The Antarctic Sun

Published during the austral summer at McMurdo Station, Antarctica, for the United States Antarctic Program

December 28, 2003

Photo by Kristan Hutchison / The Antarctic Sun

A helicopter lands behind the kitchen and communications tents at Beardmore Camp in mid-December.

Back to Beardmore:

Researchers explore the past from temporary camp

By Kristan Hutchison
Sun staff

Like the mythical town of Brigadoon, a village of tents appears on a glacial arm 50 miles from Beardmore Glacier about once a decade, then disappears.

It, too, is a place lost in time. For most people, a visit to Beardmore Camp is a trip back in history, whether to the original camp structure from 19 years ago, now buried under snow, or to the sites of ancient forests and bones, now buried under rock.

Ever since Robert Scott collected fossils on his way back down the Beardmore Glacier in February 1912, geologists and paleontologists have had an interest in the rocky outcrops lining the broad river of ice.

This year's Beardmore Camp was the third at the location on the Lennox-King Glacier and the researchers left, saying there

See Camp on page 7

Photo by Andy Sajor / Special to The Antarctic Sun

Researchers cut dinosaur bones out of the exposed stone on Mt. Kirkpatrick in December. Some of the bones are expected to be from a previously unknown type.

INSIDE

Quote of the Week

"The penguins are happier than clams."

- Adelie penguin researcher summing up the attitude of a colony

Ross Island Chronicles By Chico

Cold, hard facts

Coast Guard icebreakers

(based on *Polar Star*)

Crew: 15 officers, about 125 enlisted, and 15 more with helicopter crews

Crew age: About half the ship is 18-25

Deployments: Six months

Length: 121 meters

Weight: 12,000 metric tons

Fuel total: 4.9 million liters

Speed open water: 22 kph

Range: 560 km/day and up to 42,000 km without refueling or breaking ice

Fuel consumed per day breaking ice: 190,000 liters or more

Movement: Operates with three, 5-meter diameter, four-blade, controllable-pitch propellers, each weighing 42 metric tons.

Source: U.S. Coast Guard

The Antarctic Sun is funded by the National Science Foundation as part of the United States Antarctic Program (OPP-000373). Its primary audience is U.S. Antarctic Program participants, their families, and their friends. NSF reviews and approves material before publication, but opinions and conclusions expressed in the *Sun* are not necessarily those of the Foundation.

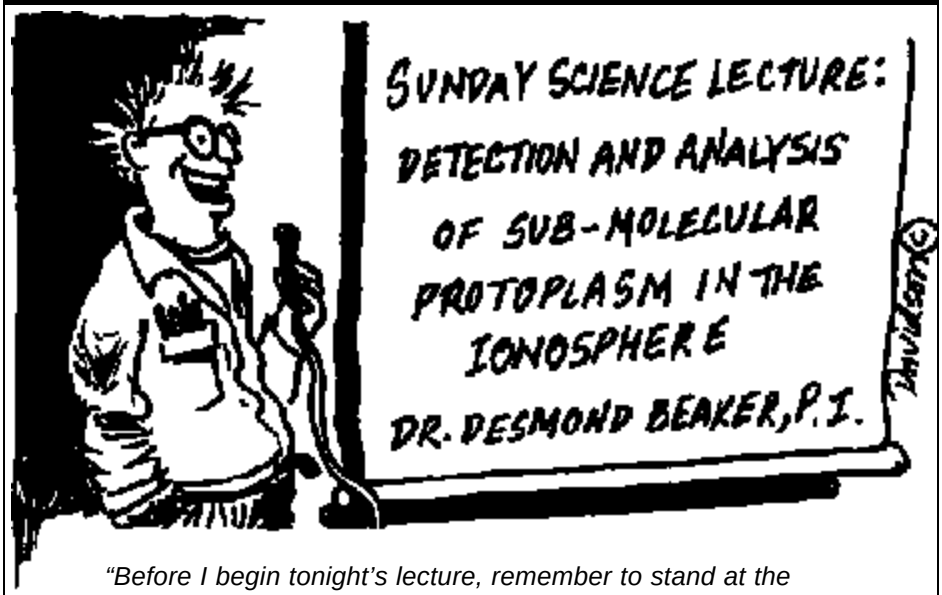
Use: Reproduction and distribution are encouraged with acknowledgment of source and author.

Senior Editor: Kristan Hutchison
Editors: Brien Barnett, Kris Kuenning
Copy Editor: Melanie Conner, Geoff Jolley, Wendy Kober, JD Menezes, Mark Williams
Publisher: Valerie Carroll, Communications manager, RPSC

Contributions are welcome. Contact the *Sun* at AntSun@usap.gov. In McMurdo, visit our office in Building 155 or dial 2407.

Web address: www.polar.org/antsun

Matt Davidson



"Before I begin tonight's lecture, remember to stand at the back of the room near the exits so you don't make a fool of yourself leaving early when you get bored!"

Green Antarctica

Station greenhouses produce fresh food, feel-good environments

By Kris Kuenning
Sun staff

There is a place in Antarctica where, even in the dead of winter, you can lie back in a hammock and bask in bright light. You can pluck pansies for a light snack, smell the fresh herbs or just hang out with a tiny forest of lettuce or a small jungle of tomato plants.

It's the McMurdo greenhouse and though it's only 200 square meters, it's some of the most valuable real estate on station for the people who live and work on the barren shores of Ross Island.

Greenhouse technician Rob Taylor knows the greenhouse is more than just a place to grow food, especially in winter.

"Winter is when the greenhouse is most effective," Taylor said. "Not only does it grow food for the winter population, but the people are also more deprived."

The McMurdo greenhouse generates up to 140 kg of food each month. From lettuce for salads to mint for Cuban cocktails, Taylor supplies both the central kitchen and individual requests for greenhouse produce.

In winter, when the station is cut off from resupply flights, the greenhouse is the only source of fresh food for the 200-odd residents. Harvesting 250 heads of lettuce every 10 days means winterers have salad a couple times a week.

In summer, when the number of people rises to more than 1,000, the greenhouse supplements the regular shipments of fresh food from New Zealand.

To comply with the Antarctic Conservation Act, everything is grown hydroponically.

"Soil contains microbes and microbial colonies," Taylor said, "so it would be theoretically possible for the microbes to escape into the environment."

Instead, the plant roots are either directly suspended in the liquid nutrients or supported by a non-soil agricultural mixture.

Signs outside the greenhouse warn smokers not to touch the plants. There are two reasons for this, Taylor said.

Not only is nicotine toxic to a lot of plants, but processed tobacco can carry the tobacco mosaic virus, which is devastating for plants like tomatoes, cucumbers and peppers.

"Because it's a linked system, if you touch one plant, it is transferred to the whole rung," Taylor said.

To combat a virus, all the plants have to be destroyed and the greenhouse started from scratch.

In early October, a subtropical insect found its way to the greenhouse. Taylor noticed specs of moving dust on the surface of the water. It turned out to be a non-native springtail.

Photo by Kris Kuenning / The Antarctic Sun

Greenhouse technician Rob Taylor relaxes in a hammock at the McMurdo greenhouse.

