U.S. DEPARTMENT OF COMMERCE ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION JANUARY 1969

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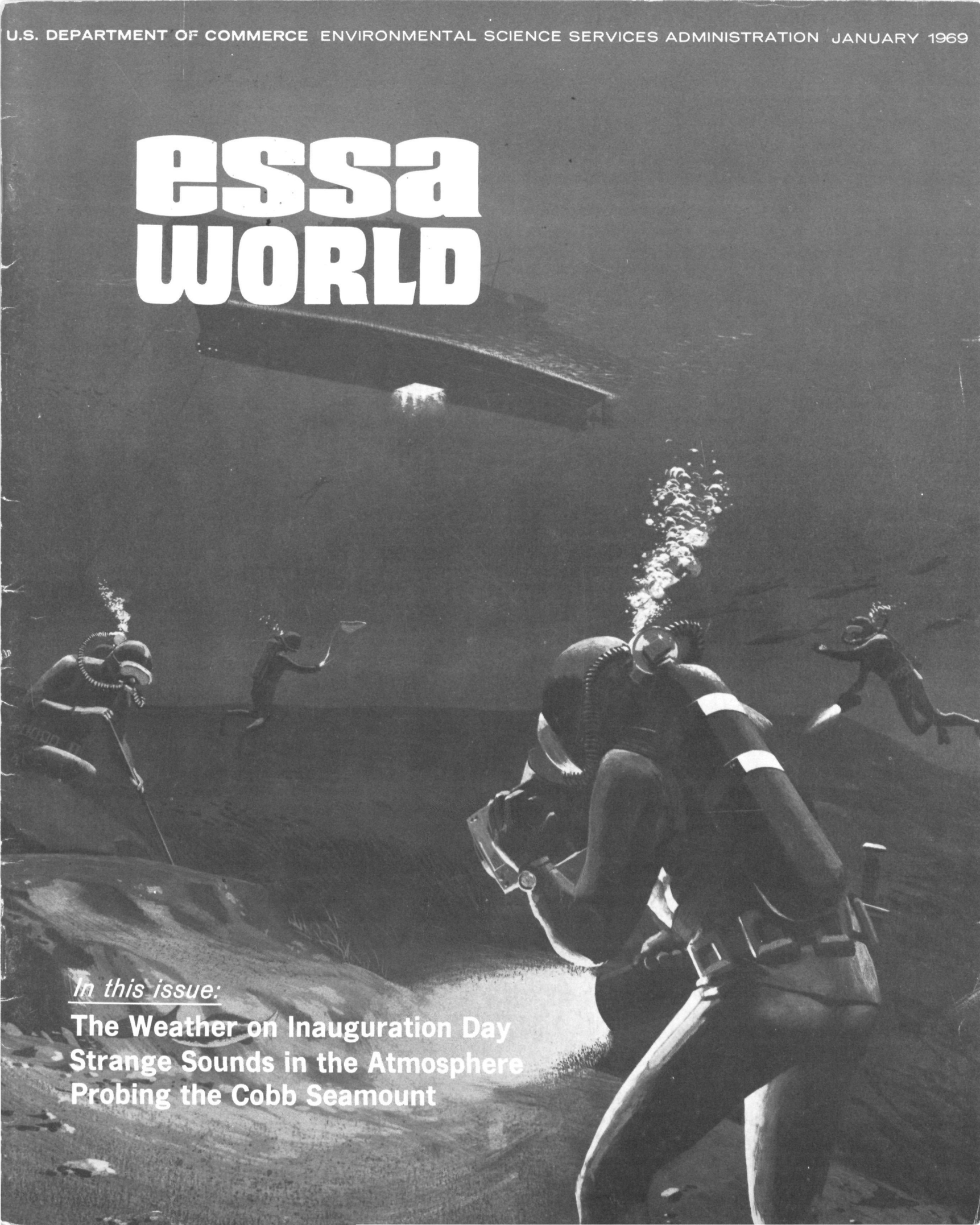

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Strange Sounds in the Atmosphere
Probing the Cobb Seamount

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
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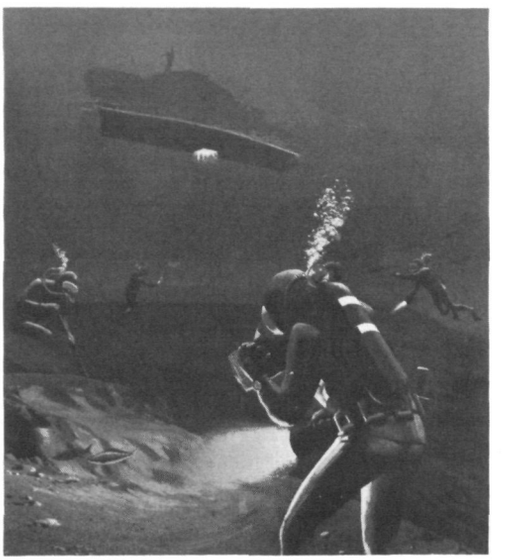

COVER
Divers explore the summit of the Cobb Seamount, in an artist's conception of the recent ESSA investigation of this underwater peak.

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Reflections on a Respectable Mission

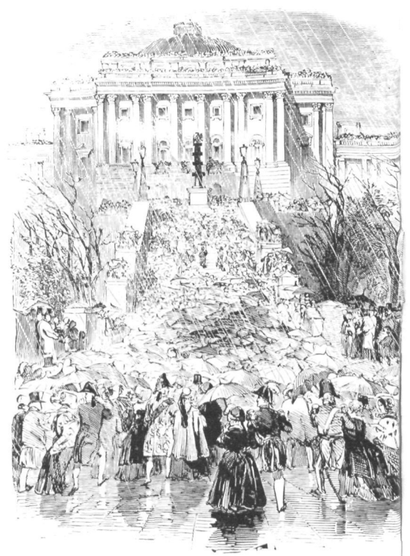
The primary mission of ESSA is to describe our physical environment. We assume that this description will be of value to mankind and that this value will develop from our increased understanding of this environment. We know that the description alone is of considerable value because we are sometimes able to use this knowledge long before we understand what we have described. Our understanding is tested by our ability to predict, and the ultimate goal could be the ability to control parts of our environment. Surely this is a respectable mission.

Mankind cannot survive without predictability. No organism or organization can function without accepted rules and without the transfer of these rules between individuals. All kinds of interrelationships require that actions be predictable. Without this, we would have chaos in government, strife in society, and mental illness in individuals. Much of our government is dedicated to making and enforcing rules, describing and predicting actions, in controlling and guiding people in accordance with these rules, or in studying nature with the same aims. So, we in ESSA are part of a universal effort to bring controllability into our environment.

Fortunately, this goal is not going to be easily attained. When we have thoroughly described ourselves and our environment, and have perfect understanding and predictability, we may be thoroughly controllable ourselves. There will be little room then for the innovator, the entrepreneur, or the seeker after knowledge. There will be no new frontiers nor new risks, and no adventures. Existence will be safe, secure and bland. For some this will be Utopia. For most of us in ESSA it will be catastrophe. Fortunately, this day is not likely to arrive very soon. As we accumulate new knowledge, we more perfectly describe the limits of our ignorance, and these limits expand at least as fast as our knowledge.

The Weather on Inauguration Day

BY PATRICK HUGHES
Environmental Data Service



INAUGURATION OF PRESIDENT POLK.—APPROACH TO THE CAPITOL.

President Taft and his wife returning to the White House after his swearing-in at the Capitol. The snow had now tapered off, leaving a street scene more suggestive of Moscow than of Washington, D.C.

It has been reported that Harry Truman, upon receiving the official invitation to his second inauguration, wrote across it in reply, "Weather permitting, I hope to be present—HST." If so Mr. Truman, a student both of humor and history, has paid Presidential respect to one of the most durable of American folk legends—bad weather on Inauguration Day. And it is a legend that deserves respect, a fact documented in the national weather archives of ESSA's Environmental Data Service, in the nation's press, and in the memoirs of past Presidents and private citizens.

The most dramatic—and tragic—example is the inauguration of William Henry Harrison in 1841. The day was cold, blustery, and overcast. Ignoring the biting wind whipping through Washington, D.C., the old soldier refused the offer of a closed carriage. Instead, without hat or overcoat, he rode a magnificent white charger to and from the Capitol, where his inaugural address kept him for an additional hour and forty exposed minutes. A month later, the hero of Tippecanoe was dead; pneumonia had developed from a lingering cold he caught on his Inauguration Day.

Abraham Lincoln may not have caught pneumonia from the weather that almost wrecked his second inauguration in 1865, but a lot of other people probably did. It had been raining in the East for two days. Washington was so deep in yellow mud that a story was going around that Army engineers had tried to lay a pontoon bridge between the Capitol and the White House, but had been forced to abandon the project because the "bottom" was too soft to hold the anchors of their workboats. At the Capitol, men, women, and children—soaked to the skin—had been standing for hours, patiently awaiting the ceremony scheduled to take place on the East Portico. Fortunately, just before Mr. Lincoln came out, the rain finally ended and, as he stepped forward to take his oath of office, the sun broke through the gloom.

The worst Inauguration Day weather in our history occurred in 1909, when William Howard Taft was forced indoors by a storm that dumped almost ten inches of snow on the Nation's Capital. Snow had begun falling the previous day and continued throughout the night, toppling trees and telephone poles, stalling trains, clogging city streets, and bringing almost all activity to a standstill. Sanitation workers shoveled snow and sand for half the night to clear the parade route, only to have the streets reburied again and again.

Despite the freezing temperature, howling wind, snow, and sleet, a large crowd gathered in front of the Capitol to view the inauguration. But the weather made it impossible to hold the

continued

ceremony outdoors. Ironically, just minutes after the swearing-in was completed, the snow tapered off.

All told, it took 6,000 men and 500 wagons to clear 58,500 tons of snow and slush from the parade route alone, an awesome statistical tribute to this Inauguration Day storm, which one Congressman termed "the worst weather on the face of the earth."

Said President Taft of the day's events: "I always knew it would be a cold day when I got to be President."

A startlingly similar storm struck Washington, D.C., on the eve of John F. Kennedy's inauguration in 1961. It left eight inches of snow and caused the most crippling traffic jam in the city's history. Hundreds of motorists were marooned, thousands of automobiles abandoned. Because of the storm, the President-elect had to cancel his dinner plans and, in struggling to keep other commitments, is reported to have had only four hours' sleep.

By sunrise, the snow had finally ended and the sky was clearing, but the day was bitterly cold. Undaunted, large crowds turned out for the swearing-in and for the inaugural parade—the latter made possible only because an army of men had worked all night to clear Pennsylvania Avenue. By noon, when the ceremonies began, the temperature was only 22 degrees, and a biting 19-mile-per-hour northwest wind cut through the thickest clothing, producing a "wind chill" condition roughly equivalent to a temperature of 2 degrees below zero in a 5-mile-per-hour wind. The temperature and wind took a lot out of the parade that followed, and out of the spectators. By 6:15 p.m., when the parade ended, practically the only ones left on the reviewing stand were the President, his brother Robert, and Robert's wife Ethel.

Obviously, there is more than a little historical support for Mr. Truman's views on Inauguration Day weather. Of the 45 quadrennial ceremonies held to date, 18 have been plagued by substantial rain or snow, bitter cold, or chilling winds. Despite this dismal record, however, the odds are high that the weather for Richard M. Nixon's inauguration on January 20, 1969, will be much more pleasant.

The reason? The 20th Amendment which, beginning in 1937, changed the date for Presidential inaugurations from March 4 to January 20. Weatherwise, the change means considerably less chance of rain or snow, though it favors lower temperatures. Bearing this out, of the seven inaugurations held since 1937, only one—that of John F. Kennedy—was marred by significant precipitation. On the other hand, one out of every three inaugurations held on March 4 was notable for its wet and miserable weather.

Meteorologically speaking, the change to January 20 seems to have been a fortunate one, and nearly 100 years of weather records for that date are equally encouraging.

Even though the coldest time of the year in Washington comes during late January and early February, temperatures on January 20 are usually not severe. The normal high temperature for the day is 44 degrees and the low is 29 degrees. The highest temperature on record is 71 degrees, which occurred in 1951, and the lowest 8 degrees, in 1940. If it rains or snows at all in Washington, D.C., on January 20, the odds are about four to one that it will do little more than wet the pavement. There are roughly three chances in ten that there will be some snow on the ground from previous snowfalls.

Average weather conditions for the noon hour, when the President-elect is usually sworn in, would be a temperature of about 37 degrees, a wind of 10 miles per hour or less, and a partly cloudy sky. The chances against precipitation of any kind during the swearing-in ceremony itself are six or seven to one, and against snow, about twenty to one. Of course it will rain or snow on occasion, and January temperatures and winds will often combine to make standing outdoors for long periods a rather chilly experience but, all in all, the odds on fair weather are pretty good.

Although official weather records for Washington go back only to 1871, there are many earlier sources of information on inaugural weather, some dating to the first days of the Republic. Much of this material is on file at the Environmental Data Service's National Weather Records Center in Asheville, North Carolina. In addition, there are the files of the National Archives, the records of private historical societies, and the eyewitness accounts available in the newspapers of the day. All of these make it possible to piece together the historical pattern of Inauguration Day weather.

The first outdoor inauguration was that of James Monroe, held in Washington on March 4, 1817. (All but three inaugurations have taken place in Washington; the exceptions are those of George Washington in New York City in 1789, and his and John Adams' in Philadelphia in 1793 and 1797, respectively.) Interestingly enough—and despite the history of horrible weather to follow—there is no record of bad weather on any of the seven previous inaugurations when the ceremony was held indoors. Once it was moved outdoors, however, the weather picture quickly changed.

Snow fell on the very next inauguration, Monroe's second, in 1821. Because March 4 fell on a Sunday, the ceremony was moved to Monday the 5th. The snow began Saturday evening, and by Sunday afternoon Washington was snowbound. The precipitation continued through Inauguration Day, forcing Monroe to change his plans for an outdoor ceremony, and to take his oath of office in the House Chamber, where subdued spectators stood watching in soggy clothing.

Although the amount of snow that fell is not recorded, the noon temperature is: a chilling 28 degrees. This observation was taken by John Quincy Adams, who was to succeed Monroe as President. On Adams' own Inauguration Day, in 1825, it rained—the weather observation again being recorded by Mr. Adams himself.

In 1845, just four years after President Harrison's fatal exposure to the elements, James K. Polk took office under an umbrella, standing in the pouring rain. The rain had begun on the 3rd and continued through the 4th. A sea of umbrellas was all that could be seen from the temporary platform where the President-elect insisted on taking his oath, regardless of the weather. On the Mall below him, thousands stood ankle-deep in mud, as the heavy rain drumming on their umbrellas drowned out Polk's Inaugural Address.

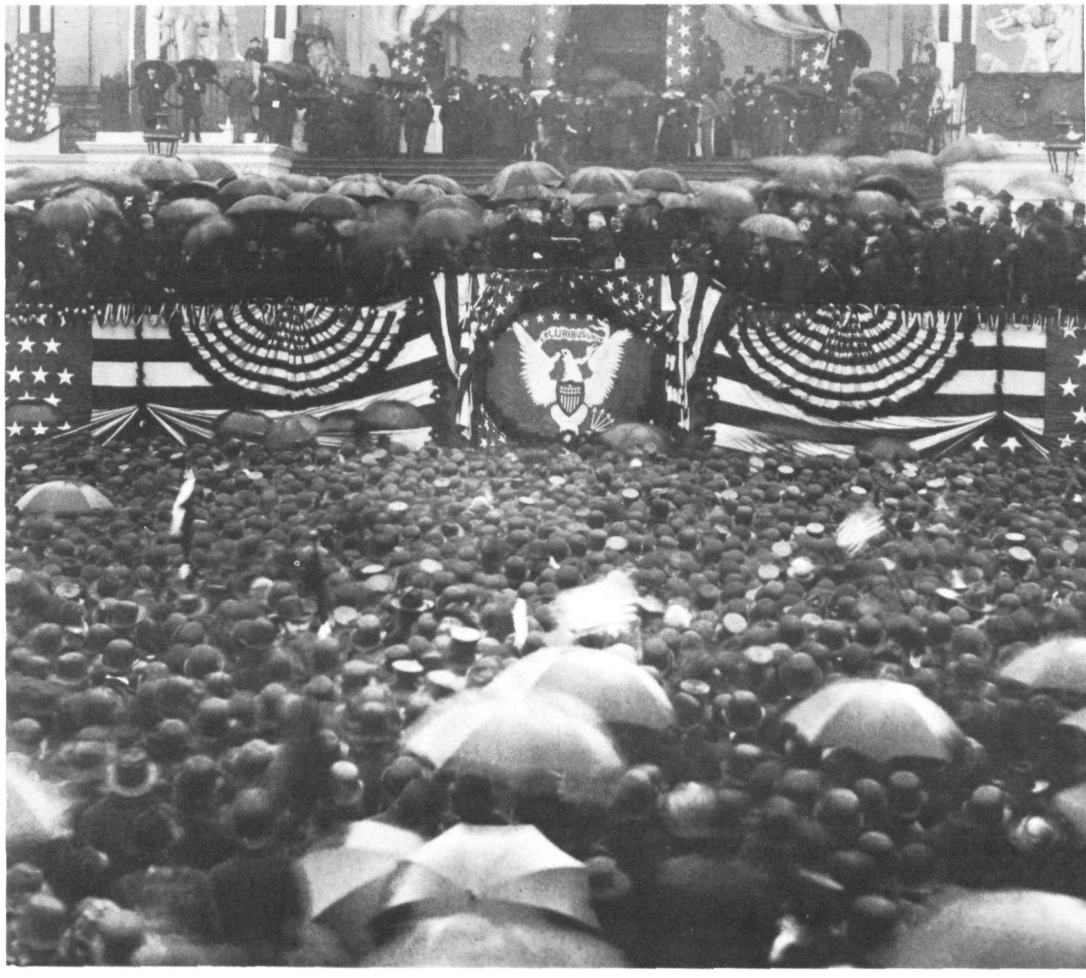
General Franklin Pierce was inaugurated President of the United States on March 4, 1853; it snowed most of the day. Heavy snow greeted the President-elect when he awoke in the morning and continued until 11:30 a.m., when it seemed the sun might come out. Shortly after he took his oath of office, however, and just as he began his inaugural address, the snow started again, heavier than ever, dispersing much of the crowd and ruining plans for a parade.

Abigail Fillmore, wife of the outgoing President, caught cold as she sat on the exposed platform during the swearing-in ceremony, a cold that soon developed into pneumonia. She died at the end of the month.

Ulysses S. Grant was the victim of a meteorological double-header. It rained on the morning of his first inauguration in 1869, and four years later he took office on the coldest Inauguration Day on record.

On March 4, 1873, the temperature at dawn was only 4 degrees above zero. During the day, icy gusts up to 40 miles an hour buffeted the city. By noon, the temperature was 16 degrees,

Photos from the collection of the Library of Congress



(Above), Massed umbrellas were the order of the day during Benjamin Harrison's inauguration in 1889. Despite the fact that his grandfather, President William Henry Harrison, had been a victim of inaugural weather in 1841, the new President Harrison refused to hold the ceremony inside, but took his oath of office and delivered his inaugural address under an umbrella in the downpour. As a precaution, however, he wore a special leather shirt under his inaugural finery. (Above left) Herbert Hoover's inaugural parade moved up Pennsylvania Avenue during a lull in the intermittent rain that fell on March 4, 1929. A heavy rain began just before the oath of office was administered, and the Capitol grounds and parade route were so crowded that it was impossible for anyone to run for cover. By the time he completed his inaugural address, President Hoover's face was beaded with water and his suit was wringing wet. (Left) The scene in front of the Presidential reviewing stand in 1909, when 58,500 tons of snow had to be removed from the parade route before William Howard Taft's inauguration. The worst weather in the history of Inauguration Day left ten inches of snow on the ground, bringing nearly all activities to a standstill and causing the swearing-in ceremony to be held indoors.

continued

Chronology of Inauguration Day Weather—George Washington to Lyndon B. Johnson

The following table presents an outline of the weather pattern through all of the Presidential inaugurations held to date. Much of the information available for the earlier years is fragmentary, some of it occasionally contradictory; where contradictions do occur, the problem has been resolved in favor of the most likely event. Except where noted, all inaugurations to date were held in Washington, D.C. Prior to 1937, the Presidential oath of office was taken on March 4; after 1937, on January 20. Whenever Inauguration Day falls on a Sunday, the ceremony has traditionally been postponed until the following day.

