Mohammed Musa Abdulahi woke one Saturday morning to find he couldn’t feel or move his right arm. He remembered he hadn’t been feeling well, that he had gone to lie down inside the schoolhouse instead of taking care of the younger students, as he sometimes did. He got up, his arm hanging uselessly at his side, and prodded his friend, who also had come inside to take a nap. The friend jolted awake, cried out for no apparent reason and raced away. Abdulahi started to walk home through his village in northwestern Cameroon and found it horrifyingly silent. The dirt roads and yards of Subum were littered with corpses. People lay unmoving on the ground, as if they had fallen suddenly while in the middle of a stroll or a conversation. The dogs were dead. The cattle were dead. Birds and insects had dropped from the trees.

Abdulahi made his way to his father’s house, only to find that his entire family was also dead—his brothers and sisters, his father and his father’s two wives. For a moment, though, there was a small hope. He touched one of the babies, and it began to cry. Abdulahi tried to pick it up, but couldn’t because of his lifeless arm, so he made a crude sling out of cloth. When he touched the baby again, it too was dead.

“It is terrible to be without a family,” he says. “Everything you do, you feel not quite right.” Abdulahi tells me his story as we sit on the southern shore of Lake Nyos, the very lake that spewed a cloud of lethal gas on the evening of Thursday, August 21, 1986, killing all 11 members of his family and at least 1,700 other people. The very lake that could explode again at any moment.

It is indeed strange circumstance that has united Abdulahi and an international team of scientists who have come to Cameroon to study the deadly lake in order to disarm it, if they ultimately can. Earlier this afternoon Abdulahi walked down the mountains from the

CARBON DIOXIDE from deep in Lake Nyos (below) welled up in August 1986 and was responsible for killing about 1,700 people and their livestock.
town of Eseh to the lake in his tan overcoat, black pants and black-and-white checked shirt. He brought a dapper presence to the shore’s chaos of monitoring equipment, raft-building supplies, inflatable boats, tents, coolers, mangy dogs, soon-to-be-cooked chickens, and frenzied, unwashed scientists—and one unkempt journalist—surrounded by their entourage of several dozen local visitors. A day or so earlier a driver on his way to meet the team at Lake Nyos had asked for directions in the city of Bamenda and had procured Abdulahi as a guide. Only a week after he had watched a broadcast about the team’s arrival in Yaoundé, the capital, and had wondered how he could become involved, Mohammed Musa Abdulahi found himself camping next to Lake Nyos, taking part in the project.

For the team members, their October 1999 arrival in Yaoundé had also marked a beginning. Since 1986 scientists studying Lake Nyos have sought to rid the lake of the deadly gas that accumulates in its bottom waters before it explodes again and kills thousands more. Degassing the lake is technologically straightforward—and in the context of natural-disaster prevention, easy and cheap. Yet accomplishing this relatively simple task has proved astonishingly difficult. Despite the clear urgency of the problem and the unique opportunity to forestall natural disaster, little has been done to protect the people around Lake Nyos. Politics, lack of financial support (because of the reactive rather than preventive orientation of some funding organizations), and miscommunication have all interfered. But in Yaoundé—despite the persistent and worrisome flickering of some of these same problems—it appeared things were finally about to happen.

Nyos is a stunning lake, surrounded variously by cultivated fields, cathedral-like rock faces and verdant hills. On the afternoon of Abdulahi’s arrival it looks gray and glass-flat calm. But in its depths, Nyos is active. It is a crater lake, one formed by a volcanic eruption about five centuries ago that left a plug of magma at the bottom of the crater. This plug cooled and the depression filled with water, 210 meters deep. It is one of many such lakes found the world over in volcanic chains—but one of only two, it appears, that have ever exploded and taken human life. The other one, Lake Monoun, lies just 95 kilometers to the southeast.

