The Geophysical Institute
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Redoubt eruptions spark volcano watch

Alaskans called it Mt. Grinch—the volcano that stole Christmas. Researchers with the Alaska Volcano Observatory called it a trial by fire. By any name, the continuing eruptions of Redoubt Volcano caught the world's attention and affected Alaska from Ketchikan to Barrow.

As this issue of the *Quarterly* goes to press, staff at the Geophysical Institute seismology laboratory continue their 24-hour watch on the simmering mountain so that health and hazard bulletins can be issued through the Alaska Volcano Observatory (AVO), in which the institute participates with the U.S. Geological Survey and the Alaska Division of Geological and Geophysical Surveys.

Early on the afternoon of Wednesday, December 13, AVO scientists were able to warn civil and military safety officials of the first in Redoubt's new series of eruptions. At 10:15 a.m. on December 14, the volcano shot a moderately large plume of ash and steam more than ten kilometers (over six miles) into the atmosphere. Like a pressure cooker with a badly set relief valve, Redoubt has been pulsing out eruptions irregularly ever since. The largest to date occurred on January 2, when a large ash plume rose to more than 12 kilometers altitude (over 40,000 feet) within 30 minutes.

The organization of AVO in 1988 has enabled scientists to monitor continuously some of Alaska's most dangerous active volcanoes. Among them is 10,197-foot Redoubt Volcano, which stands close to the population centers of Southcentral and menaces the Drift River oil terminal. Redoubt has five seismic stations, one near the top and four on the flanks of the mountain. Seismic activity detected by the stations is relayed via the state microwave system to computers at the Geophysical Institute. The monitoring effort is funded in part by the $500,000 federal grant that established the AVO through a bill sponsored by U.S. Senator Ted Stevens.

DENNIS TRABANT

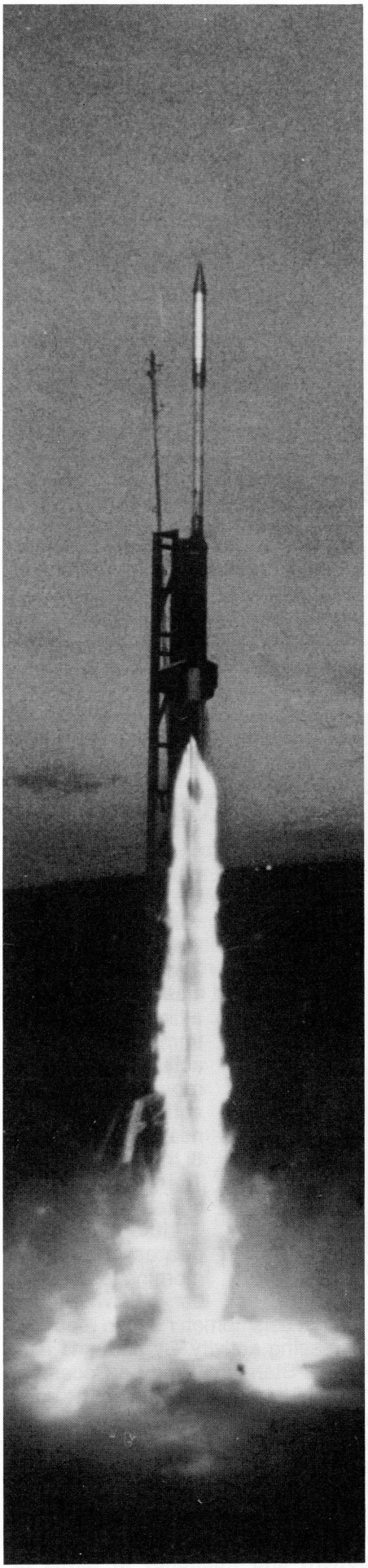


Eruptions at Redoubt Volcano have engaged the seismology and volcanology staff since mid-December.

The pre-eruption increase in seismic activity at Redoubt was first noticed on December 8, but was barely above background level. At the same time, an apparent steam plume on the flank of the volcano was visible from Anchorage. The steam plume was not considered a likely precursor of immediate eruptive activity, because the mountain had an active steam vent near the summit until the last few years. The seismicity required watching.

Little change appeared until the morning of December 11, when the summit seismometer began reporting increasing activity. By about 11 a.m. Alaska Standard Time on December 13, flank stations as well as the summit one indicated sharply increased activity—1 to 2 microearthquakes every minute. These events were of Richter magnitudes near 1, too small to be felt by humans. Within hours, AVO scientists had assessed tremor pattern and frequency in terms of

continued on 15



NEAL BROWN

Poker Flat upgrade will expand research horizons

Twenty years after the first sounding rocket was launched at Poker Flat Research Range, $10.8 million has been appropriated for the first phase of a $30 million upgrade of the facility. The upgrade proposal, developed by the institute, was supported by a national defense bill signed in November.

"We plan to build the best upper atmospheric research facility in the world," said GI Director Syun-Ichi Akasofu. "The institute staff worked hard on this proposal, and we're grateful for the support it has received from the President, U.S. Congress, and in particular, Alaska's Senator Stevens."

Poker Flat is operated by the Geophysical Institute at 30-Mile Steese Highway. Its current $1.5 million operating budget is funded by the National Aeronautics and Space Administration.

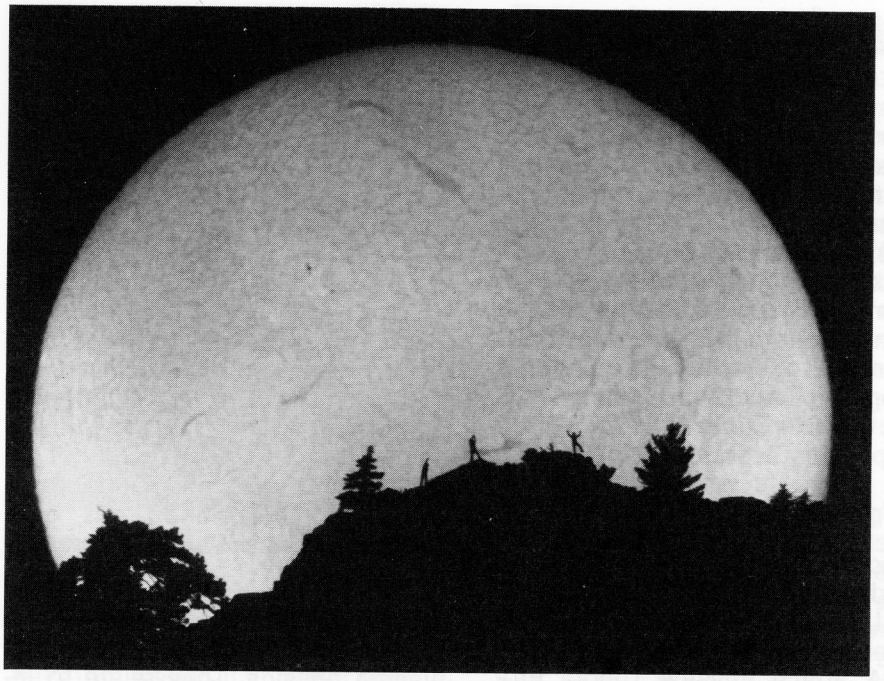
"Experiments using sounding rockets have produced significant knowledge about the upper atmosphere," said Akasofu. "And institute researchers, active in this work since the 1960s, have made substantial contributions to these advances."

Poker Flat is the largest land-based research range in the world, the only high-latitude range on U.S. soil, and the only university-operated research range. Since it was established in 1969, more than 220 large research rockets have been launched there, most of them carrying experiments to study the atmosphere at altitudes from 30 to 1500 kilometers. The range is used by institute scientists, and under contractual agreements by other research institutions and federal agencies.

"Sounding rocket programs will remain an important component of experimental research because they are a cost-effective means of supporting a variety of scientific needs," said Charles Deehr, Poker Flat's scientific director. Deehr, who has long been engaged in polar upper-atmospheric research at UAF, was appointed to oversee the range in May 1989.

Poker Flat now incorporates an optical observatory and command center, telemetry receiving stations and ground-based diagnostics needed for launch decisions, and facilities for rocket assembly and launch. The upgrade calls for renovated or rebuilt launch pads, payload assembly buildings, and control facilities; integration of a command center in a new optical observatory; and integration of an air sampling station with data-handling capabilities. New or improved observation networks will include one that will give rural Alaskan communities an opportunity to participate in near-earth space research. Deehr said first-phase funding for the upgrade will provide for building design, scientific program planning, and initial road and foundation construction.

