

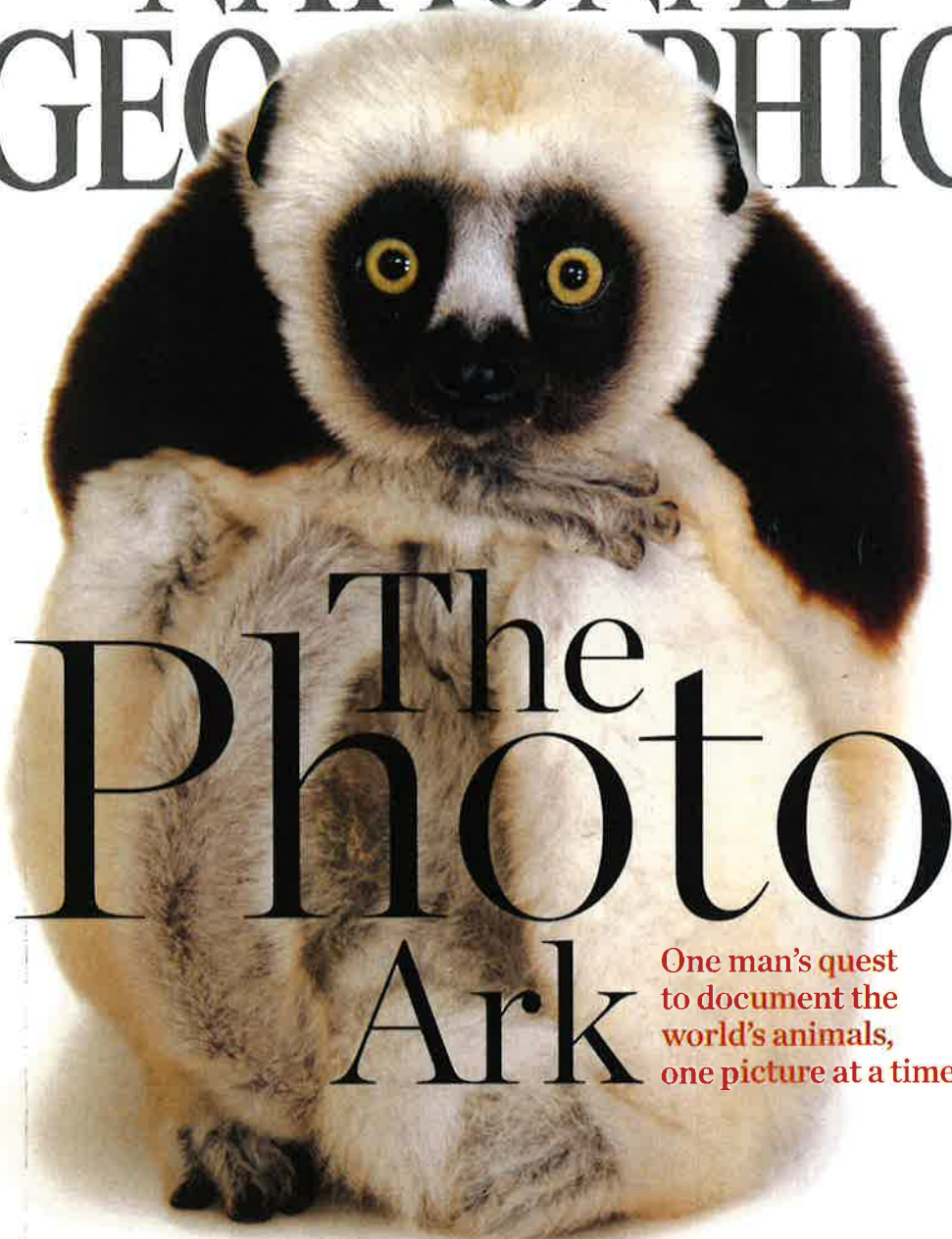
***The Science of Death***  
COMING BACK FROM THE BEYOND

***Urban Parks***  
93 Spring Days

**EXPLORER**  
Watch 'Faces of Death'  
on the National  
Geographic Channel.  
Check local listings.

APRIL 2016

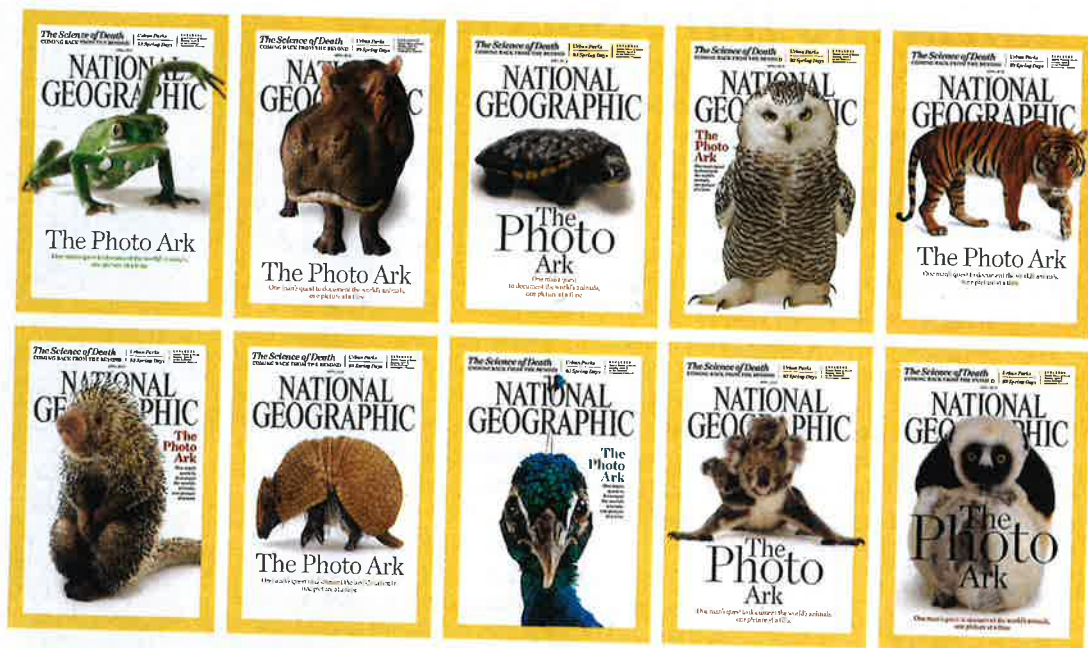
# NATIONAL GEOGRAPHIC



## The Photo Ark

One man's quest  
to document the  
world's animals,  
one picture at a time





With so many Photo Ark animals to choose from, we couldn't decide on one cover—so we made ten for this month's issue. If you didn't get the animal that you like best on your cover, call 1-800-777-2800 to purchase your favorite. Top row, from left: waxy monkey tree frog, hippopotamus, Reimann's snake-necked turtle, snowy owl, Malayan tiger. Bottom row, from left: Brazilian porcupine, southern three-banded armadillo, Indian peafowl, mother and baby koalas, Coquerel's sifaka.

## 70 Every Last One

Photographing thousands of animals to help ensure that species are preserved: That's the Photo Ark project. *By Rachel Hartigan Shea Photographs by Joel Sartore*

30

### The Crossing

Is death an event or more of a progression? Science and human experience offer answers.

*By Robin Marantz Herig  
Photographs by Lynn Johnson*

53

### Where Death Doesn't Mean Goodbye

These Indonesian villagers keep their late loved ones close. Literally.

*By Amanda Bennett  
Photographs by Brian Lehmann*

86

### Urban Parks

When you're there, civilization can feel very far away—even if it's all around. Welcome to the world's urban parks.

*By Ken Otterbourg  
Photographs by Simon Roberts*

108

### Ghost Lands

The Out of Eden Walk passes through nations haunted by their history: Armenia and Turkey.

*By Paul Salopek  
Photographs by John Stanmeyer*

### 132 Proof | 93 Days of Spring

With an image a day, a Minnesota photographer welcomes the season to his state.

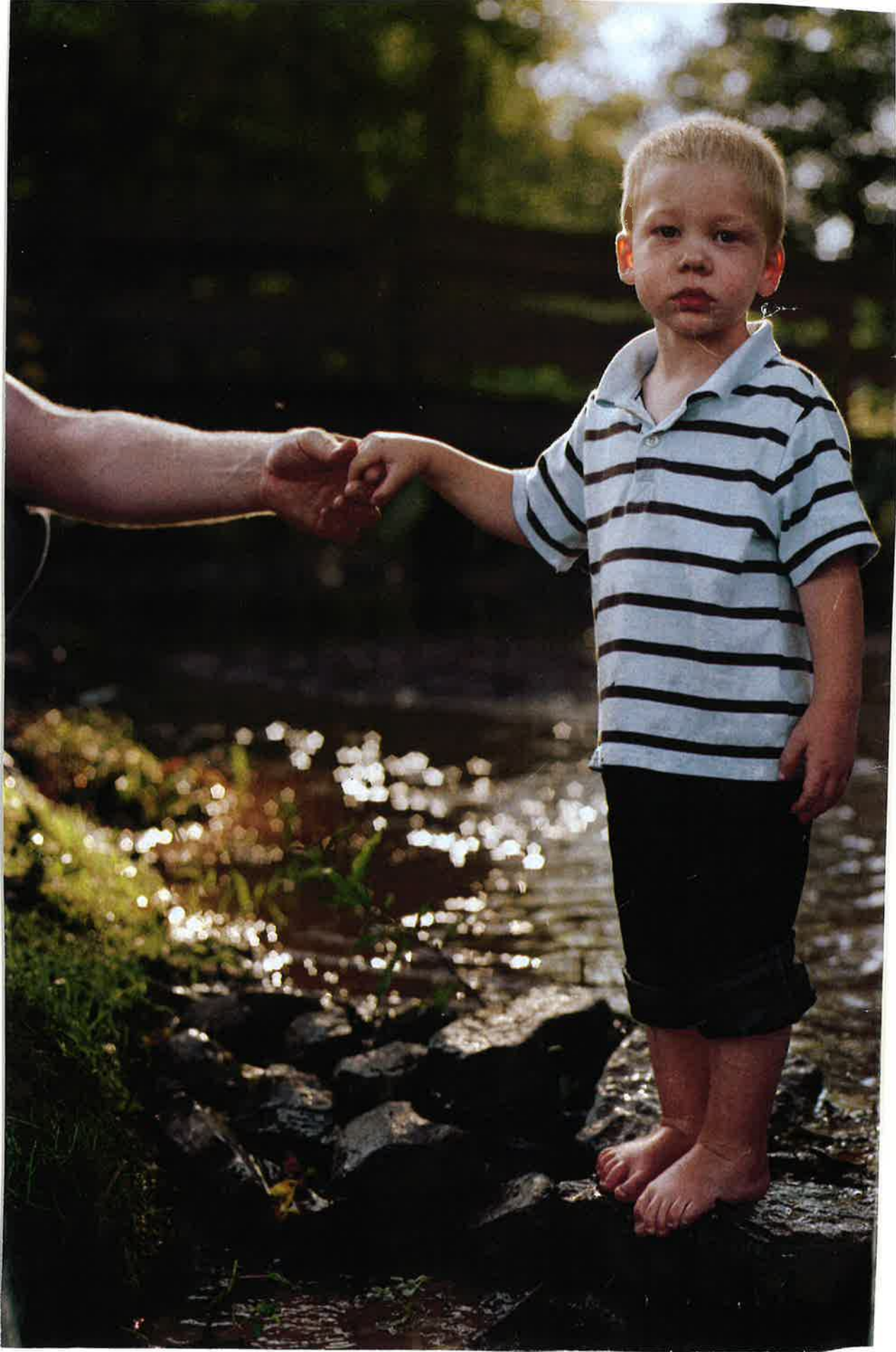
*Story and Photographs by Jim Brandenburg*

**On the Cover** Joel Sartore shot this month's cover images at (from left, by row) Rolling Hills Zoo, San Antonio Zoo, Zoo Atlanta, Raptor Recovery Nebraska, Omaha's Henry Doorly Zoo, Saint Louis Zoo, Lincoln Children's Zoo (two), Australia Zoo Wildlife Hospital, Houston Zoo.

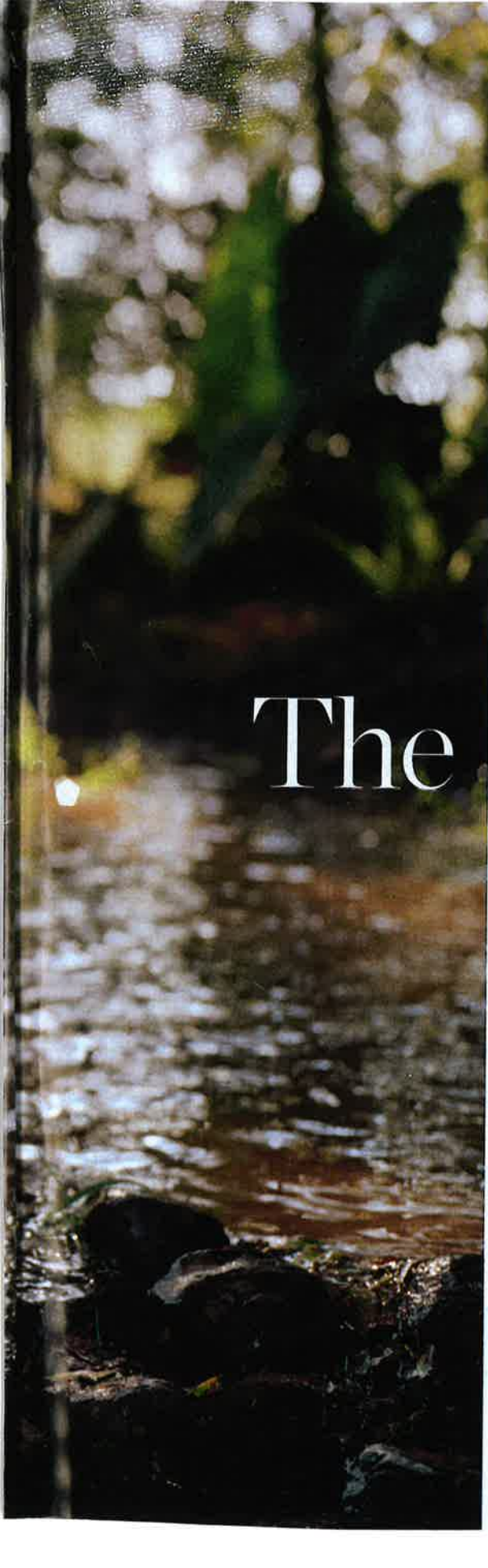
**Corrections and Clarifications** Go to [ngm.com/more](http://ngm.com/more).









