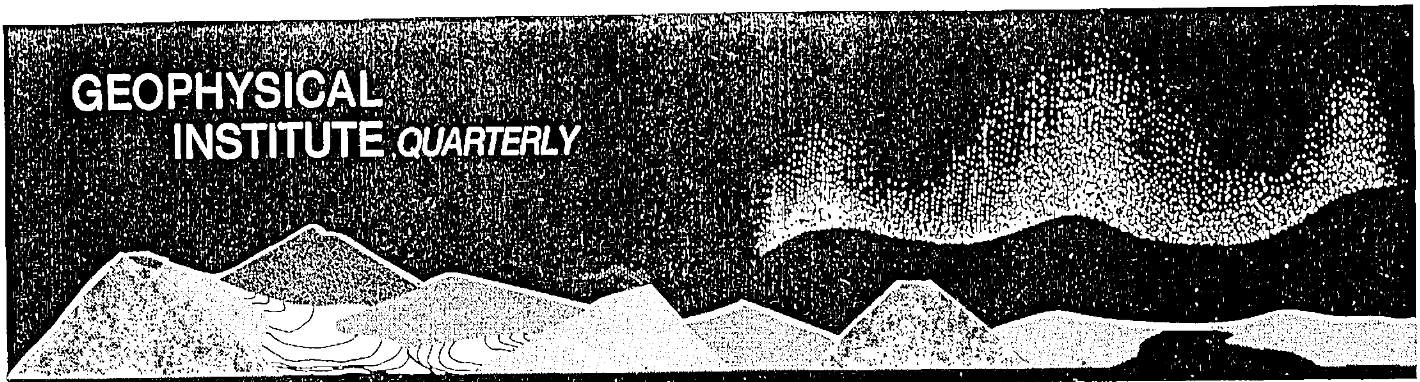

Vol. 9 · Nos. 3 & 4 Summer 1991

Satellite facility ready as ERS-1 launched

On the evening of July 16, the successful launch of the European Remote Sensing One (ERS-1) satellite was cheered by institute staffers working for the Alaska SAR Facility (ASF) project. ASF was established at the institute to receive, process, and archive data from synthetic aperture radar (SAR) satellites.

The ASF, combined with two SAR stations in Canada and one in Sweden, will provide nearly complete satellite coverage of Alaska and the Arctic for the first time. The development and operation of the Alaska station is funded by the National Aeronautics and Space Administration (NASA).

Plans call for the launch of at least four foreign SAR satellites during this decade, and agreements are now in place with the flight agencies launching the satellites (European Space Agency, National Space Development Agency of Japan, and Canadian Space Agency).

High resolution and the ability to see through clouds and darkness make SAR imaging capabilities especially valuable tools for high-latitude regions, where remote sensing is often hampered by darkness or cloud cover. The SAR system employs an active sensor using pulses of microwave energy that are scattered back from the earth's surface to produce a photo-like image.

After a two-month delay caused by rocket motor problems, ERS-1 was launched by the European Space Agency from French Guyana at about 6 p.m. According to ASF technical director John Miller, ASF expects to receive its first data transmission from ERS-1 on August 4.

"Perhaps the most intriguing research using the new data concerns the dynamics and thermodynamics of arctic pack ice, an important, but little studied component of the global climate system," said Gunter Weller, ASF project director.

"Other promising research topics include ocean wave characteristics, coastal erosion processes, glacier dynamics, soil moisture, vegetation studies, structural and quaternary geology, and permafrost."

Information from the new SAR satellites is expected to contribute significantly to arctic research on global climate change, the greenhouse effect, and sea ice. It can also be used for work related to volcanic eruptions, forest fires, mineral resource assessment, and fisheries management.

The ASF will also be one of seven national nodes for the data information system of NASA's Earth Observing System (EOS). A prime goal of the EOS program is to manage huge amounts of information about the earth's structure, atmosphere, and climate. Doing so entails not only acquiring and processing data from many

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Weather data access improved

A new link to a satellite high above the Caribbean Sea is now providing near real-time weather data to Alaskan researchers interested in atmospheric conditions. The information comes from Unidata, a national program to provide universities with access to data acquired by the National Meteorological Center (NMC). The center collects data from throughout the world for daily weather forecasting.

