The Antarctic Sun

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In the pits

Photo courtesy of Gordon Hamilton/ITASE

U.S. members of the International Trans-Antarctic Scientific Expedition (ITASE) dig a snow pit during their 2001-02 traverse across the West Antarctic Ice Sheet. This year's team of 15 people is just beginning its journey and is scheduled to reach the South Pole in about six or seven weeks.

Slippery when wet

Icestreams show how quickly glaciers move over mud

By Melanie Conner
Sun staff

A collapse of the West Antarctic Ice Sheet could ultimately raise coastlines around the world, flood parts of Boston, Cape Cod and Florida, and wipe out some island nations altogether.

Apocalyptic as that may seem, the theoretical possibility exists because the West Antarctica Ice Sheet lies on bedrock below sea level. At about 3,000-meters thick, the weight of the ice sheet depresses bedrock to an average of about 1,000 feet below sea level, which could allow sea water to slip in between bedrock and ice and destabilize the ice sheet.

"If sea water got in there it would lift the ice just millimeters – it wouldn't have to be much, but enough to apply a slippery film on the bedrock," said glaciologist Gordon Hamilton. He demonstrated the idea by pouring water on a table then placing a piece

See Icestream on page 11

Shackleton's forgotten men

Writer seeks details of expedition's 'other side'

By Mark Sabbatini
Sun staff

Almost any Antarctic enthusiast knows how Ernest Shackleton tried to cross the continent, only to be thwarted by the sinking of the *Endurance*. Surprisingly few remember the support party waiting to meet him on the other side.

Kelly Tyler is hoping to draw some attention to those 10 men, who fulfilled their mission of leaving provisions along the route even after their ship was carried away by sea ice. Three of the men died as the party marched more than 1,500 miles and hauled more than 4,000 pounds of provisions, never knowing their efforts were futile.

"Plagued by frostbite and scurvy, the party continued on, unaware the sinking of the *Endurance* has rendered the depots useless," Tyler said, summarizing the party's two-year plight in a video segment featuring recently discovered film footage. "It was the only successful part of Shackleton's original plan."

Reconstructing the party's history, scientific research and the reasons for their struggles are Tyler's goals this season as she visits many of the places they occupied in the Ross Sea area. The longtime historian and filmmaker plans to write her first book, "The Lost Men," following her visit to Antarctica through the National Science Foundation's Artists and

See Heroes on page 12

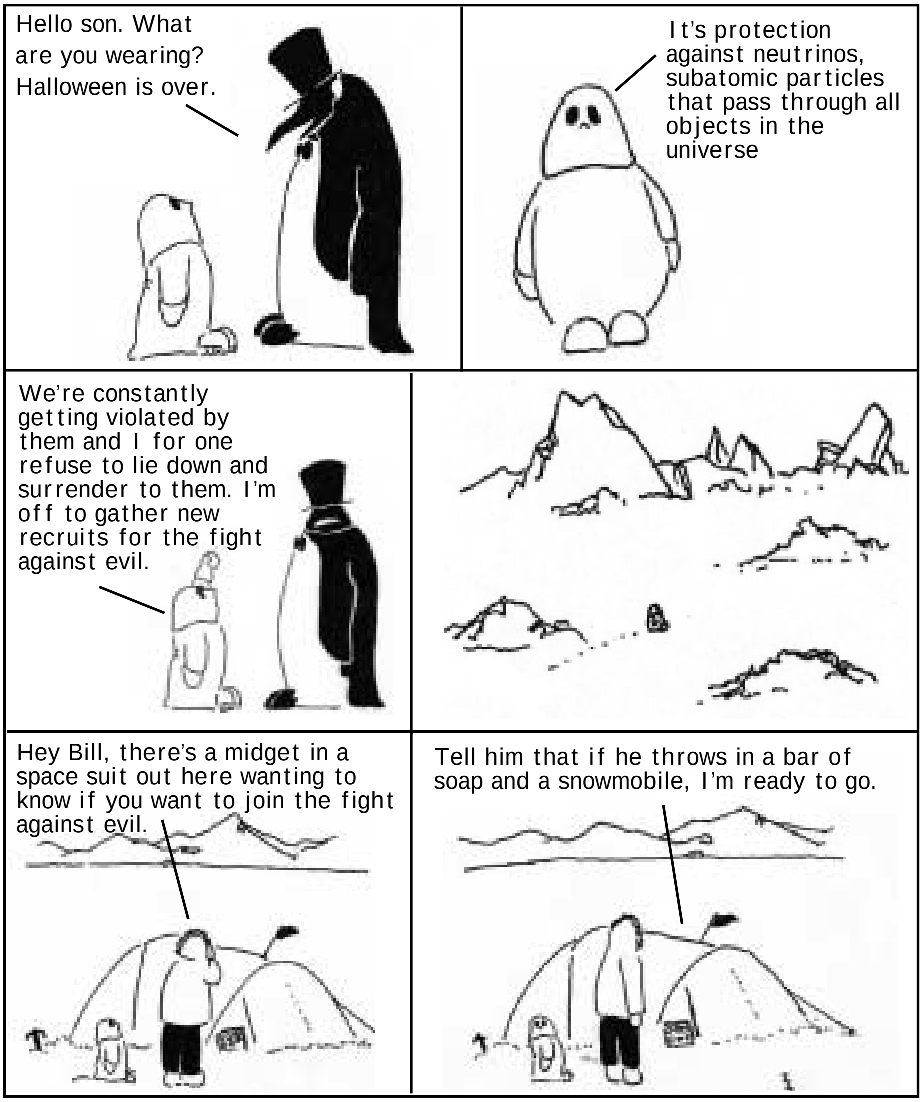
INSIDE

Quote of the Week

"This really isn't the real world."

— McMurdo worker about how things work in Antarctica

Ross Island Chronicles By Chico



Cold, hard facts

Diving records

Time humans can stay underwater without air: **3-4 minutes with special training.**

Age at which a Weddell seal can hold its breath that long: **Less than 10 days old**

Longest a Weddell seal has been recorded diving in McMurdo Sound: **86.3 minutes** recorded early this month by seal researchers.

Distance the record-setting seal swam in that time: **6,200 meters,** from Fat City camp on the sea ice to the coastline near Arrival Heights.

Previous known dive record: **82 minutes** recorded by Castellini and Kooyman in 1986.

Depth Weddell seals can dive to: **600 meters**

Deepest diving bird: Emperor penguin, to **500 meters**

Depth most scuba divers go to: **30-60 meters**

Sources: Mike Castellini and icetrek.org

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Senior Editor: Kristan Hutchison
Editors: Melanie Conner
Mark Sabbatini
Copy Editor: Liz Connell
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.

