The Vanishing World of LONNIE THOMPSON

A SECRET HISTORY OF THE WORLD'S CLIMATE, INCLUDING GLOBAL WARMING, IS BURIED DEEP INSIDE GLACIERS ATOP THE WORLD'S TALLEST PEAKS. BUT AS TEMPERATURES RISE, THOSE RECORDS ARE MELTING. ONE PALEOCLIMATOLOGIST (AND SELF-TAUGHT MOUNTAINEER) IS RACING TO PRESERVE A CRUCIAL PIECE OF OUR PAST—IN HIS FREEZER.

BY LOLLY MERRELL

PORTRAIT BY ANDREW HETHERINGTON/REDUX

It was six o'clock on a clear, subzero June morning—a "bluebird" day, as Alaskans say—and our plane began a tight spiral down to the icy saddle between Mount Bona and its volcanic neighbor, Mount Churchill, deep in Wrangell–St. Elias National Park. Looking for a crevasse-free clearing on the 14,500-foot-high col, our pilot banked into the hard wind and skimmed over the broken semicircle of rocks that marked the lip of Churchill's crater. As the plane dipped its wing, the details of glaciologist Lonnie Thompson's base camp came into view: two white domes and what looked like half-buried tangerines fallen from the cosmos—the bright, compact mountaineering tents where the team slept. Across an expanse of unbroken snow, two snowmobiles cut a line to meet the plane, hauling sleds stacked high with cardboard boxes.

"You sure you want to do this?" the pilot yelled over the whining turboprop as

FROZEN ASSETS: Thompson in his lab's "clean room," May 2004. His collection includes four miles of rare ice cores. Opposite: On Mount Sajama, Bolivia, 1997.

the plane skied to a cottony stop. I waved affirmative, kicked open the door, crawled out of the airplane into the shocking wind, and shook numb hands with Thompson, who was coughing uncontrollably in the spindrift. He wore glacier boots pulled up to his knees buccaneer style and a rag-wool hat with a threadbare pompon that wagged erratically in the gale like the tail on an excited bulldog.

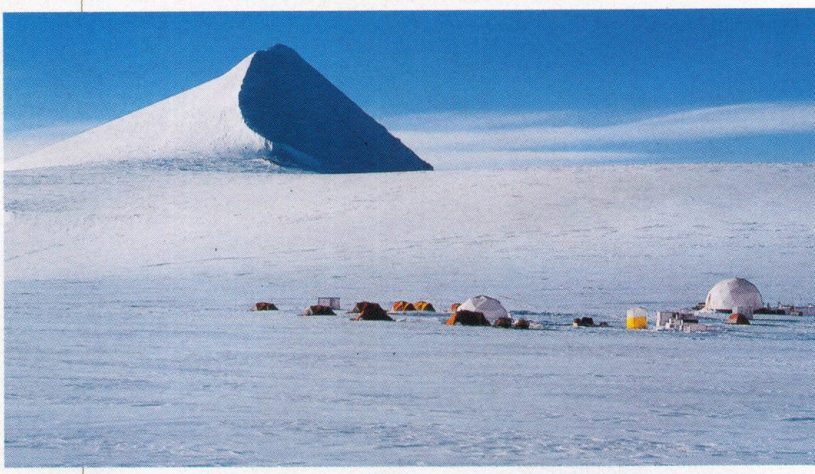
Thompson's appearance may be unprepossessing, but his curriculum vitae reads like that of an overzealous Victorian explorer. He's logged more time at very high altitude than any Sherpa or mountaineer—more than 840 days above 18,000 feet—but he doesn't consider himself a climber. He doesn't even like to hike. For the past 27 years, this 56-year-old professor from Ohio State University has been ascending strategically targeted glaciers across the planet, drilling ice cores in pursuit of the world's climatic history. (Dennis Quaid's character performs similar research in the recent film *The Day After Tomorrow.*) As a result, Thompson's cold-storage catacombs at OSU have become a sort of atmospheric almanac, preserving thousands of feet of pristine glacial ice, rich with ash from prehistoric volcanic eruptions, soot from the Soviet Union's industrial and nuclear nascency, even pollen from Genghis Khan–era Mongolian farms.