A vertical photograph on the left side of the page shows a stream with white flowers in the background. The water is dark and rippling, and the flowers are out of focus, creating a bokeh effect. The title 'The Crossing' is overlaid on the image.

# The Crossing

After toddler Gardell Martin fell into an icy stream in March 2015, he was dead for more than an hour and a half. Three and a half days later he left a hospital alive and well. His story is one of many prompting scientists to question the very meaning of death.











Linda Chamberlain, co-founder of the Arizona-based cryonics company Alcor, hugs the container where the body of her husband, Fred, is frozen in the hope that someday he can be thawed and revived. She plans to join him in cryo limbo when her time comes. Fred's last words, she says, were "Gee, I hope this works."

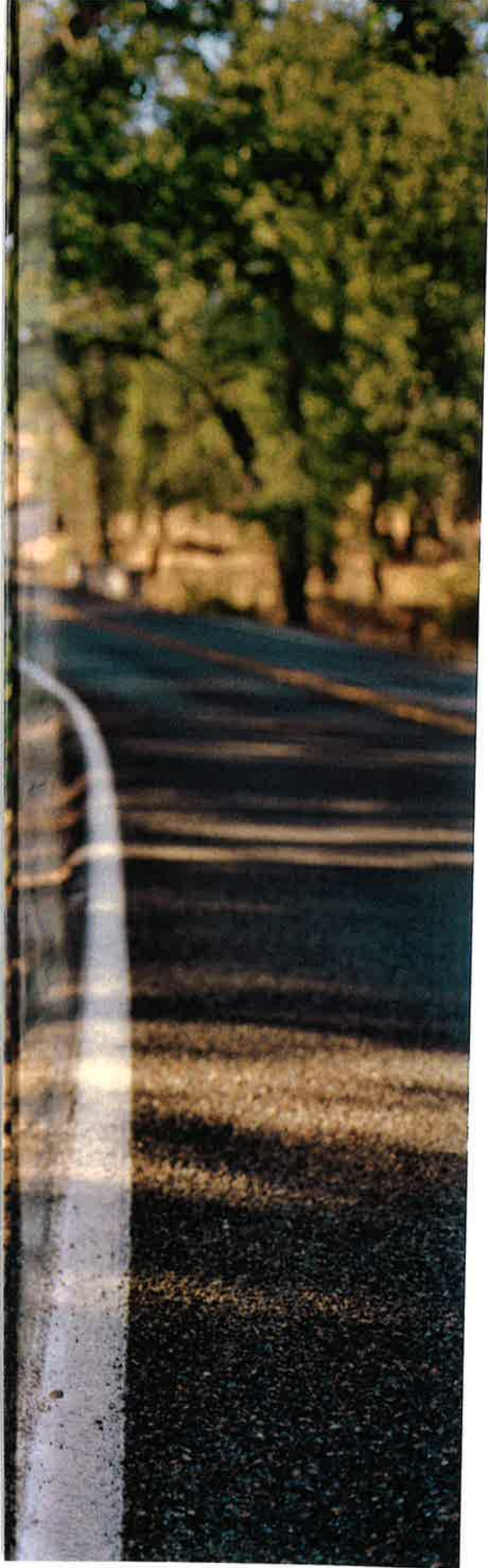












"My baby, my boy, has left such an impact," says Deanna Santana of her son Scott, who died at 17 in a car crash and whose organs and tissues were transplanted into 76 people. Rod Gramson (at center), who received the heart, met Deanna and her husband, Rich, near the road in Placerville, California, where Scott died.



By Robin Marantz Henig  
Photographs by Lynn Johnson

# At first it seemed like nothing more than the worst headache she'd ever had.

So Karla Pérez—22 years old, the mother of three-year-old Genesis, and five months pregnant—went into her mother's room to lie down, hoping it would pass. But the pain got worse, and as she vomited off the side of the bed, she told her younger brother to call 911.

It was not quite midnight on Sunday, February 8, 2015. The ambulance raced Pérez from her home in Waterloo, Nebraska, to Methodist Women's Hospital in Omaha. She began to lose consciousness in the emergency room, and doctors put a tube down her throat to keep oxygen flowing to her fetus. They ordered a CT scan, and there it was: a massive brain bleed creating severe pressure in her skull.

She had suffered a stroke, but amazingly her fetus was doing fine, the heartbeat strong and steady as if nothing were wrong. Neurologists did another CT scan at about two in the morning, and their worst fears were confirmed: Pérez's brain had become so swollen that the whole brain stem had pushed out through a small opening at the base of her skull.

"When they saw that," says Tiffany Somers-Shely, the obstetrician who'd cared for Pérez through her pregnancy with Genesis and with this baby too, "they knew for sure that it wasn't going to end well."

Pérez had landed at the ragged border between life and death, with a brain that had ceased functioning and would never recover—in

other words, it was dead—and a body that could be sustained mechanically, in this case for one reason only: to nurture her 22-week-old fetus until he was big enough to manage on his own. This borderland is becoming increasingly populated, as scientists explore how our existence is not a toggle—"on" for alive, "off" for dead—but a dimmer switch that can move through various shades between white and black. In the gray zone, death isn't necessarily permanent, life can be hard to define, and some people cross over that great divide and return—sometimes describing in precise detail what they saw on the other side.

Death is "a process, not a moment," writes critical-care physician Sam Parnia in his book *Erasing Death*. It's a whole-body stroke, in which the heart stops beating but the organs don't die immediately. In fact, he writes, they might hang on intact for quite a while, which means that "for a significant period of time after death, death is in fact fully reversible."

How can death, the very essence of forever, be reversible? What is the nature of consciousness during that transition through the gray zone? A growing number of scientists are wrestling with such vexing questions.

In Seattle biologist Mark Roth experiments with putting animals into a chemically induced suspended animation, mixing up solutions to lower heartbeat and metabolism to





near-hibernation levels. His goal is to make human patients who are having heart attacks “a little bit immortal” until they can get past the medical crisis that brought them to the brink of death.

In Baltimore and Pittsburgh trauma teams led by surgeon Sam Tisherman are conducting clinical trials in which gunshot and stabbing victims have their body temperature lowered in order to slow bleeding long enough for surgeons to close up their wounds. The medical teams are using supercooling to do what Roth wants to do with chemicals—kill their patients, temporarily, in order to save their lives.

In Arizona cryonics experts maintain more than 130 dead clients in a frozen state that’s another kind of limbo. Their hope is that sometime in the distant future, maybe centuries from now, these clients will be thawed and revived, technology having advanced to the point where they can be cured of whatever killed them.

In India neuroscientist Richard Davidson studies Buddhist monks in a state called *thuk-dam*, in which biological signs of life have ceased yet the body appears fresh and intact for a week or more. Davidson’s goal is to see if he can detect any brain activity in these monks, hoping to learn what, if anything, happens to the mind after circulation stops.

And in New York, Parnia spreads the gospel of sustained resuscitation. He says CPR works better than people realize and that under proper conditions—when the body temperature is lowered, chest compression is regulated for depth and tempo, and oxygen is reintroduced slowly to avoid injuring tissue—some patients can be brought back from the dead after hours without a heartbeat, often with no long-term consequences. Now he’s investigating one of the most mysterious aspects of crossing over: why so many people in cardiac arrest report out-of-body or near-death experiences, and what those sensations might reveal about the nature of this limbo zone and about death itself.

OXYGEN PLAYS A PARADOXICAL ROLE along the life-death border, according to Roth, of Seattle’s

Fred Hutchinson Cancer Research Center. Ever since oxygen was discovered in the early 1770s, “scientists have recognized it as essential to life,” he says. What the 18th-century scientists didn’t know is that oxygen is essential to life in a surprisingly nonbinary way. “Yes, if you take away oxygen, you can kill the animal,” Roth says. “But if you further reduce the oxygen, the animal is alive again, but it’s suspended.”

He has shown that this works in soil nematodes, which are alive in air with as little as 0.5 percent oxygen and are dead if you reduce the oxygen to 0.1 percent. But if you then proceed quickly to a much lower level of oxygen—0.001 percent or even less—the worms enter a state of suspension where they need significantly less oxygen to survive. It’s their way of preserving themselves during extreme deprivation, a bit like animals hibernating in winter. These oxygen-starved, suspended organisms appear to be dead but not permanently so, like a gas cooktop with only the pilot light on.

Roth is trying to get to this pilot-light state by infusing experimental animals with an “elemental reducing agent,” such as iodide, that greatly decreases their oxygen needs. Soon he’ll try it in humans too. The goal is to minimize the damage that can occur from treatments after heart attacks. If iodide slows oxygen metabolism, the thinking is, it might help avoid the blowout injury that sometimes comes with treatments like balloon angioplasty. At this lower setting the damaged heart can just sip the oxygen coming in through the repaired vessel, rather than get flooded by it.

Life and death are all about motion, according to Roth: In biology the less something moves, the longer it tends to live. Seeds and spores can have life spans of hundreds of thousands of years—in other words, they’re practically immortal. Roth imagines a day when using

## EXPLORER

Tune in Sunday, April 3, to National Geographic Channel’s Explorer series episode *Faces of Death*.



# Countdown to Irreversibility

The brain has higher energy needs than other organs, so it is the first to lose function—and suffer irreversible injury—when a person goes into cardiac arrest and blood stops circulating. Different regions of the brain have varying levels of susceptibility, beginning with one of the most fragile, the hippocampus.

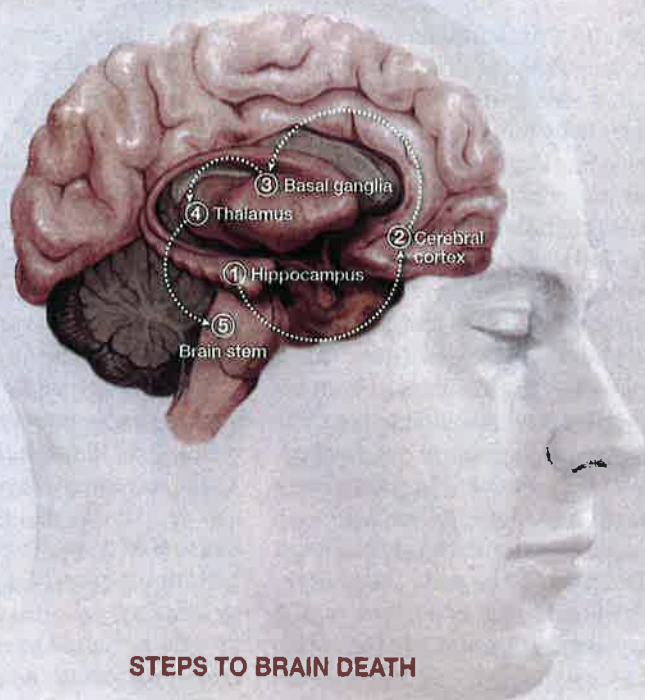
TIME BEFORE PERMANENT  
DAMAGE OCCURS IN A BODY  
AT NORMAL TEMPERATURE

0 —  
Brain  
4-5 minutes

Heart and  
kidney  
30 minutes

Liver  
1-2 hours

Lungs  
2-4 hours



## STEPS TO BRAIN DEATH



### 1. Short-Term Memory

The memory-consolidating hippocampus is the first to fail. A person who regains consciousness will find it hard to remember what just happened.



### 2. Cognitive Function

Next, when the cerebral cortex, which controls executive and cognitive functions, is damaged, language and decision-making skills are lost.



### 3. Motor Function

As the forebrain's basal ganglia lose blood supply, movements of the limbs, eyes, and other body parts can no longer be controlled.



### 4. Senses

When an oxygen-depleted thalamus can no longer send information to the cerebral cortex, the senses of sight, hearing, and touch start to fail.



### 5. Respiratory System

As the brain stem, which regulates our respiratory and cardiovascular systems, dies, breathing and swallowing stop.

MONICA SERRANO AND DAISY CHUNG, NGM STAFF. RESEARCH: MEG ROOSEVELT

SOURCES: RAYMOND KOEHLER, JOHNS HOPKINS UNIVERSITY; PEISHUN SHOU AND YUFANG SHI, SOOCHOW UNIVERSITY AND CHINESE ACADEMY OF SCIENCES





an agent such as iodide, a technique that will soon be studied in early clinical trials in Australia, can give people that immortality “for a moment”—the moment they most need it, when their heart is in serious trouble.

SUCH AN APPROACH would not have helped Pérez, whose heart never stopped beating. The day after her devastating CT scan, her obstetrician, Somer-Shely, tried to explain to Pérez’s stunned and frightened parents, Berta and Modesto Jimenez, that their beautiful daughter—the lively young woman with sparkly eyes who adored her little girl, had a passel of friends, and loved to dance—was brain-dead.

