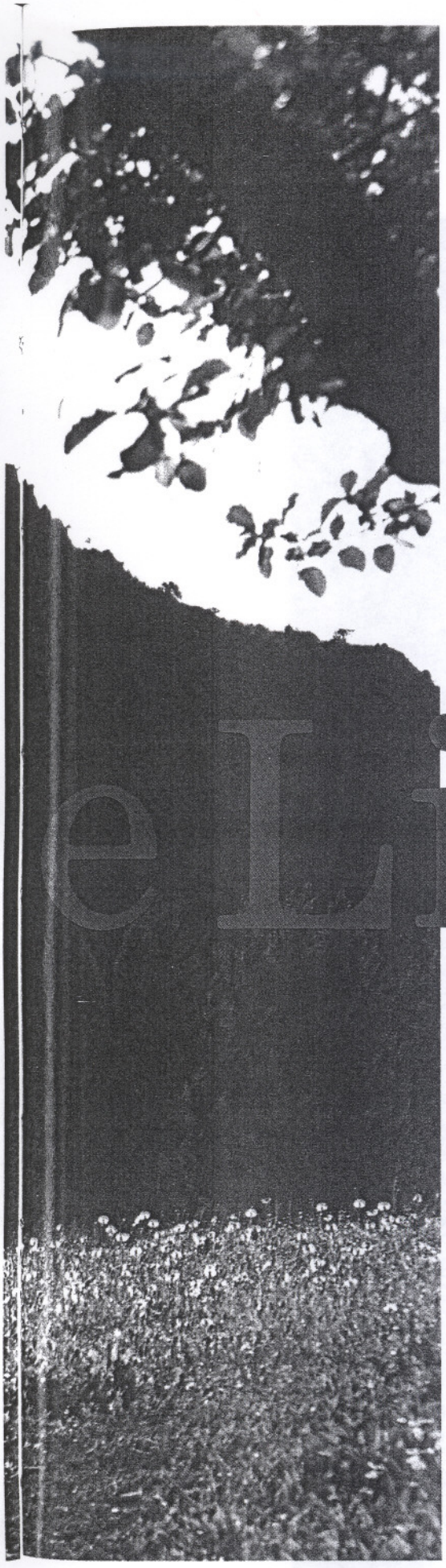


Easing into the cloudless sky, the small plane reached cruising altitude and leveled off above the desert. The meteorologist aboard scanned the earth for any signs of moisture. Old trees stood jagged, limbless, and pointing, as he noted an old red barn, weathered and half covered by a sand dune. So this was the desert Midwest. His grandfather told him there was once row after green-silver row of corn stalks, that twisted and waved in summer storms of pewter sky and wind-blown rain. He said in late summer you could walk the rows, hidden, with soft brown earth threading perfect aisles between the growth, and swollen ears of corn nestled in the stalks. It was hard for him to imagine, but of course, that was before the fever, or, as the scientific community had long ago labelled it, global warming...

Limits:

Have We Gone Too Far?

Story and Photos by Debbie Pitner Moors

It's a bleak scene scientists have been predicting will result from the global warming trend, possibly caused by the greenhouse effect. Scientists worldwide warn that steps must be taken to help slow, and possibly reverse, global warming, or the complexion of the planet may change forever.

Using data from "global circulation models," researchers predict what temperature changes will mean. The global warming trend may be tied to levels of carbon dioxide (CO2), methane, and chloroflourocarbons, all "greenhouse" gases.

CO2 creates a "shield," allowing the sun's radiation to reach the earth and blocking the escape of heat radiating upwards. Methane compounds the problem, as it rises from swamps, bogs and fecal material. As CO2 causes warming, the swamps will heat up, increasing the methane released.

Scientists also know that chloroflourocarbons "scavenge" the stratospheric ozone that protects the earth from large amounts of the sun's harmful ultraviolet radiation.

So the scene is set for a cycle that spirals upwards, with the temperature rising as it goes.

