

Transcript: Wake Me Up When It's Time to Go

[sound of phone ringing and being picked up]

Glenn Zorpette: I'm in the Copthorne Hotel in Christchurch, New Zealand, sound asleep, when the phone jangles me awake. It's the front desk calling with dismal news. My flight to Antarctica has been canceled because of bad weather at McMurdo Station, the main U.S. base in Antarctica. I have to kill a few more days in Christchurch.

Julie Deslop: My name is Julie Deslop and I'm at the University of British Columbia, Vancouver, Canada.

Glenn Zorpette: And how have you been killing your time?

Julie Deslop: I've been cycling around Christchurch and going for walks in the park and doing a little work with my very intermittent Internet connection. (laughs)

[sound of C-17 idling]

Glenn Zorpette: A few days later, wearing preposterously large white rubber boots, I'm belted into the world's most uncomfortable seat. But I'm jubilant. This is what I've been waiting for. I'm in an Air Force C-17 cargo plane, flying south for five hours, all the way to Antarctica. We circle over McMurdo Station, catching tantalizing glimpses of massive blue glaciers, rugged mountains, an active volcano, huge floating chunks of sea ice. There are even some penguins standing around. But the aircraft suddenly lurches out of its holding pattern and—gimme a break!—we're flying back to Christchurch. An ice fog has descended over McMurdo and the plane can't land. We've been boomeranged!

Julie Deslop: It was a bit long—at first it was pretty exciting, because it's a pretty interesting aircraft to be on, but after 5 hours I was ready to get off, and when we circled McMurdo station for an hour and found out we had to leave and do an 11 hour total, it was a bit much.

Charles Bentley: Well, this week is the first time I've ever had to boomerang.

Glenn Zorpette: That's Charles Bentley, a glaciologist who has been going back and forth to Antarctica for a long, long time.

Glenn Zorpette: So when was your first trip to Antarctica?

Charles Bentley: 1956.

Glenn Zorpette: So you've been doing this for half a century?

Charles Bentley: That's right.

Glenn Zorpette: What was the first kind of transport you took down there?

Charles Bentley: We went by ship all the way from the United States to Little America on the front of the Ross Ice Shelf.

Glenn Zorpette: How long did that take?

Charles Bentley: Overall, it was about a month at sea.

Glenn Zorpette: Hearing about monthlong voyages to Antarctica, I suddenly felt better about my few days' delay in Christchurch. And now it was time to spend a few hours in a terminal at Christchurch airport, beginning what will be an endless series of required briefings. All very informative.

Unidentified briefer: You'll then go to screening and on to the bus. When you get on the bus, head to the back of the bus. If you sit down in the first seat, expect to get smacked on the head with bags as every other person comes through to board that bus. Climb on to the aircraft—no photos on the way through, because if you do, you're likely to be run over by the heavy vehicles that will still be operating.

Glenn Zorpette: The folks I find milling about the terminal are, well, a different crowd from your normal departure-gate zombies.

Carl Whittington: Specifically, I'm looking at how Antarctic fish have evolved to live in their environment.

Glenn Zorpette: Carl Whittington is a grad student at Florida State who's studying biochemical adaptation.

Glenn Zorpette: So when you catch the fish, what are you looking for? Do you dissect them, do DNA samples, what?

Carl Whittington: All of the above—we'll probably be looking at fish hearts and fish muscles, so we'll take them back to the prairie lab, cut out the muscle, grind it up, get whatever protein we need out of it. That's just for the biochemical side of it.

The main thing is how organisms evolve to live in different habitats. That's kind of the big thing. Obviously, the really big picture thing would be climate change. These organisms in Antarctica are kind of on a thin line of existence. They live at a certain temperature, and if that temperature raises, it kills the animals. So that's kind of what we're looking at, how much leeway these animals have with temperature change and habitat change to survive.

Glenn Zorpette: Ken Walker, an ice-drilling technician, was also milling about the terminal, raring to get back on the ice. Antarctica never gets old, he said.

[music up full briefly]

Glenn Zorpette: Is this your first time in Antarctica?

Ken Walker: No, this will be my fourth trip, actually.

Glenn Zorpette: Fourth trip...and is it getting to be boring at this point?

Ken Walker: Oh, heavens no. It's more exciting as time goes on. Anyway, my friends and relatives may all think I have some problems, but hey, I'm enjoying the heck out of it.

[music up full to end]

Transcript: Penguins & Climate Change
Adélie Penguins, part 1

[penguin sounds]

Glenn Zorpette: Here on Cape Royds in Antarctica, you are treated to one of the most poignant scenes this planet can offer: the sight of 4000 Adélie penguins scattered over rocky hills and also on chunks of white sea ice floating in a dark blue sea. And then there's the noise.

Jean Pennycook: The penguins are very noisy at night, so we live about a quarter mile away so we can have some peace at night.

Glenn Zorpette: Jean Pennycook is an education and outreach specialist here in Antarctica. For the past four years, she's focused on the Adélies.

Jean Pennycook: The Adélies are highly animated, they're constantly busy, fussing with rocks, and cleaning up their areas, and building their nest, and stealing rocks from their neighbors, and stealing food, and pecking at each other, and gacking, and arguing over territory, so they're constantly busy and active, and they're fun to watch.

Glenn Zorpette: Do you have any funny stories about the penguins or anything that's happened that was memorable or special for you?

Jean Pennycook: I have one of those almost every day. This is an extraordinary place, and the drama—the penguin drama I call it, in the colony is every day, the dynamics between the birds, between...the birds and the seals, the birds and the weather.

Glenn Zorpette: Parenting is just one of these dynamics. Adélie penguins are strictly monogamous. For a single season, anyway.

Jean Pennycook: Because it takes two to raise a chick. And if one bird dies or doesn't come back to the nest, that nest will absolutely be lost.

Glenn Zorpette: An unattended egg will either freeze in the frigid temperatures or get eaten by a type of huge, nasty seabird called a skua. So the two parents take turns sitting on the egg. The chicks had already hatched by the time I visited, in mid-January.

