The Antarctic Sun

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December 1, 2002

The Art of fishing

Photo by Melanie Conner/The Antarctic Sun

Art DeVries tags a Dissostichus mawsoni, *sometimes called an Antarctic cod. He's studied and fished the giants longer than anyone else, and often brings other people on his fishing trips.* *See story and photo essay on page 7*

Looking for the dark side of the universe

By Kristan Hutchison
Sun staff

The scientists who brought us the size and shape of the universe are going for something even more ambitious.

A new, larger telescope could count and measure every massive cluster of galaxies visible from the South Pole and provide a detailed history of their formation. That could give cosmologists insight into the little-understood "dark" energy they now believe makes up most of the universe.

"With that information we can really solve for how the universe evolved," said John Carlstrom, a leading astrophysicist on both the planned and existing South Pole telescopes.

When it's installed in four years, the $16 million National Science Foundation telescope will be the first and most powerful of its kind. At 26 feet (8 meters) in diameter, it will also dwarf other telescopes and many structures at Amundsen-Scott South Pole Station.

"If you were hiking to the South Pole, this might be the first thing you'd see," said Carlstrom, a University of Chicago professor.

Big as it is, the discoveries the telescope is expected to make in its first year are even bigger. It could reveal whether dark energy, the stuff astrophysicist believe makes up two-thirds of the universe, really exists and what it is. In doing so it would connect physics on both the smallest and largest scales, from the interaction of particles to the development of galaxies.

"It's a way of taking the next step in understanding this crazy new cosmology that we find ourselves in," said astronomer Tony Stark of the Harvard-Smithsonian Center for Astrophysics.

The last few steps leading to the "new cosmology" were also taken in Antarctica by many of the same scientists working on the Boomerang, DASI and ACBAR projects. The DASI telescope, or Degree Angular Scale

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INSIDE

On the edge of a total eclipse of the sun
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Down to Earth astronaut explores the Ice
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Quote of the Week

"I've figured out the three things you need to run a station in Antarctica: duct tape, ibuprofen and WD-40."

- Marra Bennett, general assistant at Amundsen-Scott South Pole Station

Ross Island Chronicles By Chico

Cold, hard facts

Gobble, gobble

Number of people attending Thanksgiving dinner at each station: **McM - 1,000, Pole - 210, Palmer - 37.**

Pounds of turkey served at each station: **McM - 1,200 lbs. or about 1 lb. per person; Pole - 300 lbs or about 1.3 lbs. per person; Palmer - 75 lbs of turkey or 2 lbs. per person.**

Total turkey served in Antarctica for Thanksgiving: **1,575 lbs.**

Pounds of turkey eaten each Thanksgiving in the U.S.: **675 million or about 4 pounds per person.**

Rolls per person: **McMurdo 2 to 1; Palmer 2 to 1; Pole 1.3 to 1**

McMurdo's pumpkin pie slices to people ratio: **0.7 to 1**

McMurdo is the only station not serving minced meat pie

Widest variety of pies: Palmer, **6** - pumpkin, pecan, mincemeat, raspberry and strawberry rhubarb and banana chocolate pudding pie.

Sources: Sally Ayotte, Jon Emanuel, Wendy Beeler and University of Illinois.

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Web address: www.polar.org/antsun

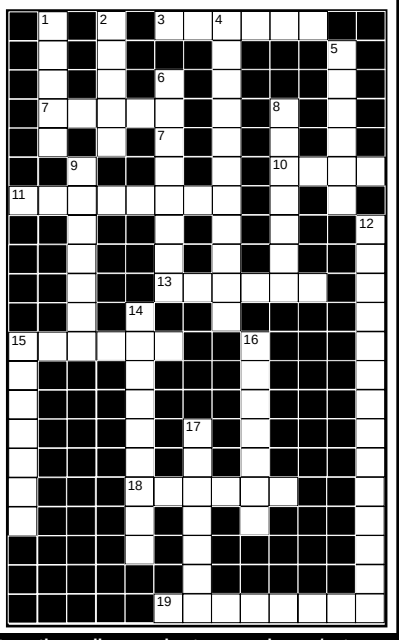
Katabatic Krosswords: The world of ice

Warning: *This is an advanced puzzle. Those who aren't ice experts might want a reference guide, or try our online puzzle which offers built-in hints.*

Across
3. Fine plates or spicules of ice suspended in water
7. Crack formed by movement parallel to surface
10. Free-floating piece of ice larger than one meter
11. Any break or rupture in an ice cover due to deformation
13. Ice in advanced stage of disintegration
15. A long ice sheet attached to the shore
18. Downstream movement of a small section of ice cover
19. Squeezed together; forced up or down in places

Down
1. Wreckage of other forms of ice
2. A smooth, continuous ice cover
4. Cover formed by various forms of ice freezing
5. Submerged ice attached to the bottom
6. Made of granular ice grains
8. Poorly defined ice edge limiting area of dispersal
9. Ice with large horizontal grains
12. Loose mass of floating ice
14. Thin, branch-like growth of ice on surface
15. Disintegration of ice cover
16. Broken ice forced upward by pressure
17. Uneveness in surface caused by horizontal pressure

Solution on page 6



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

Antarctica's stuck on the bright side

This year's total eclipse misses the Ice, but next year's goes right over

By Melanie Conner
Sun staff

Antarctica will stay out of the dark this week, barely.

Partial darkness will traverse eastern Antarctica on Wednesday as the moon passes between the sun and Earth.

When the sun, moon and Earth are aligned, a total solar eclipse will occur over Africa and Southern Australia, while a partial eclipse will occur over the rest of Africa, western Australia and Antarctica.

Racing over Earth at roughly 1,500 km an hour, the moon's shadow will touch down on the South Atlantic Ocean at sunrise, pass over Southern Africa and the Indian Ocean and end at sunset in Southern Australia. Eastern Antarctic science stations such as Russia's Mirnyy, France and Italy's Concordia and Japan's Syowa will have a view of the partial eclipse. It is doubtful that any of the U.S stations will be able to view the phenomenon; however, if anything is visible it will be between 7:15 and 7:40 p.m. for the South Pole or McMurdo stations and about 3:15 to 7:40 a.m. for Palmer Station.

"You should be able to see a total eclipse around sunset in Australia and a partial eclipse in Antarctica then," said Roy Mayhugh, astronomer and owner of Astronomy Vacations travel company.