In itself, a warmer earth might not seem so ominous. But according to most predictions, there is more to the greenhouse effect than hot, sunny days. Whole climates – and economies with them – will change dramatically. Weather will go to the extremes, from very hot to very cold and from drought to flooding.

By analyzing air bubbles trapped in Greenland and Antarctic ice sheets as long as 150,000 years ago, researchers determined the earth's temperature cycles. They found that an average temperature change of about four degrees centigrade takes place on earth in a cycle of warming and cooling, with warm eras followed by glacial periods. Yet the time between the change may have been as long as 10,000 years – plenty of time for most animals and plants to migrate, adapt, and survive.

Scientists believe the earth was recently at the peak of a warm cycle, and was heading toward a cooling period – leading to an ice age in possibly 7,000 to 10,000 years. But as early as the late 1950s, temperatures began to rise. While slight fluctuations aren't uncommon, the predicted temperature increases, influenced by the greenhouse gases, concern scientists.

If, as many scientists are predicting, the temperatures rise too quickly, animals and plants will be at grave risk. Some of the nation's scientists believe that recent droughts indicate changes have already started.

What does a four degree temperature change really mean? Many scientists feel that changes as severe as expected would melt the polar caps, causing ocean levels to rise more than six feet. The American Midwest may be drier by as much as 40 percent. Plants and animals will not have enough time to migrate, and will also face manmade barriers such as fences, cities, and highways.

Karl Stoszek, a UI forestry professor, explained the problems facing species of trees. "The most quickly dispersed trees can migrate possibly one-hundred kilometers (about forty miles) in a century. The climatic conditions for some plants will be displaced by up to six hundred kilometers (two hundred and forty miles) during the same period," Stoszek explained. "We are facing a potentially enormous problem, and it has to be solved through international efforts."

Studies are being done worldwide to address the issue and, at the UI, researchers are providing information by which the situation will be assessed.

The College of Forestry, Wildlife and Range Sciences has begun cooperation with the Soviet Union, and research will involve the UI's Taylor Ranch Wilderness Field Station.

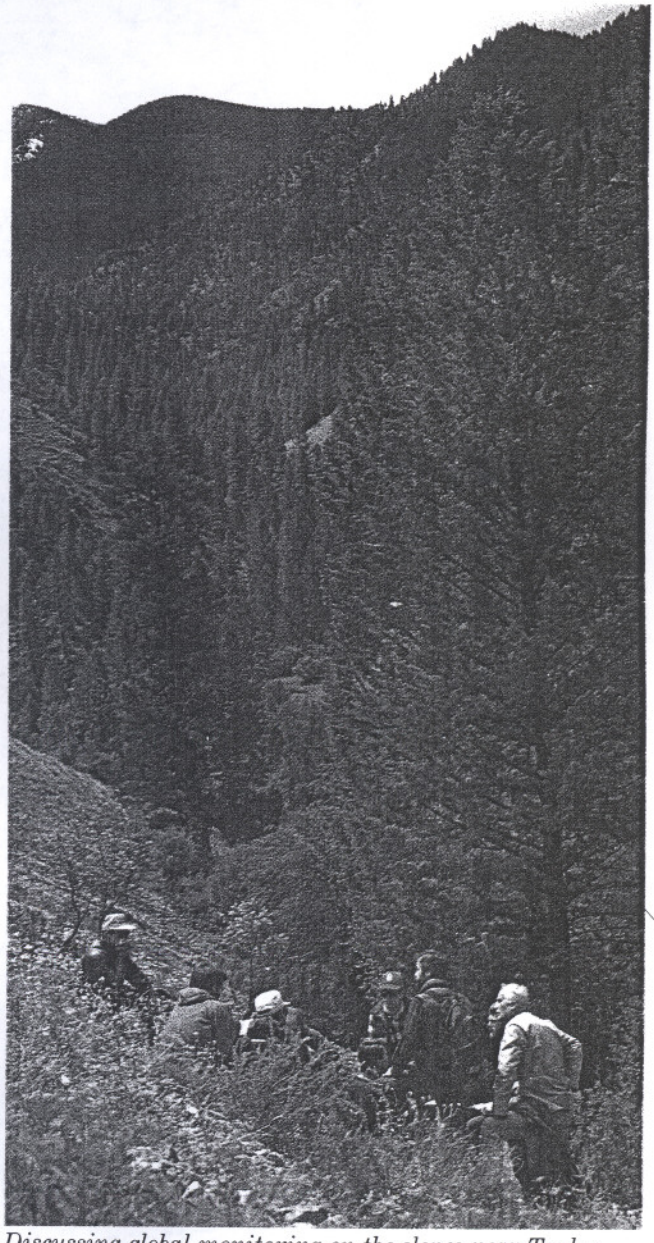
In the Department of Chemistry, a group of researchers, in coordination with NASA, have developed an instrument that measures sulphur concentrations in the troposphere, and they have traveled as far away as Brazil to test it.

