NATIONALGEOGRAPHIC.COM/MAGAZINE | JUNE 2009

SPECIAL REPORT

FEEDING THE WORLD

NATIONAL GEOGRAPHIC

THE CHRISTIAN EXODUS FROM THE Holy Land

Secrets in a Shipwreck

PINK DOLPHINS OF THE AMAZON

Enchanted Forest in Finland

A MAZE OF SOUTHERN CAVES

NATIONAL GEOGRAPHIC

JUNE 2009 · VOL. 215 · NO. 6

ED KASHI

Spiderman's web has spread to Syria. In the Christian Quarter of the Old City of Damascus, two boys play shooter and superhero. Story on page 78.

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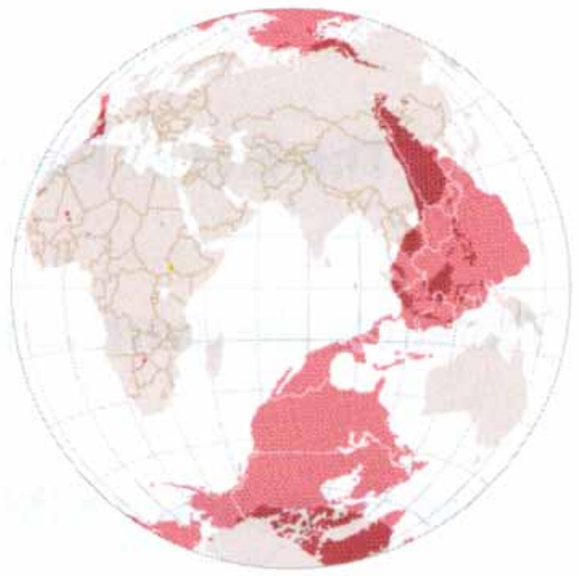
NATIONAL GEOGRAPHIC

DEPARTMENTS



KEVIN SCHAFER

ngm.com

Diving Into River Dolphins Why did they go from oceans to fresh water? How do they differ from their seafaring cousins? What dangers do they face? Our interactive graphic has answers.

On the Cover

A devout trio head to morning prayers at the Syrian monastery Deir Mar Musa.
Photo by Ed Kashi

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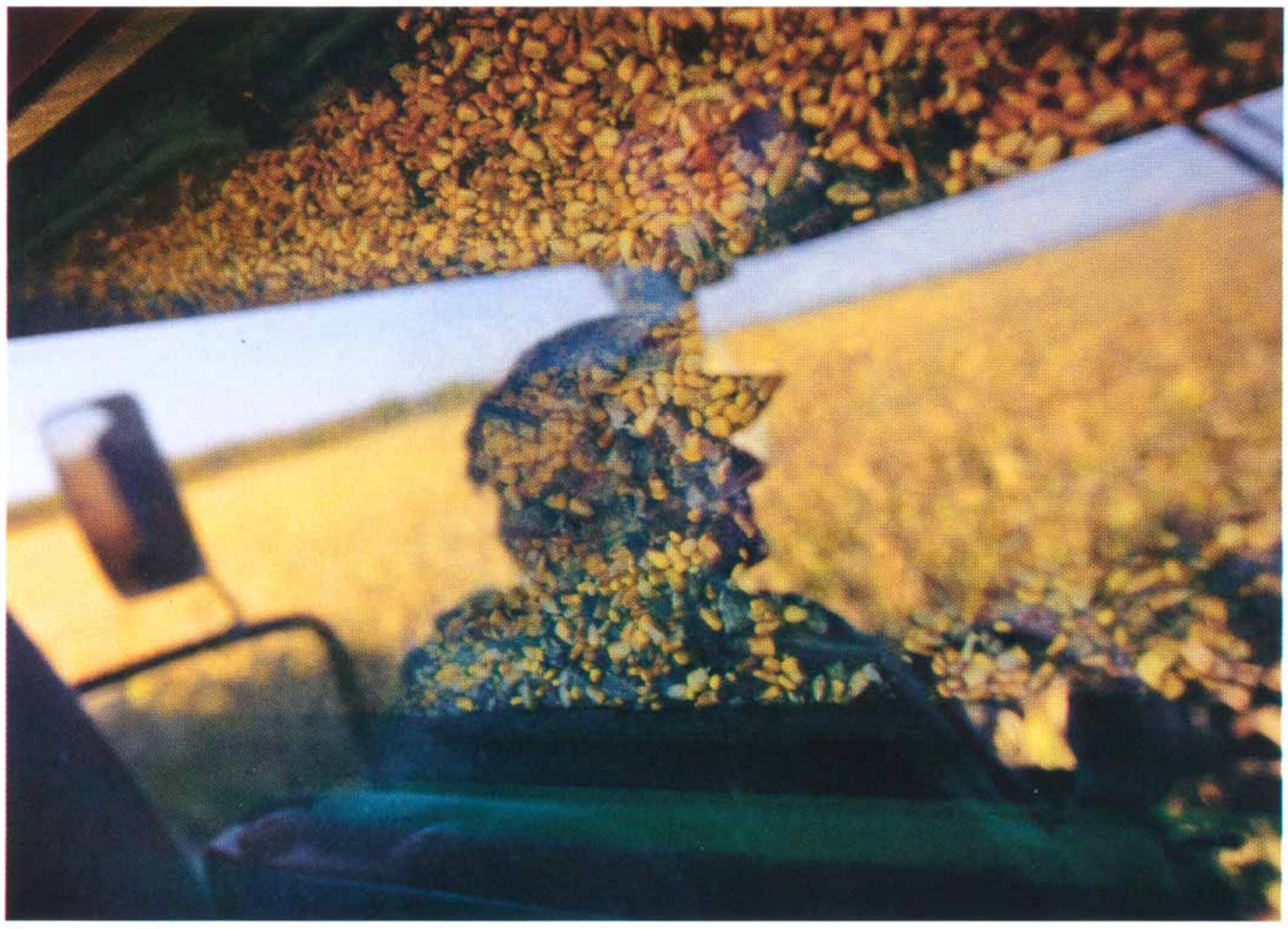
EDITOR'S NOTE



