The Antarctic Sun

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Where science goes shopping

By Mark Sabbatini
Sun staff

The atmosphere is sort of Costco meets Bob's Country Market.

A quaint bell jingles as people enter and are greeted by the store's sole employee. Shopping baskets are stacked near the first of several short aisles of mostly familiar groceries. Customers pick cans of yams and boxes of instant oatmeal off shelves one at a time — but here they keep picking. And picking.

At checkout time there's no "paper or plastic"dilemma. Instead shoppers load what may be thousands of pounds of goods into triple-walled cardboard crates, which often are destined to be thrown out of planes as they taxi down ice runways.

Thanks for shopping at the Berg Field Center Food Room at McMurdo Station. Have a nice day.

The store, tucked into the second floor of a cargo building, is where scientists and others working at remote sites stock up on supplies before heading out to the field. What's on the shelves may need to feed a few people or a dozen, for one week or six, and be suitable for cooking equipment ranging from backpacking stoves to reasonably modern kitchens.

But McMurdo residents with a

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Dressed for town

Photo by Melanie Conner/The Antarctic Sun

This well-dressed visitor hangs out along the road to McMurdo's ice runway, delighting passers-by. He seemed unconcerned by the audience he drew last week, falling asleep while paparazzi snapped shutters around him. For most of the gawkers it was the first penguin they've ever seen. "This made my Antarctic experience complete," said Frank Abbatecola, a Summit County, Colo., resident at McMurdo Station for his second season. Another Adelie penguin was spotted by the ice pier Friday.

When the Ice was green and growing

Antarctica's warmer, not gentler, past

By Kristan Hutchison
Sun staff

Long, long ago, back when Antarctica was a warm place, a hungry dinosaur choked on his dinner, which happened to be another dinosaur his same size.

Imagine the preceding battle — The 22-foot cryolophosaurus standing nearly upright on his two sturdy back legs while he ripped at the peace-loving, plant-eating prosaurapod with his sharp teeth and front claws. The prosaurapod, slightly bigger at 25-feet-long, but without enough defenses, trying to escape as they splash together into a river bed running red with his blood.

Victorious, cryolophosaurus dined in earnest, tearing large bites from his prey. Only he should have chewed a little better, because part of a leg stuck in his throat and he died there in the riverbed.

There they lay, predator and prey, while smaller dinosaurs scavenged their bodies. There they stayed as the world slowly cooled and ice covered the continent. There they were when 200 million years later geologist David Elliot spotted a bone sticking up as he looked for rocks in the Transantarctic Mountains.

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Following Scott, for a few miles
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Quote of the Week

"You haven't lived until you've crossed the Drake Passage."

— IT worker who's spent seasons at all three stations, including Palmer

Looking back

~ 750 million years ago Antarctica and North America connected.

~500 million years ago Antarctica is at the Earth's equator.

~245 million years ago Synapsids, an evolutionary link between reptiles and mammals, coexist in Antarctica with giant amphibians, some with heads at least three feet long. The synapsids come in a wide variety of both plant- and meat-eaters, ranging from cat-size to cow-size.

~190 million years ago Dinosaurs live in Antarctica, including varieties common in North America and the *Crylophosaurus ellioti*, meaning "frozen-crested lizard," which hasn't been found elsewhere.

~180 million years ago Antarctica is in the high latitudes, with a quarter of the continent inside the Antarctic Circle.

~ 65 million years ago Antarctica is near its current polar position and dinosaurs go extinct globally.

~ 35 million years ago First evidence of the Antarctic ice sheet. After that the ice sheets wax and wane.

~ 30 million years ago A current of water begins to circle Antarctica, isolating it from the warmer waters and climates to the north.

~15-17 million years ago The Antarctic ice sheets become permanent, corresponding with the beginning of global cooling.

~ 1.8 million years ago The northern hemisphere ice sheets develop.

Photo illustration by Mark Sabbatini/The Antarctic Sun

Looking at an ice-covered landscape, it's difficult to imagine the forests once growing in Antarctica. In this illustration, drawings of three trees found by paleobiologists Tom and Edith Taylor are superimposed over typical Antarctic scenery.