Based in Boulder, Colorado, Unidata is administered by the University Corporation for Atmospheric Research (UCAR), a nonprofit consortium of universities conducting atmospheric research. In 1982, UCAR established Unidata to provide a new split data feed from the weather service, allowing near real-time and forecasted data to be distributed to universities.

Before 1982, university scientists and students had to que up behind weather

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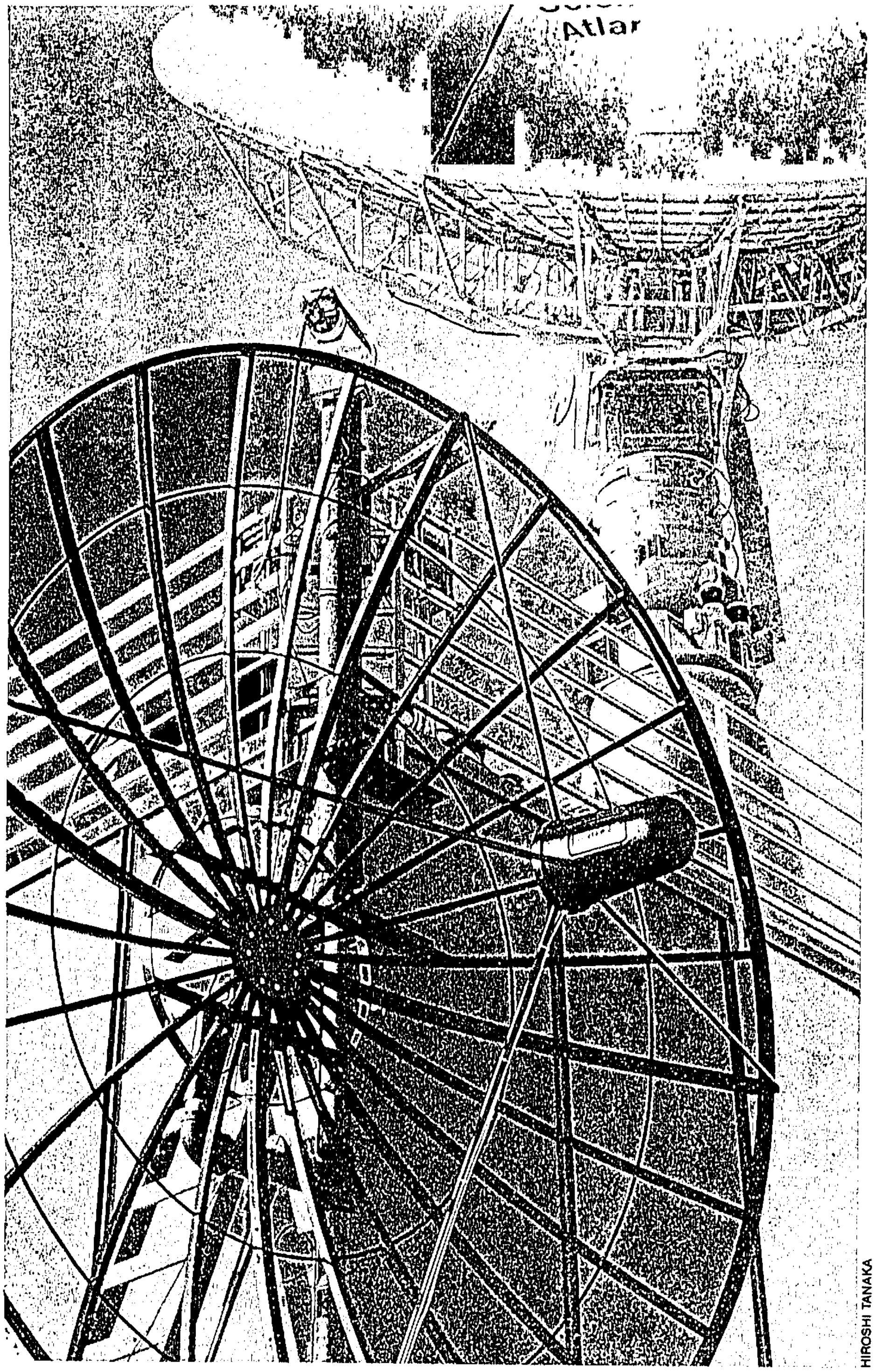
During activities to celebrate the completion of ASF, Al Renfroe, Walter Rutherford, and Tom Bicknell operate computers in the control center; in the background from left are Dixon Butler, Brett Delana of GI, Ben Holt and John Curlander. Renfroe, Rutherford and Delana work for ASF; Butler is director of the Modeling Data and Information Systems Program Office of the Earth Sciences Applications Division, Jet Propulsion Laboratory; Bicknell, Holt, and Curlander also work for JPL.

