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The Antarctic Sun

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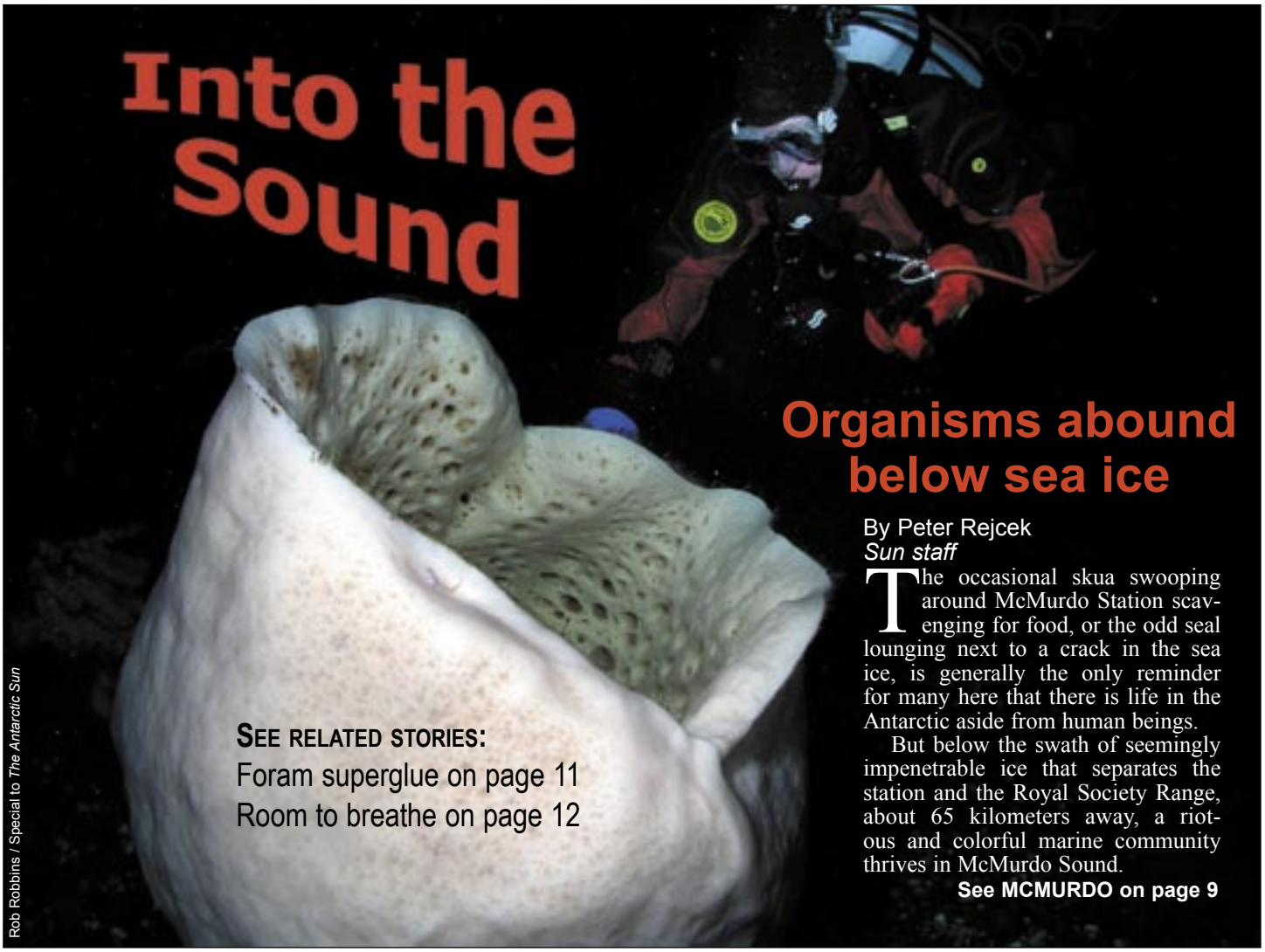

Rob Robbins / Special to *The Antarctic Sun*

Into the Sound

Organisms abound below sea ice

By Peter Rejcek
Sun staff

The occasional skua swooping around McMurdo Station scavenging for food, or the odd seal lounging next to a crack in the sea ice, is generally the only reminder for many here that there is life in the Antarctic aside from human beings.

But below the swath of seemingly impenetrable ice that separates the station and the Royal Society Range, about 65 kilometers away, a riotous and colorful marine community thrives in McMurdo Sound.

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Foram superglue on page 11
Room to breathe on page 12

Crary Lab celebrates 15 years on Ice

By Steve Martaindale
Sun staff

A plaque outside the Albert P. Crary Science and Engineering Center at McMurdo Station notes that the building was dedicated on Nov. 4, 1991. That was the original plan, but the ever-unpredictable Antarctic weather had other ideas and ceremonies were pushed back to Nov. 5.

The event was obviously flexible, even though the cast metal plaque was not. Now 15 years old, the Crary Lab, as it is more popularly known, has proven to have the elastic qualities intended from its inception.

"The design of the Crary Lab was very flexible to accommodate the various disciplines of science that would use it," said Steve Kottmeier, "not only in a tactical sense but also strategically so that it could accommodate new science that wasn't even on the horizon when the 100-percent design was approved."

Kottmeier, now director of science support for Raytheon Polar Services Co., was among a group of scientists consulted concerning requirements for a new lab. That was in 1984. By the time plans were approved and the first part of the building was ready for use, new research was already forcing the first

See LAB on page 7

Quote of the Week

"I'm so tired of looking at everyone through trees."

— Woman commenting on the number of fake plants in office spaces.

Inside

The core of the project

Peter Rejcek / *The Antarctic Sun*

Cliff Atkins, Cristina Millan and Terry Wilson (left to right) examine a fresh sediment core at the ANDRILL drilling site. ANDRILL is searching through geological history to understand the past and future impacts of global temperature change on Antarctica's ice mass. Next week's Sun *will contain full coverage of the massive undertaking.*

Cold, hard facts

All about us

Race and gender
White: **94.67 percent**
Black: **0.70 percent**
Hispanic: **2.90 percent**
Asian/Pacific Islander: **1.51 percent**
Native American: **0.23 percent**
Gender: **32.33 percent females**

Age
Youngest: 18
Oldest: 68
Mean (average age): 37
Mode (most common age): 28

Most popular names
Males: **David**
Females: **Susan**

- Top three most-represented states: **Colorado, Washington, California**
- 48 states represented (no one claims Delaware or Rhode Island)

These statistics are for the 863 RPSC contract workers on all stations and ships.

Source: Cori Manka, McMurdo human resources specialist

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Level 1 Comix **Matt Davidson**

Sea ice strong-arms USAP into backup plan

Fleet operations grooms new route to Marble Point for fuel, supply deliveries

By Steven Profaizer
Sun staff

The iron grip of the sea ice has prevented the annual fuel tanker from reaching Marble Point Refueling Station since January 2004.

