



Three-pronged attack

By Steven Profaizer
Sun Staff

Three teams are using three very different tactics on the hunt for one of nature's most elusive creations — neutrinos.

The dream of unlocking neutrinos' secrets has kept scientists tossing and turning since the subatomic particles were first theorized in the 1930s. The vision has been there, but the technology to materialize that vision has not.

Three teams of scientists are now preparing to use Antarctic ice as the key to open the strongbox that has contained extraterrestrial neutrinos' mysteries since the early universe — even though no one is sure what they will reveal.

Strange but true

Neutrinos are smaller than a single atom. They have no charge and very little mass. Magnetic fields have no effect on them. Gravity's influence on them is almost nonexistent.

Neutrinos fly across the universe, slipping between gaps in the atoms of all matter, indifferent to the worlds around them.

A star, a distant planet, a human — the particles pass right through matter as they continue in virtually straight lines from their points of creation. Neutrinos saturate our universe, flying in all directions to no particular destination.

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IN the ice



ON the ice



ABOVE the ice

IceCube
ARIANNA
ANITA

Researcher's theory on iceberg breakup making waves in scientific community

By Steve Martaindale
Sun staff

Everything scientists think about is in terms of chain reactions, Doug MacAyeal said while explaining his ongoing research with ice shelves and icebergs. After using self-deprecating humor to defend his assertions that Alaskan storms may trigger glacial breakups in Antarctica, he became equally excited by the prospect of following a couple of icebergs to their warm-water graves.

To him, it is all connected — distant storms driving ice shelf breakup, shelf fragmentation increasing ice stream flow, the Antarctic discharging more glacial mass than it receives and thereby contributing to a rising sea level — a global chain reaction, very much like the flow of his research.

Initially, the University of Chicago professor was unable to push his theories about iceberg movement beyond peer review

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Katie Leonard / Special to *The Antarctic Sun*

A Twin Otter aircraft sits next to monitoring equipment on the Nascent Iceberg.

INSIDE

Antarctic LTER scientists meet to discuss studies

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McMurdo janitor sees the Ice through her camera

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Quote of the Week

"It sounds just like summer camp, except you have to work all the time."

— Mother of a program participant describing what life on the Ice sounded like to her.

Getting better with age



Elaine Hood / Special to *The Antarctic Sun*

The Crary Science and Engineering Center at McMurdo Station turns 15 years old this month. Next week, we'll revisit the lab's past and take a look at the man whose name was nearly synonymous with Antarctic science during his lifetime.

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Cold, hard facts

The Property Trail

Total number of property items tracked at McMurdo Station by the USAP: **2,600**

Total cost of those items: **\$101 million**

Year of oldest item on record: **1945**
(two sheepfoot roller compactors)

Least expensive item in the property inventory: **\$79 Epson scanner**

Most expensive item in the property inventory: **\$5.1 million Microwave Landing System building and equipment for the airfields**

Number of computers on station: **624 desktops and 87 laptops**

Cost of Ivan the Terra Bus in 1993: **\$399,035**

Source: Corey Hubbard, RPSC property assistant

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Level 1 Comix

Matt Davidson



Aviation safety gets a lift from helitech team

By Peter Rejcek
Sun staff

Part cargo handler, part safety officer, the job of helitech generally starts early and ends late, with various pitches of activity throughout the week depending on who's going where and when from McMurdo Station.

A recent Tuesday morning found the six-member crew at the helicopter hangar earlier than usual — about 6:30 a.m. — for their weekly safety meeting. The topic: a search and rescue training exercise they had participated in during the previous week. It's an opportunity for the team to debrief and cull a few lessons learned from the experience.

The need for safety around the delicate rotary aircraft — where even an errant baseball cap snatched off the head and into the blades can cause damage — is paramount in this job.

"We make sure that the people we support stay safe," said Gifford Wong, the lead helitech who is in his third year with the department. "Our most important job is safety."

The safety discussion spills past 7 a.m. and some of the group starts gearing up for the day ahead, checking the flight schedule and making mental notes about loads and passengers. Four of the helitechs are each responsible for one of the station's helicopters, which consist of two Bell 212s and two AS350s. A fifth person generally manages the helicopter pad area, though the lines of responsibility blur when the tempo is high and someone needs a hand.

"We'll work on the pad together," said first-year helitech Mark Oetzmann, this week's point man on the ground.

The sixth member of the crew, currently Nick Giguere, works the night shift, when helos fly to accommodate camp put-ins that can't be completed during the day or upon special request. For example, some of the visual artists sponsored by the National Science Foundation (NSF) Artists and Writers Program like to fly in the evenings because of the changing light on the landscape, according to Melissa Friess, a second-year helitech.

(While the sun shines 24 hours a day during the austral summer, its circle around the bottom of the planet while still near the horizon can throw splashes of red and orange against the Royal Society Range, a series of peaks across



Peter Rejcek / The Antarctic Sun

Helitechs Mark Oetzmann, left, and Gifford Wong load a Bell 212 helicopter headed to the McMurdo Dry Valleys on Oct. 31. The helitechs serve as both loadmasters and safety officers for helicopter flights.

McMurdo Sound that top out at about 4,000 meters.)

The team assembles upstairs in the hangar by 7:30 a.m. with Jack Hawkins, the manager of PHI Antarctica, the helicopter operations contractor for the NSF, and Liz Kauffman, helicopter coordinator. They discuss last-minute schedule changes and cover any other relevant topics for the day before dispersing to their assignments.

"The schedule always changes, but we know our jobs and what we're supposed to do so it balances out," Wong remarked while dressing in fleecy, fire-resistant layers in anticipation of being outside for much of the day. As one of the two helitechs assigned to the larger B212s this week, he'll accompany the flight on its journey to Taylor Valley and Fishtail Point to assist with the movement of gear and passengers. The first stop for Jena Ferrarese, the other B212 helitech this morning, is Black Island.

The next order of business for the morning is generally to load the helicopters for the first launch of the day or to manifest and weigh passengers as they arrive at the terminal. On the pad, a helitech uses an all-terrain vehicle to pull variously colored carts (with pet names like "Meat Wagon" or "Grapes of Pax" painted on the side) loaded with cargo out to each helicopter. The loads include science equipment, multi-day backpacks and hazardous cargo such as camp stoves.