Reflected glory, corn fills the hopper of a combine at harvesttime near Oakville, Iowa.

"You have to get up early if you want to beat Otto" was the saying in Oregon's Rogue River Valley, where I grew up. Otto was Otto Bohnert, "an awesome farmer—always experimenting," says Dick Dunn, his nephew, also a farmer. Otto was famous for his 120-bushel-an-acre wheat crop in the late 1960s—in the midst of the green revolution, the movement to increase food yields by using new technology. His yields, thanks to superior wheat varieties, irrigation, and chemical fertilizers, were double the normal in our valley.

The green revolution was so successful that some experts hold that its increased rice yields made it possible for the Earth to support 700 million additional people. Today, though, growth in food production is flattening, human population continues to increase, and the toxic consequences of pesticide use and drying aquifers are painfully obvious. Demand outstrips production; food prices soar.

I wish Otto were still around to ask about the fix we're in. When I asked Dick, he said: "I think Otto thought he'd give this green revolution a shot, but he'd also be thinking there's no free lunch."

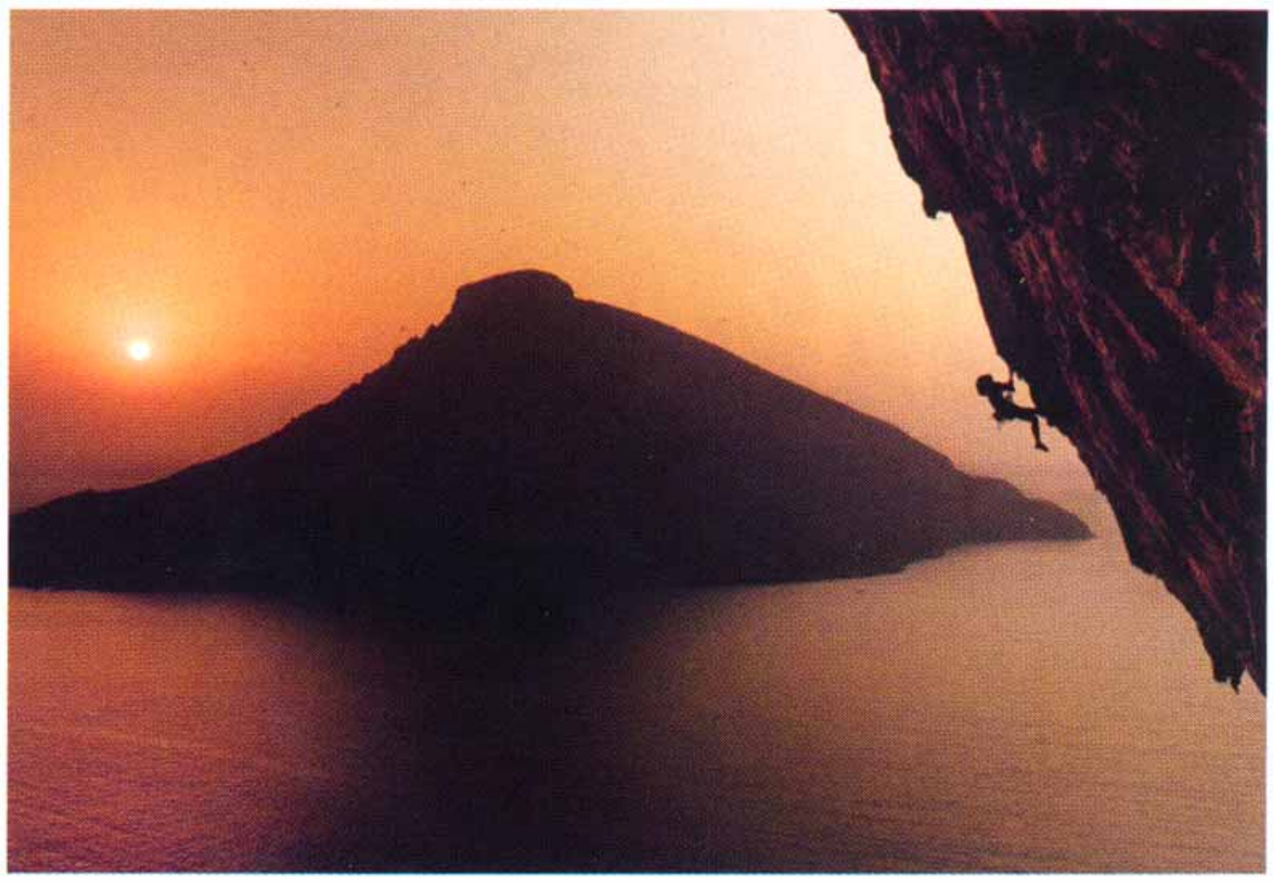
In this month's story "The End of Plenty," Joel Bourne and John Stanmeyer report on the green revolution that helped feed millions—and its consequences. They discover Otto was right: There is no free lunch.

PHOTO: JOHN STANMEYER

World of Wonder A black cat crossing your path could be good luck—if it winds up as a stunning photograph. A high-altitude perch might offer a once-in-a-lifetime view, if you're ready to capture it. Wherever you go, take your camera, then head for our website, where you can pick up tips from our editors, vote for other readers' photos, and upload your own images. For guidelines, a submission form, and more information go to *ngm.com/yourshot.*

