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The Big Melt

Tim Flannery, August 16, 2018 Issue

Brave New Arctic: The Untold Story of the Melting North
by Mark C. Serreze
Princeton University Press, 255 pp., $24.95
Extreme Conservation: Life at the Edges of the World
by Joel Berger
University of Chicago Press, 376 pp., $30.00

Austin Post/National Snow and Ice Data Center, University of Colorado, Boulder, The McCall Glacier in the Brooks Range of Alaska, photographed in 1958

Since 1980, computer models have been predicting that a rise in atmospheric concentrations of carbon dioxide will cause the Arctic to warm twice as fast as areas at lower latitudes, putting it at high risk from climate change. But as Mark Serreze explains in *Brave New Arctic*, until the 2000s many scientists working in the Arctic, including himself, were having a tough time finding conclusive evidence that humans were having an impact on the region's climate.

Serreze is now director of the National Snow and Ice Data Center (NSIDC), based at the University of Colorado at Boulder. NSIDC's Arctic Ice News website gives daily updates on the state of the poles, an exceptionally important service for those interested in the increasing effects of climate change. In 1982, however, he was an aimless geography major who almost randomly took a job as a field assistant on an expedition to the Arctic to investigate how the great ice sheets formed during the Ice Age. He thought himself handsomely remunerated at $5.00 per hour, as he measured two small, isolated ice caps on Ellesmere Island, hoping to determine whether they were growing or shrinking.

The Arctic is geographically complex, with an even more complicated weather system, and conducting research there is hard, dangerous, and expensive. Yet it's important that the work be done, because climate changes that occur there have a disproportionate effect on our planet. The Greenland ice cap, for example, contains enough water, were it to melt, to raise sea levels globally by around twenty-three feet, and the Arctic permafrost contains enough carbon, were it to be released, to increase atmospheric concentrations of CO2 by ninety parts per million (as of June 2018 it stands at 409.25 parts per million).

Even more worryingly, the Arctic also holds large reserves of methane, in the form of clathrates—icy, lattice-shaped chemical structures known as "the ice that burns." Much of it is under the permafrost both on land and under the sea, where it's held stable by temperature and water pressure. All of these factors make scientists worry about the consequences as they watch Greenland's ice melt ever more rapidly, permafrost melt extend in places, and craters form as clathrates become unstable and explode. But will any of these changes trigger a tipping point in the near future that will make climate change unstoppable? Without the strong research on the Arctic led by people like Serreze, we would be flying blind into what could be a very dangerous future.

In 1983, as Serreze was about to embark on his research career, he was "thinking about Arctic cooling and instantaneous glacierization" (the rapid growth of glaciers), and despite the computer models,

"even secretly hoping for it." The evidence for human impacts was not yet in. In 1990 the Intergovernmental Panel on Climate Change reported that the changes in the Arctic "could still be largely due to natural variability," and that unequivocal physical evidence of what the models were predicting might not be seen for at least a decade. Part of the problem was that the Arctic has a highly variable climate, influenced not only by year-to-year fluctuations but also by decadal cycles such as the shifts in atmospheric pressure known as the North Atlantic Oscillation.

It was not until around 1996, when oceanographers circulated a letter urging coordinated study of the changing Arctic, that the scientific community began making a concerted effort to understand what was happening there. Serreze played a major part in that research, yet as late as 2003 he was unconvinced that the data were showing anything beyond natural variability. That August, however, at a retreat hosted by the National Science Foundation, he had what he describes as "an OMG moment" as researcher after researcher spoke of "melt, thaw, disruption, destabilization, warming, moving, weakening, and uncharted trajectories." Others took even longer to be convinced: Jim Overland, a leading oceanographer at the National Oceanic and Atmospheric Administration, finally accepted that humans were changing the Arctic in 2008. Soon thereafter, however, things began happening so fast that only paid lobbyists, and those deluded by them, were denying the facts.