Year	President	Noon Temperature	Weather for Day	Remarks
1789	George Washington		cool and clear	New York City, April 30.
1793	George Washington		pleasant	Philadelphia.
1797	John Adams		fair	Philadelphia.
1801	Thomas Jefferson		mild and beautiful	
1805	Thomas Jefferson		fair	Observation taken by Jefferson himself.
1809	James Madison		probably fair	No specific mention of weather found for either Inauguration, but descriptions of the presidential processions, outdoor festivities, and the ladies' finery suggest the weather couldn't have been too bad.
1813	James Madison		probably fair	
1817	James Monroe		warm and sunny	First outdoor inauguration.
1821	James Monroe	28°	snow	March 5. Observations taken by John Quincy Adams.
1825	John Quincy Adams	47°	rain	Observations taken by the President himself.
1829	Andrew Jackson		warm and balmy	
1833	Andrew Jackson		probably fair	No mention of the weather, but reports of "happy crowds" in the streets, and of many people riding to and from the Capitol indicate the weather was probably pretty good.
1837	Martin Van Buren		sunny and brisk	
1841	William Henry Harrison		overcast, chilling wind	
1845	James Knox Polk		rain	Thunder heard at dawn. Rain during day .40 inch.
1849	Zachary Taylor	42°	cloudy, intermittent snow flurries	March 5. Heavy snow began during Inaugural Ball.
1853	Franklin Pierce		snow throughout the day	
1857	James Buchanan	49°	bright and sunny	
1861	Abraham Lincoln		rain till mid-morning, sunny and warm in afternoon	
1865	Abraham Lincoln	45°	rain	Heavy dash of rain at 6:25 a.m. Rain for day .30 inch.
1869	Ulysses S. Grant	40°	rain 4:50 a.m.-11:50 a.m. sunny afternoon	Rain during day .106 inch.
1873	Ulysses S. Grant	16°	clear, windy, and bitterly cold	
1877	Rutherford B. Hayes	35°	cloudy, brief periods of light snow	March 5.
1881	James A. Garfield	33°	snow until about 10 a.m., sunny and windy afternoon	Snowed all the previous night.
1885	Grover Cleveland	54°	bright, sunny day	
1889	Benjamin Harrison	43°	rain all day	Rain during day .86 inch.
1893	Grover Cleveland	25°	snow and chilling winds	Snow began early a.m., ended about 1 p.m. One to two inch accumulation reported.
1897	William McKinley	40°	clear; beautiful day	Rain during the night. Rain began again during inauguration ceremony, ended 3:45 p.m. Total rain .32 inch.
1901	William McKinley	47°	overcast	
1905	Theodore Roosevelt	45°	sunny; strong northwest wind	Patches of snow still on the ground from light fall the day before.
1909	William H. Taft	32°	heavy snow and strong winds	9.8 inch snowfall began the previous day, ended 12:20 p.m.; afternoon cloudy and windy.
1913	Woodrow Wilson	55°	overcast	
1917	Woodrow Wilson	38°	partly cloudy, windy	March 5.
1921	Warren G. Harding	38°	clear, sunny	
1925	Calvin Coolidge	44°	mostly sunny	
1929	Herbert C. Hoover	48°	rain	Rain began just before oath of office was administered, and continued for the rest of the day. (.40 inch)
1933	Franklin Delano Roosevelt	42°	cloudy	Occasional sunshine.
1937	Franklin Delano Roosevelt	33°	rain	First Inauguration held on January 20. Total precipitation 1.77 inches, with .69 inches falling between 11 a.m. and 1 p.m.
1941	Franklin Delano Roosevelt	29°	clear, with brisk wind	
1945	Franklin Delano Roosevelt	35°	cloudy	Light snow during the night ended about 9 a.m., leaving a thin white mantle on the streets.
1949	Harry S. Truman	38°	mostly sunny, windy	
1953	Dwight D. Eisenhower	49°	cloudy	
1957	Dwight D. Eisenhower	44°	cloudy	January 21. Light snow in early a.m., with a few flurries in mid-afternoon.
1961	John F. Kennedy	22°	Snow in early morning; sunny, but with chilling wind rest of the day	Eight inches of snow on ground.
1965	Lyndon B. Johnson	38°	cloudy	One inch of snow on the ground.

and cadets and midshipmen had been standing without overcoats on the windswept Mall for more than an hour and a half; several of them collapsed. When President Grant delivered his inaugural address, the high wind made his words inaudible, even to those on the platform with him.

That night the inaugural ball, held in a temporary building without heat, had to be halted at midnight so that the people—who had been dancing in their overcoats and heavy wraps—could go home to get warm.

In 1889, despite his grandfather's fatal exposure, Benjamin Harrison deliberately took his oath of office and delivered his inaugural address in the pouring rain, then stood outside reviewing the parade until dark.

March 4 fell on a Monday that year, and it had been raining hard all weekend. In front of the Capitol and along the parade route the rain beat on thousands and thousands of massed umbrellas. Although urged to hold the ceremony indoors, General Harrison refused; the people had been standing in the downpour for many hours. He took his oath under an umbrella, his words muffled by the roar of the rain. As a precaution, however, he wore a special leather shirt under his outer clothing.

Four years later, Grover Cleveland (who had also preceded Harrison as President) started his second term in a snowstorm. Rain had begun falling the previous evening, but by early morning had changed to snow. By midmorning, when Cleveland left for the Capitol, the snow had tapered off, but a biting northwest wind was blowing, and the temperature was in the low 20's. (It has been reported that when Cleveland passed the White House, his mustache was coated with icicles.) Pennsylvania Avenue was almost deserted as the Presidential procession passed on its way to the swearing-in ceremony, though small knots of people could be seen huddled in windows and doorways. The snow had stopped altogether by the time Cleveland began his inaugural address, but the low temperatures and chilling winds that continued throughout the day forced the cancellation of many planned events.

Herbert Hoover was inaugurated in 1929 in a heavy rain that began just before the oath of office was administered, and continued intermittently all day. Like many Presidents before him, Mr. Hoover took office, delivered his inaugural address, and paraded in the rain.

Because the Capitol grounds and the parade route were so crowded, it was impossible for anyone to run for cover, so the people simply stood there getting wetter. The new President himself was drenched by the time he completed his inaugural address, his face beaded with water and his suit wringing wet. Nevertheless, he returned to the White House and, an hour or so later, was back outdoors reviewing the parade of 20,000 as it passed in the downpour.

Thirty-two years later, on another Inauguration Day, a snowstorm prevented former President Hoover's plane from landing in Washington, and he had to miss the swearing-in of John F. Kennedy as President.

These, then, are some—though by no means all—of the weather woes that have plagued past inaugurations and past Presidents. With the exception of Kennedy's in 1961, each of the inaugurations described took place on the old date, March 4, rather than on January 20 when, statistically speaking, the chances favor fair weather.

Unfortunately, you can lose even though the odds are with you. The very first inauguration held on January 20—that of Franklin Delano Roosevelt in 1937—was almost washed out by one of the heaviest rains in the event's history.

Two hundred thousand visitors came to Washington for the inauguration, though several thousand never got further than Union Station. Defying a cold driving rain, a sea of people stood in front of the Capitol for hours, impatiently awaiting the swearing-in. The head of the Inaugural Committee tried to talk Roosevelt into holding the ceremony indoors but he refused, replying, "If they can take it, I can take it." At 12:23 p.m. he went out to the platform, to be cheered by the soaked spectators.

Following his oath of office and inaugural speech, President Roosevelt, at his own insistence, rode back to the White House in an open car with a half-inch of water on its floor. Later, he spent an hour and a half in an exposed reviewing stand, watching the inaugural parade splash by in the deluge.

Said harried Senator George William Norris of Nebraska, whose amendment had changed the inauguration date to January 20: "They're trying to blame this on me. You can't charge this up to me until after March 4, when you see what kind of day that is."

It was, of course, a beautiful day. □

A Race for Power . . .

CLOSING THE COMPU TATION GAP

BY ANN K. COOK

The man in the middle—between ESSA and the machine—is Mirco P. Snidero, chief of ESSA's Computer Division.

With a staff of thirty in all, the Division —a part of the Office of Administration and Technical Services—operates a central ESSA computing service for the Washington area, manages data-processing resources, and acts as a technical adviser on computing problems for all ESSA components.

Describing his Division's role, Snidero explains: "We are here to serve all ESSA components by providing guidance in automatic data processing. We keep tabs on all data-processing equipment and the use made of it."

"When someone wants computer capacity," he says, "we have to look at the request in the light of ESSA's total requirements and the dollars available. I suppose it's inevitable that we don't always end up wearing white hats."

The Division's Operations Branch, headed by Wallace Blackwell, manages a central computing facility at Suitland, Maryland., with three shifts working around the clock to process programs for all ESSA components. It serves the tightly scheduled operational computing requirements of the computing facility at Suitland, Maryland, Satellite Center, as well as major production requirements of the Coast and Geodetic Survey.

The Analysis and Programming Branch, under Donald Foster, serves in a consultant capacity to help ESSA's computer users solve their programming problems. This branch's seven staff members provide systems software support and assist users in programming for the central computer. They are alert for instances where users have common needs that a single program can serve. If requested, they will provide complete systems analysis and programming support for other ESSA units, but the Division operates on the general philosophy that it is desirable for all organizations to develop their own ADP capabilities.

"It works out better for all concerned," Snidero believes, "when scientists and administrators are on speaking terms with the computer. Occasionally, someone will bring us a job and tell us what computations he wants performed. When it is done, he'll say, 'Oh, since you can do that so easily, then let me tell you what I am *really* trying to do.' If the people who use data-processing services really understand the capabilities and limitations of this computer, this doesn't happen."

Responsibility for long-range planning to meet ESSA's future data-processing requirements is centered in the Division's Management and Planning Branch, headed by Francis Balint. This branch also works closely with ESSA groups at all levels because of its responsibility to ensure the fullest utilization of current ADP resources. In addition, it assists these groups in developing specifications, evaluating proposals, and reviewing all requests from ESSA components for ADP equipment and services.

The events leading to the creation of ESSA's Computer Division began in the early 1960's, a period of mounting criticism of Government practices in the selection and use of automatic data-processing equipment.

In late 1963, a study group was formed in the Weather Bureau to consider the agency's computer requirements. At that time, the Bureau was operating three large-scale computer installations in the Washington area, each with its own personnel and equipment. One was used by the National Meteorological Center for operational weather forecasting and analysis, one by the Satellite Center for collection and reduction of satellite data, and the third by the Geophysical Fluid Dynamics Laboratory for numerical experiments in simulating large-scale atmospheric processes.

Completed in February 1964, the study recommended centralization of the Bureau's Washington-area data processing into a single computer complex, by replacing the three major computing facilities with a single, very large computer system. At the same time, the study group urged the establishment of a centralized management group to operate the facility and to provide a focal point for agency-wide ADP planning, management, and equipment acquisition.

Subsequently, a computer task force was appointed to develop a plan for carrying out these recommendations. Evaluation of the most powerful computers then in existence revealed that no single system could accommodate full consolidation of the Weather Bureau's requirements. Nevertheless, the computers available offered significant advantages in speed and economy over the computers the Bureau had. The task force concluded by recommending an interim two-to-three year phase of partial consolidation, to be followed by full consolidation on a computer from the next generation.

An interim computer selected by the committee was to be leased to accommodate all major computer requirements in the Washington area by late 1965. It was estimated that the interim computer would be eight times faster than either of the duplicate systems operated by the Satellite Center and the NMC. According to the conversion plan, the interim system would first replace the Satellite Center and Geophysical Fluid Dynamics Laboratory equipment. When the central computer was fully operational, the NMC's equipment would also be released.

The new computer was delivered on July 13, 1965.

Just three months before, Mirco Snidero had assumed the leading role in the agency's computer chronicle with his appointment as chief of the new Computer Division.

Snidero, who was then 35 years old, had bachelor's degrees in both mathematics and meteorology, and a master's in statistics from Stanford University. From 1952 to 1962, he had served as a weather officer in the Air Force, and for the last three of these years had been assigned to the Joint Nu-

merical Weather Prediction Unit at the National Meteorological Center. After leaving the Air Force, he remained at NMC in the Computation Division, until his selection as head of the new Computer Division in April 1965.

In the three months before the computer was to be delivered, Snidero had to begin building a staff, continue the work already begun on preparing the site for the new facility, coordinate conversion by users to new computer programs, and develop a satisfactory method for joint use of the facility.

In addition, just as the computer arrived, ESSA was formed. The new agency's computing needs were plainly greater than the Weather Bureau's alone.

Snidero approaches new tasks or problems systematically. For major tasks, he has a three-column chart, showing the earliest possible completion date, the probable completion date, and the latest possible completion date—the very worst that can happen.

He is an authority on the subject of "the worst that can happen." Just about everything went wrong during his first year on the job.

Shortly after the computer was delivered, environmental problems developed at the site. Preliminary checking of the system was delayed until early September. Software for the computer—the basic and common programs which control its operation—was inadequate. That, coupled with electronic difficulties, curtailed the productive use of the system. It became clear that there would be a delay in achieving the speeds that had been projected.

The result of this succession of difficulties was that ESSA lacked one productive large-scale computer system for more than a year. To provide the necessary computer capacity, ESSA retained the National Meteorological Center's original computer and, in addition, installed two large computer systems at the Geophysical Fluid Dynamics Laboratory.

While wrestling with these problems, the Division still had to look ahead to the larger, more powerful system which, in the 1964 plan, had been expected to be available by 1967. In fact, not a single computer of the predicted power exists even today. Therefore, the Division had to produce an alternate plan.

By June 1968, the central facility at Suitland was saturated by the requirements of the Satellite Center, the NMC, and the Coast and Geodetic Survey. ESSA's deficit of computer power had forced curtailment of many research projects, and would, if not corrected, seriously affect service programs.

At the present time, NMC and the Satellite Center use 85 percent of the existing computer power at the Suitland facility. Both have operational schedules to meet around the clock. If these schedules are not maintained, Weather Bureau forecast centers and field stations throughout the United States, and other forecast centers around the world, will not receive the facsimile charts which are essential to weather prediction.

Projecting ESSA's future computer requirements in terms of the system now operated at Suitland, the Division estimates that the present power will have to be doubled by June 1969 and further increased a year later.

After exploring all the alternative courses of action, the Division proposed that a duplicate of the present system be installed at Suitland early in 1969. Installation of two parallel computer systems will ensure backup capability in case of failure in one, and will avoid the need for extensive reprogramming. In addition, suppliers will be asked for proposals on a replacement large-scale multiprocessing computer system to be installed about mid-1970. The latter system is expected to serve ESSA's needs through 1973.

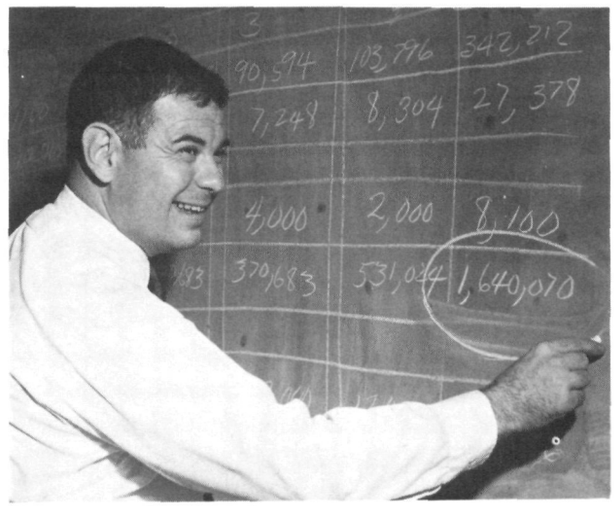
As Snidero's chart shows, the new computer is scheduled to be in operation in March 1969. It will be installed in Federal Office Building No. 4, which houses both the NMC and the Satellite Center.

Once the new computer is operational, the current system will be moved to the same site, to permit sharing of peripheral equipment and to provide complete backup. By September 1969, Snidero plans to begin providing remote service from the enlarged central computing facility to other ESSA installations. Doubling the power of the centralized facility will also allow adequate time for system research and development, work that tight production scheduling has severely restricted.

Future computer requirements are difficult to predict. Breakthroughs in research can create sudden demands for ESSA products and expanded computer requirements. For example, NMC's improved forecast model, based on primitive equations, generated increased demand for both short- and long-range forecast products with a consequent increase in demand for computer capacity.

So Snidero and the Computer Division staff must keep abreast of new developments and programs in all the agency's components as well as new developments in the field of data processing.

"That's why this is one of the most interesting jobs in ESSA," Snidero says. □



Mirco Snidero, Chief of the Computer Division.

Wallace H. Blackwell, Jr., and contractor check progress on the new computer site. (Left) In the central computer facility, l. to r., John Thomas, Rosemary Sweeny, and Robert Roth.

BY WILLIAM A. STANLEY
Coast and Geodetic Survey

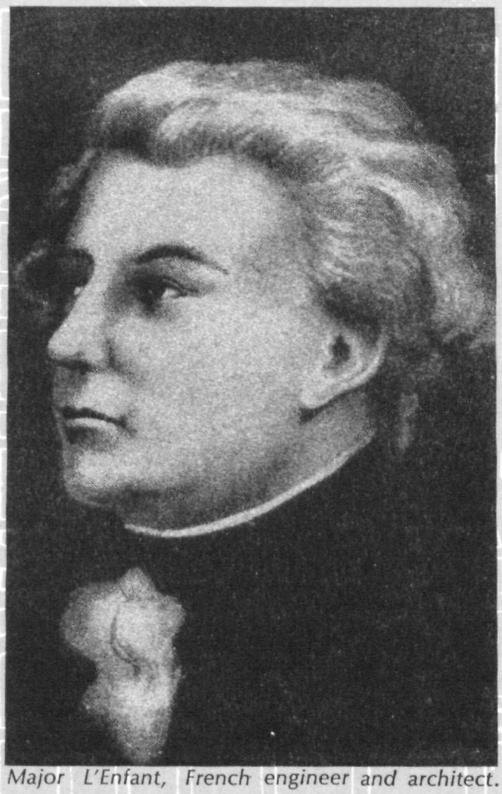
The Coast Survey's 19th century cartographic detectives rescued

A CAPITAL PLAN

A basket containing bits and pieces of varnished paper was delivered to the Coast and Geodetic Survey one day in 1887. These scraps were all that remained of L'Enfant's original manuscript plan for the City of Washington, executed in 1791. The plan had been in the custody of the War Department's Office of Public Buildings and Grounds for many years. It had been mounted on cloth for preservation and coated with varnish. By 1887, it had fallen apart and was entrusted to the Coast Survey for restoration and reproduction.

The manuscript's condition was so bad that restoration, comparison, and verification were done under solar light reflected by mirrors and with the aid of magnifying glasses and colored screens.

An exact tracing of the manuscript as it existed when it was received was carefully prepared by Coast Survey cartographers. Features not distinguishable on the original were omitted from the restored manuscript. This accounts for breaks in some of the lines and incomplete features on the present-day lithoprinted reproductions.



Major L'Enfant, French engineer and architect.

The original drawing was done in blue, green, yellow, and two shades of red. The water areas tinted blue on L'Enfant's map had faded, but their extent remained apparent.

Fifteen areas, originally shown in yellow, were proposed sites for memorials which States might choose to build in memory of individuals "whose achievements rendered them worthy of being invited to the attention of the youth in succeeding generations." The yellow tint had faded from the original plan, but the areas were restored according to the description contained in the marginal notes.

In the restoration of the manuscript, three well-defined figures were interpreted as representing areas set aside for churches. The locations were colored light red to conform with the manuscript notation.

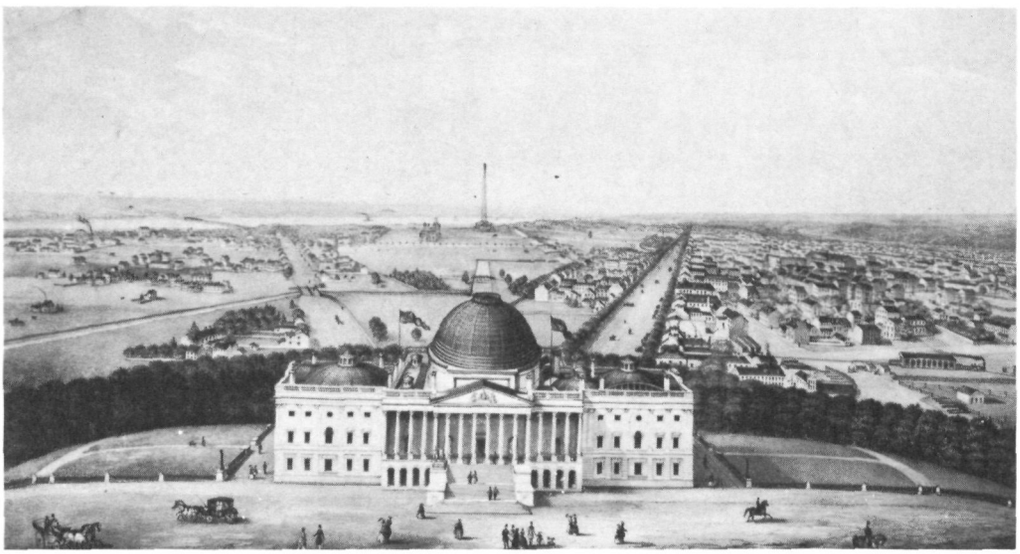
Faded green-tinted areas identified "the well-improved fields" referred to in the marginal notes as green plots. These were set aside for parks and included the areas now known as the Mall, adjacent areas in southwest Washington, and the White House grounds. A dark red tint was believed to identify buildings existing in 1791 on either side of the Mall.