Through all this globe-trotting in thin air, Thompson has broken geographic and theoretical barriers in the field of paleoclimatology, becoming the first person to drill an ice core above 13,000 feet. In the process, he's written the playbook for high-altitude glaciology. But in the past decade, what began as an esoteric project to reconstruct the history of the world's climate has evolved into something much bigger, and more urgent. Early on, Thompson made a startling discovery—that his ice contained not just clues about ancient weather patterns but also rare scientific evidence strongly suggesting human-induced climate change. It is this second finding, and the empirical data that Thompson has compiled, that has thrust him into the continued debate about the causes and consequences of global warming and made Thompson something of an eco-celebrity. Al Gore has been known to drag him onstage during environmental lectures, the *New York Times* calls him to comment on rising temperatures in Africa, and he has collected an armload of major scientific prizes, many from green-friendly European governments.

The paradox is that if Thompson is right and his ice-core data really do prove that the planet is warming, then he'd better hurry. All over the globe glaciers are melting, fast. For now, he has zeroed in on Alaska, where the average temperature has risen more than 4°F in the past 30 years—three times the global average. Already this warming has played out in dramatic made-for-TV ways: The melting permafrost is buckling highways, swollen rivers have overflowed their banks, and polar bears are wandering inland from thinning ice shelves. Thompson predicts that within 50 years even Alaska's glaciers will have melted enough that their millennia-old secrets will disappear forever.

MOMENTS AFTER I TUMBLED OUT OF THE PLANE onto the Bona-Churchill glacier, Thompson's team directed me to help load its cargo bay with the meter-long, insulated cardboard boxes from the sleds, which collectively held a couple hundred yards of ice core they had drilled from the col. Geologists have long guessed Mount Churchill to be the source of the White River Ash, the volcanic debris from two blasts that occurred sometime within the last 2,000 years. These eruptions spewed ash over more than 130,000 square miles of Alaska and Canada, an area six times the size of that blanketed by Mount St. Helens in 1980. If Thompson found a thick layer of the linty material in the ice cores, the Churchill hypothesis would at last be proved.

My breath was short in the thin air—clearly an effect of an airlifted elevation gain of 5,000 feet. The temperature was minus 11°F, and five minutes after we finished loading the boxes, the plane was hastily taxiing along the glacier, fishtailing and spitting ice, in order to lift off before its aluminum skis froze to the surface. In its belly, stacked like cordwood, were 2,000 years of Alaska's paleoclimatic history.



READY FOR A COLD ONE: Team Thompson's Alaska drill site at 14,500 feet (above). Opposite, from top: A Bona-Churchill glacier core sample, pulled from 1,500 feet below—the granite pebbles inside were a surprise; Thompson examines a fresh cylinder of ice, looking for clues of climatic change.

With the plane out of sight, Thompson motioned for me to jump on a snowmobile behind a meaty guy with a red, wind-seared face and an impressively cracked lip. "Keith Mountain," he said, his accent Australian, as he shook my mitten. Mountain's hat looked just like Thompson's, only his was unraveling around the bottom. "Grab on!" he yelled as the snowmobile lurched, then buzzed toward camp. Squinting through the gale, I could just make out the serrated peaks of the Wrangell Mountains.

Near camp, Thompson cut his engine and nodded toward an unoccupied tent. "You might need to dig it out a little," he said. In fact, the tent was buried about six feet into the glacier from four straight weeks of the maritime blizzards that dump on these peaks. I threw a pile of gear near the bunker and followed Thompson into the humid cook tent. Keith Mountain came in after us carrying a shovelful of snow, which he emptied into a propane-heated brewing vat to make instant coffee. An odd assembly of cardboard boxes created a semicircular bench along the dome's perimeter and a sagging table in the center. Each box overflowed with freeze-dried meals. I moved aside a stone-hard package of prebarbecued, shrink-wrapped ribs and sat down; a bottle of frozen olive oil wobbled on the table. On most expeditions, Thompson relies on pack animals, porters, and his back to haul in equipment. It can take three weeks just to establish camp. But the 13-million-acre Wrangell–St. Elias is cut off by unfordable rivers. To get deep into the park, you need a plane.