Jean Pennycook: These chicks need to get to what we call fledging weight and maturity, before the ice closes in the winter. They need to get to their adult plumage so they'll be able to swim.

Glenn Zorpette: Swimming for these young penguins means finding food in the open water. The Adélie penguins depend on sea ice as a platform for jumping into and out of the water. It's crucial to their survival.

Jean Pennycook: These birds are what we call ice obligates, which means they live on the ice, their food is underneath the ice, and this is where they live.

[penguin sounds]

Glenn Zorpette: Because of the connection between the Adélie penguins and the ice, these penguins have something to tell us about our changing climate. We'll get back to the Adélie penguins later in the hour.

[penguin sounds]

Transcript: Antarctica 101: Q&A

[music]

Susan Hassler: My colleague Glenn Zorpette recently returned from Antarctica. He was there as a guest of the National Science Foundation, which runs the U.S. Antarctic Program. So, Glenn, what is it about Antarctica? Why does it have such a hold on us?

Glenn Zorpette: Antarctica was the Earth's last great frontier. No one even laid eyes on it until November of 1820, when an American sea captain named Nathaniel Palmer brought his ship close enough to see it.

Then of course there was the great race to the South Pole. Starting in October of 1911, Roald Amundsen and Robert Falcon Scott raced to the pole from the edge of the continent, a round trip of about 1600 miles. Amundsen got there first, Scott and four of his men got there a month later, and all five of them died on the way back.

Susan Hassler: So tell us about Antarctica. Antarctica 101. How big is the continent? How many people live there?

Glenn Zorpette: It's more than one and a half times the size of the continental United States. As far as the number of people: If you take a random day in the middle of the summer, there might be a little over 3000 people on the whole continent who are living and working there. In the winter, when the temperatures can hit 100 degrees Fahrenheit below zero, and it's dark for 6 months, the whole population of the continent might be just 500 or 600 or less. Here's a nice bit of trivia: Only 1267 people have ever spent a winter at the South Pole.

Susan Hassler: What are the major bases on the continent, and who runs them?

Glenn Zorpette: There are a couple dozen bases on the continent. The United States runs three permanent stations; the largest is McMurdo, which houses 1100 people in the summer. The U.S. also operates the only station at the South Pole. Including the United States, there are 29 countries that are involved with scientific research in Antarctica in one form or another.

Besides the people who work in Antarctica, there are also a lot of tourists. The tourists stay mostly on cruise ships off the coast, typically on the South America side of the continent. Antarctic tourism is booming. Almost 40 000 tourists visit Antarctica every year.

Susan Hassler: What do most of the people who work in Antarctica do down there?

Glenn Zorpette: Science. Almost everybody is a scientist or supporting the science research in such fields as cosmology, astronomy, geology, glaciology, biology, or climate research. In any given season, the U.S. is sponsoring about 150 different science projects. This past year, the U.S. National Science Foundation spent about \$70 million dollars funding science in Antarctica.

Susan Hassler: Who's in charge of Antarctica? Does anybody govern it?

Glenn Zorpette: Good question. Actually, human habitation of Antarctica is governed by the Antarctic Treaty, which was signed in 1959 and has been amended several times since then. The gist of the treaty is that no nation is allowed to claim or to colonize any part of Antarctica, no nation is allowed to use it for commercial purposes, like mining for example, and nobody is allowed to use it for military purposes.

Susan Hassler: What was your most memorable moment on the continent?

Glenn Zorpette: I was in a helicopter that landed on some sea ice near McMurdo. We piled out of the helicopter and started walking towards the water's edge, about 150 yards away. It was a brilliantly sunny day, with the incredibly deep blue water sparkling in the sun, and Mount Erebus, an active volcano, looming beyond the water. All of a sudden, about a dozen Adélie penguins popped up on to the ice from the water and ran and waddled right up to us. They were flapping their flippers and sliding on their bellies and it was absolutely the most uplifting sight I've ever seen. Moments later, a pod of orcas slid gracefully by in the sound, blowing water out of their blowholes. I'll never forget that sight. I'll never forget that day.

Transcript: Briefings, and More Briefings

Mike McElroy: How many people have never been to the ice before? A few of yas. Okay. My name is Mike McElroy. I'm the CDC supervisor, and of course the object is to try your ECW gear on today.

Glenn Zorpette: Traveling to Antarctica as a guest of the U.S. Government is not like taking a vacation. It's exciting, to be sure, but the preparation is more akin to joining the Army than packing for Italy. I went as a guest of the National Science Foundation, which runs the U.S. Antarctic program. First, you have to get the most complete physical and dental examinations of your life.

[medical exam sounds]

Glenn Zorpette: Then you work with your doctor and dentist to fill out 50 pages of forms on your health and health history.

[muttering, papers shuffling]

Glenn Zorpette: Then, if you seem healthy enough...

[jet taking off]

Glenn Zorpette: ...you fly for 18 hours to Christchurch, New Zealand, where you go through several days of briefings, some more essential than others.

Mike McElroy: It does say on the DVD you're not permitted to take alcohol with you. That is not strictly true. You may take alcohol with you, not to consume on the flight south of course. All I suggest you do, if you do decide to take it, is you put it in your hand carry bag and you pack it very well. There's nothing worse than spending a couple hundred dollars on a bottle of whiskey and it gets broken. If you've never seen me cry, you certainly will. One lady did that a while ago, and she had two bottles, so I cried a wee bit longer.

Glenn Zorpette: OK. Got that? The hooch goes in the hand carry. Don't forget. All right, on to the next briefing. This one happened right after I landed at McMurdo, where eleven hundred people live in the summer. It's

the main U.S. base and the largest one in Antarctica. This one was about how to stay healthy at McMurdo.

Doctor: For your protection, there are several problems that are going through McMurdo. The first and most likely for you to get is the crud. The crud is not H1N1; it is just simple viral illness. Everybody who's here much time gets at least one crud, and sometimes three or four.

Glenn Zorpette: Bottom line, drink plenty of fluids. Wash your hands a lot. And wear sunscreen. Simple. So far, so good. But, well, watch your step...