—Doreen Fitzgerald



BIG BEAR OBSERVATORY

Sun meets Earth

Center of our planetary system, object of worship and study, the constant sun is in fact Earth's constantly changing source of power. Understanding this flow of energy through interplanetary space and into the near-earth environment is one of the basic challenges to Geophysical Institute researchers in the space physics and aeronomy group.

Electric discharges in the solar atmosphere, visible as solar flares, testify to the variability of our cosmic energy source, as do sunspots, and nearer home, the auroral activity we readily observe from the ground in the polar regions.

More than 40 years ago, auroral observations began at the institute, and the study of sun-earth interactions continues to be an important subject of both experimental and theoretical work.

Today this research is focused on the physical processes that operate to couple regions between the sun and earth and channel energy and momentum into the earth environment. The research effort emphasizes the coupling among regions of space, beginning with the sun and ending with the dense atmosphere.

Sunspots and Solar Flares

The sun is a globe of gas held together by its own gravity. Deep within its interior, thermonuclear reactions convert hydrogen into helium, releasing energy which streams out into space. In 1989, attention was focused on this activity by several giant solar flares. These large explosions are associated with sunspots and occur most often during the high point of a sunspot cycle, which repeats itself approximately every eleven years. The sun is now in the maximum phase of solar sunspot cycle 22, and the giant flares of last March, August, and October indicate it may be the highest cycle on record. Some Alaskans remember the previous high, cycle 19, that in 1958 produced a great red aurora seen as far south as Arizona.

The present heightened activity is expected to continue this year, generating large geomagnetic storms that can produce great auroral displays and disturb the propagation of radio waves. These effects are measured by satellites and ground instruments as increases in electromagnetic radiation (such as visible light, radio waves, and x-rays) and in charged particles. The radiation travels from the sun to earth in 8.3 minutes; the charged particles arrive after a period of hours or days, depending on their energies.

At Fairbanks, measurements of these effects are obtained from instruments operated by the institute, from observations at the U.S. Geological Survey College Magnetic Observatory, and the Solar and Geophysical Activity System of the U.S. Air Force and the National Oceanic and Atmospheric Administration (NOAA).

Sun Watching

Real-time images of the sun and other information related to sun-earth interactions are now available at the institute through a computerized system being developed this year. The Space Physics Analysis Center is equipped with computers and software that deliver information and images of activity on the sun and other geophysical phenomena. It can display the latest NOAA solar-geophysical data file, which includes images and data on sunspots, a solar flare listing, and solar wind information. The system can be used to call up information on past solar activity and correlate it with data from other observations.

As the center develops, it will include computer hardware that can receive and store several billion bytes of data from various satellite, rocket, and ground-based instruments. Advanced computers, display hardware, and software packages will help scientists display and analyze this information.

Dan Weimer, research associate professor at GI, oversees the new facility. His work involves satellite measurements of electric fields above the ionosphere and in the magnetosphere. Senior programmer Jim Baldridge and others are involved with the technical aspects of installation and operation of equipment.

Understanding solar-terrestrial

phenomena depends on our knowledge of the behavior of the ionized gas, or plasma, that is carried through interplanetary space by the solar wind. Plasmas are studied outside the laboratory using rocket experiments in the upper atmosphere; in the laboratory, they can be created in a vacuum chamber. A third and more recent method of studying plasmas is to simulate them using a high-speed computer. Simulations require extensive coding, or programming. Daniel Swift, professor of physics at the institute has been instrumental in developing a number of important computer codes. They have been used extensively by Geophysical Institute scientists and graduate students, including Swift himself, to study the auroral acceleration process, the dynamics of the magnetosphere, the structure of the magnetopause and the shock-waves in space plasma.

A New Theoretical Model

The cumulative effect of continuing observations and advances in experimental techniques continually changes the information base from which theory is developed and refined. Theoretical work on solar-terrestrial interactions, particularly auroral processes, is an important area of institute research.

In 1989, space physicist Joseph Kan, working with his graduate students at the institute, developed a theoretical model that can reproduce global auroral activity.

"Starting from basic laws of physics, we were able to construct a quantitative model that agrees with ground and satellite observations of auroral activity," Kan said. "The result is a greater understanding of interactions between the magnetosphere and ionosphere and why and how auroral displays occur."

Auroral activity is an optical manifestation of interactions between the solar wind (the ionized gas ejected from the sun) and Earth's magnetosphere (the region in space permeated by the earth's magnetic field). Solar wind-magnetosphere interactions also produce electric and magnetic disturbances in space. Collectively, these disturbances are called the magnetospheric substorm. The institute has played a leading role in substorm research since the concept was first established in 1961 by Syun-Ichi Akasofu, physics professor and institute director.

Kan, a professor of physics, joined the institute in 1972. He has been involved in theoretical studies of auroral arc formation, magnetopause and boundary layer structures, collisionless shock waves in space, and magnetospheric substorms. His theoretical work has been funded by the National Science Foundation, the National Aeronautics and Space Administration (NASA), and the Air Force Geophysics Laboratory.

New Research Funded

Theoretical work at the institute will be advanced by a $510,000 research grant awarded in December 1989 to professor Lou-Chuang Lee by the NASA Space Physics Theory Program. The money will fund a three-year study. The Geophysical Institute was one of seventeen institutions nationwide to be selected for one of the grants, which aim to advance basic knowledge in the areas of planetary physics, solar-terrestrial interactions, and interaction between the earth's magnetosphere and ionosphere.

Lee, a professor of physics who has been at the institute since 1978, is principal investigator for the project. Co-investigators are physics professors Joseph Kan and Daniel Swift, and Joseph Hawkins, assistant professor of electrical engineering.

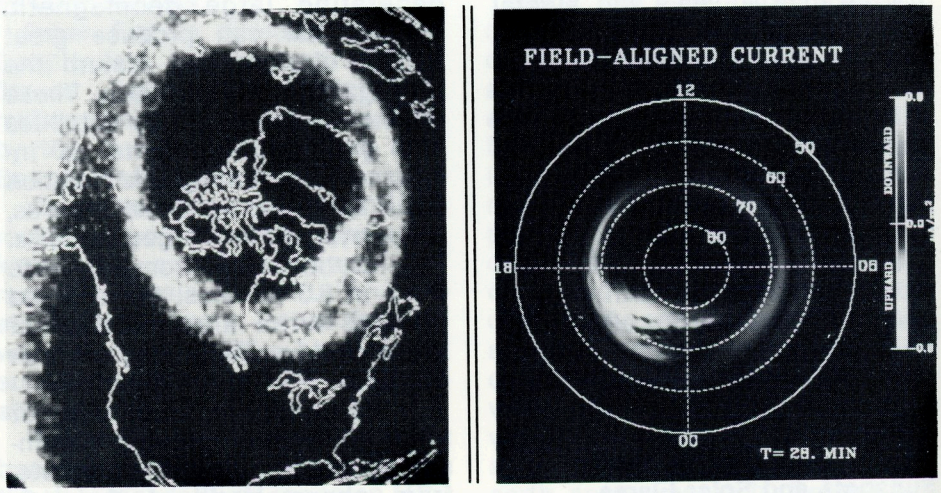


Lou-Chuang Lee, professor of physics.

The research will address several fundamental problems in space plasma physics. They relate to interactions between the solar wind and Earth's magnetosphere, including the transfer of mass, momentum, and energy from the solar wind.

Three major projects have been identified for the study of these transfer processes: research on magnetic reconnection at the dayside magnetopause; study of impulsive plasma penetration processes at the dayside magnetopause; and investigation of the dynamo processes in the nightside magnetopause-mantle region.

"We believe that a quantitative understanding of these processes is essential to the overall goal of the



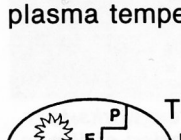
In the satellite image (left) of the auroral oval above the polar atmosphere, midnight is at lower right, where brightness indicates an auroral substorm in progress. The computer image at right shows field-aligned current density calculated from the theoretical model, with midnight at 00. Auroral brightness is approximately proportional to upward field-aligned current intensity. The bright region corresponds to the aurora during a substorm.

NASA Space Physics Division," said Lee. "The results are expected to provide a deeper understanding of the occurrence of geomagnetic substorms, and the subsequent formation of auroral arcs."

Lee received his Ph.D. in theoretical physics from the California Institute of Technology in 1975. His theories on auroral kilometric radiation and magnetic flux transfer events are well recognized. He has been involved in theoretical and simulation studies of structure, stability, and magnetic flux transfer at the magnetospheric boundaries, magnetic reconnection processes, and the generation of auroral kilometric radiation.

International Cooperation

Institute research in space physics and aeronomy is integrated with national and international programs that are designed to create a comprehensive approach to the study of coupled systems in the magnetosphere and ionosphere. The work of institute scientists involves measurements made at Svalbard, Norway; Sondrestrom, Greenland; Poker Flat, Alaska; and South Pole, Antarctica. These observations include radar and optical measurements of atmospheric wind, temperature, and electronic excitation, as well as ionospheric density, drift and plasma temperature.