"There are native Antarctic springtail, but this turned out to be a non-native, subtropical variety," Taylor said.

Springtail live only on live plants, so it's arrival is still a mystery. Rob first tried to combat it with soap, which breaks the surface of the water and drowns the insect.

Though springtail is not harmful to the plants, its existence was a potential threat to the delicate Antarctic environment and eventually the plants were destroyed, the greenhouse emptied and frozen out.

The only thing that survived was a lemon tree planted from seed several years ago by previous greenhouse technician Chris Wilt.

The McMurdo greenhouse has no glass. In a continent with only one long summer day and one long winter night in a year, the greenhouse's artificial lights create night and day every 24 hours for the plants.

"Plants do most of their respiration at night, so keeping them in constant sunlight means they're unable to exhale," Taylor said.

The artificial lights provide different spectrums of light for 16-17 hours a day but Taylor said it still doesn't approach the level of sunlight. And while most plants like a humidity level of 60-70 percent, Taylor says he's lucky to maintain 20 percent humidity in the dry Antarctic conditions.

Still, the plants thrive. They are lush, green and good producers.

"You have to force the plants to become accustomed to different growing environments. You don't want to make it super cushy for them."

But the plants make life just a little more cushy for McMurdo residents – in the dining hall and at the greenhouse itself. Taylor believes the greenhouse is a popular hangout because it allows people to re-connect with plants.

"Humans have evolved with plants, but in this area of Antarctica, you have humans without plants and I believe that when you take people out of their evolutionary background, it does something to the psyche … Even if they haven't realized they've missed it. That's how I feel, anyway. I like the fact that I grow food for people but it's more than that," Taylor said.

Palmer

There's no greenhouse at Palmer Station. Monthly supply ships from Chile alleviate the pressure to grow fresh vegetables at the tiny station on the Antarctic Peninsula.

"Space is the biggest issue right now for Palmer Station," said station manager Joe Pettit, "We don't have quite the motivation to create a greenhouse."

South Pole

Nibbling on nasturtium leaves at one end of the tiny South Pole greenhouse, Jack Giacalone is enjoying the last season in the greenhouse under the dome before it is replaced by a high-tech growth facility in the new station in February.

Giacalone and his girlfriend Theresa "Tree" Menke are the volunteer caretakers for the greenhouse. They and 14 others pitch in to produce lettuce, fresh herbs, tomatoes, cucumbers and even avocados in the

See Greenhouse on page 4

Greenhouse From page 3

coldest, driest place on earth.

Giacalone said the current greenhouse is very labor intensive. Keeping the plants alive requires daily checks of nutrient levels, acid levels and water temperature. There is also misting, planting and harvesting to be done. The 30 square meter greenhouse under the dome can produce up to four to five pounds of fresh vegetables a week.

Giacalone and Menke spend about 15 hours a week working in the greenhouse.

"It's quite a workload but there's not a lot else going on," Giacalone said, "And I'd rather be busy."

The biggest challenge is the dry air. A humidifier keeps the greenhouse between 47 and 58 percent humidity.

But, in many ways, running a greenhouse is easier at the South Pole than it would be back home.

"There are no insects, no aphids, no parasites … almost," Giacalone said.

Like McMurdo, the biggest threat to the South Pole greenhouse is the tobacco mosaic virus.

Working in the greenhouse gives Giacalone the same kind of satisfaction of growing and producing that he gets at the vegetable garden he cultivates at his home in Hawaii.

"The conditions are ultra harsh here. To have stuff growing is very unique," he said.

Space age greenhouse

The empty South Pole landscape is often compared to outer space. Now an indoor growth chamber at the Pole may be a forerunner to supporting a base on Mars.

The automated growth chamber has been designed for the National Science Foundation by the University of Arizona.

"It's like no other growth chamber in the world," said Gene Giacomelli, director of the Controlled Environment Agriculture program at UA.

Kris Kuenning / The Antarctic Sun

Jack Giacalone tends the greenhouse at the South Pole.

Though the 1,000-watt lamps pump out enough light to emulate 40 percent of a Tucson summer day, they are cool enough to touch. The water-cooled bulbs, designed by former South Pole worker Phil Sadler, mean plants can grow closer to the lamps, making more use of the growing space.

"It's going to be bright," Giacomelli said. "And that will make the plants grow faster."

All the water and nutrients are reused in the system. Carbon dioxide is pumped in for the plants' respiration. The environment inside the growth chamber will be computer controlled and monitored, but plant care and harvest will still require a human hand.

The 45 square meter space in the almost-completed wing of the new South Pole station includes twice as much growing room as the smaller greenhouse under the old dome. There's also more room for the people.

The growth chamber will be separated from a lounge area by a glass wall. In the so-called "enviroroom," people will be able to see the plants, enjoy the intense light, increased humidity and even smell the more pungent herb plants. A small "recreational" hydroponic system in the enviroroom will be accessible to everyone, Giacomelli said.

The equipment is scheduled to arrive at the South Pole a few weeks before the station closes for winter in mid-February. The growth chamber should be up and producing for this winter, but the official dedication of the greenhouse won't be until November 2004, after the station re-opens for the following summer season.

A Webcam in the growth chamber will allow the university professors and students to watch the plants grow. It could also be used as a diagnostic tool if there are problems with plant health.

Giacomelli said this system demonstrates the potential for growing in a closed system on a Mars base.

"It would not work on a space station because there is no gravity, but it could function on Mars."

The design would be lighter, though. Giacomelli said the South Pole growth chamber has been built for "heavy, long-term use."

Continental Drift

If you could pick a New Year's resolution for somebody else, what would it be?

"It would be, 'stop snoring in the TV lounge.' "
Joe Pettit, Palmer station manager from Boulder, Colorado, 14 seasons.

"That they would take a shower."
Brandon Grantham, South Pole network engineer from Las Vegas, first season.

"Two simple words: chill out,"
Rusty Rodriguez, soil yeast researcher at McMurdo Station from Seattle, third season.

around the continent

SHIPS

Polar Star near McMurdo

By LCDR April Brown
Mac Ship Ops/Coast Guard Liaison

Just in time for Christmas, the Coast Guard cutter *Polar Star* arrived at the ice edge about 31 km northwest of McMurdo at midnight on Dec. 24. Her sister ship, the *Polar Sea* should arrive about New Year's Eve to help.

You may have heard the fine whine of two stealthy HH-65 Dolphin helicopters buzzing about. *Polar Sea* will bring a third helicopter, making a total of three helicopters in the area and 22 "Coasties" added to the town's population. There are nearly 300 sailors on the ships. Rumors of an invasion are greatly ... understated. Get your shopping finished soon. Seriously, though, Coasties are a great bunch of folks and they look forward to visiting town, shopping, having fun and making friends.

It takes hard work to keep an icebreaker operating down here every season. The icebreakers and resupply ships are critical in keeping McMurdo, Scott Base and South Pole Station open year round. Let's face it, no gas, no groceries, no go. The National Guard and other air crews work hard to help the stations, but there still isn't a single plane that can bring in nine million gallons of fuel and 10 million pounds of cargo at once. That's why the ships come down each year.