The totality zone, the 73-km band of darkness where the moon completely blocks out the sun, will last barely over one minute at any given point along the course.

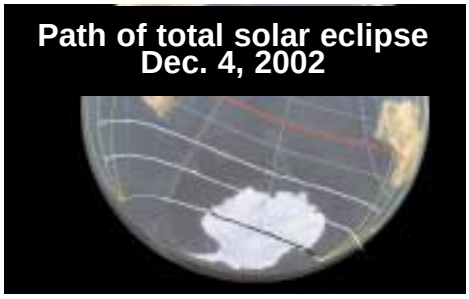
"If you're on the path of totality, you are inside that shadow for about a minute, then you come out," said William Livingston, astronomer for the National Solar observatory in Arizona and witness to 13 total eclipses from Africa to Asia.

Nick Greene, co-founder of the Astronomy Club at McMurdo Station, was disappointed to learn that he may not see much of the eclipse but is excited that next year will be the real prize, as another total eclipse will travel directly over Antarctica.

On Nov. 2, 2003, a total solar eclipse will occur over Antarctica and it is predicted that the moon's shadow will include the entire continent.

The totality zone varies widely and eclipses at the Poles are usually wider than normal, making their shadows more expansive and providing Antarctic workers with a morning's entertainment in 2003.

"It looks to me like the best viewing areas will be on the other side of the continent from us," said Greene of the 2003 eclipse. "Over here, we'll be far enough from the totality zone and light will be reflected from the snow and ice that it won't really get dark. It might be more like a cloudy day and we should be able to see it."



Wherever the sun is shining outside the shadow, it will be beyond the horizon in every direction.

"You can get very deep twilight colors. Not like a sunset that comes from only one direction. It comes from all around you," said Mayhugh.

Four hours before Antarctic participants see the celestial phenomenon, eclipse enthusiasts will experience almost two minutes of darkness aboard cruise ships off the coast of Eastern Antarctica.

"There are people that follow eclipses, we call them 'eclipse chasers,'" said Roy Mayhugh. "Many of them from varying backgrounds say, 'Hey, this is how I want to see Africa, Asia, Antarctica. Every eclipse is going to take me to an interesting place.'"

At prices ranging from $18,000 to $35,000, the 2003 eclipse will take them on a 30-day cruise from South Africa to the Davis Sea, near the Shackleton Ice Shelf. The icebreaker ship will be positioned near the point with the maximum duration of eclipse, just under two minutes. Despite the cost and likelihood for bad weather or unnavigable thick sea ice, Mayhugh's ship is filling up.

"I expect that after the holidays, the ship will fill up and sales will close," said Mayhugh, who also chaperones people to meteor showers, comets, auroras and eclipses around the globe. "But it is very typical for eclipse tours to book up about a year in advance."

People want to see a total solar eclipse at 4 a.m. in the Antarctic. Not many people are able to witness a solar eclipse at night. The eclipse will occur during an austral summer, which produces continuous daylight.

"It's the onset of the first point of contact that is really exciting," said Livingston referring to the three points of contact in a total eclipse.

The first contact is the moment when the moon first encroaches on the sun to the last instant before the sun is obscured while it is a thin crescent. During this time, the sun's rays expose the mountains and valleys of the moon's surface by shining light along its edge, creating an effect known as Baily's beads or diamonds.

"After the Bailey's beads you see the corona (during the second point of contact). It's very beautiful, an absolutely unique view," said Livingston.

Only when the sun's brightness is blocked during the second point of contact, the much-dimmer corona, or the sun's outer atmosphere becomes visible.

The third point of contact completes the eclipse as the moon departs from the sun's path. "The whole thing usually lasts about two hours, then it's over and you celebrate," said Livingston.

The personal fulfillment of witnessing a celestial event isn't the only value of an eclipse. There is also science to be done. On May 29, 1919, a total eclipse over Brazil allowed Einstein to prove his theory of relativity, when he predicted that gravity would bend starlight as it passed the sun. The muted sun allowed for Einstein to witness the gravitational pull of light rays near the sun.

Eclipses have also shown scientists that the Earth's spin is slowing down at the rate of 1.5 million milliseconds per day.

Today, astronomers want to understand the sun's outer atmosphere and why it is millions of degrees Celsius (180,000F) while the sun's surface is a much-cooler 6,000 degrees Celsius (1,100F).

Occurring an average of once every one and a half years, but often skipping many years, eclipse science becomes irregular. The weather is expected to be unfavorable to science for the upcoming Dec. 4 eclipse, as it will occur during a rainy season in Africa. The opportunities for eclipse related science next year will be limited to what can be done aboard icebreakers. The next total solar eclipse will occur in the Northern Hemisphere in 2006.

"An interesting fact is that in Tucson, where I am, there isn't going to be a total solar eclipse for about a thousand years. For almost any place it is a great rarity," said Livingston from his Arizona office.

Because of the rarity of a total eclipse, Livingston advises others to fully absorb the experience of being in the moon's shadow.

"Don't worry about science. Some people are so busy taking photos that they don't get to see it," he said. "The best thing to do is get a comfortable chair and enjoy it."

speaking of science...

The Ice from above

"In light of...abrupt ice-sheet changes affecting global climate and sea level, enhanced emphasis on ice-sheet characterization over time is essential."
—Abrupt Climate Change report, National Research Council (2002)

By Christopher A. Shuman

Are the ice sheets that still blanket the Earth's poles growing or shrinking? Will global sea level rise or fall? NASA's Earth Science Enterprise has developed the ICESat mission to provide answers to these and other questions. If all continues to go as planned, the mission will launch on Dec. 19 from Space Launch Complex-Two, Vandenberg Air Force Base, Calif. and soon be feeding back data to the National Snow and Ice Data Center.

ICESat's primary goal is to quantify ice sheet mass balance and thereby understand how changes in the Earth's climate affect polar ice mass and global sea level. ICESat will also measure clouds and aerosols for studies of atmospheric processes, as well as land topography, sea ice and vegetation cover.

As summarized in the above quote, ice sheets are complex and dynamic elements of our climate system. Their evolution has strongly influenced sea level in the past and currently influences the global sea level rise that threatens our coasts. Ice streams that speed up, slow down and change course illustrate their dynamic nature. In Antarctica, small ice shelves continue to retreat along the Antarctic Peninsula, and large icebergs are released from the largest ice shelves. Some of the factors controlling the mass balance of the ice sheets and their influence on sea level are just beginning to be understood.