Stanisław Jawor Myślenice, Poland

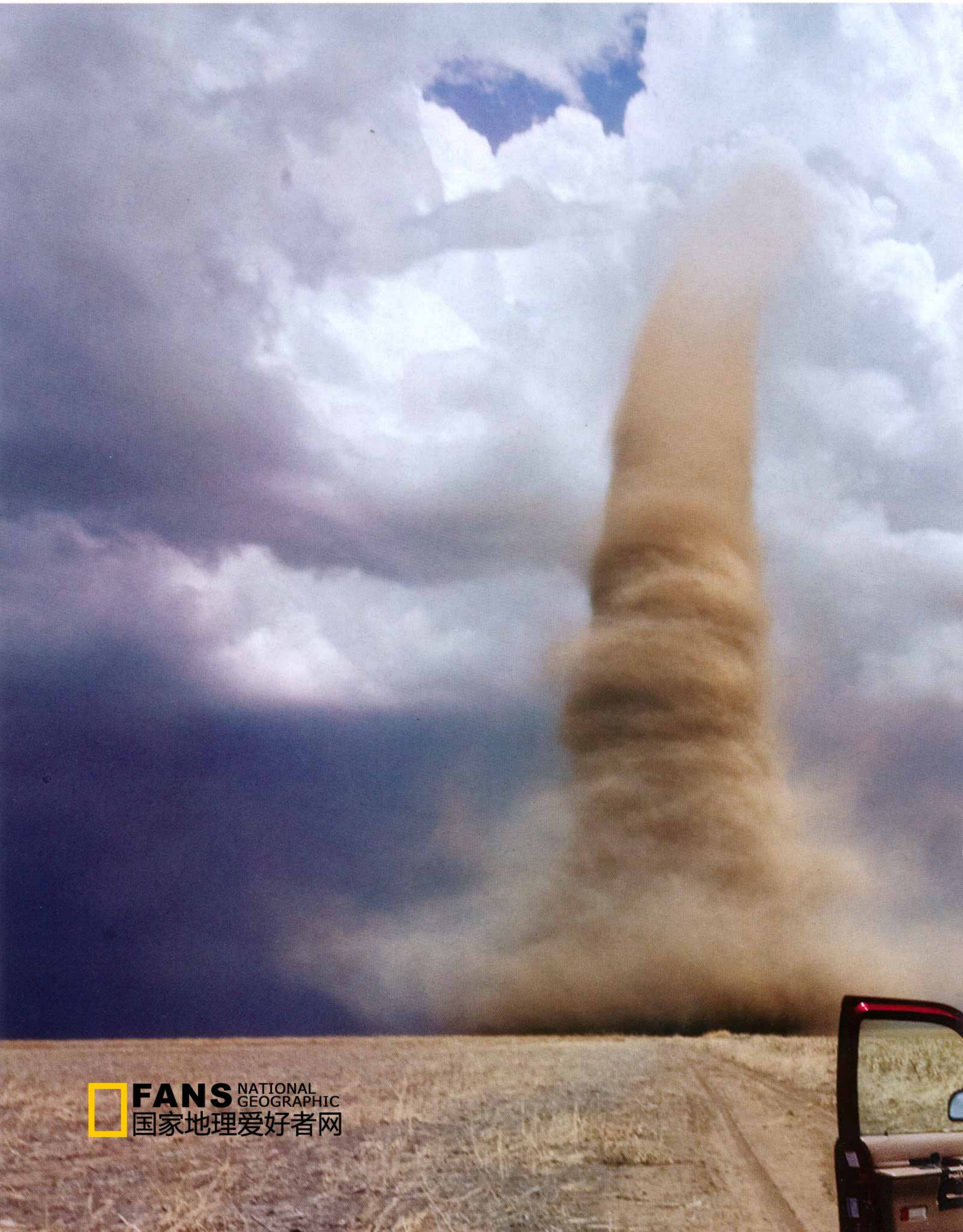
Haunting atmosphere and architecture define Transylvania, says entrepreneur Stanisław Jawor, 49. So when he spied a cat there with "shining, interested eyes" under a setting moon, it made perfect sense—and a perfect picture.



Lukasz Warzecha Edinburgh, Scotland

Rock climbing and photography are two loves of Lukasz Warzecha, 26. His passions dovetailed one day on the Greek island of Kalymnos, where he documented a strenuous ascent. The shot was voted an *ngm.com* favorite.

VISIONS OF EARTH



United States Backlit by sunlight, a brown tornado towers perhaps 4,000 feet above the parched plains of Kansas. In 2007 the state set a U.S. record, tallying 141 twisters. The mark was short-lived, though: 187 tore through in 2008.

PHOTO: JIM REED

United States The shuttle *Endeavour*—deft in orbit but incapable of terrestrial flight—catches a post-mission piggyback on a 747, soaring over California's Mojave Desert en route to Florida's Kennedy Space Center.