Polar Sea is on her fourth consecutive Operation Deep Freeze mission because of the extremely thick ice conditions of the last three years. Speaking of ice conditions, helo ops folks, PHI helicopters and the survey team helped measure the ice edge out to 30.3 kilometers. The thickness ranges from 2.5 meters thick in the first-year fast ice out near the edge, to 3-4 meters thick closer to McMurdo, including the turning basin near the ice pier. All that ice is beneath nearly a meter of snow, which is bad for icebreaking because the snow dampens the blow of the bow and causes friction on the hull, slowing the ship way down. It's sort of like trying to break a fluffy pillow with a hammer (to plagiarize the infamous "Wheeler").

Polar Star started the break-in on five diesel electric engines and three shafts, and made all of 27 meters. It was important to gauge how much she could do on diesels first. She then switched to a diesel-gas turbine (a modified aircraft engine) combination on the center shaft, providing a lot of power and control without rampant gas consumption.

Unfortunately that combo soon proved inadequate and the *Star* had to switch to three turbines, one per shaft, as the *Sea* had to do early last season for brute strength. Three turbines can momentarily produce up to 75,000 horsepower per shaft, and then drop to about 60,000 horsepower. At that rate, the ships will burn about 190,000 liters of fuel a day.

I am going to have an icebreaker pool, and the lucky winner who can guess closest to the time when Polar Star makes her first approach to the ice pier will be the recipient of some fine Coast Guard paraphernalia. I will have a sign-up sheet posted, or you can e-mail me the date and time to the minute. E-mail Brown, April in the McMurdo directory in Outlook.

Photo courtesy of Skip Owen / Special to the Antarctic Sun

Children ages 3 to 13 and residents from Argentina's Esperanza Station gather on the deck of the Gould *with Captain Mike Terminel for a photo during a tour of the vessel. The* Gould *was the first ship of the season to stop there.*

Laurence M. Gould

Compiled from reports by Skip Owen

After four-plus days of waiting for the *Laurence M. Gould* to break through heavy ice to reach them, field camps at Seymour and Vega islands were picked up on Dec. 23-24.

The *Gould* first tried Dec. 19 but heavy multi-year ice, icebergs, and ice floes blocked the way from all directions. A satellite photo sent from Palmer Station showed the ship would have had to move through about 35 km of ice to reach them.

The researchers on Seymour and Vega islands said they received several centimeters of snow. The snow cover and winds hampered the search for fossils for several days.

On the upside, the personnel at Argentina's Esperanza Station in Hope Bay on the Antarctic Sound noticed the *Gould* steaming back and forth and invited the crew to visit. Since the ice blockade looked like it would be in the way for a while, the *Gould* anchored off Esperanza at approximately 3 p.m. local time. The Argentinian children of families at Esperanza Station, ages 3 to 13, toured the *Gould*, with their teachers, mothers and the station pediatrician. For the children, it was a nice break after a long winter. The *Gould* is the first vessel to visit this season and the station's annual resupply vessel still is several weeks away. They were fascinated with the ship.

"It was a first for me to have a group of kids tour the vessel in Antarctica. We thoroughly enjoyed having them aboard, although they put quite a dent in the Pringle supply," marine projects coordinator Skip Owen said.

The Argentine station hosted a dozen of the crew from the *Gould* to dinner later, and it was a warm and pleasant visit in the best Antarctic style.

The *Gould* left Hope Bay Dec. 20 for another attempt to reach Seymour and Vega islands, but was turned back again. The ship went instead to King George Island, where seven members of one science group were able to fly out on a chartered aircraft. That gave the *Gould* several more days to try to reach the researchers on Seymour and Vega islands.

The crew celebrated Christmas Day with a fine meal, carols around the vessel, and a cruise photo on the foredeck with all

See Continent on page 6

the week in weather

McMurdo Station
High: 37 F / 3 C Low: 14 F / -10 C
Wind: 28 mph / 45 kph
Windchill: -17 F / -27 C

Palmer Station
High: 43 F / 6 C Low: 28 F / -2 C
Wind: 47 mph / 76 kph
Windchill: 17 F / -8 C

South Pole Station
High:-7 F / -22 C Low:-16 F / -27 C
Wind: 25 mph / 40 kph
Max physio-altitude: 3,099 m

Continent From page 5

the scientists, support and crew present.

On Dec. 26, the *Gould* made it through the pack ice. Although the ship still had a fair distance to go through the Antarctic Sound, Owen reported the sight of open water was a great relief as was good weather. He estimated the *Gould* would return to Punta Arenas Dec. 29.

Nathaniel B. Palmer

Compiled from ship reports

After leaving Lyttelton Dec. 18, the *Nathaniel B. Palmer* headed south with good weather and calm seas for several days. Then on Dec. 21 the weather turned for the worse, with sustained winds at 65 kph and gusts to 110 kph. The crew and others aboard report a happy Christmas.

PALMER

Lectures and new life

By Kerry Kells
Palmer correspondent

Palmer Station continues to have phenomenal weather. Our usual cloudy dark skies have cleared to offer some sun during our holiday preparations. The rare sunshine casts shadows on the glacier and makes the water around us sparkle. Most days allow for extensive boating operations. Among all the usual activities, two stand out this past week.

On Wednesday, Langdon Quetin talked about the history of krill research at Palmer. He spoke about the vessels, scientists and advancements in laboratory facilities. The ships used for transportation and research began with the motor vessel *Hero*, then the *Polar Duke* and now the research vessel *Laurence M. Gould*. He talked about the smaller research vessels used to collect krill samples. First were the raft-like vessels and trawlers which graduated to the Zodiac they now use, termed "Rubber Duke" for the advanced krill collection capabilities it has. Numerous researchers began their research in our area. For Quetin, research continues.

He gave a short biography of Mary Alice McWhinnie who wintered at McMurdo in 1974 and moved over to the Palmer side for krill research. She designed a large aquarium with constantly flowing seawater, which kept the krill alive in the laboratory. Quetin's first season was 1981 to 1982 along with Robin Ross and Bill and Peggy Hamner.

Some more advances of the late 1970's and early 1980's include the transportation of live krill back to home laboratories, which was successful due to temperature insulation. The year 1985 introduced winter research in pack ice thanks to the ice-strengthened Polar Duke. Between the years of 1995 to 1999, the Port of Nagoya Public Aquarium in Japan was the first to culture Antarctic krill through a complete life cycle, a milestone achievement in Antarctic krill research.

Photo Cara Sucher / Special to the Antarctic Sun
An Adelie penguin tends to her chick near Palmer Station.

After a long work day, a boat trip out to Torgersen Island allows an introduction to a second phenomenon in the Peninsula area. One can actually witness the hatching of a penguin chick, parents feeding their chicks and the sight of these black and gray fuzzy newcomers. The Adelie colony is full of the soft "peep peeps" of the penguin chicks. Although Fraser's group of seabird researchers, affectionately termed "the Birders", say the colonies are small overall, and still in decline, the new chicks look healthy. Certain nests are monitored throughout the summer season. They monitor when the chick hatches from its egg. The standard incubation period is 33 days from the second egg. The survival rate is one and a half chicks per nest. The main threat at their young age is the predatory brown skua. After a trip out to Biscoe Island, our seabird researchers tell me that only a few gentoo penguin chicks had hatched due to the later breeding season for gentoos. Hatching times for other seabirds, brown skuas and giant petrels, fall a couple weeks later. The Birders will continue to monitor the colonies of penguins and other seabirds and the survival of the chicks.