Kevin Pettway: For example, if you're going to go to Cape Royds, your feet are going to be covered in penguin shit. That's just what it is. It's disgusting. Those things are going to smell terrible. And then if you're going straight from there to the Dry Valleys, if you don't wash your boots, you're going to be introducing all this organic matter into the very, very sensitive dry valleys, which could affect—alter the ecosystem.

Glenn Zorpette: Broken whiskey bottles, the crud, penguin dung, what was I getting myself into? I took a few deep breaths and went on to the next briefing. This one was about how to stay alive if you get stranded outside somewhere. No pressure there, huh?

Brian Johnson: So, with your finger, I'd like you to point to the South Pole. Hold it out. I just want to see where the South Pole is.... Lee, where's the South Pole? Okay, pretty...Josh is probably the closest there. New Zealand, over yonder.

Glenn Zorpette: That's Brian Johnson, who teaches Survival 101, also known as happy camper school. His students are mostly scientists and workers on their first visit to Antarctica. Right now he's trying to teach a bunch of clueless journalists how to set up a tent.

Glenn Zorpette: I asked Brian if the survival training ever came in handy.

Brian Johnson: We took a snow machine trip from McMurdo out on the sea ice up to Cape Royds where Shackleton's hut is located. Forty-five minutes into it, the winds picked up from 0 to 20 knots. We could tell a storm was coming in. So we hightailed it to the area, set up camp, and by the time all the tents were up, we had 60-knot winds. Hard to stand up. We ended up

being out there for four nights. Everything broke, we survived, got back to town.

[music]

Glenn Zorpette: That's Antarctica for you. Life-threatening storms can blow up with little or no notice. But it's also a place of breathtaking, rugged beauty.

Brian Johnson: I think, though, my favorite spot is the area right behind me. Mount Erebus. 12 500 foot volcano. It's open. If you're up on the rim looking down on it on a clear day, you can see the molten lava bubbling in there. And my first season down, that's where I spent my birthday. So it was kind of a memorable first year and from then on it's been quite memorable."

[music]

Transcript: The Adélie Penguins of Cape Royds, Part 2

[penguin sounds]

Glenn Zorpette: Earlier this hour, I mentioned that by studying the Adélie penguins—whose biology is completely tied to the sea ice—we can learn a lot about our changing climate. Here's Jean Pennycook again. She specializes in Adélie penguins.

Jean Pennycook: The remarkable thing about this colony is that it's the southernmost colony of birds in Antarctica, so there are no colonies of penguins more south, or for that matter, any animals, more south than right here.

Glenn Zorpette: More and more Adélie penguins are leaving where they usually roost and feed, and they're moving south.

David Ainley: Penguins are moving big time. It's not just like one person moving to some new condo somewhere, it's mass—pretty rapid.

Glenn Zorpette: David Ainley is an ecology researcher who's been studying penguins for 11 seasons.

David Ainley: In the lifetime of our research, changes in numbers of penguins around, and this is the story, this is the message to humans. There's going to have to be some people moving, big time. Penguins are showing what it's like.

Glenn Zorpette: There's a reason why the Adélies are moving south.

David Ainley: The penguins are here because it's usually very windy, and you get this open water here, called a polynya. As long as it's windy, the sea ice, the water will freeze, but it'll keep being shunted north, so it's this continuous freezing process, so as long as that keeps happening, there's this open water, so when the spring comes, there won't be 10 feet of sea ice locked in place here; there will just be a little bit. And if it wasn't for the wind, there'd be no penguin colony here.

Glenn Zorpette: That's because the wind makes life easier for the Adélie penguins. The wind ensures open water, which means access to fish and krill. Remember, penguins have to get to the edge of the ice to dive into the water to go feeding.

David Ainley: If they have to walk more than a few kilometers, they start to feel—it starts to put a bit of a pressure on them.

Glenn Zorpette: The wind determines where that water is.

David Ainley: Yeah. It's all wind. Not a whole lot to do with temperature at least, at this latitude. That's one thing about climate change that doesn't register really well either—that it's not just temperature; it's changing weather patterns.

Glenn Zorpette: Climate changes in Antarctica over the past few decades have altered the continent's wind and weather patterns. And that has an impact on sea ice, which is leading to wholesale shifts in the Adélie penguin populations. Jean Pennycook says it's all connected.

[penguin sounds]

Jean Pennycook: I just hope that people are aware that their actions in the United States, or in the world, do affect what happens down here. Pollution is starting to reach here, and climate change is starting to make an effect. So I want people to be sensitive to their lifestyles, so these animals can be preserved in their habitat.

[penguin sounds]

Transcript: Greetings From the South Pole

[music, ambient noise on airplane to South Pole]

Glenn Zorpette: Moments before our Lockheed LC 130 landed at the South Pole, I was wonderfully agitated and maybe just a little bit spooked. Nervous questions raced through my mind. Will the air be so thin that I pass out? Are my sunglasses dark enough? Does this huge red parka make my butt look fat?

[airplane sounds with intercom noise]

Glenn Zorpette: The plane ski lands onto the ice, we scramble down the gangway, and just like that, we're standing on the ice of the South Pole.

Unidentified Man: How are you feeling?

Glenn Zorpette: Good.

Unidentified Man: You're at about 10 000 feet.

Glenn Zorpette: How should I be feeling?

Man: Just great. Keep drinking that water, you will be feeling great. Vladimir, how's it going?

Glenn Zorpette: Within seconds, euphoria sets in. It's partly the thin air, and partly being at one of the most legendary places on the planet.

Ann Posegate: This is just the most amazing thing. I mean, directly beneath us is a layer of two miles of ice on top of a continent. And it's just—I mean, and also the North Pole is also...way beneath that.

Glenn Zorpette: Ann Posegate was on her first trip to the Pole. She's a weather and environment journalist.

Ann Posegate: So it's just the most beautiful isolated scenery I've seen in my entire life. It's just a very overwhelming and complete feeling, right now.

Glenn Zorpette: I see that there's frost on your neck gaiter.