In the summer of 2007, Arctic ice cover reached an all-time low and was so far outside the range of the climate model projections that it shocked scientists. In summer 2012 there was so little ice in the Arctic Sea that open water reached close to the pole; for comparison, in 1980 Arctic summer ice covered an area around the size of the contiguous United States, minus Arizona. By 2012, it covered only 46 percent of that area. As Serreze explains, after that summer, scientists realized that it was a case of when, not if, the Arctic will lose all of its summer ice.

From a hard-to-detect start, climate change quickly gathered speed, and soon had the momentum of a charging rhino. So breathtaking was the shift that Serreze began to speak of the scientific community's "utter astonishment" at the rate of melt and of a "death spiral" of the Arctic sea ice. Deep concern was sparked globally when, in the summer of 2012, almost the entire surface of the Greenland ice cap began to melt. Then, at the end of December 2015, air temperatures over the Arctic briefly reached above freezing. Serreze, seemingly in disbelief, describes the event as "simply unheard of."

In February 2018, after the completion of Serreze's book, the Arctic experienced its fourth winter heatwave, with temperatures rising above freezing four years in a row. The 2018 heatwave was the most extreme, with a temperature of 43° Fahrenheit recorded at Greenland's northernmost observatory, which is just 440 miles from the North Pole. For ten consecutive days, the station recorded above-freezing temperatures, and overall this year, temperatures in the Arctic have been up to 70° Fahrenheit higher than average. Unsurprisingly, the NSIDC website reveals that winter ice cover in the Arctic this year is the second-lowest on record, with the four smallest areas occurring over the last four years.

As Serreze makes clear, the Arctic climate system is now entering uncharted territory, with the computer models no longer providing a reliable guide to the future. Will we see an ice-free North Pole in 2018? Or an ice-free Arctic just twelve years from now, in the summer of 2030? Since the US North Pole Environmental Observatory was shut down in 2015, it has been much harder to answer such questions. And the public seems apathetic. On the phone with Serreze, the veteran journalist Seth Borenstein lamented, "How many times can a journalist report on what is happening in the Arctic before it becomes so repetitive that people lose interest?"

The great Dutch writer and historian Geert Mak once told me that in 1933 the Dutch newspapers were full of stories of the threat of Nazism, yet by 1938 those same papers were all but silent on the subject. Sometimes, it seems, threats to our future become so great that we opt to ignore them. Yet if we fail to act with the utmost urgency to slow climate change, we will invite catastrophe on all humanity.

Arctic ecosystems are already responding to the changing climate. "Shrubbification" of the tundra has been evident for some time. In 1948, geologists exploring for oil took photographs at locations across Alaska. In 1999 and 2000 researchers took matching photos at the same locations. Comparing the images revealed an increase in shrubs, so that the open tundra was disappearing under them. One of the few mammalian beneficiaries of the warmer conditions is

the bowhead whale, which is finding more food. Most Arctic species, however, are finding conditions ever more difficult.

Joel Berger's extraordinary new book *Extreme Conservation* reveals just how hard-won knowledge about various Arctic species is. His abiding interest is snow oxen, a diverse group of herbivores adapted to life in the most hostile regions of Earth. One of them, the musk ox, is Berger's most long-standing subject of study. A relative of sheep and goats, it was once widespread across the Arctic. But the last European musk ox died around nine thousand years ago and the last Asian ones around two thousand years ago, leaving the sole survivors in Alaska, western Canada, and Greenland. The Alaskan population was wiped out when native people obtained guns from European traders, but was reintroduced from Greenland in 1935.

Berger's research has taken him to two of Earth's three poles: the Arctic and the "third pole," the Tibetan plateau. He has had to work in all-but-impossible situations—for example, in restricted military areas where he was opposed by bureaucrats, and in the most remote parts of Mongolia and Bhutan, where cultural differences can make research very difficult. In the US, he succeeded in securing pronghorn migration routes, convincing ranchers and oilmen of the necessity of setting aside land for conservation.