Palmer Station continues to be full of activity, both at station, on our seas and on the surrounding islands. Not only does the community of Palmer have the opportunity to learn and ask about the science conducted in our area, but also to witness science in action in the hatching of the seabirds. As we prepare for the holidays here with the final decorations, wrapping presents and preparing the dinner, Palmer Station researchers and support personnel wish everyone in the USAP a happy and safe holiday season.

SOUTH POLE

Play recalls expeditions

By Vincent Scott
Pole correspondent

This month, members of the South Pole Community Theatre presented a reading of Ted Tally's play, "Terra Nova." The play, first presented at the Yale School of Drama in 1977, is adapted from the journals and letters found on the frozen body of Captain Scott. The play follows Scott and his Terra Nova expedition on their journey combined with flashbacks of chats between Scott and his young wife Kathleen, as well as imagined scenes between Scott and his Norwegian rival Roald Amundsen, whose party beat Scott's to the Pole by a month in December 1911.

The cast included Kris Perry reading the role of Scott, Peter Rejcek as Amundsen in Act I, Vincent Scott as Amundsen in Act II, Paddy Douglas reading Scott's wife, Kathleen, Ethan Dicks as Bowers, Andrea Dixon as Oates, T. Regan as Wilson, and Dave Bell reading the role of Evans.

Logistics Supervisor Paddy Douglas, who read the part of Kathleen, said she was "struck by how we take the station for granted – and at how easy it is for us to forget that it has been paid for dearly."

"I was clearly moved by the responsibility felt by Scott towards the expedition and his men."

Photo courtesy of Susan Weber / Special to the Antarctic Sun
Above, Scott's expedition. Bottom, pictured left to right, top row: Paddy Douglas, Sheri Mason, Vincent Scott; middle row: T. Regan, Kris Perry, Ethan Dicks; bottom row: Dave Bell, Andrea Dixon

Photo by Kristan Hutchison / The Antarctic Sun

At left, researchers crowd the Beardmore Camp kitchen tent while waiting for flights in mid-December.

Below, boxes filled with rocks and fossils wait on the outskirts of Beardmore Camp to be sent by plane then ship to researchers' universities.

Photo by Kristan Hutchison / The Antarctic Sun

Camp From page 1

are still more fossils to find in the hills.

"I'd really like to see us have more camps like this," said chief scientist John Isbell, from the University of Wisconsin-Milwaukee.

It was the sixth time the U.S. Antarctic Program has set up a large hub camp to support deep fieldwork by rock hunters.

"Last time we did this was at Shackleton (Glacier)," said camp manager Dave Zastrow. Many of the same researchers were at that camp in 1995, which at about 150 people was one of the bigger field camps. This year's Beardmore camp was a third the size, with about 50 people and 40 tents. The size is partially driven by the kind of work done. The paleontologists needed helicopters and sometimes Twin Otter airplanes to carry them to rocky sites in the surrounding mountains, up to 12,500 feet high. At times the camp seemed more like an airport, with helicopters, Twin Otters and LC130 planes all landing and taking off.

"It takes everybody to bring it together - camp staff, helo pilots, scientists," Isbell said.

The camp was supposed to be fully running by Dec. 1, but a storm in McMurdo delayed the helicopters and researchers from reaching Beardmore Camp for days. Then five days of wind at the camp itself grounded the helicopters, said mechanic Andy Young.

Though weather kept the researchers from reaching their field sites as often as they hoped, when they did they made some interesting finds, including a new dinosaur, fossilized fish, petrified trees and evidence buttercups once bloomed there.

"It's been successful, especially considering the weather," Isbell said. "If you reach 25 percent of the original plan you've had a real successful season."

Though only two percent of Antarctica is exposed rock and dirt, what is exposed includes some of the best-preserved fossil sites in the world, with unique evidence of the Earth's earlier inhabitants. The fossils reveal an ancient history, but it carries a modern message, said Molly Miller from Vanderbilt University.

"The main thing is, people have to understand their place in space and time," Miller said. "What this is showing is the Earth, or what is on it, has changed tremendously."

"If we're going to understand our place on earth, we need to understand what's come before us."

In all, more than 9,000 kg of rock and fossil were flown out of the camp. Most of it will be shipped back to the geologists and paleontologists on the vessel, arriving at their universities in April. The best specimens are tucked into their luggage, testing the airline weight limits.

To keep the size of the camp smaller, the research teams cooked their own meals when they returned from the field sites, working over camp stoves in expedition tents. That changed the camp dynamics.

"There's not a central gathering point or central gathering time," said paleobotanist Edith Taylor from the University of Kansas Lawrence, who made an effort to meet other researchers anyway.

In the evening some of the researchers congregated in the communications tent or sometimes the kitchen tent, checking on the flight schedule and sharing tales of the day.

"We're biologists. We don't want to just see this (fossil) dead in the rock. We want to know who was chewing this," Edith said.

Sometimes they also swapped rocks. Loren Babcock from Ohio State University found fossilized tree trunks, almost two feet in diameter, which he gave to the paleobotanists.

"Normally what comes out of these camps is a lot more integrated science," Babcock said.

The camp has faded into the snowdrift, as a crew of carpenters dissembled the structures and reassembled them at Moody Nunatak. The tents will stay there until about the first week of February, supporting two other geology and paleontology research projects. Then it will become another layer of history.

PALEOZOIC		MESOZOIC			CENOZOIC
	248	206	144	million years ago 65	
PERMIAN	TRIASSIC	JURASSIC	CRETACEOUS		TERTIARY

Pyramidal-shaped Scott tents used for the Beardmore Camp in December are the same style Robert Falcon Scott carried up the glacier, and eventually died in on his way back. Nowadays the dome-shaped mountaineering tents are also used.

Photo by Kristan Hutchison / The Antarctic Sun

Early explorers left rock legacy

By Kristan Hutchison
Sun staff

From the first time explorers trudged up the Beardmore Glacier, they were collecting rocks.

As Ernest Shackleton hiked up the 100-mile glacier in 1908, he and his men found seams of coal among the sandstone and a rock with plant impressions.

"We can only take with us small specimens of the main rocks, as weight is of importance to us," Shackleton wrote in his journal. "From these small specimens the geologists must determine the general character of the land."

The coal and fossils proved that Antarctica was once lushly vegetated.

"That was some of the first evidence that Antarctica was not always glaciated," said paleobotanist Edith Taylor.

But the most talked about rocks from the Beardmore probably are the 16 kg of geological samples Robert Falcon Scott collected, the only thing left on his sled when the rescue party found him dead in the spring of 1912.

Polar historians are as interested in the stones as geologists are, because the extra weight on the sled and the day spent collecting them were among the factors leading the men to stop short of their next depot, 17 km away.