Thompson sank into a cardboard love seat and sat cross-legged, sipping a cup of lukewarm Nescafé while we made polite conversation. His ragged magenta nose revealed a porcelain layer of damaged skin beneath, and he sported a greasy, graying beard—a far cry from

the well-groomed professor of his OSU faculty photo. "Welp," he said, draining his mug, "how 'bout a tour?" We abandoned the fetid tent for the frozen day. The cold immediately robbed my lungs.

I coughed, trying to keep up as he strode toward the drill tent. "You ever have any health problems out here . . . with . . . the conditions?" I wheezed.

"I got a little frostbite once, on my nose. And on my cheeks. I can feel that sometimes," he said, panting a little as well. "Oh, and I've got some asthma," he added. "It's only bad in the cold."

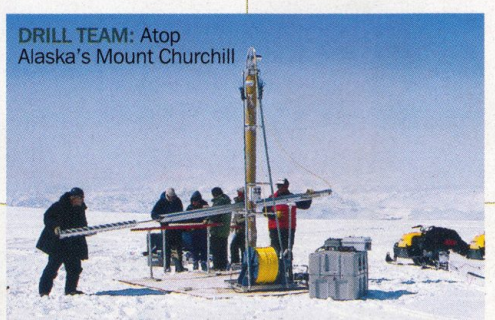
Thompson has a hint of a southern accent, a reminder of his West Virginia roots. He grew up in Gassaway, a tiny farming community in the Appalachians. His parents were educated only through the eighth grade, and his father died when Lonnie was a teen, but his mother has been a strong supporter: Last year she lobbied successfully for a Lonnie Thompson Day in his hometown.

We ducked into the tent. Standing behind the drill, in a long black coat and a leather aviator's cap, Victor Zagorodnov, a Russian-born engineer and a longtime colleague of Thompson's, tended to the four-kilowatt machine as its gleaming stainless steel shaft disappeared into the glacier. Cradling the drill cable, Zagorodnov rocked back and forth as the shaft descended. The rest of the team—another Russian veteran, Vladimir Mikhalenko, and Patrick Ginot, from France—monitored a concoction of ethanol and meltwater that lubricated the ice, allowing the heated drill head to cut around the core. The fumes reeked of moonshine, but the ethanol is, as Victor said, "less pollutant" than the noxious diesel fuel scientists use to drill at the Poles. It's a strategy Thompson adopted in order to keep his remote field sites pristine.

After the drill had cut through a couple of meters of glacier, Ginot and Mikhalenko hoisted the canister out of the small hole, gingerly laid it down, and opened it to reveal a four-inch-wide column of crystal ice. They would repeat this process for up to 14 hours a day, for weeks, even months, until they hit bedrock. In this case, using radar sounding, they had predicted a depth close to a quarter-mile.

"This is some of the cleanest ice I have ever seen," Thompson said, inspecting a meter of the diamondlike core. The sample was so well-preserved that back at his lab he would be able to see a year-by-year chronology in its layers, as with tree rings. He pushed up his glasses and leaned in close, squinting. "I'd say that's probably near 2,000 years old." The core popped and fissured, releasing thousands of years of pressure.

I stepped in to get a look, my massive down parka knocking over a few core tubes. "You can see just about anything in this ice," Thompson said, running his gloved hand over the slick, sparkling cylinder that held a paleoclimatic history of Alaska. He pointed to some bubbles and explained that the gas composition in the ice indicates temperature and levels of humidity from thousands of years ago. The presence of chloride, sulfate, and nitrate ions sketch a time line of volcanic activity and fossil fuel combustion, both of which are thought to contribute to global warming. The ice traps this evidence as it falls from the sky, creating a tidy chronological record. Thompson compares his data with historical records, as well as with other evidence from archaeologists, geologists, and climatologists, in order to confirm dates and complete the atmospheric picture. For example, a severe drought that Thompson dated from a Peruvian ice core coincided *(Continued on page 96)*



DRILL TEAM: Atop Alaska's Mount Churchill

DISAPPEARING ACTS

Five of the past six years have been the warmest in recorded weather history. If the trend keeps up, global warming will cause some of the world's finest natural attractions to vanish. To catch them before they're gone, load up your Prius and hit the road.

1 **THE SNOWS OF KILIMANJARO, TANZANIA.** Kili's famous glaciers are receding fast. Possible expiration: 15 years.