The evolution of a permanent seat for the Nation's Capital began when George Washington and Thomas Jefferson took an active part in its development. By an Act of Congress of July 16, 1790, provision was made for the selection of a "Permanent seat on the bank of the Potowmac" for the Federal City of the United States. The next year, after the choice had been made and planning initiated, the term Federal City was officially changed to "The City of Washington in the Territory of Columbia."

Three commissioners were appointed by President Washington on January 22, 1791, to take charge of the newly created territory, to supervise its survey, and to attend to the business growing out of its condemnation for public use. More than a month before the Commissioners took up their work, President Washington appointed Andrew Ellicott to survey the bounds of the territory. The French engineer Pierre Charles L'Enfant was chosen to prepare the plan of the city.

While Ellicott surveyed the boundaries of the District of Columbia, L'Enfant began planning the future city. On the tract of land where the city was to arise, there was only one established community, Georgetown, which had been in existence some 35 or 40 years.

In order to provide geodetic control for the L'Enfant plan, Ellicott located by celestial observation a true meridional line passing through the area intended for the Capitol building. The meridian was given the value of Zero and established as the prime meridian of the newly created United



Three views of Washington illustrate the city's growth over a period of 85 years. From the top, a 1795 aquatint by George Parkyns overlooks the Georgetown area along the Potomac River. A lithograph of the Capitol and the City of Washington in 1850 revealed an unpaved Pennsylvania Avenue and, directly behind the Capitol, Tiber Creek. In Ellicott's plan, "the ground where the Capitol is to stand is above the tide of Tiber Creek 78 Feet." Thirty years later, the city was much larger and the Capitol building had been completed, as the 1880 Currier and Ives print below shows. Construction of the Washington Monument, which had stopped in 1854, was resumed later in 1880 and completed in 1884. (Left) Andrew Ellicott. Photographs are from the collections of the Library of Congress.

States. The value of latitude for the point was 38° and 53′ north. These lines were accurately measured and became the bases upon which the whole L'Enfant plan was executed.

The Plan of Washington, designed by L'Enfant, was originally referred to as "a mode of taking possession of and improving the whole district to leave to posterity a grand idea of patriotic interest which promoted it."

In his initial discussions with General Washington, L'Enfant stimulated the President's interest to enlarge the size of the area to make it, in his words, "proportioned to the greatness which . . . the Capitale of a powerful Empire ought to manifest." For the future site of the Capitol, he urged the choice of a high knoll known as Jenkins' Heights, "which stands as a pedestal waiting for a monument." For the President's house, he selected a lower position with a broad sweeping view southward toward the Potomac.

For the streets, L'Enfant rejected the rectangular grid as lacking in imagination and inappropriate for the grand design he envisioned. Of the street design, he wrote: "I . . . made the distribution regular with streets at right angle, North-South and East-West, but afterwards I opened others on various directions, as avenues to and from every principal place."

Although L'Enfant asked Jefferson for plans of various European cities for reference, he emphasized that it would be his endeavor to delineate a new and original plan. However, there can be no doubt that he was greatly influenced by the plan of the City of Versailles, then the capital of France. The Capitol corresponded in position to the palace, the President's house to the Grand Trianon, the Mall to the Parc. The street patterns also had a remarkable likeness in design, such as East Capitol Street, Pennsylvania, and Maryland Avenues on the east to the Avenues de Paris, de Sceaux, and de St. Cloud. On the West, Pennsylvania Avenue was very similar to the Avenue de Trianon. L'Enfant refrained from forcing this analogy, and took into account the nature of the ground.

The plan established the width of streets and provided for "passing the leading avenues over ground most favorable for prospect and convenience." Five

continued

grand fountains were included in the plan, and due consideration was given to the existence within the city limits of 25 good springs of excellent water, abundantly supplied even during the driest season of the year.

By June 22, 1791, the historic plan was ready. L'Enfant set to work with great energy and determination to clear the principal sites and avenues, eager to establish their full extent as soon as possible and to begin the public buildings. Soon after this enthusiastic beginning, difficulties arose because of his unwillingness to submit to the authority of the Commissioners of the Federal District or, for that matter, to the President himself. One source of disagreement was L'Enfant's opposition to the immediate sale of lots within the Federal City. Before the plan had been legally adopted or even completed on paper, he forcibly tore down a house that a powerful landowner was building within a projected street.

In his ultimate rebellion against the authorities, L'Enfant withheld the detailed plan he had prepared for the City of Washington. The plan was to have been engraved in Philadelphia but L'Enfant, instead of sending his large completed manuscript, released for engraving a very sketchy type plan which the engravers found unsuitable. President Washington was informed of the situation, and he at once instructed Andrew Ellicott to finish the plan.

Major Andrew Ellicott, surveyor and mathematician, was officially appointed by President Washington in 1792 to complete the L'Enfant manuscript with the necessary data for preparing the engraving. Ellicott, the son of a prosperous miller whose family had founded Ellicott City, Maryland, in 1775, was a natural choice since he had already been surveying the ten-mile-square tract ceded by Maryland and Virginia as the permanent seat of the government.

In correcting and completing the engraver's copy, Ellicott introduced no appreciable changes. The most important alterations, which the President instructed him to make, were in the names and designations of city streets and the numbering of city blocks. East and west streets designated by letters, starting from East Capitol Street and the center of the Mall, extended to Florida Avenue on the north and to the confluence of the Potomac and Anacostia Rivers on the south,

The major differences between Ellicott's plan (left) and the same area of the city today (right) are the elimination of Tiber Creek and the creation of Potomac Park by reclaiming land from the river.

representing the northern and southern limits of the street plan. The streets running north and south were identified numerically starting with 1st Street and numbered consecutively eastward and westward from North Capitol and South Capitol Streets. The avenues were named for the 13 original states.

Three weeks elapsed from the time Ellicott started the corrections until the plan was completed for submission to the engravers. The speed with which Ellicott prepared the plan for the engravers and the similarity of the engraved map to L'Enfant's manuscript clearly indicate that Ellicott did not devise any new scheme, but filled in some of the details lacking in L'Enfant's drawing.

As a reward for completing the first official plan, the Commissioners of the City of Washington presented Ellicott with a pair of silver cups. Only a few months later, Ellicott—like L'Enfant before him—was at odds with the Commissioners and withdrew entirely from the historic project. The Commissioners then attempted to discredit him in a highly critical letter to President Washington, dated March 23, 1794.

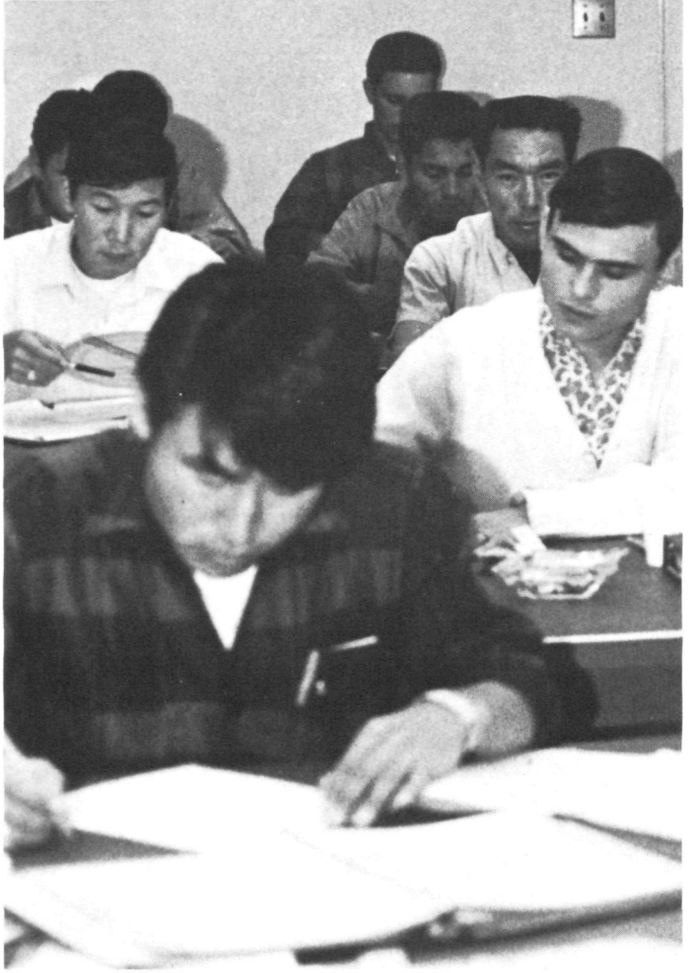
Two engraver's copies of the original manuscript were prepared by Ellicott; the first was sent to Boston for engraving and the second to an engraving firm in Philadelphia. Proofs from the Boston plate, received in Philadelphia in July 1792, revealed that this plate did not show depths in the Potomac River and the Eastern Branch. At the request of Secretary of State Thomas Jefferson, depth soundings were added to the Philadelphia engraving. This plate was regarded as the authoritative scheme of the city.

The major difference between the original plan of Washington and the same area of the city today lies in the southwestern portion. There, Tiber Creek has been eliminated, and Potomac Park and the Tidal Basin area created by reclaiming land from the Potomac River.

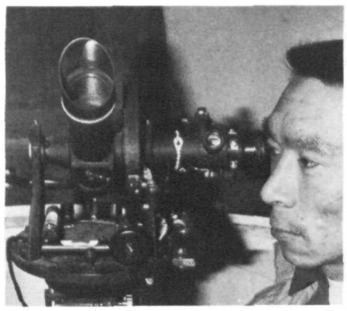
The original copperplate, engraved by Thackara and Vallance of Philadelphia in 1792, is now in the possession of ESSA's Coast and Geodetic Survey. Lithographic reproductions of this early map of the Federal City are available at nominal cost. □

Native Alaskans train for technical careers in the

WEATHER BUREAU'S FRONTIER SCHOOL



Photos by R. Zander



"If the wind is driving snow or rain against the instruments in the shelter, one must be careful to ensure accurate readings by seeing that the dry bulb thermometer *is* dry; that one's body heat does not affect the instruments . . ."

The speaker was instructor Charles O. Baker, explaining the fine points of reading thermometers under Alaskan weather conditions.

His audience was 18 Alaskan native men, learning basic weather observing techniques in an embryo project of great potential importance to native life in Alaska.

Once, the Aleut in the islands of the Bering Sea had little opportunity for a job as an electronics technician or a communications specialist. An Athapascan Indian at Canyon Village on the Porcupine River may never have seen a thermometer, much less read one.

Now, in a program pioneered by the Weather Bureau Alaska Region, such men are being trained for work at Bureau field stations. For about 18 months, native classes have been instructed in such technically oriented subjects as the care and maintenance of meteorological instruments, keeping climatological records, and the working routine of a meteorological technician.

After successfully completing the course and passing competitive Civil Service examinations, the newly trained men are assigned to Alaskan stations as near as possible

BY FORREST D. PAXTON
Weather Bureau Forecast Center, Anchorage, Alaska

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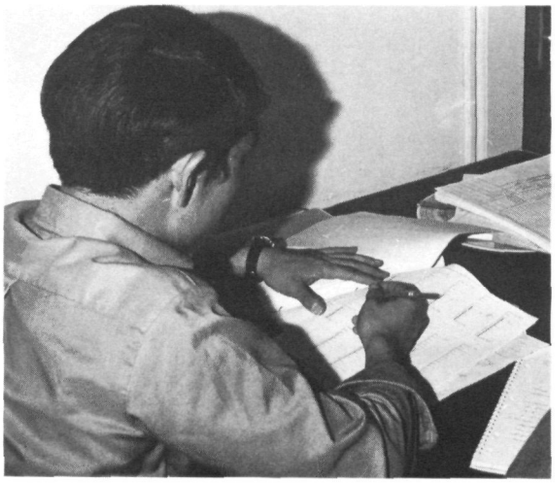

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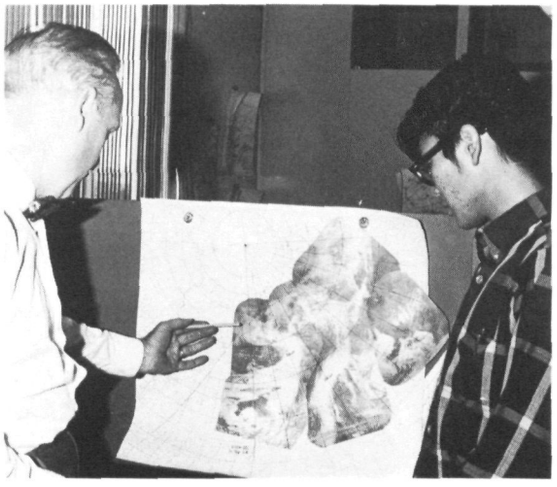

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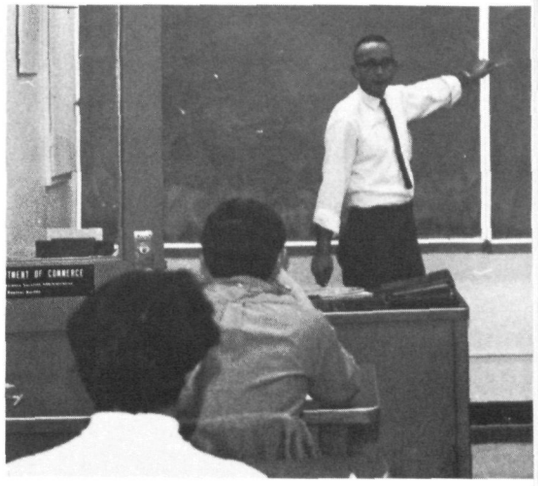

to their homes or the locations they show preference for.

The Weather Bureau project—and similar ones being considered by other Federal agencies—may have a tremendous impact on the state's economy. Alaska's native population is among the nation's poorest paid and most ill-housed. The average annual income for a working man living in an outlying village is $800.

A 25-year-old trained in the Bureau's new program can be expected to earn at least $200,000 during his working career. Moreover, statisticians estimate that the native dollar turns over seven or eight times in an Alaskan village. Thus the man who accumulates lifetime wages of about $200,000 would have the effect of adding $1,500,000 to his community's economy during his career!

For itself, the Weather Bureau hopes to create a stable nucleus of trained technicians, and thereby reduce the number of costly transfers to and from other parts of the United States. For a family of four, the cost to the Bureau of such a transfer averages nearly $8000.

Alaska may never produce an Aleut, Indian, or Eskimo who will become Director of the Weather Bureau. But the state affords a natural meteorological laboratory for the scientist. Someday, one of the screaming storms whirling out of the North Pacific may trigger the curiosity of a new Wexler or a fledgling Rossby to develop a whole new concept of meteorology. □

1. Alaskan students at work in the classroom, Anchorage Federal Building. 2. Daniel Snyder practices reading a rain gage. 3. Former trainee Joseph Alexis worked at Alaskan stations and is now a U.S. Navy weatherman. 4. Roger Nicholas (right) learns the duties of an aviation forecaster from Gordon Kilday (center). 5. A test in reading instruments to tenths of units. 6. Anchorage MIC G. Philip Weber explains satellite pictures to Daniel Gooden. 7. Instructor Charles O. Baker gives a lesson in estimating cloud cover. 8. Author's sketch of an Alaskan village. Alaska's native population is among the nation's poorest paid and most ill-housed.

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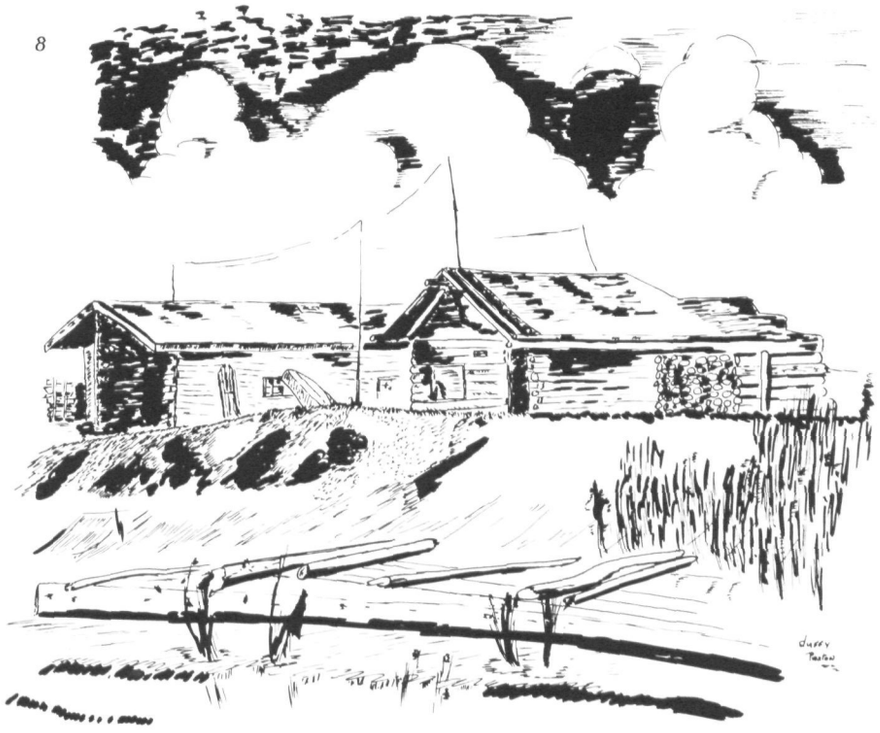

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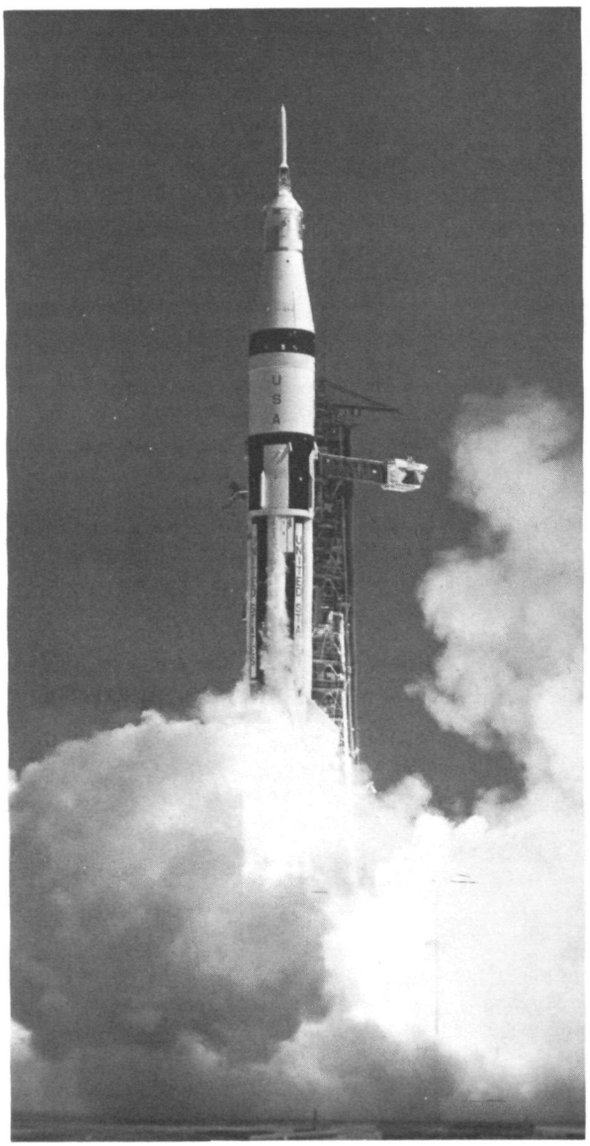