Matt Nolan/National Snow and Ice Data Center, University of Colorado, Boulder, The McCall Glacier, photographed in 2000

Berger has a record of achieving great things in the toughest places on earth. Yet he is not always welcome. In remote Inuit villages, for example, he's perceived as a symbol of distant and threatening America, which in the eyes of the locals has already done enormous damage to native cultures. He is also interested in a creature that the local Inuit have little sympathy for. As they see it, musk oxen were introduced by Americans without any local consultation, and they are thought to compete for food with the caribou upon which the villagers depend.

One of the most dangerous climatic trends for musk oxen, Berger explains, is ever-warmer winters, which can induce rain-on-snow events. He has had his own experiences with them: "Winter jackets that were dry in the cold became waterlogged in rain. In wetness and grueling wind, we grew hypothermic. Snow machines overheated. Thick sheens of river ice lost outer coats." For herbivores the impact is even more catastrophic, because the rain freezes to a hard layer of ice, making it impossible for them to reach their food. After one rain-on-snow event on Banks Island, Canada, 20,000 musk oxen, out of a population of 70,000, perished. And the effects can be felt for years, as calves born underweight struggle to survive.

But why should we care about the fate of the musk oxen? Apart from the fact that they are one of the toughest and most magnificent herbivores, they and other snow oxen may well be canaries in the Arctic coal mine. Because of their unique ecology, they are among the first to be affected by climate change, but it won't be long before the changes affecting them begin to affect other species, including ourselves. Scientists fear that, as the Arctic loses its biodiversity, the ecology of our living world will begin to unravel.

In March 2011 Berger found evidence of yet another climate-related threat to the musk ox. While flying near Cape Espenberg, Alaska, he discovered a group of fifty-two dead musk oxen, including a male who had been frozen while standing in the ice. The group had been killed by an *ivu*—a storm-driven surge of freezing seawater and ice that can travel hundreds of yards inland and push up waves of ice as high as twenty feet. As the sea ice, which absorbs wave

energy, retreats, *ivus* and coastal erosion are increasing, with tragic effects on both musk oxen and Inuit villages, which are being relocated from the coast.

Stabilizing the Arctic's climate, if it can be done at all, is the task of decades or centuries. It will require a swift cessation in the use of fossil fuels and the development of methods and technologies that will draw CO2 out of the atmosphere. But other threats to Arctic wildlife can be dealt with more swiftly. One such threat is hunting. Hunters tend to target male musk oxen, which are twice as large as females and have magnificent hooked horns. But in groups of musk oxen that lack males, infant mortality is high.

This appears to be because musk oxen have an unusual defense mechanism. If threatened by bears or wolves, they form a circle, within which they protect their young. The males, which can be very aggressive, suddenly lunge out of the circle and try to hook the predator with their horns. As the Arctic warms, grizzly bears are pushing further north, and researchers hypothesize that grizzlies and other predators are killing enough young musk oxen in herds lacking protective males to cause the population to decline.

Such scientific hypotheses are interesting, though of little use unless they can be tested. But testing hypotheses about musk ox predation is extraordinarily arduous. Predation events are rare, and a researcher would never gather enough data just by tailing a herd of musk oxen in the hopes of witnessing one. Instead, to test the idea Berger decided to try to determine whether musk oxen fear bears, reasoning that if they did, then bears must be significant predators. So he dressed in a bear costume and approached herds of musk oxen, recording their response. Just to be sure that it was the bear costume they were responding to, he also approached the same herds dressed in a caribou outfit.

Berger discovered that the approach must be made from at least a mile away and, like that of a bear bent on attack, it must not be direct. With a wind-chill factor of–15° C and a skin of ice over the snow, on his first attempt Berger took an hour and a half to get within forty-five yards of the herd. Then a bull charged—from twenty-five yards away. Instinct kicked in, and he tossed the head of his bear costume skyward, causing the confused bull to halt. Berger then struggled through the deep snow toward his colleagues, who were approaching on their snowmobiles.