2 **GLACIERS, GLACIER NATIONAL PARK, MONTANA.** When the park was founded in 1910, it featured as many as 150 glaciers. Now there are 27. Possible expiration: 26 years.

3 **JACKSON HOLE SKI RESORT, WYOMING.** Spiking average winter temperatures mean less powder in the Tetons. Possible expiration: 66 years.

4 **GREAT BARRIER REEF, AUSTRALIA.** Worldwide, coral reefs are dying. Some researchers believe the cause to be a bleaching process caused by global warming. Possible expiration: 100 years.

5 **POLAR BEARS, ALASKA.** Polar bears travel across sea ice to feast on seals. Fracturing ice means no more blubber buffet. Possible expiration: 100 years.

6 **MANHATTAN ISLAND, NEW YORK.** If Greenland's ice melts, as some scientists have predicted, sea levels could rise 20 feet and submerge the city that never sleeps. Possible expiration: 1,000 years.

—Mark Kirby

(Continued from page 77)

neatly with archaeological theories about the decline of pre-Inca civilizations. An increase in dust concentrations from a core's total average usually indicates an unusual drying period, while the unlikely presence of potassium—which the Bona-Churchill ice contained—came from fertilizer, in this case most likely blown over during the 20th century from farm fields in China.

Thompson's job seems pretty straightforward: Pull the ice intact from the glacier, send it to the lab at OSU, and translate the history it relates. It is not, however, a simple task. If glacier ice warms even slightly, water seeps through the layers, molecules get mixed up, and the climatic record is indelibly smeared. It's for this reason that glaciologists had long remained focused on polar ice, for they assumed that heat had corrupted glacial records in temperate and tropical zones. The unusual course of Thompson's professional life was set in part by challenging that assumption. Back in the 1970s, when Thompson was a grad student working in Antarctica, he had a hunch that above 18,000 feet, where temperatures almost never rise above freezing, the ice in the tropics was just as solid as that at the Poles. And because such globally influential atmospheric events as El Niño and La Niña originate in the tropics, Thompson theorized that he'd find a molecular treasure trove of paleoclimatic evidence in these glaciers. He also felt that climate records from populated parts of the world—in contrast to the isolated Poles—would better reflect the impact of future climatic events.

In 1974 Thompson set off with a couple of colleagues to scout Peru's Quelccaya Ice Cap with the aim of retrieving the first high-altitude glacial record from the tropics. They returned to Peru two years later, packing in a collection of primitive sampling equipment across 25 miles of gravelly moraines, teaching themselves mountaineering as they went. The team pulled out about 45 feet of ice using a hand-auger—the only portable drill available—only to return home with vials of meltwater. "It was hot at the bottom. I mean, we're in South America," Thompson explained. "If we wanted to keep anything frozen we'd have to get the cores off the mountain when it was cold, around 2 a.m."

Clearly, success required some ingenuity. Along with a friend, Thompson crafted the world's first collapsible, solar-powered ice drill, developed insulated "core boxes," and over the years has hired hundreds of porters to descend, in the coldest hours of the night, serious mountaineering routes all over the world with boxes of ice cores strapped to their backs. In search of cold storage, he's befriended a Chilean fish distributor with refrigerator trucks, an all-night ice cream vendor in the Gobi Desert, and a wealthy beer wholesaler in Africa. At an age when many of his contemporaries are contemplating early retirement someplace warm, Thompson is busier than ever, sampling as many high-altitude glaciers, tropical or not, as he can. On Kilimanjaro, where Thompson drilled in 2000, he may have retrieved the first and last stable ice core from the mountain's glaciers, which Thompson predicts will completely disappear by 2020. If his prediction comes to pass, the only evidence of its existence will be in a big walk-in freezer in Columbus, Ohio.

> ONE OF THE WORLD'S LEADING HIGH-ALTITUDE MEDICAL SPECIALISTS IS STUNNED BY WHAT THOMPSON AND HIS TEAM CAN ENDURE.

The night of my arrival, the wind blew in severe five-minute gales and then would suddenly stop, leaving the metallic night in hollow stillness. Around 12:30 a.m., I heard Thompson leave the cook tent and cough asthmatically as he padded across the snow to his tent. He sleeps only four hours a night. "I like to listen to Voice of America," he said, as if that might explain his insomnia. "It comes on at 4 a.m."