The institute is also a major participant in a new five-year effort that is the largest-ever organized study of the sun-earth environment. The international Solar-Terrestrial Energy Program (STEP) will include internationally coordinated ground-based, balloon, rocket, and satellite measurements; specialized data and information systems; and theoretical studies. The program calls for 16 dedicated spacecraft missions, a series of sounding rocket experiments, and a worldwide array of ground-based observatories.

STEP is coordinated by the International Scientific Committee on Solar Terrestrial Physics of the International Council of Scientific Unions. Professor Juan Roederer of the institute is president of the committee.

—Doreen Fitzgerald

Rocket experiment tests theory

Carried out 250 miles above the earth, a 1989 experiment provided support for an important theory on planet formation and the diffuse plasma through which our planet travels. Eugene Wescott and Hans Stenbaek-Nielsen conducted the research with scientists from other institutions as part of their work on the behavior of space plasma as it interacts with the earth's magnetic field. Both are professors of geophysics at the institute.

"Unlike ordinary states of matter—the solids, liquids, and gases that make up our world—plasmas are composed of electrically charged particles," said Wescott during an interview at the institute. "Governing the motion of these ionized particles are such forces as pressure, magnetic fields, and electric fields."

One of the elementary forces of nature, magnetic fields are found in the vicinity of magnetic bodies, such as the earth, and are characterized by invisible magnetic field lines. The region dominated by a planet's magnetic field is called the magnetosphere. Earth's magnetosphere begins at about 100 kilometers altitude and extends outward to the distant beginning of interplanetary space.

"The plasma encountered by the earth comes from the sun, carried by the solar wind," Wescott said. "The solar wind beats against the earth's magnetic field, compressing it on the sunward side and drawing it out into a very long magnetotail on the downwind side."

As the solar plasma interacts with the magnetosphere, some of the charged particles enter it, forming a reservoir of energy and particles. Auroral displays, magnetic storms, and interruptions to radio communications are evidence of encounters between this reservoir and the upper atmosphere.

"Because magnetic fields and diffuse plasmas are invisible to the eye, evidence of Earth's magnetic field lines can normally be seen only when auroral particles illuminate them," said Wescott. "This occurs in the ionosphere at an altitude of about 80 to 200 kilometers. However, rocket experiments using barium fluorescent plasma releases enable us to *paint* magnetic field lines in space and observe the plasma motion. This is roughly analogous to sprinkling iron filings on a piece of paper over a magnet to make the orientation of the magnetic field visible."

Thirty years ago Nobel Prize winner Hannes Alfvén theorized that a neutral gas streaming across a magnetic field through a weak plasma could spontaneously become ionized.

"The hypothesis was important to planetary formation theory because it explained how material falling gravitationally toward the newly formed sun could lose kinetic energy, be trapped in orbits about the sun, and there collect into planets and moons. It also explained the different chemical makeup of the inner and outer planets," Wescott said.

The effect Alfvén proposed was demonstrated in laboratory experiments using a plasma beam injected into a neutral gas, in small confined volumes. But a real test of the theory required experiments in free space. There the energy (waves and heated particles) would be free to escape, more closely matching conditions of the primordial solar gas cloud.

Last spring the effect was created outside the laboratory during an experiment launched at Wallops Island, Virginia. Wescott and Stenbaek-Nielsen provided the high-explosive shaped charges to produce the neutral barium gas and made the definitive optical observations of the ions created. They worked with colleagues from the universities of Alabama and Utah, Cornell University, the Goddard Space Flight Center of the National Aeronautics and Space Administration (NASA), and organizations in Germany, Denmark, and Finland.

Stenbaek-Nielsen has made a major contribution to understanding the results of this work by developing computer models that recreate optical observations made during this and previous experiments.

The research is part of a major space plasma program sponsored by NASA. In 1990, NASA's Combined Release and Radiation Effects Satellite will carry a number of chemical-release cannisters into orbit. With major roles in this program, Wescott and Stenbaek-Nielsen will use barium and other chemicals to study the critical velocity effect and plasma electrodynamics.

—Doreen Fitzgerald

Glaciologists set hot-water drilling record

Getting to the bottom of things is no simple matter, particularly when the matter is a mass of glacial ice. During two summers of field work, institute glaciologists have attacked the problem with hot water, a drilling technique they used to reach the bottom of Jakobshavns Glacier on Greenland's west coast. The mile-deep borehole drilled in August 1989 was the deepest ever achieved with the hot-water drilling technique.

The work is part of a three-year project to sample conditions within and beneath the ice of the world's fastest-moving glacier. It relates to larger questions about glacier movement and glacier-climate interactions.

"Because so many glaciers feed into the oceans, they're a factor in weather, sea level, and transportation," said Keith Echelmeyer, co-investigator for the drilling project and assistant professor at the institute. "Central to our present research is the important question of how ice streams can move at a rapid rate when they're embedded in relatively sluggish ice sheets."

Jakobshavns ice travels from Greenland's interior ice sheet through a drainage basin that converges into a well-defined ice stream. Traveling 75 feet a day, the ice stream flows 50 miles to terminate at the sea in a floating calving front. There, every day, it dumps roughly 50 million tons of ice into the water.

Understanding the motion of this ice stream should help scientists to predict the likely response of ice sheets to continued global warming. Worldwide, ice sheets up to two and one-half miles thick cover 11 percent of the earth's surface. If the global warming trend continues, it could cause the rapid disintegration of ice sheets. In turn, this would significantly raise the level of the world's oceans and, over a few centuries or so, flood the world's coastal areas.

"Major ice streams and outlet glaciers provide the main drainage routes by which an ice sheet would rapidly disintegrate," Echelmeyer said. "We have to understand ice streams before we can understand the history of an ice sheet and its effects on global sea level and climatic fluctuations."

Geophysical Institute glaciologist Will Harrison is working with Echelmeyer on the Jakobshavns project, a joint effort with Almut Iken of the Federal Institute of Technology in Zurich, Switzerland. Both Echelmeyer and Harrison are also involved in the Siple Coast Project, a cooperative study of Antarctica's Ice Stream B (*GI Quarterly*, Spring 1989; *Discover* magazine, September 1989).

Echelmeyer said they expect Jakobshavns Glacier to provide key information on factors that contribute to ice stream movement, particularly fast surface speeds. Throughout the depth of the ice stream, the scientists are observing internal shear deformation and temperature of the ice. At glacier's base, they're interested in water pressure, sliding velocity, and the deformation and composition of subglacial till (a mixture of earth, gravel, and boulders).

The glacier's size, location, and high speed make it an ideal laboratory, but logistics and mechanical considerations make the research a major undertaking. The field work directly involved six to eight people during each of the past two summers. Logistical support was provided by the Polar Ice Coring Office of the National Science Foundation, which is located at the University of Alaska Fairbanks.

To reach Jakobshavns Glacier from Alaska, the research team flew to New Jersey by commercial carrier, then by military transport to the U.S. Air Force base at Sondrestrom, Greenland. From there, a commercial flight took them to the fishing village of Jakobshavns. On the final leg, they flew by Greenland Air helicopter to the ice camp site. A helicopter was also needed to change location on the glacier, because it is very irregular and deeply crevassed. During the research, holes were drilled at three different sites across the ice stream.

"In 1988 we imported about three tons of equipment and supplies, four or five helicopter loads. This summer, fewer loads were required, because we cached some of that gear at the ice camp," Echelmeyer said. In 1989 he and Harrison were accompanied by three field assistants: Ted Clarke, Carol Petersen, and Paul Will, all of Fairbanks.



KEITH ECHELMEYER

Removing a mile-long hose from the ice takes all hands. Here the crew works to bring it up and place instruments in the hole before it refreezes, a period of five to ten hours.

The supplies included diesel fuel needed to heat water for drilling. Similar to a car wash, the technique requires hoses and hot water under pressure. The similarity ends, though, when one contemplates drilling through a mile of ice with a flexible hose. Not all glaciers are equally cold—and at -10°F, Jakobshavns and other Greenland and Antarctic glaciers are more difficult to drill than those in Alaska. Hot-water drilling on cold glaciers has been at-

tempted only for the past five years.

Working continuously for 25 to 48 hours, the crew creates an 8-inch-wide hole with the hot water drill. Water heated to near boiling is injected into the hole. That water and water from melting ice is forced back up the hole around the sides of the narrower hose. The hose, continuously warmed by hot water, helps keep the return water from freezing.

