The Antarctic Sun

Published during the austral summer at McMurdo Station, Antarctica, for the United States Antarctic Program

November 17, 2002

Photo by Melanie Conner/The Antarctic Sun

Diver Rob Robbins, Crary Lab Supervisor Steve Alexander and Water Plant Manager Jordan Dickens investigate slime coating the inside of the pipes feeding the water plant.

Attack of the terror-pods

Scientific sleuthing solves water plant mystery

By Kristan Hutchison
Sun staff

McMurdo's water supply is under attack from minuscule creatures rarely seen in such large numbers at this time of year.

It took the combined efforts of water plant operators, plumbers and scientists to figure out why water filters that normally last two months were clogging up in a day. While they think they've found the immediate source of the problem, some scientists suspect iceberg B15 may be behind it all.

"First B15 tries to take us out, then the pteropods tried, but science will win," said Crary Lab Supervisor Steve Alexander, who's been helping break the case of the blocked water filters.

Everything was running fine at the McMurdo water plant until October. Then the system began bogging down.

McMurdo was never in danger of running out of water, but the freshwater storage tanks did get uncomfortably low, said plant manager Jordan Dickens.

See Pteropod on page 7

Ozone

The good, the bad and the beautiful?

By Melanie Conner
Sun staff

California's beauty is smog-deep.

"I love L.A.," reads a worn-out, bumper sticker posted on a sign on Santa Monica Boulevard. A brown haze rises up from the valleys of Los Angeles and dissipates into the blue sky. At dusk the sun dips below the horizon and its rays scatter through the haze, creating a palette of magentas, reds and oranges. Smog created by ozone — it hovers low in the atmosphere and blankets the valleys of Southern California.

Ozone in the lower atmosphere, known as ground-level ozone, threatens the health of humans and the environment because of the toxic smog it helps produce. To better understand how the ozone works in polluted coastal cities, and maybe develop methods to stop it, researchers traveled across the globe this year to study it in Antarctica for the first time.

But isn't ozone good? A protector of Earth?

Ozone is made of the same chemical composition regardless of where it is found, but its significance varies. High in the atmosphere ozone guards Earth against ultraviolet radiation, but it is poisonous to breathe.

In Earth's upper atmosphere, what scientists considered to be "good"

See Bad on page 9

Quote of the Week

"The good part about it was they were right there where the work was this morning."

— About helicopters being stuck overnight in the Dry Valleys

Ross Island Chronicles

By Chico

Cold, hard facts

Ozone

Amount that CFC use has been reduced since 120 countries signed the Montreal protocol in 1987: **85 percent.**

Percent of CFC's used in aerosols before the ban: **28 percent**

Percent of CFC's used in aerosols today: **5 percent**

Number of ozone molecules one molecule of CFC can destroy: **100,000**

Lifetime of CFCs: **20-100 years**

People predicted to go blind as result of a 1 percent decrease in ozone: **100,000 to 150,000**

Expected increase in skin cancer among fair-skinned people if there is a 10 percent loss in ozone globally: **26 percent**

Source: Atmosphere, Climate & Environment Information Programme, U.S. Environmental Protection Agency

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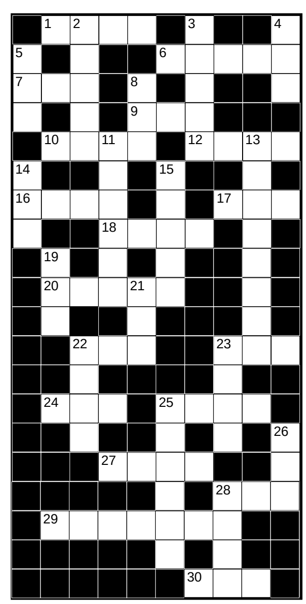
Web address: www.polar.org/antsun

Katabatic Krosswords: Acronyms

The "words" this week are all abbreviations. Be warned: not all of them are as obvious as their full names might suggest.



Across

1. Center for Astrophysical Research in Antarctica
6. Falkland Islands' gov't air service
7. Estimated time of return
9. Personal protective equipment
10. U.S. Antarctic Program
12. Provides support services for the U.S. Antarctic Program
16. Specially protected areas
17. Automatic Geophysical Observatory Servicing Program
18. New Zealand's polar program
20. Air Shower Experiment at Pole
22. Long-duration balloon project
23. Allowable cabin load
24. The teachers' Antarctic program
25. Advanced Technology for Radar Sounding of Polar Ice
27. Site of special scientific interest
28. Where clothing is issued
29. Trans Antarctic Seismic Camp
30. Extreme cold-weather gear

Down

2. Radio and TV at McMurdo
3. Trans-Iron Galactic Element Recorder
4. Antarctic program's gov't agency
5. The mechanical center
8. NSF's polar office
11. Antarctic Muon and Neutrino Detector Array
13. Does ship-based winter studies
14. Old Antarctic explorer
15. A scientific traverse team
19. A station science leader
21. Special cold-weather oil
22. Long-term research project
23. Antarctic Meteorological Research Center
25. Antarctic Search for Meteorites
26 Field operations communications center
28. The Crary lab

Solution on page 6

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

Planning for the future

New Web-based system simplifies preparing for the Ice

By Kristan Hutchison
Sun staff

The Antarctic program is taking a lesson from Amazon and other dotcoms as it reworks the process scientists go through to plan their trips to the Ice.

Scheduled to go into use in March, the new Web site should make planning an Antarctic project as easy as Christmas shopping online for a very large family.

Log into the Web site, click through and fill out the forms asking for everything from field camp sites and deploying team members to whether you will be bringing home samples. The answers determine what supplies are ordered, whether permits are arranged, when flights are scheduled and how science samples are treated on their way home.

"This is where they come to do their shopping for their trip to the Ice," said Scott Holbrook, the senior software architect for the new online planning system. "This is how we support the planning team in determining what they get on the Ice."

The new system will replace an earlier attempt to computerize the planning process, called the Electronic Support Planner or ESP. Introduced about five years ago, ESP was sent to grantees as a zipped application file and could be downloaded onto only one computer. The grantee was supposed to fill out the application on that computer, replicate the application and send it back. But ESP didn't work on many computers, including most Macintoshes, Unix-based systems and anything using Netscape 6. It was universally disliked.