Paleo

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Elliot radioed William Hammer, a paleontologist working further down Mt. Kirkpatrick. Hammer dug up the dinosaur bones, piecing together the story of the cryolophosaurus' last meal. He found the prosaurapod leg and foot bones stuck in the meat-eater's jaw and throat. The scavenging dinosaurs had left tooth marks - and a few teeth - in cryolophosaurus' legs.

The cryolophosaurus, or "frozen-crested lizard," turned out to be a whole new species and an important find in the evolution of early carnivorous dinosaurs, Hammer said. It was about 40 million years older than the next dinosaur in its evolutionary line.

That and other discoveries of fossil remains have helped puzzle together what Antarctica was like before it froze over. Hammer has found animals living at three different time periods, from pre-mammals and giant amphibians living 245 million years ago to the dinosaurs 200 million year ago. The amphibians are evidence that Antarctica was once warmer, Hammer said. They weren't migratory and couldn't have survived if the water froze in the winter.

"We envision sort of a cool, temperate climate kind of thing, kind of like coastal Oregon or Washington today," Hammer said. "It was too high latitude to be hot, but winters weren't all that harsh."

Antarctica has been at a near polar latitude for more than 120 million years, but it didn't get cold until 40 million years ago. Before then, the Earth is thought to have been an average of 10 degrees warmer. The first evidence of Antarctic ice sheets appears about 35 million years ago.

"The current situation is the thing that's abnormal in terms of geological history," said Scott Borg, National Science Foundation program manager for Antarctic Geology and Geophysics. "The world was a much warmer, much different place."

For much of that time Antarctica wasn't centered on the South Pole, but sat partially outside the Antarctic Circle. At the time cryolophosaurus choked on his last meal in what would become the Transantarctic Mountains, he was living around 65 to 70 degrees south latitude. Now the Antarctic Peninsula sits at that latitude.

By 65 million years ago Antarctica was near its present position inside the Antarctic Circle.

"Things were substantially different, but there were still prolonged periods of very short days in the winter and very short nights in the summer," Borg said. "Whatever ecosystems were there had to adjust to those sort of seasonal changes in the light."

For most of that time Antarctica would have been green, not white. Lush forests of ginkgo, ancient conifers, ferns and moss supplied habitat and food for the animals and birds.

Paleobiologists Tom and Edith Taylor found forests of fossilized tree stumps still standing in the Transantarctic Mountains. Near the Beardmore Glacier a ghost forest of 99 stumps stand erect, some still a foot and a half tall and up to 2 feet in diameter.

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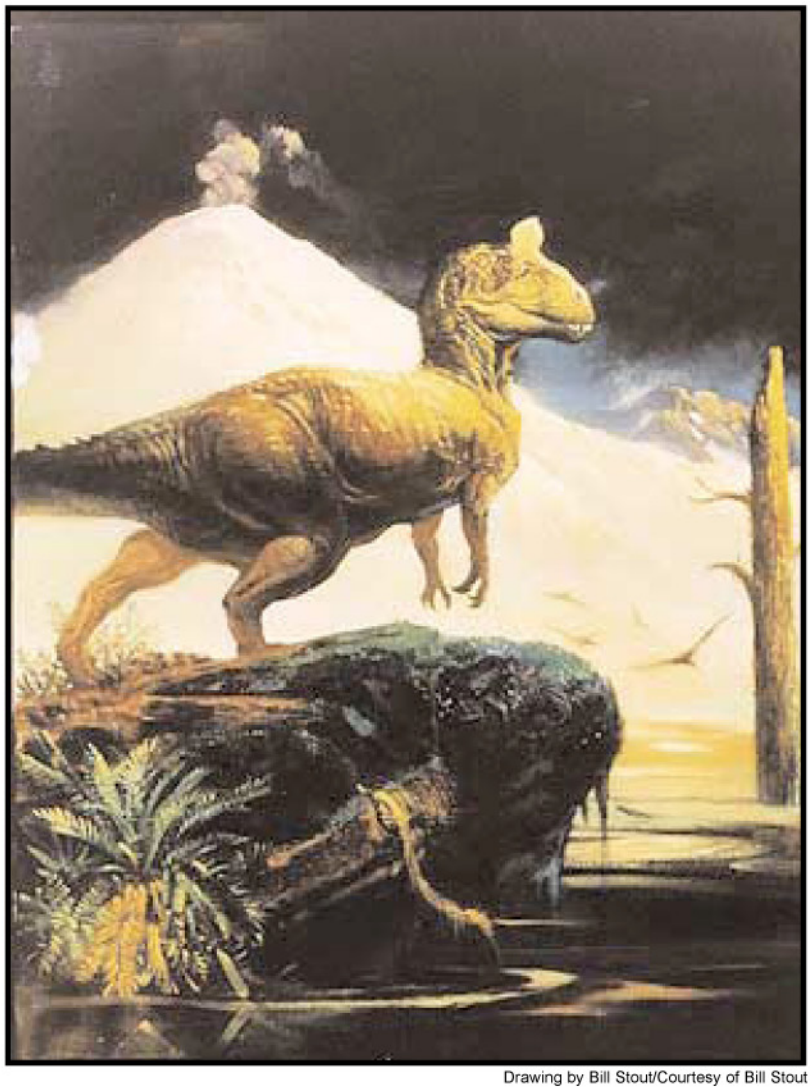