Now comes the head-scratching part: fitting all that baggage into what amounts to the volume of a soccer mom's minivan.

"If you can remember that game Tetris? This is like the real thing," Wong said while crouched in the rear passenger compartment, staring at a wall of bags and hard-cased containers. The game is about more than just getting all the gear

to fit neatly in the helicopters: it must be stored in a manner that ensures an optimal center of gravity so the whirlybird can fly correctly.

The rest of the day for the helitechs remaining at the hangar is devoted to receiving cargo for upcoming flights — either for later that day or sometime during the week — and talking with passengers and other customers about their various needs. Oetzmann makes a brief run around the station with a pickup truck to return an item from a field camp and retrieve gear from the Science Support Cargo Warehouse.

Like all the other members of his team, Oetzmann does seasonal work for the U.S. Forest Service or similar government agencies as a wildland firefighter. In that capacity, all of the helitechs have experience working around helicopters. In addition, two of the techs are helicopter pilots themselves and a third, Friess, is working on her license.

Josh Parris is one of the helitechs who would someday like to trade seats with a pilot. A science carpenter at McMurdo for three previous seasons, the first-year helitech said it's interesting to work with the helicopter department as an employee rather than as a passenger headed into the field.

"I can see what's going on with [this] aspect of it," he said.

Wong said the helitechs move an estimated 700,000 kilograms of cargo during the season. In reality, they move that massive amount of gear several times: once onto the helicopters, then in the field, often back onto the helicopter as a camp breaks up, and then back in McMurdo.

The feat gives Wong a sense of pride in his team. "We're big enough to move [all that cargo] but still small enough to be a family," he said.





Perspectives Perspectives

PQ process a lifesaver for dentist

By Fleet Ratliff
Special to the Sun

We all moan and groan about how the PQ (physically qualified) process is such an inconvenience. In my case, it literally saved my life.

I was fat, dumb, happy and retired in the late spring of 2005. I had just sold my dentistry practice for cash, had a very successful hip replacement and had my financial affairs all in order. I also had a happily employed wife who wanted to work forever and keep me on her health insurance. I was looking forward to lazing around, fishing and sight-seeing for a long, long time.

However, I then accepted a job as the “only dentist on the continent of Antarctica.” But at the very end of the physical exam, there was a problem. There was a lesion in my colon. It was cancerous and it had to be removed. There was still time. The plan was to have the surgery, heal for six weeks, strap on a corset and get on an airplane for Antarctica.

Unfortunately, the pathologist didn't buy into the plan. The report was not “bad”; it just wasn't “good.” I was not going to Antarctica. I was going to go through six months of chemotherapy! Doom. Gloom. Despair. On top of that, they couldn't even start the chemotherapy for a month. More doom, gloom, despair ...

After the surgery, there was nothing to do at first. My wife was at work. The cat had its own agenda. The surgical incision hurt. And then ... there it was.

One of the cable channels was picking up a direct feed of the Tour de France in its entirety. There was this skinny American wearing a yellow jersey. He was great! He was strong! He was a cancer survivor! He was Lance Armstrong! His cancer had been a lot worse than mine, and there he was, beating back all challengers and showing anybody who wanted to come play with the big boys that he was king of this hill.

I began getting up at oh-dark-thirty to view each stage of the race in its entirety. I had never been a fan of bicycle racing. But now I was counting seconds at every stage and watching Lance's lead widen.



Steve Martaindale / The Antarctic Sun

Fleet Ratliff, dentist at McMurdo Station, says the extensive physical qualification process required of U.S. Antarctic Program participants may have saved his life. His physical produced evidence of colon cancer, which led to chemotherapy. However, one year later, he was cleared and made the trip to Antarctica.

My life was becoming interesting again. I celebrated as he drank champagne on the final lap. Seven years in a row! Wow! Thank you, Lance!

New plan! Charge through the chemotherapy. Get back in shape. Take the treadmill test. Pass the physical exam. Get the job with Raytheon and be the “only dentist on the continent of Antarctica.”

I was not a good chemotherapy patient. It's not that I didn't try — I just didn't get along with some of the chemicals. One of my chemo nurses, Catherine Slawson, was one of those no-nonsense people. She was not going to let me quit. Not on her watch! We made it. Barely.

It was January, and I could not climb a single flight of stairs without stopping to catch my breath. The treadmill test was a looming terror. My beautiful wife, Ann Marie, bought me a home treadmill for a Christmas present. At first, I could only do five minutes slow and level. I got a heart monitor and revisited some of Dr. Kenneth Cooper's original work on aerobics.

Gradually, things started falling into place. Soon I was going uphill, faster and faster. I couldn't break into a run because of the hip, but I could increase the incline

and I could have sweat dripping off the end of my nose for an hour. My cardiac output responded and I got into the best shape I had been in for years.

I reapplied for the job in Antarctica. More tests. More letters from my doctors. More questions. Acceptance. Rejection. Frustration. More tests. Finally, acceptance but not for Winfly. I was to come with mainbody, but I was going to be the “only dentist on the continent of Antarctica.”

I owe the United States Antarctic Program (USAP) big time. If it had not been for the extensive physical, I wouldn't have even thought about having that colonoscopy and it would probably have been too late by the time I developed symptoms.

When I stepped off the C-17 onto the Ice, I was as close to crying as I have been for many years. With all due respect to Lou Gehrig (July 4, 1939), “I consider myself the luckiest man on the face of the earth.” Thanks, USAP! Thanks, Lance! Thanks, Catherine! Thanks, Ann Marie!

Fleet Ratliff is the dentist for McMurdo Station for the summer 2006-2007. People recognize him as the “guy in the bow tie.”

around the continent

SOUTH POLE

October temps break record

By Katie Hess

South Pole correspondent

The beginning of the austral summer season at South Pole was delayed this year due to some especially frigid temperatures that were not conducive to LC-130 hydraulics — a vital landing tool of the aircraft that supports operations at 90 degrees south. Looking back on October 2006, the average monthly temperature of negative 55.9 degrees Celsius broke the previous record low average of negative 55.6 C in 1981. October's average was a departure of 4.7 degrees from the norm and the mercury dropped as cold as negative 66.7 C on the 7th. There were also four daily low temperature records broken during the month.

