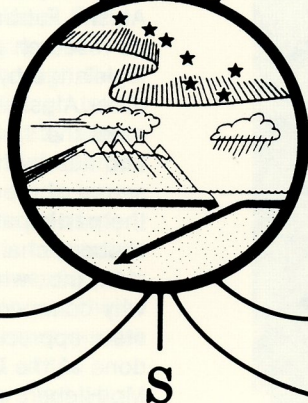




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Research in Alaska by Alaskans

Alaska represents one sixth of the U.S. land surface, and much of Alaska is located at latitudes generally referred to as "Arctic." As a matter of national policy, the United States has sponsored, and will continue to sponsor, research oriented toward understanding processes and phenomena related to the Arctic. The vast majority of the research projects to be supported by national funds will be concerned with science related to national interests, such as climate change and space science.

Competition to perform arctic research is nationwide. There is no guarantee that the work will be done by researchers based in Alaska, though there are advantages to Alaska if the work is performed by Alaskans. First, and most obvious, is the financial impact. Second, and less obvious, is the greater chance that the results of the research will lead to some direct benefit for Alaskans and the development of the Alaskan economy. It is more likely that Alaskan scientists will recognize how the results of their research can be channeled to solve Alaskan problems or aid Alaskan resource development.

In his monthly newspaper column, Dr. William R. Wood, retired president of the University of Alaska, recently discussed the benefits to Alaska resulting from actively attracting federal research dollars. Dr. Wood called attention to the amount of money spent on logistical support in the private sector by scientific field parties in Alaska and the adjacent Arctic, and the fact that there is no organized Alaskan effort to capture those logistical dollars. As a result, he said, many of those funds are spent outside Alaska. He also stressed the need for Alaska to take an active lead in arctic research, and he pointed out the necessity of financial commitment to capturing that position.

We shouldn't assume that research will come to Alaskan researchers simply because they are located here. Without supporting institutions and facilities, it is very likely that most, if not all, of this research would be done by scientists from elsewhere, visiting Alaska as briefly as possible to take the data they need and then returning home. A significant fraction of U.S.

arctic research is performed this way; such projects spend only a small portion of their budget in Alaska. In fact, the aim of these researchers generally is to keep field costs at a minimum.

Scientists based in Alaska, on the other hand, spend nearly all the budget of their project within the state. It is not a trivial contribution to the state's economy; research funding during fiscal 1987 for UAF alone amounted to \$17 million.

How does Alaska maintain and develop this industry? Nearly all the federally sponsored research awarded to Alaskans by grant and contract is performed within Alaska's university system. In order to be competitive in the hunt for these research dollars, a university must have in place the sophisticated facilities required for the research. Other states are aware of this as well, as demonstrated by the recent scramble by 35 states to provide a home for the superconducting super collider. They all realized that the existence of the super collider in their state would attract a great portion of the U.S. nuclear physics budget. On a much smaller scale, Alaskan scientists require a variety of modern, up-to-date and well-maintained laboratories to attract the U.S. arctic science dollars.

These laboratories need not be truly expensive, but there must be a commitment to keep them up-to-date in terms of equipment, maintenance and management. Such facilities usually serve a variety of users, none of whom could be expected to provide the time or even have the skills actually to manage the laboratory. To be effective, each laboratory must have a budget that is largely independent of service charges.

Not only does Alaska benefit financially from federally funded arctic science, but occasionally there are spin-offs that directly benefit Alaskans or lead to development of Alaskan resources in ways which could not have been anticipated at the time the research was conducted. This issue of the *Quarterly* describes some of these beneficial results and how they came about.

Bill Stringer
Guest Editor

Getting the Seismic Picture



A home destroyed near Anchorage during the 1964 earthquake. Seismology research such as that done at the Geophysical Institute is essential in predicting where earthquakes will occur. (J. Townsend photo, College Observatory collection.)

The problem seemed simple: knowing that their building was to stand in Alaska, the engineers designed a warehouse that would hold up (as well as anything can) in a Richter magnitude 8 earthquake. The warehouse's owners were upset over the high construction cost — building to withstand a great earthquake doesn't come cheap. They went for a second opinion: they called the Geophysical Institute.

Was this another case of a business trying to save money dangerously? No. The warehouse was to be erected on the North Slope, and the North Slope is not in a high-risk seismic zone. The Institute's seismology researchers were able to reassure both the owners and the engineers about structural requirements. With no loss in public safety, the owners were able to save more than \$1 million.