There was a language barrier. The Jimenezes’ first language is Spanish, and everything the doctor said had to be filtered through a translator. But the real barrier wasn’t language. It was the concept of brain death itself. The term dates to the late 1960s, when two medical developments coincided: high-tech, life-sustaining machinery, which blurred the border between life and death, and organ transplantation, which made clarifying that border especially urgent. No longer could death be defined in the traditional way, as cessation of breath and heartbeat, since ventilators could provide both indefinitely. Is a patient on a ventilator dead or alive? If you remove the ventilator, when can you ethically retrieve the organs to transplant into someone else? If a transplanted heart starts beating again in a new chest, was the heart donor really dead in the first place?

To address such thorny questions, a Harvard panel met in 1968 to define death in two ways: the traditional way, by cardiopulmonary criteria, and a new way, by neurological ones. The neurological criteria, which are now used to determine “brain death,” involved three cardinal benchmarks: coma or unresponsiveness, apnea or the inability to breathe without a ventilator, and the absence of brain-stem reflexes, measured by bedside exams such as flushing the ears with cold water to see if the eyes move, poking the nail bed to see if the face grimaces, or swabbing the throat and suctioning the bronchia

to try to stimulate a cough.

It’s all quite straightforward, yet also counterintuitive. “Brain-dead patients do not appear dead,” wrote James Bernat, a neurologist at Dartmouth’s medical school in New Hampshire, in the *American Journal of Bioethics* in 2014. “It is contrary to experience to call a patient dead who continues to have heartbeat, circulation, and visceral organ functioning.” His article, meant to clarify and defend the concept of brain death, appeared just as two controversial patients were making headlines: Jahi McMath, a California teenager whose parents refused to accept the diagnosis after the girl experienced a catastrophic loss of oxygen during a tonsillectomy, and Marlise Muñoz, a brain-dead pregnant woman whose case differed from Pérez’s in a significant way. Muñoz’s family didn’t want anything done to sustain her body, but hospital staff overruled them, because they thought Texas law required them to keep the fetus alive. (A judge eventually ruled against the hospital.)

Two days after Pérez’s stroke the Jimenez family, along with the father of the unborn baby boy, found themselves in a crowded conference room at Methodist Hospital, still reeling from the tragic twists of Pérez’s pregnancy. There to meet with them were 26 hospital staff members, including neurologists, palliative-care specialists, nurses, chaplains, ethicists, and social workers. The parents listened intently as the translator explained that the doctors’ tests had revealed their daughter’s lack of brain function. They heard the team offer “somatic support” to Pérez until the fetus was at least 24 weeks old, which is when he would have a fifty-fifty chance of surviving outside the womb. If they were lucky, the doctors said, they could keep Pérez’s body functioning even longer, improving the baby’s survival odds with each passing week.

Modesto Jimenez might have been thinking of the conversation he’d had the night before with Somer-Shely—the only physician in the hospital who’d known Pérez as a living, breathing, laughing, loving person—when he’d

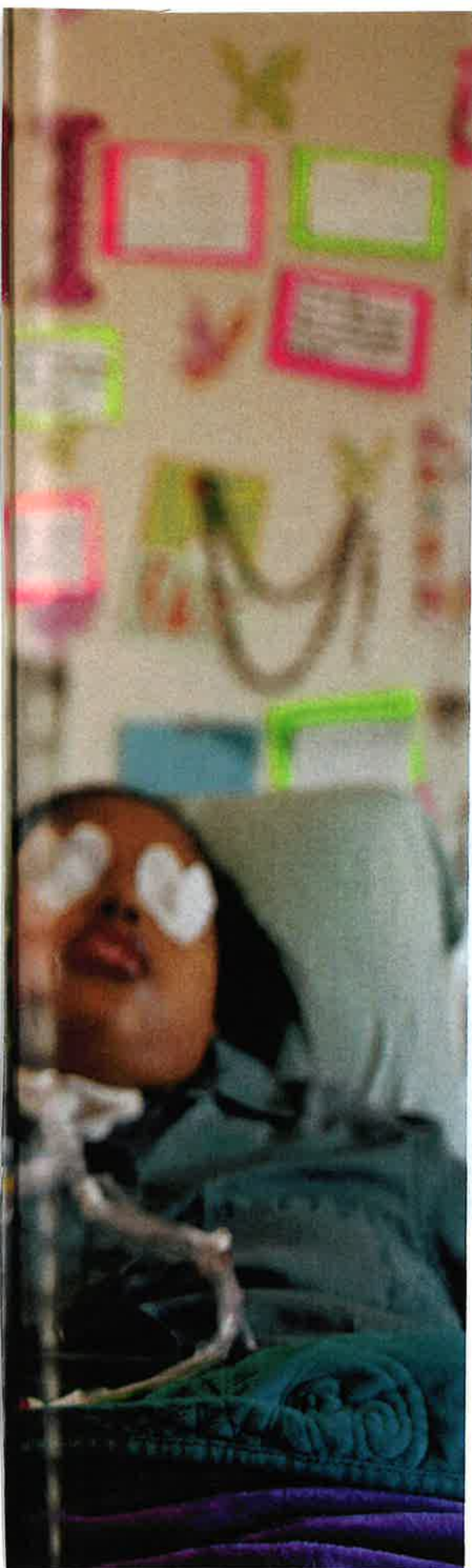






"If I had listened to the doctors, I'd be visiting my daughter in the cemetery," says Nailah Winkfield, whose daughter Jahi McMath was declared brain-dead in 2013, when she was 13. Winkfield insists that her daughter is not dead.





taken her aside and asked, “¿Será mi hija nunca despertar?”

“No,” she’d said. “Your daughter probably will never wake up.” It was one of the hardest things she’d ever had to say.

“In my clinical mind I knew that brain death is death,” she says. “Clinically speaking, she was dead at that point.” But seeing her patient lying there in the intensive care unit, Somer-Shely found that stark fact almost as difficult to believe as the family did. Pérez looked like someone who’d just come out of surgery: Her skin was warm, her chest was rising and falling, and in her belly a fetus was still moving about, apparently healthy.

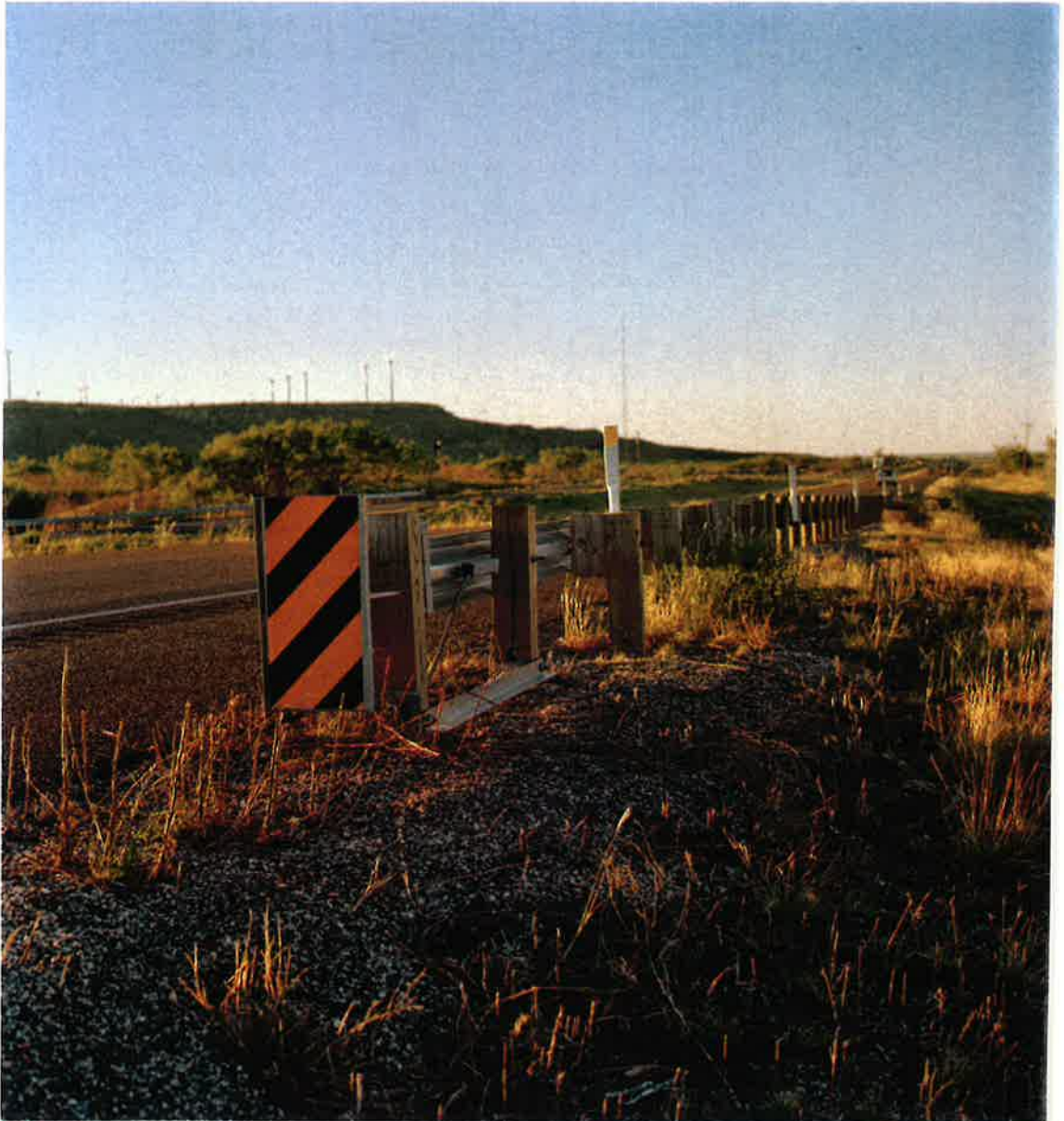
In the crowded conference room the Jimenezes nodded gravely, telling the medical team that they understood their daughter was brain-dead and would never wake up. But, they added, they would keep praying for *un milagro*—a miracle—just in case.

IF A MIRACLE is defined as bringing someone back from the dead, sometimes that does happen in medicine.

The Martin family believe they witnessed a miracle after their youngest son, Gardell, died last winter when he fell into an icy stream. He and his mother, father, and six older siblings live on a big rural property in central Pennsylvania that the kids love to explore. On a warm day in March 2015 two of the boys took Gardell, not quite two years old, out to play. The toddler lost his footing and fell into a stream about a hundred yards from his home. His brothers noticed that he was gone and were frantic when they couldn’t find him. By the time emergency rescuers got to Gardell—who’d been pulled out of the water by a neighbor—the boy’s heart had stopped beating for at least 35 minutes. The EMTs began chest compression, but they couldn’t get his heart to start up again. They continued CPR as they sped the ten miles to Evangelical Community, the closest hospital. He had no heartbeat, and his body temperature was 77 degrees Fahrenheit, more than 20 degrees below normal. (Continued on page 48)







A “spiritual cowboy” told her not to be afraid.

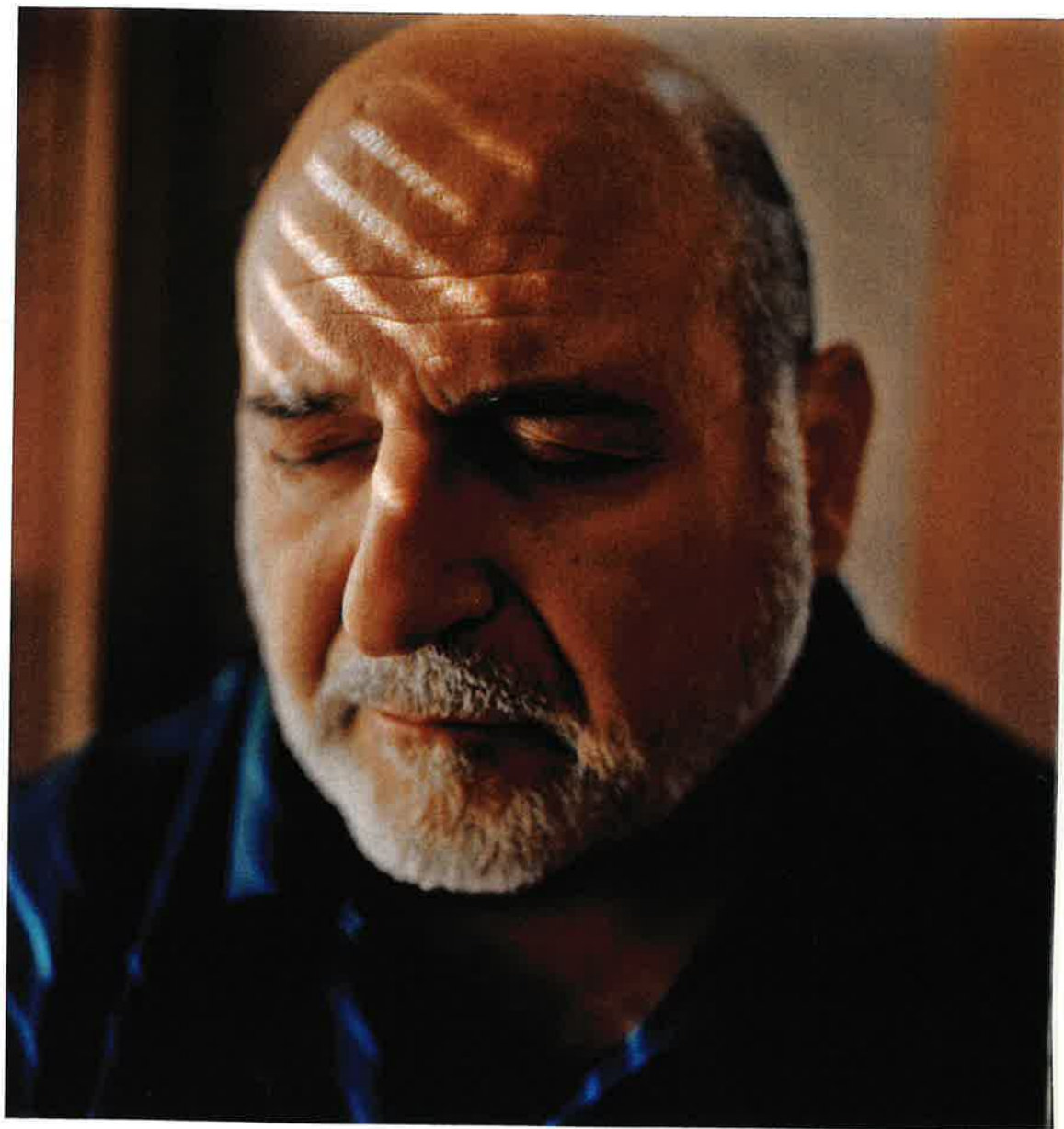






Ashlee Barnett was a college student when she had a serious car crash on a remote Texas highway. Her pelvis was shattered, her spleen had ruptured, and she was bleeding profusely. At the scene, she says, she moved between two worlds: chaos and pain on one side, as paramedics wielded the jaws of life; and one with white light, no pain, and no fear. Several years later she developed cancer, but her near-death experience made her confident that she would live. She has three children and counsels trauma survivors.