No one yet knows if the sea ice will clear out this summer. But Marble Point is a crucial fuel stop for access to the McMurdo Dry Valleys, and fleet operations isn't taking any chances on it running dry. The department groomed a new snow route this season to facilitate the transport of regular supplies and about 350,000 liters of fuel to Marble Point's thirsty tanks.

Fleet operations will divide the fuel into four different trips down the nine-hour route to Marble Point. It will also make two regularly scheduled supply trips along the new path.

The gnarled, old sea ice between McMurdo and Marble Point is covered with ice defects like cracks and hollow pockets in ever-increasing numbers. Last season, these features forced fleet operations into canceling the second of its typical crossings to Marble Point and helped necessitate a bulldozed snow route.

"It would have been impossible to get a traverse over to [Marble Point] this year," said Gerald Crist, fleet operations supervisor. "The sea ice is looking progressively worse."

The surface between McMurdo Station and Marble Point is annual sea ice, which is ice on top of the ocean that should be broken up and pushed out to sea each summer by the pressure of tides and the force of Antarctic storms.

This has not happened completely since 2001 when a massive iceberg, B-15A, stopped near McMurdo Sound and protected the ice from the natural stressors that normally wipe the sea ice slate clean each year.

"In past years, when the sea ice would go out annually, the surface, as a whole, had the characteristics of a large pool table," said Marty Reed, Marble Point traverse leader.

The Marble Point route was made by Reed and John "JP" McMullan. The two-man team worked 15- and 16-hour days for a week to complete the 80-kilometer path.

They had to use their best judgment to decide the exact location of the route, but they did have some help.

At the end of last season and the beginning of this one, a fleet operations team was able to take helicopter flights to survey the sea ice between McMurdo and Marble Point. It determined the best possible path and plotted a general course using GPS.

"It gets a little tricky at times operating a dozer while following a [GPS] heading and bouncing around on the ice," Reed said.

The helicopter scouting mission proved a success, and the team was able to eliminate many of the major problem areas by planning the road around them. However, there were some troublesome sections that proved unavoidable.

"The worst section was from Cape Bernacchi to Marble Point – the last 12 miles," Reed said. "It had everything you do not want to see on a sea ice traverse: pressure ridges, melt holes, rough ice from dirt blown down from the Taylor Valley. It had it all."

He said it took about six passes from each of the bulldozers to get this section smooth enough that it wouldn't put the fuel sleds at risk.

All USAP activities are subject to the environmental assessment process, under the Protocol on Environmental Protection to the Antarctic Treaty. Short supply traverses, such as the traverse to Marble Point, have been assessed as part of the overall USAP program.

Photos by Gregory Murphy / Special to *The Antarctic Sun*

Above, heavy equipment operator Richard Vaitonis walks among ski-equipped tanks that are used to transport fuel to Marble Point Refueling Station. Sea ice has kept the station from being refueled for the last three years.

Left, the side mirror on a tractor shows the fuel tanks in tow along the snow route to Marble Point. Fleet operations had to create and maintain an overland route to the refueling station this season.

Perspectives

Leading the program in a new era

By Christina Hammock
Special to the Sun

First there had been the question of what to use as my radio call sign. "Cryo Chick" had to be replaced with "Cryo Chris." Next came inheriting the cryo shack, formerly an admitted bastion of male pride with its over-sized pipe wrenches, pressure gauges and intimidating giant tanks. As a prank, I decorated it completely in pink. Then there were those power meetings with the astrophysics principal investigators when all the pressure was on the only gal in the room.

These were some of the many unique moments I experienced as the first woman cryogenic technician at South Pole during the 2004-05 summer and winter seasons.

Luckily, the interesting challenges of my job far outweighed the few bumps along the road. Pink décor wasn't my only contribution to the cryo shack. During my tenure, a number of advances were made to the cryo operation – automation, computerized monitoring and advanced supply prediction. I figured out the best ways to load full tanks on sleds and to sling compressed gas cylinders that often weighed more than I did. I also perfected that elusive skill, and coveted résumé-builder, of backing up snowmobiles hitched to trailers. I was often determined to show that I was strong enough for the job; I'm sure other women in the U.S. Antarctic Program can relate.

The rewards of my role in supporting science at Pole also offset the trials. Cryogenics are used to cool detectors on telescopes. These detectors measure signals so faint that even small amounts of heat-induced noise would drown out the signal. Some detectors also have superconducting metals that have to be cooled to exhibit certain properties. Liquid helium can get them to within a few degrees of absolute zero, or negative 236 degrees Celsius. The science of making nearly 40,000 liters of this extremely volatile liquid last the winter keeps the cryo tech busy and the astrophysics science programs running.

I am on another part of the continent this season at Palmer Station, where being the first female research associate has been a much easier transition. The only real change required to the male-dominated habitat of this job has been the modification of a few procedures for someone who is a bit vertically challenged. Unlike the astrophysics-rich environment at Pole, most of Palmer's biologists are women, and it's a refreshing change to find them discussing technical issues around the dinner table. It makes the only female physics geek feel a little more at home. Amazingly, I even learned that the first woman winter waste manager at Palmer had her own pink décor prank.

While there is less heavy schlepping in this job, I have to prove my technical skills. That means a lot to learn and no time to wonder what scientists back home think when they see the first female name at the bottom of the research associate e-mails. My lab has many experiments, including a VLF (very low frequency) antenna that measures the whistling remnants of global lightning strikes after their journey through the magnetosphere. There is also a UV (ultraviolet) monitor for measuring the record ozone hole and the radio-nucleotide detector that sniffs out worldwide nuclear tests. I also manage the satellite image system and generate real-time sea ice images to aid the *R/V Laurence M. Gould* in navigation.

We may all love Antarctica as a land that still has "firsts," but it's great to see women bag some of the last standing ones – a testament to the continent's persistent discrediting of stereotypes. The familiar saying, "where men knit and women drive heavy equipment" is so often witnessed here, it is almost blasé.