"It gives you a great sense of the historic when you stand there and the wind is blowing and you think they manhauled all the way to the Pole," said paleobotanist Tom Taylor.

As Shackleton and Scott leaned into the wind and their harnesses on their separate expeditions, they had plenty of time to notice the geology of the hills. Modern geologists have continued to return, still researching many of the features the early explorers first noted.

Shackleton wrote "The glacier is evidently moving very slowly and not filling as much of the valley as it did at some previous date, for the old moraines lie higher up in terraces."

This year Allan Ashworth was digging into the old moraines, finding evidence of historic glacial advances and recessions.

Ashworth did most of his work this season at Oliver Bluff, where Scott had also noted the old moraines. Ashworth has read Scott's journal for clues of places to look for more deposits.

"Those guys went very slowly and they might have noticed things," Ashworth said.

Edith and Tom Taylor thought of Scott as they collected plant fossils from Skaar Ridge, looking down at the site where Scott stopped to collect coal and fossils of wood and leaves on his trip back from the South Pole. Scott noted the "beautifully traced leaves in layers, also some excellently preserved impressions of thick stems, showing cellular structure" on a piece of coal Wilson picked up. The Taylors still come to Antarctica because the quality of plant preservation is among the best in the world.

Scott also had a fossil of *Glossopteris*, a plant. A few years later the presence of *Glossopteris* fossils on all continents was used as the first proof of continental drift.

"As plant fossils go, it's pretty famous," said Edith Taylor.

Molly Miller spent six days at Mt. Bowers where Scott collected the Glossopteris fossils. The famous explorer was in her thoughts as she collected the same kind of fossil, still of scientific interest.

"We thought of that often. 'Wow, he was here. He must have been freezing to death,'" Miller said. "In terms of geology, it does feel very historic."

Scott died sometime after March 29, 1912 with the rock still on his sledge. Some historians have suggested he might not have died if he hadn't taken the time to gather those rocks on his way back down the Beardmore Glacier, and then tried to haul the extra weight.

"We like to tell people we won't go to that extreme to get fossils," said Edith Taylor.

Her husband agreed: "I'd dump mine in a heartbeat."

It's not a decision they have to make. Now geologists and paleontologists can collect tons of rocks without worrying about the weight. They and their samples are flown out by helicopter and LC130 airplane, then the rocks are shipped north on a vessel.

PALEOZOIC	MESOZOIC			CENOZOIC
248	206	144	million years ago	65
PERMIAN	TRIASSIC	JURASSIC	CRETACEOUS	TERTIARY

Paleontologists search for dinosaur bones at a site on Mt. Kirkpatrick.

Photo by Andy Sajor / Special to The Antarctic Sun

Dinosaur hunters dig up new beast

By Kristan Hutchison
Sun staff

Wielding hammers, crowbars and dynamite, the dinosaur hunters tracked down a new animal, but they couldn't get all their quarry home.

Paleontologist Bill Hammer suspects the newly uncovered bones on Mt. Kirkpatrick could be the remains of a primitive sauropod, a type of herbivorous dinosaur with long neck and tail that lived from 248 million to 65 million years ago. Though Hammer won't know until he has time to study it back in the lab, it is likely to be a new species.

"Anything we find down here is very different from other parts of the world," Hammer said.

The last time Hammer visited Mt. Kirkpatrick, 13 years ago, he dug up the remains of the first, and only, carnivorous dinosaur found in Antarctica. The 22-foot cryolophosaurus turned out to be the oldest of its kind from anywhere in the world.

"We know very little about the early Jurassic, particularly on the southern continents," Hammer said. The only other Jurassic site in the southern hemisphere is in South Africa. With about 35 percent of the cryolophosaurus' skeleton, Hammer was able to create a model of the entire dinosaur. A month after Sept. 11 he picked up a full-sized reconstruction of the dinosaur skeleton from a Canadian maker and tried to drive back across the border.

Photo by Kristan Hutchison / The Antarctic Sun

Bill Hammer shows one of the new dinosaur bones found on Mt. Kirkpatrick

"It was too crazy a story to make up, but we still got hassled," said Hammer, who spent two hours convincing customs officials the dinosaur was legitimate. The skeleton is now displayed at Augustana University, where Hammer teaches.

This month Hammer led a team of six back to Mt. Kirkpatrick, hoping to retrieve any remaining cryolophosaurus bones, and find something new. He found about 35 more bones at the cryolophosaurus site, including vertebrae and a toe. The bones may belong to cryolophosaurus or other dinosaurs from the same site.

About 100 feet above the cryolophosaurus, mountaineer Peter Braddock spotted another bit of exposed bone. He showed it to Hammer, who identified it as either part of a pelvis or shoulder of a sauropod.

Blaster Marty Reed set charges of dynamite near the surface of the rock at three foot intervals. A boom like fireworks exploded down the mountain, but only the six dinosaur hunters were close enough to hear it.

"The main thing is you have to use light charges so you fracture the rock," said Reed, who fractured the rock to within a foot of the bones.

From there the team worked with pick axes, rock hammers, crow bars and rock saws to free the beast locked in rock. The team retrieved about 1,500 lbs of rock and bone, but left more buried in the hillside.

"I'm happy with what we found," Hammer said. "There's still more going back in there. We probably have another whole season's work there."

Hammer also wanted to visit five other sites where dinosaurs may be hiding, but bad weather kept him from flying there. He believes many of the ridges between the peaks may hold Jurassic bones.

"There's actually a lot more out there than it appears on the map," Hammer said.

NSF funded research: Bill Hammer, Augustana College.

Marty Reed sets dynamite to crack open the rock above hidden dinosaur remains.

Photos by Andy Sajor / Special to The Antarctic Sun

PALEOZOIC	MESOZOIC			CENOZOIC
248	206	144	million years ago	65
PERMIAN	TRIASSIC	JURASSIC	CRETACEOUS	TERTIARY

Photos by Kristan Hutchison / The Antarctic Sun

Above, Tom Taylor shows a vertebraria, a fossilized root structure from the Glossopteris *plant, to fellow paleobotanist Pablo Puerta. The white of the star pattern was left by the spaces between the swamp plants roots. The upper Permian fossil was found on Skaar Ridge in the central Transantarctic Mountains. At left, paleobotanist Edith Taylor wraps fossils in rags and packs them in boxes for shipping home.*

Botanists gather leaves and seeds in stone

By Kristan Hutchison
Sun staff

Based on bulk, the Taylors' plant gathering trip to Antarctica was a huge success.

The paleobotanists shipped home about 4,000 kg of leaves, seeds, stems, roots and tree trunks, all in rock.

"We got a special award for taking home the largest chunk of the continent," joked Edith Taylor.

It's the third time she and her husband Tom have been to the Beardmore Glacier, so they knew just what they were looking for and where to find it. The goal was to collect permineralized plants, a rare form of preservation in which the cell walls remain and silica fills in the spaces. Even the embryos within the seeds can be seen.

"It is the rarest preservation for plants," Edith said.

Antarctica is one of only three places in the world with such well-preserved plants from the Permian age, and the only site with plant fossils of that caliber from the Triassic. This time they were heading back to Skaar Ridge, near the camping site where Scott collected coal and wood fossils, where they've collected many important fossils before.

