Midwinter special
The Antarctic Sun

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June 21, 2004

Quiet polar night

Photo by Sean Ryan/Special to The Antarctic Sun

A full moon shines over the darkened shutters of the South Pole station. Despite the calm exterior, inside the station the largest-ever winter construction crews continue work. See page 10 for details on their progress.

Chemical defenses could become strong medicine

By Kristan Hutchison
Sun staff

The same chemical that saves sea squirts from hungry starfish may someday cure people of skin cancer.

A science team working at Palmer Station discovered the potential cancer drug while researching ways Antarctic marine plants and animals protect themselves with organic chemicals.

"We aren't down there prospecting for drugs," said Charles Amsler, a seaweed specialist on the multidisciplinary science team.

"(Antarctica) is in many respects the last frontier."
- Bill Baker
natural products chemist

"We're down there trying to understand why the species are using these chemical defenses."

In the process, the scientists sometimes stumble upon a chemical that could have medical applications. They're more likely to find something new there than in more temperate waters, simply because the Antarctic is less studied.

"The utility of doing these sorts of studies in Antarctica is that this is in many respects

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Melting holes to build IceCube

By Kristan Hutchison
Sun staff

Using hot water and ice, researchers plan to build the world's largest scientific instrument to detect some of the universe's smallest particles.

Called IceCube for its size, the project will turn a cubic kilometer of ice below Amundsen-Scott South Pole Station into a detector of high energy neutrinos. The subatomic particles exist in large quantity, but are invisible, having no charge and almost no mass, and rarely reacting with anything as they speed through the universe. In the time it takes to read this sentence, 10 million neutrinos are rushing through your body.

This lack of interaction is both the appeal and the challenge of neutrinos. Because nothing stops them, neutrinos reach Earth from the edges of the universe unchanged, but they are also difficult to detect. An existing experiment at the South Pole proved neutrinos could be detected by lowering strings of light-sensitive optical modules into deep holes in the ice. The globe-shaped glass optical modules freeze in place and watch for the faint blue flash occurring on the rare occasions a neutrino crashes into a proton, creating another kind of particle called a muon. IceCube is the next generation of the Antarctic Muon and Neutrino Detector Array (AMANDA), also led by the University of Wisconsin.

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Bad luck leads to big dinosaur dig — **Page 25**

Scientific serendipity

Welcome to the first midwinter issue of *The Antarctic Sun*. The *Sun* usually publishes only during the austral summer season, but Antarctic science and the stations that support it continue year-round, so we thought we'd bring readers a glimpse of this winter work.

As luck would have it, a theme emerged while writing this issue. Biologists studying the chemicals that marine plants and animals use to ward off predators accidentally found a possible cure for skin cancer along the way *(page 1)*. When paleontologists couldn't reach their intended dig site and were dropped off on a different island, they were sorely disappointed, but their mood changed when they found a new carnivorous dinosaur in an unlikely spot *(page 21)*. When ice blocked a cruise from reaching the site of the now disintegrated Larsen B ice shelf, the geologists instead found a new volcano, still warm under the frigid waters *(page 20)*.

Luck has often played a role in scientific discovery. The story of Newton and the apple, whether factual or not, holds true in its essence - sometimes it's the unexpected event that helps us see or think in a new way. But scientists also know there's nothing dumb about luck. The biologists send samples of chemicals they find to the National Cancer Institute, just in case they'll get lucky. The paleontologists didn't stay in their tents moping when they ended up at a site where they were sure they wouldn't find dinosaurs. They went out looking anyway. And when the geology cruise had to detour, the chief scientist had a backup plan to check an area of interest he'd noticed in a previous year.

I'm reminded of my mother, who has a knack for finding four-leaf clovers. She doesn't find them just once in a blue moon. She practically harvests them as she walks along, gathering enough to give away and still fill the pages of our dictionary. As a child her amazing luck awed me, until she shared her secret. She looks. Her eyes are always open to the world, noticing the colors in the trees, what's budding on the ground, the patterns in the clover. If that pattern changes from three leaves to four, she notices.

Scientists do the same, scanning the field of data to understand the overall pattern and notice what breaks from it. They're constantly trying to find better ways to look, like IceCube, the neutrino detector being built at the South Pole as an expansion of AMANDA, the Antarctic Muon and Neutrino Detector Array *(page 1)*. The visionary astrophysicists building the one cubic kilometer detector in the ice expect to find lots of things, but they are most interested in what they don't expect, the stroke of scientific serendipity. As IceCube's chief investigator Francis Halzen wrote:

"In the past, every time astronomers have set their sights on a new wavelength, they have discovered more than they expected…. If, after nearly twenty years of working on AMANDA, we only discover what we have set out to discover, it will be, in many ways, the most disappointing result imaginable."

Imagine how our own lives would be different if we walked out the door each morning with our eyes and minds open to discovery. Try it. This could be your lucky day.

Kristan Hutchison

Matt Davidson

Cold, hard facts

Winter

Winter population at the stations: **190 at McMurdo, 75 at South Pole, 19 at Palmer.**

Number of communion wafers consecrated by the Catholic priest in preparation for winter at the South Pole: **100.**

The best time to see auroras at the South Pole: **Lunchtime, when the auroral oval passes over.**

When McMurdo and South Pole ran out of stored fresh produce**: May.**

How eggs are kept fresh for the 6 month winter at McMurdo Station: **half the eggs are rubbed with vegetable oil after last flight in February.**

Favorite winter entertainment at all three stations: **watching videos.**

Most winters on the Ice: **Rocky Ness with 15**

Sources: *Station reports, Ethan Dicks, Jan Jasperson, Glen Kinoshita, Rocky Ness*

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Survey of tour sites widely read

By Kristan Hutchison
Sun staff

As science papers go, Ron Naveen writes a bestseller.

The results of his annual Antarctic Site Inventory used in treaty discussions, research plans and by just about every tour operator headed to the Antarctic. The Environmental Protection Agency recently printed a second edition of his 382-page Compendium Of Antarctic Peninsula Visitor Sites and copies have been sent to all members of the International Association of Antarctic Tour Operators. Some already hang enlargements of his site maps in their ships.

"It's very, very nice to have our work so respected and so used," said Naveen, who operates the inventory under the auspices of his Maryland-based educational and science foundation, Oceanites.

Launched in 1994 with a National Science Foundation grant, the site inventory involved a simple, yet novel, concept. Catching rides on the many tour ships already going to the Antarctic, Naveen and a team of associates survey each tourist stop. Penguins, shags and other seabirds, lichens and mosses are tallied and photographed. During the past decade the inventory team made 570 visits to 89 sites on the peninsula, creating a comprehensive document of what's where and how it's been affected by tourism.

"What that document's great for is it looks at over 50 of the sites the tour ships go to in Antarctica, where all the wildlife is, where the nesting sites are," said Denise Landau, Executive Director of the International Association of Antarctic Tour Operators, which distributed the inventory's compendium to its members. "It's really good site information."

After hitching rides around the Antarctic Peninsula for 10 years, Naveen has taken his research a step further with a new five-year grant from the NSF. On Nov. 14 Naveen landed back at Petermann Island, where he's been many times before. This time the ship dropping him off was the research vessel *Laurence M. Gould* and when the *Gould* pulled away, Naveen and his research group stayed. They pitched tents in several meters of snow, then mapped the mile-long rocky island using handheld GPS and began the census work.

By staying on the island for a month in November/December and again in January/February, Naveen's team was able to make a more careful and complete count of the Adelie and gentoo penguins, along with their eggs and chicks. The gentoos in particular tend to nest in nooks and crannies scattered around the island rather than central rookeries, so counting all the nests or chicks can take a day. By staying a month, Naveen could survey the birds several times and ensure the censuses were achieved at appropriate times.

"These are really the best counts we've ever gotten there," Naveen said. "When you're working off a ship and getting in for three or four hours, it's a different thing."

Camping on the island also gave Naveen a chance to observe different tour groups coming ashore. Among the 245 Antarctic locations tours visit, Petermann Island ranks sixth for number of visits. In November and December Naveen had only a few visitors, but in January and February tourists came ashore almost daily. The 30 tour groups Naveen met were all careful not to disturb the plants or animals, he said.

"For the most part there's a lot of experience among the operators. They know where to go, what to do, what not to do," Naveen said. "My view is they're doing a fairly good job and, frankly, they need to do a good job, because if they're not and the resource falls away they lose their business."

Photo by Kristan Hutchison/The Antarctic Sun

Researcher Anne Petzel watches an emperor penguin on the sea ice near Cape Royds, Ross Island, Antarctica. Penguins are curious and often approach scientists and tourists. Researcher Ron Naveen tracks how those interactions may affect the sea birds.

The swift growth of tourism to the Antarctic has led to growing concerns for the frigid and fragile ecosystem. In the past decade, the number of tourist landings on the Antarctic Peninsula each season increased more than 400 percent, from 164 to 858. While the majority of landings are concentrated in the Shetland Islands and a dozen sites on the northwestern part of the Peninsula, tours have also been expanding to new sites each year. Palmer Station ranks among the top 20 most visited locations in Antarctica.

The dramatic increases in visits have led the international bodies governing Antarctica to consider a coordinated monitoring system for all human activity, including tourism. In accordance with a decision made at last year's Antarctic Treaty Consultative Meeting, experts met in Tromsø, Norway, in March, to discuss ways tourism might be managed. Naveen was part of the U.S. delegation and will be part of the discussions that continue at the Antarctic Treaty Consultative Meeting in Cape Town in May.

He brings a uniquely rounded perspective to the talks, having been to the Antarctic first as a tour leader in the 1980s and then as a scientist.

"The inventory database is right in the thick of things," Naveen said. "Everybody seems to want our information."

Over time the inventory should show whether penguins and other Antarctic animal populations are changing because of tourists. So far, in 10 years Naveen hasn't seen any evidence that tourists are hurting the birds. The only definitive change Naveen's surveys have shown is a decrease in the number of blue-eyed shags throughout the Peninsula, irrespective of the amount of tourism. Naveen believes the shags are reacting to changes in the climate and prey availability rather than tourism.

"For the most part we scientists are rather convinced there's global forces causing change," Naveen said.

NSF funded research featured in this story: Ron Naveen, Oceanites Inc.

Perspectives

Food for thought, food for fuel

By Mark Lehman

As mid-winter approaches, producing varied and tasty food for our population of 190 has become a challenge for the kitchen staff. Although fresh eggs, potatoes and onions are still available, the hunt for vegetables now leads to the freezer. Maintaining a perspective on time and place is essential. It helps to consider the history of food in these southern latitudes, which travels back more than 100 years. Although people today will never comprehend the extreme circumstances the early cooks faced, this fact remains the same: the morale of the crew and spirit of the community is a reflection of the work we do.

Experienced in the field of polar travel, Roald Amundsen knew the value in carefully selecting an expedition cook when he chose Adolf Lindstrom. Wintering 1911, Lindstrom played a vital role in the Norwegian team's success in the race to the South Pole. Although Lindstrom adapted well to the challenges of cooking in Antarctica, providing a diverse and creative menu was nearly impossible. While today we can regularly rotate beef, pork, fish, poultry and vegetarian selections, Lindstrom was faced with tasks and worries we no longer consider. Preventing disease like scurvy was a priority, and he stayed busy butchering seal and penguin provided by hunting parties so he could serve fresh meat. Amundsen recognized the need for a diversified menu and agreed to seal meat being served only two out of three meals each day. In his book, *The South Pole*, Amundsen wrote, "We get to like seal steak more and more each day. We should all be glad to eat it at every meal, but we think it safer to make a little variety… I must frankly confess that I have never lived so well." Amundsen also described the "fabulous rapidity" with which the crew ate Lindstrom's hotcakes for breakfast. He respectfully logged, "If it is a cook's best reward to see his food appreciated, then, indeed, Lindstrom had good wages."

Photo from Amundsen's book, *The South Pole*

Chef Adolf Lindstrom was important to the success of Roald Amundsen's expedition to the South Pole.

A flavor and diversity resource for us, a greenhouse was not available to early Antarctic cooks. Today we rely on Rob Taylor, our greenhouse technician. Regularly, he arrives in the kitchen, arms filled with morning harvests. Within minutes, tomatoes, cucumbers, peppers, sprouts, lettuce and herbs are on cutting boards and incorporated into entrees and mixed salads. Though it is too small to produce bulk volume, the greenhouse is especially important during winter. We have already worked through our large shipments of New Zealand freshies. The produce walk-in now seems a massive space, containing an island of empty palettes and mostly bare shelves. Long gone are the tall towers of assorted, colorful and crunchy fresh fruits and vegetables.

In McMurdo today, 24-hour Internet and phones allow us to correspond home on a convenient and regular basis. In the dining facility, a daily news report is available for reading material. Satellites enable dining attendants to scrub pots while listening to a feed from National Public Radio. By comparison, when Charles Green was hired as a replacement cook for Shackleton's 1914 journey, the letters he sent home informing his family he was headed for Antarctica never arrived. A German cruiser torpedoed the ship carrying the correspondence and Green's family didn't hear of his whereabouts until he was rescued from Elephant Island in April 1916. Where Shackleton's men spent nearly two years without any outside contact as the events of World War I transpired, we are overwhelmed with continued updates of our current war.

During most of the early expeditions, food was used as a morale tool for transitional and trying situations. The first night after his stranded crew helplessly watched their ship sink into the Weddell Sea, Shackleton wisely called for a special meal to be served. They had just spent an entire winter on board, and the situation was bleak at best. Recognizing the need to keep spirits high, all hands were delighted with the menu selection of fish paste and biscuits. An indication of their remarkable state of mind, one of the expedition surgeons wrote in his journal, "Really, this sort of life has its attraction. I read somewhere that all a man needs to be happy is a full stomach and warmth, and I begin to think it is nearly true." The Antarctic galleys of the heroic age were not without special celebrations. A June 22 mid-winter feast was a highlight for the early polar crews. Traditional items like roast pork and plum pudding were featured, appearing alongside foods like black seal soup and caviar Antarctic.

Considering hardships of the early Antarctic journeys and contrasting them with facets of our more modern experiences is helpful. One of the important lessons to keep in mind, is as difficult as it must have been then, they still managed to advocate and practice a culture of optimism. For many, the choice of attitude saved lives. With this in mind, we are continuing the tradition of a midwinter feast started decades ago by the historic expeditions. The kitchen staff looks forward to community involvement as we prepare for a spirited mid-winter gathering and dinner on the evening of June 19.

Mark Lehman is a sous chef at McMurdo Station this winter and has worked five summer seasons at South Pole Station.

around the continent

SOUTH POLE

Winter barbecues, igloos

By Peter Rejcek
South Pole correspondent

The sun has sunk below the horizon, its light replaced by ghostly auroras and the pinprick glow of stars. The temperatures have dropped as low as -36 C. Plane contrails seem a phenomenon of a distant past.