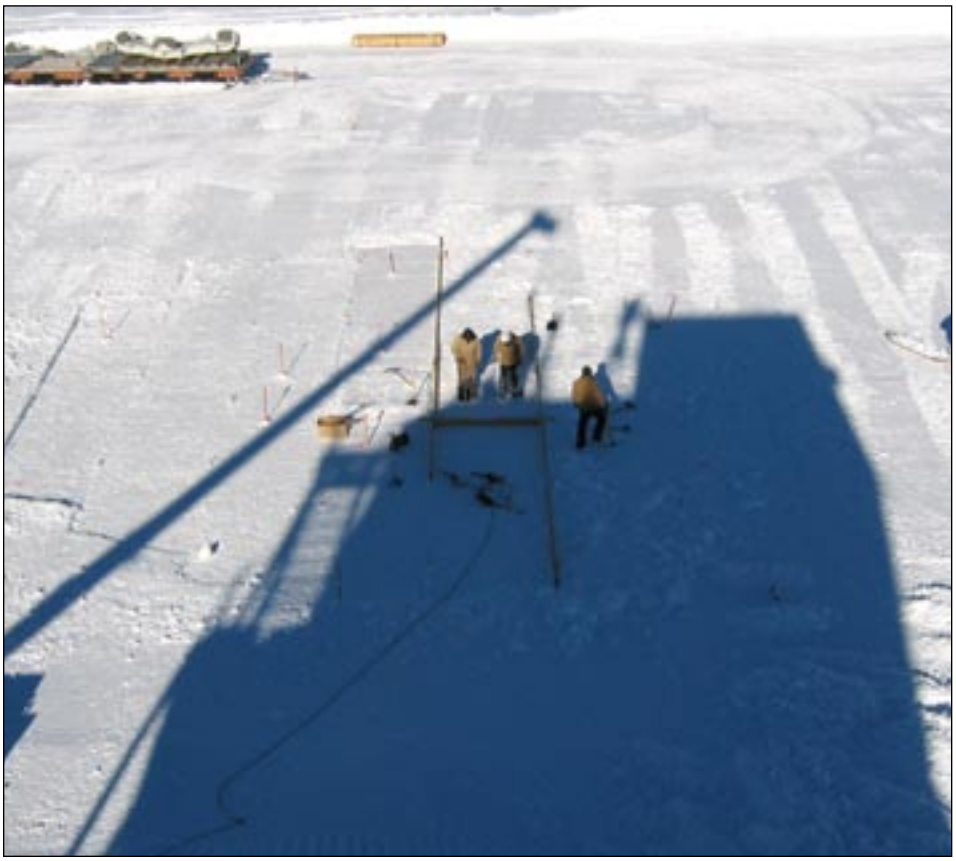
Though the USAP does have its all-male roots, it can boast a fast and impressive transition away from that era. During the winter I spent at Pole, all three of the electrical engineers and both PhDs on station were women – statistics I've never seen matched.

To figure out why, I don't have to look any further than the women around me. In this place of such incredible turnover and emphasis on getting the job done, the smart, strong and hard-working women of this program stand out equally. With its lack of entrenched institutions, the usual barriers melt away in Antarctica and women are naturally up to its challenges. We are the heavy equipment operators, the biologists, the waste managers, the engineers, and even the cryo chicks.

Courtesy of Christina Hammock / Special to *The Antarctic Sun*

Christina Hammock fills a tank with liquid helium in the South Pole station's cryo building. She worked during the 2004-05 seasons as the first woman cryogenic technician at the South Pole.

around the continent



Carlton Walker / Special to *The Antarctic Sun*

Workers at Amundsen-Scott South Pole Station prepare the pad for the South Pole Telescope project in this photo taken Dec. 11, 2005. Construction continues on the telescope this season.

SOUTH POLE

SPT work starts with a boom

By Katie Hess
South Pole correspondent

The temperature at the South Pole hung near record lows again this week, averaging below negative 40 degrees Celsius most days. The 13th brought blustery winds up to 48 kph that gave us a wind chill of negative 59 C. And on the 14th, our low of negative 46 C broke the daily low temperature record of negative 45.4 C set in 1979.

Nevertheless, operations continue to pick up with as much vigor as ever. Twenty-seven flights were scheduled last week and put us slightly ahead of schedule for missions and cargo.

The South Pole Telescope boom was the first major piece of the instrument to arrive. It was flown in Monday and was a cause for celebration in this season's enormous effort to construct the telescope, which will observe the effects of dark matter and dark energy as early as winter 2007. A shift of carpenters, iron workers and crane operators started their graveyard shift on Sunday night as part of the construction effort.

This crew, the new IceCube night shift, and the increasingly important dining facility night crew are really bringing nights to life at Pole. Now that most of the drillers and management for IceCube have begun work, we will start to see the assembly of the drill camp near the outskirts of the station during this coming week.

The time of day has ceased to matter when it comes to the activity on station. Raucous midnight kickball (even at such frigid temperatures), evening volleyball, open mic night, salsa and yoga are just some of the day-to-day Pole activities keeping us busy during our time off.

PALMER

Birders keep busy at Palmer

By Kerry Kells
Palmer correspondent

Research continues around Palmer Station.

The seabird research team (birders) recently visited Dream Island, about eight kilometers to the north of Palmer Station, where they reportedly spotted a leopard seal. Adélie penguins began laying eggs on Dream Island and the chinstrap penguins are busy building their nests. The birders have also begun weighing Adélie penguin parents and eggs. Palmer personnel keep in daily contact with the field team at Petermann Island, about 48 kilometers south of Palmer and the location of another Adélie penguin colony.

Langdon Quetin, principal investigator with the krill component of the Long Term Ecological Research team, and team member Kelly Moore, completed their second dive of the season at the *Bahia Paraiso*, a 135-meter-long Argentine naval ship that sank in 1989 and now rests next to DeLaca Island. Quetin dives at the *Bahia* every year to track the changes to the local underwater environment.

Our Wednesday night lecture included a stunning photographic slide show of a Mount Huntington expedition in

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the week in weather

McMurdo Station
High: 25 F / -4 C
Low: 2 F / -19 C
Max. sustained wind: 37 mph / 59 kph
Min. wind chill: -27 F / -33 C

Palmer Station
High temperature: 41 F / 5 C
Low temperature: 23 F / -5 C
Max. sustained wind: 45 mph / 72 kph
Melted precipitation: 13 mm

South Pole Station
High: -26 F / -32 C
Low: -51 F / -46 C
Peak wind: 30 mph / 48 kph
Max. physio-altitude: 3276 m

Continent

From page 5

the Denali mountain range in Alaska. Ryan Wallace, Palmer Station boating coordinator, joined John Evans and Paul Smotherman last May on an attempt to climb the Nettel-Quirk route on the 3,657-meter peak. Bad snow conditions moved them to the French Ridge route, where they again found bad snow conditions and had to turn back. Evans works for Raytheon Polar Services Co. as a special projects manager and had attempted Mount Huntington in 1978. Smotherman worked at Palmer last austral summer in the waste department.

The *Sedna IV* paid a visit to Palmer on Saturday. The three-masted, 51-meter, steel-hulled sailing vessel had previously visited Palmer last January. The *Sedna IV* carries a Canadian film crew as well as scientific researchers. Their mission is to study the Antarctic Peninsula through cinematography and scientific research (mainly biology, oceanography and climatology), and to bring awareness to climatic and environmental changes.

Thirteen of the 16 people on board just completed a winter season near the Argentine station, Melchior. They again stopped by Palmer for just a day and filmed some of the local islands. Fifteen members of the yacht came ashore to join us for dinner. Considered a "studio at sea," the ship is outfitted with video gear and editing capabilities. It has filmed in both the Arctic and Antarctic.

Palmer Station is preparing for the arrival of the *Laurence M. Gould* and a visit by National Science Foundation representatives, the U.S. State Department and the Environmental Protection Agency. Eight passengers onboard the *LMG* — both science and support — will disembark at Palmer Station when the vessel arrives.