"It's like a compost heap you've turned to stone," Edith said.

The Taylors know which sites and rocks are likely to contain the fossils, but it's still a bit of a treasure hunt.

"There's a great serendipity to it. You grab a rock, take a chisel, break it open and see what you find," said Tom.

They look for rocks with clear layers and some black in them, indicating the presence of organic material.

"It's luck," said Tom.

"And persistence," said Edith.

Both have paid off for the couple. The fossils they collected on this trip will be added to the collection at the University of Kansas, already the second largest collection of Antarctic plant fossils in the world with about 50,000 rocks. Many fossils from their previous visits led to a greater understanding of ancient foliage.

A fossil the Taylors left on display at the Berg Field Center has seed ferns pressed into its surface, as detailed as if they'd just been cast in plaster. The rock is 220 million years old "give or take a month," said Tom Taylor, with his usual humor.

The seed fern is unique because it is part of an extinct group of plants with leaves like ferns and seeds like flowering plants. On a previous trip the Taylors found seed ferns with short shoots sprouting from them and seeds attached, similar to a gingko tree. It was a trait that had never been found in the fossil record before.

"We carried that specimen back in our laps," Tom said.

Tom's specialty has been fungi. At the Permian site he found branches eight to 10 cm in diameter with clearly visible rings and cells. White holes were left throughout the petrified branch in a pattern recognizable as white pocket rot. The same fungus still lives in trees in the U.S., having outsurvived the trees in Antarctica by millions of years.

The Taylors have also found tree trunks with the rings still preserved, showing a growth record. The growth rings were 10 times wider than those found on trees in Alaska today, probably due to a warmer climate and the longer growing season.

"These plants were growing at higher latitude than any plants are growing today," Edith said.

In the Gordon Valley, the fossil trunks of 99 Dicroidium trees stick up from the ground, all 0.75 meters to 0.9 meters tall. They still have root structures in the ground.

"It's like you cut the forest off with a chain saw and then turned them all to stone," Edith said. She suspects the trees were killed by a flood.

The Taylors still have many questions to answer about how trees adapted to survive the long, dark winter. It is possible the trees dropped their leaves, had smaller leaves or had some other adaptation, Tom said. He hopes the answer is waiting inside one of the stones they shipped home. Most of their work will be back in the lab, where they'll oversee students slicing the rock with diamond blades and then using acetone film to collect the preserved plant cells from the fossil surface.

"It's just one page out of a huge novel that you get to read when you open that particular rock," Tom said.

NSF funded research:
Edith and Tom Taylor, University of Kansas, Lawrence.

PALEOZOIC	MESOZOIC			CENOZOIC
248	206	144	million years ago	65
PERMIAN	TRIASSIC	JURASSIC	CRETACEOUS	TERTIARY

Fishing for fossils

By Kristan Hutchison
Sun staff

Photo by Loren Babcock / Special to The Antarctic Sun

Alycia Rode stands next to a view of rock likely to have fossils on Carapace Nunatak.

Loren Babcock looks at the bare rock in the Transantarctic Mountains and sees green forests alive with animals.

"I see ponds, forests, somewhere down there eruptive fissures and some reptiles swimming around," said Babcock, a paleontologist from Ohio State University. "I see, in my mind's eye, something similar to the reconstructions you see in books."

Babcock reconstructs the past from fragile fragments – an insect wing pressed in stone, the print of fish scales, the marks left by soft shells the size of sunflower seeds.

"We're looking mostly for exceptionally preserved fossils," said Babcock, who was working with fellow paleontologist Steve Leslie and graduate student Alycia Rode. "Think about what it takes to preserve an insect wing. You know how delicate they are."

Most paleontologists look for bones, teeth and shells. Those are the hard parts of the body most likely to last long enough for phosphates or other minerals to replace the cell structure. But only 15 percent of the creatures in an ecosystem have hard skeletons, inside or out. The other 85 percent seldom leave a trace.

"Our fossil record is strongly biased toward those creatures that had mineralized skeletons," said Babcock.

He is trying to counter the bias by seeking out the rare specimens of softer body parts, particularly arthropods, the family of spineless animals that includes spiders, crustaceans and insects.

Antarctica is one of the very few places in the world where such insubstantial specimens have been fossilized from the Jurassic age, 160 million years ago. The other sites are in lower latitudes, Brazil, Italy, China and the Green River Formation crossing Colorado, Utah and Wyoming. As the only high-latitude site, Antarctica allows Babcock to look at differences in the lakebed biology of different latitudes during the Jurassic period.

During a week on Carapace Nunatak, Babcock's group filled 14 boxes with slabs of rock wrapped in white rags, about 315 kg in all. With years of experience behind him, Babcock easily found fossils in the layer of tan rock striping the red-brown basalt cliffs of the Kirkpatrick Formation in the Transantarctic Mountains.

"One or two cracks with the rock hammer and it shows there's fossil," Babcock said. "It is incredible. These are some of the most fossiliferous rocks I've ever seen."

He suspects similar deposits exist along the entire 1,280 km of the mountain range.

Many of the fossil rocks are flat slabs of fine-grained sedimentary stone, which the researchers will split open carefully in the lab and then look at under the microscope. They'll also do chemical analysis. The rocks are like history books. Babcock can see insects, crustaceans and plants on the cover, but is waiting to read the rest of the story on the pages inside.

"Once these things are split back in the lab we expect to dramatically increase the number of organisms we know to be there," Babcock said. Even on the surface, many of the rocks show remarkably clear pictures of the past. An inch-long wing, shaped like a dragonfly's, is etched onto the surface of a sand-colored stone. The threadlike web of veins shows clearly. From other sites around the Beardmore Glacier Babcock's group caught six anchovy-sized freshwater fish, complete with eye sockets.

"It's unusual to find complete fish like that with the scales on and everything," he said. "They look like someone just pulled them out of the water."

Babcock would like to figure out why these sites are so well preserved, and the number of fossils he found may help. He knows he is looking at old alpine lakebeds. Something kept scavengers and burrowers from disturbing the sediment while the creatures buried in it fossilized. It may have been a sudden change in the lake salinity, the introduction of toxins, volcanic ash or sulfur dioxide, or an event that cut off the lake beds from all oxygen, Babcock said.

"That, combined with sudden burial, is usually what causes exceptionally preservation," he said. He'll be able to determine what it was back at the lab, studying the rock structure under an electron microscope and using chemical and mineral analysis of the rock.

Representing creatures seldom preserved, the fossils could also give paleontologists a better idea of how things evolved.

"We found stuff that had not been recorded (before) and what's really unusual here is we got a more complete set of creatures from sedimentary river beds than before," Babcock said. "They help to fill in some of the details of an ancient ecological community."