"It was awful," astrophysicist John Carlstrom said of the old system. "I used to think it was ESP because the only way they could get the information was to read your mind."

As technical support for ESP, John Dowd heard all the wisecracks about how poorly it read minds and predicted future needs.

"It was a good program for the time in which it was developed. It's just there are so many more supportable ways to do it today," Dowd said. "The software it is written in is very old."

A team of seven software engineers at Raytheon Polar Services Co. in Denver has been working since July to create something better. The Participant On-Line Antarctic Research Information Coordination Environment, or POLAR ICE, will be faster, more user friendly and completely Web based. Grantees will go to polarice.usap.gov and fill out forms, much as they would to shop online.

"We're trying to make it as simple as an L.L. Bean," Holbrook said. "It's difficult though, because usually when you go to Amazon or something you order one or two books; you're not ordering 120 things."

Some grantees need over 150 items. In ESP the process became cumbersome, with new windows opening for every detail. The user could easily become lost seven windows deep, Holbrook said.

POLAR ICE will keep everything in the same window, with a trail of "breadcrumbs" or links above reminding users where they are and where they've been on the site.

Missing a line in the paperwork can drastically impact a science project. Forget to fill out refrigeration requirements, for example, and carefully collected samples could melt and be useless by they time they arrive at a lab in the U.S.

The POLAR ICE planning process will be smarter, cross-checking information submitted on one screen with the others and reminding grantees to fill in blanks.

"It's got built-in intelligence to help the user fill everything out," Holbrook said. "If you missed your cooling requirements, it will tell you."

"There are a lot of groups here and we want to make sure the resources we have are fairly accessed by all."
— *Brian Stone, NSF Representative*

The resulting data will be accessed by a new group of Raytheon employees whose sole purpose is to help with planning. Improved preparation in the U.S. should allow researchers to focus on science during their few weeks in Antarctica, without being distracted by logistics, said National Science Foundation Representative Brian Stone.

"We take top-quality researchers and bring them to Antarctica," Stone said. "We want them to be as productive as possible."

The new system will also look into the future, planning the needs of each grant several years out. In the past, the needs weren't determined until April each year, and by then it was too late to put needed equipment or supplies on the supply vessel.

"We're trying to think about the project in its entirety, rather than just doing it a year at a time," Stone said. "Wouldn't it be great if you knew you needed a certain piece of equipment, instead of buying it in June and flying it down or making it on site, wouldn't it be great if we had it in advance?"

A more complete planning process will allow the Antarctic program to be better prepared, balancing the needs of each science project and adapting when necessary because of weather.

"There's a difference between flexibility and bad planning," Stone said. "There are a lot of groups here and we want to make sure the resources we have are fairly accessed by all."

A demo version is already on the Web, at polarice.usap.gov. So far 17 grantees gave input into the software. Holbrook encourages others to try it and send in comments.

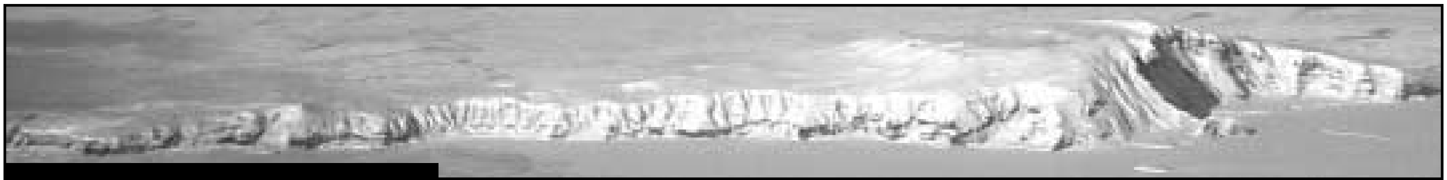
"We want all the grantees to take a look, because this is the way they're going to do it next year," Holbrook said.

POLAR ICE will be tested in January and should be working by March 1, Holbrook said. Dowd expects to answer the same number of calls from people learning the new system, but that fewer of them will be frustrated.

"It's just going to be a whole lot easier for us to support and for folks to get into," Dowd said.

If there are any problems, he can always walk down the hall to the software team and have them fix the program. An update is planned for March 2004 with features they didn't have time to add in the initial "hyperaggressive" eight-month development timeline, such as the ability for the grantees to use a built-in calendar interface for research mission itinerary planning, and for planners to control resources and supplies through an online inventory management system.

"I think everybody's eager to get rid of the old system," Stone said. "We want POLAR ICE to be as intuitive to use as buying something at REI."



Perspectives

Condition Zero

By Robert Zimmerman

Twenty feet ahead of me, I can see the outline of Charlie's snow cat trudging through the deep powder, driven snow swirling behind it like the glittery trail of a fairy. Five feet ahead of his machine, I can discern nothing.

We are heading back to McMurdo, driving south on the Ross Ice Shelf, and the weather is getting worse. Charlie and Doug are steering by GPS, and I am following them, trusting unquestioningly in their navigation. Suddenly they come to an abrupt halt and I very nearly drive over the sled they are towing behind.

There is a call on the radio. "Three-oh-nine to three-twenty…" Charlie is hailing me.

"Go ahead Charlie…"

"Where are you Zim…over?" Even with my running lights on, front and rear spotlights and two yellow beacons twirling away, Charlie cannot see that I am close enough to suggest that doctor/patient confidentiality may be in order.

We left town this morning in flat light and blowing snow, following the flagged route to Windless Bight. There, in the protected elbow of Ross Island's southern shore, Science has established a complicated array of barometric sensors able to detect a nuclear test blast anywhere on the planet, and we were to erect a tent for the technicians. I don't pretend to understand the workings of their sensitive equipment.

I first arrived at McMurdo Station in November of 1996 and began a series of menial jobs that usually involved shoveling snow or demolishing a building. I did not know it then, but I was reducing major sites of local culture into neat stacks of wood and metal. To this day, whenever I hear stories from old timers lamenting their days working and living at Willie Field, I am struck by the march of time as I guiltily admit my part in the destruction of their once-beloved home.

