The Geophysical Institute QUARTERLY

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The Changing of the Guard

FROM THE DIRECTOR

It is a great honor to be appointed the director of the Geophysical Institute at the University of Alaska, succeeding S. L. Seaton, C. T. Elvey, K. B. Mather, and J. G. Roederer. At the same time, it is a great responsibility for me to lead and prepare this institution for the next century. My goal as the director is to make this institution truly a center of excellence in every aspect of arctic geophysical research.

By this I do not mean to attempt to erect an ivory tower. Our research should and can provide the public with the most reliable practical information available to date. For example, on the basis of the most advanced knowledge, our scientists successfully and accurately predicted the recent eruption of the Augustine volcano and also have assured Alaskans about their safety after the recent Russian nuclear disaster. With our most advanced knowledge of the aurora, we will be able to predict auroral activity to ensure flawless operation of the over-the-horizon defense radar systems to be installed in Alaska in the near future. There are many additional ways we can be helpful to Alaskans.

In order to achieve this goal, we have to build up strong research teams made up of innovative individuals. We have to cultivate our traditional feeling of togetherness. We have to excel in training young researchers. Once we can accomplish those aims, we can turn any serious difficulty into an opportunity. This is our most challenging duty. As I have done in the past, I am determined to accomplish what I have set forth to do.

Syun Akasofu
Director

Dr. Gunter Weller

KUDOS

For the past four years Dr. Gunter Weller has provided the direction for the *Geophysical Institute Quarterly.* He was the founding editor and officiated in the evolution of the *Quarterly* to its present form.

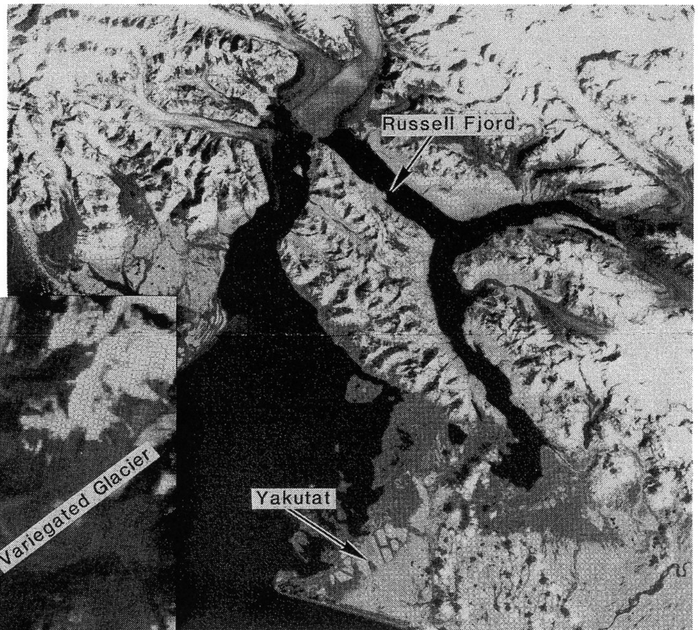
But this issue is his last as editor-in-chief of our newsletter. Dr. Weller has returned to the meteorology group to pursue his research interests and to oversee the Institute's involvement in the NASA Synthetic Aperture Radar Satellite program, described on page 3 of this issue. While his editorial hand will not be directly involved in future editions, we may call upon him for additional contributions on his work. He has not completely escaped, even though he may think so.

Thank you, Gunter, for the leadership, the skills, and the humor.

Merritt Helfferich
Assistant Director for Administration

Research in the News

RUSSELL FJORD—
RUSSELL LAKE

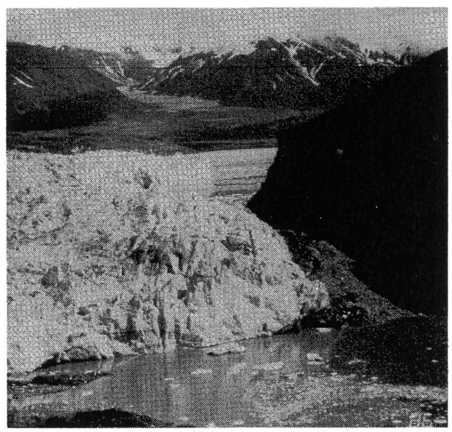


These Landsat satellite images of the Hubbard Glacier's natural damming of Russell Fjord were taken September 3, 1986. Russell Fjord was closed off by a "finger" of the Hubbard Glacier, visible in the left photo. (Photos courtesy of EOSAT Corp. and John Miller.)

Even though there are hundreds of lakes caused by glacial damming in Alaska, only one of them, that formed by the damming of Russell Fjord, has been getting attention in the news lately. One reason for this is that Russell "Lake" was the largest glacier-dammed lake in the world.