The ICESat mission is part of NASA's Earth Observing System. The Geoscience Laser Altimeter System (GLAS) instruments on ICESat will provide critical measurements across Greenland and Antarctica. Together with other ice sheet studies, ICESat will enable scientists to better understand the Earth's climate and, ultimately, predict how ice sheets and sea level will respond to future climate change.

Growing or shrinking?

This question lies at the heart of NASA's rationale for the ICESat mission. The Greenland and Antarctic ice sheets average several kilometers thick, cover 10 percent of the Earth's land area, and contain 77 percent of the Earth's fresh water

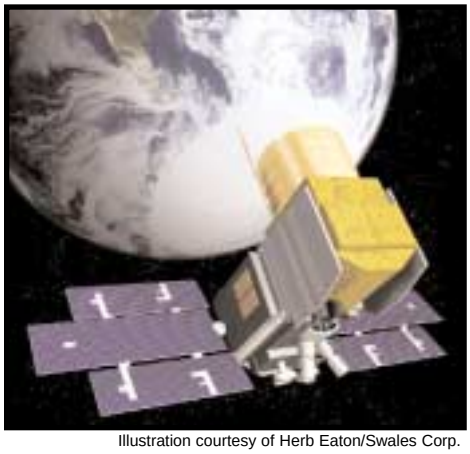


Illustration courtesy of Herb Eaton/Swales Corp.

The GLAS instrument marks measurements from ICESat while orbiting over Antarctica.

(33 million km^3). The Antarctic ice sheet has 10 times more ice than Greenland because of its greater area and average ice thickness. If their stored water volume were released into the ocean, global sea level would rise by about 80 meters. A change of only 0.1 percent in the average thickness of the ice sheets would cause a change in global sea level of about 8.3 cm. Its vast size and inhospitable environment make Antarctica impossible to monitor completely except via satellite.

ICESat is designed to detect changes in ice sheet surface elevation as small as 1.5 cm per year over areas of 100 km by 100 km. Uniform monitoring of thickness changes over Greenland and Antarctica will reduce the uncertainty in their mass balance (the difference between the total mass input and total mass output from an ice sheet) and their consequent contribution to sea level change. Elevation time-series constructed from ICESat's observations throughout its 3- to 5-year mission will quantify seasonal and interannual changes in the mass balance. Additional missions will extend the data over the next 15 years to ensure knowledge of the temporal variation in ice mass balance.

Measuring the Earth?

The GLAS instrument on ICESat will determine the distance from the satellite to the Earth's surface, and to any intervening clouds and aerosols. It will do this by precisely measuring the time it takes for a short pulse of laser light to travel to the reflecting object and return to the satellite. Although surveyors routinely use laser methods, the challenge for ICESat is to perform the measurement 40 times a second from a platform moving at 26,000 km per hour.

The GLAS instrument measures how long it takes for photons emitted from one of its three lasers to pass through the atmosphere, reflect off the surface or clouds, return through the atmosphere, collect in the GLAS telescope, and trigger special detectors. After halving the total travel time and applying corrections for the speed of light through the atmosphere, the distance from ICESat to the laser footprint on Earth's surface will be known. When each pulse is emitted, ICESat will determine exactly where it is in space using Global Positioning System receivers. The angle at which the laser beam points relative to distant stars and the center of the Earth will be measured precisely with a star tracking camera on GLAS. These data are all combined to calculate the elevation and position of each point measurement on the Earth.

ICESat — status

The overall mission, composed of the GLAS instrument, the ICESat spacecraft, the launch vehicle, mission operations and the science team, is now launch-ready. NASA Goddard Space Flight Center staff developed the GLAS instrument in partnership with university and aerospace industry personnel. Ball Aerospace & Technologies Corp. developed the ICESat spacecraft. NASA Kennedy Space Center is providing the expendable Boeing Corp. Delta II launch vehicle. The launch vehicle will carry ICESat, and a second payload called CHIPSat, into a near-polar orbit of 600 kilometers altitude. On-orbit operations will be conducted by the University of Colorado's Laboratory for Atmospheric and Space Physics. Following calibration and validation studies by the science team, ICESat data will be available from the National Snow and Ice Data Center.

Christopher A. Shuman is an ICESat deputy project scientist. More information on ICESat is available at: http://icesat.gsfc.nasa.gov/.

around the continent

PALMER

Bar ice lands in drinks

By Tom Cohenour
Palmer correspondent

It takes thousands of years for delicate snowflakes to become solid, crystal clear bar ice. Snowfall upon snowfall builds up enormous weight, slowly compressing the tiny crystals closer and closer together forming translucent ice. Eventually, air bubbles are forced out by the increasing weight completing the transformation of snow into pure ice with a weight of 1,380 lbs. per cubic yard (820 kg per cu m).

Photo by Tom Cohenour/Special to The Antarctic Sun

A chunk of bar ice as it is pulled out of the water near Palmer Station.

Not all snowflakes become bar ice. The Marr Ice Piedmont, a.k.a. the glacier, next to Palmer Station, produces tons of ice from calving that fall into various officially recognized categories. The list reads like a Biblical passage from Genesis; snow begets firn, begets ice sheet, begets glacier, begets ice berg, begets bergy bits, begets growler, begets brash.

The vast majority of ice calving off the glacier is whitish to light blue in color. Only a small fraction is clear enough to qualify as true bar ice. And it's often difficult to spot.

Photo by Tom Cohenour/Special to The Antarctic Sun

Chunks of bar ice float among the brash near Palmer Station.

Zipping about the ocean in a Zodiac requires constant vigilance to avoid serious motor damage from striking a chunk of bar ice. With a lack of air bubbles, it floats lower than other whitish ice chunks. It's clear sleek surface looks black, making it difficult to spot in choppy water.

Often bar ice can be found among the brash from recent calvings.

Brash by definition is accumulations of floating ice made up of fragments not more than 6.5 feet (2 meters) across. It can be either land ice (glacial) or sea ice, but bar ice only comes from glacial origins.

Photo by Tom Cohenour/The Sun

Ken Navarro holds a piece of bar ice.

By some estimates, the glacial origins of Palmer's bar ice are more than 10,000 years old. It was a chunk of that ancient ice the crew of Zodiac number 22 spotted one recent sunny evening.

Signed out under the name Geezers, the five old guys (FOG) somehow managed to wrestle a small slippery chunk of crystaline bar ice into the Zodiac without falling in or straining a muscle.

"Hey, it looks like a glass penguin," said one geezer.