By the time I joined the carpenter shop last year, I had destroyed more buildings in Antarctica than fire and weather combined. It feels good to build for a change.

Photo by Kim Boyer/ Courtesy of Robert Zimmerman

Robert Zimmerman rocks out at break time.

Earlier this morning, as we set to work on the tent, I questioned Charlie, almost rhetorically, "Do you ever look around and say to yourself; 'I can't believe I am doing this in Antarctica'?" Of course he had. We all have, it's a thread that connects us.

Suddenly, as if to confirm that we were in Antarctica, we were struck by a curtain of swirling snow and wind. Hunkered down out of the wind, politely devouring our sack lunches, we listened to the walls flap, and secretly planned whom we would eat first if the storm kept up. When the walls stopped shaking momentarily, we sprang to action, finishing up on the tent and anchoring it to the snow just as the next wave of weather enveloped us.

Weather in the United States' Antarctic Program is rated in conditions 3 to 1, three being the fairest. Driving back to town through condition zero, Charlie and Doug have come to a sudden stop. Understandably disoriented, they're no longer sure which way the road lays. I radio ahead: "I have a few more waypoints along this stretch. I'll take the lead."

I put the snow cat into gear and pull around Charlie and Doug into…nothing. If I didn't know better I would suspect that Christo, the international artist known for wrapping buildings, trees, islands, and fields in colorful fabric, has shrouded our vehicle in white linen. I labor forward slowly, staring intently at the display of the GPS. But it has been so ingrained in me to watch out for children and running deer that it feels wrong to rumble blindly through physical space while staring at a Game Boy.

Soon I, too, am disoriented. The snapping flags appear out of thin air just ahead of me, then to the right, then the left. I lean forward, straining for a better view but my new proximity to the windshield just creates the illusion that I am snorkeling through a bowl of cereal, the occasional flag floating by like a frosted flake in grey skim milk.

Plotted on the tiny screen of the GPS my trail resembles the erratic line of a heart monitor. My heartbeat follows this pattern, becoming significantly more spastic during those periods when I am steering sharply back and forth, crossing the trail like a bloodhound.

As we get closer to McMurdo the flags come more regularly and we can see two or three at a time. We travel faster, sitting back in heated seats, stopping occasionally to clear off the ice from our windshield wipers and check the straps on the sled. We huddle together in the lee of our vehicles to comment on our progress and compare GPS tips.

I take one more deliberate walk around my snow cat. We are nearing McMurdo, and though the workday is over, I am reluctant to get back in to the warm cab and end this adventure. I can't believe I am doing this in Antarctica. In these moments I am acutely aware that every season I spend here may be my last, and experiences like these may one day be nothing more than tired old stories. Unless my career as a photographer doesn't pan out. Then I might find myself still in McMurdo 15 years from now, misty-eyed and nostalgic as I watch a wide-eyed FNG, blissfully and enthusiastically razing the buildings I will work on this week.

Robert Zimmerman is the equipment operator at the carpentry shop at McMurdo Station. His storage locker is in Buena Vista, Colo.

Send columns up to 900 words to antsun@usap.gov.

around the continent

PALMER

Counting the krill

By Tom Cohenour
Palmer correspondent

Dan Martin and Charlie Boch spend part of each day at Palmer Station counting krill. And counting, and more counting.

"It was wild," exclaimed Martin, a research biologist, when describing one of his dives among tens of thousands of krill as he was collecting specimens.

Krill are small, translucent, shrimp-like creatures that congregate in dense masses in the ocean. Called swarms, these masses sometimes stretch for miles in every direction. Thousands of krill packed into each cubic yard of water turn the water red or orange.

There are about 85 different species of krill worldwide, although it's *Euphausia superba*, or Antarctic krill, which is the largest and most abundant in Antarctic waters.

Martin and Boch, both with the Zooplankton Component of the Long Term Ecological Research Project, could be counting a long time. It's estimated that there are about 500 million tons of Antarctic krill in the southern oceans.

"It's believed that Antarctic krill have a life span between five and eight years," Martin said. "They eat phytoplankton, single-celled plants that float in the seas and ice algae that grow on the bottom of pack ice."

Photo by Dan Martin/Special to The Antarctic Sun

Swarms of krill swim below the Antarctic ice near Palmer Station.

Photo by Dan Martin/Special to The Antarctic Sun

Mmmm...krill are a mainstay of life for Antarctic sea creatures.

The largest Antarctic krill are a mere 2.3 inches (6 cm) long and weigh only 0.035 ounces (1 g). It's hard to imagine, then, that a creature such as the gigantic 80-foot long (23 to 24.5 m), 110-ton (99,800 kg) blue whale could sustain itself on a diet primarily of krill. But what the krill lack in size they make up for in numbers. It's estimated that blue whales consume an astounding 4 tons (3.6 metric tons) or more each day. This means it may eat up to 40 million krill a day. That's a lot of counting.

Krill are so abundant that they are the dietary staple for many predators besides whales, such as dolphins, seals, fish and birds. Not to be left out of the feeding frenzy, humans also eat krill. Check out the Website http://sandypool.tripod.com/krill/id8.html and select from Krill Meal, Cooked Frozen Krill Tails, Fresh Frozen Krill Meat, or Frozen Krill.

According to an article by Stephen Nicol and Maria Clippingdale, both with the Australian Antarctic Data Committee, "Antarctic krill would have to be one of the most abundant and successful animal species on the planet. Female Antarctic krill lay up to 10,000 eggs at a time sometimes several times a season."

Estimates of krill abundance vary, but many believe that a sustainable krill harvest of around 150 million tons a year is possible. To put this enormous number into perspective, consider that less than 100 million tons of all species of fish and shellfish are currently harvested from the oceans of the world each year. "The biomass of this one species may be the largest of any multi-cellular animal species on the planet," state Nicol and Clippingdale.

The human food production possibilities of this enormous biomass were recognized by internationally known Antarctic researcher, Dr. Mary Alice McWhinnie (1922-1980) who spent the austral summer 1975-76 at Palmer Station studying the metabolism and biochemistry of Antarctic krill. In 1962 she became the first US woman scientist to participate in Antarctic fieldwork.

No doubt Dr. McWhinnie spent untold hours counting krill. And counting, and more counting.