Curt Smith / Special to *The Antarctic Sun*

The Sedna IV *visited Palmer Station last weekend, carrying researchers and a Canadian film crew. The yacht is considered a "studio at sea."*

SHIPS

NBP

Compiled from reports by 'Skip' Owen
Marine Projects coordinator

The *Nathaniel B. Palmer* put in its first ice coring station on Nov. 9, collecting three cores. Afterwards, high winds and near-zero visibility temporarily delayed sailing.

Continued high winds the next day prevented ice coring activities as the vessel continued south. Heavier consolidated ice floes were encountered and the ship was in "back and ram mode" (where the vessel rams the ice, backs up and rams it again) late in the day with progress reduced to less than 200 kilometers per day.

Little ice pressure made traveling faster and three coring stations were completed the next couple of days, including a trace metal clean core.

Progress slowed Nov. 13, but two stations were completed. The electronics technicians were finally able to isolate the problem with scanning equipment and complete repairs.

Upon reaching the polynya, an area of open water in the sea ice, the crew of the *Palmer* will begin several days of testing.

LMG

Compiled from reports by Eric Hutt and Herb Baker
Marine Projects coordinators

The *Laurence M. Gould* completed its Drake Passage crossing on the evening of Nov. 7 and headed up the Argentinean coast. The vessel arrived in Punta Arenas on Nov. 9.

The ship was back at sea and starting a southbound crossing of the Drake on smooth oceans Nov. 13. It was expected to arrive at Cape Shirreff the following day.

Continental Drift

What is the strangest thing about living in Antarctica?

"Living and working in the same small place, day in, day out, with the same group of people... and not getting sick of it."

Kristen Myers
Palmer
researcher
Virginia Beach, Va.
first season

"Just walking outside anytime day or night, the sun blinding you with the fact that you are at the South Pole."

Glenn Weldon
South Pole
insulator
Irondale, Ala.
second season

"Going out in the field and not smelling the animals."

Peggy Lubchenco
McMurdo
visiting educator
Santa Barbara, Calif.
first season

The rear exterior of the Crary Science and Engineering Center.

Steve Martaindale / *The Antarctic Sun*

Lab became state-of-the-art site for science

From page 1

adaptations.

"Local area networks were in their infancy when the 100-percent design was approved," Kottmeier said. "That was a project which required the pulling of the fiber-optic cable plant through the building. It was the location of the earliest fiber-optic network cabling in the U.S. Antarctic Program."

At the dedication, a demonstration of a local area network included only a handful of computers. Now, lines run into every office and laboratory in the center.

A current challenge for the Crary Lab is handling the massive ANDRILL project. Cara Sucher, lab supervisor, said there are 58 people associated with the project who are working in the lab, using the majority of Phase II. However, it is not the first big undertaking for Crary. The lab cut its teeth on ANDRILL's predecessor, the Cape Roberts Project, which drilled cores for three seasons, from 1997-1999.

Kottmeier said that was the first project that really used the laboratory to support the geosciences and the various disciplines associated with it. One adjustment necessary to support the paleomagnetic research of the project was to redesign the furniture. They had to bring in furnishings made entirely of wood because metal could affect paleomagnetic analysis of the ocean cores.

Both Cape Roberts and ANDRILL are ocean drilling projects, and they require hundreds of meters of rock core to be stored for preliminary analysis here before shipping to other labs for detailed analysis. When that need arose with the Cape Roberts Project, the answer was the construction of a core storage facility across the street from the lab. Its success led to the building of an adjacent ice core storage area.

Kottmeier said the biggest ANDRILL challenges this year were a scanning laboratory and a more sophisticated core sawing/splitting facility. The answers came as the Crary Lab flexed outside its boundaries again in the form of a converted laboratory van that houses a core saw and a Rac-Tent that holds an X-ray scanner. A Rac-Tent is a modular shelter system designed specifically for the support of scientific research in polar regions.

Any room?

At the dedication of the center, only part of it was completed – the core pod and two labs and the offices in the biology wing of Phase I. It wasn't until the 1994-95 season that all three phases were complete, at a cost of $23 million.

What the five pods replaced were the Eklund Biological Center and the Thiel Earth Science Laboratory.

Scientist Terry Deshler, of the University of Wyoming, worked in Thiel its last few years and said the upgrade to Crary was welcomed. In Thiel, he said each season began with an effort to just get dust off the working areas. And there was also a battle with the cold.

"When the wind blew, it got so cold we couldn't work in the lab at all," Deshler said. "Occasionally it was cold enough that some components of our instruments froze. Since ozone instruments are sensitive to contamination and our electronics to static, the drafty nature of the building also created other challenges, which are preferably avoided.

"Crary solved all these issues and provided an extremely comfortable and clean working environment, which leads to more hassle-free science, less time spent solving problems that shouldn't arise anyway, and more time to work on the fun stuff."

The extra space provided by the 4,320-square-meter facility, slightly more than one acre, was also a blessing, said Kottmeier.

"The comment made to me when I was still managing the old lab was, 'Oh, you're never going to have any problems with space with this brand new, big building,' and I said, 'Oh, yes, we will.' And it wasn't long before space was an issue, just like it is in businesses and on university campuses," he said.

The current lab manager said that space is indeed an issue today.

"We are at capacity, as far as space goes," said Sucher, who is in her first year managing Crary Lab. "I have no basis of comparison, so I don't know how unusual that is, but every single office space, every single laboratory space is currently allocated. Every single bit of staging space, every nook and cranny is being used for some kind of science project in some way or another, whether it's staging to go to the field or testing out some equipment that will soon be brought out into the field or for packing or unpacking."

She indicated that she sees that as a good thing, however: "I really like that the National Science Foundation tries to maximize the science that we do down here," Sucher said.

Let's get together

In addition to lab room, Crary also offers meeting space. It is regularly used for waste management and outdoor safety lectures. It also hosts the Wednesday night science seminar series. Plus, it opened the door for the first-ever, formal PhD-level educational program in Antarctica.

"The excellent, modern facilities of the Crary laboratory made it fully possible, in my opinion, to offer this sophisticated education and advanced research program in Antarctica," said Donal Manahan, who began the program in January 1994. "Over the years, individuals from over 100 different institutions and about 20 countries have participated in this unique educational and training program at McMurdo Station."

Manahan, of the University of Southern California, has held the month-long courses six times, most recently last year. The National Science Foundation provides

See BUILDING on page 8

Crary Lab namesake was giant in polar sciences

By Steve Martaindale
Sun staff

Albert Paddock Crary earned his spot in the history books as the first person to set foot on both the North and South Poles, but what put him in position to achieve that distinction were his roles in scientific research.

He was chief scientist for Arctic Island T3 (Fletcher's Ice Island) from 1952-1955. On May 3, 1952, the glaciologist and geophysicist reached the North Pole. While at T3, he discovered and explained "Crary waves," an unusual type of guided, elastic-plate wave. As the International Geophysical Year (IGY) approached, he was charged with establishing the United States Geological Headquarters and became deputy leader of U.S. science during IGY.