"No way," said another. "It looks like a big glass fish. See the way its tail is curved."

Finally, the Geezers agreed to name their fresh, 10,000-year-old catch, Dimples because of the small, smooth indentations covering its glimmering surface.

Dimples received a place of honor in the middle of the Zodiac for the scenic ride home. Some weekend very soon, miniature icebergs of bar ice will be floating in glasses hoisted high in salutes of celebration.

SOUTH POLE

Drilling and blasting and recalibrating

By Anne C. Lewis
South Pole correspondent

Although the temperatures don't seem to be warming up much at all, polar science is heating up here at the South Pole. The AMANDA (Antarctic Muon and Neutrino Detector Array) project is currently upgrading portions of the detector after a very successful winter during which thousands of hours of data was logged. Improved analysis techniques now allow AMANDA to detect an average of three neutrinos per day. Hundreds of atmospheric (terrestrial) neutrinos have been logged and searches for point and diffuse sources of neutrinos continue this season.

The DASI (Degree Angular Scale Interferometer) is a 13-element interferometer designed to measure temperature and polarization anisotropy of the cosmic microwave background (CMB) radiation over a large range with high sensitivity.

Since summer began, DASI has been quite busy. All receivers have been tested and all cryogenic cold heads were rebuilt, retested, calibrated and refitted. DASI is now healthy and ready for another year of CMB polarization measurements.

Quiet sector science continues drilling three 3,300 feet (1,000 m.) boreholes, despite cold temperatures that hamper support operations. Field camp support from McMurdo is proving extremely valuable to both the success of the operations and the progress in the field. Our summer supply of liquid helium and the Dewar also arrived.

Construction of the VLF beacon antenna began this past week. The location and orientation of this experiment are critical for contact with Palmer Station, where the

See Pole on page 6

the week in weather

McMurdo Station
High: 26F/-3.3C Low:7F/-14C
Wind: 26 mph/42 kph
Windchill: -35F/-38C

Palmer Station
High: 37F/2.8C Low: 23F/-5C
Wind: 39mph/63kph
Melted precipitation: 1.8 mm
Snowfall: Trace

South Pole Station
High: -32F/-36C Low:-44F/42C
Wind: 20 mph/32 kph

Pole

From page 5

receiving data acquisition system is located. We await the arrival of the first Twin Otters next week to support the Antarctic meteorite research. This work will cover the Lapaz and Pecora regions of the East Antarctic Ice Sheet.

Recently, an almost sonic boom was heard and felt around the station. Blasters came in from McMurdo and dropped 14 sticks of dynamite, 4 pounds (1.8 kg.) each, 250 feet (75 meters) down into the rodwell. The purpose was to break apart a 15-foot (4.5 meters) thick frozen ice cap. This will allow the station to complete a new sewer line project.

On the home front, Thanksgiving is looking to be quite a feast. There will be three separate seatings for the 200 folks on station. Cookie Jon has the inside of the dome smelling divine with his oakwood-smoked turkeys. Community pie baking and potato peeling nights foster our family spirit. A disco party Friday night will kick off the 90 South Thanksgiving festivities. Wishing all of our friends and families a warm Thanksgiving holiday.

Photo by Dave Stecco/Special to The Antarctic Sun

Cameron Lewis sends holiday greetings from Amundsen-Scott South Pole Station, where the traditional meal was served Saturday.

www.polar.org
Antarctic Photo Library

Aunt Sue wants to know what it's like on the Ice...

Send her to the photo library.

Find hundreds of print-ready photos at www.polar.org

Feeling stoopid?

You overdid Thanksgiving dinner and magically turned that couch cushion into a magnet for your backside. Whadda gonna do about it?

Redeem yourself by getting your brain in gear!

Enter The Antarctic Sun's Photo and Writing Festival before it's too late

Deadline is 7 a.m. Dec. 16

Four photo categories:
(one entry per category per person)
• Scenic • People
• Wildlife • Other
Photos may be digital or traditional, preferably submitted at 300 DPI

Four writing categories:
(one entry per category per person)
• Poetry: Up to 30 lines
• Haiku: Traditional 5-7-5 syllable poem
• Micro-fiction: Short stories up to 300 words
• Non-fiction: Essays, letters home, e-mails, etc., up to 300 words

Rules: One entry per category per person. The contest is for photography and art with an Antarctic theme, which will be broadly interpreted. You do not have to be on the ice to enter. Send entries to AntarcticSunMcMurdo@mcmurdo.gov or the Sun office at McMurdo Station, Building 155. Winners will be printed in the Sun, put on the Sun's Web site at www.polar.org/antsun and posted on Highway 1.

P.S. A couple trips to the Stairmaster won't hurt either

Crossword on p. 2

Continental Drift

What's the best bargain in the station store?

"The candy corns and candy necklaces. A whopping 10 cents each."
Jay Fox
McMurdo Store manager from Washington, D.C.

"That's easy, amigo. The Pisco Tradicional! Makes me want to put on a black turtleneck, grow thick sideburns, and write bad poems. Its like bottled culture! All for six bucks. Salud!"
Chris "Batcave" Coon
Palmer waste management specialist from Bend "Jake's Truckstop," Oregon

"The old Speight's Dark. It's cheap."
Shaune Claussen,
South Pole information technology specialist from San Francisco

Ice Fishing

Going from the ice hole to the lab to the dinner table, the fish Art DeVries studies give many non-scientists a taste of Antarctica.

"It's what keeps me going throughout the week," said Penny Chilton, a McMurdo janitor who's been fishing with DeVries' group every Saturday since arriving seven weeks ago. "It's always just an adventure. You're always learning new skills."

In 40 years of Antarctic research, DeVries' group has taken more janitors, firefighters, dining attendants and other general workers fishing on their days off than he can remember.

"We're happy to get them out and show them what we do," DeVries said. "Part of what we do is pretty mundane, like collecting the blood from fish, but it's nevertheless important."

See Fishing on page 8

Photos by Melanie Conner
Story by Kristan Hutchison

Kevin Hoefling (top) drives a Pisten Bully over the sea ice to fish hut 6 on a sunny Saturday evening, bringing Edgar Vega (front above) and Craige Mazur to help check the lines.

Edgar Vega (front), Kevin Hoefling and Craige Mazur (with camera) watch the azure ice hole as the line comes up with empty hooks and half-eaten bait.