SOUTH POLE

Well-fed and hard at work

By Anne C. Lewis
Pole correspondent

This year's transition has been smooth, as we slip into remembering how life works down here at 90 degrees south or figure it out quickly for the new timers. Cookie Jon and the kitchen crew manage

See Pole on page 6

Photo by Mattson Miller/Special to The Antarctic Sun

Polies greet friends arriving as the summer season ramps up.

the week in weather

McMurdo Station
High: 29F/-2C Low:4F/-15C
Wind: 47 mph/75 kph
Windchill: -30F/-35C

Palmer Station
High: 42F/5C Low:17F/-8C
Wind: 23 mph/37kph
Melted precipitation: 1 cm/0.4 in
Snowfall: 1 cm/0.4 in

South Pole Station
Not available

Pole

From page 5

to create a fury at the food line, with items such as Beaver's E-bar-L London Broil, the Stroganoff laced with fresh sour-cream, and the abundance of fresh eggs and omelet's made-to-order in the morning. The baked goods and desserts have been outstanding (crème anglaise with real cream!), and the Midrats crew is reporting high marks for the overnight.

Most of us don't eat this well at home. Another great note, there is an outstanding turnout for greenhouse volunteers— we are excited about the prospects for serious salad and freshie production this year.

The galley is alive with warm smiles, old friends and home cooking pleasures. This food fuels our souls as we push ourselves to start the season off running. This year's science, construction and airlift schedules are as ambitious as ever. Among the science, several cosmologists were on station checking on their instruments that run through the winter. John Carlstrom took time to give a talk on exploring the early universe from South Pole. Carlstrom explained his DASI experiment and how it helps confirm the "weirdness" of the universe. The talk was wrapped up with a strategy for a future telescope project that will predict the ratio of Dark Matter to Dark Energy in the present day compared to early in the infancy of the universe.

Round-the-clock shifts keep the Pole alive. The glistening ice, the near blinding light, the rumble of heavy equipment and skidoos zipping around, the fuel heaters pumping and construction crews bustling are all signs that the Pole never stops. Progress can be felt in the crisp, cold air.

It's still hard to recognize each other in all of our extreme cold weather gear; hard to know which Polie is under all those layers. In no time at all, our true colors will shine through, especially since each of us certainly squirreled away some funky piece of wardrobe we couldn't resist fitting into our allowable baggage limit. Those unique and bizarre clothing items, along with the many skua treasures, spice up our white, icy world down here at 90 degrees.

It is early in the season. Beards and eyelashes still ice up. Contrails from the idling Hercs still linger, but are slowly diminishing and we are all settling in for the upcoming months together. We are figuring out a lot of things, including how to personalize our rustic Jamesways, how to stay warm and fight off frostbite, where the extra wool blankets are stashed, the ins and outs of chamber potting, how to sleep with planes landing in the middle of the night, where to muster when the fire alarm sounds loudly under the frozen Dome, when the satellites are up so we can make phone calls, how long it takes to receive that cherished package from home, how to win the flannel sheet lottery, how to manage that two-minute shower, how to drive a Pisten Bully and how to shovel snow all day long and survive. It is certainly a unique world down here. From 90 degrees we are ready to run.

SHIPS

Floating classroom

The *Nathaniel B. Palmer* is being used as a college classroom and a floating laboratory as it travels from Port Hueneme, Calif., to Lyttelton, New Zealand. Joann Stock from the California Institute of Technology is teaching marine geophysics to 16 graduate and undergraduate students, while her research team surveys the several major fracture zones on the ocean floor.

The *Lawrence M. Gould* stopped at Hugo Island last week to repair an Automated Weather Station. The *Gould* then continued on to Palmer Station, where it delivered the head summer cook and several scientists.

30 days left

to submit entries to the Antarctic photo and writing contest.

8 categories
8 chances to win

4 photo categories: Scenic, wildlife, people and other.

4 writing categories: Microfiction, poetry, haiku and nonfiction.

E-mail entries to Antarctic Sun - McMurdo by 7 a.m. Dec. 16.

Crossword on p. 2

Continental Drift

What are you going to do to get out of town?

"I would go out to one of those floating icebergs; what was it? B15?"
Jen Petrik
McMurdo plumber's helper from Crescent City, Calif.

"I'll be walking to the downed C130 and I'll be power-walking to the ski hut...and I may fly to the Bahamas."
Ruth Ofstedal
South Pole FEMC work order planner from Minneapolis

"Stock one of Palmer's new Aqua Trikes with supplies and pedal over to Pt. Lockeroy."
Cara Sucher, *Palmer Sr. Asst. Lab Supervisor from Denver*

Pteropod

From page 1

Don't be deceived by the pteropods languidly fluttering wings and diaphanous body. These are kamikazes headed toward the water intake pipe.

"We got down close to 100,000 gallons and that is a scary figure, because that's what the fire department says they have to have as a bare minimum," Dickens said.

Antarctica holds 90 percent of the world's fresh water, but it's frozen, leaving nothing to drink or wash with. For water, McMurdo Station depends on a reverse osmosis system, which forces sea water through membranes so fine only the water molecules can squeeze through, leaving a salty brine behind.

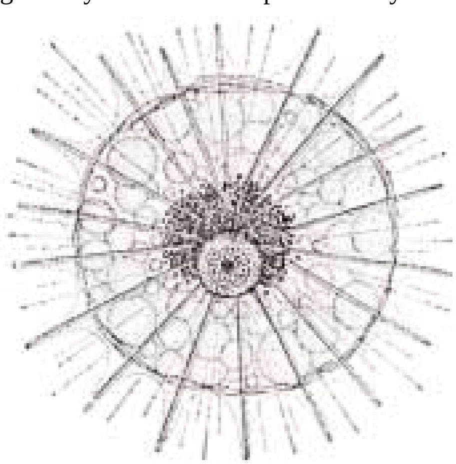
Before going through the reverse osmosis system, the sea water is sent through three banks of filters. The first set of filters are designed to strain out flotsam and jetsam, but sea creatures often get pushed through by the water pressure and end up in the sea water holding tank. From there the water is sent through media filters, 7-foot tall containers packed with layers of sand, garnet and gravel that capture the larger chunks. The media filters are cleaned by backwashing – reversing the flow of water to dislodge any organic debris.