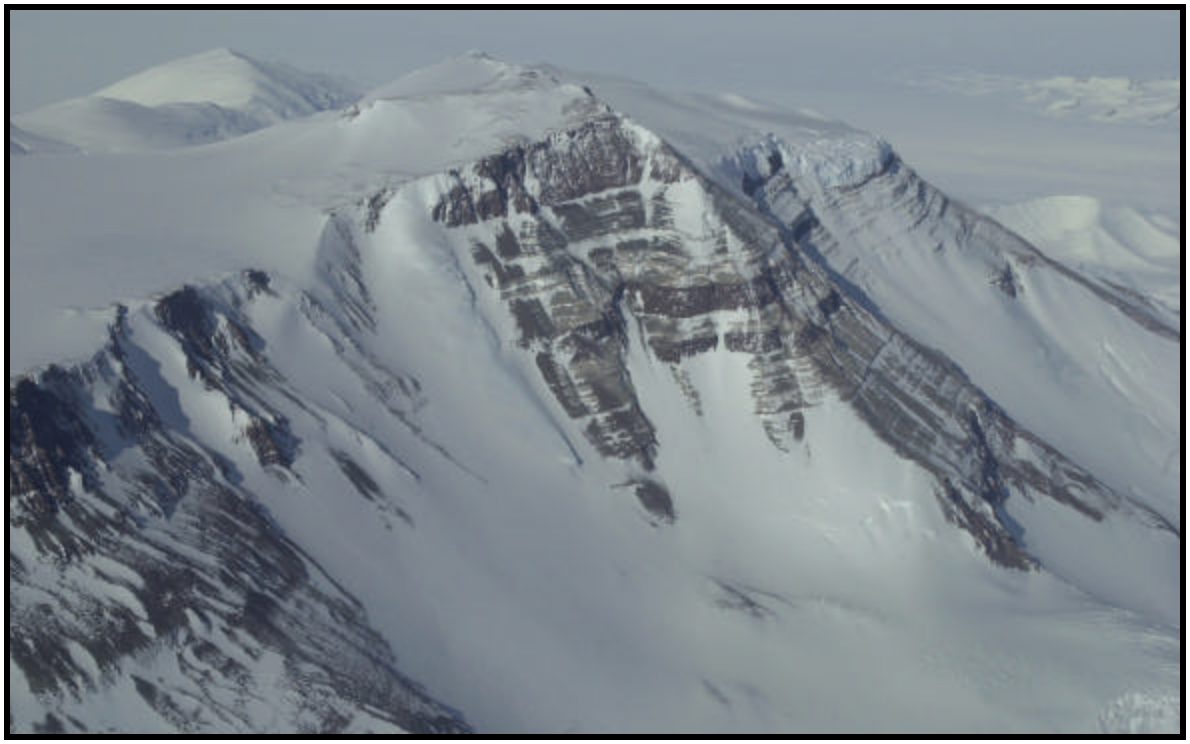
"These kinds of deposits also give us incredible anatomical information about these sort of creatures, information that would normally be absolutely inaccessible to us," Babcock said.

The fossils also tell researchers about the climate at the time. The remains of egg-laying creatures show the temperature was at least 10 C for a few weeks, since that's the temperature they require to incubate. The presence of fish shows it was warm enough for the water to be liquid for extended periods and flying insects also indicate a warmer "greenhouse" world, Babcock said.

"Once we're done with this study, this will almost certainly be the best known Mesozoic lake deposit in terms of fossilization history," Babcock said.

NSF funded research mentioned in this story:
Loren Babcock, Ohio State University, www.geology.ohio-state.edu/~lbabcock/

PALEOZOIC		MESOZOIC			CENOZOIC
	248	206	144	million years ago	65
PERMIAN	TRIASSIC	JURASSIC	CRETACEOUS		TERTIARY



Layers of rock show the periods of time near the Beardmore Glacier.

Photo by Kristan Hutchison / The Antarctic Sun

Permian past pictured

By Kristan Hutchison
Sun staff

Like trackers, John Isbell and Molly Miller read the clues left in streambeds and animal burrows to tell a larger story about life 250 million years ago.

When they first come to a geological site, it looks like a jumble of rock. Examining it closely, layer by layer, the rock begins to make sense, like the pieces of a puzzle put in order. The picture they are putting together of the Permian and Triassic ages answers questions about the environment, climate and animal life.

"We, in a sense, try to paint a picture of the physical environment and the dynamics," said Isbell, from the University of Wisconsin-Milwaukee. "It's really like a mystery or a puzzle and we'll walk up and just be frustrated, scratching our heads, wondering what's going on. Then it will start to fall into place, like finishing a novel."

Isbell and Miller came with a long list of questions to answer about the Permian and Triassic ages. Isbell has the start of an answer for one of the questions, on what caused the mass extinction of animals between the two ages, an event referred to as the Permian Triassic Boundary. Based on changes in the land surface, Isbell believes tectonic forces were involved. He's found streambeds that changed the direction of their flow, indicating a dramatic change in the ground slope.

"The patterns are more reminiscent of tectonic changes," Isbell said. "You see one change in one area, another in another area."

The glacier during the Permian also appears to have been smaller than previously thought and advancing into a lake, Isbell said.

One of the ways Miller can tell which way the streams flowed and where the lake was located is by following animal burrows left in the banks. Many of the burrows are just a half inch wide, left by insects or arthropods.

A mammal-like reptile, about as big around as a soup bowl, also tunneled through the softened ground. The tunnels filled with other material, leaving tubes two to three meters long winding through the rock.

"The behavior is recorded in rock. By reading it we can learn things about life in streams," Miller said.

She'd also like to find one of the creatures still in its burrow. The burrowing animal was closer to mammals and from the same branch that eventually evolved into mammals, Miller said.

"The fundamental question we'd like to answer is: Did early mammals evolve here at this high latitude?" Miller said.

She's found animal trails fossilized on stone. Miller looks at lines scratched on stone, like Chinese calligraphy, and reads them.

"It's all so dramatic. You're not looking at a dead bone. You're looking at an animal walking across 230 million years ago," Miller said.

Though the story Isbell and Miller are reading is an ancient one, they say it still applies to the modern world.

"What this is showing is the Earth, or what is on it, has changed tremendously," Miller said.

NSF funded research mentioned in this story:

Molly Miller, Vanderbilt University, millermf@ctrvax.vanderbilt.edu

John Isbell, University of Wisconsin-Milwaukee, www.uwm.edu/People/jisbell/

PALEOZOIC	MESOZOIC			CENOZOIC
248	206	144	million years ago	65
PERMIAN	TRIASSIC	JURASSIC	CRETACEOUS	TERTIARY

Discovering Antarctica's leafy past

By Kristan Hutchison
Sun staff

Buttercups once bloomed below where the Beardmore Glacier flows, along with shrubs and other tundra plants. Millions of years ago the glacier-filled valley was a fjord, with a glacier advancing and retreating on the southern end, said paleontologist Allan Ashworth. Digging in the debris left by that more ancient glacier, Ashworth and fellow paleontologists, Jane Francis, David Cantrill and Steve Roof found the unlikely remains of a tundra environment.

"You hear that Antarctica is white and snowy and nothing living," said Francis. "Then you hit a rock and open it up and there are leaves."

Ashworth believes the glacier advanced and retreated four to five times in the area where they were digging on Oliver Bluffs. With each retreat plants colonized the fresh glacial deposits, only to be buried as the glacier pushed forward again.