Ann Posegate: Yeah, I've noticed it's on yours, too. I'm feeling the—uh, my breath in my nose kind of freezes up a little bit. I'm a little bit short of breath. I mean, there's 25 percent of our normal oxygen level here... I'm sure I'll feel the effects over the day.

Glenn Zorpette: And then it got really weird. I saw a man wearing a stovepipe hat.

Glenn Zorpette: Sir! Are you aware you're wearing a top hat?

Ethan Good: I am.

Glenn Zorpette: And furthermore that you're wearing a reggae hat underneath the top hat?

Ethan Good: I—yeah, I'm very aware of that. It's for the purpose of filming for the South Pole International film festival. We're redoing a rap video. We rewrote the lyrics to be Pole-appropriate. Oh, what's something that's family friendly. I forget my lines. "Never thought I'd see the day, where the South Pole coming my way, believe me when I say..." and I'm gonna edit myself there because it goes off the deep end.

Glenn Zorpette: What's your name?

Ethan Good: I'm here through November, 13-month contract. Yeah, it's my second winter. It's nice and quiet. The sky's beautiful, it's a wholly different vibe. They give you head lamps to use; I used it like three times over the whole winter. You get enough starlight, starlight and aurora light. When the moon's up, it's really bright. It's not as pitch black as you might think.

Al Baker: There's no place else on the planet where we can go and lay on the ice and look up at the stars and it's 100 degrees below zero.

Glenn Zorpette: Al Baker is the science liaison officer at the South Pole. He spent the winter there in 2001.

Al Baker: I could go outside, and the auroras were so bright, and I could literally read by the light of the aurora.

Glenn Zorpette: What's the appropriate reading material for reading by the light of the aurora?

Al Baker: [laughs] Well, a lot of us read Harry Potter that year. We wrote to J.K. Rowling and mentioned that 50 people read all 4 volumes of Harry Potter in one night, which is true because our night is six6 months long."

Glenn Zorpette: The South Pole is also the site of the most elite club on Earth. It's called the 300 Club, and it's way harder to get into than the New York Athletic Club or White's in London. Here's why: To get in, you have to winter over at the South Pole, and you have to be willing to run around outside stark naked.

Al Baker: Yes. The 300 Club. I am a member of the 300 Club, and my kids say that I am certifiably one of the stupidest people on the planet for becoming a member. The way it works is, when the temperature at the South Pole drops to 100 degrees below zero, we go to the sauna and crank it up to 200 degrees Fahrenheit above zero, and we sit in there as long as we can, naked. That's about 15 or 20 minutes, until our core temperature rises probably dangerously high. And then we all en masse run outside to the Pole naked. But we can wear our boots so we don't get frostbite on our feet, run around the Pole, and run back inside to the station and into the sauna and warm ourselves back up. So yes, that's the 300 Club.

What happens is—when we actually get away with doing that without killing ourselves—when we run outside, the sweat on our bodies from the sauna freezes. So we have a layer of ice that acts as an insulation. That's only 32 degrees above zero. So we have a zero-degree Celsius layer of ice insulating us. So when I did it—it's only a quarter of a mile round trip. So I run out a quarter of a mile, and we're only outside about 10 minutes or so. By the time we get back inside, we're starting to get cold. But the layer of ice insulates our body.

Glenn Zorpette: How many members are there of the 300 Club?

Al Baker: About 40 percent or so of the station each year joins. So not everyone is as stupid as I am.

[music]

Glenn Zorpette: For Baker, the South Pole is more than just a dot on a globe.

Al Baker: I came to the South Pole in 2000, and mentally I've never left. Even when I'm home in Denver, a part of me is at the South Pole.

[music]

Transcript: Pole-ish Food: The Kitchen at the End of the World

Glenn Zorpette: The South Pole prompts visions of endless ice sheets, arcane science projects, and heroic explorers from a bygone age. But there's lots more going on nowadays at the Pole, where the United States operates a new \$175 million station. To keep that station going requires mechanics, medics, technicians, electricians, logisticians and many other workers. But it was the cooks that really intrigued me. In summertime they're cooking for 250 people in a place where there are few sensory pleasures other than eating. Some of those people need five or six thousand calories a day. And these cooks must get by with absolutely no deliveries from March until September. They must provide four meals a day, including one at midnight. And the air pressure at the pole is so low that special techniques are needed to make bread and cakes rise.

Brian Denim: A little bit of onion, some sautéed onions and some butter. Garlic, and of course the parsnips. Potatoes. A hit of cream, if we've got some, hopefully we do, but if not we'll just have to make do with milk.

Glenn Zorpette: That's Brian Denim, who's making parsnip mashed potatoes at the South Pole. He's one of a dozen cooks and bakers who work culinary magic at the end of the earth.

Brian Denim: We're doing a honey-glazed spiral ham tonight.

Glenn Zorpette: Tonight being midnight.

Brian Denim: Yes.

Glenn Zorpette: So people who stroll in here at midnight will get honey glazed spiral ham and parsnip mashed potatoes with garlic and butter.

Brian Denim: Absolutely.

Glenn Zorpette: Well, I hope I'm here at midnight.

Glenn Zorpette: When Roald Amundsen and Robert Scott raced to the South Pole in 1911, they and their men subsisted for weeks on pemmican, a fairly disgusting mix of dried and powdered meat and fat. Amundsen's men also ate their sled dogs. Scott's men spent most of the expedition slowly starving to death. But times have *really* changed at the South Pole.

James Brown: Every Friday we do steak and once on that five-week rotating menu on a Friday, we'll do crab legs and filet mignon. Some of the other things that they really like for lunch—they like Reubens, they like jambalaya.

Glenn Zorpette: James Brown is in his ninth season as the head chef at the South Pole.

James Brown: Burger day is really popular. Night meals—they like tamale pie, we have shepherd's pie, they really like that. Lasagna is really popular. Thanksgiving, we do the turkeys three ways: smoked, deep-fried, and roasted. And then for Christmas we do beef

Wellington and lobster tail.

Glenn Zorpette: And they do all that with electricity alone.

James Brown: We don't use gas at all, because fire is our worst enemy here. We're the driest place on earth. If something catches on fire, it's a catastrophe. We use a flat top that's electric.