The flexible hose is transported in 350-foot lengths, so as the hole deepens, sections have to be added. Adding hose means turning off the hot water, the only heat preventing the hole from freezing back up. As the team works to add a section before freezing occurs, the scene resembles a pit stop in a high-speed car race.

After the hole is drilled, the hose must be removed as quickly as possible so instruments can be positioned in the hole before it refreezes, a period of five to ten hours.

"Last year we lost a race, when the tip of a thousand-meter hose froze in," Echelmeyer said.

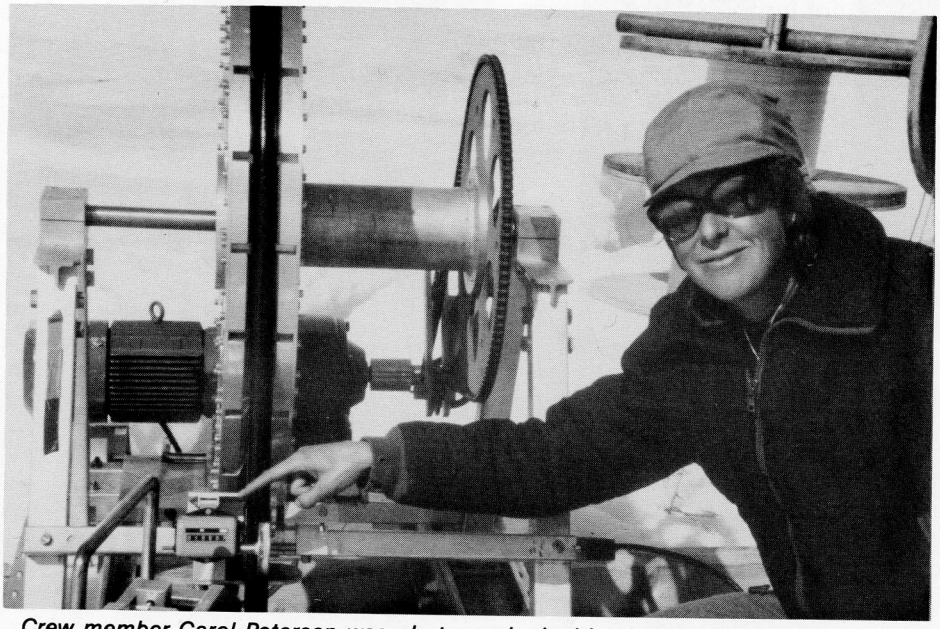
Water under a glacier is created by heat from the earth and heat from friction of the glacier. It may escape or be trapped under the glacier and subjected to pressure from weight of the ice.

"In Antarctica, where the terrain is more nearly level than downhill, this water is trapped and the pressure is nearly great enough to float the ice streams. This is not the case in Greenland."

To sample the layer of earth under the glacier, a pipe is driven in, then withdrawn. At depths of nearly a mile, it isn't easy to determine when the hose tip has hit bottom.

"The more times we can sample under the glacier, the better, but knowing you've reached bottom with the hose is like trying to feel something at the end of a mile-long rubber band."

Before the hole is drilled, radar and seismic methods can be used to determine ice depth. The Jakobshavns site was thought to be one mile deep after a radar survey, but later seismic work showed the bottom to be 1.5 miles from the surface at the glacier's center. During ten weeks of drilling in 1989, the team dug ten holes and hit bottom twice.



TED CLARKE

Crew member Carol Petersen was photographed with winch and meter when the drilling record was set.

Satellites are used to determine ice stream speed. Because satellite orbits are precisely known, a receiver tracking them from the ice stream allows the receiver's position to be known within one or two feet.

"This method has only been available for four years. It is so accurate we can know, if we want to, how fast the ice travels each day."

With the drilling completed, Echelmeyer and others will return next summer to retrieve instruments left on the glacier to monitor temperature and movement in the frozen boreholes.

The three-year study is funded by a $457,000 grant from the National Science Foundation Division of Polar Programs.

—Doreen Fitzgerald

Technology transfer agreement signed for software

A technology exchange agreement involving sophisticated imaging software has been signed by the Geophysical Institute and International Imaging Systems. The System 600 software and documentation will be used with computer imaging systems at the Alaska SAR Facility, the satellite receiving and image analysis center at the institute.

"Technology transfer through cooperative arrangements between the university and private sector has increasing importance as we seek an expanded role in technological and economic innovation and development," said Syun-Ichi Akasofu, institute director. "We expect the Alaska SAR Facility to be on the cutting edge of imaging technology and appreciate this opportunity to further our goals."

System 600 is comprehensive image analysis software that runs on both the Sun Microsystem and Digital Equipment Corporation hardware. The software and support is valued at approximately $50,000. The agreement with the California-based company was negotiated by Richard Guritz, a computer programmer and analyst at the institute.

"This is the first technology transfer agreement between a private corporation and the institute," Guritz said. "As such, it's an important step in developing our technology transfer capability, particularly in the area of intelligent properties."

The technology exchange supports software development activities for the Interactive Image Analysis System, a subsystem of the SAR facility, which is funded by the National Aeronautics and Space Administration (NASA). In return for software and support from International Imaging Systems, the institute will make available to the company results of its work to interface a portion of System 600 with Land Analysis System software. The company has been involved in developing and manufacturing image processing hardware, software, and integrated systems since 1969.

—Doreen Fitzgerald



1963-1973: Decade of Expansion

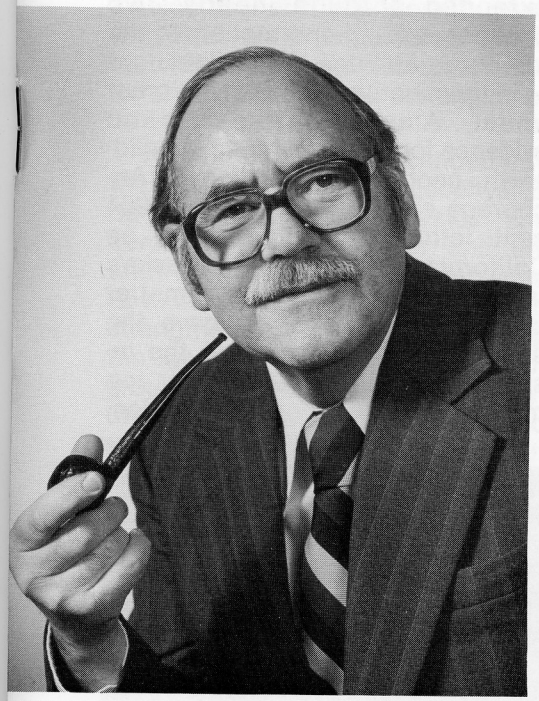
The first Annual Report issued by the Geophysical Institute covered research done in 1962-63. Its two-paragraph foreword explains the report's purpose, then concludes: "The period reviewed here is one of substantial change—the retirement of the former Director, appointment of a new administrative staff, and the decision to introduce new research programs. The latter, mostly in the field of solid-earth geophysics, will mark a departure from the Institute's traditional preoccupation with auroral-zone phenomena in the interests of a broader spectrum of geophysics."

That decision, like the initials signing the foreword, belonged to new director Keith B. Mather. With Chris Elvey, Mather had co-chaired the Long-Range Planning Committee responsible for the new directions. The foreword was not the first quiet signal of change bearing the initials KBM, and it was far from the last.

Like the institute's first director, Stuart Seaton, Mather had set out on the path leading to Alaska from beginnings in electrical engineering. His bachelor of science degree (in engineering) came from the University of Adelaide in Australia, but his subsequent career carried him over much of the globe—Britain, Ceylon, Antarctica, as well as Australia and the United States. He entered the field of geophysics via optics and

nuclear physics. In 1961, Mather arrived at the Geophysical Institute as a Fulbright visiting professor from Melbourne University (Australia); the visit ended up as a 16-year stay.

It was a time of transition at the institute. Director Chris Elvey had become the vice president for research and advanced study of the University of Alaska, leaving much of the day-to-day operation of the institute in the hands of Victor Hessler, acting associate director. Hessler saw the institute chiefly as a kind of observatory, a place superbly located to gather data that theoreticians elsewhere could analyze and use to construct geophysical models. It was not a picture wholly in accord with the views of many institute faculty members. When Elvey let them know he intended to retire before long, they saw to it that Mather, with his broad experience and background in education and research, became chairman of the committee searching for a new director.