The South Pole station is stoically enduring another winter.

Life here has often been likened to the movie "Groundhog Day," about a bitter meteorologist doomed to repeat the same day over and over again. Monotony is certainly one feature of life at the bottom of the world: Night seems eternal, and routine mainly revolves around work, food, movies and sleep. But Polies are adept at keeping the bugbear of boredom away.

In April and May, the station's population gathered for a barbecue at the beginning of each month during two-day weekends. Allan Day, an Australian working on the DASI telescope, knows how to coax the most out of his briquettes at sub-zero temperatures. The barbecues bring nearly the entire population of 75 to the dining hall for a night of feasting and companionship.

"I enjoy cooking, and being busy is way better than being bored," Day said. "It's a real tough afternoon: ... bickies and cheese, smoke, singed flesh and a few laughs with mates."

The South Pole's volunteer band, known by several names, including Fear of Commitments and the Dana Hrubes Revival Project, played at both dinner events. Like the many other afterwork activities, the band highlights the creativity and versatility of station staff. Richard Coppin, who whips up magnificent meals as one of the two South Pole chefs when he's not singing and strumming guitar, said playing in the band has been a highlight of his season.

"For one, it keeps us all really busy," he said. "We do at least two two-hour practices a week, and sometimes three, and we all put [in] individual practice figuring out things.

"Of course I love performing and our performances, two thus far, have been a blast," he added.

Polies also keep busy with tournaments. Heavy equipment operator Rob Shaw hosted a poker tourney at the 90 Degrees South bar in April. Some of the Pole's best cribbage players met on the proverbial battlefield in May.

Shaw won his own poker tournament, followed by Mike Scholz and Bride Sweeney. In singles cribbage, Tom Banks won bragging rights after beating Angela Drexler. Peter Rejcek took third. Drexler and Banks combined forces in the team cribbage tournament to take first place, while Don Jeter and Scholz hung on for second place. Jules Hartnett and Randi Dixon took third.

Radio darts with other Antarctic stations is another popular diversion. South Pole teams play against McMurdo and Scott Base via high-frequency radio, while Palmer exchanges scores through e-mail.

"It's fun and we get to harass people on the radio," said Polie Sarah Kaye.

Other activities include weekly movies, rock climbing, bingo, yoga, and countless miles on the stationary bikes and treadmills in the gym.

And one group of Polies has taken its hobby into the frigid outdoors. A massive igloo, some 3.5 meters in diameter and likely as tall when finished, is currently under construction out near the berms, away from the main station and the few red lights that mark South Pole civilization.

While the project is old hat to an Alaskan like carpenter's apprentice Adam Rein, who is providing much of the technical know-how, it's a first for others, like Kevin Dupuy, an East Londoner-turned- Kiwi.

"I'm a sheet metal worker from the east end of London," Dupuy remarked. "When do I have a chance to build an igloo?"

(Angie Rutherford contributed to this report.)

Photo by Peter Rejcek/Special to The Antarctic Sun

The South Pole band plays at a winter party (left to right): Justus Brevik, Dana Hrubes, Richard Coppin, Kevin Torphy (far back), Ethan Dicks, Sarah Kaye and Kris Perry.

Photo by Kris Perry/Special to The Antarctic Sun

Auroras dance over the South Pole Dome.

MCMURDO

Station pulls together for medevac and big storms

By Traci Fisher
McMurdo correspondent

Oddly enough, some of McMurdo Station's 190 winter residents consider the cold, darkness and wind to be the highlights of the Antarctic winter. For others, it's the 80 dozen homemade cookies baked weekly in the dining facility or participation in the bowling league, the Friday night Spanish class, or the weekly swing dance lessons.

With rooms of their own and one two-day weekend a month, though, some members of the community just choose to hibernate, finding the time and space to

See McMurdo on page 6

winter weather *(February-June)*

McMurdo Station *(historical data)*
Avg. temp: 16F/-9C to -9F/-23C
High: 21 F/-6C Low: -16F /-26C
Avg. precipitation: 4in/10 cm.
Peak wind: 94mph/151kph *(May 16)*

Palmer Station *(Feb. 15-June 4)*
Avg. weekly temp.: 37F/3C to 25F/-4C
High: 45F/7C *(Feb. 20)*
Low: 16F/-9 C *(May 9)*
Peak wind: 89mph/143kph *(May 24)*
Total precipitation: 12 in/30cm
Snowfall: 37in/93 cm

South Pole Station *(Feb. 15-June 10*
Avg. weekly temp.: -33F/-36C to -86F/-66C
High: -18F/-28C *(Feb. 24)*
Low: -100F/-74C *(June 6)*
Peak wind: 45mph/72kph *(April 2)*
Top physioaltitude: 11,605ft/3,537m *(June 6)*

Photo by Troy Marquez/Special to The Antarctic Sun

Dave Zimmerman and Laena McCarthy dine on sushi at a recreation event in the McMurdo Coffeehouse.

McMurdo From page 5

relax and enjoy the slower pace that comes with wintering at McMurdo.

Although most of the winter work focuses on maintaining the station and preparing for the return of the summer science season, Science Support Supervisor Laura Tudor is busy facilitating several science projects, including one which gathers data about cosmic rays, atomic nuclei and electrons from outer space. Another winter science project, LIDAR (Light Detection and Ranging), uses an optical radar which is visible to onlookers and gathers information about dynamics of the atmosphere and thermal behavior above McMurdo Station.

In late April, the McMurdo community pulled together in order to prepare Pegasus Airfield and maintain runway equipment for a successful medical evacuation of three patients, who are reported to be doing well after receiving medical care. The U.S. Air Force C-141 that carried them out will likely be the last plane to land at McMurdo until August.

Mid-May, McMurdo residents got to experience what winter is really all about: big storms. This was one of the worst to hit McMurdo in the past decade, remaining at Condition I for 13.5 hours with winds that sustained 34 meters per second (mps) in town (before the wind sensor broke) and an incredible 65 mps at Black Island. Wind sensors picked up gusts over 10 mps higher at both locations.

When the storm subsided, the community quickly assessed and repaired the damage, including two downed bay doors on Building 140 and another at the Vehicle Maintenance Facility, missing siding and roof sections on multiple buildings, and snowdrifts which crested over the tops of doors on several others.

Courtesy of the McMurdo community

Snow drifts block a doorway in Crary Lab after a winter storm in May.

Now living in total darkness and temperatures hovering between -28 C and -23 C, many winter workers are beginning to dream about their travel back to Christchurch, New Zealand, or about seeing the sun again on Aug. 19, when it will make its first appearance since setting in late-April. And, of course, those staying through WINFLY can't wait to see who will be back for "just one more season."

PALMER

Welcoming winter

Compiled by Sun staff

The Palmer Station winter crew settled into work and weather after arriving April 3.

On the same day the station had its last visitors for the summer. The commander of the Argentine icebreaker, *Almirante Irizar*, dropped in with researchers and officers from the vessel. The group of 12 arrived by helicopter and was given tours of the station and a reception in the lounge. The Argentinean ship was headed north, as their station and most others along the peninsula hunkered down for the winter.

Five days later the *Laurence M. Gould* left with most of Palmer's summer crew. On June 21 the *Gould* will take the remaining few, leaving only 19 people, most of whom have wintered at Palmer before.

"We just get up and go to our jobs," said winter station manager Rocky Ness, who is on his 15th winter.

Days are at their shortest, but being 197 km north of the Antarctic Circle, Palmer still gets light from about 10 a.m. to 2 p.m.

The last science team left on May 19. Until then researchers, led by Charles Amsler, Bill Baker and Jim McClintock went diving almost daily for marine samples, except when high winds and weather prevented boating. To get enough fish for one of their experiments, the station held a fishing contest. About a dozen people tried their hand, taking turns with the fishing rods.

"They all tried to do their little fishing tricks to figure out how to coax one to a hook," said Ness, though the foot-long fish tend to bite any hook they see and come up without a struggle. "It gave people a chance to get out of the house and do something different."

Cook Marge Bolton won the contest with her string of nine fish.

Station crew also volunteered as dive tenders, giving people a chance to go out

See Palmer on page 7

Antarctic winter crews use holidays and seasonal changes to break the daily monotony.

"Winter's neat that way. It's broken into some pretty interesting milestones," said South Pole station winter site manager Pete Koson. "They don't just shut the door."

Winter creates challenges at all the stations, but it is most extreme at the South Pole where the temperature drops as low as -82C and the physiological altitude rises to over 11,000 feet. At those temperatures, motors won't start.

"When it hits 80 below, nothing works outside except people," Koson said.

Sometimes even people have difficulty. The 75 Polies are isolated for eight months with little privacy or outside contact. Half the winter staff have already been there all summer.

"It's very easy to lose your perspective over winter. It's very easy to forget there's a big world out there," Koson said, comparing the Pole to an old record player. "Pole's an amplifier. It amplifies personality. Some people have a very nice personality and if you turn it up it sounds even better, and some people have a scratch."

So far the winter has been quiet and Koson hopes it stays that way.

"I won't have a problem if my watch is regarded as the most boring winter at Pole ever," he said.

Even a boring winter is broken up by natural and man-made events. The timeline along the bottom of the following pages was collected from e-mails, journals and reports from all three stations.

Palmer From page 6

on the water and see whales and leopard seals. They had several startling run-ins with leopard seals, including one occasion when two leopard seals approached the divers underwater.

Earth Day was too snowy to pick up garbage on shore, but the research divers retrieved debris from the sea floor next to the Palmer pier. They dragged up an old tire, glass Coke bottles, scrap metal and tools. It was all covered in barnacles, "looking like a reef of its own," Ness said.

Work on other science projects continued into April as well. Members of the Long Term Ecological Research Team surveyed the Humble Island giant petrels with the help of station staff and collected samples of phytoplankton. By May 10 all the petrel chicks but one had left the nesting grounds.

After several failed attempts, when fur seals blocked the way, the boating coordinator and lab manager photographed plant plots on Stepping Stone Island for biologist studying how climate change may be changing the plants.

Photo by Sonja Wolter/Special to The Antarctic Sun

Palmer Station instrument technician Barb Watson weighs a giant petrel chick on Humble Island for long-term bird studies by Polar Oceans Group scientist Bill Fraser. The chick grabbed her glove and wouldn't let go.

The ocean and glacier search and rescue response teams have been consolidated for the winter. Less boating occurs over the winter anyway, as the short days limit boating hours and bad weather becomes more frequent. That leaves the winter crew nowhere to go but up the glacier behind the station. The search and rescue team repositioned the flags on the glacier to be farther from a recently enlarged crevasse.

Expanding crevasses are another sign of the glacier recession. In order to track the recession, the science tech took digital photos and transit readings of the glacier face north of Arthur Harbor, as well as GPS readings of several spots in the Old Palmer and Norsel Point Island region.

The search and rescue team had a chance to practice their skills April 28 when a boating party failed to call in upon arrival to Humble Island. The boaters had turned off their radios to avoid disturbing the petrels they were weighing. Three SAR team members responded and determined that there was no distress and established communications with the group.

The Palmer staff keeps monotony at bay by turning any excuse into a celebration. One Saturday in late April scientists braved the 28 meters per second cold Antarctic winds to provide the station with a barbecue dinner. On Cinco de Mayo scientists and support staff pitched in to cook Mexican food for a fiesta and make a piñata. They did such a good job that the star-shaped piñata wouldn't break, even when people swung at it with their eyes wide open.

Photo by Sonja Wolter/Special to The Antarctic Sun

Sparky Dan Weisblatt makes gnocchi for a Sunday night dinner at Palmer Station.

But as the *Laurence M. Gould* pulls away June 21, the station will enter three months of true winter isolation. The next visit from the *Gould* will be Sept. 28, when it comes to bring the winter crew home and leave next year's summer crew.

SHIPS

NBP - Gone fishin'

Compiled by Sun staff

The *Nathaniel B. Palmer* has gone fishing for three months.

On May 17 the ship set out on the ICEFISH 2004 cruise, trawling the water from Chile to Cape Town, South Africa, for 16 species of ice fish. Along the way it will stop in the Falkland Islands, the Sandwich Islands and tiny Tristan de Cuhna, the least-populated island in the Atlantic Ocean.

ICEFISH stands for the International Collaborative Expedition to collect and study Fish Indigenous to the SubAntarctic Habitats. Northeastern University marine biologist Bill Detrich heads the fishing crew of 30 scientists from around the world. He hopes their catch will answer questions about the evolution, population trends, eco-biochemistry and eco-physiology of Antarctic fish. Among the specific questions are the fish's lack of red blood cells and their bearing on treatments for blood-borne illnesses like anemia and leukemia. Research done on the cruise will also touch on areas of biodiversity, biotechnology, fisheries, genomics and global warming. Detrich is chronicling the journey and answering questions online at www.icefish.neu.edu.

The journey takes the *NBP* 7,500 km from McMurdo Station, which the research vessel had left Feb. 23, two days after the last flight of the season. The miles and days between McMurdo and the *NBP*'s current venture as a research fishing vessel were busy. The *NBP* spent 47 days taking measurements of current,

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Feb. 15

Polies waved goodbye to the last flight, knowing they are on their own for eight months. Most people enjoyed the traditional screening of John Carpenter's "The Thing," an alien invasion movie set at the South Pole.

Feb. 21

The last flight of the summer season left McMurdo Station.

Feb. 23

After coming in to refuel and change crew one last time, the Nathaniel B. Palmer left McMurdo Station for the season

Feb. 24

The last tourists of the season visited Palmer Station, bringing the season total to 2,624 tourists hearing shipboard presentations and 1,148 coming ashore.

Ships From page 7

salinity and temperature in the northwestern Ross Sea for AnSlope, a multi-year oceanic experiment. AnSlope focuses on the flow of cold, dense water from the Antarctic Shelf across the continental slope and into the adjacent deep ocean. This flux is important in the formation of Antarctic Bottom Water and is balanced by onshore flow of warmer water from deep and surface layers.

The *NBP* pulled into Lyttleton, New Zealand, for a five-day port call April 10, then headed east to collect geophysical data across the south Pacific Ocean for Joann Stock of the Massachusetts Institute of Technology and Steve Cande of Scripps Institution of Oceanography. Since 1995 they've been studying the history of the separation of the Pacific and Antarctic plates, important to understanding movements of the continental plates.

Lukhanyiso Vumazonke of the South African Institute of Aquatic Biodiversity holds a skate that was collected near the Falkland Islands during the ICEFISH cruise.