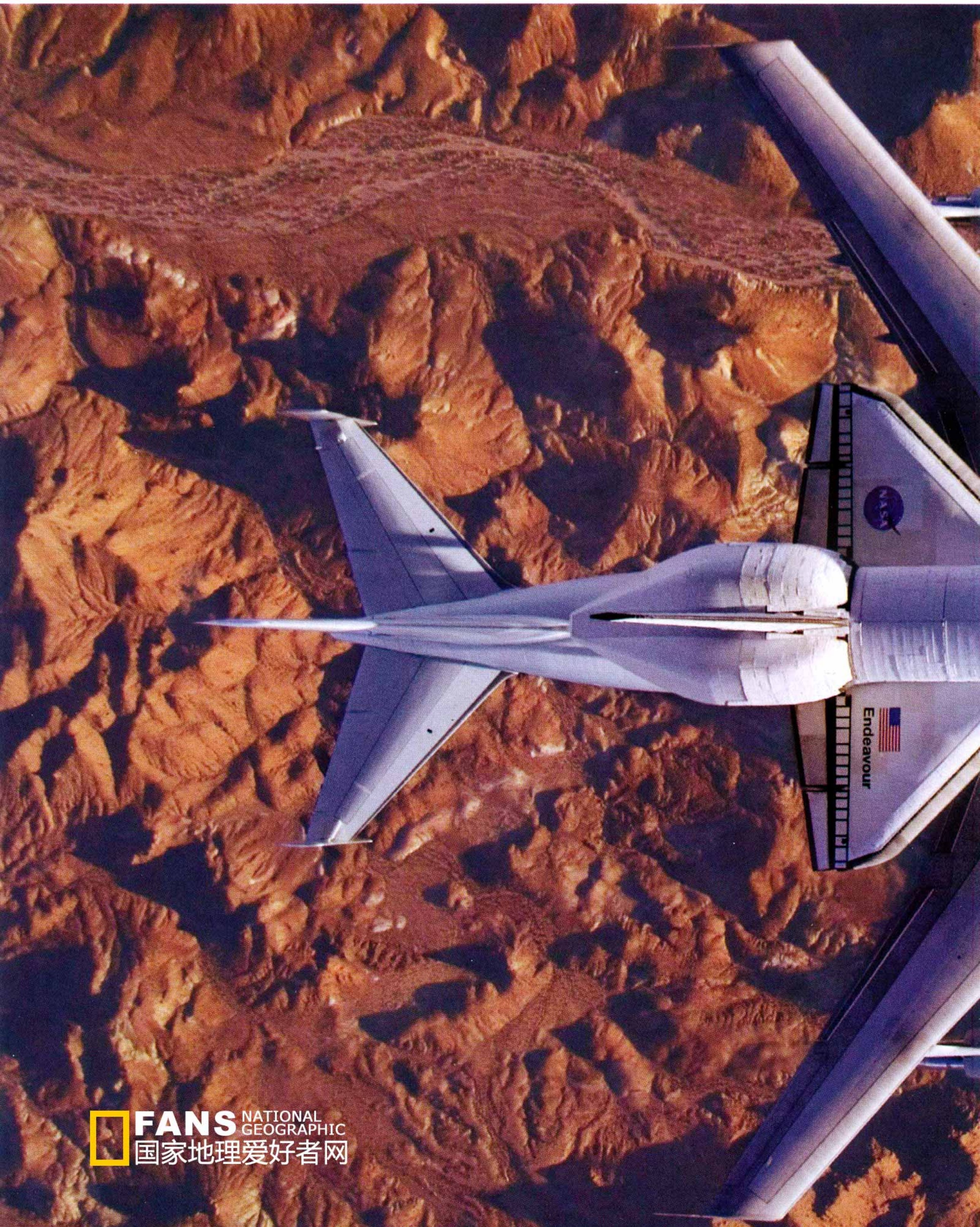