Fishing From page 7

Fishing for giants

General Assistant Craige Mazur went fishing with Kevin Hoefling, a science diver and head of DeVries' fishing crew, at 11 a.m. one Saturday morning to set the line for *Dissostichus mawsoni*, sometimes called Antarctic cod. In an orange fish hut, Mazur forced hooks the size of bracelets through the frozen jaws of yellow-eyed mullet. The hand-sized baitfish were flown in from New Zealand. It was work that numbed the hands and left a lingering odor.

"The worst part is it doesn't stop smelling for a while," Mazur said. "I washed my hands like nine times."

Soon after the line was dropped in the water and the weight landed on the bottom, 1,650 feet (500 meters) below, Mazur could feel something tugging on it.

"There was definitely seismic activity going on," he said.

Generally the mawsoni lines are left in the water for 11 hours. This time Mazur came back with Hoefling and welder Edgar Vega after dinner to see what they'd caught. The fish hut shook like a dryer full of rocks as the generator and winch slowly pulled the stainless steel line up. A five-foot (1.5 meter) section of line was wrapped in the rust brown tentacle of a jellyfish, like the remnants of a well-sucked gummy worm. The tentacles can be up to 20 feet (6 meters) long, said Hoefling.

The first 10 hooks came up empty, or dangling chunks of bait. Then Vega yelled "fish on" over the roar of the generator and Hoefling cut the engine. The silence was sudden, almost shocking, after all that noise.

Two bulbous gray eyes looked up from water so blue it looked chlorinated. Fat lips slowly opened and shut around a mouth large enough to engulf a child's head.

Hoefling reached in and pulled out the mawsoni, laying it on a wooden tray to remove the hook. It measured 40 in. (101 cm), 28 pounds (13 kg), a "little guy," Hoefling said.

The average mawsoni weighs 61 pounds (28 kg) and has a mean length of 52 in. (129 cm). The big guys range up to 200 pounds (90 kg) and nearly 80 in. (200 cm) long.

A single Weddell seal may catch and eat 150 pounds (68 kg) of mawsoni a night. DeVries' team doesn't fish every night, but when they do they generally catch several fish. In 40 years of fishing DeVries has caught about 6,000 mawsoni, enough to feed said seal for several years.

The "little guy" went into a water-filled box to be carted back to the lab, where DeVries studies the presence of antifreeze in the fish's blood and internal organs. DeVries doesn't need the meat in his research, so he usually gives that to the station kitchen, or people holding dinner parties. The light, moist white meat has a pleasant taste, most closely related to the over-fished Chilean sea bass, but it is enjoyed as much for being the only truly Antarctic food people can eat as for its flavor.

See Fishing on page 10

Patience pays off with hefty fish, which Edgar Vega (left) and Kevin Hoefling pull up to be weighed, tagged and taken back to the lab.

Kevin Hoefling collects scales (top) and measures the fish with the help of Edgar Vega.

Something fishy in the lab

Art DeVries has about eight different projects going on in his lab at any one time.

By the sink, an inside-out mawsoni stomach hangs over a petri dish, dripping liquid. In the freezer, ice-encased eggs from Terra Nova Bay hatch in an orange cooler. Down in the aquarium, dragonfish guard rocks coated with their eggs in one tub, while a mawsoni swims slow circles in another.

After more than 40 seasons in Antarctica, DeVries keeps finding something new to study under the sea ice. His first season was 1961, when he came to McMurdo as an undergraduate student working on his professor's project. He stayed almost a year.

"I kind of liked it down here," DeVries said. Having grown up on a 280-acre (112 hectares) farm in Montana, he was used to working outside in snowy, cold winters.

"Making cold engines start was what we did in Montana," said DeVries, who's had plenty of opportunities to use that exact skill around McMurdo.

He liked the Antarctic enough to return in 1963 with his own National Science Foundation-funded research.

DeVries is best known for discovering that many Antarctic fish produce a natural antifreeze to survive the subfreezing water temperatures. He's continuing to study those antifreezes, including trying to figure out whether the antifreeze he's found in mawsoni stomachs is from the mawsoni, or left over from the fish they digest. Thus the dripping stomach lining. The mawsoni it was taken from was starved, so any antifreeze in the liquid can only have come from the mawsoni itself, DeVries said.

Frozen food companies are interested in the edible

See Lab on page 13

Craige Mazur (right) and Edgar Vega fill a wooden box with water for the mawsoni, which Kevin Hoefling latches in (top left). It takes a joint effort to lift the heavy box into the back of a Pisten Bully for the ride back to the aquarium, with (clockwise from front right) Art DeVries, Vega, Hoefling and Mazur.

Fishing

From page 8

With a live mawsoni in the box, the hut acquired a fish market smell of ice, sea and fish.

The next fish on the line was more than twice the weight of the first.

Though Vega comes from Alaska, a state famous for its large fish, he was still impressed.

"It's wonderful," he said. "I've never caught a fish that big."

DeVries donned an elbow-length rubber glove and expertly removed the hook from the mawsoni's esophagus. He put a tag on it and pulled a few scales off with tweezers. Then Hoefling grabbed the large fish by the eye sockets and dropped it tail first into the blue water. The fish turned slowly around and swam away.

Most of the fish DeVries has caught over the years he's tagged and released. He's recaught 13, plus another caught by a New Zealand fishing boat last year. From those recaptures comes some of the only information about the growth, age and habits of the fish.

Dissostichus mawsoni are the largest finfish in the Southern Ocean, but they attain their size very slowly, at a rate of almost an inch (2 cm) and 2 pounds (1 kg) a year. A 132-pound (60 kg) fish is roughly 30 years old. Little is known still about their breeding habits, though DeVries believes they aren't able to reproduce until they are at least 8 years old.

DeVries shares his information with government officials making decisions about an experimental commercial mawsoni fishery.

"What I can do is provide them with life history information and age and such like that," DeVries said. "That's useful to everybody, because I think they need a good picture on how to manage the fishery."

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Edgar Vega washes his hands of the whole fishy business, while Kevin Hoefling (front) and Art DeVries pull the step out of the ice hole.

"I remember Art throwing down his line and a fish instantly bit. I thought 'This man is a god. He doesn't even need a line. He can just put his hand down.'"

—Penny Chilton, janitor and fisherman's helper

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When it comes to mawsoni, nobody else can provide the years of data DeVries has collected.

Learning to fish

Earlier scientists took mawsoni from the mouths of seals and the stomachs of whales, but DeVries was the first to actually catch one on a line in 1963.