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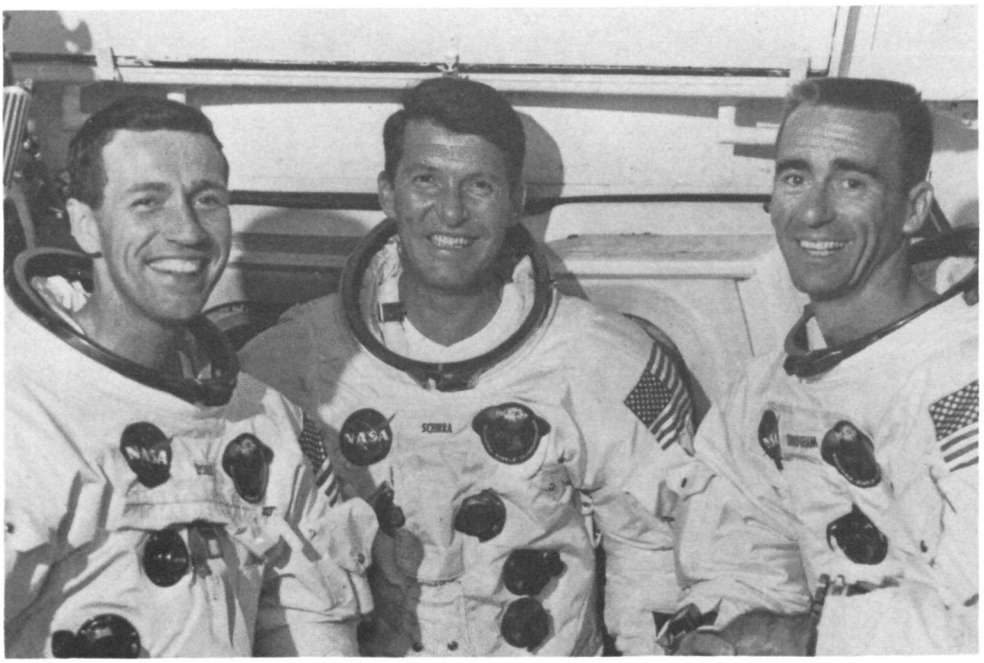

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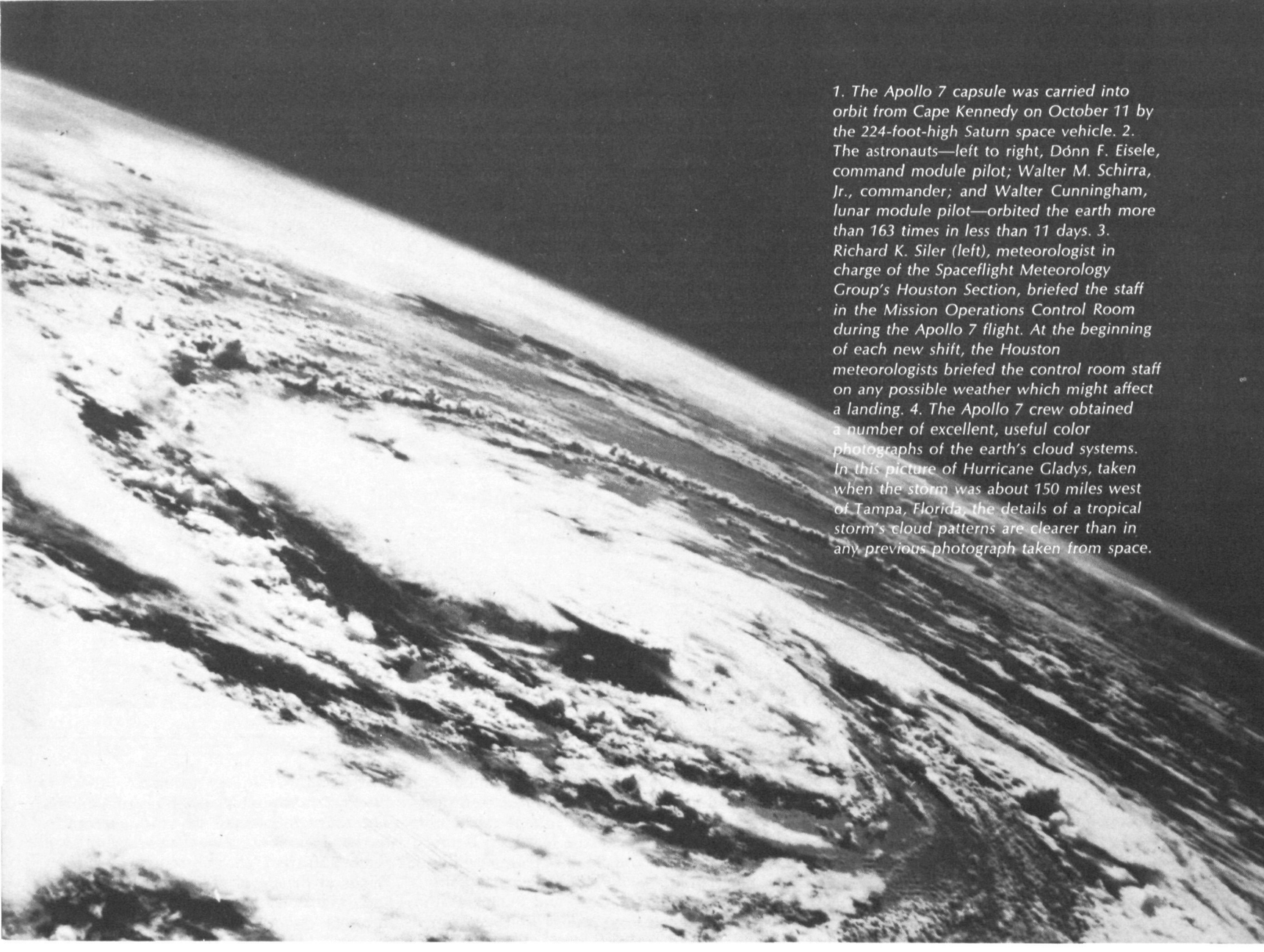
A story behind the story—

THE WEATHER AND APOLLO 7

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



1. The Apollo 7 capsule was carried into orbit from Cape Kennedy on October 11 by the 224-foot-high Saturn space vehicle. 2. The astronauts—left to right, Dónn F. Eisele, command module pilot; Walter M. Schirra, Jr., commander; and Walter Cunningham, lunar module pilot—orbited the earth more than 163 times in less than 11 days. 3. Richard K. Siler (left), meteorologist in charge of the Spaceflight Meteorology Group's Houston Section, briefed the staff in the Mission Operations Control Room during the Apollo 7 flight. At the beginning of each new shift, the Houston meteorologists briefed the control room staff on any possible weather which might affect a landing. 4. The Apollo 7 crew obtained a number of excellent, useful color photographs of the earth's cloud systems. In this picture of Hurricane Gladys, taken when the storm was about 150 miles west of Tampa, Florida, the details of a tropical storm's cloud patterns are clearer than in any previous photograph taken from space.

The nation's third manned spaceflight program—Apollo—is under way. Its goal: a landing on the moon.

Now as before, weather will play a vital role in the success of the mission. Primary weather support, funded by the National Aeronautics and Space Administration's Office of Manned Space Flight, will be provided by the Weather Bureau's Spaceflight Meteorology Group in Houston, Texas, headed by Alan Sanderson. The group is a branch of the Weather Bureau's Space Operations Support Division.*

The first manned Apollo flight carried Astronauts Walter M. Schirra, Jr., Donn F. Eisele, and Walter Cunningham on a historic earth-orbiting flight of nearly 11 days. This is the story of the Weather Bureau's support to Apollo 7.

The role of weather in this flight really started years before when the possible weather for launch, reentry, and landing had to be studied to determine what conditions might be encountered and how the spacecraft should be designed to withstand them. The Spaceflight Meteorology Group (SMG), NASA meteorologists, and NASA contractor staffs contributed to the meteorology affecting the design of the spacecraft and the rocket engines which propel it. Once the basic design of the Apollo space vehicle was established the meteorologists, largely the Weather Bureau group, assisted in planning the actual missions.

Many questions had to be answered:

What is the likelihood in each month of the year of the low-level winds being too strong for the launch?

What are the chances of the winds' causing the spacecraft to come down on land in the event of a very early termination of the flight?

Where should the many aiming points be located to fit the mission best, with good chances for acceptable weather?

Besides the background studies which aided in the design and operational planning, some special studies were made to help the SMG forecasters in predicting weather critical to the mission.

The SMG staff (with James Cox of the Suitland Section as coordinator) also helped in preparing the weather section of the Apollo Program Support Requirements Document. This section covers the forecasts needed from the SMG, the special observations needed for SMG use, plus various other NASA and Department of Defense observational requirements.

The operational support to Apollo 7 really began while it was being assembled at Launch Complex 34 at the Kennedy Space Center. (The Saturn V vehicles, such as Apollo 8, are assembled in the gigantic Vehicle Assembly Building and then moved in a vertical position to their launch complexes—with excessive winds or lightning of great concern during the move.)

Forecasting for the Launch Complex was handled by the SMG Cape Kennedy Section under Ernest Amman—with some guidance from J. R. Gulick's Miami Section, which is co-located with the National Hurricane Center. As part of the weather service at the Kennedy Space Center a continuous weather watch was maintained, to be on

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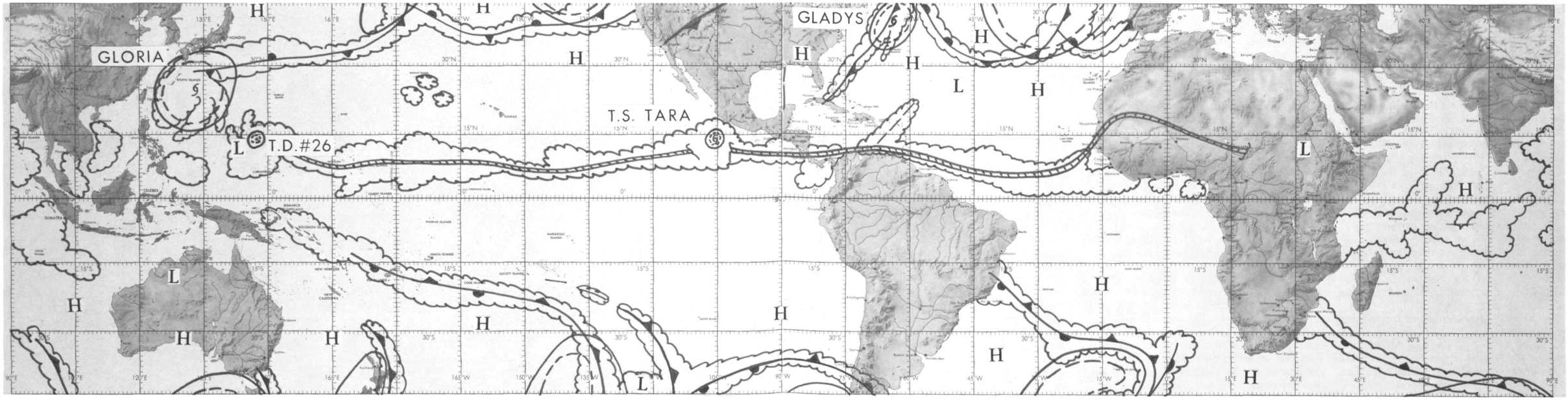
* *See "ESSA's Space Weatherman," ESSA World, April 1967.*



the alert for any local weather changes which might affect the spacecraft or the men working on it.

As the launch approached, the other Sections of the SMG were also busily planning. The Houston Section, with Richard Siler in charge, spearheaded the detailed scheduling as to just what forecasts would have to be made, by which SMG Section, and at what times throughout the mission.

The forecasts required were not confined to just one for the launch and one for the landing. Consistent with the general concern for safety in the program, many landing areas were selected for possible emergency use. For the most part, each revolution had one primary target point which would offer the best chances for prompt pickup in case there had to be a landing on fairly short notice, and each revolution also had an alternate target point, in case there was not time to reach the PTP. These landing points were all selected by the Manned Spacecraft Center's Landing and Recovery Division (with weather guidance) well in advance of the flight, but were subject to change during the mission if weather conditions were not expected to be satisfactory.

Starting a week before the scheduled launch date the Suitland Section, headed by Richard Brintzenhofe, prepared surface weather analyses each day covering the world from about 50° north to 50° south latitude.

In preparing these maps, all available guidance material from the National Meteorological Center was used, plus additional information received via facsimile from the Miami Section. The analysis for the remaining tropical portions of the Northern Hemisphere and for the Southern Hemisphere was prepared by the Suitland meteorologists—Brintzenhofe, Cox, and James Williams—augmented by Walton Follansbee of NESC and Graden Harger of the Space Operations Support Division office. Heavy reliance was placed on NESC products in much of the area of concern.

Copies of the nearly global map were sent to the SMG Sections at the Kennedy Space Center and the Manned Spacecraft Center by the SMG voice-facsimile line. A copy of the 0000 GMT map was posted each day in the astronauts' office so that they could get a feel for the type of weather systems over which they would be flying.

Starting five days before the launch date, daily forecasts were given for the launch area and for selected landing points in the event of an early termination. The launch and Atlantic area forecasts were prepared by the Miami Section forecasters, Gulick and Charles Neumann, augmented for part of the mission by a former SMG member, John Hope, now a hurricane specialist at the National Hurricane Center. (After the launch the staff was also augmented by James Nicholson of the Cape Kennedy Section.)

One weather condition of concern in the launch area is a strong low-level onshore wind, which could cause a flight that was terminated before or just after lift-off to have a landing on land with strong winds. The spacecraft would be most affected by the wind speed at about the parachute level, some 150 feet above ground at impact. Winds at that level of more than about 21 knots were considered risky.

While the Miami Section provided the principal guidance for the launch forecast, as the launch approached the Cape Kennedy meteorologists, Amman, Nicholson, and Kenneth Seal, gave a number of informal briefings and contributed substantially to the forecasts.

The fact that weather predictions are not always correct is recognized by two classes of people: meteorologists and non-meteorologists; and the earlier forecasts for the wind at Cape Kennedy were of the incorrect variety.

Although considerably lighter winds had been predicted right up to the evening prior to the launch, winds of 18 knots at the normal (30-foot) level and mostly 19 to 20 knots near the 150-foot level occurred throughout much of the launch day, October 11. These were acceptable and the other launch and emergency landing area conditions were good. Nevertheless, it was rather frightening to have weather predicted to be acceptable turn out to be so close to the unacceptable.

During the night before and the morning of the launch, the KSC meteorologists did continue to predict the acceptable conditions in a number of informal briefings.

SMG Representative, Oliver A. Gorden, Jr., and John Mukai of WBAS, Honolulu, who assisted in the Apollo Mission support. Forecasts for aiming points in the rest of the world were made by the Suitland Section.

Although other weather charts were sent from Miami and Suitland to Houston, the primary briefing map was the "strip chart," a sample of which accompanies this article. This chart was prepared at the Suitland Section three times a day, with help in the Atlantic from Miami and, via telephone discussion, with help in the Pacific from Honolulu. The facsimile copies of the strip charts were traced in Houston and smooth charts, in color, given to the flight director and the mission director.

At the beginning of each new shift, the oncoming flight director was given a thorough briefing on any possible weather which might affect a landing during his period of responsibility. Sanderson, Siler, and Roger Carter were each responsible for briefing one of the shifts.

One responsibility of the Group was forecasting for the scientific experiments which involved viewing the earth and its clouds. One experiment concerned terrain photography and one, weather photography. Stanley D. Soules, NESC, and I were the coexperimenters on the latter effort. There was also an effort to test a backup navigation system which involved obtaining fixes from the spacecraft on known features on land, and hence required nearly cloud-free skies at

Another activity just prior to launch was the preparation of a simplified weather chart for the flight crew to take with them in space, so that during the early part of their mission they could have an idea of the weather systems over which they were orbiting.

The launch occurred only two minutes and 45 seconds later than the originally scheduled time. The inclination (the latitude, north and south) reached by the spacecraft was 31.6 degrees, and, through several inflight maneuvers, the orbital altitude varied between 89 and 245 nautical miles.

After the launch, I left the Kennedy Space Center and went to the Manned Spacecraft Center to participate in some of the weather support activities there, since that is where the spaceflight mission is controlled.

Actually starting somewhat before the actual launch and continuing until the recovery, the SMG had a very active analysis, forecasting, and briefing schedule. For the two potential landing points selected for each revolution, forecasts were made some 24 hours in advance and updated later if necessary. The primary target points were generally in four geographical areas: the west Atlantic, the east Atlantic, the west Pacific, and the mid-Pacific. Sometimes they were far from those areas.

The aiming points in the tropical North Atlantic were the responsibility of the Miami Section; those in the north Pacific were the responsibility of the Honolulu

continued

Surface Prognosis V.T. 0800Z 21 October 1968

The "strip chart" above was valid for Apollo 7 orbits 144 through 150 on October 21. These schematic prognostic maps were prepared three times each day throughout the mission. They were used in briefing mission officials and served as a quick indicator of undesirable weather likely anywhere along the track, ready for use if a decision had to be made to bring the spacecraft down on short notice. Although not shown on this map, the ground tracks of the revolutions for which each strip chart was valid were traced on the maps before they were distributed in Houston. Besides conventional weather symbols for fronts, highs, lows, and tropical storms, some specialized symbolism is used on the chart. The ladderlike line just north of the Equator represents the intertropical convergence zone. The areas enclosed in scalloped lines were predicted to have greater than normal shower activity, cloud ceilings below 1500 feet, or visibility less than three miles. The smooth solid lines enclose areas with forecast wind over 25 knots or seas over 8 feet in height. The dotted lines enclose areas where winds were expected to exceed 30 knots and seas to be over 12 feet.

those points. I concentrated on the forecasting for these experiments.

Because of other activities and the limitations in film and fuel for reorienting the spacecraft, there was no need for the selection of a great many meteorological targets; but information on such major weather features as tropical storms was relayed to the crew. Based on previous briefings, the crew was generally aware of what was desired and obtained a number of excellent, useful color photographs of the earth's cloud systems. Pictures of Hurricane Gladys are particularly interesting, showing the storm's clouds and circulation in remarkable detail.

Throughout the nearly 11-day flight the preparation of analyses and prognostic maps, forecasting for aiming points, and the briefing of the NASA mission officials continued—mostly to be prepared for an emergency landing which might possibly be necessary, as was the case in the Gemini VIII flight of astronauts Neil Armstrong and David Scott.

As the end of the mission approached, the forecast for the planned landing about 300 miles south of Bermuda became important. Here, as is generally the case, the forecast was a good one. Starting with an 80-hour forecast and with only minor modifications, the prediction by the Miami Section called for the landing point to be in a frontal zone, south of a cold front, with scattered showers. Wind and wave conditions were predicted to be well below the 25-knot and eight-foot categories which might be troublesome in the landing or recovery operations.

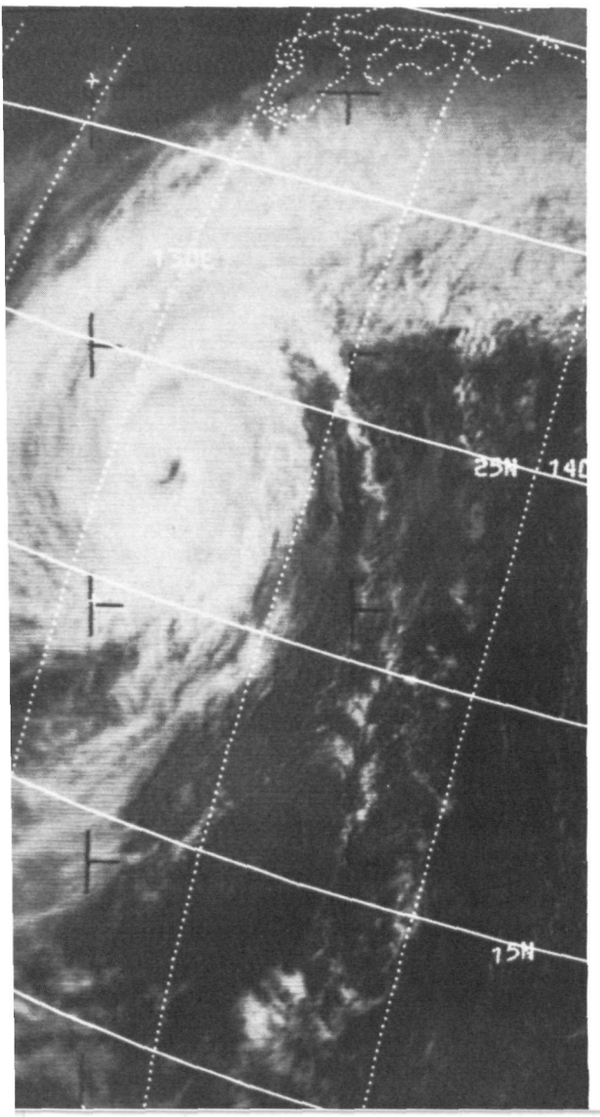
Confidence in the forecast during the last day of the spaceflight was increased by the final two missions of the Air Force 53rd Weather Reconnaissance Squadron on October 21st. Throughout the mission, there was close coordination with both Air Force and Navy meteorologists to plan reconnaissance missions and to get the observations back promptly. Also, the forecasts for landing points which involved Navy recovery forces were coordinated with Navy meteorologists.