With little time to settle in or acclimate to their new surroundings at the high and dry South Pole Station, summer crews jumped right to work this last week, taking over from the departing winter personnel. Most of the winterovers have now left the station, starry-eyed with unlimited fresh food and a summer breeze in New Zealand on their minds.

Back at the South Pole, we have been edging closer and closer to our population maximum. We currently house and feed 222 Polies, up from a winter crew of only 64. During the initial station influx, crews in the galley, waste, medical and housing departments were especially hard at work.

Heavy equipment operators are working around the clock clearing the massive winter snow drifts from the buildings, and flight operations crews are already working up to six aircraft per day.

Temperatures here at Pole were still in the negative 40- to negative 50-degree-Celsius range through Thursday. And due to obscured visibility from contrail clouds created by the cold temperatures and the plane's engines, only essential cargo (mostly winterovers) can be loaded onto the planes. The end of the week finally brought warmer



Scot Jackson / Special to *The Antarctic Sun*

South Pole residents pitch in to get a coveted delivery of mail into the Elevated Station. The same sort of human chain is used to get fresh fruit and vegetables inside before they freeze in the extremely low temperatures.

weather and flights full of needed cargo.

IceCube drillers and night shift construction workers have just begun to arrive. The sun will only rise higher and higher until the summer solstice, and we expect activity will increase over the next several weeks. The coming week should see the beginning of the season's full-on, 24/7 operations, complete with a midnight meal.

PALMER

Global warming affects Palmer

By Kerry Kells

Palmer correspondent

The *R/V Laurence M. Gould* returned to Palmer Station this past week and brought back Principal Investigator Langdon Quetin and his team member Kelly Moore. The seabird research team

spotted its first Adélie penguin egg on Torgersen Island on Nov. 7.

Hugh Ducklow, with the microbial biogeochemistry component of the Long Term Ecological Research (LTER) project, discussed climate change this week at the station's weekly science lecture. The presentation, "The Climate Mess," looked at the global carbon cycle, global and regional climate change, and climate change on the West Antarctic Peninsula. The last subject is particularly relevant at Palmer Station, where scientists have noted significant changes on the peninsula due to global warming.

Records here indicate a half-degree Celsius increase in temperature per decade from 1980 to the present. At the same time, the decline in annual sea ice is about 30 percent. This decrease will have a profound effect on ocean ecosystems

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the week in weather

McMurdo Station

High: 25 F / -4 C

Low: 1 F / -17 C

Max. sustained wind: 16 mph / 26 kph

Min. wind chill: -17 F / -27 C

Palmer Station

High temperature: 39 F / 4 C

Low temperature: 22 F / -5 C

Max. sustained wind: 44 mph / 70 kph

Melted precipitation: 3 mm

South Pole Station

High: -37 F / -39 C

Low: -49 F / -45 C

Peak wind: 28 mph / 45 kph

Max. physio-altitude: 3,236 m

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that are dependent on the sea ice, such as the Adélie penguin, which uses it as a winter habitat.

The average day when the sea ice begins to retreat or advance has changed by about 15 days per decade since 1975. The number of ice-free days increased from 35 to 104 between 1980 and 2005. One question scientists are puzzling over is whether the sea ice will completely disappear in the next four or five decades.

The temperature swing is reshaping the local geography. For example, Biscoe Point has become Biscoe Island, Norsel Point has become Norsel Island, and significant glacier retreat shows some rock on part of the bottom edge of the Marr Ice Piedmont Glacier.

The increases in and effects of global warming will continue to be researched at Palmer Station by members of LTER and other research teams.

SHIPS

LMG

Compiled from reports by Eric Hutt
Marine Projects coordinator

The *Laurence M. Gould* arrived at Palmer Station on Nov. 2 after a morning reconnaissance mission to Andvord Bay to gain information for a future cruise. After spending the night at Palmer Station, the *LMG* departed for Petermann Island to set up a camp and unload cargo.

Nov. 5 found the vessel near Copacabana, King George Island, waiting for calm weather to allow a Zodiac to get to the beach. The winds, hitting 90 kph, finally eased by the afternoon, and the *LMG* picked up one passenger and garbage



Zee Evans / Special to *The Antarctic Sun*

The science research vessel *Laurence M. Gould* is docked at Palmer Station last week. The *Gould* delivers cargo and supplies, and also serves as a shuttle between Chile and the Antarctic Peninsula to ferry scientists and support personnel back and forth.

before steaming out of Admiralty Bay. The vessel then turned north for its home port of Punta Arenas, Chile.

The extended stop at King George Island was somewhat fortuitous, as a low pressure system had passed ahead of the *LMG*, leaving the Drake Passage calmer than usual, with moderate winds and only a confused sea.

The *LMG* finished crossing the Drake on Nov. 7 and started heading up the Argentinean coast. It reached Punta Arenas on the morning of Nov. 9.

NBP

Compiled from reports by "Skip" Owen
Marine Projects coordinator

Weather has caused delays in some

scientific testing and cruise time early in the week. The *Nathaniel B. Palmer* altered its track to keep the winds and waves at its stern, but the ship was still rolling moderately in heavy westerly swells as it made its way to the sea ice edge in the Ross Sea.

The vessel is headed for the Ross Sea polynya, an area of open water in the sea ice for scientific work on CORSACS — Controls on Ross Sea Algal Community Structure. CORSACS will investigate the interactive effects of iron, carbon dioxide and light levels in the Ross Sea on phytoplankton.

The vessel reached the ice edge, or at least the fringe, on Nov. 7. Two days later, the vessel was able to collect its first three ice cores before the weather turned too foul for operations.

Continental Drift **If you could be an Antarctic animal, which would you be?**



"I think I'd be a pickle. That's kind of a vegetable but close enough."

Casey O'Brien,
McMurdo
materials person
from Baltimore, Md.,
first season



"The South Polar skua because they migrate from the southern hemisphere to the north Pacific and back. Also, here at Palmer, they don't eat cute, fuzzy penguin chicks."