Crary led various traverses in Antarctica, including a geophysical traverse from McMurdo Station to the South Pole via Skelton Glacier during the austral summer of 1960-61. Leading a team of eight others and using three snowcats with trailers, he became the seventh expedition leader to reach the South Pole by surface transportation, arriving Feb. 12.

From 1960-68, Crary was chief scientist with the U.S. Antarctic Research Program, which later became the modern U.S. Antarctic Program. From 1969-78, he was deputy and then director of the Division of Environmental Sciences with the National Science Foundation.

He was born in 1911, the second oldest in a farming family of seven children in northern New York. He graduated from St. Lawrence University in 1931 and earned a master's degree in physics from Lehigh University. He died in 1987.

The Albert P. Crary Science and Engineering Center is not the only place to find his name in Antarctica. There is also the Crary Ice Rise, located in the south-central part of the Ross Ice Shelf; the Crary Knoll, a symmetrical, ice-covered knoll that tops out at 1,520 meters in elevation, situated in the Skelton Glacier area of Victoria Land; and the Crary Mountains, a group of mountains 56 kilometers long, rising to 3,655 meters at Mount Frakes, located in Marie Byrd Land.

Jim Waldron / Special to *The Antarctic Sun*

Albert Crary was the chief scientist at the Little America research station during the International Geophysical Year 1957-1958.

Building design provides for future expansion of labs

From page 7

transportation and accommodations for 20 students. Applications are taken from around the globe for graduate students, postdoctoral-level researchers and junior faculty members with an interest in the biology of Antarctic organisms. Applications are particularly sought from scientists who have no prior Antarctic field experience. (See the Feb. 12, 2006 issue of *The Antarctic Sun*.)

When the time does come to expand the Crary Lab, its flexible nature should shine through again. It was designed along a central spine leading down a hillside. The first two phases have two pods each, one on each side of the spine. The third phase has only the aquarium, so a pod complementing that would be an option. The spine could extend for additional pods. Furthermore, the existing pods could be extended.

Kottmeier credited the late Peter Wilkniss, former director of the National Science Foundation's Office of Polar Programs, for marketing the concept of a replacement laboratory as an analytical facility.

"[He] had the vision for the Crary Lab and took the risks to get the funding for its design and construction," Kottmeier said.

Then, Hawaiian architects Joseph Ferraro and Lee Davis started determining the facility's design requirements by talking to the scientists, soliciting ideas for the design, and incorporating them into the final plan.

Peter Rejcek / *The Antarctic Sun*

South Pole research associates Nicolas Michel-Hart, foreground, and Jason Stauch learn to pipette blood in a lab at the Crary Science and Engineering Center last month.

Construction was approved in 1986 and the groundbreaking was held on Jan. 9, 1988. A golden shovel used that day hangs above a display case in the lab's entryway.

There are 101 species of sea spiders that are endemic to Antarctica, an organism that exclusively lives on the seafloor bottom.

Photos by Rob Robbins / Special to *The Antarctic Sun*

This chiton, Nuttallochiton mirandus*, is a type of mollusk that lives on rocks. Some of the species are found as deep as 6,000 meters.*

McMurdo Sound rich in marine organisms

From page 1

"It's one of the cool things about diving down here: it's so stark on the surface, and then you get underneath and it's lush under there. There's tons of critters," said Rob Robbins, dive supervisor for Raytheon Polar Services Co., the National Science Foundation contractor charged with logistical support of the U.S. Antarctic Program.

Robbins knows better than most about the plethora of life in McMurdo Sound, having spent more than two decades diving here. There are few critters he can't identify, and scientists rely on his expertise to choose a dive site depending on what organism they're studying.

For example, scientists Amy Moran and Art Woods are making their first dives in McMurdo Sound, so they're taking Robbins' advice to explore the Intake Jetty dive site near McMurdo Station as one study location. It's an area rich with nudibranchs, or sea mollusks with no shell.

Moran, the principal investigator (PI), and Woods, the co-PI, are studying how the egg masses of nudibranchs respond to cold and oxygen. They believe that the higher oxygen content of cold waters may allow the embryo masses to reach much greater size than they would in lower latitudes. Oxygen levels are double compared to those closer to the equator, they say. (See related story on page 12.)

There are about 3,000 species of nudibranchs worldwide, though only perhaps a half-dozen or so are represented in McMurdo Sound.

On the other hand, Sam Bowser has his hands full with the plethora of foraminifera around Explorers Cove across the sound from McMurdo Station. These single-celled organisms, referred to as forams for short, are an ancient and prolific life form that he says are not very well understood. But he knows of nowhere else in the world where he can find such a great diversity of the early evolving forams, whose evolutionary birth date may go back 650 million years. (See related story on page 11.)

Moran and Bowser are the only PIs leading groups under the sea ice this year to study the many kinds of critters in McMurdo Sound. While few other coastline areas of Antarctica have been as thoroughly explored, the larger view of the ecosystem is still a little fuzzy.

So, what *is* down there?

Of course, there are far more species of animals in McMurdo Sound than just forams and nudibranchs. Bowser says he sees Antarctic scallops and sea spiders everywhere on the silty sand bottom of Explorers Cove. Sea stars and sea urchins dominate where Moran and Woods have been diving on the other side of the sound. Fish, sponges, anemones and other soft corals also abound in the shallow depths where divers blow bubbles.

A Trematomus bernacchii*, or Bernac for short, is spotted among seafloor rocks, which are also home to nudibranch and sea stars.*

While the animals that live both above and below the sea ice, like Adélie penguins or Weddell seals, are probably the most emblematic of the sound, they are in the minority of life forms.

"Life here is way dominated by the invertebrates," Robbins noted. "You see some fish but not many of them. … On a coral reef, you see lots of fish."

For the armchair marine scientist or the Antarctic researcher needing to identify an animal, there is at least one online resource devoted specifically to this region. The Underwater Field Guide to Ross Island and McMurdo Sound features dozens of close-up, color photos of everything from forams to featherduster worms to krill and other crustaceans.

Peter Brueggeman, library director at the Scripps Institution of Oceanography, maintains the Web site (*http://siolibrary.ucsd.edu/nsf/fguide/*). The project was one of the original goals that brought famed underwater photographer Norbert Wu to the Antarctic beginning in 1997, according to Brueggeman. Wu's photographs provided the core collection of pictures.

"It's pretty extensive, and it's a huge help for the researchers down here," Robbins said of the online field guide.

Brueggeman, who accompanied Wu to McMurdo Sound in 1997 and 1999, has devoted "hundreds of hours" to creating and maintaining the Web site. During a phone interview, Brueggeman said he still receives photos from McMurdo divers, crediting Robbins as a key contributor.

"He knows where to find the uncommonly seen animals," Brueggeman said.

Brueggeman's detailed and annotated

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Various recources available on the marine organisms

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text accompanies individual photos. For example, he writes that "Antarctic and subantarctic sea spiders comprise 251 species, representing 21.5 [percent] of worldwide species, with 101 species endemic to Antarctica and 60 endemic to subantarctic areas."