GEOPHYSICAL INSTITUTE

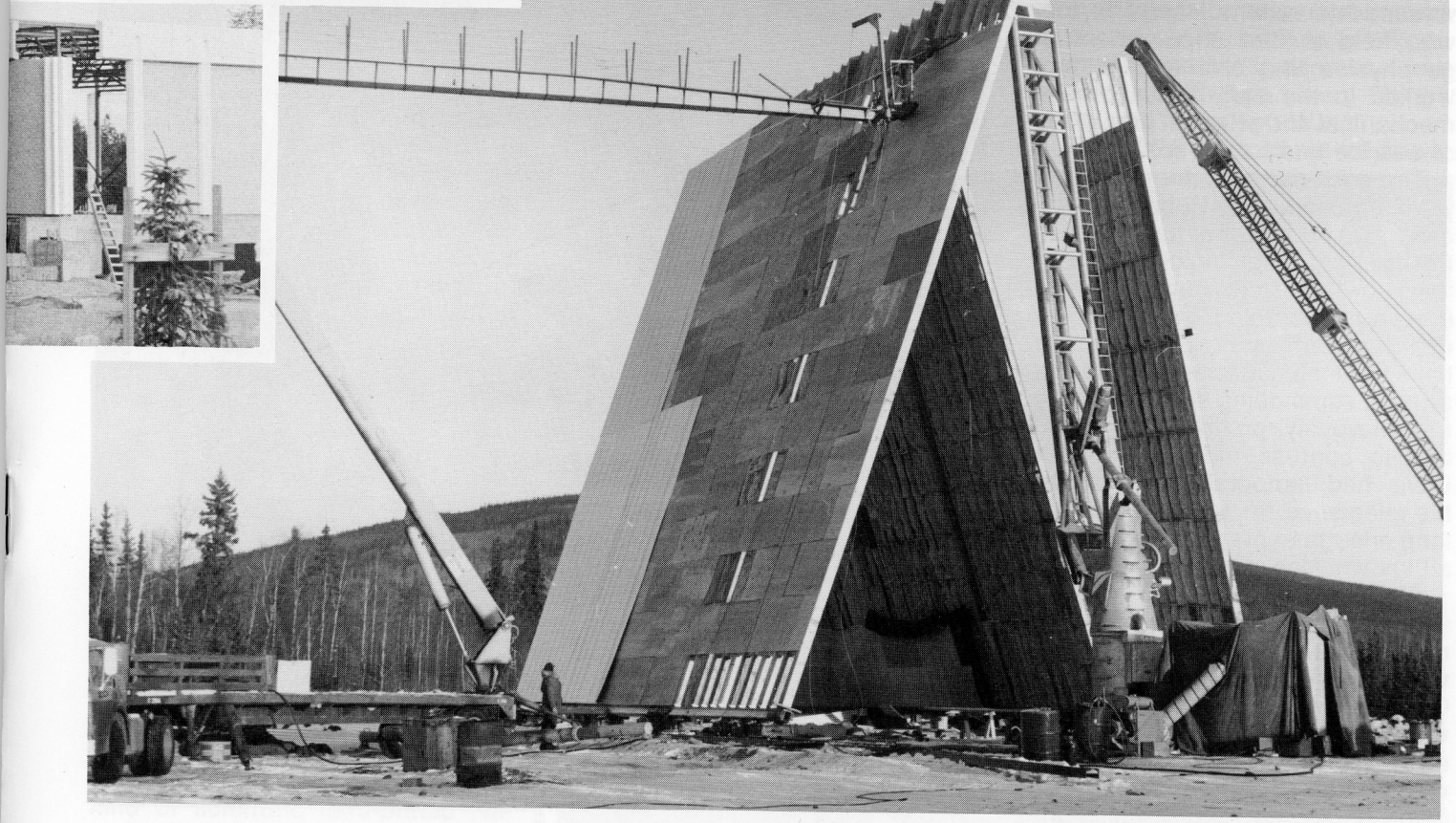
The search was difficult. The committee members set high standards to match their hopes, but found that good people were not queueing up to compete for the job. Some had good positions where they were; sometimes their spouses dreaded moving to what they feared was the frigid end of the earth. Others looked very good on paper, but not so suitable in person.

Throughout the challenging process, the committee members had a chance to watch Keith Mather in action. They were impressed—enough so to decide he should become the next director. He was named assistant director in January 1963; in July, he took over.

Broadening of the institute's field of research actually had begun before Mather entered the scene (though the staff list in the first annual report showed few people whose major interests were not linked to the aurora). In some ways, the change seemed inevitable; glaciology, high-latitude atmospheric studies, and solid-earth geophysics—propelled by the same opportunities of location—were logical additions to the scientific suite based in Alaska.

Glaciologists study not just glaciers but all forms of ice. Carl

GEOPHYSICAL INSTITUTE



As institute director, Dr. Keith Mather (center) presided over the expansion of institute research and construction of the C.T. Elvey Building (left). One of the first projects at the new Poker Flat Research Range was the pre-launch facility shown here under construction.



SAM SCOTT

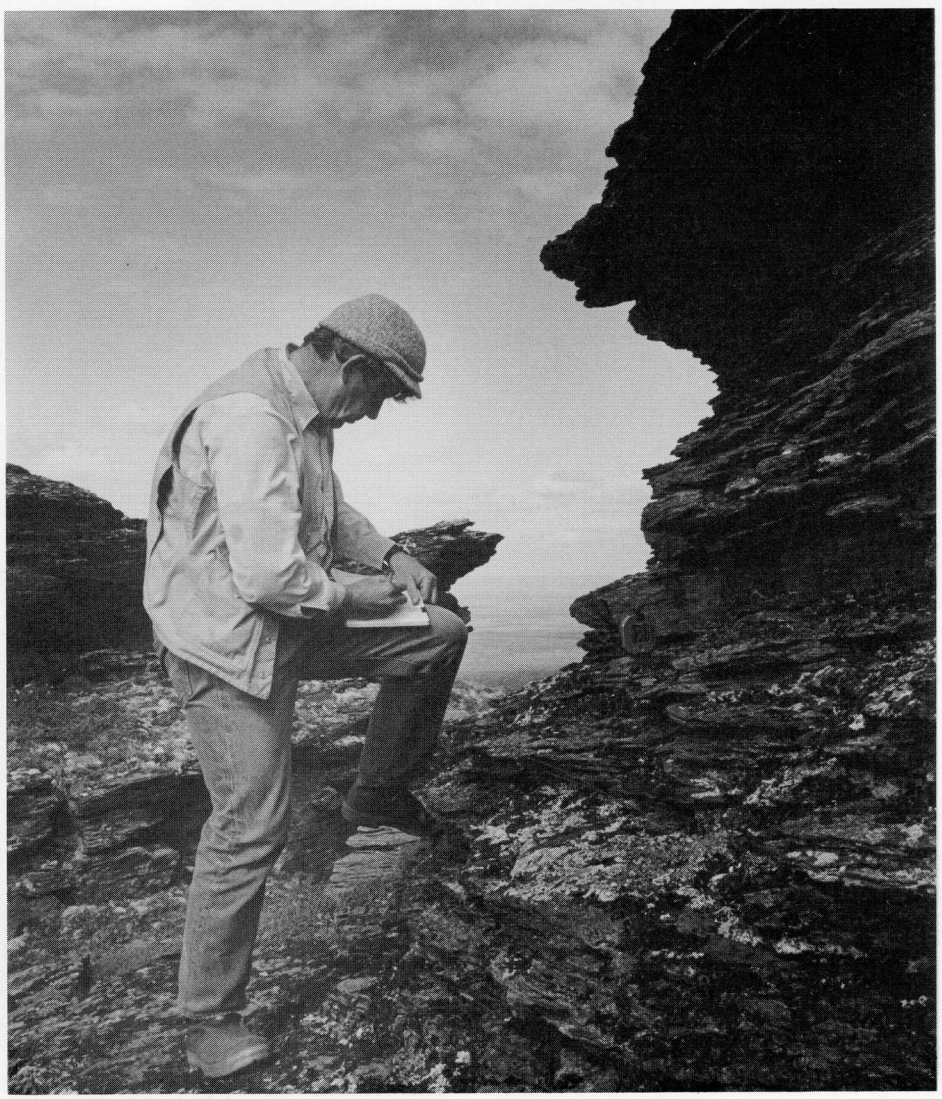
Super Cub pilot Jack Wilson (left) and glaciologist Carl Benson visit the rim of North Crater at the summit of Mt. Wrangell in 1961. The boxes are typical of freight loads carried by the plane.

Benson, who joined the institute staff in 1960, exemplified the possible breadth of the field. He was a pioneer in work on ice fog, studied seasonal snow cover in interior and arctic Alaska, glaciers in Alaska and Greenland, ice formation in small, turbulent streams, and glacier-volcano interactions. Harold Peyton, who held a joint appointment in geophysics and civil engineering, worked in the early 1960s on the mechanical and physical properties of sea ice and frozen soil.