Unaccustomed to the cold and the 20-hour Alaska sun, I finally drifted off, only to wake up around 7 a.m. as the day's 12-hour routine started. I heard Mikhalenko and Ginot carry coffee into the drill tent, where Zagorodnov was already rocking and strumming the drill cable. Keith Mountain—a meteorological scientist by training—chugged by, gloveless, on a snowmobile on his way to check a weather station he had set up about a quarter-mile from camp. I could hear Thompson on the satellite phone, perhaps calling his wife of 33 years, Ellen Mosley-Thompson, an accomplished climatologist. Maybe he was checking in with the guys at the USGS Volcano Observatory in Anchorage to tell them that, with four days left in the two-month-long expedition, his team had retrieved 1,375 feet of ice—greater than the height of the Empire State Building—but had not hit bedrock or the White River Ash.

Thompson often spends a month or more at his high-altitude field sites. His highest expedition was in 1997, to the 23,622-foot Dasuopu glacier on the northwestern flank of Shisha Pangma, in Tibet. His team left Kathmandu, in neighboring Nepal, with nearly six tons of equipment and spent two months crossing 50-foot crevasses on rickety ladders to reach the top of the glacier. Facing down criticism that he was too proprietary about his work, Thompson had invited a throng of international scientists. Only a few were hardy enough to make it to the drill site, and no one, except for his crew, camped there.

Peter Hackett, one of the world's leading high-altitude medical specialists, and a close friend of Thompson, is stunned by what Thompson and his team can endure. "He had a whole group on the Shisha Pangma trip stay at extreme altitudes longer than any other humans," Hackett told me. Hackett has worked with David Breashears, Ed Viesturs, and other exceptional climbers and has himself summited Everest. "I mean, 23,000 feet is Camp III on Everest. Maybe a Sherpa could spend a week there, but not a month."

On Dasuopu Thompson pulled up more than 525 feet of ice, which was transported by the porters and yaks down to Lhasa, Tibet's capital, and then flown to Ohio. Back at the OSU lab, his team found that, in the past century, atmospheric dust concentrations have increased 400 percent, indicating prevailing drought conditions. Meanwhile, chloride concentrations have doubled compared with those of the previous thousand years.

This sort of drastic climate change, depending on geography, can translate into flooding from fast-melting glaciers, extremes in weather patterns, rising sea levels, and massive animal migration shifts, among other scenarios. And while recent research by NASA has helped support the idea of a great meltdown of polar ice, Thompson has led the way in proving that warming affects such

widespread geography and is linked to human activity. "If you look at the century as a whole," he explained, "it seems to be the warmest since the last ice age." Believing he has eliminated the possibility that this change in the weather is a natural climatic variation, Thompson is convinced that the cause is at least partly human-induced, the result of an unnatural accumulation of greenhouse gases.

In 2000 Thompson published his findings from the Shisha Pangma expedition in the journal *Science,* to worldwide acclaim. He showed that the current cycle of warming and desertification was not only extreme but had been concentrated within the past 50 years—further evidence that the event is unnatural. "Global warming is quite real," he told me one night in the cook tent. His tone was unusually sharp. "And we're not doing a thing about it."

Although the Tibet trip cemented Thompson's reputation, it was also the site of his personal low point. During the second week of the expedition, one of his students, Shawn Wight, experienced memory loss and disorientation, signs of several dangerous altitude-related conditions. Thompson walked Wight to a lower-elevation camp, where the symptoms disappeared but a blood clot formed in his leg. Wight was then taken to a hospital in Lhasa and flown to Hong Kong. After ten days in Hong Kong, Wight's parents had him flown to the United States, against the advice of local physicians. By the time Wight arrived in a Cleveland hospital, he had been treated at three hospitals and had picked up a lung infection, which ultimately killed him, at age 26. Wight's parents filed a multimillion-dollar lawsuit against Ohio State University, charging that Thompson had been negligent. Sure that a settlement would ruin his high-altitude research program, Thompson convinced the university to fight the charges in court.