Then the water passes through a much finer set of filters made of polypropylene coils, which blocks everything larger than 5 microns, 20 times smaller than a human hair. The 5-micron filters generally need to be replaced every two months. Dickens tried to figure out what was happening as the filter's lifespan dropped to 20 days, then eight days, then 11 hours.

"When we first pulled these (filters) out and said 'What ... has been going on?' they were slimed with this orange slime we'd never seen before," Dickens said.

Photo by Melanie Conner/ The Antarctic Sun

A sample of slime scraped from the water plant pipes turns out to be a mixture of pteropod remains and bacteria. Similar goo has clogged the filters.



Radiolaria are also being sucked into the water filters.

The slime looked and felt like a mixture of Vaseline and mucous.

"We had plumbers and water tank people trying to figure out what this was," Alexander said. "But here we were at McMurdo Station, with more scientists per square foot than anywhere else in the world."

So science came to the rescue. First Art DeVries analyzed the slime and identified it as pteropod residue. Or "terror-pods" as Alexander now jokes.

Pteropods don't look terrifying. They're translucent orange bodies float through the water "like mini-Spanish dancers," Alexander said. Barely an inch tall, they have the same kind of delicate beauty as a jellyfish or the inside of an iris. Although they occur in McMurdo Sound, they're rarely seen in huge numbers at this time of year. This summer the divers swam through clouds of them.

Photo by M. Dale Stokes/NSF

A pteropod swims by.

Don't be deceived by the pteropod's languidly fluttering wings and diaphanous body. These are kamikazes headed toward the water intake pipe. They slip in silently and splatter themselves across the filters. Alexander has seen the evidence.

He and Dickens opened the tank where sea water is stored before going through the water plant to see what might be clogging the filters.

"When we opened it up there was about an inch and a half of fish mush at the bottom," Dickens said.

To get a sample, Alexander stuck a 15-foot plastic tube into the tank and began to suck, like drinking a very tall, thick milkshake with a straw.

"My eyeballs were almost coming out of my head," he said.

Back in Crary Lab, he looked at the sediment sample through a microscope and saw not bones but the various gelatinous parts pteropods leave behind.

"It was clear at the start that the initial contamination was pteropods," Alexander said. "Rather than just guess, we actually used science and microscopes to figure out what it was."

Three weeks ago diver Rob Robbins covered the water intake pipe with a plastic mesh screen, suitable for keeping out pteropods, and they called the case closed. Problem solved.

Or was it? A week later the filters were still clogging at the same rate, only nothing could be seen on them. Divers went down to check the screen over the intake pipe and scraped off a sample.

It was coated with radiolaria, single-celled marine organisms that appear under a microscope like floating glass-globes. The period-sized protozoa could easily slip through the intake screen.

Radiolaria are unusual visitors to McMurdo Sound. This year they've suddenly appeared in large numbers. Alexander

See Pteropod on page 8

Photo by Melanie Conner/The Antarctic Sun

Water Plant Manager Jordan Dickens shows Crary Lab Supervisor Steve Alexander the piles of filters that have been clogged with slime. General assistants have been cleaning the filters for possible reuse.

Pteropod

From page 7

speculates the unusual blooms of pteropods and radioloria are related to something much, much bigger.

"Everything has changed out here in the sound," Alexander said. "Maybe B15 has changed the whole biology of the area."

The iceberg B15, now 2,200 square miles, is blocking a current that usually flows from north to south along Ross Island. Now that the current has to detour further north around B15 before it turns south toward McMurdo, it may be picking up pteropods and Radiolaria that flourish in a spot of water kept open by the katabatic wind near Terra Nova Bay.

"That's all speculation. We have no evidence whatsoever," said Alexander, who would like to start monitoring the plankton in the sea water intake. "We have the perfect chance to see if B15 really has changed the hydrography (characteristic features of the water)."

But the problem at hand was still the water plant filters. Alexander extracted a sample from one of the 5-micron filters, expecting to find more radiolaria. Instead he found the filters coated with sheets of bacteria. More bacteria were found in a slick slime coating the inside of pipes carrying water to the filters and globs of the same slime were found blocking the cooling plates in one of the water plant heat exchangers, which uses sea water as a coolant.

Photo by Melanie Conner/The Antarctic Sun

Slimed filters fill a waste bin at the McMurdo Station water plant.

Now the theory is that bacteria are feeding on the corpses of pteropods and radiolaria trapped in the media filter and lining the pipes.

"It's kind of like a mass breeding ground for bacteria," Alexander said.

Bacteria can't get through the reverse osmosis process, so the water is pure and safe to drink, but the bacteria do clog the 5-micron filters.

Having to change filters every day has slowed down water production at the plant, which is running all three reverse osmosis systems, instead of the usual two, to supply the 70,000 gallons a day the station uses. Station management has been asking people to voluntarily conserve water.

The water plant still has about 450 filters left from a shipment of 1,200 filters bought in 1997, but with the current rate of use they're disappearing faster than normal. Dickens is now experimenting with having general assistants clean the filters to see if they can be reused.

Back in the lab, Alexander and DeVries cooked up a custom cleaning solution to dissolve the slime and etch off the organic layers from the media filters and 600 feet of pipe. They tested the cleaner on samples of the slime and bacteria in the lab to find the ideal concentrations of chemicals, which will be flushed through the system.

On Saturday, divers blocked off one side of the intake pipe so they can begin scraping off the sea anemones, starfish, sponges, worms and other marine life growing there. The filter feeders have been pre-filtering the water, but they are growing so fast they will soon block the 48-inch pipe, Alexander said.

Taken together, the combined efforts of the water plant operators, scientists and dive team should fix the water filter problems.

"If the theory is right, then science has solved it, rather than buckets of bleach," said National Science Foundation Representative Brian Stone.

Seth White prepares instruments on the rooftop of a building at Arrival Heights, where researchers for a new ground level ozone study tracked the level of ozone depleting compounds near McMurdo Station. At Arrival Heights, White also collects data for other atmospheric research. The data are uplinked to the researchers' institutions for immediate review.