Glenn Zorpette: For seven months every year, including the polar winter, there are no flights to the South Pole. So the kitchen crew has to make do with frozen ingredients. Fortunately, storing all that frozen food is easy.

Chris Brazelton: Yeah, everything's pretty much frozen here. It's brought down earlier and it's all stored up and stockpiled.

Glenn Zorpette: Where are the freezers for that?

Chris Brazelton: Outside

Glenn Zorpette: Oh, you just throw the stuff outside?

Chris Brazelton: Right. Yes, we have the best freezer in the world. And there's no animals or bacteria or insects or anything down here that will contaminate food.

Glenn Zorpette: So how *do* you become the head chef at the South Pole?

James Brown: I looked in the *Denver Post*. I liked the West, liked the mountains. I looked at the *Denver Post*, and it said: 'You want to work in Antarctica? Call this number.' The rest is history. Here I am.

[music]

James Brown: I've worked a lot of different places: Santa Fe, Maine, D.C., right outside of Philadelphia. None of these places compare to the excitement of being here, the uniqueness.

[music]

James Brown: The coldest temperature I ever experienced was a wind chill of 120 below zero. I don't know of many other places in the world where I would have been able to experience that. The sun dogs or sun haloes that we see, when we get the fine grains of ice blowing around in the sky, it creates a halo, or a sun dog as they call it, around the sun. Not too many places in the world where you can see it, especially as clear as we see it here.

[music]

Transcript: The 10 000-Mile Flush

Glenn Zorpette: The biggest base by far on Antarctica is McMurdo station. It's a U.S. installation that teems with workers and also scientists scurrying around setting up exotic experiments and field trips. But the station also has to take care of some pretty basic human needs. Like feeding everybody. And dealing with the waste that 1100 people produce. That's no small feat in Antarctica, where human habitation is governed by the strictest environmental regulations on the planet. In fact, the international Antarctic Treaty now requires that essentially every bit of waste produced in Antarctica be removed from the continent.

[sound of door opening]

John Larrabee: So this is basically what it looks like when it's raw.

Glenn Zorpette: John Larrabee is a wastewater technician at McMurdo. He oversees an innovative treatment plant that cleans up all the raw sewage and dirty water flowing from every pipe, drain, and spigot on the base. He's treating 40 000 gallons of this stuff a day. Larrabee gestured to a basin holding four days' worth of raw water.

John Larrabee: Kind of got a little gray color. Smell should be musty but not unpleasant. That's actually the technical term for raw water.

Glenn Zorpette: So this raw water coming from toilets and sinks isn't the color you might expect.

John Larrabee: No, it's not. What you see there, if you were to take a sample of that raw water and allow that to settle, if I just took a sample, set it on the counter for like an hour, you would see the brown stuff would settle to the bottom, and you'd still have clear water on the top.

Glenn Zorpette: Larrabee's job is to clean up the watery liquid part so it can be returned to the Antarctic and to dry out and pack up the solid part for shipment off the continent. But first they let a horde of natural bacteria break down the contents of the raw water as much as possible. The solids eventually settle out and are then sent to a press that squeezes the last bit of water out of them. And when that press is running, it's a heck of a thing to see and hear. And smell.

John Larrabee: The belts are moving, there's wash water going, it's pretty loud, it's pretty sloppy, whatever. The water will filter through the belt on the top, it comes around this way and another belt will meet up against it and it keeps traveling, and this is where you can see the two belts, and the solids should be between those two belts, it just keeps traveling over these rollers, just tighter and tighter as it goes, keep pushing that water out,

and on the end here is where it actually gets scraped off the belt and dropped down the chute, and that's where we have the big tri-walled boxes that the solids actually go into.

Glenn Zorpette: The reason for the boxes is that this pressed solid waste—it's called a cake—is actually shipped, once a year, from Antarctica all the way to a landfill in California. It's a total of 8 to 10 tons of solid waste per year. That's a lot of human excrement.

John Larrabee: It's not called human excrement. Once it's treated, it's called a biosolid.

Glenn Zorpette: Sorry. Biosolid. That's a lot of biosolid of human origin, and a long way for it to travel. Think of it as a 10 000-mile flush. The liquid portion is filtered and disinfected with UV light.

John Larrabee: This is the final end of the treatment process itself, and the water you see right here, this is actually the treated water, which will get blended with the other two tanks and go into the UV channel. So as you can see, it's pretty good water, pretty clear water, that's what we like to see; it's what we like to have.

Glenn Zorpette: I don't think I'd want to quench my thirst with it, but I don't mind that the water is returned directly to the sound. It takes a gallon of water coming into this facility about 24 hours to swirl and swish about all the basins, filters, and presses before leaving the other end clean. It all happens so elegantly and quietly, and yet so incessantly, tucked away out of sight and out of smell.

Transcript: Science, Exploration, and the Race to the Pole

[period music, Antarctic sounds]

Glenn Zorpette: The race to the South Pole began 109 years ago with the first Antarctic expedition of Robert Falcon Scott, a British naval officer. His men built a hut on the edge of the continent. They called it the Discovery hut, named after the boat that carried the 47 men to Antarctica from England.

Donal Manahan: When you come here, you can't help but notice there's a hut just a couple hundred yards away from where we're talking that was where some of the first biologists and chemists and glaciologists and physicists worked.

Glenn Zorpette: That's Donal Manahan, a biology researcher and amateur historian who's been coming to Antarctica since 1983.

Donal Manahan: Scott came down here in January 1902, built the hut, which we can walk to after a very warm dinner here in McMurdo station.

[sounds of trekking to dinner]

Glenn Zorpette: In fact, after dinner one night at McMurdo, the main U.S. base in Antarctica, we did just that. Our hostess was Dana Topousis, a public affairs official with the National Science Foundation.

[sounds of people entering the hut]

Dana Topousis: Let's see if I can open the door...yeah. And I have flashlights because it's probably not very bright.

Glenn Zorpette: OK, so here we are opening the door to the Discovery hut.

Dana Topousis: It's icy...

Glenn Zorpette: It's dark and it's small and it smells...