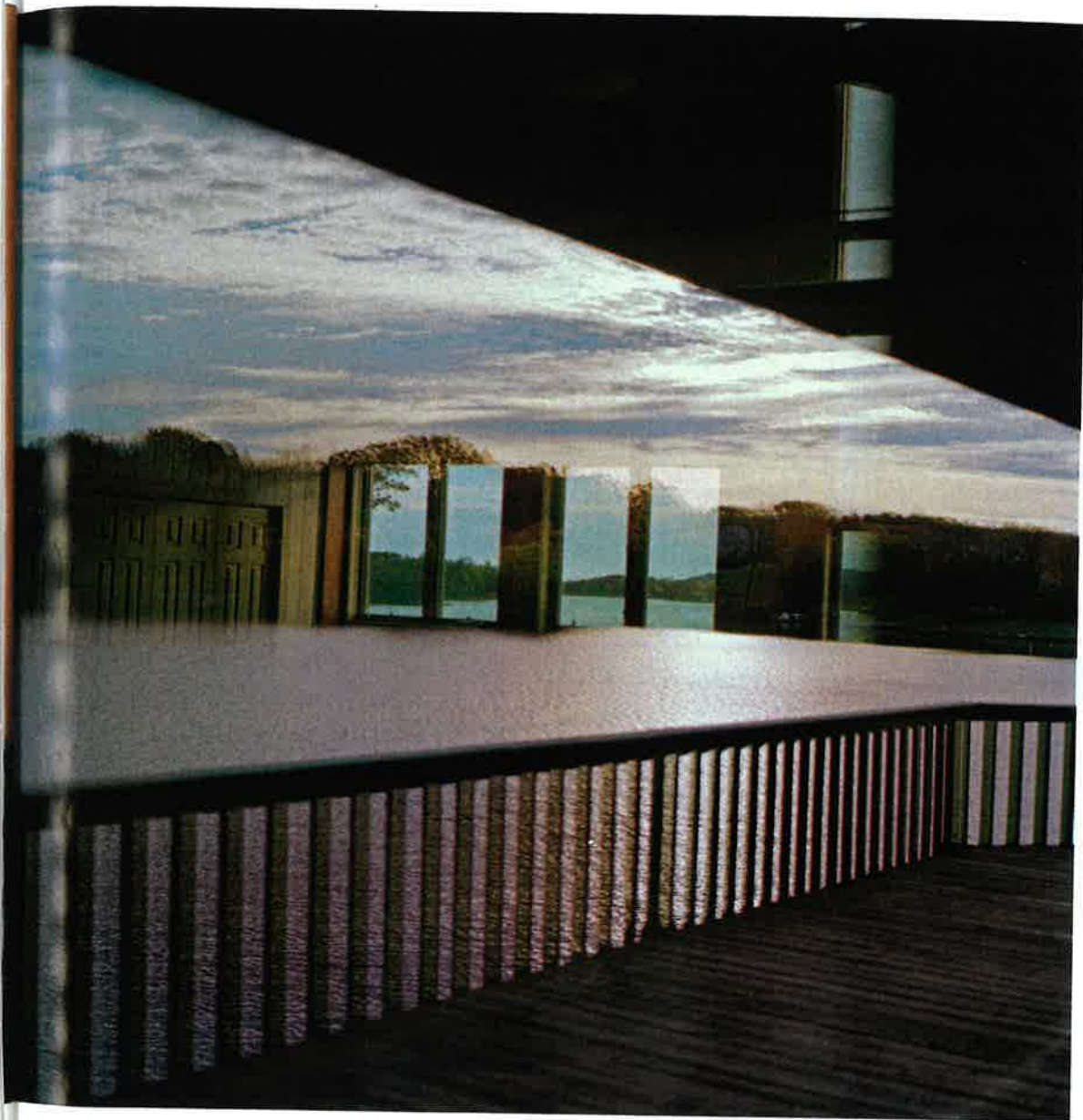




As he climbed the stairs to check on his family, his legs began to disappear.







At a family picnic at upstate New York's Sleepy Hollow Lake, Tony Cicoria, an orthopedic surgeon, had just tried to call his mother on the phone. An approaching storm sent a lightning bolt through the phone into his head, stopping his heart. Cicoria says he felt himself leave his body, moving through walls toward a blue-white light, eager to be one with God. He emerged from his near-death experience with a sudden passion for classical piano, creating melodies that seemed to download, unbidden, into his brain. He came to believe he'd been spared so that he could channel "the music from heaven."





She saw her grieving stepfather buy a candy bar.





A head-on collision landed Tricia Barker, then a college student, in an Austin, Texas, hospital, bleeding profusely, her spine broken. She says she felt herself separate from her body during surgery, hovering near the ceiling as she watched her monitor flatline. Moving through the hospital corridor, she says, she saw her stepfather, struggling with grief, buy a candy bar from a vending machine; it was this detail, a stress-induced indulgence he'd told no one about, that made Barker believe her movements really happened. Now a creative writing professor, she says she's still guided by the spirits that accompanied her on the other side.





They prepped Gardell for a helicopter ride to Geisinger Medical Center, 18 miles away in Danville. Still no heartbeat.

"He had no signs of life whatsoever," recalls Richard Lambert, director of pediatric sedation service and a member of the pediatric critical-care team that awaited the helicopter. "He looked like a child who was... Well, he was dusky, dark colored. His lips were blue..." Lambert's voice trails off as he remembers that dreadful moment. He knew that children who drown in ice water sometimes recover, but he'd never known of one who'd been dead for as long as Gardell had. Even worse, the boy had a shockingly low blood pH, a sign of imminent organ failure.

An emergency room resident turned to Lambert and his colleague Frank Maffei, director of pediatric critical care for Geisinger's Janet Weis Children's Hospital: Maybe it was time to stop trying to revive the boy? Lambert and Maffei both wanted to keep going. All the elements were as favorable as they could be in a brink-of-death story. The water was cold, the child was young, and resuscitation efforts had been started within minutes of the drowning and had continued nonstop ever since. Let's try just a little longer, they told the team.

So they continued. Another 10 minutes, another 20 minutes, another 25. By this time Gardell had been without pulse or breath for more than an hour and a half. He was "a flaccid, cold corpse showing no signs of life," as Lambert describes him. But team members kept pumping, pressing, monitoring. The ones doing chest compression rotated on and off every two minutes—it's exhausting to keep doing it right, even on a tiny chest—and others inserted catheters into his femoral vein, jugular vein, stomach, and bladder, infusing warm fluids to gradually increase his body temperature. None of it seemed to be making any difference.

Rather than call off the resuscitation entirely, Lambert and Maffei decided to bring Gardell into surgery for a cardiopulmonary bypass—the most aggressive form of active rewarming, a last-ditch effort to get his heart beating. After they scrubbed

up, they checked for a pulse one more time.

Incredibly, there it was: a heartbeat, faint at first, but steady, without the rhythm abnormalities that sometimes appear after a prolonged cardiac arrest. And just three and a half days later Gardell left the hospital with his prayerful family, a little wobbly on his feet but otherwise perfectly fine.

GARDELL IS TOO YOUNG to tell us what it was like during the 101 minutes he was dead. But sometimes people who've been rescued, thanks to persistent, high-quality resuscitation, come back with stories that are quite clear—and eerily similar. These survivors can be thought of as having crossed over to the other side and returned with stories that offer some insight into how it feels to die. Their tales from the gray zone have been the subject of some scientific scrutiny, most recently in a study called AWARE (AWAreness during RESuscitation), led by Sam Parnia. Beginning in 2008, Parnia, director of resuscitation research at Stony Brook University, and his colleagues looked at 2,060 cases of cardiac arrest at 15 American, British, and Austrian hospitals. Among them were 330 survivors, 140 of whom were interviewed. Fifty-five of the 140 patients said that during the time when they were being resuscitated, they perceived some kind of awareness.

Though most couldn't quite recall details, others mentioned sensations similar to those found in best-selling books such as *Heaven Is for Real*: time either speeding up or slowing down (27 people), peacefulness (22), separating from their bodies (13), joy (9), or seeing a bright light or golden flash (7). Some (the exact number wasn't specified) said they remembered bad sensations: fear, drowning or being dragged through deep water, or in one case, seeing "men in coffins being buried upright." The study, Parnia and his co-authors wrote in the medical journal *Resuscitation*, provides "further understanding of the broad mental experience that likely accompanies death after circulatory standstill." They wrote that the next step would be to study whether and how



these episodes—which most investigators call near-death experiences (NDEs), though Parnia prefers “actual death experiences”—affect survivors after recovery, either with positive influences or negative ones, such as cognitive problems and post-traumatic stress. What the AWARE team didn’t explore was a common aftereffect of NDEs: a renewed sense of purpose and meaning to one’s life. That’s the feeling you often hear about from survivors—especially those who go on to write books about it. Mary

experiences,” he said, also contradicting Parnia’s view of what had happened. “During these experiences the brain is very much alive and very much active.” He said that what Neal went through could have been a phenomenon called REM intrusion, when the same brain activity that characterizes dreaming somehow gets turned on during other, nonsleep events, such as a sudden loss of oxygen. To him, near-death and out-of-body experiences are the result not of dying but of hypoxia—a loss of

## Patients can be brought back from the dead after hours without a heartbeat, often with no long-term consequences.

Neal, an orthopedic surgeon from Wyoming, mentioned that effect to a large audience at a 2013 New York Academy of Sciences panel discussion called Rethinking Mortality. Neal, author of *To Heaven and Back*, described drowning while kayaking in Chile 14 years earlier. She said she could feel her spirit peeling away from her body and rising out of the river, as her knees bent backward, breaking her bones. She remembered walking down an “incredibly beautiful pathway toward this great domed structure that I knew was the point of no return—and I could hardly wait.” She described thinking how strange the whole experience was, wondering how long she’d been underwater (later she learned it had been at least 30 minutes), finding comfort in the knowledge that her husband and children would be fine without her. Then she felt her body come out of the boat and could see the first responders doing CPR. She heard one of them calling to her, “Come back, come back!”—which she said she found “really very irritating.”

Kevin Nelson, a neurologist at the University of Kentucky, was on Neal’s panel, and he was skeptical—not of her memory, which he acknowledged was intense and valid, but of its explanation. “These are not return-from-death

consciousness, not of life itself.