From deep volcanic activity, carbon dioxide (CO₂) gas rises up until it meets groundwater beneath the lake, dissolves into that water and flows into Nyos, carrying with it minerals, themselves dissolved by the reactive gas. It accumulates in solution, staying separate from the upper layers of freshwater. In most crater lakes the lower water periodically turns over, bringing any gas-rich water to the surface, where the gas diffuses harmlessly into the atmosphere. But Nyos and Monoun do not turn over. The boundary, called the chemocline, between the mineralized, dense deep water and the fresh upper water stays dangerously intact. (Similar conditions prevail at Lake Kivu in Rwanda and the Democratic Republic of Congo, although there is no record of its having ever erupted.)

In these lakes the gas saturates the bottom water until some trigger—a strong wind, a violent storm, cool weather that causes a pocket of upper water to sink, a landslide, an earthquake, no one knows—provokes a bit of deep water to move upward. No longer
strong-armed by pressure, the carbon dioxide comes out of solution; it bubbles to the surface, pulling more bottom water with it. It is thought that this uprising gains momentum, a few bubbles becoming a stream of bubbles and then, like champagne finally uncorked, the gas-laden water erupts in a great fountain—at Nyos, the jet was 80 meters high—and carbon dioxide fills the air.

A weighty gas, half again as heavy as air, carbon dioxide hugs the ground, suffocating anything in its path. When Lake Monoun exploded on August 15, 1984, 37 people were killed. Lake Nyos, which is larger and deeper, was more devastating. The cloud of gas rolled down the hills at an estimated 72 kilometers per hour, into valleys and villages up to 20 kilometers away. According to George W. Kling—a University of Michigan biologist who has extensively studied both lakes and who is the leader of the team Abdulahi has joined—the last person to die was a girl who, the morning after the explosion, descended into a ravine where the gas hung, heavy and low. Abdulahi thinks he and his friend were saved because they were sleeping in a room that somehow, despite the open door, protected them from the full onslaught of gas. Abdulahi slept for about two days, and because of lying on his right arm for so long was unable to use it for several months. Abdulahi believes the gas disturbed his friend’s mind—an observation that is consistent with reports of disorientation in many of the survivors.

Lake Nyos is clearly poised to kill again, as is Lake Monoun. According to the most recent calculations by Kling and chemist William C. Evans of the U.S. Geological Survey, Lake Nyos contains twice as much carbon dioxide as was released during the explosion (0.4 cubic kilometer today, as opposed to only 0.17 cubic kilometer in 1986). Another explosion could also rupture the fragile dam, or spillway, at the northern end of the lake, and the waters could flow as far as Nigeria—drowning or displacing as many as 10,000 people. Although the area around the lake was evacuated after the disaster and 3,500 or so refugees resettled in safe places, many people are again living nearby, drawn by the land’s richness. Cornfields abut the water’s edge on the southern side. Cattle graze the hills around the lake under the watchful eyes of their Fulani herders. And in the early 1990s some European scientist released tilapia into the fishless lake in an uncontrolled and unauthorized experiment. The fish thrived, altering the ecosystem in unknown ways and becoming another incentive luring people to the lake. With few resources or possibilities for earning a living, the impoverished people of the area have little choice but to approach the deceptively benign-looking waters of Nyos.

Perhaps fortunately, the enormous difficulty of reaching this beautiful spot keeps outsiders away. Its remoteness, however, also makes it hard to study and degas. Five days after arriving in Yaoundé, we set out for Nyos in four vehicles. Part of the team—Evans; Kling and his assistant, Karen J. Riseng; Minoru Kusakabe of Okayama University and four of his colleagues from various institutions in Japan; Gregory Tanyileke of the Cameroon Institute for Geological and Mining Research (IRGM) and I—take our places in two rented Nissan Patrols with their drivers. The others, including Tanyileke’s IRGM colleagues—Hubert Mvogo, Jacob Nwalal, Paul Nia and Justin Nlozoa—drive two trucks laden with equipment. We travel to Bamenda in comfort, passing logging trucks with some of Cameroon’s remaining old-growth forests stacked high on their backs, passing red cocoa beans that smell like vinegar and fluffy...
white manioc spread on the side of the highway to dry. We spend the night in a hotel, pick up supplies—including 36 rolls of pink toilet paper for 14 people—and head to the end of the paved road at Fundong. (We later run out of fresh water. We still have toilet paper.)

