From the Director

Sharing the Products of Publicly Funded Research with Students

Earlier this year the Geophysical Institute came under sharp criticism in the State Legislature and the press for what was perceived as a very low classroom credit-hour production by its faculty. Similar criticism also went to other research units, to the point that a Legislative Intent was written into the FY84 university budget appropriation:

"...the Legislature...finds...that too many faculty members are engaged full-time in research activities and do not teach in the classroom...The University must take measures to share the products of publicly funded research with students by requiring, wherever possible, that all faculty teach."

Let me state forcefully at the outset: in graduate education in the sciences, the sharing of research findings between faculty and students does not occur in scheduled classroom teaching. Instead, it is accomplished in joint faculty-student research work that knows no formal time bounds — in the laboratory, in the office, in the field, at the computer terminal, through graduate student advising, thesis direction and seminars. None of these activities appear in the form of credit hours taught by faculty or taken by students.

The three functions of a university are usually described as Teaching, Research and Public Service. I don't like this over-simplified, rigid subdivision. Rather, I prefer to cite two totally intertwined functions: the sharing of knowledge and know-how, and the creation of knowledge and know-how. The sharing of knowledge is with students, among the faculty, and with community, state, country and world at large. Transmitting knowledge to undergraduate students indeed is done mostly in the classroom, in the studio and in laboratory classes. At the graduate level, however, the main instructional function is to teach how to create knowledge and know-how. Here, creativity becomes an integral part of the instructional function — but creativity cannot be taught in the classroom. The main mission of graduate education, rather than passing knowledge on to the student from a textbook, is to immerse the student in an environment of incessant challenge, new ideas, critical analysis, failure and triumph, doubt and self-examination. Only through a one-to-one interaction between student and advisor, between student and apparatus, between student and data set or student and computer, can the goal of graduate education in science and technology be achieved successfully.

The 41 Division of Geosciences full-time faculty members currently available for instruction and research have a total of 110 graduate students; 37 of these are carrying out dissertation research at the Geophysical Institute. This graduate student to faculty ratio is normal in frontier sciences like those covered by our Institute. An important factor in attracting graduate students to study science in Alaska is the availability of adequately remunerated assistantships, which at the Geophysical Institute must be paid by external grants and contracts — there is no budget item for this in our state appropriation.

All this does not mean that our faculty do not teach in the classroom. Eighteen Geophysical Institute research professors (and two research associates) are currently teaching 22 courses with a total of 59 1/2 course credits. Several of these courses belong to departments in other Colleges. An important factor limiting Geophysical Institute faculty in formal classroom teaching is the budget-driven pressure on our faculty to "scramble" for external, mostly federal, support of their activities.

It is essential to find a quantitative expression of the instructional activities of research faculty that reflects fairly and accurately actual faculty effort and time devoted to graduate students. Perhaps an even more important and more basic task for us is that of sharing more effectively with the public the notion of what a real university is.

Juan G. Roederer
Alaska is a vast and magnificent natural laboratory for snow, ice and permafrost research. Ice, in its various forms, affects almost every facet of life in high latitudes. Sea ice covers the waters of the Beaufort, Chukchi and Bering Seas for up to ten months of each year. Alaska has more glaciers than any other region outside of Antarctica, the high Canadian Arctic and Greenland. Rivers and lakes may be ice-covered for nine months of the year; the seasonal snow cover blankets the state annually. Permafrost, perennially frozen ground, underlies about three-fourths of the state and most of the continental shelf under the Beaufort Sea.

For graduate students interested in studying these phenomena, it is easy to see why this unique laboratory would be an attractive “schoolroom.” Those who come to the University of Alaska and are accepted into the Snow, Ice and Permafrost Geophysics Program will undertake a double commitment. First, they must master the requisite coursework. Classes offered in the Program, for example, include Snow and Ice in the Environment, Sea Ice, Permafrost, and Glaciers. Second, they become scientific apprentices, working with one of the Institute’s faculty members on a research project. The choice and definition of this project is a complex challenge: the project should be compatible with the student’s interests and abilities; though it is usually closely related to work being done by the student’s major professor, it must be independent research - a thesis or dissertation will come from the study, and is required to represent an advancement of knowledge; finally, it must be work for which funding is available, which usually means it must be a topic of interest to a federal agency.

But the opportunities are so great that an able student always can find an appropriate project. High-latitude research forms the focus for most of the activities of the Geophysical Institute. The study of snow, ice and permafrost falls under many disciplines which have diverse objectives that range from a fundamental physical understanding of the properties and processes of ice and permafrost to solutions of environmental and engineering problems.

A typical project undertaken to gain an understanding of the fundamental physical process of glacier surging is a study of Variegated Glacier by Dr. Will Harrison of the Geophysical Institute.