Far from the tropics of South America, a forty-four-year project in Alaska, headed by a UI professor, is confirming the concerns over climatic change and the greenhouse effect.

While the topics these researchers are undertaking are vastly different, the information provides insight into the global warming trend.

Time Capsules in Ice

Sandwiched like layers of time, snow that fell centuries ago is helping predict tomorrow's weather



Discussing global monitoring on the slopes near Taylor Ranch.

patterns. Maynard Miller, UI geology professor and director of the Glaciological and Environmental Sciences Institute, has been researching Alaska's icefields for forty-four years (see *ITU, Fall 1986*).

Starting in 1946, Miller began measuring snow that has fallen over the centuries, sampling layers as far as one-hundred feet below the icy surface. By studying the samples, annual precipitation that fell hundreds of years ago can be determined. He has been able to establish climatic change cycles.

Miller's research indicates the earth should be in a cooling cycle that will peak late in the next decade. However, based on recent research, he has found that since the late fifties, temperatures have been rising. He suspects the greenhouse effect is the cause of this change.

In a recent article in *Alaska Business Monthly*, Miller said, "The extreme accumulations of ice that we have been finding in the mid-elevations of the ice field–snowfall that we've never seen before–just doesn't fit the traditional patterns. Something else is intervening. I don't have a crystal ball, but the only logical thing is the greenhouse effect."

Glasnost and Taylor Ranch

Late last May, as spring growth colored the hillsides and bighorn sheep lambed above the cliffs of UI's Taylor Ranch Wilderness Field Station, scientists boarded a plane at the Moscow-Pullman airport.

Leaving the Palouse fog, the pilot began the one-hour flight to Taylor Ranch in Idaho's Frank Church River of No Return Wilderness Area.

His passengers, including John Hendee, dean of the College of Forestry, Wildlife and Range Sciences; Karl Stoszek, professor of forestry; and Greg Hayward, recent UI doctoral graduate and assistant wildlife professor, would join a group of American and Soviet scientists already at the field station.

As the plane flew over the dense forest, black scars of the previous year's wilderness fires were visible, though the land was healing and renewing with spring growth. Snow was still capping some high ridges, and steep drainages were creased by rivers and creeks.

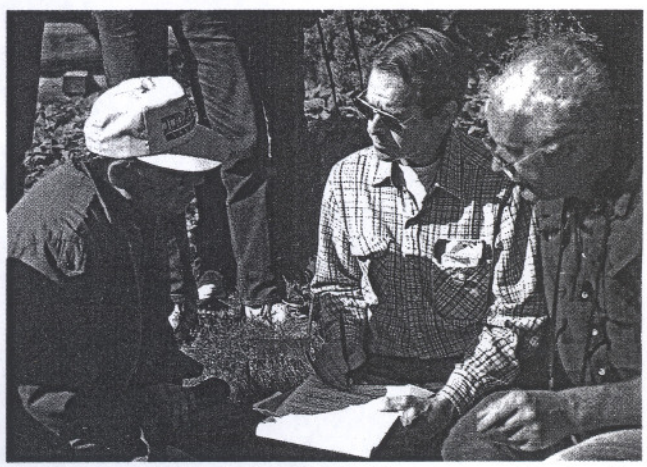
The small plane banked to the left, flirting with the field station's tiny landing strip. The pilot maneuvered the plane into the canyon and landed on a grassy strip next to Big Creek.