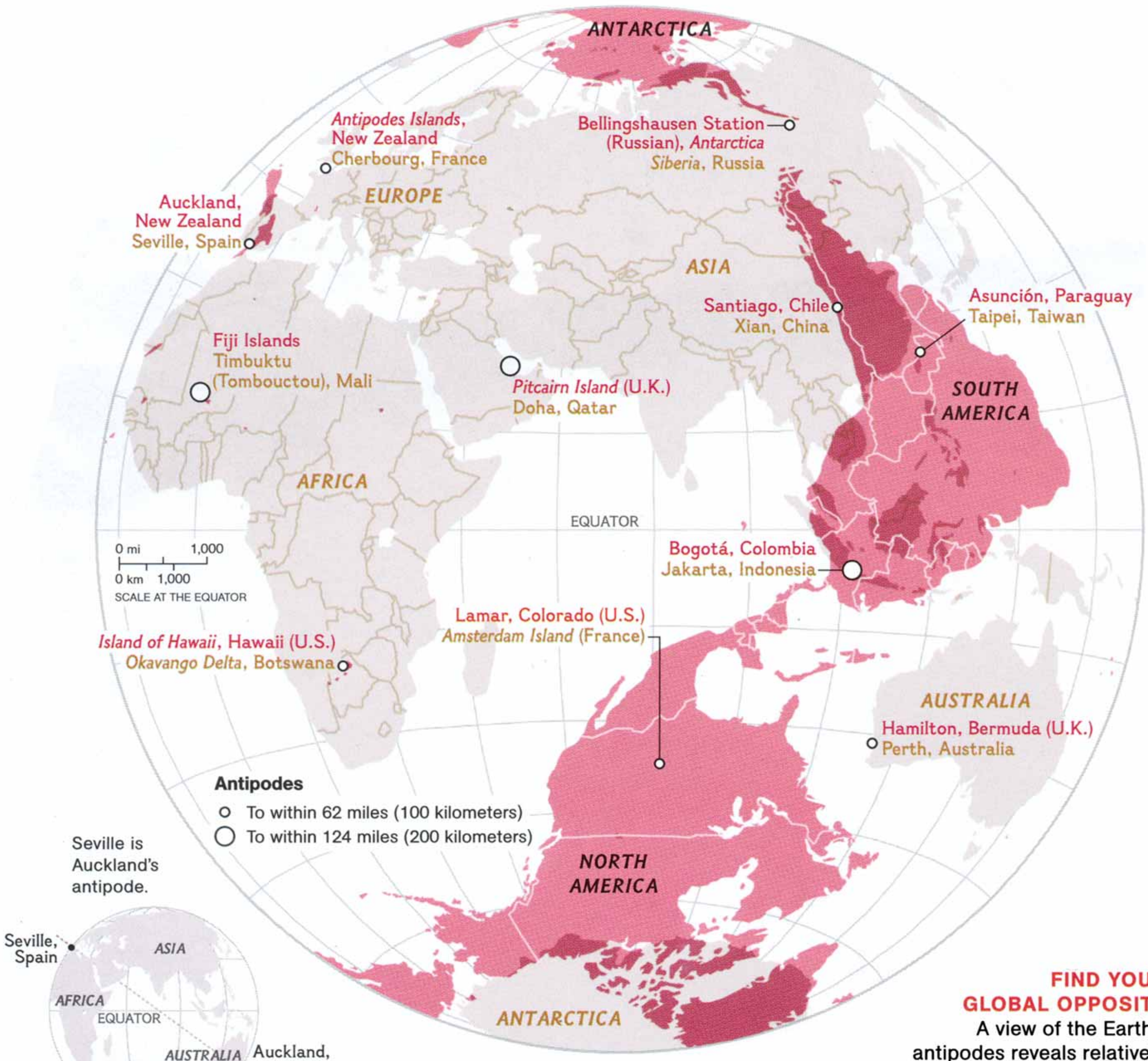