"We set some clamps on winch wire with bailing wire attached as leaders and put it right under the ice," DeVries said. "We always thought we should catch them where there weren't any seals, so that's what we tried."

DeVries prior fishing experience was mostly limited to trout fishing in Montana rivers. He'd never had to fish through ice before, particularly 10 feet (3 meters) of ice. After a few attempts they hauled up a mawsoni.

It took DeVries a few more years to perfect the current system for fishing mawsoni. He no longer uses bailing wire but a stainless steel line able to hold up to 1,000 pounds (450 kg.). His earlier system used brass door hardware to clamp the hooks to the line, but then the line would tangle as the fish swum round and round. Now he has a system of metal stops on the line and a block system that allows a hooked fish to swim in circles without getting tangled.

"Art has done a couple significant things," said Gretchen Hofmann, another physiologist who has been learning how to fish for mawsoni from DeVries. "First, he figured out the fish were here to begin with, then he built a really nice winch assembly."

DeVries team continues to innovate better and easier ways of fishing for mawsoni and other fish.

Borks and other small fry

Mawsoni are only one of about six species DeVries regularly fishes and studies. Though much smaller than mawsoni, the *Pagothenia borchgrevinki* or "borks" are DeVries favorite to catch.

For borks DeVries buys plastic kids' fishing poles at Wal-Mart, the kind with Mickey Mouse or other cartoon figures on the reel. He can also skip the pole and just drop in a few feet of line.

"They're only just below the ice," DeVries said. "You only have to reel them a half dozen turns."

Chilton was stunned the first time she went fishing for borks with DeVries. Her fishing experiences as a child involved hours holding a pole while the fish stolidly ignored her bait.

"I remember Art throwing down his line and a fish instantly bit," Chilton said. "I thought 'This man is a god. He doesn't even need a line. He can just put his hand down.'"

Then she dropped in her line, and quickly realized that borks

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Mackenzie Zippay (above) steadies the trap while her colleagues pull fish and other critters out. As Art DeVries looks on, (top right) Zippay is handed a small sea spider. The sea creatures are placed into a temporary aquarium for the journey back to the lab.

Fishing

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are just really easy to catch. DeVries returned to human status, though still one Chilton admires.

"He's been coming down here for 40 years. You've got to respect that," Chilton said.

Marine grab bag

DeVries has become a mentor for Hofmann, who started fishing in McMurdo Sound last year on her own grant. The smaller eelpouts she's working with now are easiest caught in traps, similar to crab pots.

"Pulling these traps up is kind of fun, because you just never know what you're going to get," Hofmann said as she winched one up from the bottom last weekend.

The traps captured grab bags of marine life – feathery crinoids, brittle stars, sea spiders and an octopus. Scooped into an orange cooler, the kind usually seen dispensing lemonade at picnics, they created an ad-hoc aquarium.

The octopus was a filmy white, furling and unfurling its arms. When Hofmann stuck in a finger the suckers grabbed it quickly and the octopus slowly turned orange as they engaged in a gentle tug-of-war.

Hofmann didn't need all the creatures caught in the trap, but brought them all back to the lab anyway. If she dropped them back into the ice hole they would die, because they're not used to being someplace with ice crystals, she said. Down deep, where they're from, the pressure from above keeps ice crystals from forming even though the water is sub-freezing. The water in the cooler was actually warmed up to 34F (1C) to keep these Antarctic sea creatures from freezing.

"Frankly, even if we did throw a fish in here, I'm not sure they'd be able to know how to swim down," Hofmann said.

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Back in the aquarium, Craige Mazur admires a large mawsoni. Below, Gretchen Hofmann holds the fish named after Art DeVries.

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The menagerie of sea life will be on display for a while at the Crary aquarium, until the divers swim the octopus and other creatures back down into the deeper water to release them.

Hofmann pulls another fish from the cooler and cradles it in her hand, its tail flopping over the edge. It's the pink of a newborn piglet, so translucent the insides can be seen. A layer of jelly between the skin and muscles gives the round head and smooth body an almost unfinished quality, as if it wasn't done gestating.

But what Hofmann notices is the fish's speckled chin, like a grisly beard.

"It even looks like him," Hofmann jokes, holding the *Paraliparis devriesi* up next to its gray-bearded namesake.

Like the fish, DeVries said nothing.

Lab

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antifreeze, which could be used to keep ice cream and other frozen items from recrystallizing. A friend of DeVries' in New Zealand is now researching the possibility, with funding from some dairy companies.

"I'm more interested in explaining how the fish do it," said DeVries.

He's currently most fascinated by some fish eggs sent to him from Terra Nova Bay. Another scientist working there found the eggs in the ice and sent them to DeVries in a gallon jar via Twin Otter plane. The eggs are unusual because they float and were found right under the solid ice, some of them frozen into it.

"That's pretty exciting – something new and unplanned," DeVries said. "That's what's fun about science is you see something like this and you can jump on it."

Floating keeps the eggs safe from starfish, worms and most other predators that feed along the bottom, DeVries said. But it also exposes the eggs to freezing. Frozen into the ice, the clear eggs appear like ice bubbles with two dark specks for eyes.

"They can get frozen in the ice and it doesn't seem to bother them," DeVries said. "We can't find enough antifreeze in their bodies to keep them from freezing at –1.9C, yet they're fine. It might be that the egg shell is a physical barrier."

Even after hatching out, the small fry don't freeze. Though some of the eggs have hatched, it's not apparent yet what kind of fish they'll grow up to be. DeVries sent some of the eggs back to the U.S. for molecular testing to determine their species.

The investigations DeVries is doing on the Terra Nova eggs are similar to his ongoing studies of dragonfish eggs. Dragonfish lay their eggs on rocks on the sea floor. DeVries is trying to determine how much of their resistance to freezing is due to salt content versus antifreeze.

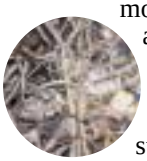
DeVries sees no end to the questions he'd like to answer about Antarctic fish, though, not having any antifreeze himself, he's beginning to feel the effect of the years and the cold.

"We put in for another three years, but I'm beginning to feel it in my joints," DeVries said. "That's the thing that keeps me going, the interest in science, but sometimes I think I'd like to sit around doing something in the tropics or coral reef."