Kristen Gorman,
Palmer field research
assistant from
Vancouver, B.C.,
second season



"I would be a penguin, of course! I'd like the relaxed and slow-paced life. You know, just take it all in."

Nicole Harkness,
South Pole
dining assistant
from Duluth, Minn.,
first season

COMMON GROUND

LTER scientists gather for first time in 13 years

By Peter Rejcek
Sun staff

Antarctic scientists studying two disparate, far-flung ecosystems are finding the regions have much more in common than one would suspect.

Researchers from the McMurdo Dry Valley and Palmer Long Term Ecological Research (LTER) Network sites came together for a one-day workshop at Colorado State University in Fort Collins on Sept. 24. It was the first time the two groups had met in such a format to exchange data and ideas.

“We’ve been trying for 13 years to have this dialogue across the continent, and we’re real optimistic that it’s going to lead to better interactions between our two groups,” said Hugh Ducklow, principal investigator for the Palmer LTER team.

Ducklow, from the Virginia Institute of Marine Sciences at the College of William and Mary, leads the biogeochemistry component of the Palmer LTER. That group works to understand the role of bacteria in the decomposition and cycling of organic carbon in the ocean.

Other components of the Palmer LTER, a marine ecosystem study, include seabirds, physical oceanography, and phytoplankton and krill dynamics. The main theme of the long-term study is observing the annual advance and retreat of sea ice and understanding the role it plays in the spatial and temporal changes of that ecosystem.

At the other end of the spectrum is the McMurdo LTER, a terrestrial site in the Dry Valleys where scientists focus on areas such as soil ecology, streams and glaciology. The individual projects attempt to fine tune the big picture of how the interaction of climate, biology and physical processes dictate biodiversity and ecosystem structure and function in the Dry Valleys.

Both Antarctic ecosystems are part of a network that consists of 26 sites of similar long-term studies, most based in and around the United States, funded by three different programs within the National Science Foundation (Environmental Biology, Biological Oceanography and Antarctic Biology). September’s meeting between the groups followed the LTER All Scientists Meeting, held in Estes Park near Rocky Mountain National Park, that included researchers from the entire network.



Courtesy of Diana Wall / Special to *The Antarctic Sun*

Researchers conduct a long-term soil warming experiment near Lake Hoare in the McMurdo Dry Valleys. The chambers are used to warm the soil, which is then sampled and compared to plots that have not been heated to determine what effects temperature changes could have there.

Finding common threads

About 4,000 kilometers separate the two Antarctic ecosystems, which seem headed in two very different directions. Palmer Station-based scientists are witnessing pronounced signs of global warming on the Antarctic Peninsula, with significant glacial retreat and shorter durations and extent of sea ice advance, while researchers in the Dry Valleys have observed regional cooling.

Interestingly, both systems experienced an anomalous climatic year during the 2001-2002 austral summer season. Record snows fell at Palmer Station during the late spring, while unseasonably warm temperatures in the McMurdo Dry Valleys caused flooding in lakes and streams. The deep snow at Palmer that year led to a catastrophic decrease in Adélie penguin breeding success and the Dry Valleys floods caused major nutrient fluxes and changes in soil nematode populations.

“Those are the exact opposite of the long-term [climate] trends in both places,” Ducklow noted. However, the consequences for the two species were consistent with the response to long-term climate trends: a decline in penguin breeding success and a reduction in the nematode population.

“They’re the dominant large organism in the two systems, and they’re responding to climate change the same way even though the climate changes are different,” he said, “so those things we didn’t anticipate at all.”

The penguins and nematodes, or roundworms, are both near the top of their respective food webs. The risk to the Adélie penguins is directly tied to the decline in sea ice in two ways. First, the sea ice serves

as the feeding ground for krill larvae, which feast on algae that grows on the sea ice in the winter. Less sea ice means fewer krill, the primary food source for the penguins. Second, the sea ice is the main winter habitat for the penguins, further stressing their population and colonies.

McMurdo LTER scientist Diana Wall said the nematodes, the dominant invertebrate in the Dry Valleys, are declining because they are particularly sensitive to ecological disturbances, such as climate change or pollution. The sensitivity is common for nematode species around the world, she explained.

“Whether this cooling in the [Dry Valleys], or perhaps warming, will cause extinction of species is unknown, but long-term experiments and monitoring such as we do with the LTER will reveal whether the decline in population continues,” Wall said.

The two teams of scientists say they believe a common mechanism may be responsible for changes both sites are seeing in surface air temperatures and varying states of water composition — water to ice and ice to water.

It may be related to a phenomenon the Palmer group is writing a paper on concerning sea ice trends in the southern Bellingshausen Sea and the western Ross Sea from 1979 to 2004, according to Sharon Stammerjohn, a post-doc at NASA’s Goddard Institute for Space Studies in New York.

In the Bellingshausen, southwest of the peninsula, sea ice is retreating earlier and advancing later, shortening the winter duration by almost three months during this 26-

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Scientists plan exchanges between McMurdo, Palmer

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year period. The opposite trend is happening in the Ross Sea, she said, with increases of winter duration by two months.

Changes in the high latitude response to the El Niño-Southern Oscillation (ENSO), a dual ocean-atmosphere phenomenon in the tropical Pacific, is partly driving these trends. The other part is related to the dominant mid-to-high latitude mode of atmospheric circulation in the polar region known as the Southern Annual Mode (SAM), or Antarctic Oscillation.

While the paper that Stammerjohn is writing involves sea ice variability, she said it's quite likely the trends under way at both LTER sites are further manifestations of the combined ENSO and SAM interaction, though the Dry Valleys is well outside the area traditionally believed to be responding to ENSO variability.

The interaction is complicated, she explained, because while ENSO hasn't really changed during the study years, the high latitude response has. This change appears to be due to a new trend in SAM over 1979-2004 that has resulted in strengthened westerly winds over the Southern Ocean, warm temperatures over the Antarctic Peninsula, and cool temperatures over the Antarctic continent. Ozone depletion and the input of greenhouse gases into the atmosphere are believed to be the culprits causing this swing in SAM.