PHOTO: CARLA THOMAS, NASA/REUTERS

Belarus Naked on an 18°F day, Valentsin Tolkachev clears an icy canal for swimming. The 69-year-old started the Optimalists—a Minsk-based club with 200-some members—in 1989 to promote hale activities in rural settings.

PHOTO: VASILY FEDOSENKO, REUTERS



FIND YOUR GLOBAL OPPOSITE
A view of the Earth's antipodes reveals relatively few overlappings of land (dark red areas).

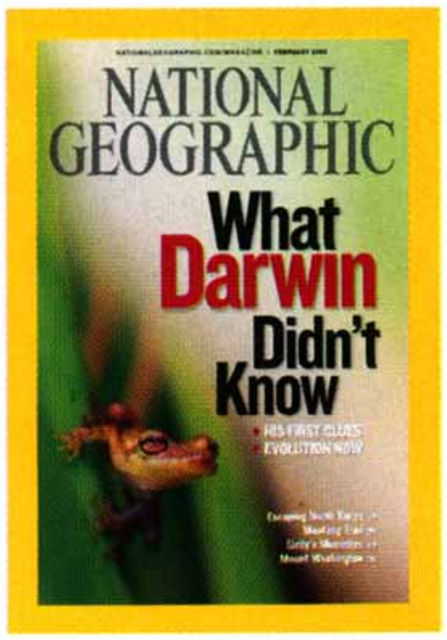
Polar Opposites It's a childhood riddle: Where would you end up if you dug a hole to the other side of the world? (Of course, that's assuming one could survive tunneling through the molten innards of the Earth.) Kids in the United States are usually led to imagine that they'd pop up like groundhogs in a rice field in China. Wrong. One look at a map of antipodes—places on exact opposite sides of the globe—shows that an American digger would end up in the Indian Ocean. As for sandbox fantasists in China, some would luck out and emerge on land in Chile.