A storm chased the *NBP* back across the dateline in April. Despite difficult weather, the *NBP* crews deployed buoys designed to drift with the current and report data to satellites.

Midway through the 26-day cruise to Chile, the *NBP* crew held an open mike night, with blues guitar, Irish folk songs and jigs played on the penny whistle and fiddle. The next day, May 1, the weather intensified, with sustained winds to 90 km/hr churning up seven- to nine-meter seas for nine hours. Three days later another storm struck.

"This marks the third system in 20 days reaching 50 kts and 25-ft seas. I guess they call it the Furious Fifties for a reason," wrote marine projects coordinator TJ Hurlburt.

The *NBP* steamed into the gale for six hours, continuing to collect data. By May 7 all 24 buoys had been deployed and were working as the *NBP* headed to port in Punta Arenas to prepare for the ICEFISH mission.

After the two-month ICEFISH cruise, the *NBP* will return to New Zealand in September for routine maintenance in an Auckland dry dock, then transit down to Lyttleton in time for the beginning of a new summer season.

Photo by Sonja Wolter/Special to The Antarctic Sun

Palmer Station residents watch as the Laurence M. Gould *leaves May 18*

LMG - Ice and fire, wind and waves

Compiled by Sun staff

After floating over an active volcano and weathering waves so tumultuous a table was torn from the wall, the *Laurence M. Gould* and crew are headed home for a break.

Usually the *Gould* stops by Palmer Station almost monthly with supplies, but this time the ship will be gone for three months. It is steaming north to Fourchon, La., where it will go into dry dock for annual maintenance.

The rest comes after a busy fall cruise season. In February scientists on board deployed more than 200 instruments and set up nearly 100 data collection points around the Shackleton Fracture Zone in the southern Drake Passage. The researchers were interested why large quantities of phytoplankton thrive on one side of the fracture zone, while the other side has much less phytoplankton. The shape of the seafloor may affect the circulation and transport of iron, which phytoplankton need.

The passengers celebrated "Leap Day" by dressing up as favorite "passed-up and jilted Village People occupations" Standout entries included a fisherman, nurse and biker. Their work was interrupted briefly on March 5, when sustained winds and confused seas sent the ship seeking shelter in the lee of Elephant Island.

Whales swam into the vicinity several times during the cruise. A southern right whale came close to the ship, and a pod of humpbacks breached and frolicked nearby. The highlight came at the end of a stop in Paradise Harbor to repack gear, when two minke whales surfaced a meter from the zodiacs and dove directly under, giving passengers a close-up view. The songs of many more whales were recorded on eight underwater recording devices the *Gould* crew collected during the cruises. The recorders had been left in the 2001-2002 season to capture the sounds of marine mammals. John Hildebrand from Scripps Institution of Oceanography will use the songs to try to estimate the population of mysticete whales in the area.

The next cruise went in search of glacial debris and instead found an underwater volcano.

In mid-April Eugene Domack led a team of scientists hoping to cruise into the area where the Larsen B iceshelf disintegrated in March 2002. His goal was to gather sediments from the seafloor below where the iceshelf had been, which could tell him how long the iceshelf had covered that area.

But the winter sea ice was already forming, and halted the *Gould* 26 km from where Domack needed to be to take sedi-

See Ships on page 9

Feb. 25

In -30C and blowing snow, crews at the South Pole flagged routes between buildings. They can't use lights, because the telescopes need constant darkness.

Feb. 27

Polies celebrated the grand opening of the new South Pole store in the station building with a tasting of wines they'd been hoarding for the past month.

March 1

The sun was low at the South Pole and in 17 days was due to dip below the horizon for the first time. Polies bet on what minute the sun would set.

March 13

A "pyroheliometer" used two glass spheres on a stand to focus the sunlight like magnifying glasses and burn a record of its elevation onto a sheet of graph paper.

Ships From page 8

ment samples.

The ice was creeping northward and blocking the *Gould* at every turn. At one point the ship became stuck in the ice for more than three hours, within a few miles from the coring site.

"At first light, the decision was made to leave the area before conditions deteriorated further," wrote marine projects coordinator Ashley Lowe.

Unable to reach his goal, Domack switched to plan B, looking at the seafloor north of Joinville Island in Larsen Channel. They mapped and videotaped the seafloor, then took samples of rock and sediment. The video revealed a young, submerged volcano (see page 17) The discovery of the volcano was made just in time, as the barometer fell to 948.5 and winds rose to 51 meters per second in the middle of Bransfield Strait on May 6. The *Gould* rolled in large swells as it headed north for Punta Arenas. Chairs fell over and the table in the chief scientist's cabin ripped out of the wall and flew across the cabin.

Since then things calmed down and the *Gould* shuttled several times between Puntas Arenas and Palmer Station, carrying supplies. On June 21 the *Gould* is scheduled to leave Palmer for a longer stretch.

When the *Gould* pulls into Palmer again, it will be carrying the summer crew for the seasonal shift change on Sept. 22.

DC

New faces and new focus

By Guy Guthridge
National Science Foundation

Getting money and getting ready are NSF bywords in the off-season.

In its budget request to the U.S. Congress for fiscal 2005 (which starts Oct. 1) NSF in its major research equipment and facilities construction account gave highest priority to six current projects, of which one is the South Pole IceCube Neutrino Observatory.

Funds requested for the U.S. Antarctic Program as a whole slightly exceeded the fiscal-2004 number. New research would include polar genomics, drilling to investigate key intervals in geologic history as Earth changed from a greenhouse to an ice-house world, preparation for coordinated studies in meteorology and ice sheet dynamics, and a 3-year project to wrap up recent observations of the southern ocean ecosystem.

In the Office of Polar Programs, Tom Wagner in April took the position of program manager for antarctic geology and geophysics, arriving from the Foundation's Division of Earth Sciences to replace Scott Borg, now head of the Antarctic Sciences Section. A volcanologist, Dr. Wagner has worked and taught as far afield as Papua New Guinea; Antarctica will be new territory for him.

Sandra Singer, facilities engineering maintenance and construction manager

Sandra Singer in May became the new facilities engineering, maintenance, and construction manager, replacing Frank Brier, who had retired. Ms. Singer in the 1990s had worked for NSF's then contractor Antarctic Support Associates, helping to develop the cost and schedule for the current reconstruction of South Pole Station. More recently, she was a Bechtel Corporation project manager dealing with destruction of old Soviet Union weapons of mass destruction.

International coordination also gets more attention in the off-season, when folks are more likely to be home instead of in the field. Staff are participating in Antarctic Treaty meetings in New Zealand and South Africa and in July will attend a meeting of the Scientific Committee on Antarctic Research in Germany.

Earlier this month, proposals for new Antarctic research projects arrived at NSF from investigators at universities all across America to begin the annual triage of peer review, operational review, and evaluation of financial supportability. The lucky few will see the light of day in Antarctica starting in the 2005-2006 austral summer.

DENVER

No off-season in Denver

By Val Carroll
Raytheon Polar Services

There isn't a spare chair and the parking lot is full. The off-season in Colorado is full on. Over 300 full-time employees and dozens of contracted staff are busy hiring, completing forms, making phone calls, sending e-mails, asking questions, placing orders and handling the myriad of details required to prepare for another successful season. The pace is similar to summer in Antarctica.

Purchasers are buying everything from sticky notes and lug nuts to liquid helium and fruit juice. Gear is being ordered, cleaned and repacked and crates are being built. Transport schedules are being arranged with airlines, Air National Guard, U.S. Air Force, Petroleum Helicopters Inc., Ken Borek Air, U.S. Coast Guard, fuel tanker, resupply ship *American Tern*, and the research vessels *Laurence M. Gould* and *Nathaniel B. Palmer*.

About 900 job-seekers from all over the country attended our in-house Job Fair in April and recruiters have been scouring one end of the country to the other. Candidates for about 800 positions are being interviewed, hired, screened, physically qualified and tracked.

Planned projects are being prioritized and staffing requirements are being approved. Publications and procedures are being updated and printed. Budgets are being developed, scrutinized, revised, and agreed upon. Planners are working with science teams to determine requirements for everything from snowmobiles, telescopes and tents, to parkas, lab space and time on the Ice.

Along with keeping in touch with their hearty-souled staff wintering on the Ice and completing reports from last season, management has been making recommendations for projects like revamping the ice-runway, dismantling the dome, buying new software, improving bandwidth and investing in energy saving technology, — all to support Antarctic science.

...and, despite all these best-laid plans, we all realize that mother nature will have the last word.

March 22
The sun set at the Pole.
"It'll be dusky for a while though, but the winter is moving in fast!"

March 28
Volunteers at Palmer Station made the final Sunday dinner of the summer, with three kinds of pasta and fresh bread. Sunday is the cook's night off.

March 31
As most of the birds moved north for the winter, Palmer Station residents were allowed to explore the islands nearby.

April 3
Despite -55C weather, Polies celebrated their first Saturday off with a band and barbeque on the upper deck.

April 3
The Lawrence M. Gould *arrived at Palmer Station with most of the winter crew.*

At left, a carpenter cuts plywood in one of the new sections of the South Pole station building. Above, a carpenter's apprentice puts finishing touches on the hall walls. An exterior view of the station is on page 1.

Photos by Kristan Hutchison/The Antarctic Sun

High speed construction builds new station records

By Sun staff

The largest ever South Pole winter construction crew continues the fast pace set by the largest-ever summer construction crew.

"Overall we are ahead of schedule," wrote Carlton Walker from the South Pole. Walker has 46 people working on a single construction shift over the winter. Over the summer he had a crew of about 100.

"There's more people working for me now than were in the whole station when I started," Walker said near the end of summer, his 14th season at the station.

The large construction crew swells the winter station population to 75 people, 30 percent greater than ever before, requiring an extra cook and filling beds in both the Dome and new station, said station manager Pete Koson. He's found a larger population has both benefits and drawbacks.

"In some ways it makes the winter a little less extreme, there are more outlets down here now than ever before, I would guess," Koson said. "On the other hand, 75 people is just too many people to have that extremely close family feeling, so there is a sacrifice."

The summer crews worked around the clock, inside and out on the new station. Weather and flights were in their favor, allowing materials to arrive before the last flight of the season in February. Now enough steel beams and other building supplies are on station to continue working through next year.

"We have everything we need," Walker said.

The summer crew managed to not only catch up on areas of the structure that had been lagging, but get ahead, Walker said. They built the walls for two new sections of the building and did interior finish work on the medical facilities, computer room, library, laundry, recycling room and store.

"I'm just absolutely amazed at the progress that's been made this season," Raytheon Polar Services president and general manager Tom Yelvington told the summer construction crew at the end of the season. "The turnaround's just extraordinary."

Now the winter crew is using some of the recently finished areas. Volunteers planned to plant seeds in the newly assembled greenhouse in June. The post office is done, but there won't be any mail delivery until the first plane arrives in late October.

The winter crew is continuing the progress, working to get the interiors of two new wings, called B1 and B2, ready for inspection next summer and a big start on another wing, B3. The new wings include the emergency pod, designed to shelter the entire crew if a fire or other disaster destroyed the rest of the station. The emergency pod contains berthing, a backup power plant and kitchen, bathrooms and a television and game room. Once the power plant is complete the old one under the dome will be demolished.

"It'll be huge," Walker said.

That leaves just two more wings for next summer. The plan is to dedicate the new building in 2007, the 50th anniversary of the station.

Winter construction at McMurdo Station primarily involves remodeling projects. Carpenters are redoing bathrooms in two dormitories, the carpentry shop and the waste water treatment plant. One dorm is also receiving new paint and carpet. They are also in the first stage of a three-year effort to replace outdated single-wall fuel tanks with fewer double-wall tanks to minimize the risk of fuel spills.

April 5

The Gould *refueled Palmer Station for the season with 65,000 gallons.*

April 7

As the sun sank in the north, it finally became dark enough for South Pole astronomers to begin work in the Dark Sector.

April 8

The Gould *left Palmer Station with the summer crew, dropping the station population from 35 to 26. Left with one cook, Palmer residents must now make their own breakfasts.*

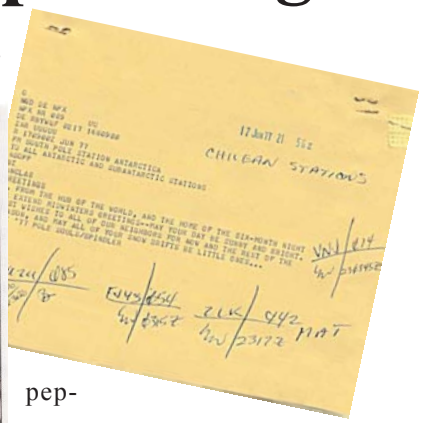
April 8

Temperatures at the South Pole became too cold to use latex balloons, which get brittle and pop before rising high enough.

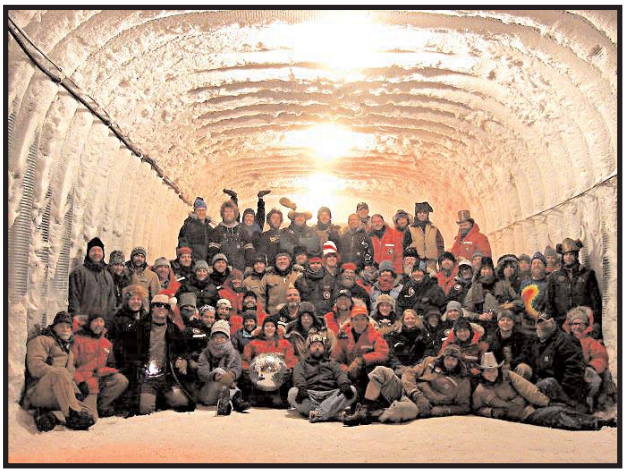
Celebrating midpoint in the polar night

By Kristan Hutchison
Sun staff

From the midwinter feast shared by Roald Amundsen and his crew below, to the cabled greetings sent between stations since the 1950s, Antarctic winter traditions continue.



Below, the midwinter photo sent this year from the South Pole.



This weekend Antarctic winter crews toast the darkness rather than curse it, celebrating Midwinter's Day, a holiday of unique importance to the most southerly continent.

Solstice marks the midpoint in the long, dark Antarctic winter, when the sun ceases moving north and begins its slow return south. This year the sun will reach its northernmost point at 8:57 p.m. June 20 Eastern Daylight Time. Because of time differences and where the international dateline falls, it will be June 21 at some Antarctic stations, including McMurdo

Midwinter's Day was first celebrated in 1898 by the crew of the *Belgica*, which spent the winter trapped in ice below the Antarctic Circle. Modern research stations developed their own traditions. Scientists and support staff at the three stations run by the U.S. National Science Foundation take an extra day off, creating a long weekend. Usually they work six days a week.