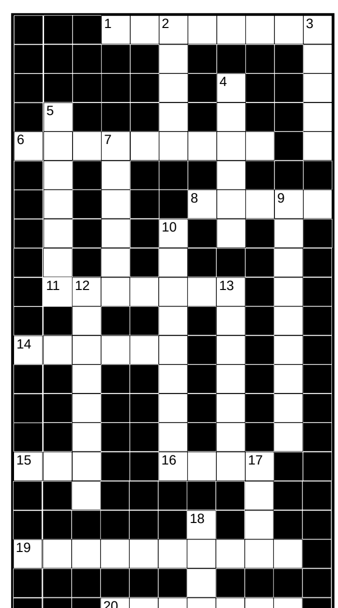
Web address: www.polar.org/antsun

Katabatic Krosswords: Life at sea

Across
1. Less slender and longer fins than other baleen whales
6. Fur seal hunted to near extinction
8. This, not temperature, has greatest effect on marine life
11. Seals with appetites for penguins, other wildlife
14. Gathering of penguin chicks for protection against prey, weather
15. Second-largest of the whales
16. Seals that hunt squid, fish
19. Krill food
20. Largest penguin species

Down
2. Whale ignored by hunters until '70s, then main target
3. Staple food for whales, penguins and others
4. Southern penguin most often seen by tourists
5. Best-known of southern seals
7. Most widely spread southern penguin
9. Only dolphin species found in Antarctic waters
10. Seal eats krill, not its namesake
12. Largest southern seal
13. Algae that live in polar region's sunlit water
17. Ultimate Antarctic scavenger
18. Largest of the whales

Solution on page 6



Squares too small? No pencil to erase your mistakes? Try our interactive online puzzle at www.polar.org/antsun

Testing the air

Measuring the invisible, odorless and absolutely essential oxygen

Photo by Jeff Otten/Special to The Antarctic Sun

Kristin van Konynenburg holds up a flask used to collect air samples at Palmer Station.

By Kristan Hutchison
Sun staff

The Palmer Station doctor watches the wind as closely as a sailor, stepping outside frequently to check if it is blowing off the glacier so she can take unsullied samples of the air.

The flasks of air are sent to a geochemist in California, where the samples help track changes in global oxygen levels.

"Antarctic air, just because it is so pure, is a fantastic measure of what's going on in the rest of the world," said Kristin van Konynenburg, the medical doctor for Palmer Station. "Unless you're sampling downwind from a lot of penguins, seals or human activity, the fluctuation in the levels of carbon dioxide and oxygen aren't due to local effects, but are reflections of global change."

When the wind is blowing from the north, off the glacier, she walks up the hill behind the station to a small hut and shoos away any skuas. Then she reads or knits while monitoring the pump that fills three basketball-sized glass flasks with air.

"It's kind of nice to have to notice where the wind is coming from all the time," van Konynenburg said. "I'm getting good at estimating the knots as well as the direction."

The glass flasks van Konynenburg sends back to Ralph Keeling at Scripps Institution of Oceanography in La Jolla, Calif., look just as empty as when they arrived. Keeling once had to bail a box of the samples out of customs when it was separated from its paperwork.

"What's in the flasks?" the customs agent asked, looking at the apparently empty glass globes.

"Air," Keeling answered.

Figuring he was dealing with a wiseguy, the customs agent responded in kind, flipping through his thick book of regulations for a duty on air.

Keeling regularly receives shipments of air from nine sampling stations spaced out across the globe, from Ellesmere Island in northern Canada and Cold Bay, Alaska, over the equator, to the National Science Foundation research stations at Palmer and Amundsen-Scott South Pole Stations.

In a decade of measuring oxygen levels around the world, Keeling has noticed the amount of oxygen is actually dropping. Generally air is made up of 21 percent oxygen, 78 percent nitrogen and 1 percent argon, with just a dash of carbon dioxide.

Most people learn the oxygen cycle in elementary school – humans breath in oxygen and exhale carbon dioxide. Plants use that carbon dioxide and release oxygen.

"The chemistry I'm talking about is nothing more than that," Keeling said. "Perhaps the only other twist is that fuel burning uses up oxygen."

The intense burning of fossil fuels in the past 200 years has been consuming oxygen faster than it can be replenished. At this rate, the world would run out of oxygen in 50,000 to 60,000 years, Keeling said.

"It's kind of the flip side of carbon dioxide production," Keeling said.

The rate of oxygen depletion can sound frightening, and Keeling has people calling him worried that someday they won't be able to breathe.

"There is a very widespread phobia about oxygen supply," Keeling said. In reality, the decrease of oxygen is barely detectable and humans would run out of fossil fuels to burn long before we run out of oxygen to breathe.

"By the time we go through all our fossil fuels we'll have used up a couple percent of all our oxygen," Keeling said.

The rate of oxygen loss is less than expected based on the amount of fossil fuel burnt. Some of the lost oxygen is being replaced by increased production of oxygen by plants on land and by the ocean, which both exchange carbon dioxide for oxygen.

"We've increasingly become aware that the oceans are also contributing to this extra oxygen production," Keeling said.

Scientists are able to calculate what they call the oxygen budget almost like a mathematical equation. They know the rate at which carbon dioxide is produced by fossil-fuel burning from industrial records kept by the United Nations. From there they can estimate how much oxygen is coming from the ocean, based on its expected response to global warming. The remaining oxygen found in the atmosphere reflects production by land plants.

The amount of oxygen plants produce equals the amount of carbon dioxide they consume. After observing the actual increases in carbon dioxide in the atmosphere, scientists can calculate how much of the carbon dioxide the ocean must have taken up to balance the equation.

In the 1990s fossil fuel burning used up about 6.3 billion metric tons of carbon, increasing the carbon dioxide in the atmosphere by about 3.2 billion metric tons. The land took up about 1.3 billion metric tons and the oceans took up about 1.9 billion metric tons.

"It does seem like the Earth is kicking in and replacing some of what is lost, but it's very unlikely that even if we stopped (burning fossil fuels), the earth would kick in and replace all (the oxygen) on any kind of humanly relevant timescale," Keeling said.

Excess carbon dioxide dissolves into the ocean, because seawater is alkaline while carbon dioxide is acidic. Together they form carbonic acid. The Southern Ocean around Antarctica is a particularly important area for the exchange of carbon dioxide and oxygen, because the Antarctic Circumpolar Current creates a mixing zone where oxygen-depleted deep water surfaces and absorbs oxygen and carbon dioxide.

"The oceans everywhere are contributing to removing excess CO_2 from the

See Air on page 6

Global Change and Atmospheric Chemistry:

Experiments conducted along the U.S. ITASE traverse

By Markus Frey

speaking of science...

The springtime ozone hole in the stratosphere above Antarctica is probably one of the most prominent changes of the environment caused by anthropogenic activities. The ozone hole's discovery in the 1970s triggered the growth of a relatively young scientific discipline: atmospheric chemistry. A part of atmospheric sciences, atmospheric chemistry tries to understand the chemical makeup of the atmosphere, how its many constituents change over time through photochemical or physical processes, how mankind is altering the natural background atmosphere and ultimately how climate changes through the so-called chemical climate feedback (e.g. greenhouse effect).

The remote polar regions, covered year-round with ice, represent an ideal natural laboratory in which to study fundamental atmospheric chemistry. Remote regions are suitable to measure the very low background levels of atmospheric trace gases due to the minimal interference by anthropogenic pollution sources, vegetation or soil-covered surfaces. In addition, the polar day and night, each lasting several months, provide two extreme experimental boundary conditions for atmospheric chemistry whose main driver is solar radiation. Results from polar atmospheric chemistry research help to explain many issues that affect life in general on our planet. Examples include the mechanisms leading to the stratospheric ozone depletion or factors controlling ground level ozone, a major pollutant in big cities.