The astonishing thing is that Berger did not give up but repeated the exercise again, and again and again, over deep snow, sharp rocks, and permafrost, enduring hours of agonizing cold. At most, he got to record two encounters per day, but often only one. Over the years, he built a data set of more than one hundred encounters and got charged "seriously" by bulls four times. Always, in the back of his mind, a question lurks: What if, while dressed in his costume, he meets a real bear?

Some of Berger's interactions with musk oxen are deeply disturbing, and it's greatly to his credit that he admits to the failures as well as the triumphs of his work. As part of his research, he darted female musk oxen with a sedative and placed radio tracking devices on them. In all, he darted 215 musk oxen, 90 percent of which returned to their herds. But some became isolated, initiating what Berger accurately describes as a "tragedy." As he tracked the isolated individuals, a sad picture emerged. Without herd protection in a harsh land, they became distressed and sought safety in holes in the snow, where they led a lonely and fearful existence.

Investigating musk oxen killed by predators can be even more traumatic. One of the animals Berger collared was attacked by wolves. The radio collar pinged in a way that signified that the animal wearing it was dead. Unable to investigate right away, Berger arrived on the scene two days later and was astonished to find another carcass, beside which the rest of the herd waited "patiently, now for a full three days, as if somehow their presence will usher their two dead companions back to life."

Berger leaned down to remove the collar: "A chunk of leg is gone. A hole punctures her abdomen. Part of the rump is eaten…. The cow lies in the snow, edges melted away by the warmth of her decaying body. I push down on her throat. Her eyes open." Horrified, Berger realized that the mutilated creature was still alive—indeed it had been eaten alive for days. She tried to get to her feet. It took three shots to put her out of her misery.

Such nightmarish moments can give researchers a form of PTSD. While studying saiga antelopes in Mongolia, Berger worried about trying to capture and collar the high-strung creatures, upon whom the

procedure had never previously been tried. At night he was haunted by a repeating dream "involving talons—vise grips tearing into my shoulder, blood exploding—the eagle's victory dance."

The bleak nature of Berger's work comes through strongly in a letter he wrote to his wife while he was researching musk oxen in the "postapocalyptic" world of Wrangel Island, in Russia. The island, in the Arctic Sea, is famous as the last redoubt of the woolly mammoth, which survived there until the Pharaonic era. Today it forms part of a military zone, and upon entering it Berger was arrested, then released to live among the rotting buildings of an old gulag. His letter reads, in part:

Three days, almost 100 miles of riding [on a snowmobile] from 5 above to 20 below, just to get a single data point. One! Just crazy? And, by the time I submit our work for publication—well, who knows, some reviewer will probably say, "sample size is too small."

Berger is a committed conservationist whose work has increased the chance that musk oxen, saiga antelopes, takin, and pronghorns will survive. But is such altruism sufficient to induce someone to live a life of freezing discomfort, trauma, frequent failure, and social alienation? As a biologist who undertook twenty-six expeditions to remote parts of Melanesia, I have some insights into the life Berger has chosen. Yes, the idea that you might be helping species survive is a powerful incentive. But another reason that near-death experiences don't put you off is incurable curiosity: you just have to know what's over that next mountain, or what that next observation will bring.

But the boiling frog syndrome also plays a part. After spending months raising the money, recruiting the staff, and acquiring the equipment needed for a project, you've invested a lot in the journey. By the time you reach your first serious hurdle in the field, to quote Macbeth, you are "in blood stepped in so far that, should I wade no more, returning were as tedious as go o'er." By the time you face that arrow pointed at your chest or that charging musk ox, it's simply too late to turn back. Such fieldwork is mostly for the young. I gave up in my forties, when those mountains just seemed to be getting steeper and more exhausting to climb, and I began to believe that I might actually die in the field. But Berger continues, his hair graying and his body crying out for rest. He is a hero of biology who deserves the highest honors that science can bestow.