With moderately disturbed weather conditions expected in and near the planned landing area, the possibility of changing the landing point was considered. Much better weather was predicted for an aiming point 200 or 250 miles farther to the southeast—out ahead of the frontal zone, but after considerable discussion the mission officials decided not to move the end-of-mission landing point. Although low clouds and visibilities might hamper the search and rescue operations, the predicted weather in the planned target area was considered acceptable, and there was not sufficient reason to justify movement of the recovery forces.

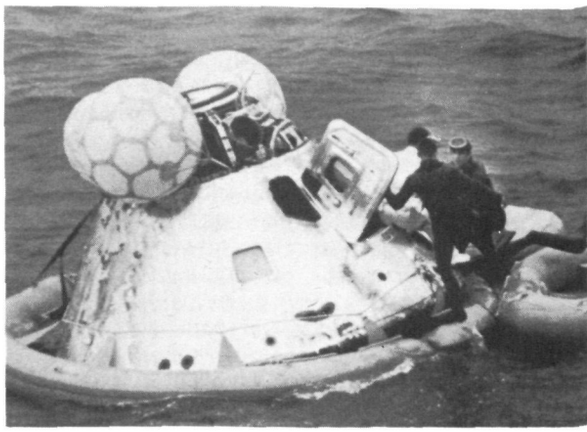
The landing occurred with acceptable winds and seas and with scattered showers as expected. As one verification of the latter, the astronauts were amply rained upon while being hoisted from the spacecraft to the helicopter.

The principal role in the weather support to this spaceflight fell to the meteorologists and meteorological technicians of the Spaceflight Meteorology Group, but a number of other activities contributed. In the Weather Bureau, the routine products of the National Meteorological Center and the special assistance from the NMC staff, and from Communications Division personnel stationed there, were helpful. The staffs at the National Hurricane Center, Miami, and at the Weather Bureau Airport Station, Honolulu, assisted the Spaceflight Meteorology Group Sections in those localities. The routine weather satellite products and special assistance from the National Environmental Satellite Center were very important to the mission. Also, particularly in the planning stage, the Group called on the Environmental Data Service and on several of the ESSA Research Laboratories for guidance.

Thus, there were many in ESSA who contributed to the successful weather support of the first manned Apollo spaceflight. □



(Left) An ESSA 7 view of Typhoon Gloria over the western Pacific Ocean. This storm produced rough seas at one of the Apollo tracking ships south of Japan. It also caused the aiming points for emergency landings in the western Pacific to be moved to safer areas. (Below) The morning sun reflects on the Gulf of Mexico and the Atlantic Ocean, in this photograph of the Florida peninsula taken from the Apollo 7 spacecraft at an altitude of 122 nautical miles. (Right) A view of the Apollo 7 recovery operation. Swimmers are attaching the flotation collar for added stability and safety. Although there were low clouds and scattered showers, as predicted, winds and seas were acceptable for the landing and recovery.



ESSA Commissioned Corps Officer turns inventor—

HIS SPECIALTY:

THE SHORT CUT

Captain Hubert W. Keith, Jr.

Captain Hubert W. Keith, Jr., chief of the Coast and Geodetic Survey's Ships Base in Miami, Fla., spends his spare time inventing articles for military use. They bear such odd names as GADGET, SAP, and UBIQUE.

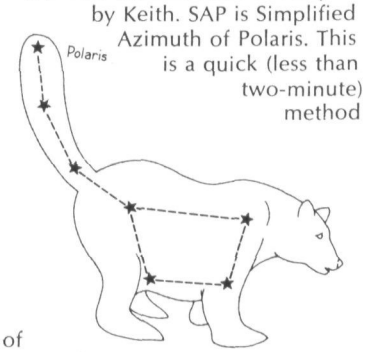
They may be odd, but they are also timely, so much so that they are being tried out in Vietnam and by the British at their artillery school in Larkhill, England.

In recognition of his work, the Army has bestowed upon him its Commendation Medal and the Society of American Military Engineers has awarded him its Colbert Medal.

Keith received the Army award for the work he did while on a tour of duty as the Coast Survey's liaison officer to the U.S. Army Artillery at Fort Sill, Okla., a post he held before he was assigned to Miami last February.

Keith's duties at Fort Sill were to advise and assist the Artillery on survey matters. Part of his advice and assistance turned out to be the development of simplified, short-cut, or emergency procedures of computation. While the accuracy achieved with these procedures is not equal to the standard survey computations, they are within practical accuracy limits of artillery work for the jobs they are to perform. They are also simple enough to be taught to non-survey personnel in minimum time, providing information when surveyors are not available.

SAP was the first item developed by Keith. SAP is Simplified Azimuth of Polaris. This is a quick (less than two-minute) method of computing the true direction of Polaris, the North Star. The outstanding feature of this method is that it does not require an ephemeris, a book of astronomical tables that has to be replaced annually. Keith's system is now being used by American, British, and Canadian artillery. It was for this development that he received the Colbert Medal.



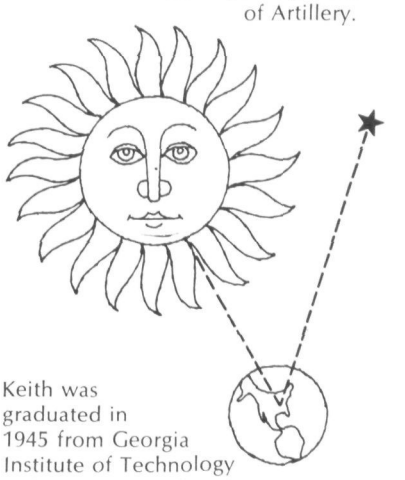
Another invention concerned a rectangular grid used by the Army on its maps and refers all directions to grid north. Astronomic and gyro oriented observations give the direction of true north and this has to be converted to grid north to be used. A Grid Convergence Nomograph developed by Keith gives this correction within 30 seconds, saving 10 to 15 minutes of computation time.

Still another invention involved a system being tried out by the Artillery to locate a point by flying a helicopter over it. Two electronic ground stations range to equipment on the helicopter to locate it, using a computer to determine the position. Keith felt that if an easy way were found to convert the slope distances to horizontal distances, the positions could be plotted graphically, using standard hydrographic plotting methods. His slope correction slide rule, using either vertical angles or the elevations of the helicopter and ground stations, gives the answer so closely that in all but extreme cases the error cannot be plotted on a 1:25,000 scale sheet. This slide rule is also being considered for use with the Laser Rangefinder now undergoing development.

GADGET was Keith's last development before he left Fort Sill. It stands for Graphical Azimuth Device, Generalized Ephemeris Tables. Fourteen of the GADGETS were completed for testing a week before his departure.

GADGET is a graphical calculator for determining direction using a measured vertical angle to the sun or to a star. Usually, this is known as an Azimuth by Altitude computation and takes about 30 minutes to compute. GADGET will furnish the answer in two minutes or less. The Generalized Ephemeris Tables are designed for simple rapid use and can be used over a 20-year period, rather than the one year of the standard ephemeris.

GADGET is currently undergoing trials by both the U.S. and British Artillery. The British objected to the name, however, because they use the term bearing rather than azimuth. So Keith coined UBIQUE, which stands for Universal Bearing Indicator, Quick Use Ephemeris. It turned out to be a felicitous choice, for UBIQUE is the motto of the Royal Regiment of Artillery.



Keith was graduated in 1945 from Georgia Institute of Technology with a degree in civil engineering, enlisted the same year in the Army, and was commissioned a second lieutenant the following year in the Corps of Engineers. He served as a topographic engineer in Japan and Korea from 1946 to 1947.

Keith began his career with the Coast and Geodetic Survey in 1948 and has spent a good part of his career aboard seven ESSA vessels. He commanded the USC&GS ships SCOTT, GILBERT, HODGSON, and BOWIE.

Between tours of duty at sea, he was chief of geodetic field parties and headed an airborne magnetic survey party to Alaska, Greenland, Iceland, Puerto Rico, and several Atlantic coast states. His other assignments included duty in the Geophysics Division at the Coast Survey's former headquarters in Washington, D.C.; at the Seattle Ships Base; and as acting head of the Anchorage field office in Alaska.

He is a native of Benning, Ga. His father was a regular Army officer and Keith as a boy lived in China, the Panama Canal Zone, and the states of Michigan, Maryland, Arkansas, and South Dakota. Keith and his wife, the former Virginia Cox of Decatur, Ga., have two children, Kenneth Wayne and Joyce Lin.

Washington: a boiler factory —

Strange Sounds in the Atmosphere

BY JOANN TEMPLE
ESSA Research Laboratories

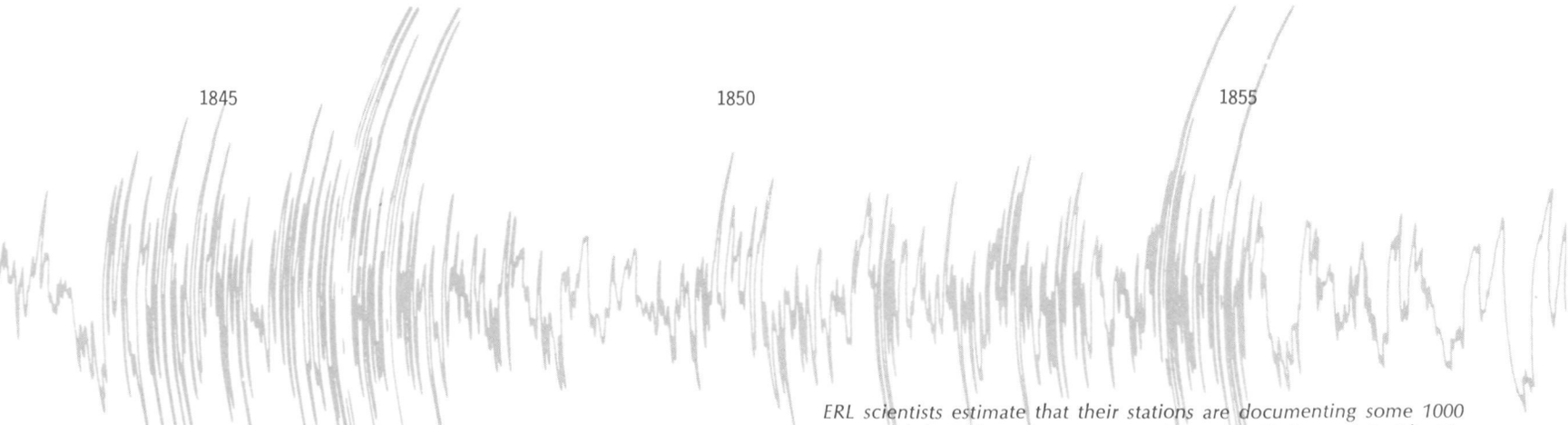
You can hear the Pacific Ocean in Colorado. In infrasound, that is. In fact, a lot of things inaudible to human ears can be heard in infrasound.

Nature is noisy. Thunder, howling winds, severe storms, and tornadoes are easily identified by ear. But, below the audible range, weather and many other phenomena in the natural environment make noise—noise that a group of ESSA Research Laboratory scientists is particularly interested in monitoring, studying, and identifying.

At infrasonic frequencies too low to be heard, sounds of substantial intensity are always present in the atmosphere. These natural sounds can be caused by many things including far distant tornadoes, volcanoes, clear air turbulence, earthquakes, and magnetic storms.

Richard K. Cook, director of the Wave Propagation Laboratory's Geoacoustics Program in Washington, D. C., defines infrasound as any sound wave with a frequency of oscillation less than 15 hertz (cycles per second), the lowest sound audible to the human ear. Waves with frequencies less than 1 hertz are of particular interest because they can be propagated over thousands of miles without substantial energy losses.

Sound waves from the epicenter of an earthquake, for example, can be propagated for great distances; this occurred at the time of the great Alaskan earthquake in 1964. Moreover, as the surface waves from an earthquake spread out over the earth, they radiate sound almost vertically upward into the



ERL scientists estimate that their stations are documenting some 1000 separate infrasonic noise sources each year. In their quest to identify natural events in infrasound, they must distinguish manmade sources also. This striking infrasonic signal obtained at Boulder was identified as the explosion of a powder plant in Carthage, Missouri.

atmosphere as they move. In effect, the vertical movements of the earth's surface create sound waves in the atmosphere. This sound can be measured thousands of miles from the center of the quake. The 1964 Alaskan earthquake produced infrasonic waves in the atmosphere which were easily measured in the Washington, D. C., area. Unlike seismological measurements of earthquakes which give an indication of the earth's motion only at the point where the seismometer is located, acoustical measurements of sound pressure at a point gives the average movement of the earth over a considerable area.

Another class of infrasonic waves is found in the atmosphere during magnetic storms. When a solar flare occurs, electromagnetic radiation reaches the earth almost immediately. An ionized gas or plasma cloud sometimes arrives one or two days after the flare. This cloud perturbs the magnetic field of the earth, causing strong and erratic magnetic field variations known as magnetic storms.

Infrasonic waves from such storms are detectable. During one of these storms, perhaps as much as 25 percent of the earth is bathed in acoustic radiation indirectly caused by the sun. Detailed comparative studies of these acoustical radiations—together with associated magnetic, electromagnetic, auroral, and other phenomena during magnetic storms—will improve the understanding of the dynamic behavior of our atmospheric environment.

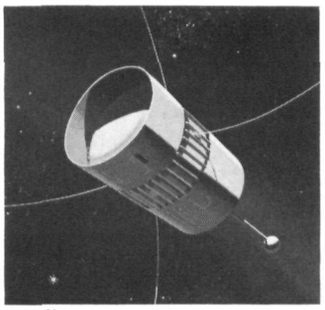
ERL has two infrasonic stations, one in Washington and one in Boulder. These are part of a cooperating worldwide infrasonic network which includes eight such stations, each with its array of microphones. There are six microphones at the Washington, D. C., station. The Boulder station has four listening posts laid out in a quasi-square some 3½ to 7 miles apart.

Vernon Goerke operates the Boulder infrasonics station. He points out that frequently the Boulder station will detect an event which Washington will not hear. The reverse is true also, depending on the nature of the event, winds aloft, and a number of other physical parameters of the atmosphere.

"Sometimes you have to really puzzle over the source of infrasound. The Soviet Union's Cosmos 213, for example, was a curious signal for a while," Goerke says. "The infrasound peaked from all four of our microphones in such a way that we knew the sound was arriving from a shock wave at a very steep angle and therefore had to be above Boulder. We finally pinned it down to the USSR's Cosmos 213 rocket body. On its re-entry path through the atmosphere it passed 112 kilometers over Boulder before finally getting low enough to burn up over Brazil." Although such adventitious observations occur only

continued

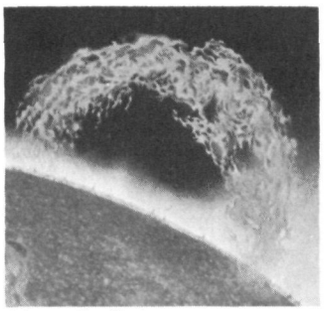
Earthquakes


Satellites

Volcanoes

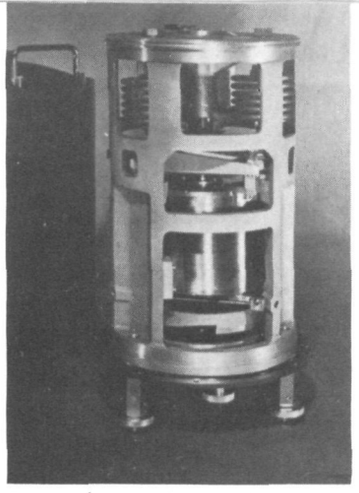
Tornadoes

Thunderstorms


Magnetic Storms

Each infrasonic microphone has one thousand feet of pipe with a hundred capillary inlets to reduce the effects of wind noise. (Left) Some examples of natural and manmade phenomena that can be detected by infrasonic ears at great distances from the source.

Gary Greene (left) and Dr. Jessie M. Young study recordings of infrasound obtained by microphones in the Washington array.



Extremely sensitive seismometers developed by the staff record tiny earth movements. (Left) Mrs. Elizabeth Hubbard calibrates the sensitive capsule of one of the infrasonic microphones.

rarely, they nonetheless offer the possibility of making estimates of the atmospheric density at the altitude where the satellite is entering the atmosphere.

Geoacoustics scientists make educated guesses from the squiggles their infrasonic stations record. An educated guess Goerke is proud of is pinpointing a "probable volcano" on August 12, 1966. This little-noticed volcanic eruption occurred in Mt. Awu in Indonesia. From the infrasonic data, Goerke estimated its location within 200 miles and the time of occurrence within 19 minutes, before the eruption was reported publicly in the United States.

The ESSA stations are designed to determine four characteristcs of infrasound—the amount of arriving sound pressure and its waveform, the direction of approach of the sound wave, the speed with which the sound is moving across the earth's surface, and the period of oscillation of the wave.

Dr. Cook explains that any sound wave causes pressure changes as it travels through the atmosphere. Infrasound from natural origins usually has wavelengths longer than two miles, and causes only very small pressure changes. In fact, infrasonic microphones must be able to detect pressure changes on the order of one-tenth of a microbar, which is about one ten-millionth of the atmospheric pressure.

The ERL scientists design equipment and techniques to increase the sensitivity of their "infrasonic ears." They have also designed, and currently maintain, equipment capable of producing minute, accurately known static differential pressures, as well as dynamic pressures to frequencies lower than one cycle every two hours.

The microphones, located at ground level in approximately the same plane, are condenser-type microphones which generate frequency-modulated voltages proportional to the sound pressure on them. These voltages are then transmitted over telephone wires or a radio data link directly to the laboratory where they are demodulated, amplified, and recorded in graphical form and on magnetic tape. The direction of approach of the wave and its velocity are determined by comparing the times when the infrasonic wave arrives at each of the microphones.

Wind flowing over buildings, trees, and hills can cause tremendous pressure fluctuations, as anyone who has listened to a rattling window on a windy day knows. Dr. Cook points out that, at infrasonic frequencies, screening out the pressure fluctuations caused by local wind turbulence and differentiating them from the pressure changes caused by infrasound is a serious problem. Local wind noise is minimized by connecting 1000 feet of pipe with 100 capillary inlets to each microphone's inlet tube. The wind's pressures then are sufficiently averaged, because of random variation along the pipe, that they do not interfere with the longer infrasonic waves, which appear at all 100 inlets of the pipe without significant change.

Data from the several stations in the ESSA infrasonic network are used both to supplement and refine theories on the propagation of sound, and to elucidate certain geophysical phenomena. Infrasonic waves can detect volcanic eruptions, earthquakes, far distant tornadoes, and meteoritic impacts. There are also persistent infrasonic waves which have not as yet been identified with any known natural phenomena.

Continued research with the network holds even more promise. For example, infrasonic monitoring may be able to measure the energy of impact from large meteorites. Even now, ESSA's infrasonic stations are used in sonic boom studies.

Infrasonic measurements have been successfully used to track severe weather systems. A violent thunderstorm moving over the Denver area on July 25, 1965, heralded its approach at the Boulder station. Comparison of surface observations of the storm and the infrasound recorded in Boulder indicate that the leading edge of the storm, probably also the region of maximum convective activity, created the infrasound.

Recent studies suggest that some extremely long period infrasonic waves arise from vertical oscillations of the jet stream at the tropopause. When these oscillations are strong enough, they apparently give rise to clear air turbulence. Accurate identification of clear air turbulence through infrasound could conceivably lead to a warning system that would enable pilots to avoid these treacherous parts of the sky.

Complementing its work in geoacoustics, the staff in Washington is also interested in seismic instrumentation for earthquake recording. They have made a detailed theoretical study of inertial (weight-on-a-spring) seismometer-galvanometer combinations. They designed a rugged short-period (0.8 cycle per second) instrument capable of very high gain. These instruments are used in quiet locations, to record earth motions as small as 20 atoms lined up in a row. They routinely record earthquakes using four of these instruments scattered around the Washington metropolitan area.

They find that the earth around Washington, like the atmosphere, is as noisy as a boiler factory, at frequencies fortunately too low to be heard. □

At the National Meteorological Center men and machines work together

improving the product

The word "massage" has a semi-humorous but very real meaning to the computer-oriented meteorologists at the Weather Bureau's National Meteorological Center.