Yuri Puzachenko and Vladim Skulkin from the Soviet Academy of Sciences stood at the end of the landing strip with Jim and Holly Akenson (*ITU Winter, 1986*), UI resident managers at Taylor Ranch. With them were Americans Dave Graber, research scientist at Sequoia/Kings County National Parks; Les Vierck of the U.S. Forest Service Northern Forest Research Laboratory in Fairbanks, Alaska; and Dale Bruns, aquatic ecologist with the Idaho National Engineering Laboratory (INEL).

Ecologists and scientists from as far away as Africa have visited the Taylor Ranch station, attracted by its potential as a global environmental monitoring site.

Puzachenko and Skulkin were two of seven Soviet scientists hosted by the U.S. Forest Service under the auspices of the United Nations Man and Biosphere (MAB) program. They were interested in the field station as a potential U.S. baseline environmental monitoring station, where studies could combine Soviet and American methods in long-term studies.

"When the U.S. Wilderness System was established in 1964, one of the abstract ideas was that these areas would provide baseline sites where



Soviet scientist Yuri Puzachenko discusses possible faculty and student exchanges with John Hendee and Karl Stoszek.

conditions could be compared with those in developed areas. Then, no one anticipated that a short twenty-five years later we would be turning to wilderness for information to assess global warming and climate changes," said John Hendee.

The environmental conservation movement began in the Soviet Union in the 1970s, and Soviets now have a national park system similar to America's. Two percent of the country's territory is strictly protected, with other areas not as severely limited.

"Serious evidence about global warming, ozone depletion, and resulting vegetation changes have made wilderness areas a critical source of data," Hendee added. "In this respect, Idaho's

wilderness may contain some of the most valuable data in the world, and the UI's wilderness field station is a unique location where it can be measured."

Though each scientist present at Taylor Ranch was expert in different areas of the ecological spectrum, their common concern centered on using the wilderness as a baseline for collecting data.

As the group began discussing the task ahead, it was apparent the Soviets and Americans were both eager to get out in the field and begin work. Cary Clark, a Colorado State University graduate student, translated, along with assistance from Stoszek. At times the animated discussion appeared to be a mixture of scientific Pictionary and charades.

Most of the first day was spent on the steep slopes surrounding the field station, as Puzachenko and Skulkin shared their methods. Discussions focused on how, by combining the strengths of American and Soviet methods, a standard could be derived so data gathered at Taylor Ranch could be compared with counterpart Soviet data.

As the scientists walked through the woods, Puzachenko would point at a tree or shrub. A nearby American scientist would identify the tree's genus and species, and communication took place not in Russian or English, but in Latin.

By the end of the day, headway had been made toward an understanding. And while points of view may have differed, there was a driving interest in the differences between methods.

Eventually, scientists will use the data to monitor the ecology of an area that is uninfluenced by local pollution. Increased disease, changes in types of species present, and clues toward change in the biosphere will help give the scientists an idea of how the greenhouse effect is impacting a pristine environment.

That night, with everyone circled around a campfire for dinner, talk ranged from global warming and Siberian tigers to fusion and Glasnost. Two distinctly Soviet scientists and their American counterparts gathered around a roaring campfire in Idaho's wilderness, speaking Latin, Russian and English, drawing diagrams by the orange light and laughing heartily over conversation. Russian song drifted from the American forest long after the moon had risen.

The next morning, work continued. The small planes would be arriving around mid-day, and Hendee and Puzachenko discussed and signed an agreement providing for future exchanges, possibly of students and faculty.