Longer records of atmospheric chemistry observations exist only at a small number of sites around the globe going back at most a few decades. However, ice cores from the polar ice caps provide scientists with the opportunity to extend that record back in time for many water-soluble species and gases. Based on reconstructed changes in atmospheric chemistry 100, 1,000 or even 10,000 years ago, it becomes more feasible to predict the future of the atmosphere currently being altered significantly by anthropogenic emissions.

Two important atmospheric trace gases, hydrogen peroxide and formaldehyde, are water-soluble and therefore found in snow and ice. They are both linked to the budget of atmospheric oxidants, which determine the oxidation or "cleansing" capacity of the atmosphere. The oxidation capacity describes how well atmospheric pollutants are oxidized and then removed from the atmosphere, and therefore has a key role in controlling the atmospheric build up of climate-changing greenhouse gases.

The interpretation of the concentrations of hydrogen peroxide and formaldehyde found in the snow is further complicated by the fact that after a snowfall these gases partially de-gas from the snowpack back into the atmosphere. This temperature-driven physical exchange between snowpack and overlying atmosphere also modulates the concentration of many other atmospheric chemical species. Furthermore, it has been recognized that in the upper centimeters of snow many not fully understood chemical reactions are taking place, as in a reaction chamber driven by sunlight.

The U.S. ITASE (International Trans-Antarctic Scientific Expedition) traverse is collecting shallow ice cores over a wide area in West Antarctica in order to reconstruct an environmental record over the past 200 years. An extensive atmospheric chemistry sampling program has been incorporated on this moving platform. The primary scientific objectives include measurements of atmospheric peroxides and formaldehyde in this region and investigation of post-depositional processes of these gases, eventually allowing for the quantitative interpretation of the ice core records in terms of atmospheric chemistry change. Research also includes the interaction between the snowpack and the atmosphere through physical and photochemical processes.

During our three-day stay at each coring site a variety of experiments are conducted in the field. The Atmospheric Chemistry Shelter houses two custom-built atmospheric detectors for the continuous measurement of peroxides and formaldehyde. Air from outside is drawn constantly into the instruments through a heated intake line, where it is passed over a flowing water stream. The respective gases dissolve in the water, a chemical reagent is added and the concentration is determined by measuring the fluorescence of the molecules then produced by that chemical reaction. A simple calculation allows one to derive the original gas concentration in the air above the snow. A second chemistry lab installed in the "Blue Room" is used to produce clean water from melted snow, and to prepare chemical reagents. Additional air filter measurements yield multi-day averages of further trace gases belonging to the family of ketones and aldehydes.

The same atmospheric detectors are also able to measure formaldehyde and hydrogen peroxide in short firn cores which are drilled with a 2-inch drill, melted and analyzed the same day. The on-site analysis minimizes contamination of the samples and also gives immediate information about snow chemistry and even annual accumulation rates based on the seasonal signal of hydrogen peroxide. The upper 30cm of snow are sampled with a specially designed snow sampler, with the samples being transported in clean, airtight glass bottles for further analysis back in the Crary Lab at McMurdo Station.

Since ozone is an important player in the photochemistry of the lower troposphere, it is also monitored using a weather balloon. The balloon is filled with the gas helium, attached to a 1,000-meter-long tether and then raised or lowered using an electric winch, with an ozone sonde, a temperature and relative humidity probe attached to it. The vertical temperature and ozone profiles of the lowest kilometer of the atmosphere give information about the layering of the atmosphere and the distribution of ozone, which are both additional aids for interpreting atmospheric chemistry measurements. Free balloon launches all the way up to the stratospheric ozone layer at more than 20km altitude are planned this time at site 1 and Hercules Dome with the intention to provide ground truthing for satellite ozone measurements.

Meteorological variables, such as pressure, air and snow temperature at various depths, relative humidity, wind speed and direction and UV radiation are also constantly monitored in order to better understand the observed changes in trace gas levels.

This year's traverse, leading us from Byrd Surface Camp in West Antarctica to the South Pole on the East Antarctic Plateau, will be especially exciting from a scientific point of view: We will be able to test our current understanding about atmospheric chemistry and atmosphere-snow transfer in very different environments, going from warm, high-accumulation sites at low elevation to very cold, low-accumulation sites at more than 3,000 a.m.s.l.

Markus Frey is a doctorate student at the University of Arizona in Tucson. The primary investigators on his project are Roger C. Bales of the University of Arizona and Joe McConnell of the Desert Research Institute in Nevada.

around the continent

SOUTH POLE

Seismic activity

By Tracy Sheeley
Pole correspondent

Our big science news for the week is the arrival of SPRESO personnel at South Pole. SPRESO (South Pole Remote Earth Seismic Observatory) is entering its second year of operations at Pole. The camp is located five miles out from the station. The group will drill three holes about 300 meters deep, then seismometers will be installed in the holes. Drill rigs are being set up as this article is being written, and drilling should be happening by the end of the week.

Seismology is the longest running observational science at South Pole – the first experiment began in the 1957 International Geophysical Year.

We also hosted our first National Science Foundation visitors, including Dr. Robert Wharton, executive officer of the Office of Polar Programs and Martha Rubenstein, Director of the National Science Foundation Budget Division. They spent several hours touring the station and becoming familiar with the unique challenges of South Pole construction and science.

Photo by Mark Buckley/Special to The Antarctic Sun

A Caterpillar works at the South Pole with Mapo in the background.

Joan Myers of the Antarctic Artist and Writers program is also on station. She is a photographer capturing views of South Pole station and its residents. She is working on a book about Antarctica, and some of her photos already have been published in the *New York Times*.

Crews work round the clock on the new South Pole Station. Preparations are being made to raise the elevated station. Finish work on the berthing rooms and the new galley is also underway.

The station population is a little over 200 – approaching our maximum of 220. With crews working 24 hours a day, we manage to keep from stepping on each other too much, but South Pole is a busy spot on the polar plateau during the summer season.

We've been breaking some weather records. On Nov. 17 the maximum temperature of –9.8F beat the temperature of –16.1F set in 1973. The following day we did it again. Our temperature of –11.6 broke the record of –13F set in 1980. Of course, since then it's been hovering around –40F, a bit on the cool side….

PALMER

Boating beyond the limits

By Tom Cohenour
Palmer correspondent

Only on very rare occasions are residents of Palmer Station allowed past the two-mile boating limit — and for good reason. Weather on the Antarctic Peninsula frequently changes suddenly and drastically.

More often, changes are so subtle inexperienced boaters easily can find themselves trapped in densely packed brash ice unable to return to the station.

But brash ice wasn't the reason Chris Denker and Brett Pickering, researchers with the Sea Bird Component of the Long Term Ecological Research project didn't return to station one evening this week.

The two scientists had arranged to camp out overnight before they traveled six miles by Zodiac to seldom-visited Dream Island, where they were conducting penguin research. As part of the arrangement, the Ocean Search and Rescue (OSAR) team was put on alert while the scientists were out.