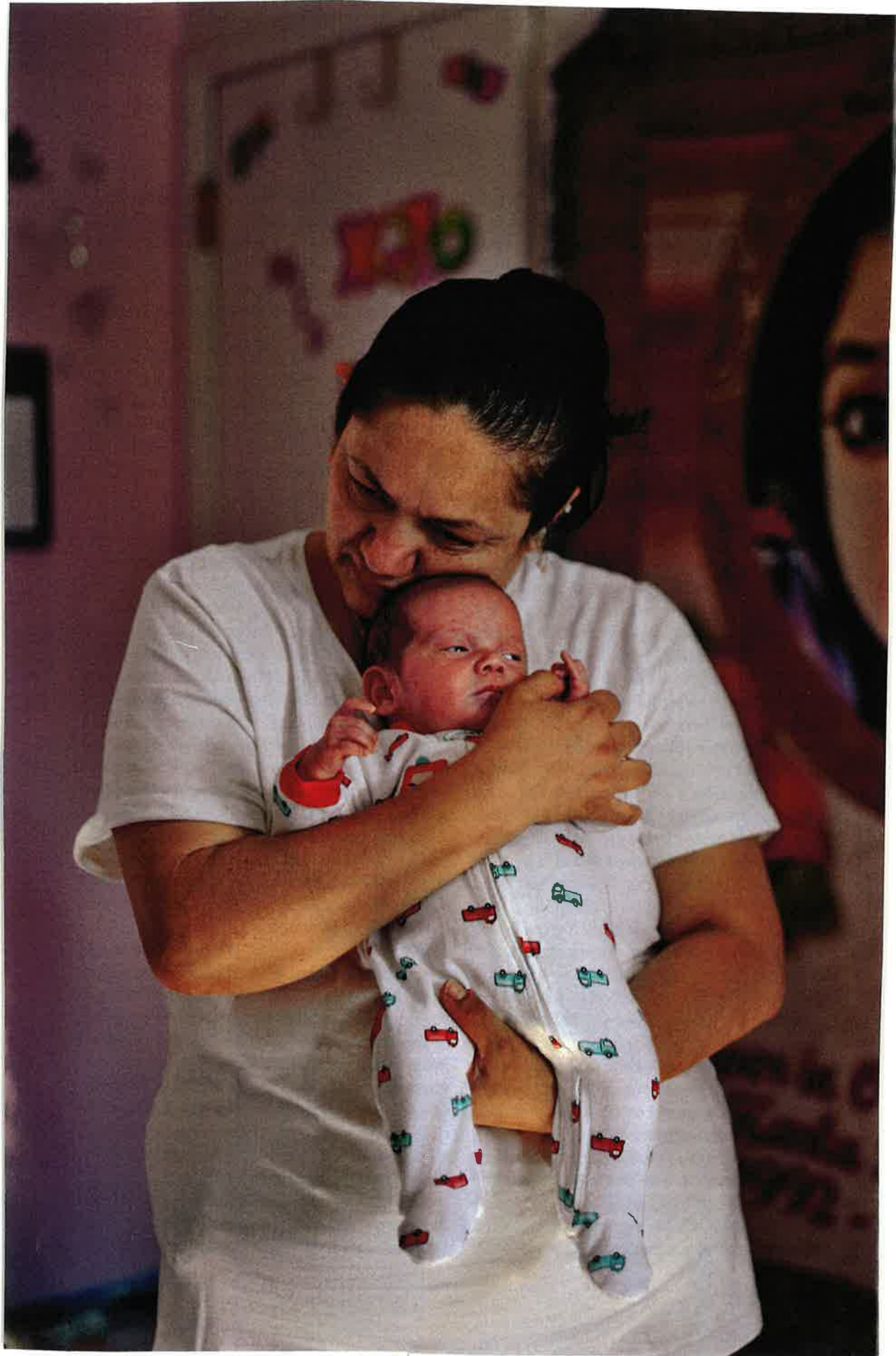
Other studies point to different physiological explanations for NDEs. At the University of Michigan a team led by neuroscientist Jimo Borjigin measured brain waves in nine rats after cardiac arrest. In all of them high-frequency gamma waves (the ones associated with meditation) became more intense after the heart stopped—more coherent and organized, in fact, than they are during ordinary wakefulness. Maybe this is what NDEs are, the investigators wrote, a “heightened conscious processing” that occurs during the limbo period before death becomes permanent.

More questions about the gray zone arise from the phenomenon of thukdam, a rare occurrence in which a monk dies but there is seemingly no physical decomposition for a week or more. Richard Davidson of the University of Wisconsin, who has spent years studying the neuroscience of meditation, has long been intrigued by this—is the person conscious or not? dead or not?—especially after he saw a monk in thukdam at the Deer Park monastery in Wisconsin in the summer of 2015.

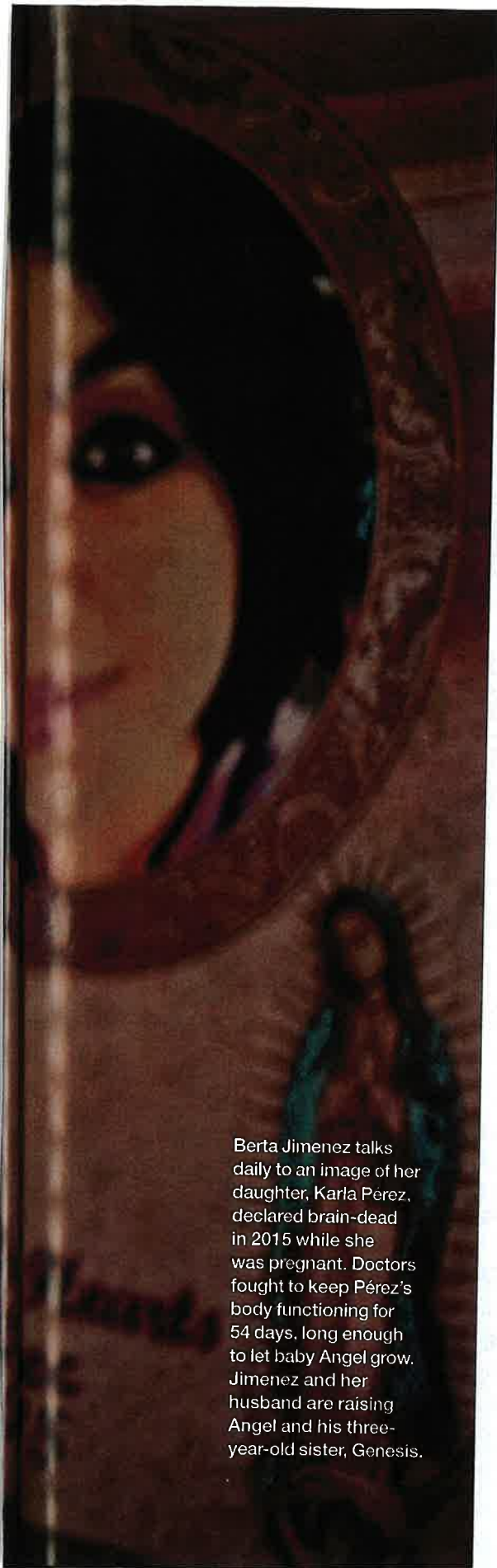
“If I had just casually walked into the room, I would have thought he was sitting in deep meditation,” Davidson says, his voice on the phone











Berta Jimenez talks daily to an image of her daughter, Karla Pérez, declared brain-dead in 2015 while she was pregnant. Doctors fought to keep Pérez's body functioning for 54 days, long enough to let baby Angel grow. Jimenez and her husband are raising Angel and his three-year-old sister, Genesis.

still a little awestruck. "His skin looked totally fresh and viable, no decomposition whatsoever." The sense of the dead man's presence, even at close range, helped inspire Davidson to study thukdam scientifically. He has assembled some basic medical equipment, such as EEGs and stethoscopes, at two field stations in India and has trained an on-site team of 12 Tibetan physicians to test these monks—preferably beginning while they're still alive—to see whether any brain activity continues after their death.

"It's likely that in many of these practitioners, they enter a state of meditation before they die, and there is some kind of maintenance of that state afterward," Davidson says. "Just how that occurs, and what the explanation might be, eludes our conventional understanding." His research, though grounded in Western science, aims for a different kind of understanding, a more nuanced one that might clarify what happens not only to monks in thukdam but also to anyone traveling across the border between life and death.

**DISINTEGRATION USUALLY PROCEEDS** swiftly after a person dies. When the brain stops functioning, it loses all ability to keep the other systems in balance. So to allow Karla Pérez to continue nurturing her fetus after her brain stopped working, a team of more than a hundred doctors, nurses, and other hospital workers had to fill in as ad hoc orchestrators. They took readings continuously, around the clock, of Pérez's blood pressure, kidney function, and electrolytes, all the while adjusting what was going into her tubes and IV lines.

But even as the team members performed the functions of Pérez's ruined brain, they still had trouble thinking of her as dead. To a person, they treated her as though she were in a deep coma, greeting her by name when they came into the room and saying goodbye when they left.

To some extent these gestures toward Pérez's personhood were made out of respect for the family, a courtesy to avoid seeming to treat her as an inert baby vessel. But in a way, the gestures went beyond courtesy. They reflected how the



people attending to Pérez actually felt.

Todd Lovgren, co-leader of the medical team, knows the anguish of losing a daughter—he lost one too, the oldest of his five children, who would have been 12 years old had she lived. “It would have offended me not to treat Karla like a person,” he told me. “I saw a young woman with painted fingernails, her mom doing her hair, with warm hands and warm toes... Whether her brain was still functional or not, I don’t think her humanity was gone.”

Speaking as a parent rather than a clinician, Lovgren says he thought something of Pérez’s essence was still there in the bed—even though he knew, by the time of her second CT scan, that not only was her brain not functioning but large portions of it were dying off and peeling away. (Despite this, he hadn’t tested for the last of the three criteria of brain death, apnea, fearing that removing Pérez from the ventilator for even a few minutes might harm the fetus.)

On February 18, ten days after Pérez’s stroke, it became clear that her blood wasn’t clotting normally—an indication that dead brain tissue was getting into her bloodstream, one more sign to Lovgren that “she was never going to recover.” By this time the fetus was 24 weeks old, so the team transferred Pérez from the main campus back to Methodist Women’s, the maternity hospital. They managed to correct the clotting problem for the moment. But they were ready to do a C-section as soon as it became clear that it was time to let go, when even the semblance of a living person that their skills and instruments had patched together was beginning to fall apart.

TO SAM PARNIA, death is potentially reversible. Cells inside our bodies don’t usually die when we die, he says; some cells and organs can

remain viable for hours, maybe even days. The timing of the declaration of death is sometimes a matter of personal attitude, he says. When he was in training, he notes, people would stop CPR after just five to ten minutes, assuming that any longer would mean irreparable brain damage.

But resuscitation scientists have learned ways to keep the brain and other organs from dying even after the heart stops. They know that lowering body temperature helps—which happened naturally with Gardell Martin, and which happens deliberately in some ERs that routinely chill patients before doing CPR. They know that persistence helps too, especially in hospitals that use machines to regulate chest compressions or that someday might use drugs such as iodide.

Parnia compares resuscitation science to aeronautics. It never seemed possible for people to fly, yet in 1903 the Wright brothers flew. How incredible, he says, that it took only 66 years from that first, 12-second flight to a moon landing. He thinks such advances can happen in resuscitation science too. When it comes to reversing death, Parnia believes we’re still in the Kitty Hawk era.

Yet doctors are already able to snatch life from death in stunning, inspiring ways. In Nebraska that happened on April 4, 2015, the day before Easter, when a baby boy named Angel Pérez was born by C-section at Methodist Women’s Hospital just before noon. Angel is alive today because doctors were able to keep his brain-dead mother’s body functioning for 54 days, long enough to let him grow into a small yet otherwise perfectly normal newborn, two pounds, 12.6 ounces, miraculous in his ordinari-ness. A baby who turned out to be the milagro his grandparents had been praying for. □



At the start of this project photographer **Lynn Johnson** connected with a friend whose mother, Phyllis, was dying. Find the family’s powerful story at [ngm.com/more](http://ngm.com/more).

**What meaning do you hope readers find in their story?**

The intention of the project was to ask, How do you want to die? Because we’re all going to do it. This is how

one woman and her family moved through that time. And they did so with a lot of tenderness and love, with an effort to help her be pain free and fear free.






***The Science of Death***  
COMING BACK FROM THE BEYOND

***Urban Parks***  
93 Spring Days

**EXPLORER**  
Watch 'Faces of Death'  
on the National  
Geographic Channel.  
Check local listings.

APRIL 2016

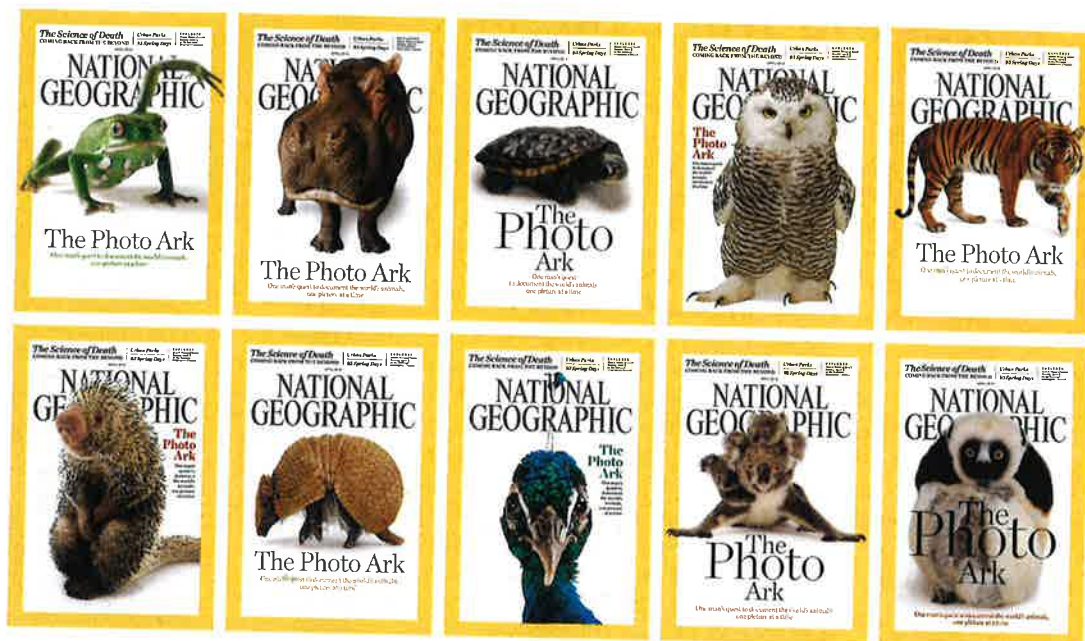
# NATIONAL GEOGRAPHIC



## The Photo Ark

One man's quest  
to document the  
world's animals,  
one picture at a time





With so many Photo Ark animals to choose from, we couldn't decide on one cover—so we made ten for this month's issue. If you didn't get the animal that you like best on your cover, call 1-800-777-2800 to purchase your favorite. Top row, from left: waxy monkey tree frog, hippopotamus, Reimann's snake-necked turtle, snowy owl, Malayan tiger. Bottom row, from left: Brazilian porcupine, southern three-banded armadillo, Indian peafowl, mother and baby koalas, Coquerel's sifaka.