UNIVERSITY OF ALASKA FAIRBANKS



Installed near the larger Alaska SAR Facility antenna on the roof of the Elvey Building, the new Unidata antenna gives GI researchers improved access to meteorological data.

HIROSHI TANAKA

Weather data

continued from 1

forecasters and the aviation industry to obtain NMC data, waiting about a month until it was shipped and archived in the database at the National Center for Atmospheric Research (NCAR).

Since 1982, about 90 sites have installed Unidata for research and applications in meteorology laboratories. The data are transmitted by the satellite downlink under a contract with Zephyr Weather Information Service, Inc.

Because Alaska and Hawaii are the final frontiers for this program, the Unidata Program Center in Boulder devoted considerable time and effort to help the Geophysical Institute implement Unidata in Alaska; the University of Hawaii is now working to put the system in place.

At the institute, the Alaska Volcano Observatory (AVO) and the Alaska Climate Research Center were instrumental in setting up the Unidata system. This required installation of a four-meter satellite antenna, a decoding device, and disk storage. The target satellite (C-Band Spacenet 3) above the Caribbean Sea is just 3.6 degrees above the horizon from Fairbanks.

The real-time data makes it possible to assess various Alaskan weather extremes—cold spells, heavy snow, chinook winds, arctic fronts, and blocking highs. Computer graphic displays of daily weather analyses of high-low pressure systems will be useful laboratory material for meteorology classes, and it may one day be possible to provide these graphic products to public broadcasting services.

We now can produce daily updates of temperature-time series for a week, with a three-day prediction for the Fairbanks area, as well as upper-air wind fields over the Alaska region.

The NMC global analysis contains such basic meteorological variables as zonal and meridional wind speeds, temperature, geopotential height, and relative humidity. Worldwide, these are obtained in the atmosphere along grids of 2.5 degrees latitude and 5 degrees longitude and at 10 mandatory vertical levels. Data are transmitted for forecasting times of 0, 6, 12, 18, 24, 30, 36, 48, and 60 hours and updated twice daily for 0000 and 1200 Universal Time Coordinate. The forecasting field is not restricted by the 60 hours, but is available up to 10 days for selected variables provided by the European Center for Medium Range Forecasting.

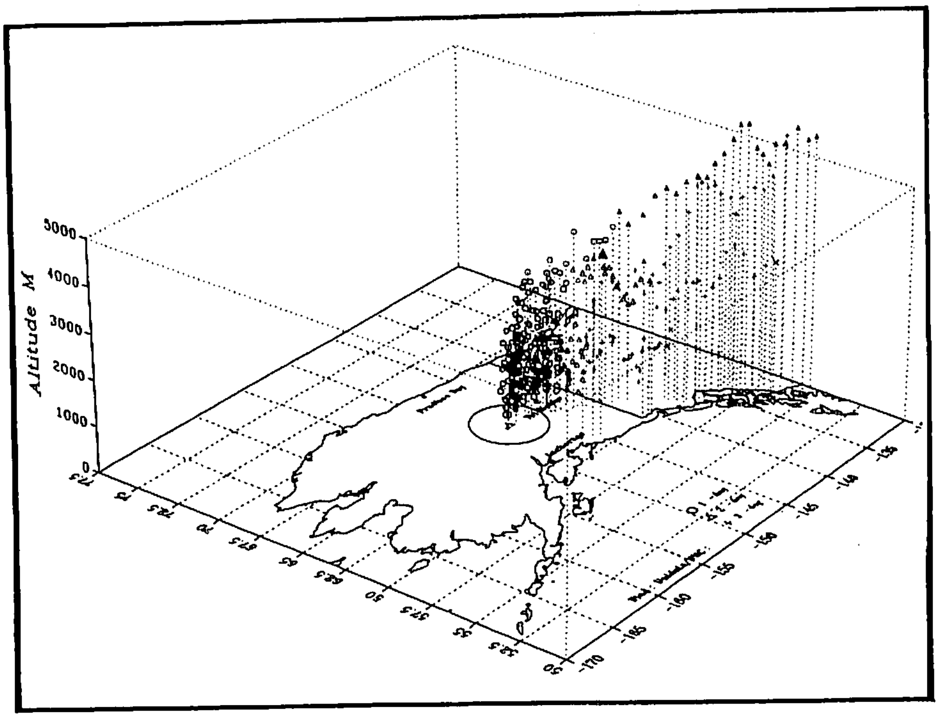
Other meteorological variables, such as precipitation, vertical motions, sea level pressure, tropopause height, pressure, temperature, sea surface temperature, buoy level wind speeds, and snow cover are also available.