Photo by Cara Sucher/Special to The Antarctic Sun

At Palmer Station, Zodiacs are essential transportation.

Doug Fink, OSAR team leader, is also Palmer's boating coordinator. In that capacity, Fink facilitates safe and efficient boating for science and support as well as recreation. On any given day Fink can be found performing duties such as maintaining boat motors, modifying science platforms on the Zodiacs, assisting scientists, repairing boats, monitoring weather and sea-ice conditions, or teaching boating classes.

"Zodiac travel is permitted only after successful completion of boating school," said Fink. "Boating I and the Islands Course are required for all passengers while those wishing to be operators must also pass Boating II," he added. A minimum of two operators must be among any boating party leaving station.

Boating I is a classroom setting that covers an introduction to boating regulations and basic cold weather survival. The Islands Course is a hands-on practical class taught in the Boathouse which includes the use of equipment such as survival caches, tents, stoves, flares, radios and hypothermia treatment.

Boating II takes place in a Zodiac on the ocean. Students learn boat launching and landing, knot tying, motor use, and

See Palmer on page 6

the week in weather

McMurdo Station
High: 32F/-0.3C Low:6F/-14C
Wind: 26mph/42 kph
Windchill: -29F/-34C

Palmer Station
High: 41F/5C Low:26F/-4C
Wind: 39 mph/62kph
Melted precipitation: 1.5 mm.
Snowfall: 1 cm.

South Pole Station
High: -10F/23C Low:-43F/-42C
Wind: 17mph/27kph

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boat care. An orientation visit around the south and north islands teaches students where landing points and survival caches are located on various islands. It concludes with a man overboard drill where students practice methods to get a person back into the boat. The drill includes conscious as well as unconscious victim retrieval.

A float coat is mandatory apparel for all boaters. The one-inch thick, bright orange float coats must be zipped up and the beaver tail fastened to keep a person afloat. The beaver tail is an extension of the back of the coat that hangs down. It's brought up between the wearer's legs and fastened to clips on the front of the float coat.

For withstanding the extreme stresses of frigid waters, rock and sharp ice in Antarctica, inflatable Zodiacs are superior to wood, aluminum, or steel boats. Constructed of Hypalon, they're flexible, durable and easy to repair. Large buoyancy tubes and a low center of gravity make a Zodiac practically impossible to capsize while multiple air chambers make it nearly impossible to sink.

Palmer's two-mile boating limit includes nearly 10 square miles of open water dotted with the jagged rocky shoreline of 20 main islands and dozens of small, nameless rocks. Eleven of the 12 survival caches are within the boating limit. The 12th survival cache is located four miles outside the limit on Dream Island.

Denker and Pickering had plenty of supplies on their planned overnight, and didn't need the survival cache that day, so all the extra gear and those delicious milk chocolate bars, dried fruit and cashew nuts are still there waiting.

Photo by Doug Fink/Special to The Antarctic Sun

Scientists take water samples out of a Zodiac, maneuvering through the brash ice near Palmer.

Air From page 3

atmosphere. All parts of the ocean are important and everywhere is struggling to keep up," Keeling said. "There are regions that will saturate faster than others and the region that will saturate last is the Southern Ocean, because that's where there's the most deep water."

Because of its position on the Antarctic Peninsula, sticking out into the Southern Ocean, Palmer is a particularly good area to see the effects of the ocean on the oxygen supply. The levels of oxygen around Palmer are lower because the oxygen is being drawn into the ocean.

Keeling has also noticed some seasonal variations in the Palmer air samples. As the upper layers of water cool in the winter it becomes easier for the deeper water to rise and mix, decreasing the amount of oxygen in the atmosphere. In the summer the upper layers of water warm slightly, holding back the deep water, and phytoplankton living near the surface expel oxygen.

Though the change in oxygen levels is imperceptible to a human, the change in the ocean is easy to sense.

"At the beginning of the summer season there is really no smell in the air – it's just crisp and smells like nothing, except maybe cold," van Konynenburg said. "When the phytoplankton bloom later in the season you start to notice the ocean's rich, green smell."

Taking the air samples has made van Konynenburg more aware of the effects people have on the atmosphere and the seasonal cycles of carbon and oxygen.

"It makes me think twice about starting up my car when I get home, that's for sure," van Konynenburg said.

Crossword on p. 2

Continental Drift

What science experiment really needs to be done in Antarctica?

"I think you should really test Twinkies as a housing material. I've heard they last 11 years in a normal environment. They'd last centuries down here."
Dan Kray
South Pole cargo handler from Oswego, N.Y.

"We either need to find the motherlode of gold or get some experiment that would populate Antarctica."
Greg Weber
McMurdo electrician from Boise, Idaho

"I would love to see the science that is already being done accessible to regular non-science folks...An outreach program for the general public to understand what we are studying."
Michelle Ferrara
Palmer researcher from Seneca Falls, N.Y.

Photo courtesy of Gordon Hamilton/ITASE

Two agricultural tractors pull living, research and equipment sleds across the West Antarctic Ice Sheet during the 2001-02 U.S. International Trans-Antarctic Scientific Expedition. The "trains" are completing a four-season project this year.

Driving to the Pole

ITASE heads south from Byrd Surface Camp with a destination in mind

By Mark Sabbatini
Sun staff

One of the oddest collections of vehicles ever to take a road trip is about to wrap up a four-year journey by delivering some unusual cargo to the South Pole: several tons of ice.

Not that there's a shortage at the bottom of the world, but this isn't just any ice. It's part of a collection providing some of the first in-depth data about a large part of Antarctica.

Those making the trip say the collection, combined with similarly detailed data about everything from the ozone to the bedrock two miles beneath their feet, may help turn the continent from one of the least-known areas to the best when it comes to environmental knowledge. In turn, that may shed new light on worldwide matters such as long-term climate patterns and global warming.

"I would say it's one of the most comprehensive glaciological scientific undertakings ever done," said Dan Dixon, a field assistant at the University of Maine who is about to begin his second trip.

This year's 900-mile drive is the final section of the U.S. portion of the International Trans-Antarctic Scientific Expedition (ITASE), a project involving 20 countries. Participants are primarily using ice samples, radar, balloons, satellite imagery and other methods to learn more about weather patterns, ice flow, snow accumulation, atmospheric conditions and other aspects of West Antarctica during the past 200 to 1,000 years.

Participating countries are traversing different areas, with the U.S. covering portions of West Antarctica and the South Pole. U.S. organizers hope to make a future two-season traverse inland of the Transantarctic Mountains.

Those traveling the final portion of the U.S. route this season cite a number of "firsts" to date, even though research in many areas is years from completion. Most of the achievements cited involve gathering information using new methods or at a level of detail not achieved before.

Two "trains" of assorted scientific sleds, each pulled by a large agricultural tractor, have made round-trips on the West Antarctic Ice Sheet during the past three years. This season the trains will make a one-way trek that ends by crossing over to the eastern part of the continent.

"It's really great to actually have a destination," said Susan Kaspari, a graduate student at the University of Maine making her second traverse. "The huge bonus is we don't have to turn around and backtrack."