"Midwinter sort of sneaks up on you," said South Pole station manager Pete Koson. "We are all staying pretty busy down here, which I think helps keep your mind off the little things you might start to miss."

For Midwinter they trade good wishes with other stations around the continent and even the White House. President Eisenhower began the custom of sending an official greeting to the Antarctic stations on Midwinter's Day. In recent years other world leaders have followed suit, including the British and Indian prime ministers.

"People involved in Antarctic activities know the hardship and loneliness some of you are experiencing down South and have high respect for the work of all expeditionary," read a message from the Brazilian Antarctic Program in 2001. "Now that the longest night has passed, let's cheer the forthcoming return of the sun and let its brightness and warmth raise our spirits."

As the early explorers did, today's winter crew dress in their best and feast in style.

At McMurdo Station the midwinter meal starts with a cocktail hour. The station managers act as waiters, pouring wine and serving an assortment of hors d'oeuvres: blackened sea scallops with tomato chili pepper and cumin aioli, roasted red pepper and potato pancakes, pumpkin raviolis and sticky rice dumplings. The cafeteria is transformed with decorations and linen table cloths. The greatest transformation is the people themselves, who for one evening doff heavy parkas and Carrhart overalls to appear unrecognizably refined in button-down shirts or dresses.

"Midwinter is a time of celebrating and I usually feel like 'Wow, we're halfway done already?'" said Lynn Hamann. "Last year, we had a fancy dinner in the galley with lots of starlight decorations, a dance, tablecloths and wine, and we all dressed up for the occasion."

This year the menu includes roast duckling, green lip mussels and Napoleon of halibut, crab and shrimp with saffron, garlic and thyme sauce.

"I have a very creative staff and expect a wonderful meal," wrote McMurdo chef Jan Jasperson.

Each of the 44 Antarctic stations celebrates with its own set of midwinter traditions. A few people from McMurdo Station usually visit New Zealand's Scott Base next door for the Polar Plunge. Hardy - or foolhardy - souls jump into a hole cut in ice meters thick to dunk in subfreezing water. The landlocked South Pole crew has its own version - the 300 Club. Joining the 300 Club can happen only on

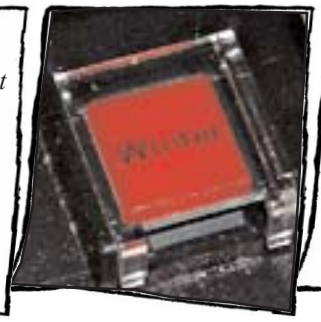
See Midwinter on page 12

April 10

An emergency medical flight picked up three sick people at McMurdo Station and dropped off groceries and mail. All three recovered well.

April 16

Science technicians at ARO pressed the red WINTER button, turning off solar instruments on the roof until the sun returns in September.



April 19

A partial solar eclipse was visible on Palmer Peninsula.

April 21

Palmer residents recognized Earth Day by sending the divers down to clean debris from the seafloor beside the pier.

Midwinter

From page 11

days when the temperature outside drops to or below -100F ambient temperature. Then the sauna is cranked to 200F and people run from one temperature extreme to the other lightly clad. At Palmer Station, people just jump off the dock into the harbor.

For Palmer Station, June 21 is the day they wave goodbye to the research vessel *Laurence M. Gould* as it leaves them isolated for three months. The 19 people left at Palmer celebrate by sitting down together for a large meal, said station manager Rocky Ness.

"For us it's going to be the start of our winter, where there's one small group that's alone together uninterrupted, but it's also beginning to be the end of winter at the same time because the days are getting longer," Ness said. "It's kind of a contradiction, both the beginning and the end."

Both are worth celebrating, said Ness, who enjoys the solitude of winter.

"I like that feeling of just kind of being on our own," he said. "There's less change. You know who you're wintering with."

Because it's just short of the Antarctic Circle, Palmer never loses the sun completely. Even on Midwinter's Day they get daylight from about 10 a.m. to 2 p.m., though it's usually muted by clouds. Still, they look forward to the day when the sun rises above the mountains that blocking it from direct view in midwinter.

"At Palmer the first time the sun clears the glacier, where you can see it, that's when people are like, 'Whoohoo! Winter's about over," Ness said.

Midwinter celebrations at Australia's Casey Station typically start with a champagne brunch, followed by a short dip in the Antarctic water and a longer soak in their outdoor hot tub, wrote John Rich, a past station leader at Casey. The meal starts formally, then relaxes into an evening of poetry reading, music and skits.

At the British Rothera Station, the entire week before Midwinter's Day is dedicated to preparations, with all but the most necessary station duties put on hold while people plan games, go skiing and secretly work on a handmade gift for the exchange, such as picture frames made from old sledge runners, wrote Stuart Wallace, a past winterer at Rothera. When the day itself arrives, the BBC World Service broadcasts a special half-hour radio show for the winter crews at Rothera, Halley and Bird Island. The broadcasters read messages from the families and friends of everyone wintering, and play a song requested by each station.

Typical winter greeting from Palmer Station. Many of the same people are back this year.

The type of celebration may vary from station to station, but they all share a sense of isolation, and a comradery across the ice.

"Not everyone is cut out to be a winter-over," wrote Lynn Hamann, now in her third winter working for supply at McMurdo Station. "It takes a certain kind of stamina. When the blanket of darkness is gently thrown over Antarctica and one has four long months of night to look forward to, it can be overwhelming for some, both physically (circadian rhythms) and mentally (depression)."

The sun set for the winter three months ago at the South Pole and two months ago at McMurdo Station on the coast. Twilight lingered about a month after, but since then the scientists, construction crews and support staff have lived in the dark, day and night. At the South Pole they can't even turn on lamps to light their way, since telescopes in the Dark Sector rely on the constant darkness. The windows are all shuttered to keep indoor lights from polluting the darkness.

The winter staff have quickly become as attuned to the phases of the moon as we usually are to the daily track of the sun across the summer sky. Waiting for the new moon, their eyes adjust to starlight.

"Words are not suitable to describe the clear night skies with millions of colorfully twinkling bright stars in formations we don't see in the States, such as the Southern Cross," wrote Hamann. "The 'upside down' moon is breathtaking, especially in those dark months in Antarctica in the winter. The full moon is so bright in May, June and July it seems like the sun."

But nothing really can replace sunlight, the vital source of vitamin D that triggers our bodies' sleeping and waking cycles. Without it, people often find themselves sleeping more and feeling sluggish.

June 20 is the turning point in the sun's seasonal circuit, the longest summer day in the northern hemisphere and midnight in the southern winter's night. From now on Antarcticans will be counting down until dawn, coming first to McMurdo August 21 and then to the South Pole September 23.

"I am sure that other people are reflective (as I am) about when the next time we see the sun will be," Koson said. "But of course, the sunrise isn't even close to the end of the winter, just another milestone of sorts, along with last flight, sunset, total dark, midwinter, first light and first flight."

May 5

A lunar eclipse was visible at McMurdo. Palmer residents couldn't see it, but celebrated Cinco de Mayo with a fiesta and piñata.

May 16

A storm laid waste to McMurdo Station, tearing out doors and windows, but hurting nobody.

June 20-21

(depending what side of the dateline you're on)

Midwinter's Day

June 21

The Gould *will leave 19 people at Palmer Station, where they will be isolated for three months while the ship goes into dry dock.*

July 4

The U.S. stations will celebrate American Independence Day in the dark. McMurdo usually holds a carnival and indoor parade.

After the research come the meetings

While most researchers leave Antarctica for the winter, their work continues up north, with lots of work analyzing data, presenting findings at conferences and making plans for future years.

Attending all the Antarctic-related meetings could be a full-time job. Some of these meetings, and a few agenda items, are highlighted below.

McMurdo Ground Station Science Workshop
March 9-11, Columbus, Ohio
Workshop participants discussed options for collecting data from the next generation of polar operating satellites, which could be in orbit by 2006. The new satellites offer increased capabilities and open the doors to new science and possibilities for observing and learning about the atmosphere, ocean, cryosphere, lithosphere and biosphere system. However, they require new receiving equipment. The ground station, locally known as the "golfball," was installed in 1993 by the National Science Foundation and National Aeronautics and Space Administration, and participants considered ways it might be upgraded. The workshop report, The Future of the Next Generation Satellite Fleet and the McMurdo Ground Station, can be read at http://amrc.ssec.wisc.edu/MGS/index.html.

International Partnerships in Ice Core Sciences
March 13-16, Algonkian Regional Park Sterling, Virginia
About 60 people attended the workshop to discuss ways to combine international resources and experience to facilitate ice coring science and reduce costs. For details visit: http://niclsmo.unh.edu/IPICS/IPICS.html

American Physical Society
March 22-26, Montreal, Canada
More than 6,100 physics papers were presented at the annual March meeting, including a paleoclimatological instrument developed as a spinoff of the Antarctic Muon and Neutrino Detector Array at the South Pole. For details visit: http://www.aip.org/

Sub-Antarctic Fisheries Management Advisory Committee
Canberra, Australia, March 25
http://www.afma.gov.au/fisheries/antarctic/mac/default.php

International Polar Year meeting
March 31-April 3, Paris, France

International Assoc. of Antarctic Tourist Operators annual meeting
April 27-30, Christchurch, NZ
President Denise Landau described the meeting as "very constructive." Almost all 70-members attended. They added a provision to the IAATO bylaws saying all members will have no more than a minor transitory impact on Antarctica and are considering formalizing an accreditation scheme for tour operators. Nadene Kennedy from the National Science Foundation gave an overview of the 2003-2004 Antarctic tourism and allocation of visits for the coming season. For more: www.iaato.org

15th Global Warming International Conference & Expo on Clean Energy Technology and Low GHG Transport Technologies
April 20-22, San Francisco
For details visit: www.globalwarming.net

Arctic Science Summit Week
April 21-28, Reyjkavik, Iceland

European Geophysical Union
April 26-30, Nice, France

American and Canadian geophysical unions joint assembly meeting
May 17-21, Montreal, Canada
U.S. Antarctic Program researchers presented papers on several topics, including records of the late Holocene climate taken from ice core in the Dry Valleys and a seismological model of the East Antarctic crust and upper mantle produced by the Transantarctic Mountain Seismic Experiment (TAMSEIS).
For details on TAMSEIS, visit http://epsc.wustl.edu/seismology/jfisher/.
For more on the meeting visit: http://www.agu.org/meetings/sm04/index.shtml

Fifth International Congress of Arctic Social Sciences (ICASS V)
May 19-23, University of Alaska, Fairbanks

14th International Offshore and Polar Engineering Conference
May 22-28, Toulon, France
The conference covered recent research on interdisciplinary engineering, structures and systems, mechanics and materials, energy and environment in the fields of the coastal to deep ocean and the Arctic to Antarctic.
For details visit www.isope.org

Antarctic Treaty Consultative Meeting XXVII
May 23 - June 4, Cape Town, South Africa
Representatives from all 45 signatory countries attended this annual conference for Antarctic Treaty Parties. The meeting agenda included discussions of scientific cooperation, tourism management, biological prospecting and the International Polar Year coming in 2007-2008. The Scientific Committee on Antarctic Research (SCAR) and the Commission for theConservation

See Events on page 14

Aug. 21

Sunrise at McMurdo Station. The first light will illuminate the horizon in the weeks before.

"The mountains across the bay (that we forgot were there) come back into view in glorious colors... A watercolor rainbow of nacreous clouds fills the skies and it's like a painting."
-LH

Aug. 20-26

Tentative schedule for three Winfly flights to arrive at McMurdo Station, bringing new summer crew to prepare the station and ice runways for main body.

Sept. 23

Dawn at the South Pole.

IPY puts the bottom of the world at the top of the list

The ends of the Earth will be the center of the scientific world in 2007-2008, if hoped for plans to create the next International Polar Year come to pass.

Planned for the anniversaries of the first and second International Polar Years, and the International Geophysical Year, scientists around the world are hoping the new IPY will lead to similar increases in exploration and discovery.

The first International Polar Year in 1882-1883 launched two expeditions to the Antarctic, one setting up a research station on South Georgia Island. Fifty years later as part of the second IPY, Admiral Byrd spent a winter alone in the first inland research station in Antarctica.

The current era of Antarctic research began with the International Geophysical Year in 1957-58, when stations were established at McMurdo, the South Pole and other locations. Traverses over the Antarctic icecap yielded the first informed estimates of the total size of Antarctica's ice mass. The IGY also led to confirmation of continental drift, launching of the world's first satellites and ratification of the Antarctic Treaty in 1961.

A year ago the International Council for Science established an IPY Planning Group, with endorsement from the World Meteorological Organization. Interest in the event has been broad. When the IPY planning group asked for suggestions they received more than 200 responses. Fifteen countries have already established national IPY committees.

The areas of proposed study include assessing large-scale environmental change in the polar regions, exploring the polar sea floor and subglacial landscape, and using satellite and remote observation techniques to extend the reach of science.

As part of the IPY, the International Partnerships in Ice Core Sciences proposed an international project of coring coastal sites along the large ice sheets of Antarctica and Greenland and drilling deep ice cores to obtain the longest possible climate record.

Other scientific organizations are planning an Electronic Geophysical Year (EGY) to coincide with the IPY as a means of providing an international focus for e-science and virtual observatory development across all the geosciences. The EGY is supported by the International Union of Geodesy and Geophysics, the Scientific Committee on Solar-Terrestrial Physics, the International Union of Geological Sciences, and the Society of Exploration Geophysicists.

For more details go to: http://dels.nas.edu/us-ipy/index.html

Events From page 13

of Antarctic Marine Living Resources (CCAMLR) attend the meeting as observers. The International Association of Antarctica Tour Operators (IAATO), United Nations Environment Programme (UNEP), International Maritime Organisation (IMO) and others attend as experts. All treaty decisions are made by consensus. For details visit: www.ats.org.ar/27atcm/e/index.htm

Climate Variability and Predictability (CLIVAR) Conference: Understanding and Predicting Our Climate System
June 21-25, Baltimore, Maryland, U.S.
Under the auspices of the World Climate Research Programme (WCRP), the international CLIVAR focuses on describing and understanding variability and change of the physical climate system on time scales from months to centuries and beyond. The keynote speaker is Rita Colwell, director of the National Science Foundation. For details visit: www.clivar2004.org

International Symposium: "A Century of Discovery: Antarctic Exploration and the Southern Ocean"
June 28-30, Southampton, UK
Cosponsored by (SCAR), this symposium marks the 100th anniversary of the arrival of Robert Scott's vessel, Discovery, home to the UK from his voyage of scientific and geographic exploration in Antarctica. The speakers include author Bill Fox, a grantee to McMurdo in summer 2001, who will make a presentation on "Terra Antarctica: A history of cognition and landscape." For details visit: www.soc.soton.ac.uk/Discovery

Scientific Committee on Antarctic Research and COMNAP
July 25-31, Bremen, Germany
Concurrently running working groups, exhibitions, scientific symposium and open science conference, including "Conference on Antarctica and the Southern Ocean in the Global System," For details visit: http://www.scar28.org

International Geological Congress
August 20-28, Florence, Italy
More than 8,000 abstracts and 200 scientific sessions are planned for this international conference, which draws more than 3,500 earth scientists from 141 countries. For details visit www.32igc.org

Ecology of the Anarctic Sea Ice Zone Final Symposium
September 27 - October 1, Korcula, Croatia
The scientific session will cover all of the key areas of EASIZ science.