"I think in the end, both ENSO and SAM are implicated in the sea ice and regional climate changes; it's just not a clean picture," Stammerjohn said.

Scientists for both sites are applying for funds from the LTER Network to write a synthesis paper to describe the phenomenon and the ecological responses occurring in each system. The possible discovery may have continued unnoticed without the 20-plus scientists putting their heads together.

"When you get groups of people together they see things with different vision, different eyes, and it helped us to uncover something neither of us had anticipated at all," Ducklow said.

Grantee exchange

Scientists from both camps see more opportunities for synthesis. In fact, the two sites are discussing the logistics and merits of exchanging members for a field season. This could mean marine biologists may figuratively fish around in the ancient Dry Valleys lakes and soil specialists would plow through virgin dirt around the peninsula that's been uncovered as glaciers retreat.

Wall, with the Natural Resource Ecology Laboratory at Colorado State University, said she would relish an opportunity to visit the burgeoning terrestrial environment in the Palmer LTER. Wall's team



Courtesy of Diana Wall / Special to *The Antarctic Sun*

"I think it changed how we are thinking about this ecosystem."

— Diana Wall
McMurdo Dry Valleys LTER scientist

Nematode Scottinema lindsayae at 2,400 magnification.

studies the soil flora and fauna in the Dry Valleys. She also said the meeting stimulated different ideas on how she may approach this year's field season.

"I think it changed how we are thinking about this ecosystem," she said.

The meeting also raised a slew of new questions, Wall added, that the scientists will want to revisit in another meeting. "What kind of meteorological data — snow cover, decline in soil moisture, temperature changes — do we see in the Dry Valleys that may be paralleled in a different way in the marine system?"

For Ducklow, a visit to the lakes in the Dry Valleys would offer an opportunity to look at fossilized carbon that was possibly washed into the lakes during a previous era. The carbon he normally sees near Palmer Station is young organic carbon produced by phytoplankton in recent days or weeks.

"It would be fun to go . . . and try our techniques and look at their system over there," he said.

More to come

Other subjects discussed at the Antarctic forum ranged from upcoming International Polar Year activities for individual investigators to the effects of tourism on the continent and its possible role in educational outreach.

About 15 years ago, fewer than 7,000 tourists visited the Antarctic Peninsula region. This year, nearly 30,000 people are expected to travel to the extreme south for an opportunity to see penguins, seals and icebergs, according to the International Association of Antarctic Tour Operators.

While scientists are still trying to determine what possible stresses these increased numbers may have on the ecosystem, they see a ready venue for educating the public and promoting environmental awareness.

"It is a great opportunity to talk to the tourists and get them to see the value of the science that we do," Wall said.

Another workshop between the science groups is planned, though a date has not been set. However, the Antarctic scientists will host the next meeting of the LTER Science Council in May in Portland, Ore. The meeting will be an opportunity to not only showcase what's happening around McMurdo and Palmer but also to place their data in a global context of ecosystem change.

"It sounds kind of crazy, but the marine influences on terrestrial systems, and the terrestrial inputs back to the marine, are being studied elsewhere," Wall said. "Scientists are finding these linkages increasingly important. We just haven't done it for Antarctica."

NSF-funded research in this story: Hugh Ducklow, Virginia Institute of Marine Sciences at The College of William and Mary, <http://pal.lternet.edu/>; Diana Wall, Natural Resource Ecology Laboratory at Colorado State University, <http://www.nrel.colostate.edu/projects/soil/MCM/in>.



Christina Hammock / Special to *The Antarctic Sun*

Decreases in annual sea ice around the Antarctic Peninsula have caused declines in the Adélie penguin population in the area, such as these penguins on Torgersen Island.

Science teams search out 'particle of the mystic'

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tion, and the more scientists learn about them, the stranger they seem to be.

"They exist in a way that's almost otherworldly," said Peter Gorham, principal investigator of the neutrino detector ANITA (ANtarctic Impulsive Transient Antennae). "They have very little interaction with matter as we know it. They don't affect anything that we do day to day. In some ways, they are the particle of the mystic. Physicists know they exist and can make precision measurements of their characteristics, but everything about them is strange and unexpected."

One of neutrinos' bizarre truths is that despite the lack of effect that matter has on them, they exert an enormous amount of influence on matter.

"In the early universe, before there were any elements, neutrinos dominated for some time," Gorham said. "During that time is when all the elements were formed. And without that neutrino soup in the very early part of the universe, we would not have the elements we have now. We could not. They are absolutely, inextricably tied into chemistry, physics and the physical elements. Those things could not exist without neutrinos."

To see the unseen

Neutrinos' huge importance and vast numbers have not, however, provided an easy way to study the particles. But there is one interaction that has given scientists an opportunity to observe them indirectly.

A neutrino is so small that it slips through the gaps in matter, but no one is at the wheel. The fact that they don't often run into other subatomic particles shows how small they are, not that they somehow zigzag through an atomic obstacle course.

Every once in a while, a neutrino happens to miss the gap and plows directly into a piece of an atom, destroying the neutrino and producing a reaction that scientists can detect. The collision creates a cone of visible light and a radio pulse that expands from the point of collision and continues in the direction the neutrino was headed. Scientists can use the information gathered by the observation of these reactions to learn neutrinos' direction of origin, speed and energy.

Researchers need to make their observations in a medium that is effective at transmitting the radio and light, and they have found the best substance to be ice — something of which Antarctica happens to have the world's largest supply.

The three current neutrino projects plan to look at either the radio or light signature to study neutrinos' origins and physics. But despite studying the same particle, the groups go about it in very different ways.



Ethan Dicks / Special to *The Antarctic Sun*

A string of IceCube's sensors descends into a hole drilled in the ice near the South Pole Station on Dec. 26, 2005. Eighty such strands are scheduled to be deployed as part of the neutrino detector array.

In the ice

The IceCube neutrino observatory at the South Pole is about to enter its third season of construction. Eighty strands of sensors buried vertically in the ice will make up the array. The sensors are called photomultipliers and detect the light created by the neutrino collisions.

When a neutrino hits an atom that makes up the ice, it destroys itself, but the collision creates a negatively charged particle called a muon. The muon then continues in the same direction the neutrino was headed. And as it travels through the ice, faster than light would through the same substance, it produces a cone of blue light, which is called Cherenkov radiation.