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Photo by Mark Sabbatini/The Antarctic Sun

Eric Steig, left, Paul Mayewski, center, and Gordon Hamilton discuss preparations at McMurdo Station's Crary Lab for this year's ITASE traverse.

ITASE

From page 7

Climbing to the bottom

This season's trip will be the second scientific caravan to traverse to the South Pole, coming nearly 40 years after Major Havola led a group there in 34 days in 1964.

"If you look at the configuration it doesn't look that different," said Paul Mayewski, the U.S. ITASE field leader, and a professor and director of the Institute for Quaternary and Climate Studies at the University of Maine in Orono.

The amount and quality of data collected this time will be markedly different, of course. Partly because the modern trekkers plan to spend 40 to 50 days making the trip, but mostly due to technological improvements such as satellites, global positioning systems, better ice drilling equipment and alternative sources of power such as solar panels and wind generators.

Much of this season's terrain will be higher, drier and colder than previous U.S. ITASE trips, since the Pole is about 4,000 feet higher than the 5,000-foot-high starting point at Byrd Surface Camp. The slope is gradual enough that no problems are expected while traveling, but the conditions mean some differences — mostly minor — are likely in how data is collected and what results will be obtained.

There is less precipitation nearer the Pole, for example, so sections of ice extracted there will probably feature thinner annual layers and therefore date further back in time than ice from snowier areas. Atmospheric chemistry measurements are likely to be different as the traverse moves away from the West Antarctic Ice Sheet, with fewer maritime-influenced elements, such as sodium, detected.

"We're going to have probably the first high-resolution climate record from the Pole since 1980," said Eric Steig, a science investigator who is a professor at the University of Washington in Seattle.

Team members packed more clothes and made small changes to equipment so it will function better in colder weather. But three years of field experience have also allowed them to fine-tune research and travel methods.

"Last year was the first time there were no mechanical problems," Dixon said. "So this year, knock on wood, the (tractors) will perform well."

The final step of the journey will be helping to pack up a 300-meter ice core being drilled at the South Pole by members of Ice Core Drilling Services at the University of Wisconsin, led by Terry Gaecke, which will be used for ITASE and other projects.

Participants said they haven't noticed much extra attention being paid to this year's traverse by the media or observers in the science community, although the Pole destination is intriguing to many who have been following the journeys.

"If we said we're going to 87 degrees south, 115 degrees west it would be a lot harder for people to identify with that," Mayewski said.

Life on the road

There are a few newcomers this season, but most are returning to a familiar routine in the field.

Participants spend long and often bumpy hours in the sled-mounted huts as they are dragged at roughly 7 mph across the icy landscape by the agricultural tractors. They stop about every 60 miles (100 km) to dig snow pits, drill ice and take other measurements.

Workdays can last 16 hours and sleeping arrangements are less than lavish for most in the cramped nine-bunk "Blue Room" trailer. The few leisure moments may be a game of frisbee if the weather is favorable, or a DVD movie on somebody's laptop computer if not.

"I've definitely lived and worked in cramped quarters before, but nothing to this degree," said Jim Laatsch, a field assistant from Dartmouth College who is one of two first-time Antarctica visitors on the trip.

There's also a kitchen trailer where a few participants sleep, a storage trailer for ice cores, a shelter for simple mechanical work, an outhouse and several science huts with various equipment.

Previous trips may have worked out many of the bugs in the system, but additional planning and attempts at improvements were still a big part of the agenda before deploying to the field. The team made sure it had plenty of everything from storage boxes to Sharpie markers. They also sought extras such as power outlets by each bunk (unlikely) and a watertight storage box to thaw food so it won't drip on people's belongings.

Space will be a bit tighter than normal this year since 15 members is one or two more than past trips. Also, all of the ice and other material collected must be carried the entire trip. In past years the cores were left until the return trip, but that obviously isn't possible on a one-way trek.

"It probably just means more packing and shuffling around for us," Mayewski said.

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ITASE

From page 8

A day at the office

There are 11 projects being conducted in six fields of study, but participants are quick to point out there is considerable overlap and sharing of data. Satellite imagery helps chart the course in advance. Shallow and deep radar readings of the ice are collected as the trains move across the continent, providing further information about good sites to collect samples. At the sites, data collected from a variety of air, snow and ice experiments provides chemical details sought by many researchers, such as the elements and reactions present in the atmosphere in present and past years.

"All the science is the same," Dixon said. "We've reached the fine balance with our disciplines. Each helps determine the validity of the others."

Most of the field work is more physical than scientific, as snow and ice are packed into special storage containers, balloons are launched and automatic weather stations set up to provide future atmospheric readings. Analysis of the materials and data, by ITASE members and others, will take years in many cases.

"The reality is most of our work is back home," Steig said.

Dixon said so far he is analyzing ice cores from the first two years of the U.S. traverses, not those he collected last year. He said he's hoping to do a more detailed study using all of them.

"It's a several year job really, because there's so much data," he said.

Steig is overseeing the final year of his project, after sending his graduate students on previous traverses. He is reconstructing the region's temperature history by using satellite imagery and measuring the ratio of heavy to light isotopes of oxygen in the ice cores. The isotope ratio in the ice is largely affected by the temperature where the snow originally fell.

"If we're able to figure out the relationship between isotopes and temperature of the ice for the past 20 years we can determine temperature data as far back as the core dates," he said.

Knowing such details has implications that go far beyond a remote section of the world's most isolated continent.

Global warming is a topic of worldwide discussion, based largely on historically unusual warming in the Northern Hemisphere, Steig said. But he said researchers don't know if that pattern applies to the Southern Hemisphere. Many large icebergs have broken off into the Ross Sea region in recent years, but at the same time the East Antarctic Ice Sheet has actually cooled off during the past 20 years.

"One of the main things we've done so far is we now have a beautiful map of recent ice sheet temperatures," he said. Eventually, he said, that can be used to help determine if the cooling in East Antarctica is part of a normal global weather pattern.

ITASE participants also hope to find answers in other related fields of research from their traverses, but most said it's too early to draw many conclusions from work done so far. Steig said it may take five years before he has results he can publish as definitive answers.

The trip also offers a final chance to test and refine equipment developed during the ITASE project, some of which participants hope to use on future polar research in Antarctica and elsewhere.

Drilling specialist Mark Wumkes is hoping this traverse will prove a portable ice drill he designed is fully "road-ready." If so, it could have a major impact on future field expeditions, since the 200-pound drill is much more portable and can collect samples much faster than present

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Photo courtesy of Markus Frey/ITASE

Markus Frey, a doctorate student and ITASE field assistant, releases a balloon to gather atmospheric chemistry data during a stop in the team's 2001-02 traverse. He will continue the experiments daily this season.