Scientific Committee on Antarctic Research XXVIII
October 3-9, Bremerhaven, Germany.
For details visit
http://www.scar28.org

SCAR Bird Biology Working Group
September, Ushuaia, Argentina

Sept. 23
The Gould *arrives at Palmer Station to deliver the summer crew and take away the winter crew.*

Oct. 5
First main body flight scheduled to McMurdo Station. The actual flight date will depend on weather.

Nov. 1
First flight scheduled to South Pole station.

sources
Photos by Sonja Wolter, Glenn Kinoshita and Bill Servais. Quotes from Glenn Kinoshita and Lynn Hamann.

Science after Sunset

Stories and photos by Kristan Hutchison / *Sun staff*

Lighter than air, colder than ice

Winter temperatures at the South Pole freeze spit midair, but several of the astrophysical projects can't take the heat.

"It's way too hot for us," said scientist Nicholas Tothill, who works with instruments that prefer temperatures 200C colder than the average –80 outside. "We go to the South Pole and then we cool stuff down."

To further chill highly sensitive astrophysical equipment, the scientists use the same substance that keeps party balloons afloat – helium. Without it the instruments can't work, but science techs have as much difficulty holding onto the flighty element as children do keeping their balloons from drifting away.

"Most of it just boils off in storage," said Tothill, his bushy beard and thick, leather gloves lending him the look of a good-natured lumberjack.

The gloves are to insulate his hands and the liquid helium as he transfers it for AST/RO, the Antarctic Submillimeter Telescope and Remote Observatory belonging to the Smithsonian Institution. The heat in his fingertip would be enough to instantly evaporate a liter of liquid helium.

Steam rushes from the tip of the metal tube as Tothill tries to feed it into another one. The liquid inside boils as it comes in contact with room-temperature air, but its steam is cold, frosting over nearby surfaces. Then the flow stops, blocked by a chunk of frozen air.

Liquid helium has the lowest boiling point of any known substance, -269C, so it is able to bring the astrophysics equipment within a few degrees of absolute zero. Though helium is a challenge to work with, it is currently the only practical way to get the experiments that cold.

"It's crucial to us," said the astrophysicist in charge of AST/RO, Antony Stark from the Smithsonian Institution. "It's absolutely essential to our operation."

Scientist Nicholas Tothill transfers helium to cool AST/RO.

All of the detectors used by AST/RO are superconductors, which need to be kept below 4 kelvin, a few degrees above absolute zero. Any heat, including that given off by the detectors themselves, gets in the way of a clear reading.

"The cooler we make it, the less noise it adds to the signal and the happier we are," Tothill said.

AST/RO needs about 10 liters of helium a day. This winter a new instrument, SPIFI (South Pole Imaging Fabry-Perot Interferometer), is piggybacked onto AST/RO. SPIFI uses 25 liters of helium a day, because it is trying to measure minuscule amounts of heat.

Another South Pole telescope, Viper, and the associated receiver, ACBAR (Arcminute Cosmology Bolometer Array Receiver), require refills of helium and nitrogen every three days to maintain a temperature of -269C. The actual detectors are cooled even further to measure slight temperature variations in the cosmic microwave background radiation left over from the creation of the universe, which is itself -270C.

"If helium runs out, I will be done," said Justus Brevik, the Viper winter technician.

Over the summer 18,000 liters of helium were delivered to the South Pole in tanks that just barely fit inside an LC130. That supply needs to last until the next flight in late October, through the most critical research season.

"Calculations suggest we'll make it through the winter with something like three tablespoons to spare," Tothill said.

Losing cool

Many winters the helium runs out before the resupply arrives. All it takes is a hairline crack in a seal on the vacuum insulated containers to allow the helium to escape.

"This is a very difficult thing we're trying to do," said Jesse Alcorta, cryogenic technician for Raytheon Polar Services. "A 275-day winter is really pushing the limits of what we can do realistically."

The difficulty holding onto helium isn't limited to the South Pole. Though helium is the second most plentiful element in the universe, relatively little is found on Earth because most of it has floated away. So little is left that the element was not discovered until 1868 when a French astronomer watching a solar eclipse noticed a new yel-

See Helium on page 17

The dark side of research

Like nocturnal animals, astrophysical telescopes see better in the dark, cold polar night.

They prefer the South Pole winter, when the atmosphere is too chilled to hold any water vapor, making for a clearer view of the cosmos. After the sky darkened in April the telescopes were able to start work, but the best months will be the coldest - August and September.

"That's when we can start doing the stuff that's almost impossible from other places," said Nicholas Tothill, a winter scientist for AST/RO, the Antarctic Submillimeter Telescope and Remote Observatory.

Birthplace of stars

AST/RO looks at the places in the galaxy where stars form out of molecular gas. The molecular gas between the stars is so thin it would seem like a vacuum to lab scientists if you could bring it back to Earth in a bottle.

Already this winter AST/RO put the finishing touches on a two-year survey of the center of our galaxy. From the survey, Smithsonian Institution astrophysicist Antony Stark has a better understanding of how the galactic center works. A ring of gases orbits the galactic center, Stark said. The gases are stable at low density, but as new material is slowly added the gas rings density reaches an unstable point and the gas forms thousands of stars in a few million years.

The entire cycle takes about 20 million years, depending "on how much the galaxy has eaten lately," Stark said. The gases are about five times warmer than the researchers had expected and

See Dark on page 16

Above, Cornell University astrophysicist Gordon Stacey explains the inner workings of SPIFI, a new, more sensitive detector At right, Justus Brevik clears snow from Viper telescope.

Dark

From page 15

significantly denser, containing enough gas to make 10 million stars the size of the sun, Stark said.

"We're due for a burst," Stark said. "It will come in the next few million years, but it's way in the galactic center, so it doesn't really affect the Earth"

Stark recently submitted a paper on interpretations of his findings to the Astrophysical Journal Letters. The paper can be read at www.tonystark.org.

Getting a clearer view

Scientists still don't completely understand how stars form, or why some situations create more red ones while others form more blue. One of the challenges has been seeing the gases. Though hydrogen is the most common molecule, it's invisible to the detectors because it doesn't emit radiation. The detectors can see carbon monoxide, which radiates energy at multiples of 115 gigahertz. AST/RO observes the lines at 230 ghz, 460 ghz and 805 ghz, but sensing higher frequencies is difficult. Next they'd like to be able to look at ionized gases, particularly ionized nitrogen. Ionized nitrogen is a coolant for the interstellar medium, which must cool and contract to form new stars, said Gordon Stacey, a Cornell University astrophysicist.

Ionized nitrogen is at 1,500 gigahertz and for frequencies that high the atmosphere is nearly opaque. To achieve the needed clarity, detectors are usually sent outside the atmosphere on aircraft, rockets or spacecraft, but the atmosphere at the South Pole is clear enough to try because of the low temperatures and dry air.

"It's never been done from the ground," Tothill said.

Until now. This winter two complementary detectors piggybacked onto AST/RO will look at the 1,500 gigahertz frequency. In July Tothill and the other winter scientist working for AST/RO, Jules Harnett, will turn on SPIFI, the South Pole Imaging Fabry-Perot Interferometer. When temperatures reach their lowest in August and September they'll try TREND, the Teraherz Receiver with Niobium Nitride Device.

"We're going to prove that we can do it," Tothill said. "Just getting the first few lines (of data) is going to be a lot of fun."

SPIFI will look at the lifecycle of stars, from birth through redistribution of matter. Stacey is most interested in using SPIFI to look at the Large Magellanic Cloud, a dwarf galaxy sitting over the South Pole. The Magellanic Cloud has been through fewer generations than our galaxy, so has fewer of the heavy elements created in the nuclear reactions of stars. This lower quantity of heavy metal makes it similar to what might have been seen in the early universe.

Tothill expects about two weeks of weather sufficiently clear to detect at the 1,500 gigahertz frequency. At other astrophysical observatories, such as the James Clerk Maxwell Telescope on a mountaintop in Hawaii, the best Stacey could get was two to three days.

"The South Pole site is so superb," Stacey said. "You can get reliably good weather in the short submillimeter windows."

Despite the short window of time, having these detectors on the ground instead of in orbit is cheaper, faster and easier to fix, Tothill said. Developing the detector and getting it working takes only two to three years, instead of the decade usually needed to get a satellite designed and launched. If the detector has problems, the researchers can fix it, and the equipment is less likely to break to begin with since it doesn't need to be launched from a rocket "which is basically like having a bunch of guys kick it," Tothill said.

Mapping the universe

In the nearby control room for the Viper telescope, winter science tech Justus Brevik works amid a maze of wires and computers. Every few days he climbs to the roof and brushes snow off the mirror-like surface of the bowl-shaped receiver. The 2.1-meter telescope is used by the Arcminute Cosmology Bolometer Array Receiver (ACBAR) to measure subtle variations in radiation released at the creation of the universe – cosmic microwave background.

"There's no kind of telescope that can look back further in time or farther away than a microwave telescope," said Greg Griffin, a winter science tech from a previous year who helped Brevik get set up.

Previous years' data produced some of the most detailed maps ever seen of the early universe. The maps look like splatter paintings or multicolored inkblot tests, but to the trained eye of researchers the splotches of red, yellow, green or blue represent the seeds of galaxies.

"You might see some maps that look like sort of a zigzag pattern, blue and red," Griffin said. "That's because of the way our galaxy is moving through the universe."

The data gathered this year will corroborate whether the earlier discoveries about the size, shape and content of the universe hold true, and whether theories about how the universe originally inflated hold true.

"Here's this inflation theory and you're seeing it come to life on your screen," Griffin said. "You really do see things on your screen that are entirely new."

NSF funded research in these stories:
Antony Stark, Smithsonian Institution, http://cfawww.harvard.edu/~adair/AST_RO
Gordon Stacey, Cornell University, www.astro.cornell.edu/SPIFI/new/spifi.html
William Holzapfel, Univ. of California Berkeley,http://cosmology.berkeley.edu/group/swlh/acbar

Submerged volcano discovered

Sun staff

While icebergs floated above Antarctic Sound, a new volcano erupted below.

Researchers found the undersea volcano on a mid-April cruise to the northern tip of the Antarctic Peninsula. The cruise's original destination was the area where the Larsen B ice shelf had been before it disintegrated in March 2002, but when the way was blocked by ice, geologist Eugene Domack from Hamilton College decided to check out an underwater cone he'd noticed during a cruise in 2002.

"It wasn't the science we were funded to go down and do, but sometimes when the ice conditions are too heavy you have to come up with a second plan and a third plan," Domack said. "We said 'We've got the tools, let's nail this intriguing feature.'"

The researchers sent down a mud scudder, a torpedo-like video camera towed just above the seafloor. The images showed that though the volcanic cone itself is heavily overgrown with marine plants and animals, several areas of rock were bare of vegetation, indicating they were newly formed, Domack said.

Their suspicions were confirmed by the water temperature near the cone, which was 0.5C to 1C, compared to an ambient water temperature of -1.8C.

"We saw telltale signs, absolutely definitive, of geothermic heat," Domack said. Domack and co-investigator Amy Leventer from Colgate University brought back samples of the cone in plastic bags for Colgate volcanologist Karen Harpp.

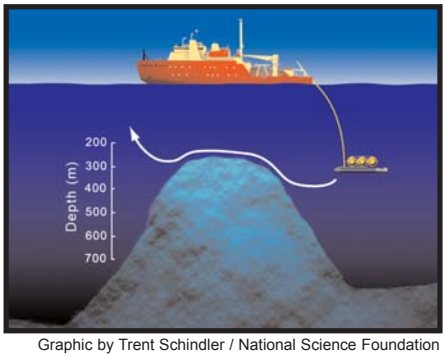
"It's different from the average pacific seamounts that I've seen," said Harpp, who usually works in the Galapagos Islands.

The samples had the typical rounded look of volcanic cobble, Harpp said. The rock looks like basalt with a glassy coating. Since glass doesn't last long in the sea, that's another indication that the volcano is either relatively young, or still active, Harpp said. The crystals were also small and fine, lacking the larger crystals that develop when magma sits inside a bigger chamber for a long time before erupting.

"The exciting part about it is this is not old crusty altered rock that's been sitting down there for a long time," Harpp said. "Potentially it's still active."

In 1997 mariners saw discolored water in that area, which could have been an indication of volcanic activity below, Domack said. Harpp said more analysis will need to be done to determine the age of the feature and what geological formation is causing it. The volcano lies along a fracture zone in Antarctic Sound.

The volcano may be one of several. Harpp said such features tend to appear in groups and the maps Domack's team made of the bottom showed two smaller cones nearby. Undersea volcanoes are common in certain areas of the world, Harpp said.



Graphic by Trent Schindler / National Science Foundation

An artist's depiction of the camera track as it is towed over the volcanic cone.

The yet to be named volcano is unusual in that it exists on the continental shelf, in the vicinity of a deep glacial trough carved out by past glacial expansion across the seafloor. The volcano stands 700m above the seafloor, extending to within 275m of the waters surface. It contains at least 1.5 cubic km of volcanic rock.

While the volcano has received a lot of attention, Domack is still interested in the seafloor below where the Larsen B ice shelf used to be. He will make another attempt to reach his study area next February and hopes the ice conditions will be in his favor. If it is, Domack will expand on his initial observations of the sediment core, which he's publishing this year.

NSF funded research featured in this story: Eugene Domack, Hamilton College, http://www.hamilton.edu/news/exp/antarctica/2004/

Helium

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low line in the solar spectrum, leading to its name derived from the Greek helios for sun. Other scientists of the time doubted his claim until helium was found on earth in 1895 after treating uranium with mineral acids.

Today helium is produced from natural gas, mostly from wells in Texas, Oklahoma, Colorado, Wyoming and Kansas.

"We do most of the helium production compared to the rest of the world," said Norbert Pacheco, helium team leader at the U.S. Bureau of Land Management.