The single road heading north from Fundong is ghastly and effectively isolates the region around Lake Nyos. It is more a series of vast muddy pits, connected, on a dry day, by an uneven dusty trail, than it is a road. For 13 kilometers we slip and slide and lurch and stick, and the sway bar on one of the Nissans breaks. By late afternoon it is clear that despite Kling’s frustration we can’t get any farther than the village of Bafumen. Members of the Japanese team wisely find a house to stay in, and the rest of us pitch our tents in a cemetery, right below a memorial to victims of the Nyos disaster. Lake Nyos is just 17 or so kilometers away now, but it seems as inaccessible as Yaoundé. And word about town is that the bridge on the road to Eseh has been washed out.

We start out the next morning with fresh faith. The sway bar had been soldered back together, and the evening’s chill softened by Bafumen’s supply of warm beer. After repairing the first flat of the day, we reach the bridge. It hasn’t been washed out. The left side is, in fact, intact. Only the right side is falling into the river. The entire team descends from the vehicles, and there is much scientific and highly technical muttering about mass and stability and speed and load and distribution, in the midst of which Mvogo jumps in the equipment truck he commands—“The Grandmother”—and speeds her across. By the end of the day we have reached Eseh, spent hours waiting out a downpour, and have set up camp after hiring the entire town to carry, on their heads, all our things—including the hard, heavy suitcases infelicitously packed by team members who thought we would be driving right to the water’s edge—the six kilometers down the steep slippery-when-wet path to the lake. In the middle of camp we place a blue crate filled with canisters of oxygen: 10 minutes apiece for just 10 of us. (Some of us initially try to set up our tents on a hill so that we will be safer if the lake decides to explode again. But it proves too difficult, and with a small but nagging fear we pitch below in the main camp.)

The first task the next morning is raft building. After the explosion in 1986 Kling and his colleagues set up a climate station on a raft in the middle of the lake to monitor temperature, wind, sun and rainfall. That station, beaten ragged by the weather, no longer functions, and the raft needs replacing. In addition, the team needs to install thermistors that will hang from the new raft at nine different depths to record changes in temperature—which reflect the movements and chemistry of the lake’s waters. They also need to lower probes to measure the carbon dioxide’s pressure. Only once these instruments are in place will it be safe to think about a major degassing. Every stage of that operation must be observed to see if it is dangerously altering conditions. So the first order of business is to build a raft sturdy enough to hold the new climate station, to anchor the various probes, and, if possible, to provide a large enough platform from which the scientists can drop canisters to collect water so they can measure carbon dioxide concentrations. The Japanese contingent, under the direction of engineer Yutaka Yoshida of Yoshida Consulting Engineer Office in Iwate, Japan, takes charge of building the raft.

By the time Abdulahi arrives in camp two days later, the raft has been completed and the climate station assembled and attached to it. Abdulahi finds room in one of the tents and borrows some clothes for his stay. The following day he helps Evans and Riseng with their work. The thermistors need to be unwound, marked for depth and taped firmly together for stability, so Riseng sends her assistants to the far ends of the cornfields with the long wires that will stretch nearly to the lake bottom. Seventeen men are scattered between the bright-green plants, wires draped over their shoulders—one of them, 201 meters away, is barely visible on the horizon of a field. Abdulahi helps Riseng rewind the thermistors and then decides to brave a trip on the lake, where he checks the anchors for the new raft with
Evans and Tanyileke. The sun is blindingly hot. Some of us sit around camp in a stupor. A Fulani gentleman brings a gift of avocados. The day stretches on.

Abdulahi comes back from the lake. He now has one of the walkie-talkies and has become a field coordinator, helping everyone find what, or whom, they need. We sit on a box of equipment and—between static-pocked demands from the transmitter—talk about his desire for a family. He says he has met a woman he wants to marry and who wants to marry him, but her family has objected. They are hoping for a rich suitor instead of an electrical engineer, the occupation Abdulahi chose years ago. “Why is this happening?” he asks sadly. “First my family, now a wife.”