Sciencemobile

Roving researchers study Antarctica eleven ways

This season's trip by the U.S. segment of the International Trans-Antarctic Scientific Expedition (ITASE) will feature 15 members working on 11 projects in six scientific disciplines. Among the projects:

- The expedition's field leader is Paul Mayewski, a professor at the University of Maine who has led more than 35 Antarctic expeditions and others in Greenland, the Himalayas and the Tibetan Plateau. He and field assistants Dan Dixon and Susan Kaspari are looking for past climate data by seeing how much sodium, calcium and other elements known as ions are in the ice cores. The amount and mixture of various ions indicate likely weather patterns for the era being examined. It can also detect and provide information about "extreme" events such as the large-scale volcanic eruption of Tambora in 1815, atmospheric nuclear testing during 1950s and '60s and what appear to be unusually common El Nino patterns recently.
- Steve Arcone, an investigator working at the U.S. Army Cold Regions Research and Engineering Laboratory in Hanover, N.H., is examining snow and ice surfaces at relatively shallow depths using a high-frequency radar that probes about 330 feet (100 meters) beneath the surface. The shallower readings provide more details about the surface layers than deeper radar, allowing for the selection of evenly layered sites to extract ice cores, and better measurements of snow accumulation rates between core sites. A separate radar at the front of one of the "trains" detects crevasses during the traverse, although none have been spotted during previous trips.
- Gordon Hamilton and his doctoral students Blue Spikes and Leigh Stearns of the University of Maine are studying the distribution of snowfall across the ice sheet and measuring ice flow along U.S.

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Photo by Joan Myers/Special to The Antarctic Sun

"ITASE in a way is going to develop the giant missing link."

— Paul Mayewski, U.S. ITASE leader

ITASE

From page 9

equipment that weighs 1,200 to 2,000 pounds.

"In 15 minutes you can do what you used to do in one day," he said.

A major reason is the drill can collect samples without requiring large snow pits to be dug first, normally the most time-consuming part of the process, Wumkes said. The snow pits are needed because the larger drills lose the top meter of a core because they must be lowered below the surface to start drilling. Digging a pit and collecting samples can take most or all of a day, due to its size and the difficulty of getting "clean" samples unaffected by outside elements.

Wumkes' drill extracts cores two inches in diameter, compared to the 3-inch cores obtained from the main drill on the ITASE traverse. But he said his drill should penetrate up to 200 meters deep —two to three times the depth of most cores being collected during the traverse — and that capability will be tested for the first time this season.

If the drill is efficient enough it could allow researchers to fly to a site and return the same day after extracting ice cores. Wumkes, who plans to build at least one more of the drills after the traverse, said it's also simple enough for scientists to use without bringing drilling personnel along. And while it can't completely replace the need for snow pits — which are needed for near-surface data — fewer will likely be needed for many projects.

Not the end of the road

Mayewski said the experience of ITASE during the past several years proves Antarctic traverses deserve strong support in the future.

He said they have the potential to replace and be more efficient than fixed field camps. The large-scale equipment is also sufficient to plough runways for support planes and install remote data collection instruments in isolated locations. There are also other fields of study that can be undertaken during the traverses.

"These 11 projects are by no means the only ones that can be done," he said, referring to this year's ITASE research.

There will be no U.S. traverse next season, but Mayewski said he is confident the two-year trip from the South Pole to Northern Victorialand along the Transantarctic Mountains will eventually be approved. Several members of this year's traverse said they are interested in continuing their work on the Ice if and when that happens.

It will probably take 10 years before the ITASE traverses of all participating countries have enough ice cores to allow for an in-depth climate and environmental history of the continent, Mayewski said. He said Antarctica has only 10 to 50 years of instrument data, depending on the region, making the detailed reconstruction of a 200-year time period in a relatively short period all the more impressive.

"ITASE in a way is going to develop the giant missing link," he said.

Science

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ITASE routes using high-precision GPS instruments. Markers left at the ice drilling sites are being measured annually to determine their vertical velocity which, combined with snowfall rates, provide a way to calculate thickening or thinning of the ice sheet. The group is also using satellite imagery to map the traverse routes. Data collected by the ITASE team in the field is leading to better interpretations of the satellite imagery.

• Markus Frey, a field assistant who is a doctorate student at the University of Arizona in Tucson, is conducting ice chemistry experiments by studying the makeup of snow samples, launching balloons to gather ozone readings and analyzing sections of ice up to three meters (10 feet) beneath the surface that are melted in the field. He said he should collect a larger and more consistent amount of data this season with the help of Betsy Youngman, a Phoenix science teacher who is spending her first season in Antarctica as a field assistant, since she will be able to launch balloons daily. Results from Frey's research will provide additional atmospheric chemistry data in previously unmeasured regions, as well as information about other subjects such as ozone depletion.

• Brian Welch, a postdoctorate fellow at St. Olaf College in Northfield, Minn., is using a deep radar system to measure ice thickness down to the bedrock – about two miles in some cases. The resulting data can provide information about the flow of the ice, historic events such as volcanic eruptions and geologic deposits from the bedrock.

Other members include Eric Steig, a science investigator; Mark Wumkes, the traverse's drilling specialist; Lynn Peters, chief mechanic and camp manager; Carl Hess, another mechanic; Andrea Isgro, the safety officer and cook; and field assistant Jim Laatsch.

Follow the ITASE journey at www.secretsoftheice.org

Icestream

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of paper over the spill, letting it slip and slide on the thin film of water.

Parts of the West Antarctic Ice Sheet are already slipping to the sea at an accelerated rate in part because of the slick surface below.

According to Hamilton, scientists want to understand these ice streams in order to create a computer model that could predict the future of the West Antarctic ice sheet based on the most current and accurate data.

Ocean-bound ice

Like frozen molasses creeping over a tilted tabletop, glaciers are forced by gravity toward lower elevations. In Antarctica, the Transantarctic Mountain Range acts like a dam for ice from East Antarctica. Just as spillways release water from dams, valleys release glaciers from the mountains, allowing ice to continue its seaward journey.

While the glaciers inch their way toward the Antarctic coastline in West Antarctica, faster-moving streams of ice cut through the glaciers, sometimes moving three times as fast as the surrounding ice. These ice streams, some 40 miles wide, transport massive quantities of ice as if riding a conveyor belt toward the sea.

"Ice discharge is dominated by fast-flowing ice streams," said glaciologist Howard Conway.

Moving an average 50 to 100 meters per year, ice streams are significant to researchers studying the West Antarctic Ice Sheet because faster-flowing ice can act as indicators to larger glacial patterns.

Researchers monitor and study stream behavior using satellite imagery, seismic sensors and radar detections. They want to understand what creates the flow, what keeps it from solidifying with the surrounding ice and what holds the streams back.

"Nobody really knows for sure why they form," said Hamilton. "There is something special probably happening at the bed."

According to glaciologist Sridhar Anandakrishnan, the sediments, water and topography of the bed could also help him understand the onset of rapid flow.

On satellite images of ice streams, mostly labeled A through F, such geological features as stream lines, crevasses or raised beds are visible. The streams often respond in unpredictable ways to the features below. Researchers want to know what the bed would look like minus the ice.

Ice on the go

Like glaciers in general, ice streams flow due to a balance of lubrication and friction.

Possibly related to friction, Ice Stream C stopped flowing about 150 years ago. Scientists are unsure why.

"A lot of people have been trying to figure out why Ice Stream C stopped," said Charles Raymond, a glaciologist who has studied its boundaries, crevasses and other geologic features to help in understanding the phenomenon.

Ice needs more force to move over rough bedrock, just like sanding wood, said Hamilton, who is mostly interested in knowing what holds the ice sheet back.