A massaged forecast is one produced by NMC's computer and modified by a human analyst—a blending of man and machine skills which has produced progressively better guidance forecasts for use by Weather Bureau field offices.

How much better? To determine the effectiveness of numerical weather prediction (NWP), forecasts are compared with the actual weather which occurs during the period covered. This is called verification. The accompanying graphs, based on these verifications, indicate the extent of improvements noted in NMC products.

In order to bring out clearly the effect of the computer, most of the statistics have been broken down into three periods: Pre-NWP corresponds to the time before computer forecasts were available to NMC forecasters; April 1958 to May 1966 corresponds to the time NMC forecasters had available as guidance the barotropic and 3-level baroclinic forecasts; and June 1966 to February 1968 corresponds to the time the forecasters had available as guidance the 6-layer or primitive equation forecasts.

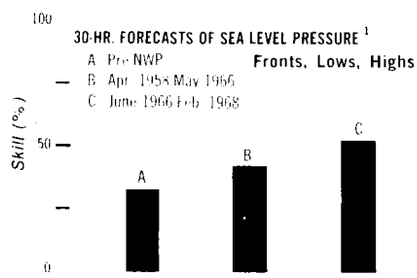
All of the verification statistics, with the exception of upper-wind and temperature forecasts, are products that result from a man-computer mix. In other words, NMC forecasters spent some time in attempting to remove expected errors in the computer forecasts, thereby improving the forecast guidance received at field stations via facsimile and teletypewriter circuits. Verifications have shown that the forecaster is not successful in improving computer-produced upper-wind and temperature forecasts.

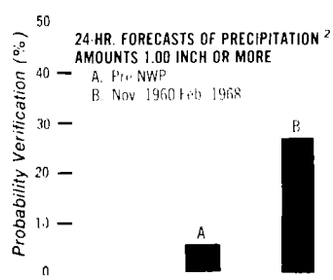
The steady improvement in sea level and 500 millibar (18,000 feet) forecasts has been brought about by first, the introduction of computer forecasts and second, improvements in computer forecast models. The period of record begins in 1947 for the sea level verifications and 1954 for the 500 millibar verifications.

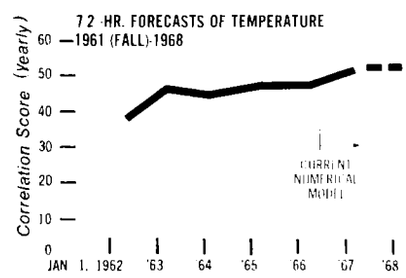
The man-machine blend has produced better guidance for precipitation forecasting, too. At first glance, the dramatic jump in the probability verification of 24-hour predictions of precipitation amounts suggests the influence of computer forecasts. However, beginning in November 1960, quantitative precipitation forecasts were prepared by a specialized group of forecasters at NMC. In spite of changes in computer forecast models since 1960, the verification figure has remained about the same lends credence to the conclusion that human forecasters caused and maintain this improvement—not the computer.

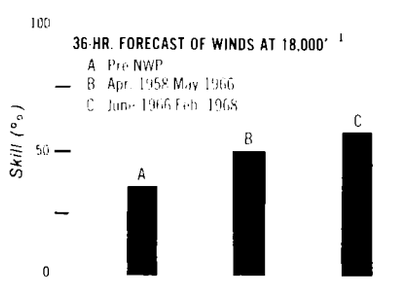
The change from the 3-level baroclinic forecast model to the 6-layer baroclinic model at NMC has resulted in improved upper-wind and temperature forecasts which are used for aviation flight planning. The improvement is most dramatic for the temperature forecasts.

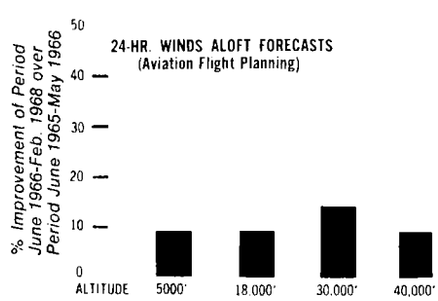
Extended range forecasts of temperature and precipitation have also shown an improving trend, which correlates with the beginning of computer guidance forecasts and with improvements in forecast models. □

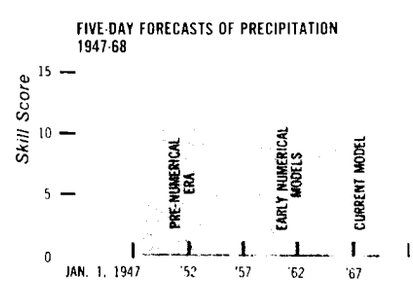


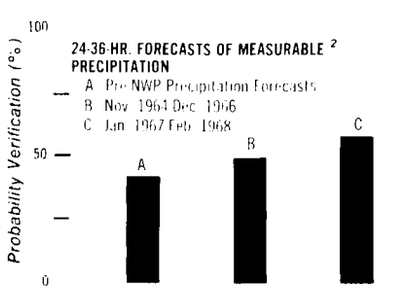


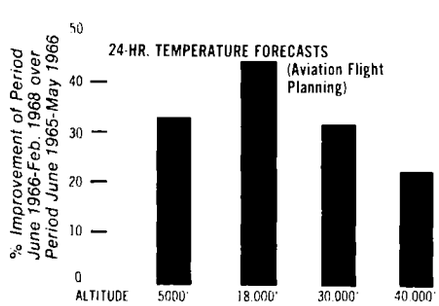


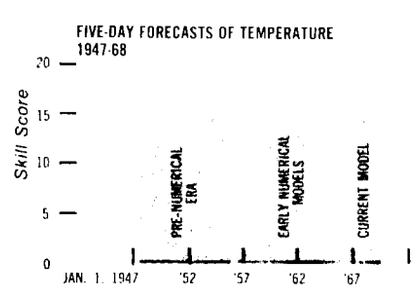












[1] The Skill (%) figure is derived from a scoring system which measures the accuracy in predicting sea level pressure gradients or 500 millibar pressure height gradients.

[2] The verification statistic is the probability of receiving measurable precipitation once it has been forecast.

Launch towing divers over the summit.

Preparing to submerge to the Cobb summit.

Divers working from a small tender.

Exploring the Cobb Seamount.

As he had for many days, the master of the U.S. Fish and Wildlife Service M. V. JOHN N. COBB searched the seas around him for any indication of the schools of tuna reported off the coast of Washington and Oregon.

It was the first day of August 1950, and his last logged position was a bit less than 300 miles off the coast. His attention was drawn to the east by an accumulation of sea birds on the horizon. Following a fishermen's rule which associates sea birds and fish, the COBB turned to investigate.

Initially, the investigation was directed at the sea surface, looking for the elusive tuna. Almost

PROBING the COBB SEAMOUNT

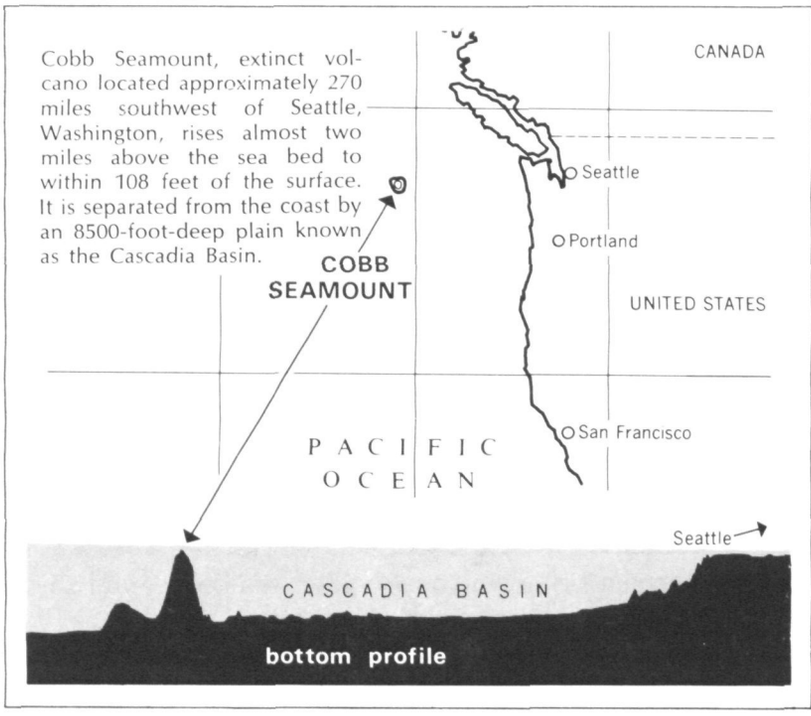
unnoticed, the echo-sounding equipment was indicating a steady shoaling from the 1500-fathom depth it had measured when the birds were sighted.

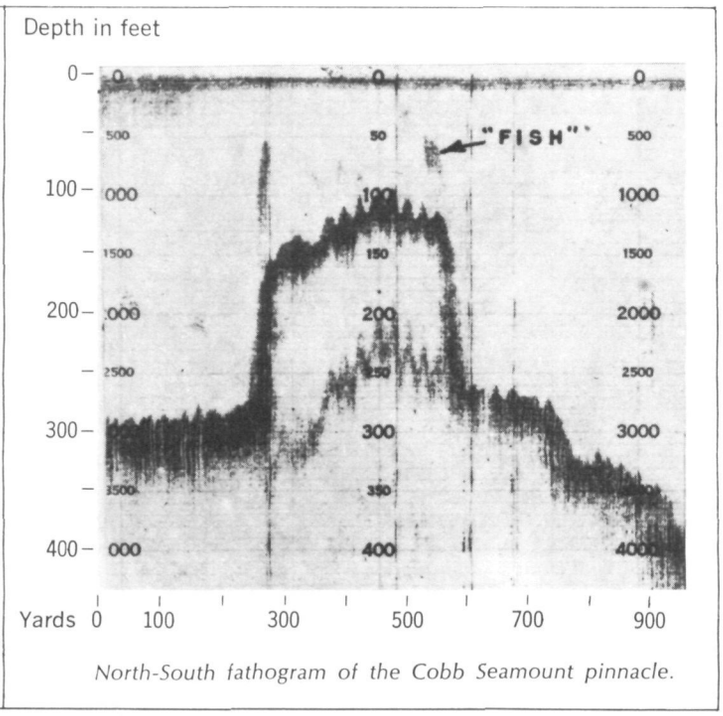
The crew's subconscious attention to the echo sounder changed to alert concern when the instrument indicated that the bottom was only 50 fathoms deep and still shoaling rapidly. No offshore shoal of this magnitude had been reported in the area.

Only after determining that the minimum depth was about 20 fathoms did the COBB resume its search for fish. Although it found no tuna, the COBB had discovered—and given its name to—one of the world's unique seamounts.

continued

BY ROBERT E. BURNS
Director, Joint Oceanographic Research Group
ESSA Research Laboratories





North-South fathogram of the Cobb Seamount pinnacle.

Eighteen years later, with the nation newly aware of its stake in the oceans, Cobb Seamount was to become the target of a fascinating undersea project. That expedition, on which the author served as chief scientist, produced new knowledge of an area which may one day become a submarine Gold Coast and which certainly will go down in the annals of marine science as a frontier.

Seamounts are relatively isolated submerged peaks which have a relief of more than 500 fathoms above the surrounding sea floor. They are generally steep-sided and have comparatively small summit areas. Almost all true seamounts are volcanic in origin, and their form is quite comparable to some of the more famous volcanic peaks, such as Fujiyama, Rainier, and Vesuvius. The total number of reported seamounts is now approaching two thousand, with discoveries continuing as research and survey ships move into new areas.

Although seamounts are found in all the world's oceans, scientific interest in them dates only to the early 1940's, when H. W. Murray published his original description of "Submarine Mountains in the Gulf of Alaska." Murray's work was the outgrowth of surveys made for many years by Coast and Geodetic Survey ships between Seattle and Alaska. As a result of this continuing program, the Gulf of Alaska seamounts are the most completely described in the world. Their names read like a roster of former C&GS employees (Bowie, Campbell, Eickelberg, Gilbert, Heck, Pratt) . . . or vessels (PATHFINDER, SURVEYOR).

Cobb Seamount is only one of the many that dot the sea floor in this portion of the northeast Pacific, but it stands quite apart from all the others in that its summit is nearer the sea surface than any other known oceanic seamount. The summit depth of most seamounts is a few hundred fathoms. Cobb rises to within 20 fathoms of the sea surface, where sunlight can support plant life, and where the summit is affected by the surface currents and subject to a scouring action by the larger of the North Pacific sea surface waves. These unique features, together with its accessibility, excited interest in the possibility of carrying out significant research at the seamount.

For more than a decade after its discovery, the seamount was visited periodically by ships representing many organizations, including the Coast and Geodetic Survey (which conducted the original controlled bathymetric survey), the Fish and Wildlife Service, and the University of Washington. University scientists visited the area on several occasions, investigating the geology and biology of the seamount itself, and conducting physical oceanographic studies to evaluate the effect of the seamount on otherwise "open ocean" conditions.

By the early 1960's, it was generally recognized that Cobb Seamount offered a unique site for oceanographic research, and the concept of using the seamount as a site for instrumented measurement was suggested. The early part of the 1960's saw several initial efforts to obtain measurements at the seamount, efforts whose primary result was additional experience in the problems of working under the difficult conditions that prevailed.

By the summer of 1965, the summit area had been reasonably well explored by means of echo sounding, sampling, underwater television, and underwater photography, as well as by free divers.

Shortly after ESSA's Joint Oceanographic Research Group was formed (July 1965), the possibility of a joint research project at Cobb was discussed, and a JORG proposal was submitted to ESSA, outlining a three-year effort directed toward establishment of a fixed instrumented mast at the seamount. Possible research tasks were proposed by various groups at the University and at JORG, and an informal working group was established. When a regionally generated proposal to study Cobb (Project SEA USE) was sponsored by the Oceanographic Commission of Washington early in 1968, the ESSA interest was maintained through the ESSA-University function of JORG.

The OCEANOGRAPHER departed Pacific Marine Center on October 4, with several specific objectives to be accomplished at Cobb.

The marine geophysical project of JORG was interested in obtaining a controlled underway geophysical survey (bathymetry, gravity, and magnetism) over the seamount and its immediate environs. There were still inconsistencies and gaps in knowledge of the detailed morphology and composition of the summit, and these were to be examined in as much detail as time and position-control permitted.

Some additional biological and geological sampling was planned, as was a search for Coast and Geodetic Survey sea-surface wave recorders that had been placed on the summit in February of 1967.

Since many of these objectives were of specific interest to the local SEA USE proj-

ect, the investigation was planned as a cooperative one between ESSA and representatives of SEA USE. The ESSA participation involved the USC&GSS OCEANOGRAPHER, her officers and crew, as well as the Chief Scientist. SEA USE was represented by a diving group which included, in addition to the sponsoring Virginia Mason Research Center team, representatives of the University of Washington, Honeywell, Inc., and a local structural engineering firm. Thus, the cruise objectives were served by members of Federal, State, industrial, and academic groups working on a project of mutual interest.

Anyone familiar with wave conditions and storms in the northeastern Pacific is aware that October is not the most favorable time of the year to attempt the work proposed, and the trip from Seattle to the seamount confirmed it.

After a very rough ride which took about twice the time it would have in better weather, the OCEANOGRAPHER approached the seamount in mid-afternoon on October 6th. Finding a feature as small as the seamount is still a problem, in spite of the Loran-A which was available as a navigational aid. An initial search pattern—which would put the ship on course over the summit—was started, but was interrupted when a particularly sharp-eyed lookout sighted a buoy ahead. Several passes close to the buoy indicated that it was Canadian and that it marked the southeast corner of the summit area of Cobb.

Following some additional reconnaissance to obtain a rough delineation of the summit in relation to the existing buoy, the ship placed its own marker buoy, which was to be the point of reference for the initial phases of the work. By this time, darkness had fallen, and the ship left the summit area to begin the underway geophysical survey which was to take up the night hours through the rest of the operation.

Next morning, the weather had abated considerably, and a day of diving operations and development of the detailed bathymetry of the summit area was begun. These daytime operations were to alternate with the underway geophysical survey at night, with return to the summit for more diving in the morning. Although the underway nighttime operations were relatively routine for the OCEANOGRAPHER and went very smoothly, the daytime operations were all new to the ship. The smoothness with which they were handled is an indication of a degree of responsiveness that normally might be expected only on ships that are well-practiced in the problems of supporting a comprehensive diving operation in the open ocean several hundred miles from land.

With everything going well and even a little better than planned, the ocean proved again that it can be most uncooperative about revealing its secrets. Just before noon, with one group of divers working off of the ship's launch, disaster struck the second team which was working off the stern of the anchored ship. Shortly after reaching the bottom on an initial trip preceding an attempt at obtaining oriented samples of the rock, the divers were forced to 'bail out" when their supply of surface-supplied gas lost pressure.

Although both were quickly taken aboard, one of them was in trouble because of an extended period without air and a too-rapid ascent from about 135 feet. The decompression tank was ready for him, but there was a period of uncertainty as to the seriousness of the damage to the injured diver. This prompted the ship's doctor to request a move toward shore, so that additional help could be obtained if the diver's condition deteriorated.

After sinking the marker buoy to eliminate a hazard to navigation, the OCEANOGRAPHER abandoned station and headed for Seattle. Treatment by the doctor aboard was successful and, after a series of tests in Seattle, the diver was pronounced unaffected by his experience.

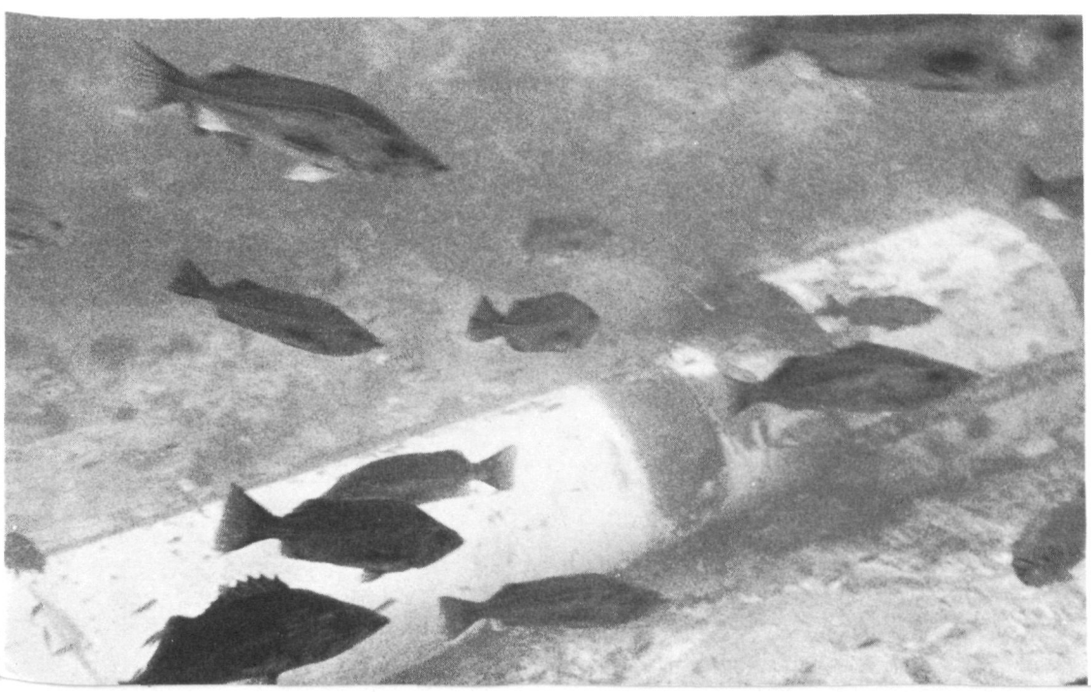
Although the emergency caused the expedition to leave Cobb with many planned tasks incomplete or undone, the good fortune of a well-timed break in the seasonal bad weather had permitted overall results better than anticipated on the basis of the climatology of the region.

The expedition to Cobb Seamount demonstrated conclusively that not even the OCEANOGRAPHER can overcome the fundamental limitation to detailed survey that is imposed by the absence of a fixed and readily recoverable base line at the summit of the seamount. Without this type of base line, any future work at Cobb will be forced to spend too much time simply finding where the ship (or a temporary reference buoy) is located in relation to the summit. Until such a base line can be established, the new information that can be added to past data by any new cruise will be disproportionately small.