With the raft done, the instruments down and water samples collected, Kling and his colleagues have set the stage for the degassing operation that will, with luck, commence this fall or winter. Over the past several years, Kusakabe and Yoshida prepared a $3-million plan to degas the lakes that was submitted to the Japanese International Cooperation Agency by the Cameroonian government. Their design entails running 12 pipes into Nyos, at three different depths, and allowing the CO₂-laden water to froth up, perhaps at the initial rate of 320 kilometers per hour, to release its gas. They envision three such pipes at Monoun.

This idea has been around, in various iterations, since Lake Nyos exploded. And a version has been tested on both lakes. In 1992 Michel Halbwachs of the University of Savoy secured funding from the French government and the European Community to do a preliminary degassing test in Monoun. Halbwachs and his colleagues, Tanyileke among them, lowered a five-and-a 14-centimeter-diameter pipe and, using a motorized pump, sucked up some bottom water. Because of the pressure differential, a self-sustaining fountain of gas-rich water gushed up in both pipes, and carbon dioxide diffused away. They were able to close valves in the pipes to shut off the release.

The success of the Monoun project led to a similar effort in 1995 at Lake Nyos. With money from Gaz de France, Halbwachs and others lowered a 14-centimeter-wide, 205-meter-long pipe. Things did not go as smoothly as they had at Monoun, however, and after the fountain started, the pipe rose, terrifyingly, from the bottom. Fortunately, no explosion was triggered, and the experiments suggested degassing was feasible.

Halbwachs had a different plan from Yoshida and Kusakabe’s. His entailed only five pipes for Nyos and a remote on-off switch that could be controlled via satellite from France. Although the scientists met in Yaoundé in October to hash out their disagreements, and appeared to do so, the conflict emerged a day later at a public meeting with members of a newly formed Cameroonian interministerial committee on degassing. Halbwachs presented his five-pipe plan, and Kusakabe presented the 12-pipe
version. The ministers focused on the discord, and for a short and wrenching time it looked as though the entire project was going to be derailed.

Ultimately, Henri Hogbe Nlend, minister of scientific research and technology and head of the committee, reassured everyone that the disagreements were petty. “Any number they give now is false, everything is an estimate,” he said forcefully. “The technology that they have explained will keep evolving.” No one, he added, should expect the architects of a cathedral to supply specifics in the face of such a great enterprise. Uniting the various ministries behind the operation had been a monumental task. Without their combined support, the roads would not be improved, the areas around the lakes would not be evacuated, and the Cameroonian military would not be present at the degassings with oxygen tanks in case of an explosion. Minister Nlend, apparently, was not going to let some minor grievances thwart the project. And all the scientists are collaborating again.

“We, the scientists, are still wondering, was it enough to just send reports to everyone?”

The disagreement was atypical for a community that has been largely collaborative for more than a decade. The debate is partly the result of scientific disagreement, but in truth, the differences in designs are negligible. It appears to have resulted more from a lack of communication among the researchers about, or during, their efforts to get funding. Hallbwachs felt excluded from work for which he had laid the foundation. The others say they were pursuing funding catch-as-catch-can, thinking all along that Hallbwachs would work with them. “We have always assumed that anyone who cares about these lakes is working together,” Kling says.

Securing funding for the project has indeed been a desperate venture. Here are two lakes that will explode, thousands of people at risk and an easy solution that could cost as little as $1 million. And yet. Although various researchers have received support from their governments or their institutions to study the lakes, it has frustrated many of them that they have not been able to get money to degas them. In 1992, for instance, a meeting on degassing was organized with the support of UNESCO and the United Nations Development Program. But neither institution put forth money for the actual project, Kling says. The scientists have tried some other channels with little success. Kling and a colleague tried to interest oil companies—which have a powerful, lucrative presence in Cameroon. No luck. And the same year as the U.N. conference, Kusakabe’s efforts to get money from the Japanese International Cooperation Agency came to naught as well. Some say the Japanese government wasn’t as committed to the degassing as it was to other projects in Cameroon. Others say that the Cameroonian government, which had to rate the project as the number-one aid priority to receive funds, couldn’t reach consensus and that one minister favored a well in his village instead.