Scientists have found the ice under the South Pole to be the ideal location to observe the effect. The South Pole lies on the Polar Plateau, which is covered by three kilometers of ice. The landscape of snow is flat, like an icy, white sheet pulled taut against the Earth. The ice that lies below the surface provides the vast, dark and transparent background that scientists need to study the neutrinos' light show.

Construction crews have installed nine strands so far. Each string of 60 sensors requires a hole be drilled so crews can lower it almost two kilometers down into the ice. When complete, the array will consist of 4,800 sensors and have a volume of one cubic kilometer. The infrequency of the events IceCube scientists study means the array must be that large in order to be truly effective, said Francis Halzen, principal investigator for the project.

IceCube works by registering the exact time each equally spaced sensor gets hit by the collision-produced light — down to three billionths of a second. The scientists

can then combine the data from each sensor to create the data set they need.

"Now it's up to nature to deliver; it's out of our hands," Halzen said.

The team expects to install 12 more strands this season and will have the material on hand to complete two additional strands if they get ahead of schedule, Halzen said.

Next year, the group expects to finish 14 to 16 strands. Construction estimates are more conservative this year due to the effort to move IceCube operations out of its current, temporary laboratory, he said. The new facility will serve as IceCube's permanent nerve center, where scientists can monitor data and calibrate the array. The relocation effort will require the nine previously installed strands to be disconnected from the system and powered down.

"[Moving to the new lab] is something we're very concerned about, but it has to happen," Halzen said. "The experimentalists tell me that this is OK, that there's nothing to worry about. We've turned off strings before and brought them back to life, but some of these strings will be off for more than a week, so it's a bit scary."

He said the key to completing this season's aggressive agenda is to start on time. Last season, the team lost several drilling weeks while making improvements to the drill system.

"This year we just have some fine tuning," Halzen said. "Last season we were doing major revamping to some of the equipment."

"After this [season], we hope it just becomes routine construction. We'll have to wait and see. I guess nothing is ever routine in Antarctica."

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Radio pulses to reveal neutrinos

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On the ice

About 80 kilometers away from McMurdo Station this season, another science team will test its theory for a massive neutrino detector near Minna Bluff on the Ross Ice Shelf.

Unlike IceCube, this array would try to detect the radio pulse, instead of the light, created by neutrino collisions with the ice.

“What I need to find out is if the ice is transparent enough [to transmit the radio pulse] and if the bottom of the Ross Ice Shelf acts as a mirror, which it should. The bottom of the Ross Ice Shelf is water, and water reflects radio,” said Steve Barwick, principal investigator of ARIANNA (Antarctic Ross Iceshelf ANTenna Neutrino Array). “That’s the linchpin of [the project].”

If the theory is proven, Barwick and his team plan to construct an array of antennae, which will point down into the ice and capture the radio waves reflected off the bottom of the ice shelf.

The array would function in a similar way to IceCube, with each sensor registering the nanosecond it detects the pulse.

ARIANNA is specifically designed to look for the highest energy neutrinos, which are some of the rarest of the already elusive particles. The scientists want to be able to detect 40 to 50 of these events each year, Barwick said, and therefore have designed the array to epic proportions.

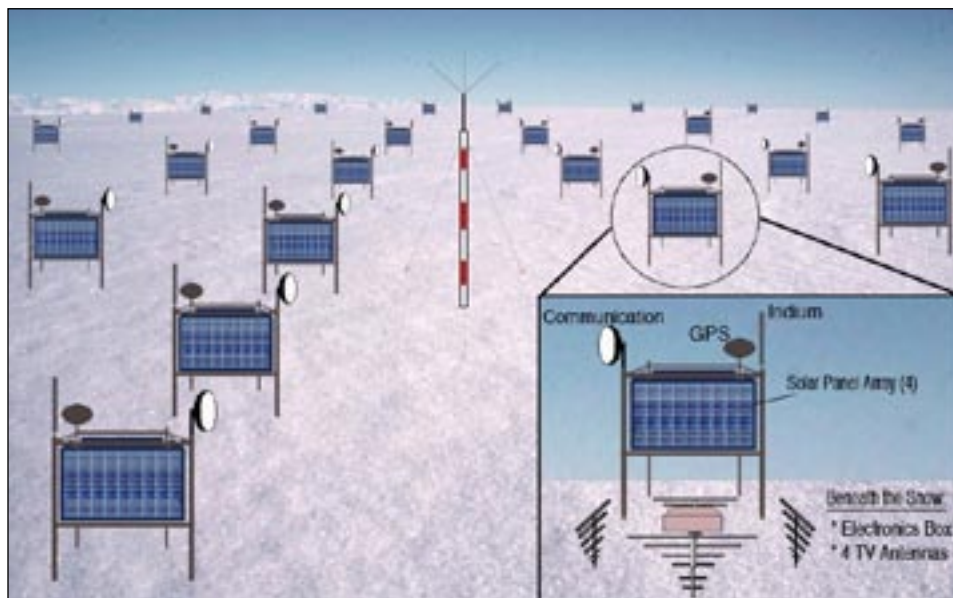
The current specification calls for ARIANNA to be built as a square grid, 100 by 100 sensors wide, with about three football fields in length between each.

“We’re talking about 10,000 of these antennas,” Barwick said. “If we could make it any smaller we would. ... There just aren’t many of the reactions we’re looking for. That means [we] have to build a huge detector, much bigger than IceCube, much bigger than anything we’ve built before. So, ARIANNA would be a 30-kilometer by 30-kilometer array of antennas — that’s pretty darn big.”

Above the ice

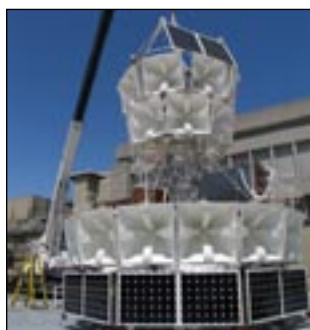
IceCube is still under construction, and the plans for ARIANNA are just starting to solidify. But neutrino scientists around the world won’t have to wait until those projects are constructed to get their first glimpse of extraterrestrial neutrinos hitting Antarctica’s icy surface. One neutrino detector will be fully operational this summer as it soars high above the planning and construction activities of the other projects — the balloon-borne ANITA.