The arrays of data on the multidimensional grids are stored in the mainframe disk using network Common Data Form, a data file that allows users to create, access, and save data. Because no explicit data conversion is required for this data form, a variety of equipment can access the data through the local area Ethernet.

As a support system for research and education, Unidata has undergone a decade of planning, testing, and operation, but its meaning ultimately depends on the innovation of individual research efforts.

At GI to date, the primary Unidata user has been AVO. Following the 1989-90 eruptions of Redoubt Volcano, information on atmospheric conditions was used to develop a method for determining where a volcanic plume will travel after an eruption. The volcanic plume prediction model was developed as an interdisciplinary project of AVO and the institute's atmospheric science and satellite data processing groups. It uses Unidata's upper-air wind as the core of the database (see *GI Quarterly*, Fall 1990).

Other atmospheric scientists at the institute plan to use Unidata to monitor trace



This figure shows a result of back trajectory analysis done at the Alaska Climate Research Center of the Geophysical Institute. By analyzing previous weather patterns it is possible to trace the route of atmospheric particles from the point of measurement back to their source.

gases and aerosols at high latitudes. Daily back trajectory analysis (see figure) computed with Unidata provides information on arctic haze and trace gases; the back trajectories show where the air we breath today originated. The same principle has been used at GI to construct a forward trajectory analysis-prediction scheme for forest fire smoke during summer. Vertical cross sections of wind field in the troposphere and stratosphere will provide basic information for arctic ozone hole observations and can be used in conjunction with upper-atmosphere rocket observations.

Researchers plan to use data on surface and low-level winds for a sea ice monitoring project related to global change research. Wind data and satellite observations will be used to determine wind driven stress and sea ice drift. Another proposed project is to establish a comprehensive climate database for arctic research that combines satellite data from the Alaska SAR Facility with the NMC weather data now available.

The National Weather Service, of which the NMC is part, is administered by the National Oceanic and Atmospheric Administration. The National Center for Atmospheric Research is administered by UCAR.

Dr. Hiroshi Tanaka

Invention converts hydrocarbons

A University of Alaska invention that electrically converts the weight of hydrocarbon molecules has been granted a United States patent. The inventor is Dr. William Sackinger of the University of Alaska Fairbanks (UAF) Geophysical Institute. A possible use of the device is to convert low-molecular weight molecules, such as methane, into higher weight molecules, such as hexane and octane.

"There are at least nine development steps that must be accomplished before this method can be used in full-scale production," said Sackinger, "but if it does prove feasible for industrial applications, its use could greatly extend the world supply of transportation fuels."

At remote oil fields such as those on Alaska's North Slope, it may be possible to convert methane, the main component of natural gas, into larger petroleum molecules that could be transported by the existing oil pipeline. The device also has the potential to convert methane directly into ethylene and propylene, the building-block molecules for the petrochemical industry.

Sackinger initiated the patent application process in 1987, and applications are pending in many countries. He credits the successful patenting process to former UAF chancellor Patrick J. O'Rourke, who in 1989 established a policy of financial support for patent applications of faculty, staff, and students. The patent, titled "Electrical Device for Conversion of Molecular Weights," is the first to be issued to the University of Alaska.