The solid-earth sciences at first were represented by Robert Forbes, associate professor of geology, and Eduard Berg, a seismologist who arrived in 1963 from Central Africa. (Berg's memorable Continental accent frequently echoed through the halls from the public announcement system, summoning students—who mischievously practiced imitating him to confuse their peers.) Neil Davis had temporarily transferred his allegiance from auroral studies long enough to prepare a catalog of all known Alaska earthquakes.

Studies of atmospheric phenomena other than ice fog were represented at first by Mather's own work (with visiting scientist Yngvar Gotaas from Oslo) on katabatic winds in Antarctica and Ben Fogle's research on noctilucent clouds, also with Gotaas. By 1964 Takeshi Ohtake (soon known as Taku, a nickname echoing Juneau's local glacier) had arrived from Japan, adding expertise in precipitation phenomena and cloud formation. In 1966, Gerd Wendler added strength in the areas of meteorology, micrometeorology, and climate research to institute studies. Bernard Haurwitz, one of the world's most highly regarded meteorologists, in 1964 began his continuing stint as visiting professor of meteorolgy—a series of visits that extended through nearly two decades, adding enormously to the institute's abilities in the field.

In the meantime, the earth's crust under Alaska gave dramatic evidence for the importance of solid-earth geophysics: the great Anchorage earthquake of March 1964 sent lethal tsunamis as far as California, after devasting Alaska's largest city and many smaller coastal communities. It gave the small seismology group at the institute great impetus, and far too much to do. Under Forbes' direction,



SABRA McCRACKEN

Professor of geology Robert Forbes planned and initiated development of the solid earth research program at the institute.

the group began to develop.

Plate tectonics, a major revolution in the earth sciences, was rapidly unfolding. Continental drift was being quantified through global research on earthquake distribution, paleomagnetism, and apparent magnetic anomalies in ocean floors. In 1966, David Stone arrived to build a paleomagnetic laboratory for studying Alaska's paleogeography and tectonic history, its microplate and terrane structures, and the origins of its volcanoes.

While the institute expanded into the broader spectrum of geophysics, its roots in space physics and aeronomy grew stronger and the staff in these areas expanded from 22 to 28 researchers. The aim was to strengthen theoretical work, develop the laboratory program, and adapt ground-based studies to new opportunities afforded by rocket and satellite techniques. In 1963, Dan Swift arrived from the Massachusetts Institute of Technology, providing more strength to the theoretical side of this work. Among others, radio astronomer Kenelm Philip, ionospheric physicist Dharmbir Rai, and molecular physicist Roger Sheridan (who began the first laboratory physics research in Alaska) were aboard by 1965, soon to be joined by plasma physicist Tom Roberts.

Set forth so baldly, it would seem as if the 1960s comprised a decade of smooth and uneventful growth. It was not. For one thing, the institute was rapidly outgrowing its building. Problems of adequate space had existed before Mather became director; former director Elvey, in September 1962, had estimated that twice the floor area then available was needed for the staff to have adequate work space—and the staff had since expanded. As a temporary expedient, to avoid refusing admittance to new graduate students, stacked trailers were added to the north and east sides of the institute building. The annex, as the trailer array was called, was a flimsy solution; the struggle for a new building occupied much of the director's time.

Then there was the impressively diverse staff to challenge his managerial skills. More than ever before, the institute had become a kind of scientific mini-United Nations. Scanning the schools attended and previous appointments of the scientific staff alone reveals something of the melange of accents and attitudes to be found in the institute's crowded halls.

Norway was represented not only by Yngvar Gotaas but also by Leif Owren, a skilled skier and head of the arctic radio propagation program. Denmark provided Hans Stenbaek-Nielsen, who worked with polar cap absorption events and auroral conjugacy after joining the institute in 1967. Ed Berg's accent was debated by the tin-eared as being either French or German, but no one questioned that Al Belon was French. Seismologist Hans Pulpan's Austrian-accented German joined Gerd Wendler's in 1968; then-student of volcanology Juergen Kienle added Swiss tones in the '64-'65 school year. Gunter Weller brought a doctorate in meteorology from Melbourne and a unique version of Australian-Teutonic accent in 1968.

To hear the true sounds of home, Mather had only meteorologist and visiting faculty member Neil Streten for staff conversation, but an array of students from Down Under contributed their unique Australian vowels to the hubbub in the 60s: George Cresswell, J.R. Blake, John Boyd, and Jim Calegari brought the voice of the Strine-speaking peoples to the north.

Though long-time staff member and radio physicist R. Parthasarathy had a model mid-Atlantic accent, the music of English as spoken in corners of the Indian subcontinent rose from many throats: Ziauddin Ansari, Ishaq Mirza (both from Pakistan), Rama Singh, Doroswamy Venkatesan, Dharmbir Rai, Dipak Ray, and Brahma N. Srivastava all shared in the work of the institute during the 1960s. Seismologist Nirendra Biswas was appointed in 1971; Kolf Jayaweera in 1970 added the unique tones of Ceylon as well as studies in the physics of snow and ice crystals.

Japan had long been represented at the institute; as of July 1963, when Mather took up the reins, both Syun Akasofu and Masahisa Sugiura were well established here. Taku Ohtake's name appeared in the next annual report, as did that of Sekiko Yoshida; it was noted that she had previously worked at Tokyo University for several years on a joint project with the Geophysical Institute and was well-known for her studies of cosmic radiation. Susumu Kubota, a specialist in seismic instrumentation, joined in 1965. Students came to the institute during the 1960s and early 1970s from places like Tohoku (Teizi Henmi, for example), Kyoto (Fumihiko Yasuhara), and Tokai (Kei Anma) universities.

Nor was Japanese the only oriental language to be heard in the crowded corridors of the institute. In 1965, for example, master's degrees were awarded to Jih-Kwin Chao, Ching-I. Meng, and Yam Suen Wong.

This partial list does not fully cover



AEP ARCHIVES

Damage caused by the 1964 earthquake called attention to Alaska's seismicity and the need for research.

the array of nationalities to be found in the institute during the Mather years among members of the scientific staff, the technical support group, or the students. It can't begin to hint at the number of regional accents to be found among the North Americans who worked and studied at the institute during the period. And it does not begin to hint at what must have been the worst culture shock facing Keith Mather in Alaska: a dignified person of affable if academically formal style, he found himself directing a group of inveterate hoaxers and pranksters.

In part he could blame that on his predecessor, because Chris Elvey had not discouraged some frisking about on the part of his "boys"—as long as the work got done. But in part Mather had only himself to blame. With the departure of mathematician Russ Carr, who first served in the position, he named Neil Davis to be assistant director in May 1965. If anyone could claim title as top prankster, it was Davis; as far as his fellow pranksters were concerned, his new prominence simply made him a better target.

It was an era in which the institute held a certain reputation for irreverence. Many hoaxes seemed to involve the ubiquitous computer chips, residue of the punch cards necessary for computational work at the time: hapless victims would open a file and find their laps full of tiny paper flecks. Some were more complex: an innocent officer in the Naval Reserve found himself apparently recalled to active duty, courtesy of his colleagues. A few extended well beyond the institute: what began as a cheerful bet between two institute staffers ended up as the Great Tanana Raft Classic, a race of more than 50 home-built and hand-powered craft along 80 miles of river to Nenana.

In all of this, most attempts to catch Davis out fell short: disappointed jokesters who salted his office tobacco jar with chopped-up rubber bands reported that Neil never even noticed. (Davis later admitted he'd thought it was a "really lousy batch" of tobacco, noting that occasional bits seemed unusually likely to leap great distances from his lit pipe. But he smoked it all.)

Perhaps the joking worked as it should, to relieve the intense pressures of study and research, of life in Alaska, of imperfect people working toward perfect understanding of some aspects of the universe, because the work certainly got done. Some of the more significant research accomplishments were in areas of "traditional preoccupation" at the institute. In 1964, Syun-Ichi Akasofu identified and described the auroral substorm, an intermittent, one- to three-hour disruption and recovery of normally quiet auroral forms. (Subsequently he developed the concept to include magnetic, ionospheric, x-ray, proton aurora, very low-frequency emission, and micropulsation substorms, all of which he related to the magnetosphere in a unified theory.)

Then there was the matter of conjugacy in aurora, a project developed from Elvey's 1958 proposal to the Air Force concerning the relationship between disturbances at the two ends of magnetic field lines in the northern and southern hemispheres. Under Al Belon's continuing leadership, this study of morphologically matching auroras at opposite ends of the same field line began in 1961 as an analysis of ground-based all-sky camera photographs; the results were extremely promising, but not fully conclusive. In 1966, the study resumed, now using instrumented aircraft flying conjugate paths across Alaska and the Pacific Ocean south of New Zealand. The project confirmed that matching, mirror-image auroras occur during geomagnetically quiet times and that predictable distortions of the geomagnetic field lines occur during disturbed times.