Photo by Melanie Conner/The Antarctic Sun

The "good" guys: ozone up top

By Melanie Conner
Sun staff

Earth donned a heavier layer of sunscreen this year over the Southern Hemisphere. The active ingredient: ozone.

This year, scientists confirmed the smallest ozone hole since 1988, after abnormal weather patterns in Earth's upper atmosphere interfered with the chemical reaction process that breaks down ozone molecules.

In 2002, the hole covered an area of about 6 million square miles, about the size of Antarctica, down from 9 million to 10 million square miles seen during the last six years.

Observations from all three U.S. science stations indicated comparatively high concentrations of ozone and lower levels of ultra violet (UV) in September. Palmer Station experienced record-low UV levels until mid-October. South Pole Station's UV levels are usually lower than other stations during September because it is the last to receive the spring sunrise; however, UV levels dropped even further on Sept. 25, when the hole stunned observers once again by splitting into two.

"The split was unprecedented and is clearly documented in satellite data," said researcher Germar Bernhard, who maintains the National Science Foundation's UV monitoring network in Antarctica. Bernhard explained that one part of the hole traveled close to South America, mixed with warmer air and disappeared by the first of October. The second part was located off the

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Bad

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ozone blocks harmful ultraviolet rays from the sun by providing a vital protective a layer. The "good" ozone, occurring naturally in the stratosphere (about 10–30 miles above surface) is gradually being destroyed by the combination of man-made chemicals and the intensity of the sun's ultraviolet rays. Together they release chlorine and bromine molecules, which break up "good" ozone.

In contrast to ozone in the upper atmosphere, ozone in the lower atmosphere threatens humans and the environment. Known as ground level ozone, it occurs when motor vehicle exhaust, industrial emissions, gasoline vapors and chemical solvents mix with summertime heat and sunlight.

"It is important to remember that the chemistry that happens at surface is completely disconnected from what happens in the stratosphere," said researcher Linnea Avallone from the University of Colorado at Boulder.

In heavily polluted regions, the amount of ozone is generally greater near the surface of Earth, up to about two kilometers or a little over one mile. In clean regions ozone is more uniform with altitude all the way up to the beginning of the stratosphere. "'Surface' ozone typically refers to the lower 500 to 1,000 meters of the atmosphere, near Earth," said Avallone.

Surface ozone affects people in every polluted city in the world.

Exposure to high levels of ozone can inflame and damage the lining of the lungs. It can also lead to shortness of breath, chest pain, wheezing and coughing, while long-term exposure may decrease the lungs' ability to function. Ozone can not only aggravate, but also may cause asthma. Those most at risk for ozone-related health effects, include children, anyone with heart or lung disease and adults who work or exercise outdoors.

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VOC + NOx + heat + sunlight = ozone

Good

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Antarctic Coast, facing Africa. During the first two weeks of October, it moved again toward the South Pole and gained strength.

"The splitting occurred because extensive troposphere activity pumped energy into the stratosphere," said researcher Terry Deshler of the University of Wyoming. "The energy deposited in the stratosphere reduced the size and strength of the polar vortex. This is the situation frequently observed in the Arctic, but seldom in the Antarctic."

Scientists agree that this year's peculiar weather pattern should not be viewed as a long-term trend. However, it appears that Mother Nature sought self recovery following last year's record-high ozone hole, which was larger than the combined area of the United States, Canada and Mexico.

"It is not possible to make predictions for next year," said Bernhard. "The depth and size of the ozone hole depend very much on meteorological conditions, e.g. the strength of the polar vortex – and those cannot be forecasted with sufficient accuracy one year ahead."

Measured continuously with a combination of ground, balloon and satellite-based instruments, the small ozone hole in 2002 is a result of instability in the annually occurring, strong polar vortex during the Antarctic winter night.

Creating an ozone hole

After wafting into the atmosphere from Asia, Europe, Africa and the Americas and circling Earth, decades-old pollutants known as chlorofluorocarbons or CFCs migrate to the stratosphere, the upper atmosphere, where airplanes travel and Mt. Everest crests. Eventually the pollutants wind up in the polar vortex, a weather pattern that encircles and isolates Antarctica from warmer temperatures.

"It needs to be cold in the stratosphere to form a hole, otherwise there would be a hole around the world," said Bernhard. The cold stratosphere over Antarctica promotes the formation of ice

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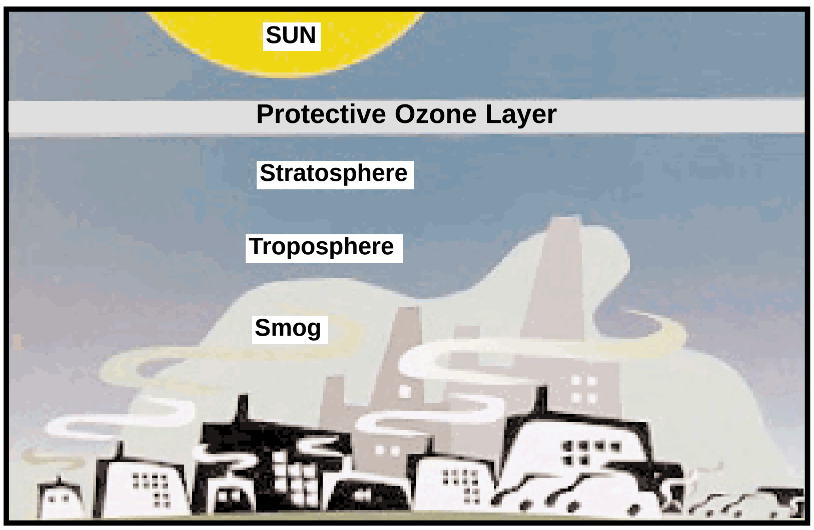
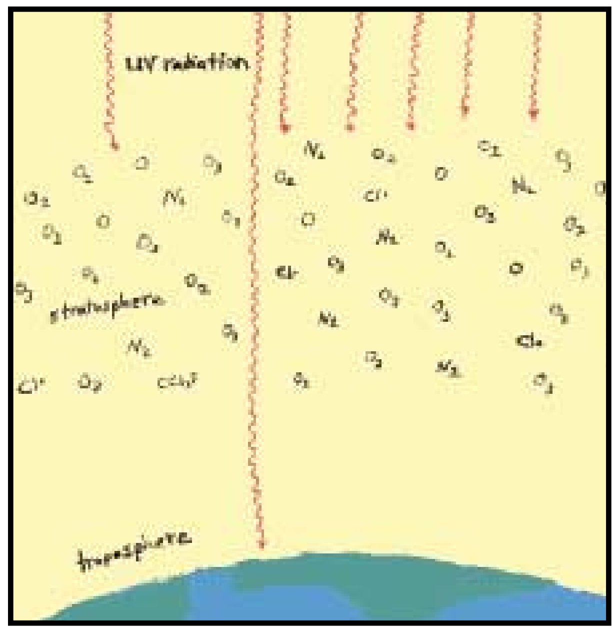