Dana Topousis: Like old horse straw.

Lee Hotz: I believe that Scott actually never lived here...this was one of their secondary buildings.

Glenn Zorpette: Lee Hotz is a columnist for *The Wall Street Journal* and a veteran Antarctic traveler.

Lee Hotz: It's actually where they had their jollies. They used it as a theater....So its purpose was as a kind of secondary storage area but also as a shelter.

[music]

Glenn Zorpette: Here's the race to the Pole in a nutshell. Robert Scott's Discovery expedition—between 1901 and 1904—came within 480 miles of the Pole. His main purpose was actually scientific and geographic research. Among other things, Scott and his men discovered the Dry Valleys, an ecologically remarkable area not far from present-day McMurdo base. The next expedition was Sir Ernest Shackleton's; he had been on the Discovery expedition but had had a falling out with Scott. On January 9, 1909, Shackleton got within 97 miles of the Pole before being forced to turn back.

Finally, in the greatest race of the great era of human exploration, Scott and the Norwegian Roald Amundsen raced to the Pole starting in 1911. Amundsen and his team left in October and got there first, at 3 in the afternoon on Friday, December 14, 1911. Scott and four men left in November and got there on January 18, 1912, a month after Amundsen. On the return trip, Scott and his four men all died of starvation, illness, and hypothermia. Scott and two of the men perished just 11 miles from a food depot that would have saved their lives. But a terrible blizzard confined them to their tent for nine days. Diaries found in that tent described pain and hardship and endurance almost beyond human imagining.

Donal Manahan: A typical day, if you read the diaries, are: Wake up early in the morning. Your boots are so cold that it can take you one to two hours to get your foot into your boot. You have to—Scott writes about this toward the end of his life as he was coming back—that the sweat and accumulation in your boots are such that your boots are stiff and iced up, so you put your already cold feet in an inch or so, wait for that tiny amount of heat from your

foot to thaw out the boot, move in another bit. Then when you get your boots on, and the rest of your clothing, you then strap yourself to a sled that might be roughly 1000 pounds, and there's four men pulling it, and you pull that thing for maybe 12 hours a day. And at the end of that 12 hours, you stop, you put up your tent, and then even to get inside your frozen sleeping bag can also take hours, because you have to rely on the tiny amount of heat from your body to melt the sleeping bag so you can slide into the sleeping bag. Do you sleep? No. They shiver the whole night sometimes. And then the next day, you start all over again. Month after month after month.

Glenn Zorpette: Amundsen, who was first to the Pole, is regarded as a cunning, implacable competitor. Scott was until recently thought of as a courageous man whose poor judgment led four men to their deaths. More recent reviews have emphasized Scott's dedication to science and his terrible luck at the end of his trek. Shackleton will be forever remembered as a charismatic leader whose fortitude and daring led to the rescue of 24 of his men stranded on an ice floe during a failed 1914 expedition.

Donal Manahan: There's a great, great quote from the geologist who was with Shackleton and Scott, Raymond Priestley, who in the 1950s said the following, and he summed it up just beautifully: "For science, give me Scott. For rapid and efficient transport and exploration, give me Amundsen. But when things seem hopeless, get down on your knees and pray for Shackleton."

[music]

Transcript: The Fearsome Nematodes of the Dry Valleys

Glenn Zorpette: The McMurdo Dry Valleys. The name suggests the wastelands of Australia. But it's Antarctica, and it's one of the most beautiful places I've ever seen. These Dry Valleys are among the most arid places on Earth. There's very little snow, and not a lot of ice except for some scattered glaciers. And yet inside the Taylor Valley where I was standing...

[sound of water trickling]

Joseph Lee: When I came down into Taylor for the first time and heard that, it almost brought a tear to my eye. After two months of not hearing any liquid water except for what we have in the pot, and this is just—I love it.

Glenn Zorpette: Joseph Lee is a postdoctoral fellow with Portland State University and the McMurdo Long-Term Ecological Research group, also known as the LTER. Lee knew exactly where that noise of trickling water was coming from.

Joseph Lee: It's the sound of some old ice. Water deposited 4000 years ago.

[sound of water trickling]

Glenn Zorpette: Up in the accumulation zone of one of the glaciers, apparently.

Joseph Lee: And right now, when the sun shines in the peak summer, it melts, flows down...into the streams, into the ponds, and ultimately into the lakes. So that's what I'm interested in, the ground—it's this big unexplored source for water, for chemistry, for all the things that the LTER is interested in.

Glenn Zorpette: These little trickles of water sluicing their way through the Dry Valleys can mean the difference between dormancy and animation to some rather well-adapted creatures.

Joseph Lee: The dominant predator here in the Dry Valleys is the fearsome nematode. It's a microscopic worm that eats both algae and also other microbes.

Glenn Zorpette: Are there nematodes unique to this area?

Joseph Lee: The nematodes—most of them are endemic, so they're from here and are unique to here. They adapt to the subfreezing temperatures in the winter by drying themselves out, and as soon as the first trickle of water comes from either melting snow in the spring or a trickle of water of a glacier, or in my interest, the melting of permafrost, the wicking up of water, they snap into activity and start eating, respirating, multiplying, and living their lives in the summer.

Glenn Zorpette: Nematodes belong to a simple food web to which Lee and his

team are making small experimental tweaks. They add some extra water here, some extra food there, and observe how food webs respond to a changing environment.

Joseph Lee: And given that we're part of the larger food web, seeing how the nematodes adapt tells us a little about how we adapt as a species.

Glenn Zorpette: Very few critters other than nematodes can live in the Dry Valleys. Take seals, for example. Ray Spain is a Raytheon employee who assists the scientists.

Ray Spain: We have a lot of mummified seals up and down the valley. We're not really sure why they come up here. For some reason they tend to go further and further up valley, so they're gaining altitude, and they're going over big lumpy rocks. It can't be easy travel, because they travel much better in water. And of course they die because they can't get back to sea.

Glenn Zorpette: The seals will wander as far as 10, 12 miles away from the sea, hauling their blubbery bodies over rugged mountains and hills.