For the last 15 years Professor Will Harrison of the Geophysical Institute has been studying the surging Variegated Glacier, near the Hubbard Glacier in the Yakutat area of Alaska. His research has helped in determining the causes of the Russell Fjord dam. Researchers from the U.S. Geological Survey, and Harrison, all believe that an important factor in the March 1986 damming of Russell Fjord has been the surging of the Valerie Glacier, which is next to the Hubbard Glacier. The Hubbard, a glacier whose terminus is in ocean tidewater, is in the "advance" part of a cycle typical of this kind of glacier. The cycle consists of four phases: (1) the glacier advances down its fjord by pushing an underwater "toehold" or moraine in front of it, which limits iceberg calving to a moderate rate; (2) a slight climate change or other event causes the glacier to retreat back off its toehold; (3) very rapid calving occurs because of the deeper water behind the toehold moraine; and (4) the glacier breaks up all the way back to shallow water, where calving stops. The glacier then will slowly begin advancing down the fjord again. As the Hubbard advanced, and pushed the moraine across the mouth of Russell Fjord, it got a strong nudge from the surging Valerie Glacier.

Glacier surging can be caused by the failure of the glacier's internal plumbing system to drain surface water efficiently. This results in an effect that resembles a partial floating. It gives a vastly increased rate of sliding over the glacier bed. The *surging* Valerie Glacier probably pushed the *advancing* Hubbard Glacier and produced the natural dam. The dam burst in early October, and caused the lake to revert rapidly back to a fjord. Vegetation patterns and Native oral history tell us that Russell Fjord has been dammed before, as recently as the mid-1800s. Scientists say that the Nunatak Glacier, as well as the Hubbard, has been responsible for the damming in the past. It is possible that the recent dam will form again within the year, although some think it will be a decade or much longer before Russell "Lake" is created.



The terminus of Hubbard Glacier, with Disenchantment Bay in the foreground and Russell "Lake" in the background. This August 1986 photo shows the dam intact. The dam broke early on the morning of October 8, when huge volumes of water rushed out of Russell Fjord until it reached sea level. (Photo by L. R. Mayo, U.S.G.S.)

RADAR FACILITY AT UAF

ASF

The Elvey Building, home of the Geophysical Institute, soon will be sporting a new "ornament" on its roof. A 30-foot diameter satellite-tracking and -receiving antenna will be mounted there, as part of the new Alaska SAR Facility (ASF). The antenna will receive SAR data from polar orbiting satellites, and the data will then be processed by a computer, also to be housed in the Elvey Building. All this is the result of a recent agreement between the National Aeronautics and Space Administration and the University of Alaska, an agreement that establishes the Geophysical Institute as a satellite receiving, processing, and analysis station. NASA will provide about $15 million worth of equipment, and also will provide funds for operation. The university expects to receive grants to analyze and do research based on data acquired from the radar satellites, which are scheduled to be launched in the early 1990s.

The facility will enable researchers to study sea ice along the northern coast of Alaska in relation to offshore petroleum activities; ocean waves, eddies, and fronts that are important to fishing fleets; geological features used in mineral resource assessment and earthquake hazard studies; glaciers and river ice and their hydrological importance; vegetation; and permafrost.

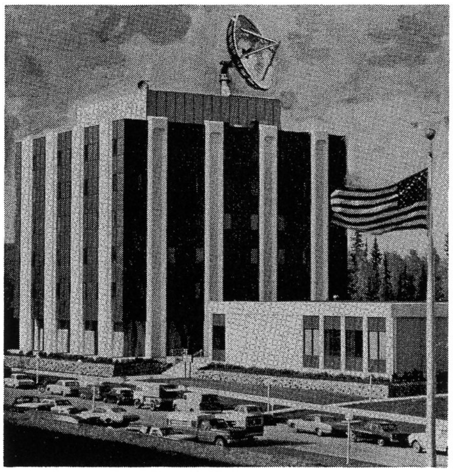
The Geophysical Institute is a logical place for this facility because of our history of involvement in similar projects. In 1958, the Institute tracked the first earth satellite, Sputnik, with locally made equipment, and later installed the first satellite-tracking station in Alaska for NASA. This led to the establishment of the Gilmore satellite tracking station near Fox, Alaska, now used primarily for weather satellites. John Miller, who has been senior engineer for these satellite projects, will be serving that function for the ASF project. Gunter Weller, geophysics professor, will manage the project.

WHAT IS SYNTHETIC APERTURE RADAR?

No matter what it sounds like, a "synthetic aperture" radar (SAR) is not one with a nylon-covered hole somewhere within it. First, in the language of technology, a radar *aperture* is an antenna. Second, this kind of antenna is *synthetic* because it behaves like an enormously long antenna. It "synthesizes" by broadcasting radio signals and receiving their returning echoes while it is in motion.

Aircraft- or spacecraft-borne radar creates images of features of the earth's surface by bouncing radio waves off the ground and displaying the return signal on a screen. The image produced from the largest antennas will have the finest detail because the radar beam is very narrow. But the largest antenna that can be conveniently placed on a satellite (about 15 meters long) would normally produce a poor image with only coarse detail. By using subtle information in reflected radio signals, synthetic aperture radars can create an image that would usually require a much larger antenna. Because a satellite-borne radar antenna is moving, the radio signals that bounce back from a broad area on the ground are either compressed or stretched out when received at the satellite (this is the well-known Doppler effect). The compressed signals are measured as higher frequency and the stretched signals are measured as lower frequency. Modern electronics can measure very small frequency differences and therefore the direction from which the returned signal comes can be determined to high precision.