As we reported in Vol. 1, No. 2 of the Quarterly, Variegated Glacier near Yakutat has been surging for about a year and a half. Dr. Harrison, along with Dr. Charles Raymond of the University of Washington, Dr. Barclay Kamb of the California Institute of Technology, and other American and European scientists, students and technicians, has been monitoring the glacier for 10 years to learn more about what causes glaciers to surge. Variegated has been known to advance roughly once every 20 years; the last major surge was detected in 1964. The latest surge began in early 1982 and stopped abruptly on July 5 of this year.

The Variegated Glacier team measured the surface motion of the glacier by surveying techniques and with automatic cameras, and made special measurements with seismometers, strainmeters and tiltmeters. They used boreholes for TV observations of the glacier bed and measurements of ice deformation and subglacial water pressure, and observed the stream draining the glacier.

The maximum speed of glacier movement observed during the height of the advance was about 70 m (210 ft) per day. Water vapor streaming from crevasses in midwinter, and a close correlation between drops in glacier speed and floods originating under the glacier, leave little doubt that water is a key factor in the process. Probably the failure of water to drain through the glacier leads to some kind of partial floating and rapid motion. The advances are most likely linked to the instability of the glacier itself and are not climate related.

The surge of data acquired has rivaled that of the glacier itself in magnitude, and the team will be very busy for several years reducing and interpreting it.

In these aerial photos of Variegated Glacier taken approximately one year apart, one can see the changes caused by the most recent surge which began in early 1982 and ended on July 5, 1983. The last major surge was detected in 1964.
Graduate training is an integral part of the Geophysical Institute's responsibility. Incoming graduate students are put to work on a thesis research project in addition to their course work. This ensures training in the techniques of observation and analysis and an early acquaintance with the literature and current issues of geophysics. Most important, it encourages students' scholarship and creativeness through closer association with activities of the staff. They are also expected to participate fully in the life and aspirations of the Institute as a part of their broader training. With this kind of experience, graduates are well equipped to become productive members of the scientific community.

Our graduates have been successful in Alaska as well as in various parts of the world.

Dr. John Davies, graduate from the Geophysical Institute and presently State Seismologist for the State of Alaska (see entry below) recently compiled some interesting statistics on our graduates in the field of Solid Earth Geophysics (our other graduate study program in Space Physics and Atmospheric Sciences is discussed separately below). For the period 1962-1983 there were 109 graduates with M.S. or Ph.D. degrees. For the 99 out of the 109 which he could trace, here are some statistics on where they are and what they do.

<table>
<thead>
<tr>
<th>By location:</th>
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<tbody>
<tr>
<td>Alaska</td>
<td>53%</td>
</tr>
<tr>
<td>Lower 48 States</td>
<td>35%</td>
</tr>
<tr>
<td>Foreign Countries</td>
<td>12%</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>By employment:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Industry</td>
<td>45%</td>
</tr>
<tr>
<td>(Oil &amp; Mineral</td>
<td>Exploration)</td>
</tr>
<tr>
<td>State of Alaska</td>
<td>20%</td>
</tr>
<tr>
<td>(incl. teachers, professors)</td>
<td></td>
</tr>
<tr>
<td>Federal Agencies</td>
<td>10%</td>
</tr>
<tr>
<td>Ph.D. Students</td>
<td>10%</td>
</tr>
<tr>
<td>Other</td>
<td>15%</td>
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</tbody>
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Almost all of these graduates (96%) stayed in the general field of solid earth geosciences (as opposed to selling furniture, etc.). A relatively large number (10%) are in charge of major programs, either as directors, vice presidents, chairmen or chiefs of industry, government or academic groups.

In our other graduate study program, namely Space Physics and Atmospheric Sciences, 105 men and women graduated between 1957 and 1983 (53 of them with Ph.D. and 52 with M.S. degrees). Although we do not have exact statistics for this group at present, we know that many of them stayed in Alaska, while others became prominent in other national and foreign scientific institutions. Below is a random sampling of only a few of the 214 graduates of both the Solid Earth Geosciences and Space Physics and Atmospheric Sciences Programs.

**A Sampling of Our Graduates...**

**BENJAMIN NICHOLS** (Ph.D. 1957) is a professor at Cornell University at Ithaca, New York. He was one of the developers of the Arecibo radar installation, which tracks radio signals from deep space and is one of the prime tools of radio astronomy in the world.

**ROBERT S. LEONARD** (Ph.D. 1961) is Director of the Radio Physics Laboratory of SRI International at Menlo Park, California. He has been active in developing ways to monitor nuclear test ban tests, both in the atmosphere and underground.

**T. NEIL DAVIS** (Ph.D. 1961) is now retired and a Professor Emeritus at the University of Alaska. Dr. Davis has remained active in his efforts to educate the Alaskan public in scientific matters of general interest through newspaper columns and his books "Alaska Science Nuggets" (1982) and "Energy/Alaska" presently in press.