But like natural gas, supplies of helium are limited. The U.S. has an estimated potential of 8.9 billion cubic meters, while the rest of the world is thought to have about 16.1 billion cubic meters.

"Just like oil, it's a renewable resource if you've got 10 million years to wait around for it," Alcorta said.

About 80 million cubic meters of helium were used in the U.S. last year and another 40 million cubic meters were exported. The U.S. also has about 766 million cubic meters of helium stockpiled. Besides party balloons, helium is used for medical MRIs, welding, cryogenics, lasers, nuclear reactors, liquid fuel rockets and as an artificial atmosphere for divers.

"In the last couple years it's been reported that we're going to have shortages and that the demand is going to outpace the supply by 2008 or 2010," Pacheco said.

The shortages may have been delayed by economic slowdowns in the last few years, which reduced demand, Pacheco said. Now Alcorta expects world helium supplies will become scarce in 40 to 60 years. Before it runs out he believes new advances in mechanical refrigeration technology will reduce the reliance on helium at the South Pole, though helium will still be needed to launch weather balloons. He's more concerned with whether the helium in tanks at the South Pole now will last the season.

"In 12 years I think we've only managed to go twice with liquid helium at the end (of winter)," Alcorta said.

One of the difficulties is measuring how much helium is left and how fast it is evaporating. To guard against loss, each tank is equipped with a gauge to indicate the liquid level and sits on a scale, so any sudden loss of weight will be noticed. Eight liters of liquid helium weigh about 1 kilogram.

They haven't been able to pinpoint the causes of failure, but Alcorta believes part of the problem is caused by storing the helium tanks outside, exposed to the South Pole's extreme weather. That may cause the vacuum-seals to become brittle and leak. It's also hard on the science techs transferring the helium, which can take from 10 minutes to an hour outside in -80C. Construction is planned to begin in 2005 on a new facility to house the stored helium and the nitrogen plant.

"A new facility will go a long way in helping us manage some of the problems we've had," Alcorta said.

So far the helium is holding out this winter, and Tothill hopes there's still some left in August and September, when South Pole conditions are best for the detector.

Assembling the drive system of the drill supply hose reel for the enhanced hot water drill in Madison, Wisc.

Photo by Lucia Simion/Special to The Antarctic Sun

IceCube

From page 1

With 700 optical modules frozen in 19 holes over a 200-meter-diameter area, AMANDA records about four neutrinos a day. At that rate, researchers could wait decades for a major discovery.

University of Wisconsin astrophysicist Francis Halzen wants results before he retires, so in 1998, a year after the first phase of AMANDA was completed, he submitted a letter to the National Science Foundation proposing to expand the detector.

"In every way you look at it, it's a hundred times larger, except in cost," said Halzen, lead investigator for IceCube. "In cost, it's more like 10 times larger."

After five years of planning, completion of a 167-page Comprehensive Environmental Evaluation and arranging for broad international collaboration, the $272 million IceCube project was finally approved for construction by the National Science Board in May 2004. The lead institution is the University of Wisconsin. The NSF provides $242 million, with the rest coming from other countries.

The Comprehensive Environmental Evaluation included review by other countries, and concluded that while the project may impact the science facilities at the South Pole, it will have little environmental impact because there are no plants or animals. The project had already received top reviews from scientific organizations in Germany, Sweden, Belgium and the U.S.

"We are very excited about the excellent scientific opportunities of IceCube," wrote German reviewers at a national laboratory in Hamburg. The reviewers urged that the project move forward without delay "so that the unique role of IceCube is not lost."

This month the drilling equipment begins the journey by truck, boat and plane to Antarctica, where a square kilometer of ice will be riddled with as many holes as an infantry range target, but with much more precision. Already wooden stakes around AMANDA mark out the locations for 80 new holes, each numbered with black marker. The new holes will build out around AMANDA like growth rings on a tree, extending to within a half kilometer from the station.

"You can think of the detector as AMANDA growing every year," Halzen said. "We're doing science now and we just keep doing it and as we keep going we better discover something."

Drilling deep

The drilling itself is a feat of engineering, though it sounds simple enough – just squirt hot water into ice to melt out a hole. The tricky part is making sure that hole is deep enough, straight enough and melts fast enough.

"The design and construction of the drill is an accomplishment in itself," said IceCube project director Jim Yeck at the University of Wisconsin Space Science and Engineering Center. "A significant investment in a new technology like this creates new opportunities. We already know of opportunities where people would like to use a drill like this for other scientific applications."

The IceCube holes will be 400 meters deeper than those drilled for AMANDA, and there will be four times as many. AMANDA's drill was the biggest in the world, but for IceCube it is too small. The Ice Core Drilling Services at the University of Wisconsin designed one twice as big and twice as hot.

"Hot water drilling is a pretty barbaric process. You just add more heat all the time, no matter what the problem," said ICDS lead drill engineer Bruce Koci.

The new drill will use 2.5-inch diameter multi-ply rubber hose, an inch thicker than the old drill and capable of spurting 757 liters of water per minute into the hole. A new, more efficient generator will heat the water to 90C, the boiling point at the South Pole. In less than 40 hours the drill will melt a 60 cm diameter hole down 2.5 km from the snow surface. The drilling process will use about 30,250 liters of diesel fuel to heat 61,000 liters of water for each hole.

One of the largest pieces of the drilling assembly waits at the South Pole. The 47.6 metric ton hose reel arrived at the Pole in January, filling three LC130 cargo planes.

"That's kind of the tip of the iceberg in terms of cargo," said Eivind Jensen, Raytheon Polar Services project manager for IceCube support. "The main body of cargo, almost the rest of it, is coming this year."

Getting the 2.9 km of hose and the rest of the drilling equipment to the South Pole this year will take 55 of the 326 scheduled flights, Jensen said. When assembled, the drilling equipment takes up half a city block.

"We have about the world's heaviest ice drill here and we're looking for particles that don't weigh anything," Koci said.

This first year they'll be satisfied to get the drill running by January and four holes made. Though the technology is tried and true, actually running a drill that large may take some practice and last minute equipment adjustments.

"We're still going to be building the space ship on the way to Mars," Koci said.

Drilling will continue for six years, running 24 hours a day for about 59 days each summer, with the goal of producing from 12 to 16 holes a year. As many as 80 holes will be drilled by the end of the project.

"It really is cutting edge science," Koci said. "That's what's exciting about it."

Glass eyes in the ice

As the drill pulls out, a cable strung with glass globes will be lowered into each hole and frozen permanently in place. These are the eyeballs of the project, optical modules looking down for flashes of

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IceCube

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blue light. The blue flashes indicate a neutrino collision created a muon, propelled in nearly the same direction as the original neutrino. By projecting the path back into space, researchers hope to determine where individual neutrinos originate.

In July, workshops in Wisconsin, Germany and Sweden will begin assembling the 5,120 optical modules needed to fill all the holes. Each takes a week to make, Yeck said. Photomultipliers, the pupil of these mechanical eyes, are mounted inside 33 cm glass spheres commonly used to deploy instruments in the ocean.

AMANDA used 700 similar, though simpler, modules. Small electronics boards were added to the IceCube modules, turning the ice into a network of light-sensitive computers.

"You can think of IceCube as 5,000 PCs that are talking to you and they all send you signals they have detected light," Halzen said. "Electronics love South Pole ice, because it doesn't move and it's cold."

At the South Pole, the ice sheet is about 3 km deep, covered by a layer of dry snow pack. The snow compacts as it is buried beneath each year's snowfall. At 100 meters below the surface the ice density is about 0.8 grams per cubic centimeter. Deeper and denser still, any bubbles are compressed, forming a clear and uniform ice below 1,400 m., the depth where IceCube begins.

Only deep oceans and dark ice are sufficiently transparent, deep, dark and large for the modules to see the fleeting flashes of blue. Locations in the Mediterranean Sea may be used for future neutrino telescopes, but liquid lacks the stability of ice. Remote as it is, the South Pole has better infrastructure for supporting large science projects than any other suitable location, said Halzen.

Photo by Lucia Simion/Special to The Antarctic Sun

Photo by Tom Hutchings/Special to The Antarctic Sun

Above, Jeff Cherwinka, Terry Hannaford, Ted Shultz, Jay Johnson, and Jim Green pose in front of the empty hose reel after assembling it at the South Pole. It took three cargo flights to bring the reel pieces to the Pole and many more will be needed to bring the supply hose, which Ted Shultz inspects in Wisconsin at left. The large water heater is in the background.

The network of optical modules will see about 400 neutrinos a day, predicts Halzen. As with AMANDA, the results will be sent back to his computer in Madison, Wisc. daily.

"We can look at neutrinos detected yesterday," Halzen said.

Science of discovery

While IceCube is built to see neutrinos, the astrophysicists who designed it are looking for something more. They just don't know what.

Halzen most hopes to find "something we didn't predict."

The construction of neutrino telescopes is overwhelmingly motivated by their discovery potential in astronomy, astrophysics, cosmology and particle physics. IceCube can search for the sources of neutrinos, including Gamma Ray Bursts or Supernova explosions, Active Galactic Nuclei, the decay of super heavy particles, cosmic rays, exotic particles and WIMPS (Weakly Interacting Massive Particles).

Much depends on chance. The first discoveries could occur while IceCube is still being built, or may require collecting and closely examining years of data after the project's 15-year lifespan ends, as did the experiments that originally discovered neutrinos, Halzen said.

"The quest for basic understanding of nature has yielded great dividends to our standard of living," Yeck said. "You're looking at something that can be rather esoteric to people, but the quest can be valuable in itself."

NSF funded research featured in this story: Frank Halzen, University of Wisconsin, http://IceCube.wisc.edu

Continental Drift — What's the best thing about winter?

"The lifelong friendships one makes and gets to keep years after sharing winters at McMurdo."

Lynn Hamann,
McMurdo supply team from Estes Park, Colo.,
3 winters

"Seeing the Southern Lights. They are simply amazing."

Chad Carpenter,
Pole electrician from Tuleta, Texas
2 winters

"The best thing is just being here with these people again in this place that I like so much."

Rocky Ness,
Palmer station manager from Northfield, Minn,
15 winters.

Sunday storm breaks windows, rips roofs

Nobody was hurt in McMurdo's storm of the decade, though repairs will continue into summer

Sun staff

Hurricane force winds shook McMurdo Station awake at 5:30 a.m. May 16.

"It was one of those things where you are suddenly wide awake and knowing that something is not right," wrote Lynn Hamann, who works in supply. "The wind shaking the building was the reason...must have been a big one to make us all wake up at the same time."

It was a Sunday, the one day most people usually can sleep in. McMurdo store keeper Zoe Vida put on earphones to try to go back to sleep, but her bed was quaking, along with the rest of the building.

"It was pretty frightening," she said.

Nobody knows how strong the winds were at McMurdo because the wind instrument blew away in the storm, but before it did it clocked 42 meters per second. At Black Island the peak wind was 76 meters per second. The temperature, with windchill, dropped to -54C.

Chef Bobby Loglisci was already up making brunch in the kitchen when he heard a creaking and banging in the exhaust system, as the wind blew smoke back down the pipes. When he stepped outside he couldn't see more than a foot ahead and had to cling to a dumpster to keep from blowing away. Within minutes his pants were embedded with snow and ice.

Several hours later, after he'd returned to work, a friend came to alert him to a ruckus in Loglisci's room. The wind had ripped his window from its hinges, spewing several inches of snow across his room.

"There was one of my neighbors, a 90-pound woman trying and failing to hold the shutters of my window closed. The snow was pouring in and it sounded like a freight train in my room," he wrote.

Within minutes about 30 people were in his room helping shovel snow and cover the gaping window with plywood.

The litany of damage National Science Foundation station manager Bill Coughran sent reads like the aftermath of war, with 85 significant items. Seven buildings lost doors, windows, roofs or exterior walls, including a window in building 159 that crossed the room like a bullet, causing an exit wound on the other side. Bay doors ripped off two buildings and the roof over the boiler room of building 155 peeled back. The roll-up door and roof were completely torn from a storage building. The shuttle bus shelter was carried by the wind and lodged against a pickup truck parked nearby. All the windows on one side of a shuttle bus blew out, along with nine windows from seven trucks and vans. The wind snapped three power poles, knocked down power lines and bent a flag pole to a 45 degree tilt. The helicopter landing pads were swept up and wrapped around portions of the Chalet, the administrative center in the summer season.

Photo courtesy of the McMurdo community

During the May 16 storm, gale winds blew in the garage door to the heavy machinery shop, allowing snow to blanket vehicles parked inside.

Storm stats

Peak wind recorded before the gauge blew away
42 meters per second = 82 knots = 94 mph

Peak wind at Black Island
76 mps = 147 knots = 169 mph

Temperature, with windchill,
- 65 F = -54C = 291 Kelvin

Shipping vans and waste barrels were thrown about. Even rooms that still had windows and doors filled with snow, as the wind blew it through tiny holes. All the communication went down during the storm and two weeks later the station was still without the few television broadcasts they receive from off-continent.

"It was by far the worst storm I have seen in my five winters," said carpenter John Ackley.

At New Zealand's nearby Scott Base the 15-hour gale blew off a hangar door, blew in the windows on two vehicles and overturned two shipping containers. Antarctica New Zealand chief executive Lou Sanson told the New Zealand press the storm was the biggest to hit Scott Base in 10 years.

Two people spent the night in a recreational A-frame hut about 3 km from New Zealand's Scott Base. Luckily nobody was camping out in the recreational trailer, called Silver City. It caved in under the wind and snow.

"You know with hurricanes the trailer park's always getting hit," Vida said.

Despite the damage to buildings, nobody was injured. The search and rescue team put guide ropes up between the dorms and the main building with the cafeteria so people could come and eat. Many people spent the day in their rooms or in the common areas. The station store opened and sold $600 of food and souvenirs in two hours.

"People thought of their families a lot during the storm," Vida said. "People kept saying 'You don't send the photos of the storm with the roofs gone to your mothers.'"

The intensity of the storm and the cleanup and repairs that followed left people exhausted, she said. Two weeks later the cargo department held a barbecue party to celebrate cleaning out all the snow that had filled the cargo bay after both doors blew off. The theme was "What is this and where did it come from?" as they tried to identify items blown around in the storm.

"There are heaps of pieces and parts the community gathered up around station, after the storm," Hamann said.

The greening of Antarctica

Photos courtesy of Christopher Ruhland/Special to The Antarctic Sun

Above, Christopher "Wally" Ruhland collects plant samples for analysis. At right, Tad Day carries plastic pipe cut into segments to use as planters.

Warming weather and melting glaciers make way for plant study

By Kristan Hutchison
Sun staff

As melting glaciers expose more beachfront property along the Antarctic Peninsula, plants are taking root.

