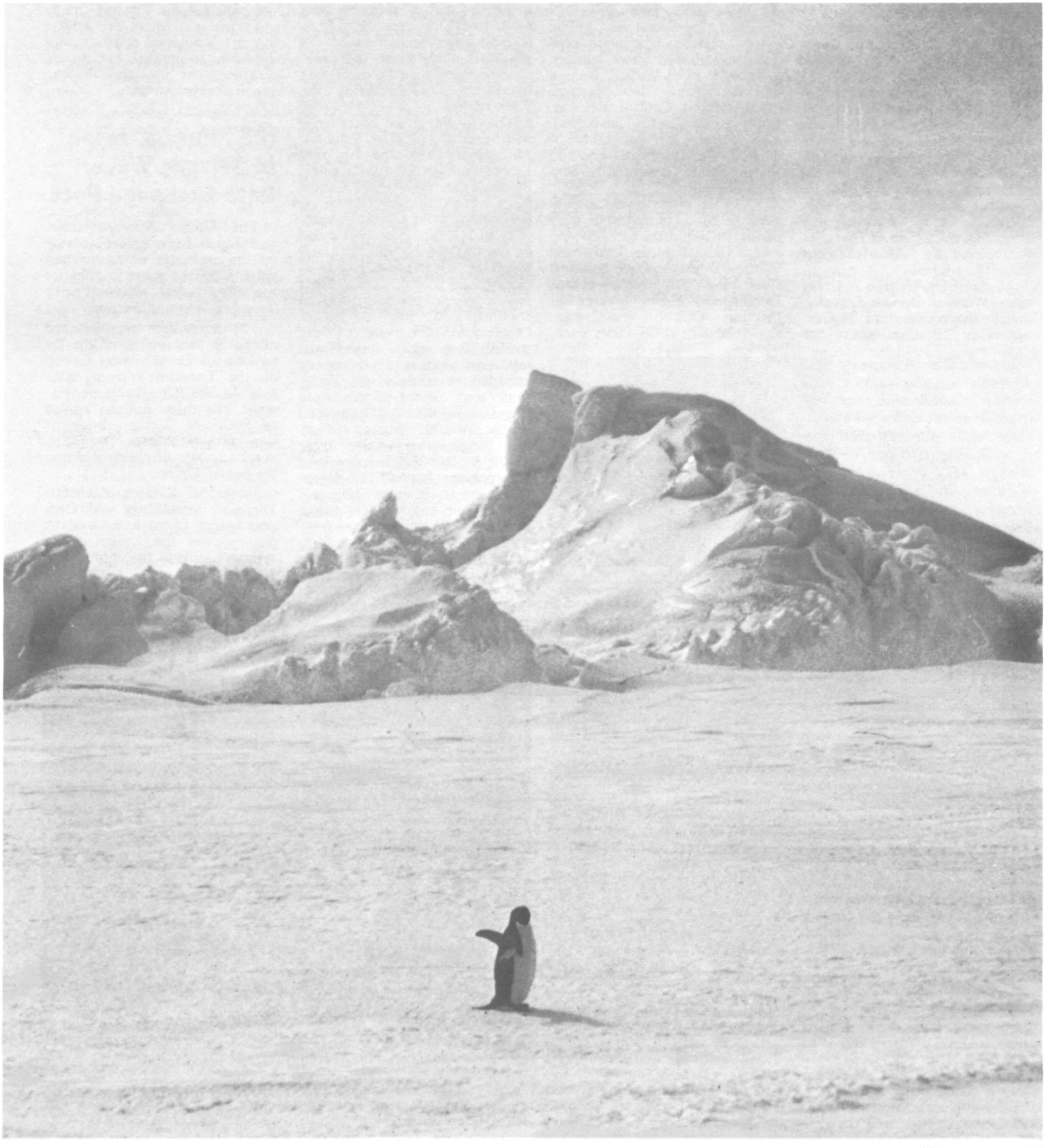

(Story on page 27)