**SYUN-ICHI AKASOFU** (Ph.D. 1961) is a professor at the Geophysical Institute. A prominent scientist with numerous awards and recognitions from within the U.S. and abroad, he is active as an educator and has trained a large number of graduate students at the University of Alaska.

**LAWRENCE R. MAYO** (M.S. 1963) is Project Chief of the Cold Regions Hydrology Project Office of the U.S. Geological Survey in Fairbanks. His field of activity covers the study of Alaskan glaciers and their hazards, including outbursts from glacier-dammed lakes, surging glaciers and iceberg calving from Columbia Glacier.

**RICHARD D. REGER** (M.S. 1964) is Chief of the Minerals and Materials Inventory Section of the Alaska Division of Geological and Geophysical Surveys in Fairbanks. His responsibilities include the statewide inventory of minerals, gravel and other resources.

**CHARLES B. FAHL** (M.S. 1965, Ph.D. 1973) is owner-manager of Alaska Environmental Consultants, a consulting firm in Anchorage specializing in meteorological, climatological and environmental matters of concern in Alaska.

**BENSON FOGLE** (Ph.D. 1966) is Program Manager of Polar Atmospheric Sciences at the Division of Polar Sciences of the National Science Foundation in Washington, D.C., which sponsors research in both the Arctic and the Antarctic.

**JOHN O. ANNEXSTAD** (M.S. 1966) is Associate Curator for Lunar Samples at the Johnson Space Center in Houston, Texas. He is involved in the study of lunar rocks brought back by the Apollo missions as well as meteorites that fell in Antarctica.

**JOHN S. BOYD** (M.S. 1968, Ph.D. 1973) has become the head of the Antarctic Policy and Transport Study section at the Australian National Antarctic Research Expeditions in Hobart, Australia.

**ALAN D. JOHNSTONE** (Ph.D. 1970) is a Research Fellow in the Department of Physics and Astronomy of University College, London, working on the measurement of energetic particles in the aurora by using sounding rockets.

**JOHN N. DAVIES** (M.S. 1970, Ph.D. 1975) is State Seismologist for the State of Alaska and responsible for assessing the seismicity of the State and the hazards posed to the population, roads, bridges and buildings in the state by earthquakes, ground motion, tsunami, etc.

**A. LEE SNYDER** (Ph.D. 1972) is now a colonel in the Air Force and was recently cited by the editors of *Aviation Week & Space Technology* for his significant contributions in the field of over-the-horizon radars.
Recent Grants and Contracts

Why would scientists in Alaska study processes in the atmosphere, the oceans and the earth's interior which occur as far away as the Antarctic? Because in order to understand Alaska, it is often necessary to look at our entire “Spaceship Earth”, and particularly other polar areas which are linked to Alaska by similarly occurring processes. Geophysical Institute professors and graduate students are currently involved in studies of areas outside Alaska as discussed below.

IONOSPHERIC STUDIES IN GREENLAND

A large radar, formerly located at Chatanika, Alaska, near Fairbanks, was recently moved to Sondrestrømfjord on the west coast of Greenland to continue studies there of the ionosphere at heights from 100 to 500 km (60-300 miles) above the earth's surface. The region of particular interest is the cusp region of the earth's magnetosphere (see Encyclopedia Geophysica, Quarterly Vol. 1, No. 4). Professor Brenton Watkins has received a grant from the National Science Foundation to study these phenomena through the use of the radar.

EARTHQUAKES AND VOLCANOES IN ANTARCTICA

Alaska has over 40 active volcanoes and numerous very intense earthquakes each year. These violent events occur in a belt around the entire Pacific Ocean, the so-called “Ring of Fire” which has its origin in the movement of the Pacific Plate, due to continental drift. South of the Pacific Plate, volcanism and earthquakes also occur in Antarctica, for example at Mt. Erebus, which is located close to the U.S. antarctic support base in McMurdo Sound. Professor Jürgen Kienle is studying the volcanic and seismic activity of Mt. Erebus through a network of five seismic monitoring stations, some precariously located on the ice-covered, wind- and snow-swept slopes of the volcanic cone. The funding for the project is provided by the National Science Foundation.

SPITSBERGEN STUDIES

Spitsbergen, officially called Svalbard, is located at 78°N latitude (about 400 miles closer to the North Pole than is Pt. Barrow) at the boundary of the North Atlantic and Arctic oceans. The Geophysical Institute has a battery of equipment with which the aurora is observed and measured. This is one of many stations throughout Alaska, northern Canada, Greenland and northern Europe from which different parts of the auroral oval (see Encyclopedia Geophysica, Quarterly Vol. 1, No. 4) are studied. Our graduate students get part of their education in viewing and studying these phenomena that encircle the North Pole. Professor Charles Deehr is in charge of the studies at Spitsbergen, which are funded by the National Science Foundation.

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