What if there had been long-term local residents to tell the engineers that the Slope didn't have earthquakes? All that might mean is that earthquakes are rare. No one now alive, for example, experienced the great quake that shook the southeastern United States early in the last century, and the denizens of Dixie don't think of themselves as living in earthquake country. Yet civil engineers from Alabama to Maryland are now aware that designing for strong ground motion is necessary in their part of the country; the record is in the rocks as well as the archives, and such an earthquake probably will come again. Conversely, a high fre-

quency of earthquakes does not necessarily indicate high risk of a very strong earthquake. Along the creeping section of the San Andreas Fault in central California (north of Parkfield), for example, there are many earthquakes of magnitude 3 or less, but no record of large quakes of magnitude 6, 7, or 8.

Right now, the only way to predict earthquake hazard is statistically, by studying the records, analyzing them, and extrapolating from them. The better the records, the better the chances of predicting accurately. Part of the record, as noted above, is in the earth itself. Geologists, using every tool from rock hammers to sophisticated sensors aboard satellites, have found dateable offsets on faults that give information on recurrence intervals and magnitude as well as locations of past earthquakes.

But the most useful records are those from continuously operating seismic networks. *Continuously* is a highly significant word here, because earthquakes occur sporadically, separated sometimes by decades. It takes many years of monitoring and data gathering to accumulate the information necessary to understand the seismic hazard of a particular region. It's essential that the monitoring networks receive reliable governmental support in order to accumulate long-term records of seismic activity that can then be available when needed for planning a specific project for a specific location.

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Staying in Touch

A few years ago, the University of Alaska Fairbanks attempted to explain its research programs to the state legislature by inviting legislators and other Alaskans to the campus, to meet the scientists, visit laboratories and nearby field stations, and get a sense of the activities here. Among the participating citizens was Augie Hiebert, chairman of Northern Television, Inc., who volunteered to explain why commercial radio stations in the state appreciated the basic research done at the Geophysical Institute. Mr. Hiebert should know; he helped start station KFAR in Fairbanks in 1939, then KFRB in 1948, and now controls 5 stations in Fairbanks and Anchorage.

For a radio wave, the far north is very inhospitable environment. Roughly put, an AM radio signal treats the nighttime ionosphere (the layer of the atmosphere that's 100 to 300 km above the earth) as a mirror, travelling up to and bouncing down off it to a receiver. In the temperate zone that "mirror" can be seen as fairly smooth and predictable, but in the high latitudes it is extremely variable and complex, changing with the time, season, sunspots, shifts in the earth's magnetic field, auroral activity and other factors. The ionospheric mirror here effectively has lumps, dips, even holes; the radio waves can go every which way, and the waiting receivers may pick up gusts of static, fading and surging signals, stray broadcasts from hundreds of miles away, or nothing at all.

Successful broadcasting, then, has depended on finding the right radio wave propagation principles for the north. That is where Institute researchers have come in, with their knowledge of the aurorally disturbed ionosphere and its effects on radio wave propagation. They helped select the best frequencies, beam direction and other adjustable features for making the broadcast band work, and today there are many stations broadcasting successfully throughout the state without interference from "station side" stations. Further research is still being done, with support from the Federal Communications Commission to determine which broadcast band channels should be assigned to stations in Alaska and in the northern tier of the contiguous U.S.

— Successfully

Two-way communications have also been challenging for Alaskans. Early in this century, the U.S. Army constructed telegraph lines through the Yukon and Alaska. Even though telegraph wires can be affected by auroral storms, this historic project helped the communities along the line to stay in touch and to obtain needed medical advice and other emergency assistance. But more was needed. As two-way radios were developed, their use expanded to link the more remote communities with the rest of the world. Because the radios used were operated in the frequency range of 2 to 15 MHz, frequencies at which radio waves are reflected from the ionospheric "mirror," two-way radio communications were often subjected to "blackouts," and like the one-way broadcasts, were generally unreliable.

By the mid-60s, experimenters at the Geophysical Institute, who had been studying radio transmission and reflection and the changes in the earth's atmosphere caused by the aurora, had learned which radio frequencies were least affected by auroral events and other ionospheric changes. With support from the National Institutes of Health, an experiment in the early 70s tied the Public Health Service hospital in Tanana with several villages as well as the large Alaskan urban centers. Inexpensive VHF (Very High Frequency) transmitter/receivers, operating in the 135 to 149 MHz range, were linked via a satellite in geostationary orbit over the equator, directly south of the center of Alaska. Initially the network was used to transmit medical information and education materials. The method proved so useful for transmitting information quickly and without auroral interference that it was soon duplicated in other communities and expanded to include other information.

Nowadays Alaska's high-tech communications systems are a model for other parts of the world where the problems of staying in touch are abnormally great — even areas without aurora have sent observers to see how we do it. In that transition from backward and remote to well-connected and up-to-date in the means of staying in touch, the Geophysical Institute has had a strong hand in helping Alaska.



Geophysical Institute researchers are shown drilling a rock core sample in Kachemak Bay. The direction of the magnetic field in bedrock helps define the "terranes," and thus aids in locating gas, oil, or mineral deposits. (D. Stone photo.)

