

An aerial view from an airplane window looking down at a vast, flat, white landscape of Antarctica. The sky is a clear, pale blue. The top of the image shows the underside of the airplane's fuselage and a propeller.

Beyond Imagination

by Veronika Meduna

When I was getting ready for my first visit to Antarctica, I'd already explored the icy continent many times in my mind. This imaginative version was a frozen land at the end of the world, a white wilderness hostile to life. It was also limitless, beautiful, and empty. Above all, my idea of Antarctica was of a place that never changed. I'd read that Captain Robert Scott had left a dead emperor penguin in the hut his men built for their ill-fated expedition. The penguin was still there a century later.

A bell-wether

I was going to Antarctica to report on the work of scientists who were studying what the climate was like in the past. While I was filled with anticipation, two days before leaving, panic hit. What if something went wrong? What if I got stuck there? Can people even make phone calls from Antarctica?

As I boarded a cargo plane for the eight-hour flight across the world's wildest ocean, I was still anxious. I worried that the real Antarctica would be nothing like the place I'd imagined. And I only had three weeks – surely not nearly enough time. The latter turned out to be true. On that first visit, I spent most of my time sleepless and overwhelmed. I was determined to make

the most of the constant daylight so I could understand a place everyone referred to simply as “the ice”. Antarctica was so vast, so full of stories. It seemed not only different from my imagined frozen land but somehow *beyond* imagination.

Thankfully it wouldn't be my only visit. Over the next twenty years, I returned to the ice twice more. I learnt that far from being separate and never-changing, Antarctica connects us. It drives global weather patterns and ocean currents, and in a warming world, it's changing faster than most places on Earth. The continent is our bell-wether of climate change.

The world's largest ice cube

Antarctica is the world's largest ice cube, frozen on top of a rugged mountain range that disappears almost completely under the ice. The continent has so much ice (three-quarters of our planet's fresh water) that it comes with its own vocabulary. There is the huge, continent-covering frozen blanket that splits into two ice sheets, which in turn are made up of smaller ice caps, ice domes, frozen rivers, and glaciers.

Antarctica's ice moves in constant slow motion. From the sheets, it flows out onto the ocean. Here, beyond the fringes of the continent, it becomes ice shelves, floating

but still attached to the land-based ice. The largest of these is the Ross Ice Shelf, the starting point of many famous expeditions, including Captain Scott's forlorn haul to the South Pole. It's also where New Zealand built its research station, Scott Base, in 1957.

Beyond the ice shelves, an apron of sea ice circles the entire continent. The sea ice moves to its own rhythm: expanding during the dark months of a polar winter and shrinking during summer, when the sun doesn't set for six months. This is Antarctica breathing in and out.

Tiny bubbles

All three of my trips took place during the summer, when most scientists work. Although there was a large gap between visits, I caught up with the same people each time. Talking with them, it became clear that the ice is changing at an accelerating pace.

Antarctica is one of the world's best-kept archives. It contains records of environmental conditions that stretch back millions of years. Climate scientists go there to work out what the future might bring. The ice is a looking glass on the past, and this was always my focus, as it was for many of the scientists.

On my first trip, after I'd completed survival training at Scott Base, a helicopter dropped me at the Dry Valleys, one of the few places in Antarctica not covered in ice.

My destination was a field camp where a team of scientists had lived on a glacier for weeks. They'd dug out a massive cavern so they could reach deep layers of ice.

Nancy Bertler is a glaciologist. She told me that in Antarctica, falling snow encloses dust and bubbles of air. Over time, the fallen snow builds up in layers that turn to ice. The deeper the scientists cut down through this ice, the further back in time they travel. Bertler thinks of each icy layer as a treasure trove. The air bubbles are tiny samples of ancient atmospheres, and the mix of greenhouse gases they contain represents a snapshot of past climates. These bubbles tell us that Earth's atmosphere has more greenhouse gases now than at any time in the past 800,000 years, long before the beginning of our species.

The sea floor

A decade later, I had the chance to look even further back in time. I joined geologist Tim Naish and his team as they drilled deep into the sea floor beneath the Ross Ice Shelf. Like the ice, the sea floor also builds up in layers that hold information about the past. These scientists managed to reach back about 5 million years, to a time when greenhouse gas levels were similar to the ones today and Earth was a warmer place. It's these layers on the sea floor that tell us the area now covered by the world's largest

ice shelf was once open ocean. For Naish, this window on Antarctica's past – and a warmer world – was also like looking at the future.

By the time I returned for my third trip, some of his projections had become reality. A warming ocean was melting floating ice shelves from below. Glaciers flowing out to sea were shrinking and retreating fast. Smaller ice shelves were collapsing. Antarctica's melting is now raising seas around the world.

Still there

I haven't been to Antarctica since 2019. In that time, we've learnt that the average temperature on the Antarctic Peninsula has climbed by 3 degrees Celsius – far more than the average rate of global warming. The massive current that circles the frozen continent is also speeding up, and scientists think this might be changing the way sea water carries heat and nutrients around the globe. Even East Antarctica, long thought to be a sleeping giant, has seen the collapse of ice shelves. And in the middle of the continent, the coldest place on Earth, temperatures briefly soared to more than 40 degrees above the normal monthly average.

The dead emperor penguin in Scott's hut is still there, but its living relatives have joined the list of endangered species. Emperors depend on Antarctic sea ice to raise their chicks. The penguins' ideal conditions lie within a narrow comfort zone. Too much ice means they have to travel a long way for food and their chicks might starve. Too little ice means the chicks might not have enough time to grow fat or develop their coat of waterproof feathers. If the current trend of global warming continues, Antarctica's sea ice is expected to decline at a rate that puts emperor penguins at risk of extinction by the end of the century.



Close ties

For a long time, Antarctica was a place we could only imagine. It has a very short history of research: the earliest land expeditions there go back only a little more than a century. But each team returned with evidence of Antarctica's close ties with the rest of our planet.

Scott's expeditions had a scientific purpose, alongside adventure. Even as his men were returning from the South Pole, disheartened and starving, they lugged 16 kilos of fossils they'd collected along the way. Among them were samples of

Glossopteris, an extinct beech-like tree from 250 million years ago. The tree had also grown in Australia, Africa, and South America, and it was the first evidence that Antarctica was once part of a prehistoric landmass known as Gondwana.

Today, despite its distance from other land, Antarctica remains connected to the rest of the world through the atmosphere and the ocean. The continent drives ocean currents that push warm water up along coastlines in the northern hemisphere, where most people live.

Keeping promises

Antarctica is an early-warning system about global change. It's also a galvanising force, encouraging us to act. We've done it before. In the 1980s, finding the ozone hole above Antarctica led to one of the fastest global agreements governments around the world have ever made. They quickly banned the household chemicals that were causing that hole.

Now the continent is telling us that climate change is well and truly under way. For scientists like Bertler and Naish, the ice has delivered the strongest message yet. In 2015, almost two hundred countries signed the Paris Agreement, a legally binding international treaty to address climate change. Now we need to deliver on that promise to keep the ice frozen.



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