Above: Surface ozone is located low in the troposphere and produced by a chemical reaction with man-made pollutants and sunlight. It is considered harmful to life. Right: High above Earth, ozone is naturally occurring and protects life by blocking UV radiation.



Graphics made by Atmosphere, Climate & Environmental Information Programme.

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Ozone also destroys rubber.

"People in L.A. have to replace windshield wipers often because the rubber gets worn out. The ozone layer is very harmful," said Avallone. "People from L.A. or New York know exactly what I'm talking about. It's also called smog. It has a long life and can be transported far, far away from where it is produced."

To escape the smog, this year Avallone traveled to Antarctica to study the chemistry of ground level ozone.

In the process of a two-month study, Avallone and her student Gannet Hallar found that ozone is affected by man-made pollution at McMurdo Station and, possibly discovered a new bromine compound.

"We came to Antarctica because we were looking for a place where surface ozone depletion happens," said Hallar. "The nice thing about Antarctica is that it is clean. It doesn't have trees or other atmospheric interferences. We couldn't figure anything out in California because there is so much pollution that it would disrupt the study."

But California will eventually become a key location in surface ozone studies because it has a high concentration of ozone and a coastline where bromine derived from sea salt may have significance. In the polar regions, researchers are trying to understand the relationship between the sea salt chemistry and decreases in ozone.

"Is that good or bad?" said Avallone, "It could be good, if the sea salt chemicals attack the ozone. But we just don't know if it really is enough to counteract pollution."

Bromine ultimately breaks down both ground level ozone and upper atmospheric ozone. In the stratosphere, the sun's ultraviolet rays cause a chain reaction that changes inert chemicals into active chlorine and bromine molecules that attack ozone. In the troposphere, the part of the atmosphere nearest Earth, ultraviolet rays also cause a chain reaction that ultimately releases bromine from sea salts to destroy ozone.

By studying in Antarctica, researchers hope to find a baseline to better under-

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clouds upon which the chain of chemical reactions of ozone destruction depends.

On the surface of ice clouds, which form inside the cold, dark polar vortex, inert chlorine from man-made pollutants transform into active forms of chlorine. The first rays of sunlight appear at the end of the Antarctic night, continuing the chain reaction and these chlorine attack and destroy ozone.

"The ozone hole months are sunrise in August to late November or early December," said Bernhard. The harmful UV rays are most dangerous in November, when the sun is high in the sky, allowing rays to cut directly through the thin stratosphere where ozone is depleted. During September and October when the sun is low on the horizon, the rays travel a longer path and thus through more ozone.

Ultraviolet B rays are short, high-energy light waves known to cause skin cancer.

"The shorter the wavelength, the more energy. Since UVBs carry more energy (than UVAs) they penetrate deeper into the skin, damaging DNA," said Deshler. "When many DNA cells are destroyed, the chances of not repairing them properly increases and this can lead to cancer."

The short and fast invisible rays also dive deep into the Southern Ocean, leaving marine organisms unprotected from the sun's power. This effects one of the world's most productive marine ecosystems by damaging microscopic algae called phytoplankton that form the foundation of the Antarctic food chain.

"When ice starts to break up at the end of the polar night, marine organisms are exposed to elevated UV levels under the ozone hole. It is extremely complex to quantify the effects of increased UV on ecosystems, and this topic is therefore still the focus of ongoing research," said Bernhard. "However, without the upper layer ozone there would be no life on Earth."

The Green Beam

By Mary Edwards
Special to the Sun

When winter residents at McMurdo Station see a green streak in the sky, they know the science technician has turned on the Light Detection and Ranging System or Lidar.

Built in 1991 by the Italian Institute of Atmospheric and Climate Science, the Lidar collects data on the composition of polar stratospheric clouds. Also known as nacreous clouds, these colorful clouds appear in the otherwise dark sky in the polar spring.

As nacreous clouds form, the Lidar's green laser beam shoots like a beacon from the Crary Lab roof. The laser beam is reflected back from the clouds that rest 14 to 16 miles above Earth, where ozone is located. The Lidar's telescope component amplifies the reflected light rays and records the cloud's altitude, surface area and composition – liquid or solid.

The Lidar's cloud composition information allows scientists to determine whether the clouds contain the correct chemicals needed to increase or decrease chlorine dispersal. Chlorine is a key component in the destruction of ozone, and the creation of the ozone hole over Antarctica each year.

Photo by Melanie Conner/The Antarctic Sun

McMurdo science technician Seth White records atmospheric data at Arrival Heights. The data includes UV levels for researchers at Biospherical Instruments Inc. who are members of the NSF's UV Monitoring Network.

UV Review

As of Nov. 11, the ozone hole is well away from all three U.S science stations. Last month the ozone hole was centered over the South Pole from Oct. 12 to Oct. 21, then traveled north and became centered over Palmer Station between Oct. 24 and Nov. 2, with its edge reaching as far as South America. It moved toward the Atlantic Ocean on Nov. 3.

UV levels at McMurdo Station remained the lowest on record until Oct. 12, when the levels rose to average levels. Levels fell again on Oct. 22 to record-low levels, where they remain.

South Pole: UV levels were also at record-lows for all of October, with the exception of the period when the hole was centered over the pole and UV levels grew to normal. UV levels remain well below historic records.

Palmer: Until Oct. 21, UV levels remained some of the lowest on record, but rose sharply until Nov. 3. On Nov. 9, Palmer was outside the ozone hole and UV levels dropped suddenly.