Dark

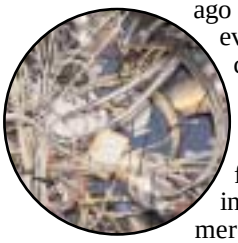
From page 1

Interferometer, has been churning out universe-shattering new discoveries since it was turned on in 2000, confirming with Boomerang that the universe is flat, accelerating and made up mostly of some kind of unknown energy. Just this year DASI recorded data scientists had been seeking for years that verifies cosmological theories about the origin and evolution of the universe.



"This beautiful framework of contemporary cosmology has many things in it we don't understand, but we believe in the framework," said Clem Pryke, a member of the DASI team. "This new result was a crucial test for the framework to pass."

The framework has developed over the last 70 years, long enough that most people are familiar with the thought that the universe began about 14 billion years ago with the Big Bang, an event in which all the particles of the universe began rushing away from each other. Only astrophysicists really think about the first fraction of a moment in which the universe was a mere speck then suddenly expanded exponentially. In the infancy of the universe it was a dense jumble of photons, electrons and protons, but as the universe expanded and cooled, hydrogen molecules were able to form. Gravity eventually pulled the hydrogen together to form the stars, galaxies and other structures we see today. As hydrogen formed, the photons were released to travel out in all directions - a scattering of microwave emissions Carlstrom describes as "fossil radiation."



It's that leftover cosmic microwave radiation that DASI observed for clues to what had happened in the infancy of the universe.

If theorists were right the radiation should have been slightly polarized in its last collisions with matter, just as sunlight is polarized when it reflects or scatters off snow.

Like visible light waves, the radiation initially moved in random directions, up and down, back and forth. When the waves collide with something they are synchronized to oscillate in the same direction, like sunlight striking a mirror and bouncing off as glare.

DASI set out to detect this polarization in the cosmic microwave radiation last year.

Polarization is difficult to sense and DASI was the first, opening the way for future studies. The year before DASI had precisely measured the temperature fluctuations in the cosmic microwave radiation by collecting data from 32 spots in the sky over 92 days. The signal of polarization was 10 times weaker and DASI had to focus on two spots in the sky for 270 days to detect it.

Photo by Joan Myers/Special to The Antarctic Sun

The inside of DASI, the telescope that has been untangling the structure of the universe.

Around day 200, the DASI team realized the polarization was there.

"It's right as you would expect for the theory," Carlstrom said. "It lends confidence that we're on the right track and we really should believe in the dark matter and dark energy."

The amount of dark energy in the universe was an earlier DASI discovery. Looking at the temperature fluctuations measured two years ago, they found about 5 percent of the universe is ordinary matter. Galaxies, stars, planets, oceans, buildings, cars, last night's dinner and any other noun you can think of still make up only a measly 5 percent of all that is.

> "The big surprise is, since the universe is flat, there has to be more stuff out there, but we can't find the stuff."
> —John Carlstrom, astrophysicist

In addition to ordinary matter, there is dark matter, which can't be seen. Scientists know it's there because they see the way it pulls on other things, exerting a gravitational force. Dark matter accounts for about 30 percent of the universe.

To make sense of the universe being flat, there had to be something more there. By flat, astrophysicists mean that parallel beams of light in space will remain parallel forever, rather than curving away or toward each other. To do that, there had to be a precise balance of substance in the universe. Any more or less and the universe would be curved, the light beams would bend one way or the other.

"The big surprise is, since the universe is flat, there has to be more stuff out there," Carlstrom said. "But we can't find the stuff."

Whatever that stuff is, it doesn't have a gravitational pull like matter and dark matter do. If anything, it seems to push things apart. Since it doesn't act like matter, physicists presume it's an unknown form of energy. And since they can't see it, they call it dark. Dark energy - the stuff that theoretically makes up 65 percent of the universe.

Currently, there is no good physical explanation for what this dark energy actually might be. Starting with Einstein, physicists have theorized about how dark energy interacts with the universe, but they don't really know. That's what they hope to discover with the new telescope. If current indications that dark energy exists are correct, the new telescope will be able to give detailed information on its properties.

The presence of dark energy could explain why the universe seems to be

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Photo by Joan Myers/Special to The Antarctic Sun

The outside of the DASI telescope and the MAPO building where data is collected and stored.

Dark

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not only expanding, but accelerating.

Think of a firework exploding in the air, one of those large, colorful ones set off by the city on July 4. Initially the sparkling pieces speed away, pushed by the force of the explosion, but gradually they slow down as the initial force is expended and eventually they are drifting, very gently, to the ground.

Now imagine the same firework in outer space, in a vacuum. The sparks would keep going, but in their original directions at almost constant speed. If you watched long enough, and very closely, you would see the sparks being slowed very slightly by the gravitational attraction pulling their masses together.

Originally the universe was expected to do the same, slowing as it expanded. Except it's not; it's gaining speed, as if the firework sparks were streaking out at increasing rates, without any visible means of propulsion. It's possible that as the universe expands the matter within it is diluted, but the dark energy is not and continues to propel the universe apart at ever-increasing rates.

That's called the cosmological constant, but up to now it's been only a number on a page.

"The South Pole telescope actually gives us a probe of that, not only whether there is a cosmological constant but how strong is it as a function of time," said John Ruhl, a Case Western Reserve University cosmologist involved in the new telescope project.

Astronomers agree that understanding dark energy is one of the key scientific questions to be resolved in the next decade. A South Pole telescope made their list of the top 10 research priorities in a 2000 survey.

The new telescope will still look at the same cosmic radiation DASI did, but at a shorter wavelength. The technology and wavelength are similar to those used by other telescopes at the South Pole, but the new telescope will be much stronger. The largest similar telescopes now at the South Pole are ASTRO and VIPER, both 7 foot (2 meters) in diameter.

"Essentially we're going to build a telescope that's four times the diameter of those, which is 16 times the collecting area," Carlstrom said.

It will have an array of 1,000 bolometers, or heat detectors, making it the largest and most powerful telescope of its kind.

"The plan is to use this telescope to scan the sky and detect all the massive clusters of galaxies," Carlstrom said.

The South Pole is uniquely suited for such telescopes because they need to be able to see clearly through the atmosphere, without the view being distorted by water vapor or atmospheric instability. They also need to be at a high elevation and work in the darkness. The South Pole offers six months of uninterrupted dark and cold, and a dry, stable atmosphere at an elevation of 9,300 feet (2,790 meters).

The first task for the 8-meter telescope will be to detect every massive galaxy cluster in a 4,000-square-degree area, a 10th of the sky. Using cosmic radiation like a backlight, the telescope will detect clusters of galaxies.