While a few plants have eeked out a living on the peninsula for thousands of years, the warming climate seems to be giving them a growth spurt. In December biologist Tad Day counted thousands of plants where fewer than 100 grew four years before.

"There are several new populations of plants starting up on some of these newly deglaciated areas along the shores of islands," said Day, an Arizona State University researcher who studies the effects of climate change on two species of antarctic plant.

The two plants, antarctic hairgrass *(Deschampsia Antarctica*) and antarctic pearlwort (*Colobanthus quitensis*), are thought to have migrated to the peninsula in the past 20,000 years, probably as seeds carried from South America by birds, Day said.

Day and co-investigator Chris Ruhland from Minnesota State University first went to Palmer Station in 1995 and have witnessed dramatic changes in that time.

"The glacial retreat around Palmer is just amazing," Ruhland said. "When you can physically see glacial retreat over a 10-year period it's downright scary."

Over the past 50 years the average temperature of the region has increased 2.6C degrees, based on measurements taken at Faraday and Vernadsky stations, Ruhland said. The levels of ultraviolet radiation also increased in the last 20 years, Day said. When the ozone hole hovers above in the spring and early summer, the plants and animals below soak up twice the ultraviolet rays.

Beyond watching the trends, Day and Ruhland created an antarctic garden in the Palmer backyard this summer to experiment with different future climate scenarios and see how native plants respond.

"It's a unique opportunity to study plants in an area where climate is changing dramatically," Day said. "A lot of these changes are predicted to happen at more temperate latitudes in the not so distant future."

The scientists carefully transplanted about 240 plants from Biscoe Island near Palmer Station, using short pieces of 4-inch diameter PVC pipe as planters. They placed the pots by the dozen into frames, where the climate can be manipulated. Some of the frames have 30-watt infrared heaters, adding 1.5 Centigrade degrees to the outside temperature, Day said. Other frames have filters to screen out ultraviolet light. The amount of light screened out each day will be based on the difference between predicted UV for the day and what it would be without the ozone hole.

"We're actually just trying to remove the amount of UV that is enhanced each day due to depletion," Day said. "Nobody has done that before."

The plants grow slowly enough that Day and Ruhland don't expect to see any clear results until the final year of their three-year grant.

"A lot of these changes are subtle and you may not be able to pick them up the first season after an experiment has started," Ruhland said.

After a few years they predict a measurable increase in plant growth and seed production under the warmer temperatures. Under normal Antarctic conditions the *Deschampsia* grass blades grow from 5 cm to 7 cm tall. The pearlwort cushions grow about 2 cm a year, getting up to 12 cm in diameter. Similar experiments in the arctic tundra showed plants there went through a growth spurt the first few years they were warmed, then stalled as they ran out of nutrients. Day thinks antarctic plants will sustain their accelerated growth rate longer, because the soil along the Antarctic Peninsula is rich with nitrogen.

"You've got to understand not only the plants, but what that does to the litter and what that in turn does to the soil properties, which affects how the plants will grow several years down the road," said Day, who is analyzing samples of the dirt in his lab as a baseline.

Soil along the Antarctic Peninsula is much different from the volcanic dust found around McMurdo Station or the Dry

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Keeping it clean: *Preaching and practicing environmental ethics*

By Sun staff

Like ethical hikers, the U.S. Antarctic program tries to limit the footprints it leaves behind.

Trash is packed out, whether it's a new fuel spill or an old dump site. Field camps are pulled out following the backcountry camping mantra "Leave no trace."

This year a large fuel spill about 2 km from McMurdo Station led to several changes in how fuel is transferred, as reported by National Science Foundation Environmental Policy Specialist Pamela Toschik to the Antarctic Treaty Meeting in early June.

The spill occurred Oct. 20, when a coupling failed along a 15-cm-fuel line, spilling about 7,000 gallons of fuel onto the sea ice.

"Response to the accident was rapid, and recovery of fuel was well above normal expectations for a spill," Toschik wrote.

The fuel response team dug a trench, 50 meters in diameter, around the spill to isolate it. Then the fuel was pumped out for nine days. The fuel response team was able to recover 3,200 gallons of fuel. Another 580 gallons evaporated. In all, more than 90% of the fuel was removed from the site, according to Toschik's report.

Prefering to stop spills before they happen rather than mop them up after, the investigators did a thorough review of the cause. They found several factors contributed to the failure of the cast aluminum couplings, including the composition of the couplings, the procedure used to prevent snow burial of the fuel line, fuel line cleaning, temperature induced stress, or possibly improper bolt tightening during assembly. In response, they found couplings forged of a stronger material to replace the old ones and changed some of the routines for assembling and maintaining fuel lines.

The Antarctic program has taken other measures to prevent further accidents or spills including replacing flanges with welded pipes, consolidating fuel storage, providing secondary containment for large chemical storage tanks, using best practices for storage of chemicals and waste, training operators, and promoting awareness. In addition, long-range site planning, zoning, and consolidation have reduced the physical footprint that is at risk of contamination.

Taking out the trash

This month the *Laurence M. Gould* is taking out the trash from Palmer Station. Some of it is old enough to be considered treasure.

Like campers of bygone eras who cut wood for fires, Antarctic researchers used to burn or dump their trash. Until 1988 the trash at Palmer Station was burnt outside, leaving three piles of ash and contaminants. Since then all trash has been sealed in containers and shipped north from whence it came.

This year the shipment includes some of the older trash, the final stage in a three year plan to clean up the small station. In 1996 and 1999, the first two stages of cleanup, about 226 cubic meters of ash, 2.8 shipping containers of debris, 1,400 kg of suspected asbestos, and 9 55-gallon drums of hazardous debris were removed. This year's trash haul contains about 180 cubic meters of ash.

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Valleys, Day said. In places the Peninsula has two to 10 centimeters of organic material, developed over the years from plant debris and manure from seals and birds.

"They're kind of primed. They've got lots of nutrients," Day said.

Despite the rich soil, only the two vascular plants have taken root in Antarctica. Mosses have done much better, with more than 30 varieties clinging to the wet and rocky islands. But Day is interested in vascular plants, because they grow faster and are similar to economically important plants in the northern hemisphere.

"Other plants have been introduced in the past from southern South America and surprisingly none of them have survived," Day said. "As it gets warmer I wouldn't be surprised if the potential of plants that do somehow make their way down there from Tierra del Fuego would be improved; that they would become established and survive."

The hairgrass and pearlwort have adapted to lower temperatures, photosynthesizing even when it's 0 Celsius. In the northern hemisphere, most plants stop photosynthesizing when it gets that cold. The typical optimal temperature for plants is 22 to 26 Celsius. Ruhland and Day checked the photosynthesis of the Antarctic plants on a rare warm day, when the temperature was above 20 Celsius, and found the rate of photosynthesis was actually swamped out by the respiration of CO_2, Day said.

But even the Antarctic plants can't grow through snow. The experiment is off for the winter while the plants lie dormant. They will begin to grow again in the spring, when the snow melts away in November and the Antarctic gardeners return to turn on the heat lamps.

Photo courtesy of Christopher Ruhland/Special to The Antarctic Sun

Graduate student Sarah Strauss collects penguin guano to transport back to Arizona State University for nutrient analysis.

NSF funded research featured in this story: Thomas Day, Arizona State University, http://photoscience.la.asu.edu/photosyn/faculty/day.html

Chemical From page 1

the last frontier," said Bill Baker, a natural products chemist on the multidisciplinary science team. "There's very little that's been done in Antarctica as far as natural products research, so there's more likelihood of finding natural products with drug potential."

When Jim McClintock began studying the chemical defenses of sea stars at McMurdo Station in 1986, only Paul Dayton at Scripps Institution of Oceanography had done significant work on the ecology of the Antarctic seafloor and the role of starfish. McClintock quickly realized he needed to bring a chemist onto the research team and in 1992 Baker joined him. More recently Amsler joined the project, which moved to Palmer Station in 2000. Amsler and McClintock both teach at the University of Alabama Birmingham.

"The field of chemical ecology, by virtue of its name, combines different disciplines," said McClintock, who is a marine ecologist and invertebrate zoologist. "We do bring different expertise to the table and when combined they add up to more than the sum of their parts."

Cold and unique frontier

Little was known about Antarctic chemical ecology when the researchers started, because "most biochemists like to swim in warmer waters," said Baker, who is on the Chemistry Department at University of South Florida. "In many respects we have the place to ourselves."

Antarctic marine life is ripe for study, with a diverse population of uniquely evolved species, Baker said. The Antarctic Circumpolar Current began circling the continent more than 20 million years ago, separating it from warmer waters and allowing the marine life to continue evolving independently. Antarctic evolution was driven by a different pattern of predation than other parts of the world. In temperate and tropical waters, fish or turtles are the big eaters, grazing on sponges and other immobile prey as they swim by, so chemical defenses are commonly used in defense. Because of the lack of fish predators in the polar oceans, an early paper in the journal Science hypothesized the polar regions would be chemical-free zones.

"Though the prediction had been for very low levels of chemical defenses we found them to be not uncommon at all," McClintock said.

Near Palmer Station the primary predators for sponges are sea stars, who dine by extending their stomach onto their dinner and digesting the food before sucking it back inside. Since Antarctic sponges need to protect themselves from the digestive juices of starfish on their surface rather than a bite into their flesh, some have evolved a thin layer of chemical deterrent on the outside. The green sponge (*Latrunculia apicalis*) has chemical defenses only two to four millimeters deep.

Photo by Sonja Wolter/ Special to The Antarctic Sun

Maggie Amsler helps another member of her science team prepare for a dive on April 10. The divers collect samples of marine plants and animals to feed to starfish as they try to determine the role of natural chemicals in the Antarctic ecosystem.

"We think this may be an adaptation to the kind of predator you find that's so common here in Antarctica," McClintock said.

The sponges also use chemicals to keep plants and animals from clogging their pores or intruding on their space.

Fishy taste test

To discover those chemicals, the science team first concentrated on finding out what starfish would or wouldn't eat. After gathering 35 species of plants and animals from the subtidal zone, basically everything they could collect in enough quantity, the researchers fed bites of it to hungry *Odontaster validus*, a red starfish. If the starfish pushed the sample away the researchers tried to figure out why, breaking down the chemical composition of the meal until they identified which one repelled the starfish.

More than half the species they offered the starfish had some sort of chemical deterrent, and all the most common species did.

"It's not the highest level of chemical defenses in the world, but it's pretty important in terms of those populations," Amsler said.

Figuring out the responsible chemical compound takes from a few weeks to a year. Baker chemically separates the sample, making extracts of it much the same way we use coffee beans to make coffee. Each portion is again put to the taste test and whichever is still unpalatable is divided further. The process continues until the active compound is found.

So far Baker has identified about 50 to 60 compounds. About a third are unique and the rest are identical to ones found elsewhere in the world. In the seaweeds, he identified about a dozen compounds, mostly similar to ones that make algae taste bad in other parts of the world.

Possible cure

Baker routinely sends each unique organic extract or compound to the Cystic Fibrosis Center and the National Cancer Institute, just to check if it might be useful. In October he sent a sample from *Synoicum adareanum*, a bottom-dwelling invertebrate called a tunicate or sea squirt. Rooted to the seafloor without shells, blob-like tunicates around the world synthesize compounds such as the eudistomins as a defense. Several months after receiving the sample, the National Cancer Institute called Baker to say that the compound from the tunicate actively destroyed four of seven types of melanoma. Melanoma is a skin cancer that kills about 7,700 people in the U.S. each year, according to the American Cancer Society. The compound from the *Synoicum adareanum* attacks the melanoma without harming other cells, making it potentially suitable for drug development.

Baker named the new compound "Palmerolide," for its discovery near Palmer Station and its molecular structure, part of a chemical group known as polyketide amides.

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Chemical From page 23

Palmerolide won't be found in pharmacies for about 20 years, the typical time it takes to test cancer drugs. In that time 90 percent of compounds being explored are dropped, Baker said.

"A lot of things can work in a test tube that don't work in an organism," Amsler said.

Though it is not a sure thing, the researchers are very excited to possibly have a part in saving lives.

"Finding something that had an impact on a human disease as deadly as cancer would be a huge feather in the cap of a career in science," McClintock said. "To make some contribution, no matter how small, to fighting a disease like that."

This isn't the first discovery of a potential cure in the Antarctic. The Antarctic red sponge *Kirkpatrickia variolosa* contains chemical compounds that have bioactivity against cancer and is also undergoing further study by New Zealand chemists to explore its drug potential.

More may be waiting to be found. The same forces of evolution creating distinctive chemical compounds to avert a predator or keep another organism from intruding could also make compounds that disintegrate organic materials or restrain cell growth, making them useful treating diseases including cancer, AIDS, tuberculosis, bacterial infections and cystic fibrosis. The National Institutes of Health is currently developing at least five drugs from sponges, including several to fight cancer.

"Exactly the same kind of thing can happen with the compounds for the algae," said Amsler.

But the success of their research doesn't rely on finding potential medicines. This season Amsler set up two new experiments to try to answer what triggers brown algae to produce compounds that make them unappetizing to their main diners, tiny crustaceans called amphipods.

Studying a sea forest

The underwater scape along the western side of the Antarctic Peninsula is a forest of brown algae, a kelp-like seaweed. In some areas Amsler estimates there are 17 tons of algae per acre, almost all of it brown.

"These guys are the trees in the forest, so things that affect them would have very broad impacts," Amsler said.

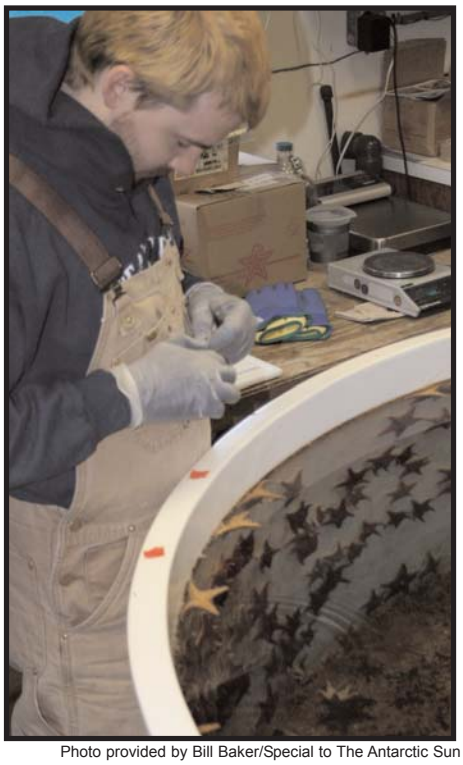


Photo provided by Bill Baker/Special to The Antarctic Sun

Kevin Peters tests the palatability of sponge extracts to starfish in the Palmer aquarium.