"From talks at Taylor Ranch, it is clear that both the Soviet and the American scientists are very concerned about global warming and what actions should be taken in addition to scientific

research," said Hendee. "We under-utilize the scientific value of wilderness areas. Global monitoring is one way to make them worth what it costs to set them aside."

Skimming Along the Ocean

Frequently last summer, University of Idaho chemistry professor Sherry Farwell found himself aboard a research plane, propelled 500 feet above the Atlantic ocean at a speed of more than 300 miles an hour. Chances are, he didn't have much time to enjoy the view.

Farwell was aboard NASA's Lockheed Electra aircraft with a special analytical instrument he and UI analytical chemistry PhD students Bill Chatham and Douglas MacTaggart designed and constructed to rapidly measure trace sulfur compounds in the atmosphere. The instrument is an "Automated Metal Foil Collection/Flash Desorption/ Sulfur Selection Detection System," or as it's known in the lab, "The Flasher."

Sulfur is a major component of acid rain, but it is also involved in making clouds.

"We think that sulfur compounds have a lot to do with cloud formation, cloud cover and control of precipitation patterns," said Farwell.

Which raises interesting questions concerning global warming. One of the unknown factors in predictions scientists are making is cloud cover. If more dense clouds are present, the earth will be cooler than scientists are predicting it will be with less cloud cover.

In addition, Farwell said, about twelve miles into the atmosphere, there is a stratospheric layer of particles like a "band of dust," that acts like a filter and to help control radiation and the balance of sunlight striking the earth. A major component of this "dust" is sulfur.

Farwell, during many six-hour daily flights on the Electra, was participating in one of the first instrument tests in a project that is part of NASA's Global Tropospheric Experiment (GTE). The troposphere is the part of the atmosphere that extends from the earth's surface to heights of about twelve miles (at the poles) to six miles (at the equator).

NASA's major goal, in its overall tropospheric chemistry program, is to improve scientific understanding of the complex global tropospheric chemistry and to assess the global atmosphere's susceptibility to changes from human-related activities. A major part of the NASA-GTE program is the Chemical Instrumentation Testing and Evaluation (CITE) project. CITE projects are designed to test new monitoring instrumentation for precision, accuracy, ruggedness and especially field portability, because the instruments will be used at remote locations rather than in a conventional research laboratory.

Farwell's flights in the aircraft were actually part of a three-year, $225,000 research grant funded by NASA and awarded to the UI on the basis of his rsearch group's expertise in measuring atmospheric sulfur gases.

Other participants in the project included scientists from West Germany, Brazil, Pennsylvania, Virginia, Georgia, Washington, and Miami.

Each group shipped the instruments they developed to Wallops Island, Virginia, for phases one and two of the project. The first phase was done on the ground, where the National Insititute of Standards and Technology (NIST) provided low concentrations of sulfur gases for the scientists to measure. The concentrations were known only by NIST, and the various instruments were tested to see how close they came to the known amounts. Phase two involved flying the instruments over the Atlantic Ocean for a three-week period, close to land and then miles out over the ocean. Farwell said by taking air samples close to the shoreline, where human influence is greatest, and out over the ocean, where it is the least, scientists obtain information on how human activity is impacting the natural atmospheric cycles.

The next step of the project sent MacTaggart and Chatham and the instrument to Natal, Brazil, where similar NASA flight tests were performed for another three weeks. As predicted, the total sulfur gas concentrations in the marine air from remote sampling locations over the southern Atlantic were usually lower than those from the northern Atlantic. Higher sulfur gas levels were measured whenever the aircraft flew through plumes of air that came from the continent. Although the monitoring data collected is important, it isn't the primary reason for the NASA-GTE-CITE experiment at this time. The different instruments aboard the plane were primarily there to be tested for accuracy, precision, and reliability.

The UI team returned from Brazil in October, and, having completed the project's field portion successfully, are awaiting results on the overall measurements. Farwell explained that having the instrument system perform so precisely under such rugged conditions is a good indication the UI research team will continue to be involved in future NASA-GTE projects. ✲