Brueggeman is always on the lookout for more photos of animals and specific behaviors. One item on the wish list includes a sponge called *Asbestopluma lycopodina.* He is after a macro photograph showing the carnivorous sponge, which somewhat resembles a pipe cleaner, capturing tiny crustaceans such as krill on Velcro-like protrusions called spicules.

While there are still blanks to fill, Brueggeman said he believes the online field guide is a fairly unique resource that has proven valuable for marine ecologists and others.

"It's given a *lingua franca* for the scientists and students to talk among themselves," he said.

> "It's different from other ecosystems in that it's structured by ice."
>
> *— scientist Amy Moran*

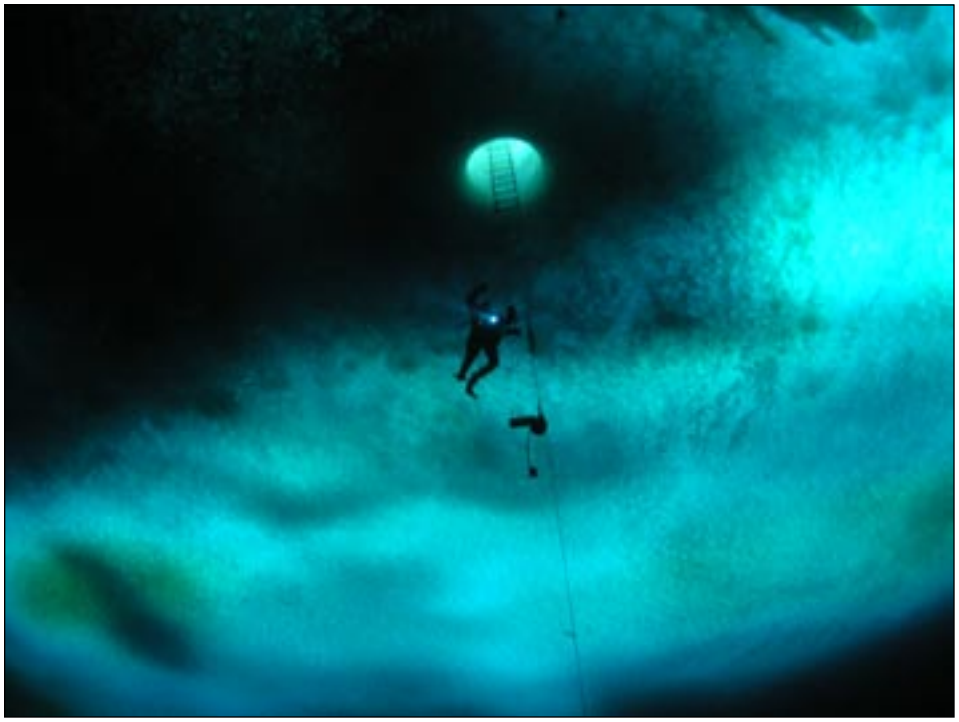
A different kind of resource also grew out of Wu's visits to McMurdo Sound. The book "Under Antarctic Ice: The Photographs of Norbert Wu" features pictures of the marine environment, accompanied by text from Jim Mastro. A professional writer and photographer, Mastro worked in Antarctica on and off for 23 years as a scientist, diver and science laboratory supervisor.

Mastro said via e-mail that the book synthesizes "40 years of research into a natural history of the sound. It's the only place that's been done, to my knowledge."

For science divers, there is an "Antarctic Scientific Diving Manual" that describes 20 established dives sites around the sound in detail. Information includes common fauna and the benthic geography a diver may find.

Always questions to answer

Much of the early coastal and benthic, or seafloor, ecology of the sound was conducted by Scripps researcher Paul Dayton and a few others in the 1970s. Dayton spent more than 50 months in McMurdo Sound, performing research during more than 500 dives under the ice. Other scientists followed in the 1980s and 1990s for some additional broad ecology research, but a full-scale study of the ecosystem has never come forward.



Photos by Rob Robbins / Special to *The Antarctic Sun*

Divers ascend to the bottom of the sea ice at the Cape Evans Wall, a popular dive site for scientists in McMurdo Sound.

"Now people are looking at specific questions. … A lot of microbiology," Robbins said.

Moran noted that bathymetric studies of the McMurdo Sound seafloor, unrelated to her own fieldwork, showed deep troughs or gouges where icebergs have pushed through the region. "It's one of the most disturbed ecosystems in the world," she said. "It's different from other ecosystems in that it's structured by ice."

That statement has been particularly true over the last decade due to heavy ice cover in McMurdo Sound. At some dive sites, the divers must bore down about six meters to reach the nearly freezing salt water.

Robbins said he hasn't noticed any changes in the region's ecology due to the long-term ice cover. The thick ice does make for some claustrophobic diving, however.

"It's dark," he said. "Normally you go out there and it's light. You dive under the ice and there's this big glowing light. … Before this started happening, you just didn't need [flashlights]."

While individual investigators will continue to study the specialized components of the McMurdo Sound ecosystem, a broad scale ecosystem investigation, such as the Long Term Ecologic Research programs at Palmer and the McMurdo Dry Valleys, has not been initiated.

"It's interesting that in an area that's been so intensively studied, [McMurdo Sound] has not been … documented very well," Bowser noted. "We really need some fundamental information."

Some basic information that would be helpful includes bathymetry and other physical measurements, such as water temperatures and currents.

"There are no comprehensive studies, and so much remains unknown," Mastro said, echoing Bowser's sentiments. The list of questions is long, according to Mastro.

"What about all those amazing critters from the deepest parts of the sound that sometimes show up in fish traps? What about the mid-water ecology?" he asked. "What about all the unknown interactions between benthic invertebrates? Why do the sea urchins tend to move up into the anchor ice at about the same time they spawn?

"Lots of questions, no answers."

NSF-funded research in this story: Sam Bowser, New York State Department of Health Division of Molecular Medicine, www.bowserlab.org; Amy Moran, Department of Biological Sciences at Clemson University, http://www.clemson.edu/biosci/faculty/moran/lab/Antarctic_research/Index.html; Art Woods, Division of Biological Sciences at University of Montana; and Norbert Wu, U.S. Antarctic Artists and Writers Program, www.norbertwu.com.

LITTLE THINGS, BIG PACKAGES

Single-celled organisms provide sticky solutions

By Peter Rejcek
Sun staff

Sam Bowser studies one of the most abundant organisms in the ocean, an amoeba-like life form with wide-ranging potential in everything from nanotechnology to medical superglue.

To unlock the potential of foraminifera, Bowser has been diving under the sea ice in McMurdo Sound for more than 15 years. His favorite dive site for studying these single-celled creatures, called forams for short, is Explorers Cove at New Harbor across the sound from McMurdo Station.