Already the algae face a change in the climate along the Antarctic Peninsula, along with increased ultraviolet light through the ozone hole. To see what this trend might do to the seaweed, the researchers transplanted two species of brown algae 35 feet closer to the surface of the water where more light would reach it. Some of the algae were screened to limit the UV radiation, while others were left to bear the brunt of the sun. After six weeks, the researchers tested to see if the algae had compensated by producing more phlorotannins, which act as a sunscreen for the plant.

The phlorotannins also are distasteful to the amphipods living and feeding on the algae, so an increase could make the plant unpalatable and leave the tiny crustaceans hungry.

"We were interested in a basic question of what the brown algae are doing, but it's even more interesting from a global perspective because of increases in the ozone hole," Amsler said. "Might that change the dynamics of the food chain, because these seaweeds are far and away the dominant species."

He already knows an increase in phlorotannins would slow down the decay of brown algae when they die, delaying the release of carbon and other nutrients.

"It's something that's so obvious we almost don't have to test, because we know this carbon is a major source for those communities."

Dinner on the defensive

The second experiment looked at whether the predators themselves prompt brown algae to produce protective phlorotannins. Pieces of brown algae were kept in buckets. In some buckets amphipods and snails nibbled at the seaweed. In other buckets, graduate student Anne Fairhead wielded a razor to mimic amphipod bites.

"There are other examples where it's not the wound that's the cue, it's the saliva," Amsler said. "Again, it's understanding how these really important keystone species are reacting with their potential predators. Tiny little predators like that are the kind that could be influenced by a defense you turn on."

The researchers already identified unusual interactions between amphipods and a yellow sponge. Antarctic sponges come in shades of yellow, red, orange and green. The researchers found this curious. Usually color is used to ward off predators that associate a certain shade with toxins, but Antarctic predators can't see.

After some experimentation, the researchers found each pigment was a defensive compound protecting the sponge. In one case, the yellow pigment mimicked a chemical regulating molting in amphipods. When an amphipod eats the sponge, the chemical pigment inhibits molting and the amphipod dies.

"This is the first example of such a relationship in the world's seas, although many land plants make molt-interfering compounds to keep herbivorous insects from eating them," McClintock wrote in his online journal.

That discovery brought them one answer closer to understanding how "dinner" defends itself from the "diner" if it can't run away.

"There are many lifetimes of work to be done in Antarctica," McClintock said. "It's a very interesting system we work with and many fundamental questions need to be answered."

NSF funded research in this story:
Charles Amsler, University of Alabama, www.uab.edu/uabbio/s022/

Dinosaurs discovered in unlikely places

Sun staff

A stroke of bad luck led paleontologists on the Antarctic Peninsula to one of the biggest finds of the season.

They planned to land on Vega Island, where previously found dinosaur bones waited in the permafrost, but heavy sea ice blocked their way in November. After a week of failed attempts, the *Laurence M. Gould* dropped the scientists on James Ross Island instead.

Team leaders James Martin from the South Dakota School of Mines and Technology and Judd Case from Saint Mary's College of California felt there was no chance of finding anything but marine reptile bones there, since the island had been underwater and about 64 km off-shore when Antarctica was inhabited. They went through the motions of looking for bones anyway, walking out onto a steep-sided, basalt-capped ridge at the end of a headlands. Case was ahead of the rest of the group when he noticed small, rounded stones of the kind ancient marine reptiles swallowed for ballast or gizzard stones, as chickens do. Looking a bit farther he found angular joint bones, a sign the bone had belonged to something more interesting than a marine reptile.

"Hey, I've got something you might find interesting," Case told Martin over the walkie talkie.

While the professors conferred, their graduate student jumped up and down and announced what they would soon corroborate "It's a dinosaur!"

The team spread out like kids at an Easter egg hunt, and everyone found something for the basket.

"Literally over a span of about 20 minutes everybody is beginning to find pieces of what we presume is the same animal," Case said.

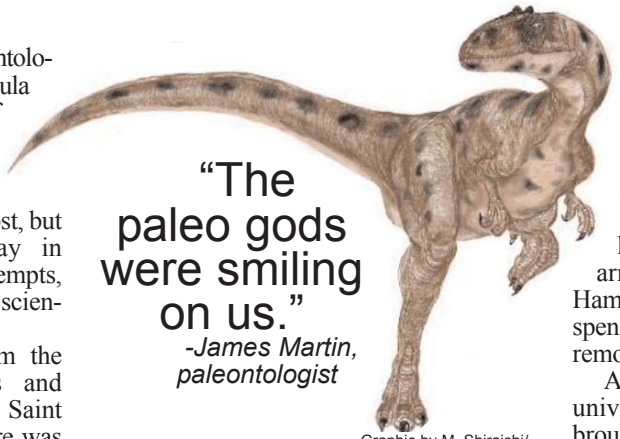
The next day they sieved the dirt in a 50-meter by 30-meter area.

"We picked it up and screened the whole area, took every piece of bone we could find," Martin said.

Back at the camp they began to puzzle together bits of bone, gluing them with super glue. In all, they found about 30 percent of the dinosaur - a couple leg bones, hind limbs, parts of teeth, pieces of the skull, fragments of foot and ankle, and a little bit of toe.

"For a dinosaur in the middle of the ocean, that's pretty good," Martin said.

The toes, claws and teeth showed it was a meat eater. It most likely lived 70 million to 75 million years ago, at the end of the Cretaceous period. At that time the climate on the coast of Antarctica was temperate, cool and forested, similar to the Pacific Northwest.



"The paleo gods were smiling on us."
-James Martin, paleontologist

Graphic by M. Shiraishi/ Courtesy of Judd Case

They believe the creature belonged to a population of dinosaurs that survived in Antarctica long after their kind died out elsewhere. The still unnamed dinosaur stood upright on its hind legs, but was small for the time, being about 2.5 meters tall. It likely hunted in packs.

"It's a real thin, fast dinosaur," Martin said. "It looks a little like velociraptor in Jurassic Park, but I don't think it could open doors and things like that."

This is the fifth dinosaur found in the James Ross Island region. Martin and Case are still surprised it ended up on the floor of the Weddell Sea.

"This guy must have floated and bloated," Martin said.

"The fact that we ended up with only the head and feet are not atypical of when they get floated and munched on by sharks and other animals," Case said. "There's not a lot of meat on the head and feet."

They had plenty of time to consider the possible scenarios as wind and rain buffeted their tents, and delayed the *Gould* from picking them up for three days.

"Overall, it was quite an experience, but the paleo gods were smiling on us," Martin said.

Meanwhile, in the mountains...

At almost the same time Case and Martin found their carnivore on the coast, another team of paleontologists discovered a new herbivore in the hills. Paleontologist Bill Hammer identified the fossilized pelvis of a primitive sauropod on Mt. Kirkpatrick near Beardmore Glacier in the Transantarctic Mountains. The pelvis measures about a meter across. Hammer estimated the early sauropod was between 1.8 and 2.1 meters tall and up to 9 meters long. It would have been similar to the four-legged, tree-browsing brachiosaurus. Based on the age of the rock it was embedded in, the sauropod lived about 200 million years ago.

Hammer's new find was about 100 feet above where he'd dug out the first carnivorous dinosaur to be found in the Antarctic 13 years ago. In April the 680 kg. of rock and bone his team dug arrived at Augustana College, where Hammer teaches. Graduate students will spend the rest of the summer carefully removing the new sauropod from the rock.

A similar process is going on at the home universities of all the researchers who brought home fossils samples from the Beardmore paleo-camp this season.

"We plan on spending much of the summer working on the rock and synthesizing the data we collected in the field," wrote John Isbell, from the University of Wisconsin – Milwaukee, who had been chief scientist for the Beardmore Camp.

Paleobotanists Tom and Edith Taylor from the University of Kansas had the largest haul of rock and fossils, about 4,000 kg. As soon as the fossils were unloaded in April, they started slicing them into 2 cm slabs with a diamond-coated blade. The surface is then etched with hydrofluoric acid. Already Tom Taylor said they've found treasures hidden inside the rock. He's most excited by a seed cone of a cycad plant. In previous Antarctic trips the Taylors found and described a cycad pollen cone and stem, but this is the first seed cone they've found. Better yet, an insect had bored into the cone, indicating that insects probably were involved in pollinating the cone, just as they do in modern cycads today. In fact, the beetles pollinating today's cycads may have evolved in tandem with the plant.

"These are things that have not been seen before in the Permian and Triassic, and in fact provide new opportunities to study not only the plants, but the intimate relationships between plants and animals," said Taylor. "We're real pleased with what we found this year."

Based on some of their findings, the Taylors, their students and postdoctoral associates are preparing presentations for August meetings of the Botanical Society of America and the American Phytopathological Society, as well as papers for several science journals. Meanwhile six students will spend their summer slicing up the remaining rock, probably making more discoveries along the way.

NSF funded research featured in this story:
Judd Case, Saint Mary's College of California,
Bill Hammer, Augustan College
Edith Taylor, University of Kansas,

Profile

Top-secret ingredient in South Pole kitchen

By Kristan Hutchison
Sun staff

The South Pole winter cook can steer subs as well as make them.

Taking the helm was one of Don Highsmith's duties during his 17-year career cooking aboard Navy submarines. He enlisted in 1980, after trying 10 months of college and deciding he wasn't ready for the academic track.

"I got a heck of an education, book-wise, travel-wise, interpersonal relationship-wise - any way you can think," Highsmith said.

He sailed with nine subs, including three Trident submarines and four fast-attack subs. By the time he served aboard the special operations nuclear submarine *USS Narwhal*, he'd risen through the ranks and his duties included being chief of watch, which meant he was trained to steer the vessel.

Though he served through the end of the Cold War, the Panamanian invasion and the Persian Gulf War, Highsmith said their actual activities remain classified.

"I was fortunate enough to be attached to some ships that did some pretty interesting things in the name of our nation's defense," said Highsmith. "They did all the seek-and-destroy kind of things."

In 1985 Highsmith was aboard the *USS Narwhal* when it surfaced at the North Pole, the first of four times he'd go there in a submarine. The next year he almost had a chance to visit the Antarctic, but shortly before his deployment to the polar clime his father died and the Navy decided to find him an assignment closer to home.

"It's something I've been chasing since," Highsmith said.

Upon leaving the Navy he worked several years as cook aboard Edison Chouest ships, the same company that operates research vessels for the National Science Foundation in the Antarctic. The ships he worked on supplied oil rigs in the Gulf of Mexico. Then he moved to military sealift.

He lived for five years in Singapore, having discovered in his travels an affinity for Asia.

"It's the people, the weather, the food," Highsmith said.

The Asian connection is apparent in some of the foods he serves at the South Pole, where he spent his first year in 2001-02. He was used to planning menus months in advance from working on submarines, so he adapted easily to the cooking, even though all the food had to be ordered a year before.

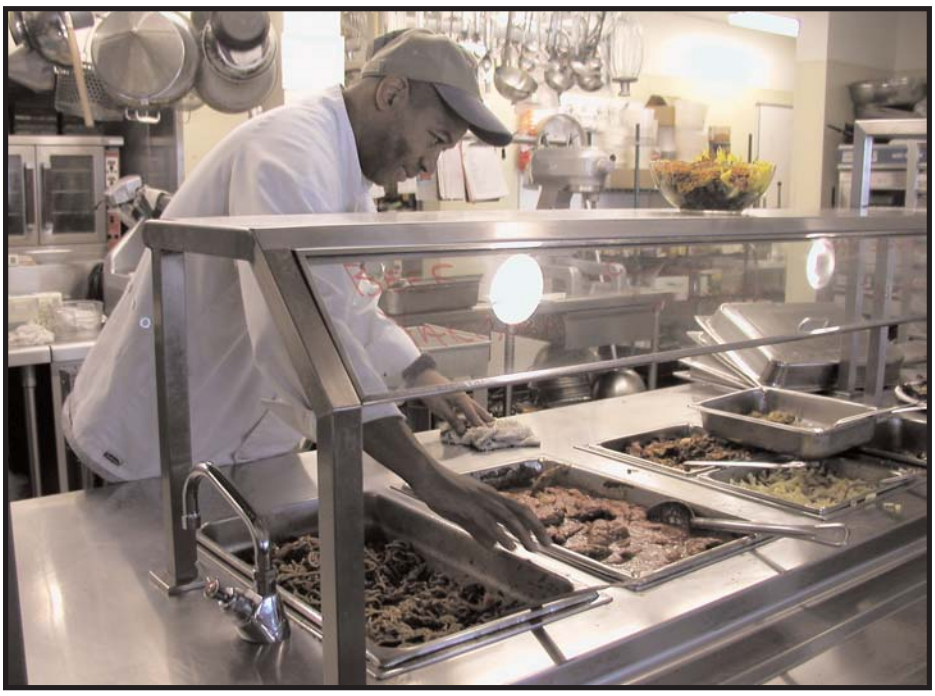


Photo by Kristan Hutchison/The Antarctic Sun

South Pole chef Don Highsmith checks the hot food line.

"It's almost the same situation - long stretches of time, no fresh vegetables," Highsmith said. "You have to rely on creativity."

After working on submarines, the confines of a winter didn't faze him either. He had spent up to nine months straight on a submarine and gone as long as 73 days without surfacing.

"There is no comparison. The South Pole station would win hands down. For one, I don't have to wear a uniform," Highsmith said at the beginning of his second winter. "And there's a lot more room and we have women here."

The cold, however, was a shock.

"You don't realize how cold it is until you experience it," Highsmith said.

That first winter he was living in the hypertats, which meant walking to the kitchen in the Dome every day.

"It was nice walking to work, seeing the stars, seeing the auroras," he said.

This year he's living and cooking in the new South Pole station. The meat-and-potatoes crowd enjoys Highsmith's cooking and personality, wrote station manager Pete Koson.

"Don fits in well with this particular crew this winter," Koson said. "We have a pretty rough-and-tumble group, not real touchy-feely, you might say, very direct, professional and businesslike. Don's personality is right on track with that, although he is always good for a laugh too."

His first season Highsmith sang and played percussion in a jazz/country/pop band. This winter he brought his trumpet and xylophone, but he hasn't had time to join the band.

When he leaves the Ice in November, he plans to run a marathon in Bangkok and then the Great Wall Marathon in China on Jan. 25. Highsmith started running in high school in Baltimore as a player on the football and lacrosse teams. He's run five marathons already, with his best time 3 hours 50 minutes.

Not bad, he said, "considering I don't really get to train like I could."

Most of his training has been on treadmills aboard submarines, ships or at the South Pole.