Advances appeared on other fronts as well. Working with researchers who had access to electron microscopes at the University of Chicago and the U.S. Army's Cold Regions Research and Engineering Laboratory, Carl Benson found that combustion products are the prime sources for ice fog nuclei in urban Alaska. The first electron microscope in the state was installed at the institute in 1964, enabling Taku Ohtake to undertake more sophisticated studies of nucleation particles and to reconfirm the importance of pollution to the formation of ice fog. By the early 1970s, Glenn Shaw and Sue Ann Bowling were aboard, extending capabilities in the meteorology section.

Solid-earth geophysics began receiving basic data of utmost importance when the seismic network was established. By 1965, stations were operating at McKinley Park, Tanana, and Black Rapids; by 1969, eight stations were reporting via telemetry to the institute seismology laboratory.

GEOPHYSICAL INSTITUTE



Standing by a B-17 used for optical observations during a 1963 solar eclipse are C. Deehr, P. Michalow, A. Belon, G. Romick of GI, and Q. Allen, E. Brown, P. Dauphen, and J. Yersak of Aero Service Corp.

GEOPHYSICAL INSTITUTE



Demonstrating the verification of conjugate auroras are, from left, Neil Davis, Milt Peek, Wallace Murcray, Hans Nielsen, Russ Beach, Jim Wells, and Eugene Wescott.

Seismic work was also important in the intensive field work at Katmai National Monument begun in summer 1965. This started the long-term effort to gain predictive understanding of Alaska's volcanoes—work given further impetus by the 1965-68 eruptions of Mt. Redoubt volcano. (This continuing effort produced impressive results 21 years later, when institute and Alaska Division of Geological and Geophysical Survey researchers were able to forecast an impending eruption of Mt. St. Augustine, predicting the time within hours. Later joined by United States Geological Survey personnel to form the cooperative Alaska Volcano Observatory, they also accurately forecasted the 1989 eruption of Mt. Redoubt.)

Another long-term effort begun in the mid-60s was the paleomagnetic study of Alaska. Its aim was to provide basic information about the well-traveled pieces of the earth's crust now composing Alaska, but its practical implications range from mining through earthquake and eruption prediction. David Stone was given 15 pages of the 1966-67 annual report to introduce his subject and his laboratory, an indication of Mather's understanding of its importance; the director always monitored report content carefully.

By the end of the 1960s, the glaciology team also had begun a focused, multi-year study. McCall Glacier, in the Brooks Range, was the subject of some study during the IGY (discussed in the previous *Quarterly*). When Wendler, Benson, and Weller set up the institute field camp in 1969, they intended to build upon and expand the earlier work on a continuing basis. (Presciently, given late 1980s headlines, one underlying aim of the work was to use changes in the glacier as a gauge of possible climate change.) That was only one project in the broad program the glaciologists had set themselves, which covered many aspects of snow and ice; the first true glacier specialist arrived in 1972, when Will Harrison joined the staff. Also arriving in the early 70s were sea-ice specialist Bill Sackinger, permafrost expert Tom Osterkamp, and Lew Shapiro—a geologist who found himself studying ice.

Long before then, the space and facilities problem had become untenable. The *Future Program* section of the 1964-65 annual report commented, *"Plans for further broadening the scientific program are now dependent entirely on the availability of office and laboratory space...A note of staff despondency can be detected in the rumor that the new building will be a pyramid of 120 trailers."* But the regents had agreed there was to be a new building, and an architect had been named.

The next good news came on election day 1966, when Alaska voters approved a bond issue obligating the state to supply $2.5 million for construction. That was, perhaps, the simplest part of the funding package. Grants from the National Science Foundation ($1,025,000) and the U.S. Office of Education ($600,000) came through, after complex and lengthy efforts on the part of the institute administration. In 1968, construction began. Finally, two years later, the institute had its new home.

The 1969-70 annual report contained a curious mix of emotion buried in the factual accounts of progress and activity. There was exuberance in the many photos of the new building, with its glorious elbow room—eight floors and nearly 66,000 feet of useful space. Its seminar facilities were celebrated with an inaugural symposium, fully documented in the report. Possibilities for future work were noted, taking the opening of the geochronology laboratory, complete with Don Turner as resident potassium-argon dating expert, as an example.

Yet the report also contained a sorrowful note: several pages of fine print beginning with, *"The two men who, in their own different ways, developed and rendered viable the Geophysical Institute in Alaska died during the past year—Professor C.T. Elvey in March and Professor Sydney Chapman in June, 1970."* The institute's original home had been named for Chapman in 1968; its new headquarters were named for Elvey.

The Elvey building was not the only new structure institute researchers occupied during the late 1960s. A sprawl of curious and cobbled-together buildings had been added to their holdings some twenty miles north of Fairbanks: the headquarters—or base camp, at least—for the Poker Flat Research Range. Scientific rocket flights had come to Alaska, if by a rather circuitous route.

Neil Davis was among the U.S. scientists intrigued by the auroral research possibilities of rockets. After participating in rocket-based studies at the Ft. Churchill, Canada, launch facility, he conceived the idea of an Alaskan equivalent—or better. Even though the National Aeronautics and Space Administration had commissioned him in 1964 to assess possible sites, nothing further might have developed without international politics.



Neil Davis was photographed in 1969 with one of the first NASA payloads fired at Poker Flat, a Nike Tomahawk rocket.

DENNIS COWALS

The Department of Defense had scheduled a major series of barium-release experiments for Thule, Greenland, in spring 1968. Then, just before the experiments, a U.S. B-52 carrying nuclear weapons crashed off the coast near Thule. With Danish parliamentary election campaigns and worldwide ban-the-bomb sentiments at a peak, it suddenly became important for a sounding launch facility to exist on U.S. soil. With prodding from Davis, the site survey was dusted off; the defense agencies found themselves committed to conducting their experiments at Poker Flat the following year—and the institute was committed to the stupefying task of building a rocket range.

Subsumed in the frenetic activity of building Poker Flat had been another struggle, more quiet but no less painful. As the 1960s drew to a close, so too had the National Science Foundation's ability to deepen its pockets (one year, in fact, NSF had notified grantees that they might not receive the full funds called for in their contracts). Mather believed it was imperative that the institute broaden its funding base, and that meant pursuing contracts with defense-related agencies. The thought was not wholly pleasing to the entire faculty.

The reasons for doubt were not trivial. A chief one, of course, was the worry about secrecy; scientists want to publish, debate, and discuss their work openly. Then there was a contribution from recent local history: Project Chariot. This proposal by the Atomic Energy Commission in the late 1950s called for using nuclear explosives to blast a harbor on the Alaska coast near the village of Point Hope. It had left confusion and bad feelings at the university; the debates had cost some careers dearly.

There were also some individual experiences that led to sincere doubts if military procedures and scientific ones could be reconciled. (During the course of his work in infrasonics—the study of extremely low-frequency atmospheric pressure waves caused by volcanoes, storms, auroras, and nuclear explosions—Buck Wilson had received a request for data from a defense agency for the period covering some French A-bomb tests in the Pacific. He asked what dates were required; "Sorry," came the response, "the dates are classified information." Annoyed, Wilson checked back issues of the *New York Times*. The paper had indeed reported the French explosions, and Wilson sent data for the correct days.)

Yet Mather insisted; he saw it as a case of adjust or perish, because funds were simply inadequate otherwise. In one-on-one sessions and group meetings, institute administration and faculty came to terms on the kinds of projects that could be accepted. The accord made possible the development of Poker Flat and much valuable work.

By the time the 1970s rolled onto the calendar, the Geophysical Institute had attained very nearly the form it has today. The Elvey Building was occupied; Poker Flat was established. The fields of space physics and aeronomy, atmospheric sciences, glaciology, and solid earth geophysics were represented. Though it has advanced considerably in the ensuing years, the technology to serve those sciences was also well in place—not only the geochronology and paleomagnetic laboratories noted above, but also the supersensitive optical equipment and television cameras developed in large part under Tom Hallinan's guidance.

One more technologically propelled field was then just beginning to enter the institute's purview: the 1970-71 annual report noted, *"One of the great efforts of the past year that is expected to have its pay-off in a new class of scientific work during the coming year was the submission by the University of an elaborate proposal for use of remote-sensing data from the NASA Earth Resources Technology Satellites (ERTS)."* Al Belon, chief of the optics program, had also guided the institute into the new realm of satellite-gathered data. It was the first step along a path culminating in the Alaska Synthetic Aperture Radar Facility and many studies employing remote sensing.