"This one spot – Explorers Cove – has the highest diversity that we've been able to find so far," said Bowser, a research scientist with the New York State Department of Health. "This is a hot spot for diversity of these things – a cold spot but a hot spot."

Forams are single-celled protists, a classification for organisms that possess a nucleus but do not fall into the animal, plant or algae kingdoms. They were one of the first organisms to develop shells (called tests), with an evolutionary family tree whose roots may reach back 650 million years. Many of the world's largest forams live in the deep sea, below 600 meters from the surface, though thousands of smaller species live in shallow coastal areas, brackish water or moist soil. Another 40 species are planktonic, or free-floating.

Conditions in McMurdo Sound at Explorers Cove – cold, dark, with a silty sand bottom – mimic those where giant forams normally inhabit but at far more modest depths that are accessible to divers. Bowser and his group of divers will spend the next couple of months punching holes in the multi-year sea ice to capture thousands of specimens from the seafloor.

Henry Kaiser / Special to *The Antarctic Sun*

Sam Bowser shows some single-celled organisms, called foraminifera, taken from the ocean floor at New Harbor in McMurdo Sound in January 2005. Bowswer has been diving in McMurdo Sound for about 15 years.

Bowser said his group is particularly interested in the early evolving forams, whose carnivorous appetites may have affected the spread of multi-cellular creatures just getting a foothold on the planet millions of years ago.

"The predation pressure [by] the forams might have played a role in early diversification [of] multi-cellular critters," he said.

The early evolving forams are larger and more diverse at higher latitudes, and have had millions of years to tailor their proteins for life in various ecological niches, according to Bowser. He hopes that through gene sequencing he can characterize those specialized proteins.

"Some of them may be important for public health," he said.

One particularly intriguing characteristic of forams is their shell, which they build using particles on the ocean floor and cement together with an adhesive they secrete. This foram superglue could potentially be used in a variety of medical applications, such as an organic suture.

"This stuff is an incredibly sticky, chemically resistant material – part sugar/part protein – that binds dissimilar materials in a wet, salty environment," Bowser wrote in a previous issue of the *Sun* several years ago. "If you think of the human body as a wet, salty thing then you can imagine lots of uses for such a natural product."

Bowser first came to the Antarctic in 1984 to explore the forams as a source of this biological adhesive. But, he said, the work suffered from a lack of understanding about their evolution. Since that time, he's focused on their evolutionary traits, a change that has paid big dividends for the researcher. More than two decades ago, it was believed that maybe a half-dozen early-evolving foram species existed in Explorers Cove. Instead, scientists have discovered hundreds of different kinds, many only known by their molecular signatures.

"The extraordinary diversity of the single-chambered, early evolving types of forams would be our major finding," Bowser said when asked about the most

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Emily Stone / Special to *The Antarctic Sun*

Diver Dug Coons lowers a laundry basket into a dive hole at New Harbor during a field season two years ago. The basket is used to pull up sediment cores taken during a dive. Coons was a member of Sam Bowser's science group studying foraminifera. Bowser and a mostly new group of divers are back again at New Harbor looking for forams.

Room to breathe

Frigid waters provide some invertebrates plenty of O_2

By Peter Rejcek
Sun staff

Antarctica makes life difficult for many organisms that call the icy continent home. But the sub-freezing temperatures in the Southern Ocean may offer ideal conditions for embryonic development in some marine invertebrates.

That's part of the attraction that has drawn Amy Moran and Art Woods to McMurdo Sound, where they are diving under the sea ice to collect various species of nudibranchs and their egg masses. Moran and Woods are interested in how organism design relates to its particular environment, and the role oxygen and temperature play in that interchange. They want to compare how these variables affect development at high versus low latitudes.

"When you come down to the Antarctic, the rules are all different. Are egg masses different, too?" explained Moran, principal investigator (PI) from the Department of Biological Sciences at Clemson University. "If that turns out to be the case, then we'll be able to make some broader scale inferences about animal organism design as a whole."

The water in the Southern Ocean and McMurdo Sound is about negative 2 degrees Celsius. (The salt in the water prevents it from freezing at the normal threshold of 0 C.) The oxygen content in the water here is almost double that of the lower latitudes near the equator because gases can dissolve more easily in cold water, according to Moran.

"This is a very oxygen-rich place," she said.

The cold temperatures also slow down the metabolic rate of invertebrates. A slower metabolism requires less oxygen. That combination of high oxygen content and low metabolic rate means creatures like the nudibranch, a soft-bodied marine snail, find themselves in a far more robust oxygen environment than their lower latitude brethren.

"They're right on the physiological edge," Woods said of the nudibranch egg masses that develop in latitudes closer to the equator, where oxygen content appears to be just sufficient enough to support life. Woods is the co-PI on the project, from the Division of Biological Sciences at the University of Montana. This is the first of two field seasons for the team.

Peter Rejcek / *The Antarctic Sun*

Above, Cheryl Lowry helps scientist Amy Moran, center, with last-minute adjustments to her gear before a dive at the Arrival Heights dive hole earlier this month while dive buddy Bruce Miller readies his camera.

Right, scientist Art Woods shows off one of his nudibranch finds during the day's dive.

Below, a nudibranch rests at the bottom of McMurdo Sound.

Rob Robbins / Special to *The Antarctic Sun*

Peter Rejcek / *The Antarctic Sun*

There are about 3,000 nudibranch species worldwide, though only about seven or eight are in the Southern Ocean. Nudibranchs typically deposit their eggs within a gelatinous spiral. The researchers chose to study nudibranchs over other marine invertebrates because the body of knowledge about the warm water counterparts of the organism is fairly large, they said.

"They're a little bit like marine butterflies," Woods noted, explaining the additional attention that the colorful species receives.

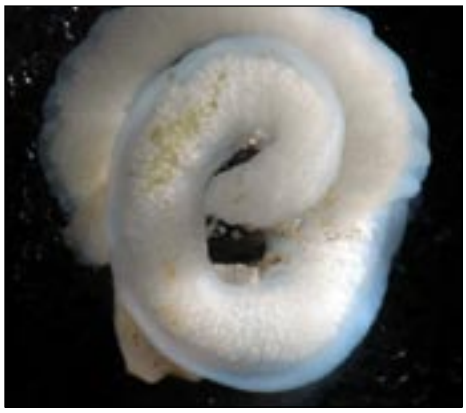
Woods has developed models that predict the egg masses here should be much larger and more densely packed with eggs than those found in lower latitudes, based on the oxygen content and metabolism rates. They've already noted marked differences between *Tritoniella belli* in McMurdo and a related species call *Tritonia diomedea* found along the west coast of the United States. The egg masses of the former appear far more tightly packaged, like "very tight sausages."

The gestation periods are also hugely different, just days or weeks for the warm weather species while the Southern Ocean nudibranchs may take months or years to develop, another disparity possibly related to water temperature.

"You think about Antarctica being this

See EGG on page 13

Peter Rejcek / *The Antarctic Sun*



Art Woods / Special to *The Antarctic Sun*

Art Woods examines a nudibranch egg mass (like that pictured above) under the microscope while testing for oxygen levels. Amy Moran watches the results of the test on a laptop.