The word "antipodes" in Latin means "those with the feet opposite," a reference to the old European belief that people south of the Equator had feet growing from their heads. They should have been thinking fins: From most locations in the Northern Hemisphere, the opposite spot is water, since oceans cover 70 percent of the Earth.

Playing antipodes produces amusing pairings. Bermudans would still enjoy sea breezes by Perth, Australia, but climate shock would await Timbuktu's desert dwellers, who'd come up near tropical Fiji. And as one player says, "Imagine the disappointment of someone digging their way out of Siberia and ending up in Antarctica." *—Tom O'Neill*

MAP: JEROME N. COOKSON, NG STAFF

LETTERS



February 2009

Darwin's First Clues

I'm glad you used the correct term, "natural selection," rather than "survival of the fittest." "Survival of the fittest" has been an excuse for many to adopt a selfish attitude instead of a cooperative one. Survival is not just an individual matter. It is the survival of groups that counts, and groups survive through love, generosity, and cooperation.

PAUL ALCIERE
Hingham, Massachusetts

Escape From North Korea

There will, unfortunately, always be places that people need to flee in order to live a decent life. China's insisting that these are "economic migrants" and repatriating them to her ally North Korea is not much different than the United States' condemning many refugees the same way and repatriating them to countries that have been condemned for their lack of human rights.

TRINA KING
Rio Rancho, New Mexico

Mustangs

While I am sympathetic to the point of view of ranchers, I believe that mustangs have a place in wild America. However, claiming that the horse is a native species is desperate logic. That same rationale would have elephants, via the woolly mammoth, designated as indigenous.

JARED ZAUGG
San Francisco, California

The article states that energy companies have a huge impact on the horses but never states how. Do the companies fence in thousands of acres, or do they merely fence in the half acre or so needed at each drilling site? These horses are an invasive species, like nutria and kudzu in the South and tumbleweeds and eucalyptus trees in the West. To some, they are just as big a nuisance. Sure, they are pretty and evoke a lot of dreamy ideas about the days before nuclear power and computers, but the fact is, they don't belong here.

KENNETH R. JOHNSON
Beaumont, California

Where the Dead Don't Sleep

In the photo on pages 120-21, I noticed what appears to be a contemporary flexible electrical conduit behind the heels of the mummies in the upper row. As an electrical engineer, I can appreciate the concerns of whoever installed it. Besides being up close and personal with residents, an installer is generally responsible for the cost to restore any collateral damage. The slightest bump might have dislodged a skull or something worse. I wonder how the installer calculated what he would charge to work around such fragile artifacts?

SCOTT NEWENS
Sacramento, California

Backyard Arctic

Yes, people have died in the White Mountains. But the mountains did not kill them. Hubris did, as author Neil Shea points out. Winter hiking (and dying) is a minuscule part of what Mount Washington is.

JEFFREY PORTER
Pelham, New Hampshire

In April 1974 I was a college freshman participating in a wilderness program. Ill equipped and clueless, ten students and one leader headed out for six days of climbing. On the third day, climbing up Mount Madison, we encountered waist-deep snow and the infamous sign: "The area ahead has the worst weather in America." We discussed turning back, but our leader insisted we push to the summit. We reached the top of Madison. It was getting dark. Walking around Madison Hut, we found a broken window just large enough to fit ourselves through. Knowing we would not survive the night outside, we entered. For the next two nights a storm raged. We got out of our sleeping bags only to go outside to relieve ourselves. You haven't lived until you've tried to go in 90-mile-an-hour winds, squatting on a sheet of ice. I have never been mountain climbing since.