## 70 Every Last One

Photographing thousands of animals to help ensure that species are preserved: That's the Photo Ark project. *By Rachel Hartigan Shea Photographs by Joel Sartore*

30

### The Crossing

Is death an event or more of a progression? Science and human experience offer answers.

*By Robin Marantz Henig  
Photographs by Lynn Johnson*

53

### Where Death Doesn't Mean Goodbye

These Indonesian villagers keep their late loved ones close. Literally.

*By Amanda Bennett  
Photographs by Brian Lehmann*

86

### Urban Parks

When you're there, civilization can feel very far away—even if it's all around. Welcome to the world's urban parks.

*By Ken Otterbourg  
Photographs by Simon Roberts*

108

### Ghost Lands

The Out of Eden Walk passes through nations haunted by their history: Armenia and Turkey.

*By Paul Salopek  
Photographs by John Stanmeyer*

## 132 Proof | 93 Days of Spring

With an image a day, a Minnesota photographer welcomes the season to his state.

*Story and Photographs by Jim Brandenburg*

**On the Cover** Joel Sartore shot this month's cover images at (from left, by row) Rolling Hills Zoo, San Antonio Zoo, Zoo Atlanta, Raptor Recovery Nebraska, Omaha's Henry Doorly Zoo, Saint Louis Zoo, Lincoln Children's Zoo (two), Australia Zoo Wildlife Hospital, Houston Zoo.

**Corrections and Clarifications** Go to [ngm.com/more](http://ngm.com/more).





# Where Death Doesn't Mean Goodbye...

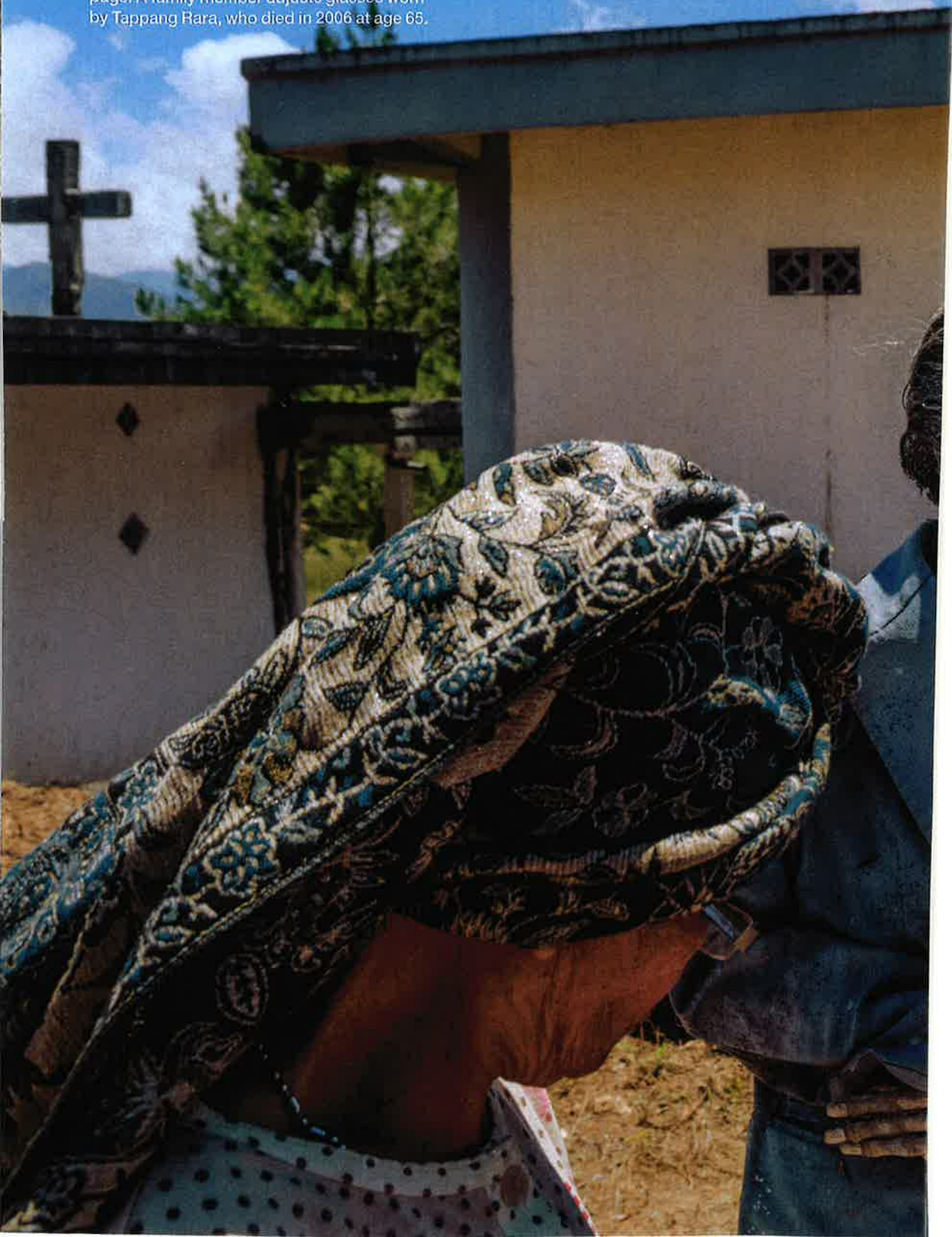


*In a remote corner of Indonesia,  
the departed—and their corpses—  
remain a part of the family.*

BY AMANDA BENNETT    PHOTOGRAPHS BY BRIAN LEHMANN



Friends and family inspect the body of Debora Maupa', who died in 2009 at age 73. A well-preserved body, mummified with a solution of formaldehyde and water, is thought to bring good fortune. Preceding page: A family member adjusts glasses worn by Tappang Rara, who died in 2006 at age 65.





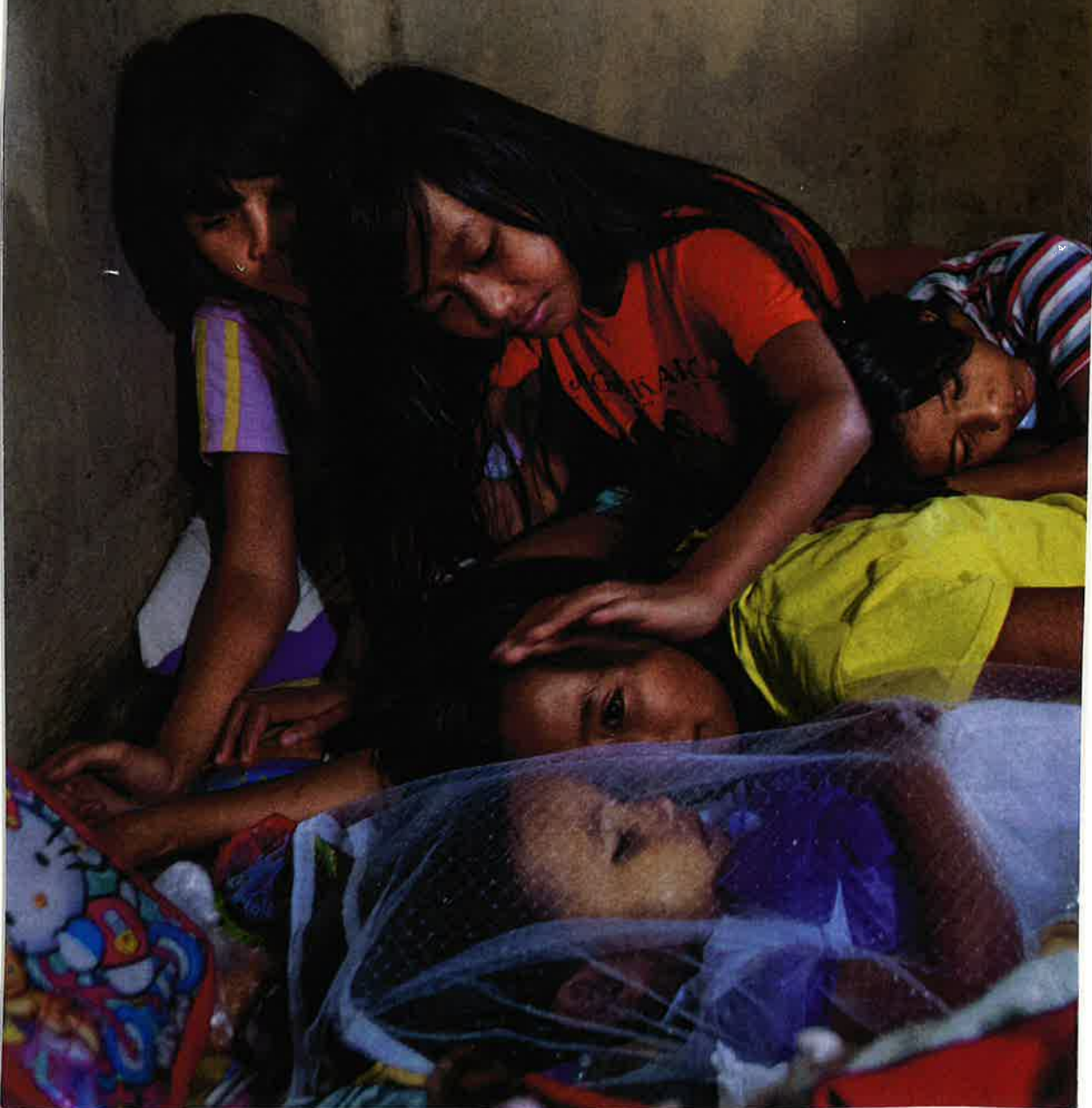




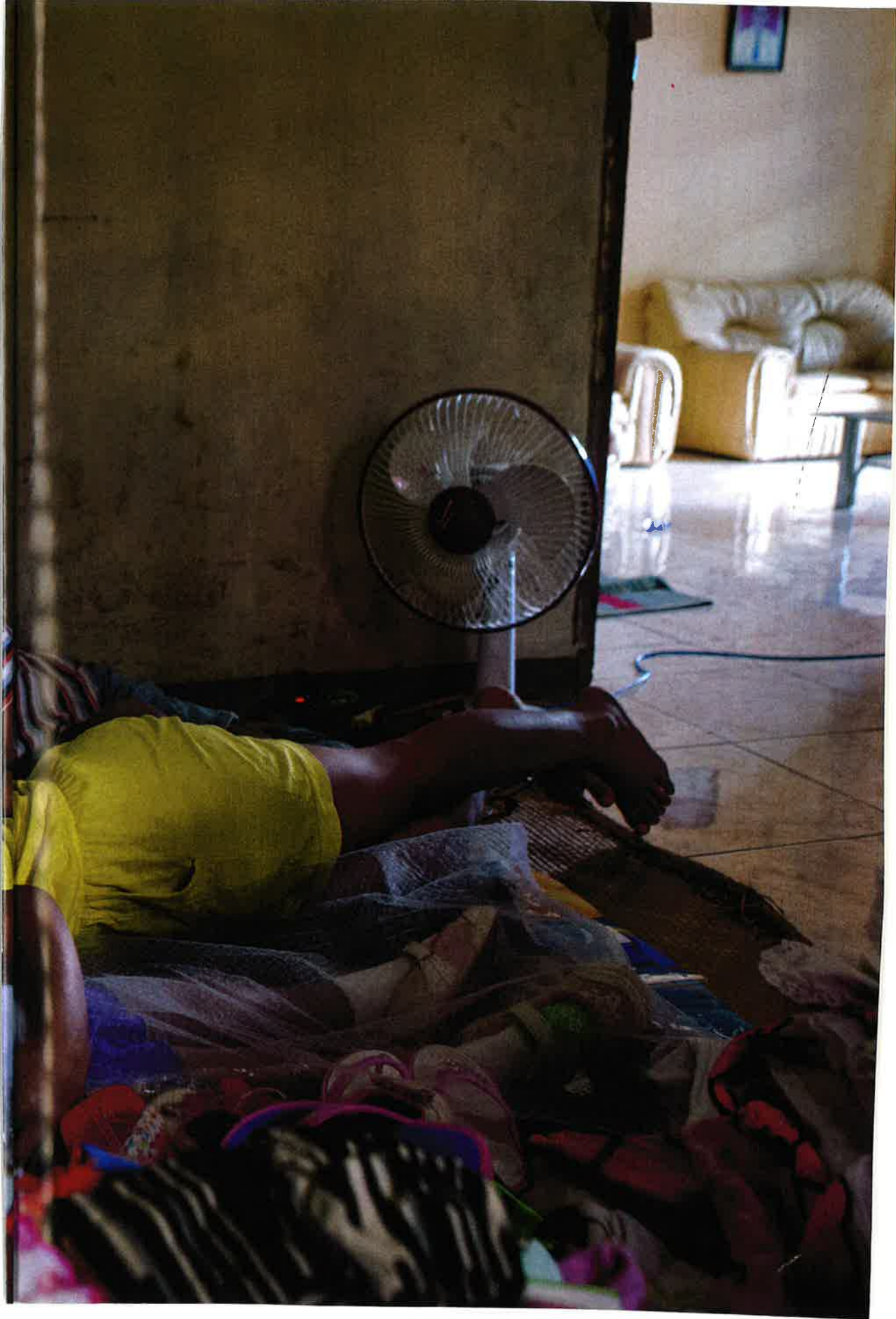




Near Rantepao, Sulawesi, cousins and sisters surround three-year-old Syahrini Tania Tiranda, who died the day before. They touch her and talk to her. To them she is to *makula*'—a sick person.