Drawing by Bill Stout/Courtesy of Bill Stout

Cryolophosaurus wanders through a very different Antarctica in this illustration.

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"This was a good-sized forest that had a canopy to it and probably was wet underneath, where there were lots of ferns and plants and things like that," said Tom Taylor.

In the Triassic period, the general vegetation pattern was similar to areas of New Zealand with glaciers in the mountains, then vegetation spreading down to the coastline. Some plants went dormant in the winter, but most didn't. One large ancestor of modern conifers dropped fern-like leaves in the fall. Despite the dark winters, the trees had growth rings 10 times the size found on trees growing now in Alaska. The Taylors were surprised to also find cycads, a tree with a spongy trunk that now grows in tropical areas.

"Everybody loves the animals," said Edith Taylor, "but plants provide the air we breath, the food we eat and the clothes we wear."

The animals that once lived along the Antarctic Peninsula also relied on the vegetation growing in what was then a warm, humid climate, said Jim Martin, professor and curator of vertebrate paleontology for the South Dakota School of Mines, who has also been bone-hunting in Antarctica.

"This would have been a well-vegetated area," Martin said. "Much warmer and more humid than it is today, completely different than the snow and ice you're experiencing now."

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Antarctica's Jurassic park

Some of the dinosaurs and other giant reptiles living in early Antarctica:

Ankylosaur
Heavily armored, tank-like plant eating dinosaurs. They ate low-lying plants, such as ferns, shorter cycads and moss. It was found on Ross Island.

Cryolophosaur
The only carnivorous dinosaur found in Antarctica to walk semi-upright on its back legs. Its name means frozen-crested lizard, for the cold region where it was found and the characteristic crest on the top of its skull, above the eyes. It was about 22 feet (7 meters) long. A cryolophososaurus skeleton was found in the Transantarctic Mountains.

Hadrosaur
Duck-billed herbivores with horny beaks. They ran on two legs, but may have walked on all four while grazing. They probably lived near bodies of water.

Hypsilophodontid
Meaning "high-crested tooth," these were a group of small, gazelle-like, herbivorous, large-eyed, long-legged, five-fingered, four-toed, herding dinosaurs. Hypsilophondontids had no natural defenses from predators except their speed, senses and small claws on their toes. Usually up to 10 feet (3 meters) long, an unusually long one, 13 to 16 feet (4 to 5 meters) long, was found on Vega Island.

Plateosaurid prosauropod
Herbivores with long necks and tails, walking on either two or four legs. Its bottom jaw attached well below the level of its teeth. They ranged in size from about 10 to 33 feet (3 to 10 meters). It was found being eaten by the cryolophosaurus in the Transantarctic Mountains.

Lystrosaurus
The "shovel lizard" was a heavily-built, mammal-like reptile, with a stubby tail. Instead of teeth it had two tusk-like fangs made of horn. It was a plant-eater about 3 feet (1 meter) long that lived in herds near lakes and swamps.

Mosasaur
A carnivorous marine reptile with 4-inch (10 cm.) long teeth. They were up to 33 feet (10 meters) long and had 3-foot (1 meter) long skulls. The lower jaw could unhinge to eat things larger than their own heads. They were not dinosaurs, but are the ancestors of monitor lizards.