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stand the connections between ozone loss and bromine in coastal areas.

"We want to understand the chemistry in a clean place first so that we can go to a polluted place and look for differences," said Avallone.

Avallone first looked at the Arctic for a clean place to study surface ozone depletion, but it wasn't clean enough.

Beginning in the mid-1980s, researchers saw annual ozone decreases in the Arctic springtime. After conducting a series of studies, researchers found some ozone was caused by naturally occurring chemistry, not pollution. The Arctic atmosphere also contained pollutants from automobiles, factories and industries, making it difficult to study the natural ozone or to find a truly clean environment.

"The more we understand the chemistry of the atmosphere, we can understand how our actions affect the atmosphere," said Hallar.

Avallone is not sure if the study will continue into future years, but if so there might be another topic of scientific interest: The detection of a new bromine compound.

With less than six known bromine compounds normally existing in the troposphere, it could turn out to be a significant find.

"I expected to see the same chemistry as in the Arctic: As ozone decreased, halogens and bromine, especially, would be there. First, the compound I measured should only be present when there is sunlight, but something showed up at night," she said.

After checking her instruments and conducting a series of tests, Avallone believes she may have detected a new bromine compound.

"I certainly didn't get what I expected and that's fine," said Avallone. "There were lots of surprises."

Profile

Like father, like daughter

By Kristan Hutchison/*Sun staff*

As a 10-year-old, Gretchen Hofmann was aware of Antarctica as the place where Dad went to release balloons.

Thirty years later they are both Antarctic grantees looking at climate change from different disciplines.

"When I came down, it was like I understood a part of my dad's life I'd only heard about," said Gretchen, a physiologist studying Antarctic fish and their inability to respond to sudden increases in temperature.

Dave Hofmann was a physics professor at the University of Wyoming, Laramie, when he first came to Antartica in 1971. He was part of a balloon project taking the first South Pole measurements of ozone and particles in the stratosphere.

"I imagine sitting around the table we probably talked about 'What are you doing that for, Dad?'" Dave said. "'Well, it's never been done before.'"

Dave has returned to the Antarctic 18 times. In 1986 his research group was part of the National Ozone Expedition and helped identify chlorofluorocarbons as the cause of ozone destruction.

For many years he came down at Winfly in August to begin taking samples and it was always a gamble whether he'd make it home in time for Thanksgiving.

"It used to make my mother crazy," Gretchen said.

Gretchen and her siblings talked to their dad on Ham radio and through phone patches from the South Pole. He'd send them back letters decorated with stamps and full of the Antarctic lingo – "eating at the chow hall," and being "grounded by a Herbie."

"I always knew the language," Gretchen said.

He'd also bring back boxes of sheepskin from New Zealand and disappointing Christmas presents. Gretchen never understood why he gave them U.S. Antarctic Program coffee mugs and crystal penguins, until she came to McMurdo and discovered that's what there was in the station store. Now she sends him the Antarctic program calendar each Christmas.

"I grew up in Operation Deep Freeze t-shirts," Gretchen said. "I wore little t-shirts that had penguins on them."

For Gretchen, the dinner table was her first science course. By age 12 she could recite the surface chemistry of ozone. She often went to her dad's balloon launches on campus, but she was more interested in biology than physics

Dave admits the one time he tried to push his daughter toward physics turned out to be a mistake. When Gretchen was a college freshman, Dave convinced her to sign up for physics for engineers instead of the more basic physics class offered for other students.

"That was a nightmare," said Gretchen. After getting all A's in high school, she scored 30 percent on the first physics tests. "It was a real wakeup call."

Gretchen went on to earn a Masters and PhD in biology, and is now on the faculty at the University of California in Santa Barbara. She did it all on her own, claims Dave, working as an Albertson's checkout clerk to pay for her living expenses while in college.

"I never spent a dime on her. She had full-ride scholarships all the way through," Dave said.

"He's such a liar," said Gretchen, pointing out the condominium her parents bought so she could rent it from them while she studied at the University of Colorado in Boulder and the truck they helped her purchase.

By the time Gretchen came to Antarctica, as a teacher for the Antarctic biology course in 1995, McMurdo was already familiar from her dad's photos and stories. Gretchen's experiences were different though. Last year she sent him photos of herself with a 93-pound mawsoni she'd caught.

Photo courtesy of Dave Hofmann

Gretchen and Dave Hofmann, daughter and dad, on Observation Hill.

"She got to go out to Cape Evans. I never got to go there. She gets to ride around on snowmobiles, things like that, so I'm a little envious," Dave said. "But then, she's never been to the South Pole."

Not that she minds.

"I don't even really have the burning desire to go to Pole, because there's no ocean there," Gretchen said. "I'd much rather go somewhere biologically interesting, like Cape Crozier."

Dad and daughter have crossed paths only a few times on the Ice. One year Dave's flight to the Pole was delayed and he spent five days in McMurdo. Gretchen took her dad fishing for research specimens and out to the ice edge to make some measurements, things he'd never done in his Antarctic trips.

Last year Dave went to Palmer. As director of the National Oceanic and Atmospheric Administration's Climate Monitoring and Diagnostics Laboratory in Boulder, Colo., Dave usually sends other scientists to take care of things in the Clean Air sector at the South Pole.

"Now that he's a big cheesy, he comes down less and less," Gretchen said.

While Dave's research in the upper atmosphere led him further into climate studies, Gretchen's research took her underwater. After five seasons teaching marine biology in Antarctica she won her own three-year grant, studying how fish and marine invertebrates tolerate changes in temperature.

"I'm incredibly proud of her, because she's done this all on her own," Dave said. "She knew what she wanted to do."

As if completing a circle, their two areas of research are crossing again, as Gretchen looks at how the climate changes her father predicts may affect fish.

"When I started dealing with this kind of biology I realized I'd been pre-trained at the dinner table to understand what was going on," she said.

Though she came to it on her own, Gretchen's research is exactly what her dad told her to do when she was in eighth grade working on a science project. She recalls him stomping into her room, asking what she was working on, and then saying "You know what you ought to study. The effects of climate change on biology."

Apparently dad did know best.