"What we can do with this new telescope is actually look at these blank areas of sky, where we expect to discover thousands of galaxy clusters no one has seen before," Ruhl said.

Because of the time it takes light to reach Earth, the telescope is actually looking back in time at these galaxy clusters when they were young. By charting clusters at different distances and ages, the scientists expect to see how dark energy has been affecting their formation and growth. It's a bit like looking at a photo of your extended family and getting a sense of the aging process, or understanding the laws of motion by studying snapshots of a rolling ball. For the first time scientists will have a way to study the dark energy itself.

"It's the next big leap," Ruhl said. "No matter what happens, we're going to learn an enormous amount with this new telescope."

Profile

From the moon & stars to rocks from mars

By Kristan Hutchison/*Sun staff*

When Cady Coleman picks up a meteorite in Antarctica, she knows what it's been through.

She too has approached the Earth from orbit and hurtled through the atmosphere, though the space shuttle has better landing gear than space rocks. Coleman has been on two space shuttle missions, in 1995 and 1999, for a total of 21 days in space.

She is in Antarctica this season to help the Antarctic Search for Meteorites (ANSMET), a joint effort of the National Science Foundation and National Aeronautics and Space Administration. The experience will also help her prepare for a possible stint on the International Space Station.

"There's actually no closer place to space to practice a long-duration expedition," Coleman said. "Which would mean either a space station or Mars."

Growing up in Fairfax, Va., she'd never considered the possibility of becoming an astronaut.

"It wasn't something girls did," Coleman said.

Then astronaut Sally Ride gave a talk at the Massachusetts Institute of Technology, where Coleman was an undergraduate chemistry student on an Air Force scholarship.

"I thought 'I want that job,'" Coleman said "But you never think you'll get it."

She finished her PhD in polymer chemistry and began applying to the space program. The year she was accepted, 2,400 people applied and 24 were chosen. Coleman said they looked at personality, track record, ability to work on a team and medical history. She went through six days of physical tests and a one-hour interview.

In 1992 she reported for duty with the space program in Houston, Texas, and in 1995 she flew her first mission. A short video the crew made of the flight shows Coleman manipulating experiments, strapping in to sleep and washing her hair, the long, brunette locks floating above her like a cartoon of someone who's been electrocuted.

All the space mission instructions were written with the "50 percent stupid factor" in mind, as Coleman calls the fact that thinking abilities seem to drop when astronauts first arrive in space. It may just be the distraction of being in a weightless environment.

"Part of your brain is trying to process this different environment all the time," Coleman said. "You're trying to read and over to the side a pencil is floating up in the air and your brain is saying WHOA."

From the shuttle window she could see the continents and oceans move by below, but the most interesting view was the horizon line, where the curve of the Earth and its atmosphere showed against the black background of space.

"There are 30 different colors of blue between Earth and the black of space," Coleman said. "It's one of those things you never see in a picture."

The space shuttle orbits too far north to see Antarctica from space.

She got a few hints about what Antarctica would be like from another astronaut who had been meteorite hunting in Antarctica before. Coleman said he told her, "In a harsh environment like that, mostly you need to bring your attitude and your willingness to do hard work."

She's got the attitude, said Bob Marstall, a National Science Foundation artist grantee who has known Coleman for many years through her husband, glass artist Josh Simpson.

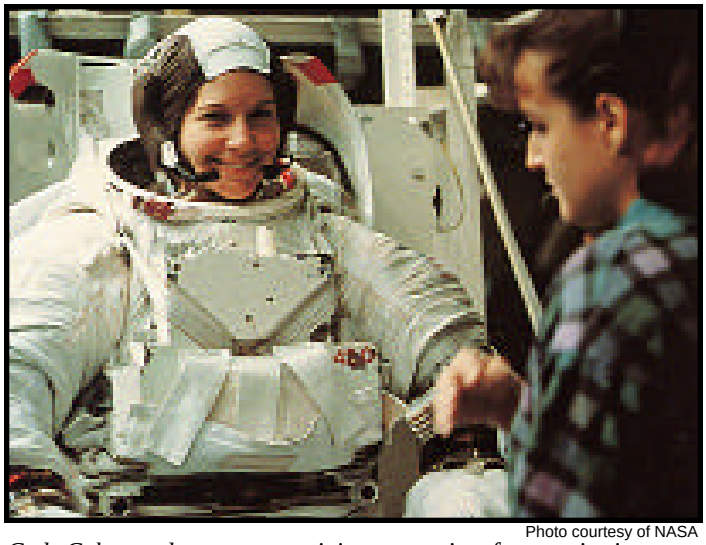

Photo courtesy of NASA

Cady Coleman dons a space suit in preparation for practice in space walking in NASA's 40-foot-deep pool.

"She's just like everybody else in most respects. She's very warm and friendly, vivacious," Marstall said. "When you layer in what she does for a living, it's just like 'Oh, wow!'"

Challenging as Antarctica and the space program are, Coleman said being a mom is the greatest challenge and reward in her life. Because her husband is in Massachusetts, where he has a glass-blowing studio set up on their 200-year-old farm, and she's in Houston, Coleman ends up taking care of their two-year-old son, Jamey, alone.

"I've always vastly underestimated the difficulty of being a single mom," Coleman said. "It's just hard to be alone with a toddler who needs constant attention."

Jamey can point out his mom's seat in the shuttle and thinks anything in a helmet is mom "whether it's an astronaut or a hazardous waste worker," Coleman said.

While she's working at mission control Jamey listens to her broadcast over the TV.

"He hears me and runs over and hugs the TV," Coleman said, flipping through a small album of photos of her son and husband.

While Coleman is in Antarctica, Simpson is taking his turn as single parent. She plans to bring him a t-shirt that reads, "My wife went to Antarctica and all I got was the two-year-old."

"In some ways it's harder here than it will be on the space station," said Coleman, who will celebrate her 42nd birthday in the field.

She has volunteered for a thre- to seven-month mission on the space station. If chosen, she'll be able to phone home every day and e-mail as often as she wants. She'll have fewer options in the field in Antarctica for six weeks. She plans to call home a few times a week on the Iridium phone.

In a way, Antarctica also may be more of an exploration than her shuttle missions. Though very few people have been in orbit, the meteorite team plans to explore parts of Antarctica for the first time.

"We're going to go places people haven't been, maybe ever. That could lead to significant results," Coleman said.