Egg masses appear hardier than lower latitude ones

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horrible place for animals to live because it's really cold and that's true in a lot of ways," Moran said, but that does not necessarily appear to be the case for these egg masses.

The possibility for the egg masses to be larger than normal could be a manifestation of what Woods called "polar gigantism," the tendency of species that live near the poles to be bigger than those that live in the tropics. They've found evidence of polar gigantism in other local species such as sea spiders.

"They can get up to the size of dinner plates [here]," Woods said of sea spiders.

The scientists are also artificially creating egg masses in the Crary Science and Engineering Center at McMurdo to further test their hypothesis. By creating different densities and sizes, they may be able to determine the physiological threshold of the cold-water species.

The oxygen content in the core of egg masses of temperate species is nearly zero, meaning they're at the physiological edge of survival. The oxygen content in the middle of the egg masses here is much higher, another advantage to the cold-water environment.

That brings up the almost inevitable discussion about global warming. If ocean temperatures in the lower latitudes increase even a little, that may spell trouble for the nudibranchs there because their egg masses may be depleted in oxygen, as less of the gas would be dissolved in seawater.

The certainty of that conclusion will depend, in part, on what the two scientific divers and their team discover above and below the ice.

"Hopefully, in the end, the model and the data will be consistent with one another," Woods said.

NSF-funded research in this story: Amy Moran, Department of Biological Sciences at Clemson University, http://www.clemson.edu/biosci/faculty/moran/lab/Antarctic_research/Index.html; Art Woods, Division of Biological Sciences at University of Montana.

Bowser: forams may offer nanotechnology applications

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significant achievement of his research thus far. "It was totally unexpected, and has led a group of about 20 other [scientists] to look more carefully at the diversity and worldwide distribution of these critters."

However, scientists have been frustrated in their attempt to adapt the adhesive for commercial purposes.

"Unfortunately, the glue is so good it gums up all the equipment that we analyze it with," Bowser explained. "I'm a hated man among our analytical chemistry department."

Focusing on the evolutionary traits of the forams has also led to potential discoveries outside Bowser's original goals. For example, he said the protein tubulin that has evolved over the millennia has allowed foram microtubules, a minute filament, to develop what Bowser called "nano springs." These springs could be useful in nanotechnology as a biological solenoid. (Nanotechnology is a field that develops small devices only a few nanometers in size.)

"We had originally set out to explore the forams here as a source of new biological adhesives," Bowser mused. "Our slow progress on that front led to the work on their evolution. A very convoluted string of blind luck, failures and ultimate success – but that's the way that science works, eh?"

NSF-funded research in this story: Sam Bowser, New York State Department of Health Division of Molecular Medicine, www.bowserlab.org.

Shawn Harper / Special to *The Antarctic Sun*

Some of the body cells in this tree-structured forminifera are located below the sediment surface.

Profile Bringing Berlin to the Ice

By Steven Profaizer
Sun staff

Much like his life, Georg Bakker's radio show is an eclectic mix strung together by a common theme.

In his life, the strand of commonality is community. In his radio show, it is his country of birth – Germany.

This is Bakker's second season hosting "*Deutsche Welle Eis Radio*," or German Wave Ice Radio, on McMurdo's amateur radio station. His only real format constraint is that he exclusively speaks in German and plays Germany-related music.

This can pose a bit of a problem on an American Antarctic station, and Bakker is forced to be pretty broad in his definition of "Germany-related." He searches through the radio station's vinyl archives for German bands, German words and other German connections.

"David Bowie used to live in Berlin," said Bakker, McMurdo's nurse manager. "Lou Reed made a song about Berlin. The Beatles played in Germany and actually recorded a couple of German songs. Chuck Berry sings 'Roll over Beethoven.'"

The only genre off-limits is classical, because he says it is too easy. And it's the variety and the creative challenge of finding songs that Bakker said he thinks are the most fun aspects of his show.

It can sometimes be a challenge to fill the two-hour slot, but other times it can be shockingly easy. Once, Bakker found a 1960s record of Heintje, whom he compared to a kitschy, German, young Michael Jackson.

"He was about 12 or 14 years old, and he would sing all these really cheesy songs. Apparently he made a record in English, so I played it," Bakker said. "I actually called my mom up and dedicated one of the songs to her. She couldn't believe they had that album."

Of course, most people on station wouldn't know any of that happened by listening to his show. After all, every word from his greetings through his song dedications are in German.

"When you speak German on the radio here you know not that many people can understand you, so you can be free and you don't have to have stage fright," Bakker said. "People will come up to me later and tell me they have no idea what I'm saying but that they really like the show."

Bakker was born in Jemgum, a small town near the border of Holland in Northern Germany. He moved to the United States in 1985 and became a permanent resident a few years later. This is his third season on the Ice in four years, each time working with the medical department.

Steven Profaizer / *The Antarctic Sun*

Georg Bakker talks to an in-studio guest while hosting his radio show on McMurdo's amateur FM station Nov. 17. During the show, Bakker only speaks German and plays Germany-related music.

He has spent the last four years on the move, living out of suitcases, traveling to Antarctica and visiting family.

It's been a long time since Bakker has had some real space to call his own. Before coming to Antarctica for the first time, he spent about 15 years in a Vermont commune with shared housing.

He lived there in a small village with 60 other adults and about 30 children. Their community was located on 200 acres of land that had been purchased by the founders of the commune and was free to live on for people who liked it there. It had its own school where the adults worked together to teach the children. The families were from all around the world – Brazil, France, England, Germany, Italy, New Zealand and the United States.

Bakker felt a wonderful sense of community there that he feels many people are trying to find.

"I think a lot of people come back [to Antarctica]," he said, "because they experience a sense of community that they can't find back home."

He said he is lucky to have found Adamant, Vt., a town located about an hour from the commune where he lived. It's also just a short drive from his daughter, Lena, who is a junior at the University of Vermont.

He has been able to connect with the Adamant community even though it is half a world away from where he was born, he said.

"After all these years living in Vermont, I feel in between the two cultures. Germany is not my home anymore, but it feels really familiar. When I go back to Germany, I feel very Americanized," said Bakker. "And when I'm in the States, I have an accent. I hear almost every day, 'Where do you come from?' So I definitely don't feel like an American."

Language is one of the key areas where he said he lives between the countries. Bakker speaks English, dreams in English and mostly reads in English. But it isn't his first language. He also left Germany in 1985, and the language has continued to develop without him.

"It's kind of like I'm living out of a linguistic history book when I'm there," Bakker said.

So what is home to a German living in America, who fairly recently left the place he lived for 15 years and has been on the move since?

"I've lived long enough in Vermont now that I consider that my home," Bakker said.

And home he is headed. Bakker plans to make this his last season on the Ice and buy a house in Adamant.

He said he sees his radio show as a good analogy for his last season here; he's relaxed, doing what he wants and enjoying every minute of it.