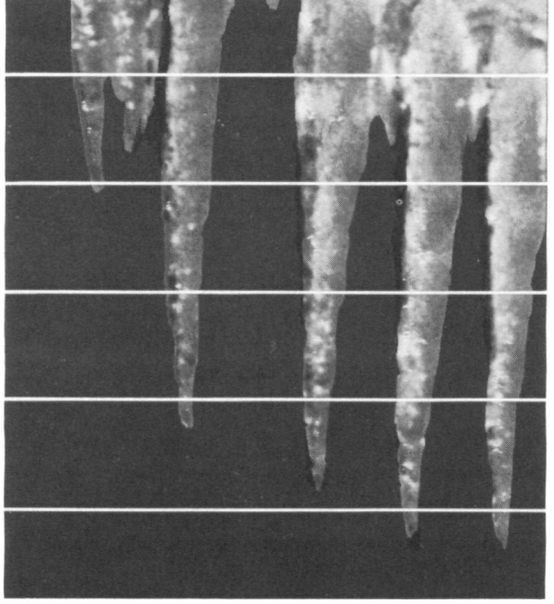
Of the specific major objectives of the trip, more than a third of the underway geophysical work was completed, and the remainder will be carried out by the OCEANOGRAPHER. Because of the lack of adequate absolute positioning control, the investigation in detail of the summit's shape was less than had been hoped. Although the plan to have OCEANOGRAPHER install a fixed acoustic homing beacon had to be abandoned when the operation was cut short, our present information about the summit is considerably more comprehensive than before the trip. Information which was obtained, however, has filled in several gaps remaining from past work, and resolved some of the apparent contradictions concerning the shape and composition of the top of the summit area.

The summit top is remarkably flat (everywhere between 19 and 21 fathoms depth), measures approximately 300 by 500 meters, has a surface which resembles an aggregate of coalescing and slightly rounded pillow-lavas, is covered with a white algal growth, and is clearly limited in area by an encircling scarp which plunges steeply to depths of 25 to 30 fathoms.

This defines the limits of what must be considered one of the most valuable pieces of real estate in the ocean . . . the place where the proposed research mast and the manned habitat will be placed. And possibly, the site of the first open-ocean research and monitoring station in which man will carry on his work from a habitat on the sea floor. □



(Left) The broken base of Oregon State University's TOTEM II, the remains of an earlier experiment in placing an instrumented mast on Cobb Seamount.



Degree Days, measures of fuel consumption, are

REAL COOL STATISTICS

One daily statistic computed at Weather Bureau offices hits every householder right in his pocketbook.

That statistic is the degree day, a useful measure of coldness devised by heating engineers early in the century.

They found that when the daily mean temperature is 65 degrees or higher most buildings require no heat to maintain an inside temperature of 70 degrees. The daily mean temperature is obtained by adding together the high and low temperatures reported for the day by the nearest Weather Bureau office, and dividing the total by two. Thus, if the high is 70 degrees and the low 52 degrees, the daily mean temperature is 61 degrees (70 + 52 = 122. 122/2 = 61).

Each degree of mean temperature below 65 is counted as one degree day. When the mean temperature is 61, four degree days (65—61) have accumulated during the 24-hour period.

For every degree day, more fuel is needed to maintain a comfortable 70 degrees indoors. A day with a mean temperature of 35 degrees—30 degree days—would require twice as much heating fuel as a day with a mean temperature of 50—15 degree days.

Industry's rapid adoption of the degree-day system came with the increasing use of automatic heating systems during the 1930's. The high cost of storing oil and gas puts a premium on precise evaluation of fuel use rates and peak demands, and on efficient scheduling of deliveries.

So valuable has the degree-day concept become that daily or monthly totals are routinely computed for all temperature observing stations in the Weather Bureau's network.

Daily figures are used by fuel companies in scheduling deliveries. When Mr. Jones, for example, moves into a new house, his oil supplier runs a short test to determine the amount of fuel per degree day needed to keep the Joneses' new home comfortable. If the heating system uses one gallon of fuel for every 4.4 degree days, oil deliveries will be scheduled to meet this burning rate.

With gas or electric heat, a central dispatcher must ensure that consumption does not exceed the system's capacity. Each system has a critical degree-day load, which is related to the local climate, peak demand costs, and other factors. When daily degree days exceed the critical value, less essential industrial activities may be curtailed. Such low-priority customers pay a lower off-peak rate in exchange for their agreement to shut down when degree days reach a certain level.

The economic impact of a cold spell can be enormous. Fuel costs in a service area may easily total $5,000 to $10,000

As degree-day totals mount, fuel consumption increases and more deliveries must be scheduled. The high cost of storing oil and gas puts a premium on precise evaluation of fuel use rates and peak demands and on efficient scheduling of deliveries. Large fuel companies look ahead by converting the Weather Bureau's forecasts of maximum and minimum temperatures into degree-day estimates.

for each degree day. Therefore, large fuel companies look ahead by converting the Weather Bureau's forecasts of maximum and minimum temperatures into degree-day estimates. Many industries hire private meteorologists, who refine weather forecasts into predictions of hourly or peak degree-day rates, trends, and changes, to suit their clients' needs. In recent years, degree-day predictions have become a regular feature of the Weather Bureau's 30-day outlook.

Professional heating engineers use degree-day statistics for purposes that range from checking the efficiency of large heating plans to estimating how much more, or less, fuel than normal is being burned. Individual householders with a mathematical bent can do the same.

To apply the degree-day concept to your own home, keep a record of the accumulated degree days and of your home fuel consumption for a week or two. Then divide the amount of fuel used by the degree-day total during this period, to find the amount of fuel per degree day required to heat your home.

The resulting figure can be multiplied by the normal yearly degree-day total for your locality to estimate the amount of fuel you will use for home heating in an average winter.

The same method can be used to check on the efficiency of your home heating system, just as professional engineers do with large heating plants. When you know the amount of fuel per degree day normally required to heat your house, it is easy to determine whether a sudden increase in fuel consumption is due simply to colder weather, or whether your furnace is not using fuel efficiently and needs adjustment.

Maps and tables of degree-day normals for each month of the year are published by the Environmental Data Service.

The maps are useful only for broad general comparisons, because temperatures, even in a small area, vary depending on differences in altitude, exposure, prevailing wind, and other circumstances.

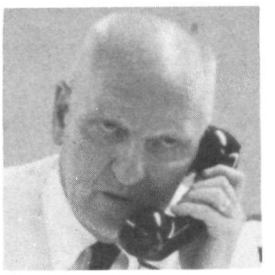
From a map of mean annual total heating degree days, it can be estimated that fuel consumption in central Wisconsin (8000 degree days) would be roughly double that in southern Illinois (4000 degree days), and about four times greater than that in south central Alabama (2000 degree days). All of this is true only if building construction and living habits in these areas are similar. Since such factors are not constant, these ratios must be modified by actual experience.

Tables of normal monthly and annual heating degree days for U.S. cities provide a more accurate basis for comparison. The tables published by EDS show, for instance, that Washington, D. C., has a total of 4224 degree days in an average year, while Boston, Mass., accumulates 5634. From this information, it can be calculated that a home in Washington may be heated comfortably with three-quarters of the fuel needed to heat a similar home in Boston.

Degree-day comparisons within a single area are the most accurate. For example, March fuel costs in the Midwest average about 70 percent of those for January. In Chicago, the coldest six months in order of decreasing coldness are January, December, February, March, November, and April.

In a normal year, the degree-day total in Barrow Alaska, climbs above twenty thousand. International Falls, Minnesota, accumulates more than ten thousand. Key West, Florida, has just over a hundred.

But wherever you live, your heating bill will mount as the degree days increase during the winter season. □



HERB THOM

He Puts the Degree Day to Work

ESSA's "Mr. Degree Day" is Herbert Thom, senior research fellow with the Environmental Data Service. Over more than 25 years, he has expanded the usefulness of the degree-day concept by developing statistical methods for applying it to a wide range of needs. He has won an American Meteorological Society award 'for outstanding contributions to the advancement of applied meteorology."

The degree day was developed and named in 1915 by Eugene D. Milener, who noted that gas consumption increased with the number of degrees that the daily mean temperature fell below 64 degrees. The generally accepted base is now 65 degrees.

Mr. Thom first delved into degree days during World War II, at the request of the Army Corps of Engineers. Because transportation, fuel, and manpower were at a premium during wartime, the Corps was seeking a way of determining adequate fuel supplies and planning fuel delivery schedules for 650 military installations in the United States and Alaska. Mr. Thom devised a formula for estimating fuel requirements, based on the frequency distribution of seasonal degree days. During the first year of its use, the formula saved several million dollars in transportation costs alone.

Another wartime effort directed by Mr. Thom was the development of an annual degree-day map for the Office of Price Administration to use in allocating fuel to different parts of the nation.

In the early 50's, he developed a method for converting monthly normal temperatures into degree-day normals. Temperature normals do not have a direct correlation with degree-day figures, because the temperature normals include days when the average temperature exceeds 65 degrees, while degree-day statistics exclude them.

Later, he demonstrated that the same method can be used to convert mean temperatures to degree-day bases lower than 65 degrees. Bases below 65 are needed to estimate fuel consumption in special buildings, such as warehouses, where inside temperatures below 70 degrees are maintained.

A direct application of the degree day was developed by Mr. Thom in 1961 for the Department of Health, Education and Welfare. In setting standards of public assistance. states include fuel for heating as one of the major budget items, along with food, clothing, and shelter. Mr. Thom and his staff prepared a set of tables for estimating seasonal fuel consumption in dwellings of poor, average, and best construction throughout the United States.

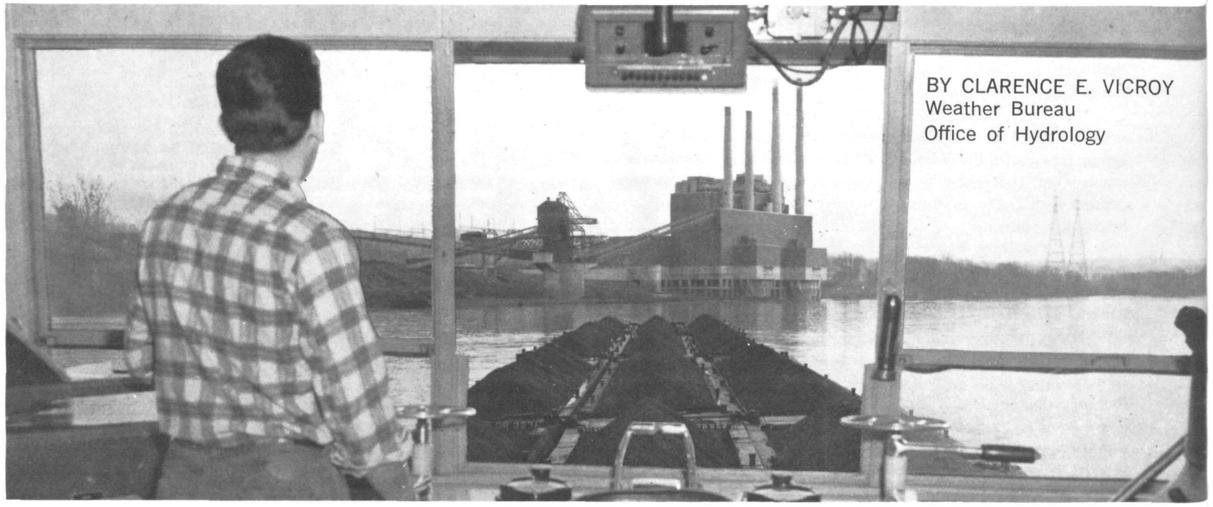
In recent years the increasing use of air conditioning, and the resulting load placed on electric power systems, created a need to apply the degree-day concept to cooling. Mr. Thom thereupon reversed the usual procedure for computing degree days and came up with a set of equations for determining mean monthly cooling degree days—that is, degree days above 65 or any other base—from mean monthly temperatures.

His newest study is an analysis of the distribution of highest daily heating degree days. Heating gas companies must pay a premium price to their wholesalers when they draw more than a certain quantity of gas in a single day. In a process called "peak shaving," the gas companies circumvent the higher prices by manufacturing butane gas for distribution through the system on days when the cutoff point is likely to be exceeded. To do this, the companies must build standby manufacturing plants. The design of these supplementary plants is a function of the possible demand, which can be determined from the frequency distribution of highest daily heating degree days.

While the degree day has proved to be an exceptionally versatile tool, Mr. Thom emphasizes that it is useful only as a measure of demand for fuel or electricity. Because it is an average, it cannot be applied to the design of houses or of heating and cooling systems, which must be built to accommodate the extremes. □

Busier than salmon swimming upstream . . .

OUTGUESSING OLD MAN RIVER



BY CLARENCE E. VICROY
Weather Bureau
Office of Hydrology

The barge's cargo depends on predicted river depths.

Water-covered river front of Evansville, Ind., during 1937 flood. (Left) A computer has brought about remarkable changes in the operations of the Ohio River Forecast Center. Left to right are Mrs. Vivian M. Moehlman, Jose A. Buil, Thomas J. Bowers, William Winston, and Thomas J. McPhillips.

Remember the brain teaser—if the rungs on a rope ladder hanging from the side of a barge are 18 inches apart and the tide is rising one inch every 14 minutes, how long will it take the water to rise from one rung to the next?

The answer is obscured by irrelevant information,* but usually water inching up the side of a barge is extremely relevant and a Weather Bureau River Forecast Center is involved in a $600-an-inch decision.

One company whose freight-laden barges ply the Ohio has calculated that the amount of cargo it takes to make one of its vessels settle one inch in the water is worth $600 in freight charges. Economically, a capacity load is ideal, but the barge may have to pass over sand bars and other underwater obstructions, so the exact stage of the river at a number of points along the barge's route must be known days before the loading takes place. Multiply the $600-an-inch factor by a tow of several barges and the money riding on accurate river forecasts for the 10 days it takes a barge to go from New Orleans to Pittsburgh is considerable.

Flood forecasts and warnings get the Ohio River Forecast Center at Cincinnati in the news often enough—perhaps too often for residents along the Ohio, Wabash, Kanawha, Scioto, Kentucky, and other rivers and streams in the eight-state area served by the Center. But hydrologic forecasting covers a lot of ground between the headline-grabbing extremes of flood and drought. This includes navigation forecasts of river stages, discharge and velocity forecasts for water quality management (amount and kind of dilution water available and travel time), and ice forecasts (due to the effect of ice on navigation and dissolved oxygen—a factor necessary for municipal water supply treatment).

While the mission of providing hydrologic forecasts and services is common to each of the Weather Bureau's 12 River Forecast Centers, selecting a typical one would be like trying to pick a typical river. Each is affected by unique features of geology, geography, and meteorology. At the Ohio River Forecast Center, however, hydrologists face a full spectrum of weather/river relationships; and the Cincinnati office provides a good example of the operations of Weather Bureau river and flood forecasting services in general.

The Ohio River Forecast Center, headed by Carl M. Relyea, has a long history of public service. Activated in 1946, the center serves an area of 136,840 square miles of the Ohio River Basin—from Wheeling, West Virginia, to near Paducah, Kentucky—a reach of nearly 800 miles. A staff of seven professional hydrologists prepares and issues river stage forecasts for approximately 140 key points along the Ohio River and its tributaries.

A good river forecaster is more than a professionally competent hydrologist. The job demands an understanding of meteorology, climatology, geology, and civil engineering. He also has to develop an intuitive feel for the land, water, and sky which can turn a meandering stream into a raging torrent in a matter of hours. As the time for a scheduled forecast approaches, he is busier than a salmon swimming upstream.

Preparation of a river stage forecast entails a tremendous amount of computation. It requires knowledge of the soil moisture condition—a vital feature in determining the proportion of rainfall that will run off the ground into the river channel. The channel capacity in all reaches must be known. Measured rainfall reports must be collected from a great number of points so that an areal rainfall coverage can be computed. Other equally important considerations are vegetation conditions of the drainage area—a factor which regulates the runoff volume due to loss by interception and evapotranspiration and has large seasonal variation; and the slope of the drainage area—a key to the velocity and shape of a flood wave as it travels downstream.

* The barge and the rope ladder would rise with the tide, of course, and the distance from the water surface to the ladder rung would remain constant.

Initially all of these computations were performed by slide rule or adding machine and required many man-hours of laborious hydrograph preparation. This manual work included, in part, the adding of columns of figures contained in a whole series of hydrologic tables; for in order to forecast for any given point on a river, data from all upstream points must be considered. This hydrologic arithmetic consumed hours of the forecasters' time—time that meant less advance warning. It is impossible to manually process all data and check computations in the few hours available for timely forecast preparation.

In 1948, an electronic flood routing analog computer was placed in service at the river forecast centers. This computer could produce an outflow hydrograph from the upstream hydrograph by proper adjustment of electrical controls.

The analog computer gave way to a high-speed digital computer as technology advanced, and the hydrologists were relieved of much of the tedious, time-consuming manual work that was necessary to produce a river forecast. The computer makes no arithmetic mistakes, and is impartial in handling data and computations. It is now possible to use shorter final increments which more closely approximate a mathematical solution to the forecast problem.

The computer is programmed to accept rainfall data, compute the runoff using antecedent conditions stored in its memory, convert this result into volume of flow in the rivers, and print out the volume and stage forecasts for large stretches of the river in a matter of minutes. Based on the known rainfall, the computer furnishes the stage and flow of the river for selected gaged points for six-hour intervals for a period of five days or more. The computed data is then reviewed by the hydrologists in the River Forecast Center for consistence and validity. The definitive river forecasts for the public are then issued.

Stored in the computer's "memory banks" are thousands of bits of information concerning the past history of streams in the Ohio River Valley and the relationships of various combinations of precipitation, melting snow, and soil moisture conditions. These relationships include the unit hydrograph ordinates, rating tables, reservoir capacities, routing coefficients, and other factors related to stream flow. Temperature, precipitation, and stream height observations taken at about 500 points are collected from River Districts by Weather Bureau facilities at Indianapolis and Evansville, Indiana; Nashville, Tennessee; Louisville, Kentucky; Cincinnati and Columbus, Ohio; and Huntington, West Virginia, and transmitted to Cincinnati.

Still more information is received via special communications links from the National Meteorological Center near Washington, D.C., where satellite pictures, radar observations, computer models of the atmosphere, and data from thousands of observation points around the world are combined into up-to-date weather forecasts.

With such a flood of data, it is easy to see why the Ohio River Forecast Center prizes its computer. William E. Hiatt, the Weather Bureau's Associate Director for Hydrology, called the Cincinnati switch from manual to computer techniques "the most important advance in service for the Ohio River Basin since the establishment of the Center in 1946."

So the Weather Bureau hydrologists at the Ohio River Forecast Center (who are even now eyeing the winter temperature and precipitation patterns which will affect their spring forecasts) have a new partner.

With a computer handling much of the hydrologic bookkeeping, the Center's staff has been freed to work on ever-increasing demands for timely and accurate river forecasts. The result is increased public service, with the capability of providing a broader spectrum of hydrologic forecasts for water quality control, management of water resources, and efficient, safe use of land and property adjacent to the rivers. All of these contribute directly to the economic growth and well-being of the nation. □

ESSA NEWS BEAT
U.S. DEPARTMENT OF COMMERCE ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION

Twenty-One ESSA Employees Receive Gold, Silver Medals For Outstanding Service To The Nation

The Department of Commerce conferred its highest honors on 21 ESSA employees at the 20th Annual Honor Awards Program.

The Gold Medal—the Department's highest award— was presented to Newton A. Lieurance, ESSA's director of Aviation Affairs; Captain Allen L. Powell, chief of the Coast Survey's Ship Construction Group; Richard C. Kirby, acting director of ERL's Institute for Telecommunication Sciences; Thomas J. Hickley, director of the Coast Survey's Engineering Development Laboratory; and Ernest G. Bice, meteorologist in charge of the Weather Bureau's Brownsville, Tex., station.

Mr. Lieurance was honored for his major contributions to the technology and administration of aviation weather services. Captain Powell was recognized for highly significant contributions and leadership in the development of new concepts in the superior design of oceanographic and hydrographic ships of exceptional advantage to the national oceanographic program. Mr. Kirby was cited for exceptional service in the area of telecommunications. Mr. Hickley won the award for outstanding contributions to the effectiveness of Coast and Geodetic Survey technical systems through personal creativity and the guidance of other employees, and Mr. Bice received the award for outstanding leadership of the Brownsville, Texas, station under the extreme emergency conditions caused by Hurricane Beulah in September 1967.

The following received Silver Medals in a ceremony at which Secretary of Commerce C. R. Smith gave the principal address:

Dr. James K. Angell, chief of ERL's Air Resources Trajectory Laboratory.

James R. Neilon, chief of NMC's Information Processing Branch.

Burton F. Loveless, chief of the Procurement and Supply Management Branch, ESSA.

Dr. Terrell L. Noffsinger, chief of the Agriculture and Forestry Section, Weather Bureau.