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Arctic fieldwork challenges students

Editor's note: *This account by Catherine Hanks, abridged for the* Quarterly, *first appeared in the "Brooks Range Geologic Research Program Newsletter" (Feb. 1991), which is published by the UAF Tectonics and Sedimentation Research Group. Hanks, who is participating in the group's integrated geologic studies of the northeastern Brooks Range, will complete her doctorate during the fall semester, 1991.*

Many people are naturally curious about how fieldwork is actually done in such a remote area as the Arctic National Wildlife Refuge (ANWR). We typically get such questions as "Where do you fly from," "How big are your camps," "How long are you in the field," and, most common, "What about **bears?**"

The summer field season for UAF faculty and student geologists begins well before they actually leave for the field in mid-June. Because they will not leave the study area until the end of the season, everything they possibly could need must be packed in advance. Our research is usually conducted from remote camps of only two people. A researcher and field assistant are flown by helicopter to a location in the study area, left for one or two weeks, and then relocated. Careful planning and preparation are required during the weeks and months beforehand to assure maximum safety (and comfort!) during the four- to eight-week stay in the field.

Food is carefully chosen, keeping in mind the amounts needed (some field assistants eat prodigious amounts!), space constraints (canned goods are heavy and take up lots of space), durability (will that cheese still be edible in early August?) and interest (*another* two pounds of Velveeta?!). Once a satisfactory array of edibles has been assembled, it has to be packed in containers impervious to weather, bears, and ground squirrels. We use 20 mm ammunition cans, each holding a five- to seven-day food supply for two and weighing approximately 50 pounds. These are mailed to the main logistical base for our ANWR studies, the arctic coastal village of Kaktovik on Barter Island.

More than food must be gathered; any and all necessities must be flown in, including clothes for any weather, camping gear, and research materials. Safety items are essential: a first-aid kit, shotgun and shells, and radios. And don't forget spare parts like batteries, and the luxuries—books, cards, and chocolate. Each person easily may assemble over 250 pounds of personal gear, not counting food.

Although basic requirements are the same, each researcher has a personal style; one may take a folding chair, another an extensive library, another a hot water bottle, or even a shower tent. The only limitation is that gear and food for each camp must fit in one helicopter load.

The researchers are flown via a local bush airline to Kaktovik, where the U.S. Fish & Wildlife Service station serves as our main logistical base. There, after they locate the first ammo can of food, the geologist, field assistant, and their gear are loaded into a Bell Jet Ranger, and they are off to their first camp. Although they probably won't see anyone other than the helicopter pilot and their adviser for the next two months, the pair will not be totally out of touch. A single-sideband radio is used to maintain daily contact with a group member in Fairbanks, other spike camps, or the base. Someone is usually available in case of emergencies, to confirm camp moves, relay messages, or lend an ear to the field geologist who tends to wax poetic on the geology she is seeing.

Depending on the type of geology being done, the terrain, and the weather, most geologists work in a two- to three-mile radius from camp, though longer *death marches* are not uncommon. Depending on the emphasis of a student's thesis, the work can include mapping, sampling, collecting structural data, or measuring stratigraphic sections. Because the sun doesn't set in the high arctic at this time of year, each pair will eventually set their own schedule—some have been known to work from noon to 3 a.m. With the work of geologizing and maintaining camp, days are very full and never boring. Mosquitoes, July snow storms, vast caribou herds, inquisitive ground squirrels, and an occasional bear are all part of daily life. Every effort is made to keep camps and traverses clean and bear-proof, with minimal impact on the local vegetation and wildlife.