The politics may never be fully plumbed, but the larger issue is that many aid organizations are responsive, not preventive. Many people within this community have emphasized the dangers of this approach. But OFDA’s Neal says it has only lately begun to change and points to recent mitigation efforts at AID and the Federal Emergency Management Agency. “I think at AID there has been a learning process and a cultural shift in the past few years that mitigation is increasingly the important way to approach problems and that by running in after an earthquake or merely saving bodies and providing first aid, we don’t do anything for the long-term problem,” she says.

It is in great part because of Neal’s interest in Cameroon and its lakes and because of her strong belief in mitigation that $433,000 finally came through for Kling and the team last fall. The OFDA grant was triggered by the eruption of Mount Cameroon in the spring of 1999. The office sent John P. Lockwood, formerly of the U.S. Geological Survey, who had studied Lake Nyos, to determine the extent of the danger. After meeting with U.S. Embassy representatives in Yaoundé and Cameroonian scientists...
and ministers, he concluded that if OFDA really wanted to help Cameroon, it should do something about the lakes.

Although the degassing seems to be on track now, many researchers still feel somehow guilty—as though they should have done something more and because they didn’t know exactly what to do. Tanyileke worries that he and the others were not clear enough about the danger—at least not in a way that moved anyone to act. “We, the scientists, are still wondering, was it enough to just send reports to everyone?” says Tanyileke one late afternoon at Nyos. We are sitting on a cooler in the sun, and the weight of the heat even late in the day is leaden, stupefying. “They weren’t strong enough to make them sit up.”

As we talk, a nine-person delegation from Nyos village arrives. They are arrayed in finery—hats, umbrellas, bright robes—and bring a letter from their chief, Fon Tang-Nembong: “Our dear visitor we are very very happy to see you people here in our lake. We here to say will come to you all.” Tanyileke describes what the team is doing and why. “An explosion could happen any day,” he warns, adding “if we are doing anything that is going against your traditions, you must tell us.” All the members of the team, but Tanyileke and Evans in particular, try to explain their work to the people they meet.

Such communication is crucial for many reasons, not just for good relations. It encourages people to be wary of the seemingly safe lake. It fosters scientific awareness that Tanyileke hopes will contribute to making Nyos a research center once the lake is degassed. And, finally, it helps to quell an unhelpful rumor. The rumor began, according to anthropologist Eugenia Shanklin of the College of New Jersey, when a priest who visited the devastated villages described the scene as resembling the aftermath of a neutron bomb. And so the bomb story was born. One version has Americans and Israelis detonating the device to get to diamonds under the lake. Another has a blond-haired Peace Corps worker placing the bomb so that Americans could live in the region.

The rumor rankles the team—and the Peace Corps and the U.S. Embassy in Yaoundé and, perhaps, the Israeli medicals who provided disaster relief in 1986—and could interfere with evacuation efforts during the degassing if some of those same groups participate. Shanklin finds the emergence of a modern myth intriguing—just as intriguing as the region’s ancient tales. One of the legends suggests that what happened at Nyos and Monoun is not without precedent: a myth of the Kom people describes a lake that suddenly exploded and decimated a tribe.

For their part, the delegation from Nyos doesn’t seem suspicious of the team’s work. “We are very happy for your coming here,” Tamaki Cheteh says. “Everyone in Nyos is sick from this gas.” And then, in a request as remarkable as Abdulahi’s foray on the lake, a member of the delegation asks to taste the water that killed many of his relatives. With Abdulahi standing nearby, Tanyileke offers him some of the carbonated water collected right near the bottom. Everyone gathers around, and, in turn, they drink from the depths of their lake.

Readers interested in supporting the effort can send contributions to the Cameroon Degassing Project, Dept. of Biology, University of Michigan, 830 N. University, Ann Arbor, MI 48109-1048.