O

ne night, a little before seven, Elisabeth Rante pulls a golden curtain back from the doorway. Together we slip inside. She speaks to her husband. "Papa...Papa," she whispers. "We have a guest from far away." Behind us, second eldest son Jamie enters the room with a tray and walks up quietly. "Here is your rice, Papa. Here is your fish. Here are the children," he says.

As we back silently out of the room, Elisabeth says softly, "Wake up, Papa. It's time for your dinner." I turn back for a moment as eldest son Yokke explains: "She's taking your picture, Papa."

A touching family scene. Nothing that couldn't happen anywhere on Earth. Except for one thing. Elisabeth's husband, a former clerk in the city marriage bureau, has been dead for nearly two weeks. Here, in the handsome, melon-colored concrete house of a respected and prosperous family, Petrus Sampe lies motionless on a wooden twin bed, a red patterned blanket tucked under his chin.

For several more days in this house on the fringe of the town of Rantepao, in the remote highlands of the Indonesian island of Sulawesi, Petrus will lie in this bed. His wife and children will speak to him as they bring him food four times a day—breakfast, lunch, dinner, and mid-afternoon tea. "We do this because we love him and respect him so much," Yokke says. Elisabeth adds, "Before, we used to eat together. He's still at home—we should feed him." Formalin (formaldehyde plus water) treatments shortly after death mean the body will not putrefy, but in time it will mummify. The room's scent is nothing more than the usual hint of sandalwood in a Torajan house. On the wall a picture of Jesus Christ leading a lamb looks down.

Four days later, after musical tributes, a Christian religious service, and a pork, vegetable,

and rice dinner for more than a hundred, family members lift Petrus from the bed into a coffin. Videographers record the event. Eight or more children—relatives and friends from the neighborhood—push each other out of the way to get a better view. Afterward Petrus will remain at home, in his coffin, until his funeral in December, four months from now. His wife will live in the house with him until then; some families follow the old custom of never leaving a dead person alone. Until the funeral, Elisabeth and her children will call him *to makula'*—a sick person. "We believe that even though the father is *to makula'*, his soul is still in the house," Yokke says.

For Torajans, the death of the body isn't the abrupt, final, severing event of the West. Instead, death is just one step in a long, gradually







Risma Paembonan takes dinner to her mother-in-law, Maria Salempang, who died two weeks earlier, at 84. Time at home with parents can be highly prized. "I'm not sad, because she's still with us," says another Torajan woman of her 73-year-old mother, who has lain dead in the house for more than a year.

unfolding process. Late loved ones are tended at home for weeks, months, or even years after death. Funerals are often delayed as long as necessary to gather far-flung relatives. The grandest funeral ceremonies are week-long events drawing Torajans home in a vast reverse diaspora from wherever in the world they may be. When a brigade of a hundred or more motorcycles and cars rips through town accompanying a corpse home from far away, traffic stops in a manner that not even an ambulance or a police officer can command. Here, death trumps life.

Torajans do not reject medical treatments for life-threatening conditions. Nor do they escape

grief when loved ones die. But far from pushing death away, almost everyone here holds death at the center of life. Torajans believe that people aren't really dead when they die and that a profound human connection lasts well past death. Death for many Torajans is not a brick wall but a gauze veil. It is not a severing but just another kind of connection. Often in Toraja the deep link with a loved one doesn't end at the grave. Periodically some northern Torajans bring their relatives out of their tombs to give them fresh clothing and burial shrouds.

No one knows exactly when Torajan death practices began. The Torajan language was





## Toraja Heartland

Nearly half a million Torajans live in the highlands of the Indonesian island of Sulawesi. The vast majority, at least 90 percent, are Christians, but they remain influenced by their traditional religion, Aluk To Dolo, or Way of the Ancestors.

written down only in the early 20th century, so most of the old traditions are still oral. Only recently, through carbon dating of wooden coffin fragments, have archaeologists concluded that there are Torajan death practices that date back at least as far as the ninth century A.D. The first Dutch ships arrived in what is now Indonesia in the late 16th century, searching for nutmeg and cloves. Just over 300 years later they reached Toraja, a cultural region that today encompasses the districts of Toraja Utara and Tana Toraja. Thanks to Dutch missionaries, it's a Christian enclave, made up mostly of Protestants but also Roman Catholics, in a majority-Muslim country. Christianity has tried more or less successfully to partner with traditional practices: Nearly every step of a Torajan death is greeted with prayers, readings from Matthew or John, and a recitation of the Lord's Prayer.

Toraja is dotted with villages perched high on the side of cliffs or nestled deep in the valleys below. Rantepao, a dusty town of 26,000, is reached mainly via an eight-hour trip from Sulawesi's largest city, Makassar, on 200 miles of corkscrewing, cliff-hugging road. The villages in turn are connected only by winding, one-lane dirt paths carrying two-lane traffic that dodges dogs and toddlers along routes pocked with head-banging, watermelon-size ruts.

I made the tough trek here after years spent writing and speaking about an American way of death that glorifies medicine and drugs but fears

death, which it considers a failure of technology or will. That leaves most Americans dying in institutions, when the majority say they would prefer to die in peace at home. After my husband, Terence, died, I began seeking alternatives. I have come here to explore a culture that is even more extreme, but in the opposite direction.

There are obvious limits to my search. Feeding the dead, letting bodies hang around, and opening coffins aren't practices the rest of us will likely adopt anytime soon. Even so, I can't help wondering if the more gradual rhythm and pacing of Torajan death practices don't hew more closely to the actual racking and shuddering experience of human grief than do our own more buttoned-up rituals.

Seeing, talking to, and feeling the presence of a dead loved one are commonplace in the West, write Colin Murray Parkes and Holly G. Prigerson in *Bereavement: Studies of Grief in Adult Life*. "I talk to him and quite expect him to answer me," they quote one widow as saying. Grief itself, they say, doesn't follow a clean trajectory but rather erupts and calms in cycles over many years—just as Torajan death practices do. But the Western habit of sweeping the dead out of sight within days or even hours of death would seem far too abrupt to a Torajan. "My mother died suddenly, so we aren't ready yet to let her go," says Yohana Palangda, as she begins to weep. "I can't accept burying her too quickly." Her mother has continued to receive guests in





an upstairs room for more than a year. Because Yohana's mother was the village chief—a position Yohana now has—villagers continue to come to seek blessings for important events, or even permission to marry.

Michaela Budiman, an anthropologist at Charles University, in Prague, Czech Republic, writes that if the deceased in Toraja were buried immediately, it would be “as if a hawk careened suddenly upon its prey, snatching it in its talons and vanishing forever in the split of a second.”

So what is the difference between Yohana's reluctance to let her mother go and our own? Or between Elisabeth's conversation with her dead husband and the ones Western widows secretly hold with theirs? Or Elisabeth's family's feeding ritual compared with novelist Joan Didion's reluctance to part with her dead husband's shoes, lest he need them when he returns? The best thing to resolve grief is time. What if we, like the Torajans, gave ourselves more time to unspool it at its own rate?

A FEW DAYS AFTER my visit to the deceased Petrus Sampe and his wife, another man's funeral is in full swing at the other end of town. I climb a shaded bamboo structure the family has built for out-of-town guests. I curl up on a rug next to a young teen, the granddaughter of the deceased. Dinda applies eyeliner. She fiddles with her smartphone. Everyone likes funerals, especially for the chance to meet faraway relatives, she says, as three younger cousins romp nearby, including around their grandfather's coffin.

Hundreds of men, women, and children wander below or sit chatting in the shade of ancestral homes—called *tongkonan*—distinctive stilted structures that carpet the region, their giant curved roofs seeming to float like huge red boats on seas of palm, coffee trees, and bougainvillea.

The spaces between the *tongkonan* are cluttered with squealing pigs bound to bamboo poles, soon to become lunch. Women in slim black-and-white sheath dresses sell cigarettes. A motorcycle vendor hawks Mylar balloons. Sleek, fat water buffalo are everywhere, lounging

under trees, standing alongside the road, or being walked in circles by young men who tend them as affectionately as they would pets. A master of ceremonies high in a tower above the crowd addresses a magnificent animal, its huge, gracefully curved horns as wide as a man is tall.

“You are the most important buffalo here,” he says. “You will go with this man to the next world and make him rich.”

A grand Torajan funeral is measured in the number and quality of buffalo, which serve as a form of currency. Everything about the funeral is hierarchical, cementing the status of the dead person's family, the people who attend, and many who don't. Today is near the end of more than a week of meals, receptions, meetings, prayers, entertainment, and carefully choreographed rituals separating the dead gradually from life. The body moves from the home into the family's ancestral building, then into a nearby rice barn, then to the funeral tower overlooking the ceremonial plain.

Funerals glue Torajans tightly, one family to the next, one village to the next. Funerals consume savings as people outdo each other in gifts of animals, creating multigenerational obligations and conspicuous consumption. Your cousin donates a buffalo? You must give a bigger one. You can't repay a past gift? Then your son or daughter must. If they can't, the burden will fall to your grandchildren. This dark side of funeral obligations can be clearly heard in the cries of the emcee announcing the gifts. “Whose pig is this?” he intones over a loudspeaker. “Whose buffalo is this?” In a metal-roofed shelter below, government officials tally the quality and size of each gift for tax purposes. At the ceremony's end the neat ledger will be presented to the family, which will be expected to reciprocate when some member of a giver's family dies.

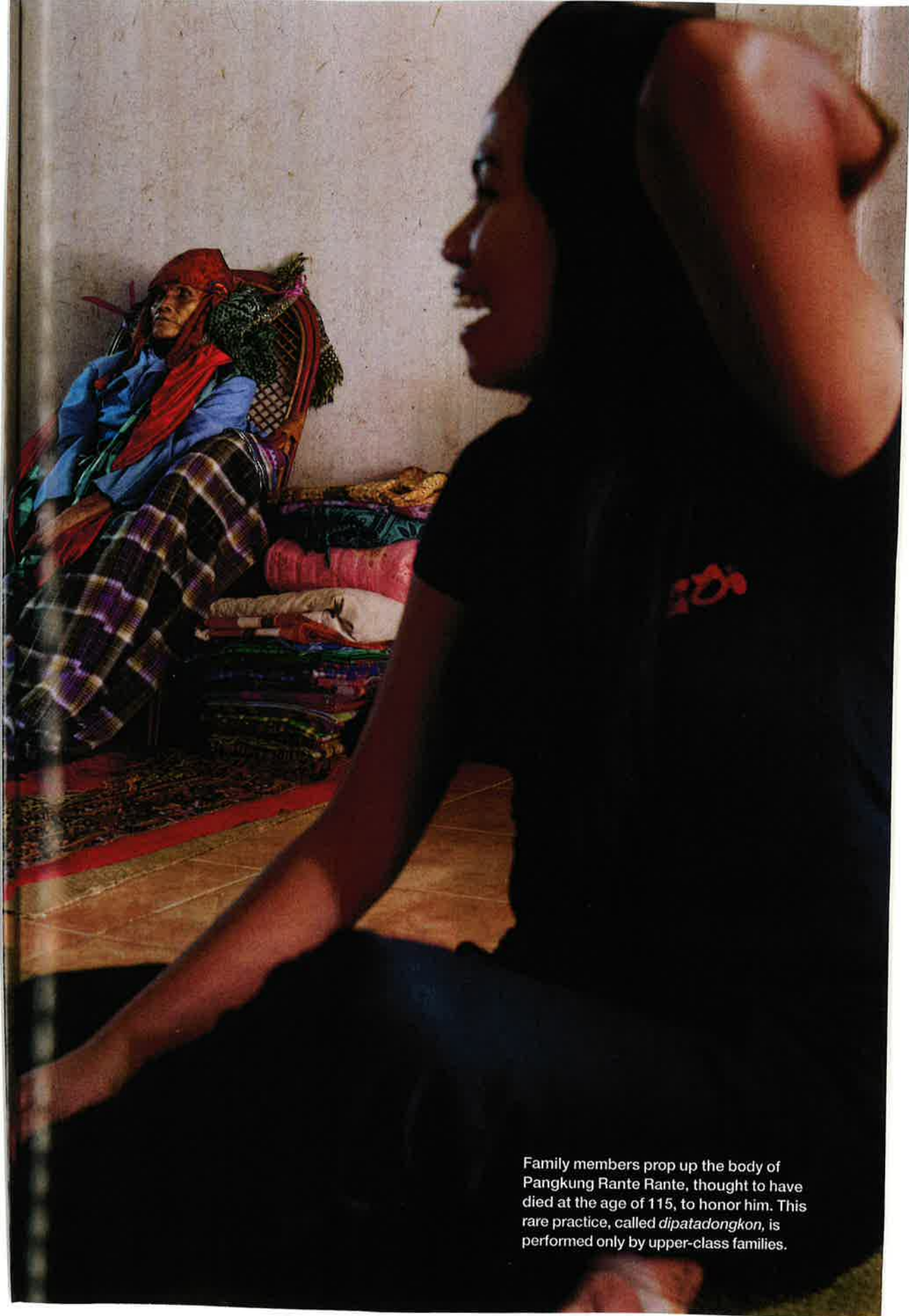
Torajan funerals are also great fun. A funeral is a wedding, a bar mitzvah, and a family reunion all in one, easily outstripping the conviviality of Irish wakes. Lavish funerals are a chance to meet and mingle, to eat and drink well, to enjoy games and entertainment—even to network for jobs or eye prospective mates. There











Family members prop up the body of Pangkung Rante Rante, thought to have died at the age of 115, to honor him. This rare practice, called *dipatadongkon*, is performed only by upper-class families.



are water buffalo fights. (“No gambling,” the emcee announces. “The family is Christian, and the police are here. The family does not support gambling.”) As a cry goes up summoning the strongest to move the coffin to the tower, at least 50 young men seize the bamboo poles. They chant their way around the field, pumping the coffin up and down as the lyrics grow bawdy: something about body parts, and size, and sexual prowess. A water fight breaks out, with the bearers drenching each other, and the guests, with water from plastic cups.