Although scientists won't know for certain what bedrock features cause friction until further data is collected, stream beds are thought to be too weak to hold the ice streams back. The beds seem to contribute to the ice streams moving faster than surrounding glaciers, in part because of a wet, slippery bed, called "till."

"It is the muddy sludge that is taking the ice with it to sea," said Hamilton. "The studies are all about mud."

What keeps glaciers from slipping in mud and sliding all the way to the coast is the friction created where the fast ice meets the slow ice or the shear margin. In the shear margin, where the speed of the ice decelerates to about 2 meters a year.

"Glaciers are normally bounded by rock walls," said Hamilton. "But ice streams flow through an ice sheet, it's a channelized part of the ice sheet and rubs against the ice around it."

On the edge of the streams, the crevassed and jumbled ice often forms seracs up to 20-feet high, making the shear margin the only visually identifiable feature on the expansive white plateau.

"Everything is pushed, ripped, it's like you're looking at a whitewater river," said Hamilton. "It's amazing. It's like the eighth Wonder of the World. And the crevasses are an iridescent, bluish-black color that is impossible to describe."

Hamilton and others spent two austral summers studying shear margins. The science crew picked their way through crevassed terrain that more closely resembled Swiss cheese than a snow plateau. Roped together, they walked over snow bridges and navigated the terrain, placing and retrieving aluminum poles to track the movement of ice flow.

"You could feel the crevasse bridges collapse beneath you. We'd try to stay the hell alive," said Hamilton. "You can hear the snap and you see the snow crystals depress and a wave would come toward us and a dark hole would open up."

To obtain data from many Antarctic ice streams glaciologists have traversed the shear margins, planted poles to measure the following year and mapped the streams with radar.

Using these methods, scientists learned that Ice Stream B is slowing down and its shear margins are widening. It is possible that the inactive Stream C has affected it in some way, or that a widened channel may allow more ice to flow. Streams D and E are less restricted by their margins than B.

"I've claimed that if you were to fully lubricate those, that would be significantly different in terms of ice going to the ocean and raising the sea level," said Raymond. "If these things can evacuate, then sea level would rise five to six meters."

For now, researchers hypothesize the future and continue collecting data that may increase the accuracy of their predictions.

"If the ice sheet increases, the sea level goes down. If it decreases, the sea level goes up," said Anandakrishnan. "This is the Holy Grail of Antarctic glaciology."

"Everything is pushed, ripped, it's like you're looking at a whitewater river."

— Gordon Hamilton, glaciologist

Kelly Tyler gathers material for her research on Ernest Shackleton's Endurance *expedition at the whaling station on South Georgia Island. The station is where Shackleton found help after being stranded in pack ice when the* Endurance *sank. Tyler is gathering material at McMurdo Station this season on the Ross Island party, which spent two years providing a line of supplies for the second half of Shackleton's planned journey across the continent. The party remained ignorant of the* Endurance*'s fate until they were rescued.*

Photo courtesy of Kelly Tyler

Heroes

From page 1

Writers program.

Tyler's previous projects include producing, writing and directing the two-hour television documentary "Shackleton" for NOVA public television, and working as the coordinating producer for the IMAX film "Shackleton's Antarctic Adventure." She said she has studied the Ross Sea party for the past seven years and feels it deserves wider recognition.

"I was fascinated with Antarctic history and the history of scientific exploration here," she said.

"It's one thing to save yourself if you're up a creek, but the driving motivation for these men was a sense of loyalty and responsibility for the welfare of Shackleton's party."

The Ross Sea party

The Ross Sea party arrived in McMurdo Sound aboard the *Aurora* in January of 1915, according to a narrative of the expedition by Tyler and other historical texts. The men planned to make two sledging trips to leave supply depots every 60 nautical miles to Mount Hope, about 400 miles away. Shackleton's party, anticipating a 120-day traverse of the continent, planned to carry just enough provisions to reach the supplies left by the *Aurora*'s crew.

The going was tough from the start, as men and dogs struggled to drag overloaded sledges across soft snow and sastrugi in blizzards with temperatures as low as –68F, according to the diaries of some members. They were soon forced to carry partial loads and double back, thus traveling four miles for every mile of actual progress. Within a month they were dangerously low on rations and the dogs, exhausted and underfed, started dying on the trail.

Part of the party returned to their base while three men struggled to 80 degrees south to lay the farthest south depot of their first trip. When the men returned on March 25 they found the ship and all but three of their companions were gone.

The *Aurora* had been blown out to sea by winds estimated at more than 120 mph and would drift 1,100 nautical miles to the north during the next 10 months, leaving the six men remaining at the base with no clothes or gear beyond what they were carrying. They spent the next two months in the snow-filled shack at Hut Point, built by Robert Falcon Scott's party in 1902, using salvaged tents to make clothing and fur sleeping bags for boots. Provisions left at three McMurdo Sound huts, plus seal meat, became the mainstay of their diet.

In June of 1916 McMurdo Sound froze securely and the men crossed on foot to Cape Evans, where they found the other four members of their party. They decided the second trip to cache supplies for Shackleton must be completed despite their setbacks, and prepared as best they could during the remainder of the harsh polar winter.

In October nine members of the Ross Sea party set off in parties of three with their four remaining dogs on a planned five-month sledge, this time needing to lay caches all the way to 83 degrees 37 minutes south. Feeding their urgency was the thought Shackleton's party might be racing for those supply depots. They had no way of knowing Shackleton and his crew would abandon the *Endurance* at the end of the month.

Once again they were overloaded and at times covered the same ground as many as 14 times. On Jan. 4, one of the stoves salvaged from Scott's hut failed and three men were sent back with it. Another stove failed after leaving a depot at 82 degrees south, forcing the remaining six men to continue together.

Near the end of January two men showed obvious signs of scurvy, and one had to be left behind about 40 miles from their final depot. The others reached Mount Hope on Jan. 26, 118 days after their trip started.

The two men first inflicted with scurvy had to be hauled on sledges during the return trip and one, photographer Arnold Spencer-Smith, died March 9. All of the men had scurvy by then, as blizzards had reduced daily rations drastically, but a few days later they reached Hut Point.

Their troubles were far from over, however. Their ship was gone and they were forced to live primarily off seal meat while staying in the frigid hut, originally built as a storehouse, not for long-term habitation. On May 8, Captain Aeneas Mackintosh and Victor Hayward decided to walk to a more comfortable hut at Cape Evans despite the fact it was too early in the season for solid sea ice. Two days later a search party found evidence that the pair was carried out to sea on an ice floe.

At that same time, Shackleton would sight South Georgia Island from the *James Caird*, where the worst of his endeavor would end after a grueling trek across the island.

Once the Ross Sea ice firmed up, the three remaining men at Hut Point moved to Cape Evans, where the other four members of the party were staying. They would spend the next several months continuing science research that was part of their original mission.

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"That the effort was unnecessary, that the sacrifice was made to no purpose, in the end was irrelevant. To me no undertaking carried through to conclusion is for nothing. And so I don't think of our struggle as futile. It was something the human spirit accomplished."