Considering the whole exhilarating and exhausting time, perhaps the most apt comment came from KBM himself. Appropriately, it was inspired by a prank. When the staff had barely settled into the new Elvey building, much grumbling came from people who found the new quarters devoid of character. It was agreed that the building needed some sort of christening, some dramatization of the character of the institution it now housed. Spontaneously, an idea appeared, and the appropriate players were drafted.



An unidentified man watches Larry Sweet and Keith Mather work on the aurora mural that decorates the institute.

At high noon on an otherwise unremarkable day, a small crowd gathered on the ground in front of the Elvey Building. Far above, at the eighth floor parapet, vague action was dimly visible. Then a rope appeared, followed by boots, followed by the rest of a suitably clad alpinist. Gene Wescott, experienced member of the Alaska Alpine Club and possessor of an excellent poker face, was executing a perfect mountaineer's descent of the Elvey Building. Cheers rose from the assembled spectators as Wescott reached ground. With an appropriate symbolic action, the Elvey Building had become a true home for the Geophysical Institute.

The director issued a firm memo against any further such shennanigans. But later, when someone asked him about the Great Descent of Elvey, he smiled ever so slightly. "This," said Mather, "is an unusual place." He paused and puffed on the pipe. "There are some extraordinary people here."

Indeed it is; indeed there are. The scientific record stands as proof.

—Carla Helfferich

Redoubt

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what they knew about the behavior of the Cook Inlet volcanoes, and issued the warning.

"Seismic monitoring allowed us to forecast the impending eruption, but we don't know how long this period of activity will last," said Juergen Kienle, professor of geophysics and volcanologist at the institute. "From 1965 to 1968, Redoubt had four periods of activity, in January 1965, January-February 1966, January 1967, and December-January 1967-68. We know it erupted in 1902 and again in 1933; we know it erupted in 1778 and 1819 as well, but—except that they always seem to happen during the winter—we don't know very much about the earlier events."

This was the second successful forecast of a volcanic eruption in Alaska; the first was made before the 1986 eruption of Mt. St. Augustine—another event that led to cancelled flights.

"Volcanoes of the Redoubt and St. Augustine type create ash particles with a melting point very close to the operating temperature of jet engines," Kienle said. "When ash is sucked into an engine, it melts, forming a glassy coating that blocks small apertures, leads thermocouples to malfunction, and just generally ruins the engine." Acid aerosols in the plume can also etch glass and metal surfaces, and abrasive effects can sometimes be so bad that transparent windshields suddenly turn opaque.

Kienle suspects it was thermocouple malfunction that led to the December 15 near-disaster aboard KLM flight 867. The aircraft flew through the ash plume and all of its engines shut down. The big jet glided steeply downward for several minutes, losing four kilometers in altitude, before the pilot was able to get the engines started and land the plane safely at Anchorage. "The temperature sensors are misled into thinking the engines are overheating, so they shut down automatically to prevent fire," Kienle said. "That may be what did it."

After KLM's close squeak, the rerouting and canceling of flights destined to or through Alaska's largest city reached epidemic proportions. Thousands of holiday travelers—and tons of holiday mail—were stranded in airports from Salt Lake City to Pt. Barrow as airlines refused to risk encountering ash that is not clearly visible on radar. Meteorologists and remote sensing specialists at the Geophysical Institute are attempting to develop methods to help track the dangerous ash plumes, but for now both passengers and pilots understand that rescheduling may be necessary on short notice.

JIM COCCIA



Volcanologist Juergen Kienle mans the phone while state seismologist John Davies checks information from seismic monitors at the volcano.

The gritty, abrasive ash poses a hazard to all manner of machinery and to human lungs: where the ash reaches ground, people who smoke, have asthma or other respiratory sensitivities, and the elderly are advised to stay indoors; outdoor exercise does more harm than good. After one plume descended at Kenai on January 8, schools there closed for three days to protect ventilation systems and avoid damage from tracked-in gritty mud, until a wet snowfall settled the ash.

A hazard apparently not directly related to the ash is the one most threatening to the Drift River terminal: flooding. At some 35 kilometers from the volcano, the facility should not fall victim to any lava flow from Redoubt, but water flow—and ice blocks, and ashy mud—could endanger personnel and property.

"When hot material from the volcano triggers sudden melting of snow and ice on the mountain, it's like breakup out of season for the Drift River," Kienle said. "With enough ash mixed in, you get mudflows—like the one that buried most of the town of Armero in Columbia when Nevado del Ruiz erupted a few years ago." In fact, at least one large mudflow has come down the Drift River during the present series of eruptions. That January 2 event was larger in volume than the one that destroyed Armero, and than any of the mudflows from Mt. St. Helens that took out bridges over the Toutle River. "And it's not as if this should be some big surprise—the survey party working on the start of that terminal had to be evacuated during the eruptions in the late 60s." Employees have been evacuated from the terminal, and millions of gallons of oil stored there have been shipped out.

Forecasting volcanic eruptions is equally useful in situations where the information shows that an eruption is unlikely. This was the case in July 1988, when a costly and disruptive evacuation was avoided at King Cove, Alaska. In that instance, analysis of seismic information allowed the AVO to reassure residents that the coastal village was not endangered by an imminent eruption of Mt. Dutton volcano, which is nine miles from the town.

Kienle, who has studied Redoubt, St. Augustine, and other volcanoes in Alaska and around the world, was among the people whose efforts created the volcano observatory. At the institute's seismology laboratory, he works with state seismologist John Davies, John Power of the AVO, Chris Nye of the institute and ADGGS, and others to monitor the activity—and its effects—of Redoubt and other Alaska volcanoes. Thomas Miller of the USGS coordinates the AVO volcano monitoring in Anchorage and the cooperative field studies program; he serves as AVO spokesperson during a volcanic crisis. Davies coordinates volcano monitoring activities in Fairbanks.

Redoubt

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Other institute personnel who sacrificed sleep and much of the holiday season to watch instruments and answer phones included Charlotte Rowe, Steve Estes, and Guy Tytgat. Bruce McKibben and Kay Lawson put up with an especially annoying loss: while most other institute employees enjoyed the annual Christmas party, they were enduring ashfall at Kasilof, across Cook Inlet from Redoubt, to install a slow-scan television camera for observing the volcano.

From all this effort has come not just greater safety and better information for Alaskans during the present crisis, but also reams of data to improve AVO's predictive abilities.

"As volcanologists learn more about the chemistry, structure, and behavior patterns of specific volcanoes, and are able to monitor them, we're coming closer to achieving real-time forecasts of volcanic eruptions," Kienle said. "It's like any field, in a way—the more we know, the better we get. And we're on a steep learning curve right now."

—Carla Helfferich

GI Notes...

REAPPOINTED—John Davies will serve another 2-year term on the National Earthquake Prediction Evaluation Council. The group advises the USGS director on scientific information related to earthquake hazards. Davies has been on the board since 1984.

JOB WELL DONE—Six GI employees were recognized by Chancellor's Meritorious Service Awards in December: **Mike Cogan**, **Brett Delana**, **Cole Sonafrank**, **Marla Wells**, **Helga Wilm**, and **Cindy Wilson**. The cash awards emphasize the value of workers who, in the estimation of coworkers, make outstanding contributions to the university.

CONFERENCE SET—June 11-15 UAF will host the International Conference on the **Role of Polar Regions in Global Change**. The meeting is sponsored by the U.S. Arctic Research Commission, the Polar Research Board of the National Academy of Sciences, the Arctic Research Consortium of the United States, the American Meteorological Society and the American Geophysical Union. For more information contact **Gunter Weller**, chairman, Polar Research Board, c/o Geophysical Institute, University of Alaska Fairbanks, Fairbanks, AK 99775-0800.

TO WASHINGTON—Joan Gosink, associate professor of geophysics, has accepted a position as director of the Thermal Systems Program, Division of Chemical and Thermal Systems in the Directorate Engineering Dept. of the National Science Foundation. She will be with NSF for approximately one year.

IN MEMORIAM—The institute has received word that Howard Francis "Skip" Bates, age 62, died January 26 in Anchorage, while undergoing medical treatment. Skip was among the first eight Ph.D. graduates of the Geophysical Institute, earning a doctorate in geophysics from the University of Alaska in 1961. He first joined the institute in 1952. His career as researcher included work in radio physics, aeronomy, and later, glaciology. He also taught electrical engineering courses, and after retiring from the institute in December 1979, he worked as an electrical engineer at Eielson Air Force Base. Skip is remembered as a man who ignored his physical disabilities and concentrated on his abilities. Aside from his academic career, he was a pilot, avid outdoorsman, and stimulating conversationalist. Skip was born in Portland, Oregon, on March 27, 1927. His wife, Florence Martin of Fairbanks, survives him.

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