Ray Spain: Long way for a seal. With little tiny flippers for feet. And then there's no bacteria here to break them down. So they just desiccate. They just dry out and become a bag of bones with beef jerky around them.

Glenn Zorpette: Goes to show just how hostile the Dry Valleys can be. Which is why Ray Spain takes the logistics and safety aspects of her job so seriously.

Ray Spain: We get people who arrive here who are graduate or undergraduate students who have never been camping before.

Glenn Zorpette: This is probably an unusual place to start camping, an arid Dry Valley in Antarctica.

Ray Spain: Yeah, but you know, if it's the first time, you can just lay out the rules and say this is how you do it. Whereas if it's somebody who's camped a lot of other places, it's probably harder, because they say, "What do you mean, I can't just pee on the ground?" It might be harder that way. Most of the people—I've never had anybody come out here and just not been able to handle it.

Glenn Zorpette: What about challenges? Have you had any unusual challenges?

Ray Spain: Challenges. I would say personalities in a small space are the biggest challenge. We spend all our time together. You have one small building to share, and you're with those people 24/7. You work with them, you eat with them, you're just with them all the time. So you can imagine being stuck with your family in a small cabin. So even people you know very well, it can be very challenging after not just weeks but months.

Glenn Zorpette: Still, Joseph Lee finds the Antarctic, and the Dry Valleys in

particular, an endlessly rewarding habitat to explore.

Joseph Lee: On those few occasions when the wind dies, and you're 10 or 15 miles from camp, you're the only soul in the valley, and it's absolutely breathtaking. The opportunity, though, to really study this place, to understand it, to get an appreciation not just of its surface beauty but how it's functioning and changing with time, is really the great opportunity. It is a life-changing experience, and it's a very addictive place to do work. There's a lot of data here, and a lot of information, and as you can hear, it's critical because it's melting out every day.

[sound of water trickling]

Transcript: 5.4 Million Square Miles, One Cash Machine

[door opening and closing]

Glenn Zorpette: It's a continent of five and a half million square miles, but Antarctica has just one cash machine. It's right inside the entrance to Building 155, which houses the galley at the main U.S. base, McMurdo Station. But, come to think of it: Why is there even one cash machine here? There aren't any malls. There isn't even a Starbucks. Not yet, anyway.

[beeping]

Glenn Zorpette: How often would you say you use it?

Tony Dixon: Once a week?

Glenn Zorpette: And where do you tend to spend the money around here?

Tony Dixon: Store.

Glenn Zorpette: You mean the store in the galley?

Tony Dixon: Yeah.

Glenn Zorpette: What kinds of things do you buy?

Tony Dixon: Typically souvenirs for back home and snacks. Things like that.

Glenn Zorpette: Besides the shop here in Building 155, there are a couple bars, a coffee shop, a post office, and other consumer attractions.

Corinne Morse: People sell things. They make jewelry down here. And people knit things and sell. There's also a massage therapist here, that she does services for that. And there's also a hairdresser. She does barbershop, and tips for that.

Glenn Zorpette: Corinne Morse is the dispersing specialist for McMurdo Station, which means that she gets to stuff the ATM machine full of 20-dollar bills.

Corinne Morse: There's about \$50 000 that goes out of that machine every week, and I fill it up every week on Saturdays.

Glenn Zorpette: So McMurdo station has its own quirky, self-contained economy. Twenty-dollar bills go out of the cash machine to the souvenir shop and the bars and the massage therapist, and then they make their way back to the cash machine. Back and forth. By the way, the bars are called Gallagher's and Southern Exposure, which is affectionately known as Southern.

Glenn Zorpette: Do the twenties pretty much, just bounce back and forth between this machine and Southern?"

Lisa Jenkins: They are all over the station. It's pretty amazing the—how the money turns around here. People write notes on their bills and they get them back eventually.

Glenn Zorpette: That's Lisa Jenkins. She tends bar at Southern Exposure.

Lisa Jenkins: There's a lot of twenties that are in cycle, that are in circulation now, that I forget what it says on it, but someone took a stack of them and just wrote their name all over them. And they're just all over the place now.

Glenn Zorpette: They're still here.

Lisa Jenkins: Yeah.

Glenn Zorpette: Months later.

Lisa Jenkins: Oh yeah. Years later.

Glenn Zorpette: Thank you very much.

Lisa Jenkins: You're welcome.

[door opening and closing, music]

Transcript: Finding Neutrinos in a Cubic Kilometer of Ice

Glenn Zorpette: Neutrinos are among the most common things in the universe—and yet they're also among the most difficult to detect. In a unique effort to see these subatomic particles, engineers are now turning a cubic kilometer of ice under the South Pole into one of the oddest telescopes in the world. By spotting some of the countless neutrinos that streak across the universe, this telescope should help scientists understand mysterious things: like black holes, exploding stars, and dark matter, the invisible stuff that makes up 23 percent of our universe.

[pump-room sound]

Glenn Zorpette: How do you make a hole two and a half kilometers down into solid ice? You melt your way down. It takes two days and 20 000 gallons of hot water. Dennis Dillings showed me how it's done.

Dennis Dillings: That's our drill water for this project.

Glenn Zorpette: So you actually use hot water to drill?

Dennis Dillings: Yes we do.

Glenn Zorpette: There's no metal bit. Just hot water.

Dennis Dillings: We use 200 gallons a minute at 90 °C which is boiling in the environment. And we push it out at 1000 pounds of pressure out of a three-quarter-inch nozzle. That equates up to the power of a Burlington locomotive, a big one at full power, coming out of that nozzle. That's why this drill will drill what it drills.

[pump-room sound]

Glenn Zorpette: Dillings is the drill manager for the company building the IceCube observatory. So far he's drilled 79 of these mile-and-a-half holes in a kilometer-square stretch of ice near the South Pole. He has seven more to go.

[machinery running]

Glenn Zorpette: Once a hole is drilled, technicians lower into it a string of 60 basketball-sized light detectors. By February of 2011, over 5000 detectors will lie frozen in a billion tons of ice. They're going to look for the most elusive particles in the universe: neutrinos.