Scientists have designed this detector as a payload for one of NASA’s long-duration



Steve Barwick / Special to *The Antarctic Sun*

Above, an artist’s representation of ARIANNA demonstrates the neutrino detector’s concept. It is designed to be a grid of 10,000 stations, which will register radio pulses generated by neutrino collisions in the ice. Scientists plan to construct the 100-by-100 sensor grid on the Ross Ice Shelf.



Jeff Kowalski / Special to *The Antarctic Sun*

Left, the ANITA payload sits at the Stanford Linear Accelerator Facility where it was calibrated by sending pulses of high-energy particles into an almost 8-ton block of ice. The device will be deployed by long-duration balloon over Antarctica this season. ANITA will be looking for high-energy neutrinos through detection of radio pulses.

balloons. The stadium-sized balloon will carry ANITA around the continent at about 38,000 meters in the air, said Gorham, the project’s principal investigator.

“We can see an awful lot of ice from afloat — about a million cubic kilometers at one time,” he said. “Most of the other neutrino experiments are focused on relatively small volumes of ice.

“We’re looking at as much of the ice as we can see at one time, which works out ... to be about 10 to 15 percent of the whole continent. We’re able to see neutrinos interact if they happen anywhere in our field of view — even out to the horizon. These neutrinos can collide a mile down in the ice and create a radio pulse that propagates up and is detected by our balloon 400 kilometers away.”

ANITA is after the same high-energy neutrinos for which ARIANNA will search. These neutrinos have never been observed but must exist, according to the laws of physics, said Gorham. He related the expectation of these neutrinos to seeing the muzzle flash of a gun, smelling the smoke, and searching for the bullet.

“If we don’t see these neutrinos with ANITA,” Gorham said, “there’s still a little

bit of wiggle room for theory to recover, but it’s going to get uncomfortable because our basic, prime theories of how things [work] are going to be challenged.”

ANITA will fly for up to 40 days this season. While it can survey much more land at one time than its ground-based cousins, it’s limited by the duty cycle of the balloon. And since ANITA is a single-point detector, it cannot gather the detailed information about each interaction that the array detectors will.

“ANITA will be able to make crude measurements of energy and direction to establish the nature of the particle but not much beyond that,” Gorham said. “It’s really very focused on the discovery rather than the precision measurements.

“It’s [part of] the classic experimental effort to try to challenge what we don’t know and see if we can chip away at our ignorance.”

NSF-funded research in this story: Francis Halzen, University of Wisconsin-Madison, icecube.wisc.edu; Steve Barwick, University of California, Irvine; Peter Gorham, University of Hawaii, www.phys.hawaii.edu/~anita.

Alaskan storm broke up Antarctic iceberg

From page 1

toward funding for research. His first stroke of luck came in 2000 when iceberg B15 calved, or broke off, from the Ross Ice Shelf. Concerned that the monstrous iceberg, almost as large as Connecticut, could block shipping lanes to McMurdo Station, the National Science Foundation authorized a special two-year study.

That research spawned a four-year program, currently in its last year of funding, which included placing four seismometers on icebergs. All of those set the stage for the big payoff in MacAyeal's chain of events.

The big breakup

On Oct. 27, 2005, iceberg B15A — the bulk of the original B15 — having since wandered from the mouth of McMurdo Sound, suddenly shattered. In a span of about six hours, it broke into seven large pieces and about a thousand little pieces, MacAyeal said.

The equipment placed on B15A to monitor the iceberg's movement became a potential source of insight into how and why it broke up. A mission was conceived to salvage the equipment. It involved a pilot and someone from the Field Training Safety Program setting out in a Twin Otter filled with drums of fuel. They stopped en route to the distant iceberg to transfer fuel from the drums into the airplane. The reward came when they were able to retrieve the data and return it to the scientists.

As researchers analyzed the information available on the iceberg, they found themselves ruling out likely causes. Its course had been relatively straight. Winds prior to breakup were at their lowest velocity of the month. Its speed had been at its lowest levels.

Likewise, the seismometer showed nothing in the beginning of the month, but then there was an ocean swell and then, "waves big enough to resonate the iceberg relentlessly, hour after hour," MacAyeal said. In the beginning, the waves came in at a very low frequency. Over the next few days, the slower and higher frequency waves continued to rock the Antarctic coast.

Long-distance information

Analyzing the rising frequency of the wave lengths and their intervals, scientists were able to calculate the distance to their origin — 13,454 kilometers from Cape Adare. Readings from other seismometers confirmed similar readings and the intersection of the plots was in the Gulf of Alaska. Sure enough, five to six days before the breakup of B15A, a monster storm raged off of Alaska, kicking up waves more than 14 meters in height. MacAyeal's team checked readings from Pacific buoys and



Brien Barnett / Special to The Antarctic Sun

various islands, and they were able to track the diminishing waves on their southern route.

Using what they learned, they have since inspected dozens of storms, both larger and smaller, and tracked the progress of their waves across large expanses of ocean and ending in Antarctica.

MacAyeal boiled his theory down to what he called simple and dirty: "I'm saying that nasty ocean waves, that happen when you have hurricanes and other storms way out there in the Pacific, those waves are coming here to Antarctica and they're the main energy we see out there on the sea ice right now."

The room for argument, he said, is whether it is a coincidence that the storm waves arrived at the time the iceberg broke up or if it is an essential necessity that the waves are pounding the iceberg at breakup.

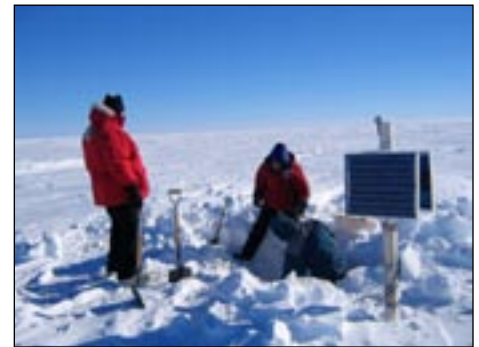
What he is trying to prove now, he said, is if such wave action can influence ice shelves and the calving of new icebergs.