I had been reluctant to bring up the trial, aware that it had been hard on Thompson, who leads his projects, and his crew, with familial affection. Later that afternoon I caught him alone in the cook tent and gingerly broached the topic. He got philosophical. "In 1991, in Peru, I stayed in a hotel run by a physicist," he said. "This guy also claimed to be an astrologer, and he insisted on telling my fortune. He said, 'When you're 52, you'll have a bad experience, but you'll get through it.' The day that I was walking to trial, it struck me that it was my birthday. I was turning 52." The judge sided with Thompson and OSU.

Back in the main tent that afternoon, I watched Zagorodnov, Ginot, and Mikhalenko move in rhythm to the throb of the drill. They had already reached the unprecedented depth of 1,477 feet. This team had no problem with 30 straight days of this labor, 12 hours a day, at miserable temperatures and extreme altitude. "Russians are great for this work," Thompson explained. "They're used to the cold and the harsh living conditions."

Not to mention remarkably patient. As the drill reached deeper into the glacier, each core was now taking an hour to retrieve. Thompson and I trudged back to the cook tent. Just as we started into a second cup of Nescafé, Ginot whipped back the tent door: They'd hit the bottom—bedrock. We hurried to the drill dome, where Zagorodnov pulled up the last core. There was something in it: a perfect ring of pebbles suspended in gin-clear ice like asteroids in a model solar system. After 32 days of watching rods of ancient history emerge from this frozen mass, Thompson had made the record books, again: the longest high-altitude core ever retrieved, 1,509 feet. Not only that, but the lack of a thick layer of ash proved that conventional geologic wisdom had been wrong; Mount Churchill had most likely not been the site of the massive eruptions that created the White River Ash.

That night, we celebrated with steamed shrink-wrapped ribs. Ginot produced a bottle of Baileys. Drinking and gnawing on bones, I asked Thompson where he wanted to go next.

"Mars," he said quickly. "It has an ice cap. And an 80,000-foot-high mountain." That seemed to satisfy the requirements for a Thompson expedition. "I've submitted a proposal to NASA."

"I'll bet they're howling with laughter around the NASA table right now," said Mountain, deadpan.

"They're always laughing," said Thompson, licking his fingers. "It would be the last great expedition."

What does he think he'd find?

"Not sure," he said. "But I have a feeling that Mars, at one time, was not such a bad place." ▲

For a Q&A with glaciologist Lonnie Thompson, visit *www.nationalgeographic.com/adventure.*

TIM CAHILL

(Continued from page 50)

had another lesson. He picked up a green elm twig, a little thicker than the pencil, and the snapper took the twig in another flashing strike. It wouldn't let go. The counselor carried the twig around, with the turtle dangling tenaciously at the end of the branch, until we got the impression that snappers are the pit bulls of the lakes. They'd snap your finger like a pencil; they'd grab your big toe and never let go.

Worse: This was just a small turtle. The camp counselors had captured a giant snapper for our education and edification. The horror of that turtle's fate troubles my thoughts even today. It was big: The shell on the creature was as large as a manhole cover. (I just walked out of my house and measured the manhole cover in my street: 27 inches across. Big snappers have shells that are up to 18 inches across. I'd still say this unfortunate animal was manhole-cover-size. He must have been 40 years old, about as old as snappers get.)

Having been taught to fear the turtles—this was for our own safety—we were now shown that they were mortal. Counselors roped the turtle up by its hind legs on a high crossbar at the rifle range and fired half a dozen .22 rounds into the blameless creature's head.

That image has haunted my dreams for several decades.

Nevertheless, when we, as campers, got our boating badges, we were allowed to row over into the lily pads. I found a need to capture snappers. It was easy enough from the boat: Just lift a lily pad. If there was a snapper under it, you could pick him up by the shell, as the counselor had done with the smaller turtle. I'd look the snapper in the eye—I never saw anything there other than total reptilian indifference—then carefully put him back. Perhaps I was trying to apologize to an entire species.

The years went by, and somehow puberty got all mixed up with everything, including snapping turtles, so that I imagined the turtles would take their revenge out on my manhood, such as it was. Such as it is. Believe me, this fear has taken a lot of the joy out of skinny-dipping.

I am not afraid of snapping turtles. What I fear are *unseen* snapping turtles, coming up from below, to seek their ultimate retribution. Perhaps this is not irrational at all. Maybe it's just damn scary. ▲