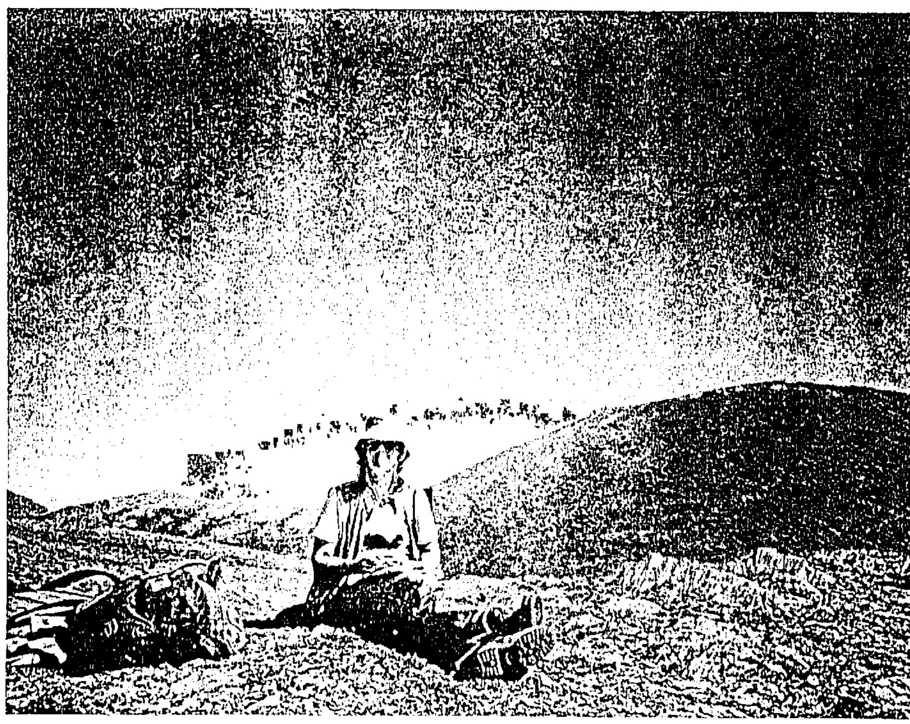
The periodic helicopter moves are eagerly anticipated, with a new ammo can of food, the hope of mail, and the prospect of a new and exciting camp. The helicopter rarely returns from such a move empty. Along with depleted ammo cans and garbage, the pilot comes to expect the ubiquitous load of rock samples that, depending on the study, can weigh several hundred pounds.

And what about bears? Everyone has their bear stories to relate, ranging from a rock-imitating bear who runs at the slightest sound to the bear that seems to enjoy camp life. To date, all bears and geologists have survived their mutual encounters—though it is frequently difficult to tell who is the most frightened! Only occasionally has one of us had to fire a shotgun at a bear, and then only with the intent to frighten the animal away.

At the end of eight weeks, after the final traverse has been made, the last sample bagged, and the last frying-pan pizza consumed, the teams return to civilization with a grand collection of wild stories and tall tales of amazing rocks, incredible mosquitoes, and the bear that finally left camp. The rest of the year is spent in Fairbanks studying maps and captive rocks, trying to more fully understand the geological complexities encountered in the field.

For many this experience will be one of life's most rewarding—an unparalleled opportunity to study the fascinating geology of a remote area of the planet, and in the process, to experience the arctic wilderness in a way few others can.

Hard work, isolation, and beauty are hallmarks of summer fieldwork in the Arctic. Catherine Hanks is shown here in the northeastern Brooks Range, the setting for numerous studies by graduate geology students at UAF (photos by Mary Keskinen).



GI NOTES

ICE TECHNOLOGY—Papers are invited for the 3rd International Conference on Ice Technology (ITC92), Aug. 11-13, 1992, in Boston, Massachusetts. William Sackinger of GI will co-chair the conference, which is organized by the Wessex Institute of Technology and co-sponsored by the Scott Polar Research Institute. Such ice-related topics as physical properties, navigation, ice and wave dynamics, remote sensing, forecasting, ground freezing, and arctic marine transportation will be covered. For more information, contact Sue Owen, Conference Secretariat, Wessex Institute of Technology, Ashurst Lodge, Ashurst, Southampton SO4 2AA, UK. International Telephone: 44 703 293223; International Fax: 44 703 292853.

NEW ASSIGNMENTS—Several administrative changes have been made at GI: Merritt Helfferich is now associate director for institute relations and Robert Grove has been named operations manager. Professor Joe Kan has added part-time responsibilities as associate director for research. Gunter Weller continues to serve as deputy director.

THE PUBLICATIONS office has been renamed the **GI Information Office** to better reflect responsibilities for public information and media relations, as well as publications and special projects. Under supervision of the associate director for institute relations, the office is directed by the institute editor and staffed by a public information officer and a publications assistant. The present editor, Doreen Fitzgerald retires in August.