"So, I'm saying that if this is true," MacAyeal said, "if it continues being true and my hypothesis continues being right, that means that storms in the tropics and the Northern Hemisphere and Southern Hemisphere storm belts are at the root of what determines the rate of calving of icebergs from the Antarctic ice shelves."

If that is true, and knowing that levels of storminess change, he said that would indicate that the calving rate of the Ross Ice Shelf would change.

"Then you would say, 'What would be the consequence of that?'"

He said scientists studying ice stream



Katie Leonard / Special to The Antarctic Sun

Above, Doug MacAyeal's group uncovers seismometer equipment in the field on Oct. 30. The group is in its last funded season and is repairing and upgrading many of its instruments in the field.

Left, MacAyeal adjusts wires on the weather and GPS station installed on B-15A on Oct. 31, 2003. MacAyeal leads a McMurdo-based science group that studies the drift and breakup of icebergs.

flow believe that ice shelves act like corks to ice streams. If a shelf breaks up, it could "uncork" the stream and its flow of ice into the ocean would increase.

"And if the ice stream speeds up, that means that Antarctica is discharging more mass than it receives," MacAyeal said. "That mass has to go somewhere; it goes into the ocean and that means the sea level rises."

A chain reaction

Meanwhile, his attention is directed to a couple of other icebergs — B15K and C16 — which are drifting north, carrying scientific equipment that is now too far away to be recovered. Even though funding for his study ends this year, MacAyeal said he hopes to receive data from this wandering equipment for another 10 years, offering an accelerated look at global warming.

"In their world, they're going to warm like gangbusters because they're going to go to about 40-48 degrees south [latitude] and into that warm, temperate water. We're going to want to continue to watch how they move, as well as to how they melt and break up."

And he can't help but look even further down the line, even toward the "far-fetched" idea that studying the drift patterns of icebergs may be useful one day for tapping their vast fresh water content for people in need.

NSF-funded research in this story: Doug MacAyeal, University of Chicago, <http://ice.ssec.wisc.edu/iceberg.html> and <http://geosci.uchicago.edu/~drm7>.

Profile Janitor focusing on work

By Steven Profaizer
Sun staff

The janitors of McMurdo Station and the people of the African country of Senegal may not have much in common, but they will soon have one shared experience — being filmed as part of amateur documentaries by Sharona Thompson, or Sountou Bombara, as she is known in Senegal.

The first-year janitor plans to turn her camera toward her co-workers this season in an attempt to capture their life in Antarctica.

“I think that there’s a compelling story in the janitor world here on what would bring people — talented, intelligent people — to come down to scrub toilets for a summer on the bottom of the planet,” said 34-year-old Thompson. “I want to go underneath the surface of that and explore it.”

Filming documentaries is a newfound passion of Thompson’s. She first discovered her interest in 2004 while working with Tostan, a non-profit organization in Senegal, to document movements among villages regarding women’s health and human rights.

After about a year of interviews, she created three films from her footage. Tostan then showed the documentaries to world leaders and donors.

“I really got turned on to the power of film,” Thompson said.

Documentaries may be a new medium for her, but Thompson is no stranger to either art or the Ice. The art major hails from California, which is where she heard tales of working in Antarctica from her two siblings, Leah and Will, who had both spent time in McMurdo. Her brother even joined her this season and is back on station for the first time in six years.

Thompson said she has aspired to become involved in issues of social change since high school and has found documentaries to be a very natural fit.

“I think that filming documentaries is good hybrid of two things I’m very interested in — art and activism,” she said.

Her involvement in Senegal stems not only from her conviction for Tostan’s cause but from her personal connection to the people of that country. She lived in one of the country’s many villages for two years with the Peace Corps in the late 1990s. There she worked to improve the villages by building gardens and mud stoves. This is also when she first got involved with Tostan, working as a liaison for the program in her region of Senegal.

Thompson’s love for the African country is obvious — her passion for the people



Steven Profaizer / The Antarctic Sun

Sharona Thompson looks through her camera while wearing her cleaning gloves and safety glasses. She plans to film a documentary about the janitors with whom she works.

“I think that filming documentaries is a good hybrid of two things I’m very interested in — art and activism.”

— *Sharona Thompson*

and the culture fills any room where she’s talking about it. And you’re almost as likely to catch her sweeping the halls to a Senegalese dance beat on her iPod as you are to any American music.

When you ask about the mud-hut villages — one of her favorite parts about Senegal — you can see her senses light ablaze with the memories. Sights, smells and tastes seem to move from the past to the present as they transport her back to her small village. Her resulting description sounds almost as though she’s walking through the village and describing what she sees:

“There’ll be a compound with an open area and a big tree where people hang out under the shade and all the huts face inward with another compound right next door. People just kind of move through. Little naked kids are running around.

“You’ll have women, mainly throughout the entire day, preparing the meals for the whole family. They have these big mortars and pestles where they’ll be pounding the grain. And they’ve got these buff arms.

They’ll be cooking over an open fire.”

Despite the obvious joy she gets from reflecting on her time in Senegal, her experience there was also a time of painful growth and realization, Thompson said.

“I had never had real experience with people who were on the brink of being able to have food to eat or not. That was hard to see — really hard.”

Her love for the country’s people and passion for their plight continues to motivate her. Thompson is currently saving money to return to the villages of Senegal.

She has already saved up and purchased a better video camera and computer than she had to work with on her first trip, and she plans to continue capturing the Senegalese saga firsthand.

“I’m excited and dreading it at the same time,” she said. “After Peace Corps, it took me a few years to recover, to be honest. Seeing poverty on that level was disturbing to me. I had never experienced anything like that. It’s life on such a more raw level.”

Thompson said that now that she’s had that experience, she has to be part of the solution. So it seems that the people of Senegal have made a lifetime friend and advocate in Sountou Bombara.

While she prepares for her return to Africa, she said she sees her Antarctic documentary not only as chance to develop a new hobby but as a way to sharpen her skills to help spread the word of Senegal’s progress.