Mark Krasberg: Neutrinos are really neat—they're chargeless, they're almost massless. You've actually got 10 million going through your thumb every second. They're really, really hard to detect.

Glenn Zorpette: Mark Krasberg is a physicist on the IceCube project. He explains that because neutrinos don't interact with anything, they're very hard to detect. But that same lack of interaction also means they can zip across vast stretches of the universe unimpeded. So to astronomers, neutrinos are like minuscule messengers carrying news about exploding stars, baby black holes, and other violent events that occurred unimaginably far away, and an unimaginably long time ago.

Mark Krasberg: ...since neutrinos are chargeless, they go on a straight line through the universe. You basically, if you have a source, just have a straight line going back, and you can ask an astronomer, What's at that spot in the sky?

[music]

Glenn Zorpette: Neutrinos can also come from sources closer to home. In fact, neutrinos coming from the center of our Sun or our Milky Way galaxy could give physicists clues about the nature of dark matter, the mystery mass that pervades our universe but about which nothing is known. But how do you detect particles that are almost undetectable? Well, the IceCube telescope is looking for the one-in-a-million neutrino that crashes into an atom of an ice molecule and creates another particle called a muon. As that muon shoots through the ice, it gives off blue light. In the pure, incredibly clear ice of the South Pole, that tiny bit of light can travel hundreds of feet. And then it can hit those basketball-size light detectors.

Mark Krasberg: It's basically an inverse lightbulb. It collects the light and converts it into charge. There's a computer on top of here and the signals go to the surface.

Glenn Zorpette: Researchers hope these ghostly particles will help them solve some of the biggest mysteries of the universe. If they do, then one day this strange telescope under the ice might not seem so strange after all.

Transcript: The Big Bang, the South Pole, and Everything

Glenn Zorpette: The South Pole is a great place to study origins of the universe. Here's why. One of the main things that cosmologists do is analyze the microwave radiation that permeates the universe. That radiation is called the cosmic microwave background, and you can think of it as an echo of the big bang that launched the universe into the glorious spectacle that we see today. With its dry, stable atmosphere, the South Pole offers outstanding viewing conditions for two microwave telescopes that could unravel the deepest mysteries of the universe.

[clanking/talking sounds]

Glenn Zorpette: Physicist John Carlstrom of the University of Chicago leads the way up to the roof of the South Pole Telescope. It towers five stories above the powdery white snow.

[clanking sound up for 1 to 2 seconds then fade]

John Carlstrom: This is a 10-meter diameter—it's actually a little larger, but 10 meters as it's projected toward the sky—telescope for looking at radiation from the big bang, what we call the cosmic microwave background radiation.

Glenn Zorpette: Carlstrom is the mastermind behind this [US] \$19 million telescope. He explains that the cosmic microwave background radiation is like an echo reaching us from 13.7 billion years ago.

John Carlstrom: And it allows us to take a snapshot, see what the universe was like. So we can take telescopes like this and develop images of what this radiation looks like where it's a little more intense and less intense, hot spots and cold spots. And when we develop these pictures and look at them, what we're seeing is the baby infant picture of what our universe looked like.

Glenn Zorpette: Carlstrom's studying these maps for clues to dark energy, the utterly mysterious force that makes up 70 percent of our universe. Astronomers know very little about dark energy, but they do

know that it counteracts gravity and causes the universe to expand at an ever-increasing rate. One of the major mysteries of dark energy is that it can't account for the formation of the largest structures in the universe, which are clusters of galaxies. Studying when these galactic clusters formed and how they've changed could answer some basic questions about the origins of our universe, such as: How important was dark energy in the early universe? When did it kick in? How has it evolved? In its search for answers, the South Pole Telescope scans the skies for galaxy clusters.

John Carlstrom: There's a little shadow against the cosmic microwave background, and that shadow is because you've just detected a cluster of galaxies. So you're looking at the largest object the universe has ever created, and you're going to see it as a hole, a depression in the intensity of the cosmic microwave background. Fewer photons.

Glenn Zorpette: To detect those tiny temperature dips, the telescope's photon detectors and one of its mirrors are kept extremely cold.

Glenn Zorpette: In a round chamber beneath the South Pole Telescope, superadvanced refrigerators keep the telescope's mirror at 10 degrees kelvin. That's about -450 degrees Fahrenheit—even the South Pole is blisteringly hot by comparison.

[sounds of helium pulsing]

John Carlstrom: It's helium rushing through these lines—helium for our refrigerators. The refrigerators have this pulse of helium that goes in to cool the detectors.

Glenn Zorpette: In 2011, Carlstrom and his colleagues will move on to another huge cosmology topic—the theory of inflation, which says that the universe began expanding exponentially right after the big bang, when the entire universe that we see today was about the size of a grapefruit. Down the hall from the South Pole Telescope, another telescope, called BICEP, is already trying to test the theory. Harvard astronomer John Kovac leads the BICEP team.

John Kovac: There's a specific pattern that would be characteristic of gravity waves that would have been created by an initial epic inflation in the first tiny fraction of a second if the universe underwent an inflationary expansion.

Glenn Zorpette: Translation? Okay. Inflation theory says that the explosive expansion of the universe would've created gravitational waves. And these waves would've left a signature, kind of like its own graffiti, in the cosmic microwave background. What would that graffiti look like? Well, think of it as a slight swirl in the radio signal. Graduate student Justus Brevik helped build the BICEP detectors that sense that swirling pattern.

Justus Brevik: What we do is we sit there and we scan the sky with these detector arrays and build up maps. And we have about an 800-square-degree field that we look at, and we scan over that for about a year and half to create a map of the polarization signal.

Glenn Zorpette: By studying the polarization of the microwave background, Carlstrom and his team may finally find hard evidence not only of gravity waves but also of inflation. Even in cosmological terms, that would be big.

John Carlstrom: What we would detect is what I think is, effectively, a smoking gun for inflation, for this incredible theory that the universe inflated from a subatomic region of space-time.

Glenn Zorpette: In other words, we'd have proof that the whole universe expanded from something much smaller than an atom. It would be the biggest news ever from the bottom of the world.