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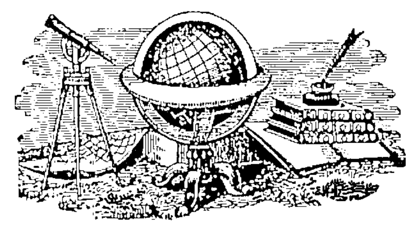
NEW DIRECTOR—Jim Strandberg has been appointed director of the Poker Flat Research Range. He will oversee range operations and the Poker Flat upgrade project. A registered mechanical and civil engineer in Alaska, Strandberg has extensive northern regions consulting engineering and project management experience. He has worked under both federal and university procurement systems and much of his professional experience is in applied research. A lifelong Alaskan, Strandberg holds degrees in mechanical and arctic engineering from the University of Alaska. He and his wife Emiko reside in Fairbanks with their two children.

CONGRATULATIONS TO GI students who completed their degrees during May 1990-May 1991. Ph.D. graduates were space physics majors Da-Qing Ding, Lie Zhu, and Yong Shi, physics major Masatoshi Yamauchi, and geophysics majors Fucheng Li, Timothy Matava, and Lorraine Whitworth Wolf. Earning master of science degrees in geophysics were Patricia Moore, Thomas McSweeney, Rebecca Queen, Takahiro Takeuchi, and Tingjun Zhang. M.S. degrees in physics were awarded to Donald Hampton, Edward Hoch, and Ning Jing, and in space physics to Todd Jack. Earning M.S. degrees in geology were Jennifer Ziegler, Matthew Zukowski, Robert Goff, and Gregg Hakkila.

BENEFIT CONCERT—The second annual "Scientists as Artists" concert of classical music was presented by UAF volunteers in April. Proceeds were donated to GeoCare, the GI employee assistance fund. Performing from GI were professor Juan Roederer, staff seismologist Charlotte Rowe, and Eiluned Roberts, who is a 1991 summer intern at GI. Other performers were Marvilla Davis, Wendy Stofer, Vera Alexander, Ted Cooney, and Charles W. Davis II. Rowe also organized the event with assistance from other GI staff members and graduate students.

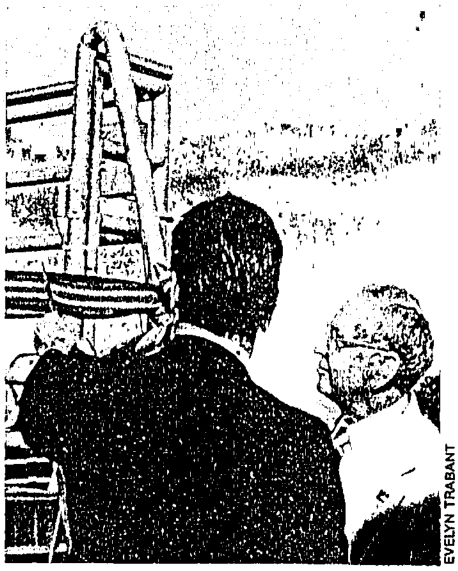
RECOGNITION—Dr. Troy Péwé received an honorary doctor of science degree from UAF in May. Péwé first came to Fairbanks in 1946 to study permafrost, a poorly understood phenomenon at the time. While working for the U.S. Geological Survey, Péwé joined the University of Alaska faculty part-time to head and develop the UA Geology Department, (1954 to 1965). His research helped define permafrost and improved arctic engineering practices. A founder of the International Permafrost Association, Pewe continues to study permafrost throughout the world. At his retirement from Arizona State University he was professor and head of the geology department.

NEW EDITION—The second edition of *Understanding the Aurora* will be available approximately August 1. The 24-page, soft-cover booklet gives an elementary explanation of the aurora and the forces that create it. It can be ordered from the Business Office, Geophysical Institute, University of Alaska Fairbanks, Fairbanks, AK 99775-0800: $1.25 each for 1-10 copies, $1 each for 10 or more copies, postage and handling included.