Plesiosaur
Flippered marine reptiles, with long, snake-like necks, tiny heads and wide bodies. They were not dinosaurs, but ranged in size from 8 to 46 feet (2 to 14 meter) long. They lived in the open ocean and breathed air. Plesiosaurs remains were found on Vega Island on the Antarctic Peninsula.

Illustration by Bill Stout/Courtesy of Jim Martin

Synapsids battle in an artist's rendition of an early Antarctic scene.

Paleo

From page 7

Visiting islands along the Antarctic Peninsula in past years, Martin, Judd Case from California, and their colleagues found evidence of ancient marine reptiles, dinosaurs and shore birds. The bird fossils look remarkably modern, suggesting Antarctic birds may be a link in the surviving evolutionary chain.

"What is exciting about this is they are very modern in their appearance and elsewhere there are birds that are very primitive that later become extinct," Martin said. "We think that Antarctica was a seed, or at least an important area of dispersal, for modern birds."

A single tooth they found on Vega Island helps confirm the hypothesis that South America was once connected to Antarctica. The one-and-a-half inch long tooth is identical to those found in North America belonging to hadrosaurs, a duck-billed dinosaur about 15 feet high and 30 feet long.

"This tooth is so close to some of the North American teeth you couldn't tell them apart," Martin said.

The hadrosaur was a land-based dinosaur, so its presence in the Antarctic islands supports theories that there was a land connection between the Americas and Antarctica before 65 million years ago.

"The thinking is that this allowed migration pathways," Borg said.

Martin and Case believe possum-like marsupials found in North America could have followed that path through South America and across Antarctica to Australia, but their remains are more elusive than the larger dinosaurs and reptiles.

In areas of Vega Island that might once have been shallow water, the Martin-Case team found a number of marine reptiles, including mosasaurs or giant lizards and plesiosaurs, long-necked reptiles similar to descriptions of the fabled Loch Ness monster.

The mosasaurs were meat-eating reptiles up to 50 feet long, with large jaws and sharp teeth. Martin-Case's group found lots of those teeth and jaws. The plesiosaurs were flippered reptiles about 25 feet long that lived on fish and other swimming animals.

Some of the scraps of bone Martin has found just make him want to return and look for more, like the claw of a theropod, a meat-eating dinosaur.

"We are seeing some tantalizing evidence for them," Martin said, "and we are hoping of course to find a partial skeleton, something like that."

Martin believes there's much more evidence of early Antarctica frozen beneath the permafrost, but it's hard to dig up dinosaur bones when the ground is like cement.

During the peninsula's mid-summer thaw, Martin can sometimes dig down two to three feet before he hits permafrost. He has tried to thaw the ground down further, without much success.

"There's not much we can do beyond that level," Martin said. "You can work all afternoon and get about two inches down. It's labor intensive when you're using a pick."

In past seasons he had to leave some surprising finds behind in the frozen ground.

"We are hoping a plesiosaur skull will be on the end of this neck that's going into the permafrost," Martin said.

Working on the Antarctic continent, Hammer has been able to fly in jackhammers to help him.

When they manage to remove a bone, the cold is still a problem. The standard practice is to wrap fossils in plaster and burlap, like a cast on a broken leg, Martin said. But the plaster is made with water, which freezes before it sets.

Despite the challenges, Antarctica has proved to be one of the best sources of fossil plants from the Triassic and Permian ages, the Taylors said. They found plant fossils in petrified peat at two locations in the Queen Alexandra Range. Peat deposits of that age had only been found in one other place in the world.

Many of the Antarctic plant fossils are also unusually well-preserved through a process called permineralization. In permineralization, silica in the Antarctic groundwater infiltrated the plants before they decayed, preserving the cells and tissues intact. For the researcher looking back in time, it's like the difference between finding someone's initials inscribed in cement, or finding their entire body buried under a house.

Martin, Hammer and the Taylor's all hope to return and look for more evidence of Antarctica's warmer side.

"There are probably more out there," said Edith Taylor. "We just haven't covered every inch of the Transantarctics."

Editors note In February 2006 a credit, a caption, and a phrase were corrected in this story. We apologize for the error.