"It's just this tiny little window between glaciers when the rivers flowed and carried these things that the glacier ground up," Francis said. "It's quite amazing that anybody ever found them, because they're so rare."

The ancient glacial deposits were exposed in the sides of the Oliver Bluffs as the modern Beardmore Glacier carved its own way through the valley.

"They include landscapes that existed with life on them," Ashworth said. "Basically in places we could peel back a layer and reveal an ancient tundra."

The group uncovered the wood and leaves of a relative of the Nothofagus, commonly known as the southern beech tree in South America, Tasmania and New Zealand where it still grows.

"The form we find here is not a tree. It's at best something that crawled out along the ground," Ashworth said.

Dave Cantrill discovered a cushion plant, which grew in the shape of a mound about the size of a basketball top. The cushion plant grew outward in annual layers. Each time it was buried by sediment the plant would push up through the dirt and re-establish, leaving concentric layers representing the sediment and growth patterns.

"It sort of tells us of the dynamics of the system and how these plants struggled to survive," Cantrill said.

They've also found about six types of moss and seven flowering plants, including buttercups, complete with seeds, leaves and pollen. The vegetation is mostly low, creeping plants, similar to what is found in the Alaska tundra.

"You can actually see how the plants were growing along the ground and between boulders and were tenacious," Cantrill said.

The five-person team camped on Oliver Bluffs for three weeks. At their campsite the wind whistled and roared over the glacier. Nights were so cold Ashworth's sleeping pad and blanket froze to his cot and one morning he woke with his lips stuck to the tent. Their work site, 100 yards away from the tents, was protected from the winds.

"It's one of those things where the camp was kind of miserable, so there was incentive to go to work," Ashworth said.

Much of their work was done 60 feet up the side of cliffs, sometimes on ladders or in harnesses rigged by the group's mountaineer, Forrest McCarthy. Some of the rock had to be broken open with dynamite by blaster Marty Reed before the researchers could pry it out. When they found a layer of fossils, it could take several days to excavate.

"You spend a lot of time searching and not finding anything, and then when you find a gold vein you follow it," Francis said.

They're shipping home about 60 boxes of rock, totaling nearly two tons, and many of the discoveries will come as they examine those more closely.

"Most of the things we work on are pretty small, so discoveries on them are almost always going to be made in the lab," Ashworth said.

The rocks Ashworth brought back from the same site in 1995 contained beetles, insects, mollusks and a fly that had never been found in Antarctica before.

"They contain organisms we previously didn't know were there and they help our understanding of Antarctica's climatic history and also the evolutionary relations," Ashworth said.

NSF funded research mentioned in this story: Allan Ashworth, North Dakota State University.

www.ndsu.nodak.edu/instruct/ashworth/

Photos courtesy Steve Roof

Above, paleontologist Steve Roof digs for plant fossils on Oliver Bluffs above the Beardmore Glacier.

Right, leaf fossils collected by Allan Ashworth's group.

PALEOZOIC	MESOZOIC			CENOZOIC
248	206	144	million years ago 65	
PERMIAN	TRIASSIC	JURASSIC	CRETACEOUS	TERTIARY

Profile Teacher learns by doing

By Kristan Hutchison
Sun staff

Andrew Sajor is better equipped than most eighth-grade science teachers to dig up dinosaurs in the Transantarctic Mountains with a jackhammer and pickax.

Having first spent 23 years fixing power lines in storms, he knows how to use tools in bad weather.

"Working out in the field, a lot of the tools we use are the same I used in the power industry," said Sajor, a teacher from Plattsburgh, NY, who came to Antarctica in December as part of Teachers Experiencing Antarctica. The National Science Foundation funded program gives science teachers a chance to experience field science and incorporate their experience into their curriculum.

Five other teachers came to Antarctica as well. Seventh- and eighth-grade teacher Amy Stoyles is working with Laurie Connell studying yeast growing in the Dry Valleys. Eighth-grade teacher Colleen Brogenski went up Mount Erebus with volcano researcher Phil Kyle.

Sajor worked with paleontologist Bill Hammer's team, camping on the Beardmore Glacier and retrieving dinosaur bones from Mount Kirkpatrick at 3,800 meters.

In his online journal at www.tea.rice.edu Sajor wrote: "I count myself extremely fortunate to have landed with Dr Hammer, for a number of reasons. First, when you mention to someone you are going to the Beardmore Glacier, their eyes glaze over and they become very envious. To a person, they all comment that that place is the real Antarctica. Second, working on the removal of a rare and exotic fossil, life doesn't get any better. Third, to be attached to a team of world-class scientists."

The paleontologists also felt lucky to have Sajor along. He turned out to be a useful member of the team, jumping in to do everything from fix computer problems to move heavy rocks.

"He's definitely very outgoing, very friendly. He's got just an incredible wealth of expertise," said Nate Smith, a graduate student working on the team. "He pitched in as much or more as everybody on the team."

Sajor took a very circuitous route to teaching, and Antarctica. He grew up in Westchester County, NY. While a college student in Plattsburgh he was hired as a lineman for the City of Plattsburgh Municipal Lighting Department. He stayed, eventually becoming chief lineman.

"I was happy for a long time," said Sajor, who enjoyed working outside and the excitement of going out in a storm to fix sparking lines.

Photo courtesy Andy Sajor

High school science teacher Andy Sajor gets hands-on experience with a paleontology team at Beardmore Camp.

"You built something every day, so you walked away and you said 'I did that,'" Sajor said. "You had a visible, tangible sense of accomplishment, which is pretty nice to have."

After many years, Sajor was spending most of his time training the other linemen, and he realized that was the part of the job he liked best. A friend working at Plattsburgh State University College convinced him to go back to school for a teaching degree.

He finished the degree without expecting to get a job as a teacher, since jobs were hard to come by. Then a local school called and offered him one, at a fraction his lineman salary. Despite the pay cut, his wife, Kathy, and daughters, Brooke and Zoe, encouraged him to take it.

"They said, if it's going to make you happy, do it, and I did. I've never been sorry," Sajor said.

Now Sajor teaches ninth grade and accelerated eighth grade science, as well as twelfth year physics and an astronomy lab at Plattsburgh State University College.

"I kind of spread myself all over because it's just fun. I love doing this," Sajor said.

As a teacher, Sajor rarely cracks open a textbook. Instead, he has students learn by doing. For physical science demonstrations he uses lineman's tools and examples from his own experience. He's built a wind tunnel for students to test airplane wings they've designed. Sometimes he leads the students outside to analyze stream beds and sediment structure.

"They can start to see the forces of uniforminteranism," said Sajor, referring to the geological theory that changes occur slowly over time and clues to what has happened can be found by looking at what forces are currently at work on the landscape. "The present is the key to the past."

Sajor also pursues research projects during the summer, giving him lots of hands-on science experience to bring back to the classroom. In the past summers he has worked with the Institute for Global Environmental Strategies and gone to sea aboard the research vessel *Oceanus* to study the paleocurrents of the Gulf Stream. He enjoys working with scientists, who tend to be professors.

"They're all educators as well as researchers," Sajor said. "That's what should happen at the high school level as well."