Charles G. Knudsen, deputy director of the Eastern Region, Weather Bureau.

David L. Coveney, principal assistant at the John F. Kennedy International Airport Weather Bureau office.

Dale R. Harris, meteorologist in charge at Pomona, Calif., Weather Bureau.

Allen D. Pearson, director of the National Severe Storms Forecast Center, Kansas City, Weather Bureau.

Charles M. Crouch, meteorologist in charge at Amarillo, Tex., Weather Bureau.

Albert Whimpey, chief of the

Continued next page

Seated left to right: Dale R. Harris, Terrell Noffsinger, Ernest Bice, Capt. Allen L. Powell, Dr. Robert M. White, ESSA Administrator; Newton A. Lieurance, Richard C. Kirby, Thomas J. Hickley. Standing, Charles M. Crouch, Charles G. Knudsen, Burton F. Loveless, Allen D. Pearson, Harry H. Glahn, Jack C. Pales, J. Glenn Dyer, Douglas Christensen, David L. Coveney, James R. Neilon, Banner I. Miller. Not pictured are James K. Angell, Ernest E. Thomas, and Albert Whimpey.

all in the family PERSONNEL NOTES

Dr. Donald P. Martineau of the Office of Naval Research has been appointed ESSA Deputy Assistant Administrator for Plans and Programs. For the past four years, Dr. Martineau has been associated with the Office of Naval Research oceanographic programs, with additional duties on the staff of the Oceanographer of the Navy. Dr. Martineau has a bachelor's degree in physics from Clark University, and received his master's and doctorate in oceanography from New York University.

Captain John O. Phillips, former commanding office of the USC&GSS OCEANOGRAPHER, has assumed the post of Coast Survey Associate Director for Geodesy and Photogrammetry. Capt. Phillips, a 25-year Coast Survey veteran, has seen extensive sea duty since he joined the agency in 1942, including assignments on 11 ESSA ships off the shores of the United States, the British West Indies, and the Philippines. A former commanding officer of the PATHFINDER, and chief of the Geodesy Division, Capt. Phillips was awarded the Department of Commerce Gold Medal in 1960.

Robert H. Reece has been named Special Assistant to the Weather Bureau's Director of Executive and Technical Services, replacing George C. Allen, who retired.

Capt. Gerald L. Short has been appointed to head the C&GS Mid-Continent Field Office, the Survey's largest field administrative unit. Capt. Short, a 28-year Coast Survey veteran, assumed the Kansas City post following the retirement of Capt. Edward B. Brown. His most recent positions have been as chief of the Operations Division at the Pacific Marine Center in Seattle, Wash., and as commanding officer of the USC&GSS PATHFINDER.

Lt. Richard J. DeRycke is now commanding officer of the USC&GSS FERREL. Lt. DeRycke has been with the Coast Survey since 1962, when he joined the Commissioned Corps following graduation from the State University of New York Maritime College.

Donald R. Baker, senior research hydrologist, now heads the newly established Satellite Hydrology Program of NESC's Environmental Sciences Group. Formerly with the Office of Hydrology's Research and Development Laboratory, Mr. Baker has done graduate work in physics and recently completed a master's degree program at Stanford University.

Lt. Cdr. Darrell W. Crawford has been named chief of the Operations Division at the C&GS Mid-Continent Field Office, Kansas City, Mo. Lt. Cdr. Crawford joined the Commissioned Corps in 1961 after graduation from Ohio State University, and has recently completed graduate studies in geodesy at Purdue University.

Cdr. Richard Houlder has become chief of the Coast Survey's Photogrammetry Division, replacing Capt. Sobieralski, who retired last November. Cdr. Houlder joined the Coast Survey in 1952. He is a graduate of Northeastern University, and has served as commanding officer of the USC&GS Ship LESTER JONES and aboard the BOWEN, PATHFINDER, and OCEANOGRAPHER.

Jack R. Nunan, WB Pacific Region headquarters marine observations specialist, recently became official in charge of the Truk WB airport station in the Trust Territory. Mr. Nunan, a former Navy weatherman, entered the Bureau in 1952.

Lt. Cdr. Robert Ganse is the new executive officer of the USC&GSS McARTHUR, based at Honolulu, Hawaii. Lt. Cdr. Ganse succeeded Lt. Cdr. Sigmund R. Petersen.

Marshall E. Soderberg, forecaster at the Weather Bureau's Grand Rapids, Mich., office for the past seven years, has been named head of the station. Employed by the Bureau for 27 years, Mr. Soderberg's first weather assignment was at Sioux City, Iowa.

A. L. Zimmerman has been appointed hydrologist in charge of the Salt Lake City River Forecast Center. Mr. Zimmerman was previously assigned as agricultural and marine services meteorologist in the Bureau's Western Region headquarters.

Francisco T. Perez, Jr., is now official in charge of the WB airport station at Yap, Caroline Islands, in the Pacific Trust Territory. Mr. Perez, who joined the Weather Bureau in 1957, is the first Guamanian to hold a Weather Bureau OIC position.

Howard E. Hybskmann has assumed the official in charge position at the Pocatello, Idaho, WB airport station. Mr. Hybskmann has been stationed at Pocatello for the past seven years as a forecaster-observer.

Ashby E. Craft has been selected official in charge of the Allentown, Pa., WB airport station. Mr. Craft joined the Bureau in 1945 after serving three years in the Army. Prior to his present appointment, he was technician in charge of the Nome, Alaska, WB airport station.

Lt. Joseph W. Dropp has been appointed Officer in Charge of the Officer Training Section at Norfolk, with responsibility for conducting and supervising the training classes for officers selected for the ESSA Commissioned Corps. Lt. Dropp joined ESSA in 1963, after graduating from the State University of New York Maritime College.

Leslie A. Warren, Jr., a 27-year Weather Bureau employee, is the new official in charge of the Salem, Oreg., WB airport station. Mr. Warren, who was most recently assigned at Billings, Mont., is a second-generation Bureau employee, whose father is a past Assistant Regional Director and meteorologist in charge at Albuquerque, New Mex.

(continued)
Archives Branch, Coast and Geodetic Survey.

Douglas H. Christensen, electronics technician at the Brownsville, Tex., Weather Bureau station.

J. Glenn Dyer, deputy chief of the Overseas Operations Division, Weather Bureau.

Dr. Harry R. Glahn, chief of the Objective Forecast Branch, Systems Development Office, Weather Bureau.

Ernest E. Thomas, research cartographer, Office of Hydrography and Oceanography Research Group, Coast and Geodetic Survey.

Jack C. Pales, supervisory physicist at ERL's Air Resources Laboratory, Las Vegas, Nev.

Dr. Banner I. Miller, Prediction Development Branch of ERL's National Hurricane Research Laboratory, Miami, Fla.

USC&GSS EXPLORER To Aid Disadvantaged Young Men

The USC&GS Ship EXPLORER has been transferred to the U.S. Office of Education for use as a floating classroom to train hard-core unemployed for jobs in oceanography.

The 219-foot, 1900-ton hydrographic survey vessel was decommissioned last January by the Coast and Geodetic Survey at its Atlantic Marine Center, Norfolk, Va.

The Office of Education said that Ogden Technological Laboratories, Inc., will establish the curriculum and provide instructors for the $155,000 program. The ship will be berthed at the former Naval Gun Factory on the Anacostia River.

The program is aimed at training 120 unemployed disadvantaged young men between the ages of 16 and 22 from the Washington area as oceanographic aids for positions in the government and private industry. This is believed to be the first attempt to train the hard-core unemployed in this field. The 15-month program provides for classes of 40 hours per week lasting eight to ten weeks.

The 28-year-old EXPLORER has given yeoman service to the Coast and Geodetic Survey in peace and war. She was built in Houghton, Wash. When launched in 1939, she was the largest and most modern of the Coast Survey's ships.

The EXPLORER was enroute to Johnston Island in the Pacific when Pearl Harbor was attacked. She had just finished a hydrographic and topographic survey of the Midway Islands. Unlike other Coast Survey vessels, the EXPLORER remained under Coast Survey jurisdiction while working with the Navy, which installed armaments aboard her for protection against enemy attack. The ship repelled an attack by Japanese planes near Attu while conducting surveys in the Aleutian Islands.

Thousands of Coast Survey officers and men served aboard the EXPLORER during her 28 years of service. About 60 of them, including five former captains of the ship, were present when she was decommissioned January 26.

Golden Smokey Award Given to Fire Weather Service Meteorologists

Golden Smokey Award of 1968 is accepted by Bill Krumm, Weather Bureau's western fire weather coordinator, from E. P. Cliff, Chief of the Forest Service (left) and Osal Capps, president of the National Association of State Foresters. It is the nation's top forest fire prevention award.

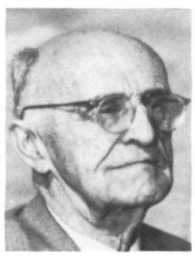
The Weather Bureau's Fire Weather Service has been given the Golden Smokey, the nation's highest forest fire prevention award.

Although the award has been made 20 times, the Weather Bureau is only the third Federal agency to receive it.

Sponsored by the Advertising Council Inc., the National Association of State Foresters, and the Department of Agriculture's Forest Service, the 1968 award recognizes outstanding service by Fire Weather Service meteorologists at more than 50 stations, according to Edward P. Cliff, Forest Service Chief.

The gilded statuette of Smokey Bear, symbol of forest fire prevention, was given for outstanding service in alerting the public to fire danger. Mr. Cliff said the result had been prevention of fires that would have destroyed thousands of acres of woodland.

WALTER LAMBERT, GEODETIC LEADER, DIES AT 89



Walter Davis Lambert, 89, of Washington, an international leader in geodetic science for more than half a century, died October 27, 1968.

He attended Harvard University, receiving a B.A. degree in 1900, and an M.A. degree in 1901. He was an instructor in mathematics at Purdue University in 1901 and 1902. Then he transferred to the University of Maine, where he was an instructor in mathematics and astronomy from 1902 to 1904. He was employed by the Coast and Geodetic Survey in 1904 as a mathematician. From 1907 to 1911, he was at the University of Pennsylvania where he was a Harrison Fellow and taught mathematics. He reentered the Coast and Geodetic Survey in 1911 and remained until 1949 when he retired, except for the period of 1917-1919, when he served as a First Lieutenant in the U.S. Army.

Following his retirement from the Coast and Geodetic Survey, Mr. Lambert served as a consultant to the Department of Geodetic Science at Ohio State University. He continued his research, giving guidance in the extension of geodetic knowledge to include those problems dealing with the external gravitational field of the earth, this being an essential part of missile and satellite orbital studies.

He was a leading authority in the study of earth tides. His interest in astronomy included the geodetic aspects of that science which concern the rotation of the earth, the motion of the pole, occulations and eclipses, and near-earth satellite orbits. Many of his publications relate to the gravitational field of the earth and the theoretical reduction of gravity measurements to a common reference system. The mathematics of the ellipsoid and the numerical analysis of geodetic adjustments are the subjects of much of his work. There is no single part of the science of geodesy to which he did not make some significant contribution.

Mr. Lambert was President of the Section of Geodesy of the American Geophysical Union from 1925 to 1932; President, Philosophical Society of Washington, 1930; and Vice President, Washington Academy of Sciences, 1930. He took a very active part in the affairs of the International Association of Geodesy, serving as the President from 1946 to 1951.

Many honors were bestowed upon Lambert. In 1949, he was elected to the National Academy of Sciences. In that same year, he received the Bowie Medal, the highest award of the American Geophysical Union. That year he also received the Exceptional Service Award of the Department of Commerce.

Those who knew him will never forget his willingness to help any of the younger colleagues who were interested in pursuing any scientific problem, whether it related to geodesy or some other branch of the physical sciences.

NMC Is Transmitting Computer-Produced Ocean Wave Forecasts

Computer-produced ocean wave forecasts are being transmitted from the National Meteorological Center for use in high seas weather broadcasts and to alert coastal forecasters to the possibility of dangerous breakers and surf. The new ocean wave forecasting program began October 1.

Forecasts for 24 and 48 hours include significant height of wind waves, swell, and combined, or overall, wave height conditions.

The program, modeled on a method used by the Navy Fleet Numerical Weather Center in Monterey, Calif., was developed in the Techniques Development Laboratory of the Weather Bureau's Systems Development Office.

Anatomy of Waves Studied by LASIL At Virginia Beach

The fascinating process changing the forms of ocean waves as they move shoreward, break, and surge has been studied by ERL's Land and Sea Interaction Laboratory.

The waves were filmed by a fixed camera on the Virginia Beach Fishing Pier. Every morning, Dr. Robert Byrne and his associates set up a vertical lattice of pipes perpendicular to the shore near the pier, providing a grid against which the waves could be measured. The study was generally conducted between low and high tides for about eight hours each day. At the completion of each day's work, the pipes were dismantled.

The study will permit LASIL to develop mathematical equations for predicting how high various waves will rise on a sloping beach or seawall.

The equations will aid engineers concerned with shore protection structures and will provide insight into the mechanisms by which sand is moved under different wave conditions.

ESSA Exhibits In Nine Boat Shows

The ESSA story will be presented to hundreds of thousands of recreational and commercial boatmen in 1969—thanks to boat show managers in nine cities who have donated exhibit space.

The exhibits, produced by ESSA's Graphics Branch, will describe the marine and weather services offered to boating interests by the Coast and Geodetic Survey and the Weather Bureau. These will include nautical charts, tide tables, current tables, tidal current charts, VHF-FM radio weather, and coastal display warning systems. Catalogs and descriptive literature will be available to showgoers.

Cities and dates for the shows are as follows:

San Francisco (Cow Palace), Jan. 10-19; New York City (Coliseum), Jan. 22-Feb. 2; Houston (Astrodome Complex), Jan. 23-28; Baltimore (Fifth Regiment Armory), Feb. 1-9; Boston (War Memorial Auditorium), Feb. 8-16; Washington, D.C. (D.C. Armory), Feb. 15-23; Miami (Miami Beach Convention Hall), Feb. 21-26; Chicago (International Amphitheater), Mar. 21-30; and New Orleans (Rivergate Auditorium), Mar. 29-Apr. 6.

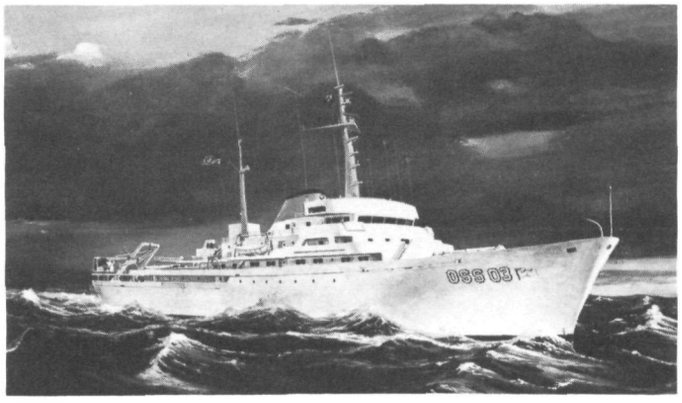
RESEARCHER CHRISTENED; RAINIER, FAIRWEATHER COMMISSIONED

October was a notable month for the Coast and Geodetic Survey, which saw one new vessel christened and two others commissioned.

Commerce Secretary C. R. Smith delivered the principal address as the USC&GSS RESEARCHER was christened on Oct. 5, in Toledo, Ohio. The ship, first of a new class of compact scientific survey vessels, was christened by Mrs. John C. Bull of Alexandria, Va., widow of Rear Admiral John C. Bull. Matron of honor was Mrs. John C. Bull, Jr., of Baltimore, Md.

The RESEARCHER, a 2800-ton air-conditioned vessel, will be 278 feet long and will have a normal operating range of 13,000 nautical miles. She will have 4000 square feet of enclosed laboratory space and accommodations for 13 officers, a crew of 54, and 18 men and women scientists.

The new ship will be a modified, slightly smaller version of the Coast Survey's largest vessels, the 303-foot, 3805-ton USC&GSS OCEANOGRAPHER and DISCOVERER. She will be just as sophisticated, however, equipped with the latest electronic equipment, but more economical to operate and still capable of conducting the complete range of marine research activities.



USC&GSS RESEARCHER. (Right) Secretary of Commerce C. R. Smith was principal speaker at christening of USC&GSS RESEARCHER. He is pictured with Mrs. John C. Bull (center), widow of Adm. Bull, who christened the ship, and Mrs. John C. Bull Jr., matron of honor.

Special features for oceanographic surveys will include a large underwater bow bulb to house deep-finding transducer arrays; a 20-ton oceanographic crane especially designed to launch and retrieve small research submersibles; a multi-station winch instrumentation system to provide accurate and instantaneous information throughout the ship on line-out, speed, and tension for any principal winch in operation; and the latest navigational and weather devices, including the capability to use satellite systems.

After completion, the RESEARCHER will engage in oceanographic surveys in the Atlantic Ocean and Gulf of Mexico. Her home port will be Miami, Fla., site of ESSA's Atlantic Oceanographic Laboratories, but she will also operate out of ESSA's Atlantic Marine Center in Norfolk, Va.

A double commissioning ceremony was held Oct. 2 in Seattle for the USC&GSS FAIRWEATHER and RAINIER, sister ships.

Principal speaker was Under Secretary of Commerce Joseph W. Bartlett. Among those speaking were Dr. John W. Townsend, Jr., ESSA Deputy Administrator; Rear Adm. Don A. Jones, Coast and Geodetic Survey director; and Rear Adm. Norman E. Taylor, director, Pacific Marine Center.

The ships were formally turned over to Cdr. John B. Watkins, Jr., commanding officer of the FAIRWEATHER, and Cdr. Robert E. Williams, who commands the RAINIER.

The four-million-dollar ships were constructed in Jacksonville, Fla., and will operate in Alaskan and west coast waters. The 231-foot, 1627-ton vessels are equipped with the latest electronic, depth-recording, and positioning equipment. The ships will generally chart U.S. coastal waters to help provide safe navigation for commercial shipping and recreational boating. They are also equipped for limited oceanographic surveying of U.S. continental shelf areas.

"Clouds", New ESSA Brochure, Is Published

A new ESSA pamphlet contains 26 full-color cloud photographs, and can be unfolded and posted as a guide for cloudwatchers in schools or at home.

Titled "Clouds," the publication describes the various cloud types and the altitudes where they form, and includes the symbols used on ESSA Weather Bureau maps to indicate cloud types.

"Meteorologists are . . . professional watchers of clouds, reading present and future weather partly from the development of different cloud types," the pamphlet says, and illustrates the professional meteorologist's view of clouds as seen by satellites and radar.

"At ESSA," the publication concludes, "whether the vantage point is a satellite or radar or the trained eye of a meteorologist, the emphasis is on using present knowledge of clouds to provide vital weather services; and on developing new knowledge of clouds as part of an effort to improve man's understanding of the air ocean in which he lives."

"Clouds" is for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, at 25 cents per copy.

Submarine Canyons Found In Pacific

The USC&GSS MCARTHUR, commanded by Cdr. Ronald L. Newsom, has reported the existence of four submarine canyons beneath the sea and hundreds of caves along the shore following a recent survey of the sea floor off the north coast of Molokai Island in Hawaii. The largest cave extended 200 feet inside the island and was deep enough for the ship's 25-foot launch to navigate. The MCARTHUR also discovered a coral-encrusted anchor believed to have been from the wreck of an old sailing vessel.

ERL's Weickmann Studies Chilean Drought Problem

Dr. Helmut K. Weickmann, director of ERL's Atmospheric Physics and Chemistry Laboratory, has returned from a mission designed to help the Chilean government alleviate its acute drought problem.

The government of Chile requested the Agency for International Development to supply a scientific advisor for a situation which seriously affects many areas of its economy. Dr. Weickmann was selected for the task.

Dr. Weickmann reports that there is great enthusiasm in Chile for research-oriented rainmaking studies and, in fact, much work is already underway. Dr. Weickmann studied three areas in northern Chile—Arica, Antofagasta, and the River Loa watershed—and several areas in central Chile.

In Arica, a rainmaking project called META is underway sponsored by the Chilean government. In Antofagasta, Project Cammanchaca is designed to study the possibility of collecting fog water. In various neighboring mountain sites, fine nylon screens are used to collect these fog droplets and direct them into a collection barrel. One square meter of net collects about five liters of fog water each day. Since the mountains around this port city are in fog some 200 days a year, the collection of fog water could be a significant addition to the drinking water supply as there is neither rain nor subterranean water.

The River Loa watershed is the only major stream in northern Chile. Since the clouds in spring are usually convective types whose rain could be increased artificially, Dr. Weickmann estimated that natural rainfall could be increased by as much as 20 percent. The drought in central Chile is another problem, since the precipitation is essentially non-convective.

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