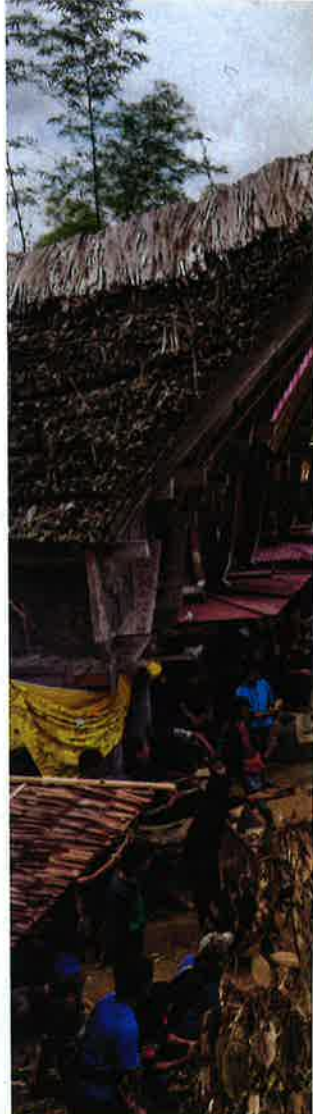
“You can make an excuse for a wedding, but you have to come to a funeral,” says Daniel Rantetasak, 52, who sits one bright afternoon in the VIP section at the funeral of Lassi Allo To’dang, Dinda’s grandfather. Daniel figures he has attended more than 300 funerals in his lifetime. He says that at a funeral like this a minimum of 24 buffalo should be sacrificed. Sometimes the number may exceed a hundred. At an average of 20 million rupiah per buffalo (\$1,425)—prices can go much higher for the most prized, mottled ones—an elite funeral can top \$400,000 in buffalo costs alone, paid for by socially compulsory donations and by the many family members who send money home from abroad. Food and drink for hundreds of guests and temporary bamboo housing for visitors add to the costs. People devote resources to funerals even while struggling to pay \$10,000 for university expenses. One woman remembers her grandmother saying funds were too scarce to pay for college. A few weeks later her grandmother spent thousands on pigs for a relative’s ceremony. “I was a victim of tradition,” the woman says. It is commonly said that in Toraja, one lives to die.

Yet some Western tourists who come to Toraja seeking the exotic pageantry of funerals find that the human connections, unflinching contact with death, and sheer fun help shift their thinking about their own culture’s habits. “When someone dies in Spain, it’s the worst thing that can happen in a family,” says Antonio Mouchet, an IT consultant touring from Madrid. “We Western people...don’t think of the

end. Here, they have been preparing for years.”

I avert my eyes at the buffalo sacrifice—55 will be killed in total. It feels brutal to Western sensibilities. Torajans look on unfazed; their concern is more for the group than the individual, says Stanislaus Sandarupa, a Torajan and a linguistic anthropologist at Hasanuddin University, in Makassar. The buffalo’s obligation, he says, is to provide meat to ensure human existence. People, in turn, must care for the species and make sure it endures.

WHILE THE FUNERAL is unfolding in town, another set of ceremonies is taking place in the countryside. August is a month not only for funerals but also for *ma’nene’*—the “second funerals” held by families every few years when they return to ancestral tombs to tidy up, bring









Water buffalo in Toraja are raised to be sacrificed. Until then, boys (and sometimes girls) care for them with affection and pride, as they would a fine stallion or an expensive car. At the funeral the animals are killed by a machete chop to the jugular. The more buffalo sacrificed, the greater the prestige.

the dead snacks and cigarettes, and take long-buried bodies out for a turn in the sun and put fresh clothing on them. Daniel Seba Sambara presides over a gathering that includes his wife, a daughter and granddaughter, son, son-in-law, and many others congregated around a grand family crypt on a breezy spot overlooking a valley. Daniel wears new trousers and looks slightly surprised, as if peering out from behind new wire-rimmed glasses. He died in 2012 after 20 years with diabetes. This is the first time his family has seen him since he was interred. This week, for the ceremony of *ma'nene'*, he was hauled out along with a dozen or so much longer

dead relatives, his companions in the crypt.

Relaxed and fit, Pieter, Daniel's son, followed his father in the construction business in Papua Province, more than a thousand miles away. Pieter's orange polo shirt is fashionable. His English is excellent. His daughter, Monna, a civil engineer, passes around cell phone pictures of her choir camp in Cincinnati. Pieter and his family are thoroughly modern Torajans.

So how does he feel seeing his three-years-dead father lashed to a stucco pillar, with relatives posed at his side? Proud. And excited. His father's body is relatively intact and recognizable, unlike those of other relatives lying nearby,





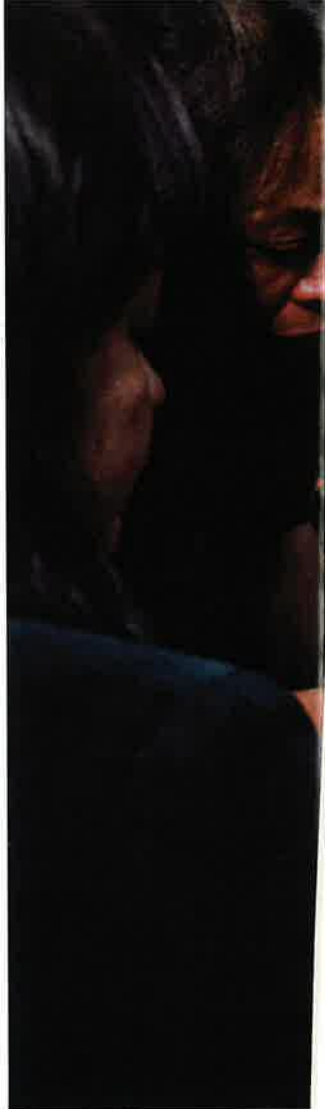
which look more like Halloween skeletons. His skin is smooth. His fingernails and beard have grown since they saw him last, relatives exclaim. Daniel was nicknamed Ne' Boss—Grandpa Boss—years ago, a commentary on his rags-to-riches success. The body's state is a sign to Pieter that he too will prosper. "Not everybody is like this. It will bring his children and grandchildren success," he says, gleefully.

I approached this moment with trepidation. After all, we Westerners cringe at the sight of a corpse. Confronted with several, I find myself curiously calm and interested. Everyone is festive, wearing bright colors and appearing decidedly happy. The smell is musty, like a bunch of blankets put away wet and stored for several years. The sight is definitely odd but surprisingly not unpleasant or gruesome. "The way they handle the bodies, it's not scary at all," says Ki Tan, an Indonesian who grew up in the Netherlands, as he watches a family interact with a group of long-dead loved ones, including a year-old child, dead for 38 years. Nearby, a 21-year-old backpacker from Berlin grows reflective. "I feel very lucky to have seen this," says Maria Hart, recalling sadly that she was so upset by her own grandfather's death that she refused to attend his funeral. "On a personal level, I take some comfort in the tradition," says Kathleen Adams, an anthropologist at Loyola University Chicago who has lived among Torajans and their dead.

THE IMPORTANT THING, Torajans say, is that they are not just individuals. The death of one person is only the dropping of a single stitch in an intricate financial, social, and emotional canvas winding backward through ancestors and forward through children. How did Torajans come to believe this? I wonder. Go ask Kambuno, the people say. He's the man who knows the answers.



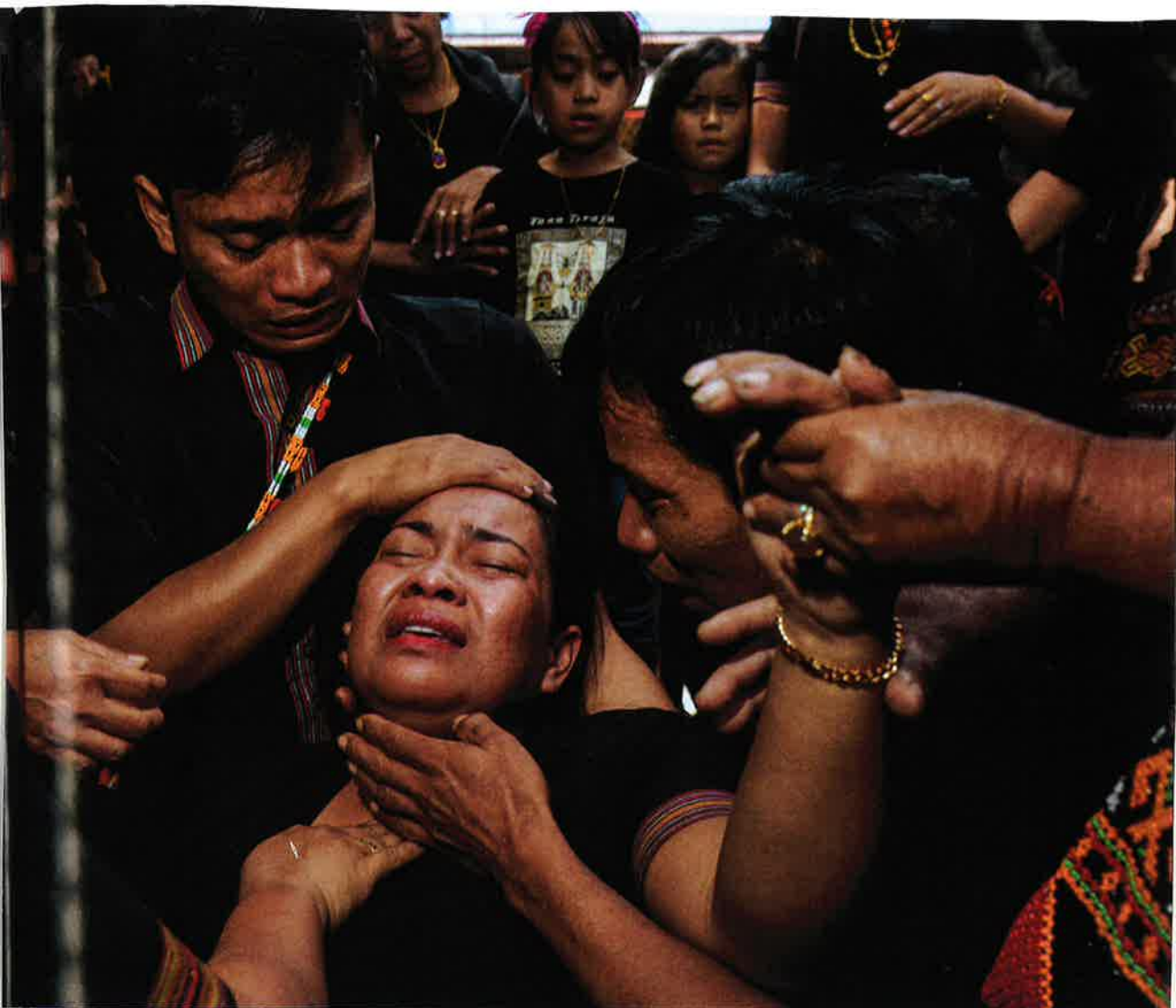
Watch a *ma'nene'* ceremony, or "second funeral," and listen to Torajans talk about their relationship with the dead. You can find the video at [ngm.com/more](http://ngm.com/more).



In search of Kambuno, we wind northward from the small town of Pangala, skirting rice fields and passing through village after village. Shopkeepers, motorbike riders, and passersby direct us. Everyone knows where Kambuno lives. Two schoolgirls in white shirts, navy skirts, and black ties hop in the car to point the way. When the road peters out, we continue on foot up a steep, rocky course.

We find Petrus Kambuno, wiry, goateed, almost toothless, cutting grass by the side of the road. "You are lucky you found me," he says. "There is no one left but me who knows these stories." He claims to be 90 years old. He spins a Genesis-like creation tale, with Toraja at its center. "Here God created man in heaven, and woman from the Earth," he says. Looking out over lime green terraced rice fields framed





Tini Patiung breaks down moments before a group of men carry her mother to her grave. Ester Patiung died ten months earlier, at age 62; her body was kept in the family home as decisions were made about her funeral ceremony.

against an aquamarine sky, it's easy to believe that God chose this to be his Eden.

Kambuno continues: God gave the gifts of bamboo and bananas from the Earth and betel and lime from the heavens. "He commanded us to use these things that give people pleasure to ease our grief, to make ourselves feel happy if we are sad when someone dies."

I realize I'm asking the wrong question. Torajans, it appears, are probably more deeply connected than we are to the way people everywhere feel death: the desire to stay connected to loved ones in both body and spirit; to believe that people don't ever really die permanently;

and to have, and to become, an ancestor. So the question isn't why do Torajans do what they do, but why do we do what we do? How did we distance ourselves so much from death, which is, after all, just a part of life? How did we lose the sense of being connected to each other, to our place in society, in the universe?

Kambuno gestures at his family crypt, which he says holds more than ten relatives. "My father is in here," he says. "But I am here, so he is not really dead. My mother is in here, but I have daughters, so she is not really dead. My daughters have been exchanged for my mother. I have been exchanged for my father." □





Cristina Banne, who died in 2011, is held up by her son Bartolomeus Bunga' as grandson Jerry Putra Bunga' gives a thumbs-up. With more than half of Torajans living elsewhere, funerals bring families back together.