BOOK AVAILABLE—Robert Hunsucker of the institute has authored *Radio Techniques for Probing the Terrestrial Ionosphere*, which describes basic principles, capabilities, and limitations of all generic radio techniques used for ionospheric research in aeronomy and space physics. It will help readers interpret ionospheric data and select techniques for specific research problems. An extended annotated bibliography of salient papers is included. Order from Springer-Verlag, Heidelberger Platz 3, W-1000 Berlin 33, F.R. Germany for $135 U.S. (Visa, American Express, or MasterCard accepted).

THE FINNISH ACADEMY of Technology has elected GI professor William Sackinger a foreign member, an honor given to non-Finnish citizens for special merit in technical scientific research. The academy is an independent, nonprofit group organized to promote technological research and development and to consider the societal effects of technology. Sackinger is particularly interested in the academy groups for energy efficiency and consumer welfare, the environment and crucial limits for technology, and education and international competitiveness. He also chairs the international advisory board of the Arctic Center, a research institute at the University of Lapland in Rovaniemi, Finland, and coordinates the cooperative research agreement between UAF and the Technical Research Center of Finland.



EVELYN TRABANT

John Miller looks on as Jeff Hilland symbolically opens ASF by cutting a ribbon on the antenna. Hilland is ASF task manager for the Jet Propulsion Laboratory; Miller is Alaska SAR Facility technical director.

Satellite station

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remote-sensing platforms, but also archiving and distributing data to scientists throughout the United States and abroad.

In contrast to one mammoth centralized repository and ordering facility, the EOS program has opted to disperse the archiving and distribution functions among regional centers that specialize according to scientific discipline, data holdings, or both. The Alaska SAR Facility serves as the national repository for satellite SAR data, as well as conventional weather-satellite and Landsat images, for coverage of arctic areas.

In late April, an international audience visited the Geophysical Institute to attend ASF ribbon cutting ceremonies marking completion of the facility. At the opening ceremony, Stan Wilson of NASA headquarters outlined the history of ASF, following brief speeches by GI Director Syun-Ichi Akasofu, University of Alaska President Jerome Komisar, and Jim Hasselberger from the Office of the Governor.

Construction for ASF began in 1988, after NASA selected the University of Alaska Fairbanks as a SAR facility site. A 10-meter antenna, built by Scientific-Atlanta and installed on the roof of the institute, is the most visible component of the facility. On the institute's main floor, control equipment and computers were added. By early 1991 the SAR processor and computers for the archive and operations system had arrived, and by April, the operational readiness review was completed. The project now employs a staff of approximately twenty people at the institute.

Invention

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"Professor Sackinger's innovative approach to this problem represents the kind of creativity that is vital to research at the Geophysical Institute," said Dr. Syun-Ichi Akasofu, institute director. "Our staff is encouraged to explore ideas of potential value to Alaska, and we look forward to the successful application of Dr. Sackinger's work."

Under an initial $177,000 grant from the U.S. Department of Energy, the pressure and voltage conditions for best operation of the device are being investigated by Sackinger and by Vidyadhar Kamath of the UAF Petroleum Development Laboratory at UAF in a joint program with Brian Morgan and Robert Airey of Imperial College, University of London.

Sackinger said his device applies some of the same physical principles of ion production and movement that take place in the aurora borealis, but with the addition of many tube surfaces to increase reaction rates.

"The invention uses an electron source to ionize natural gas which is at room temperature and at one-thousandth of atmospheric pressure," he said. "An electrical voltage is used to accelerate the ions in the low-density plasma. The ions are allowed to strike the inside surfaces of many small tubes, where they combine with gas atoms already absorbed there to form larger hydrocarbon molecules."

By repeated application of this process, natural gas can be changed into liquid fuels. Heavy oils can also be cracked, hydrogen added, and they can be changed into lighter hydrocarbon molecules. The process can thus change either methane or heavy oils into liquid fuels that are easy to move through pipelines and to use in vehicles.

Initial experimental results have shown conversion of methane into ethane and other light hydrocarbons, and a technical report is in preparation.

With 32 years of professional experience, Sackinger's research has spanned many specialties in geophysics and electrical engineering. Along with his present work on the electrical conversion of methane, his research at UAF has covered such topics as corrosion of arctic pipelines and arctic offshore structures, ice island generation and movement, spray sea ice, and environmental assessment in arctic development. He has been a member of the Geophysical Institute research faculty since 1970.

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