—Dick Richards, member of the Ross Sea party

Photo by Josh Landis/From The Antarctic Sun archives

Shackleton's Ross Sea party spent two years at the Cape Evans hut on Ross Island. After their ship disappeared in a storm, they had to scrounge supplies from garbage piles left by Robert Scott's expedition.

Heroes

From page 12

On Jan. 10, 1917, the *Aurora* steamed into McMurdo Sound with Shackleton aboard. The party received a hero's welcome upon reaching New Zealand a month later. Shackleton, in his memoir of the expedition, wrote "no more remarkable story of human endeavor has been revealed than the tale of that long march."

Applying science to history

The facts of the Ross Sea party's journey require extensive archival research to piece together, due to their relatively obscure place in history, Tyler said. She said many questions remain that can only be answered by following some of their footsteps.

"The scientific staff of the Ross Sea party were here in the early days of scientific investigation on the continent," she said. "They were struggling for survival with the very phenomena that they were trying to understand. I'm finding that current scientific research sheds a fascinating light on the events of the expedition."

Tyler will interview scientists and others at McMurdo about medical issues, sea ice conditions, the surrounding terrain, weather, the ability of people to live and travel here, and to get help identifying locations in film and photographs of the expedition. She will also reexamine scientific research that members of the Ross Sea party performed at locations such as Cape Evans and Mount Erebus.

The one man who didn't participate in the second trip to cache supplies stayed at Cape Evans and collected weather data every four hours, regardless of conditions, Tyler said.

"I think their data was neglected at the time," she said. "The data is a valuable record from the early part of the century."

Tyler, who is also a visiting scholar of the Scott Polar Research Institute of Cambridge University in England, did previous research that led to the discovery of about 15 minutes of film from the trip lost within the archives at the British Film Institute. The footage has been released as part of the DVD edition of Shackleton's "South." She said the footage was mentioned in diaries, but her research at one point indicated it was at the bottom of the English Channel in a ship sunk by a German U-boat in 1917.

"One thing about archives is they are overwhelmed with material and sometimes treasures get lost in the archives," she said.

The research and writing process have hardly been linear, Tyler said. She said she may write a few lines about the party's experience with scurvy, then end up studying nutritional issues for months.

"The research process never stops," she said. "Even when you're ready to start writing, new questions arise constantly. The research is fascinating."

And while the Ross Sea party members may never attain Shackleton's level of fame, the thoughts of one member who survived indicate little disappointment.

"That the effort was unnecessary, that the sacrifice was made to no purpose, in the end was irrelevant," wrote Dick Richards, years after the ordeal. "To me no undertaking carried through to conclusion is for nothing. And so I don't think of our struggle as futile. It was something the human spirit accomplished."

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Profile

From Olympian to teacher to Antarctica

By Mark Sabbatini/*Sun staff*

Betsy Youngman doesn't talk much about her past, but when she says teaching science and working in Antarctica are world-class achievements, it's worth listening.

She's a two-time Olympian who says her current work is as rewarding and challenging – and at times has earned her more respect – as her days as an athlete. Making it to the Ice is just as tough as qualifying for the Games, she said, and the accomplishments by people are more varied "and contribute to the betterment of mankind."

"Yeah, I did something that everybody recognizes, but there are people here who have done some really cool things," she said.

Those who might consider such statements false modesty need only look at the credentials she lists as a member of this year's U.S. International Trans-Antarctic Scientific Expedition (ITASE) team: there's no mention of her Olympic past. Same thing if you look up other projects connected with her job teaching junior high students at Phoenix Country Day School. Look hard enough on the Internet and you'll see a brief mention of her Olympic background by an Ohio skiing organization she belongs to.

Youngman said she prefers listening and doesn't like getting caught up in "labels," which is why her past accomplishments may remain unknown among those she's around. She said she also finds it more interesting to talk about what's happening now rather than dwell on the past, where it's all too easy for people to "label" her.

"It's nice to know who people are now and not label them by their job or their past," she said.

She will spend the next several weeks making the 900-mile ITASE traverse from Byrd Surface Camp to the South Pole. Her responsibilities include taking daily samples of snow for chemical analysis and launching weather balloons three times a day to sample ozone and other atmospheric data.

The research is for a doctorate project by Markus Frey, another ITASE participant who worked with Youngman in Greenland in the summer of 2001 when she was selected to work in the Teachers Experiencing Antarctica and the Arctic (TEA) program. This year he needed a field assistant for his ITASE project.

"Immediately I was thinking of her," he said, adding she is getting extra responsibilities this season after proving diligent and reliable in Greenland.

Science has been a part of Youngman's life since her childhood in northeast Ohio. Her father was a Navy engineer who taught discipline, while her mother was a landscape architect and botanist who taught her to be curious and creative.

Youngman also spent plenty of time outside with her sister and brother, learning to ski at the age of 4 and competing in swimming at an early age. Both siblings also became top athletes – her brother was twice a first alternate for the Olympics – but she said that was never the primary focus of her youth.

"My parents never pushed us athletically," she said. "They gave us opportunities, but they really, really stressed education."

Her interest in the outdoors led her to get a degree in environmental science and government at Bowdoin College in Maine. She got a few short-lived jobs as an environmental consultant in the months after graduation, but decided her career goal of protecting and preserving the environment could be better achieved through a teaching job she accepted in Cleveland.

"When you teach you affect the future," she said. "Everybody can probably look back and think of a teacher who inspired them to do what they do."

Photo by Mark Sabbatini/The Antarctic Sun

Betsy Youngman takes time from her busy schedule at McMurdo to ski on the sea ice. A former Olympic Skier, Youngman now skis for fun.

College was also where she was first exposed to Olympic competition, getting a college roommate who would go on to win a gold medal in the 1984 games. Youngman said she also became friends with a number of other Olympic athletes at school "and I realized it wasn't that far out of reach."

She didn't pursue Olympic competition until she graduated in 1981, but nearly made the 1984 team as a cyclist. She said her refusal to take steroids played a key role in failing to make the final roster.

The bad taste from that experience led her to drop out of competition for a year before returning to compete for a spot on the 1988 cross-country skiing team. Helped by students who held bake sales, her husband and a Blue Cross/Blue Shield grant, she continued teaching part-time while training four to six hours a day.

Youngman qualified for the Calgary Games in 1988 and the Albertville Games in 1992, finishing with "middle of the pack" times at both Games in a field of 70 to 80 competitors. The most memorable moment, she said, occurred away from the competition.

"When I walked in that stadium at the opening ceremonies of the Games and saw the flags, it was just so incredible to be able to represent your country," she said.

Among those who knew she was competing was Brian Welch, now a fellow ITASE team member. Welch, a two-time competitor at the NCAA cross-country championships, said he didn't know her well at the time, but her abilities were obvious.

"I was never in Betsy's league," he said.

Youngman moved to Arizona and started teaching at Phoenix Country Day School when her husband Bob, whom she married in 1983, was transferred there as part of his research job. She is posting journals and lessons for her students on the Web while in Antarctica, calling such real-world exposure a hook that has proven highly successful in getting them interested in science.

The journey to the South Pole appears as though it will be colder and more challenging than the work she performed in Greenland, but that's hardly a deterrent for Youngman.

"It's another notch. It's another step up, challenge-wise," she said.