Tracking Terranes for Fun and Profit

It is seldom clear where research will lead or what the applications will be. Consider: in the 1960s the development of new sensitive magnetometers made it possible to measure very weak magnetic fields trapped in rocks as they were forming. Modern magnetometers can measure fields as small as one billionth of the earth's field in rock samples as small as one inch in diameter.

As rocks form initially, the magnetic minerals included in them align so that a rock becomes magnetized with the same orientation as the earth's magnetic field. In most rocks this record of the earth's field is very stable, so if a rock is found to have a magnetic field that is at an angle to that expected for its location, it can often be demonstrated that the whole rock unit has moved since it was formed. Once the equipment for measuring weak magnetic fields was available, researchers could utilize the technique of measuring the ancient (paleo) magnetic fields of rocks and then estimating their original (as compared to their current) locations, and the paths they followed to get where they are now. This work was instrumental in developing the idea of continental drift, the hypothesis that large sections of the earth's surface are gradually moving and changing the geography of the continents and oceans.

Geophysical Institute researchers using these paleomagnetic tech-

niques found evidence that the best way to explain the discontinuous geologic makeup of Alaska was by using a model in which chunks of land called "terranes," varying in size from a few tens of miles up to hundreds of miles long and wide, and each with its own unique geologic history, had drifted together over millions of years.

Determining the planet's history and processes is scientifically satisfying in itself, but the work also has significant practical results. Knowledge of terranes is very important to understanding the patterns of mineralization and fossil energy deposits in Alaska. Minerals tend to occur in the collision zones, where a lot of volcanic activity is generated, and petroleum develops in large basins where significant amounts of organic remains collect. The formation of economically usable deposits also requires that the organic remains be heated to form oil and gas, which are then trapped in porous rock and capped or sealed in by impervious rock. Since the jostling of the terranes can either produce or destroy these needed conditions, an understanding of the movements of the terranes is important to locating exploration targets for both the petroleum and the mineral industries. Thus, tracking the movement of the Alaskan terranes, a continuing research effort at the Geophysical Institute, is not only interesting but useful.

One of the tools developed using accumulated seismic data is the seismic zone map, which engineers find useful in planning for earthquakes. The Uniform Building Code Seismic Zone Map utilizes five zones of increasing earthquake hazard. The assignment of these zones is based on historical records of the locations, frequency and severity of earthquakes: zone 0 is the least hazardous, where earthquakes either do not occur or are not strong enough to be felt, and zone 4 is the most hazardous, needing the most earthquake-resistant structures. The map is published as part of the Uniform Building Code, so it is easily accessible, but the Geophysical Institute seismology lab occasionally gets requests for help in interpreting the map and for additional information. (That was the case with the North Slope warehouse reported above; incidentally, the Slope is in zone 1.)

Seismology research has proved its usefulness time and again, and must continue uninterrupted to provide seismic information that can be used for future planning as well as in the development of earthquake prediction capabilities. Eventually we'll not only be able to build our buildings to withstand any earthquake that might occur in its area, we'll also be able to predict when and where an earthquake will occur.

Recent Grants and Contracts

Benson to Work on More Snow

Dr. Carl Benson has been granted \$73,010 by the U.S. Department of Energy, to extend his "Research on the Seasonal Snow of the Arctic Slope" plus a \$7,000 supplement to his National Aeronautics and Space Administration grant for "Remote Sensing of Global Snowpack Energy and Mass Balance; In Situ Measurements on the Snow of Interior and Arctic Alaska."

The nine-month seasonal snow cover in the Arctic, and its melt processes, constitute an important aspect of the hydrology of the area, and have an interactive effect on the distribution of some plants.

Dr. Benson's studies will not emphasize snow in isolation, so to speak. His research involves the role of snow as a participant in the geophysical and biological processes of the far north and will include analyzing the chemistry of the snowpack; determining the heat and mass transfer between snow, its substrate, and the overlying atmosphere during the melt period; and interpreting the interaction between snow and vegetation.

Monitoring Bradley Lake Seismicity

Dr. Niren Biswas has received a grant of \$45,025 from the Alaska Power Authority for monitoring seismic activity in and around the Bradley Lake Hydroelectric Project site on the Kenai Peninsula.

At present, a network of eleven vertical-component seismographic stations is operated on the Kenai Peninsula by the University of Alaska Fairbanks and the U.S. Geological Survey. This network monitors local and regional earthquakes routinely. To increase the capability of the network, there are plans to supplement it with a high-gain three-component (vertical, north-south, east-west) digital station at the Bradley Lake Hydroelectric dam site in 1988. Also, there are plans to install two digital three-component strong-motion seismographic stations at the dam site in 1989. Data for the entire network will be recorded at the Geophysical Institute for continuous assessment of earthquake activity in the Bradley Lake area.



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