The radar system on board the satellite sends the radar pulse to the ground and receives the Doppler-shifted signal back. Then the somewhat "processed" signal is sent to a receiving station on the ground. The antenna on the Elvey Building will pick up this signal from the satellite and the computer will produce a clear image of the earth's surface on a screen.



Artist's concept of the new radar antenna to be installed on the roof of the Elvey Building.

CHERNOBYL RADIATION

Glenn Shaw, physics professor at the Geophysical Institute, set aside his usual research for a while last spring to help monitor radioactive fallout in Alaska from the Chernobyl nuclear reactor in the Soviet Union. Within days of the first announcement of the accident, which occurred April 25, 1986, Shaw was measuring radioactivity from air filters gathered in Alaska.

The Chernobyl monitoring project grew out of the Geophysical Institute's arctic haze studies. Over the last ten years, these studies have shown that Alaska is often directly downwind from Eurasia. In winter the winds very frequently enter Alaska from the north, bringing large quantities of industrial pollutants. The Chernobyl accident occurred after the normal winter pattern had changed, so that the winds carrying radioactive fallout entered Alaska from the south. If the accident had occurred during the winter, Shaw believes the fallout could have been ten times greater.

To track the fallout, Shaw and other UAF researchers analyzed paper air filters from Valdez, Barrow, Poker Flat, and the roof of the Geophysical Institute, starting May 2. By mid-May the levels of radioactive iodine began to rise. Although the Chernobyl fallout was detected here, the levels of radioactivity are not considered dangerous by experts.

Even though UAF scientists detected as many as 12 different isotopes, the university equipment is not designed to detect all forms of radiation or all isotopes. For this reason, air filters collected in Alaska were also sent to federal laboratories for investigation. The State of Alaska provided some funding for this project, but most of the work was conducted on "a very short shoestring," according to Shaw.

Recent Grants and Contracts

SKYWAVE INTERFERENCE

Robert Hunsucker, physics professor at the Geophysical Institute, has recently been awarded a grant for studying skywave interference of AM radio broadcast frequencies. He will provide the Federal Communications Commission (FCC) with new data that they can use to make channel allocations for standard AM broadcast stations in the northern tier of the U.S. and Alaska. Frequencies are presently assigned to these stations on a "non-skywave interference" basis using data obtained several decades ago at mid-latitudes. Since the points of reflection in the ionosphere for most of the skywave transmission paths lie in the part of the ionosphere that is perturbed by the aurora, the new data should more realistically describe the behavior of the signals. Skywave transmissions from several standard broadcast band stations (550-1600 kHz) located in Alaska, Canada, and northern-tier continental U.S. are recorded continuously at a field site near Fairbanks.

The variation in signal strengths from these stations is being analyzed as a function of time of day, season, sunspot cycle, and magnetic activity and will be assembled in a data base from which "monthly median skywave curves" will be made. The FCC will then use these curves as a basis for future AM broadcast band channel allocations. These results should improve rural coverage of Alaskan and other stations by better describing potentially bad interference problems.

ROCKET RESEARCH

Gene Wescott of the Geophysical Institute has been awarded funds to continue his rocket-borne plasma injection experiments. The objective of the study is to get three-dimensional measurements of ionospheric and magnetospheric convection, and deduce electric fields in the vicinity of auroral forms that are both parallel and perpendicular to the earth's magnetic field. In order to do this, Wescott has developed a rocket payload with three high-explosive shaped charges. Two charges are ejected and detonate with timers and the third is detonated from the ground when it is in the auroral form. The first payload was flown from Poker Flat in March 1986 into an aurora over Arctic Village, Alaska. Wescott plans to continue the program with two rocket flights into polar cap auroras, to be launched in February 1987 from Sondrestrømfjord, Greenland.

DOWN-DIP TENSION

As all readers of the *Quarterly* should know by now, the Pacific plate is slowly sliding under the portion of the North American plate on top of which Alaska sits. The plate sticks here and slips there, jerking its way down in a process that causes most of Alaska's earthquakes. How and where this happens is a question that may be answered by an investigation undertaken by Larry Gedney of the Geophysical Institute and John Davies of the Alaska Division of Geological and Geophysical Surveys. They are studying earthquakes clustered near Gold King landing strip on the north slope of the Alaska Range. By noting the direction of the motion that constitutes each of these small quakes, they have found evidence that a portion of the Pacific plate is still going down, dipping steeply under tension to the north at an angle just west of north. The Gold King airstrip is 600 km north of the Aleutian trench, where the plate begins its descent, making these earthquakes the northernmost connected with the same tectonic system that caused the Good Friday earthquake in 1964.

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