ANTONIA CESARI LIEB
Ithaca, New York

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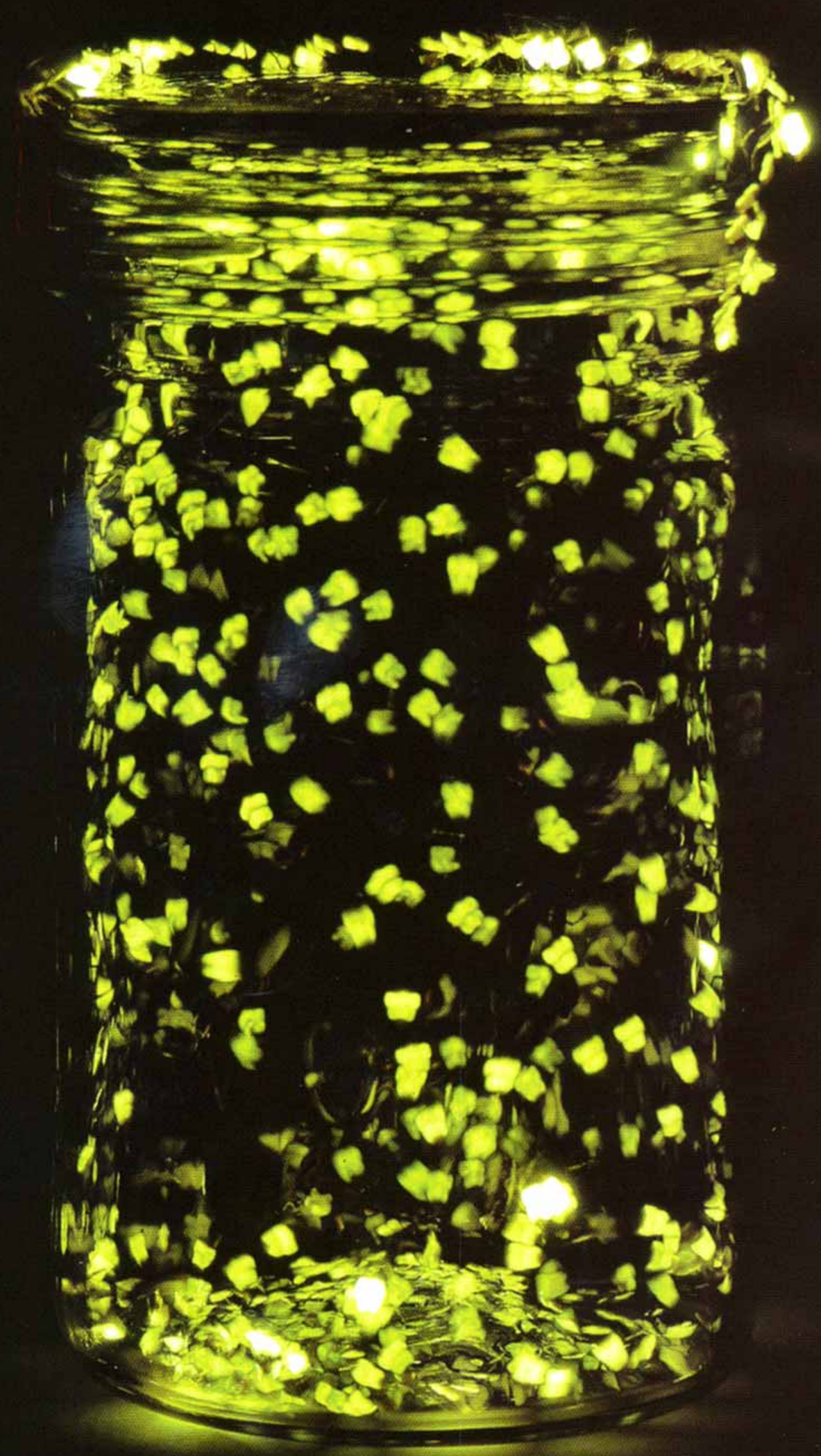
Dimming Lights

If the dark seems a little darker these days—and the world a bit less wonderful—it probably is. Researchers in Asia, Europe, and North America are seeing dramatic declines in fireflies.

Thailand is one place that seems to be losing the bioluminescent beetles. For centuries they blinked along Thai rivers with splendid synchronicity. Foreign visitors compared their lights to chandeliers or Christmas candles. Locals were able to fish solely by their flashes.

But the glow appears to be fading. "Twenty years ago I saw many," says Thai entomologist Watana Sakchoowong. "Now there are no more."

Scientific counts are just starting. No one has yet confirmed what's causing the population drops, but experts suspect habitat loss and light pollution. In Thailand, riverbanks where larvae fed on snails have been built over or undercut by waves from tourist boats. Artificial light from shoreline developments, meanwhile, makes it hard for firefly adults to find each other and mate in the changing night. *—Karen E. Lange*



KEEPING COUNT

The world has more than 2,000 firefly species—and now a host of websites set up to tally population totals. Here are a few.

- **Firefly Watch**
  mos.org/fireflywatch
- **Fireflies in Houston**
  burger.com/firefly.htm
- **U.K. Glow Worm Survey**
  galaxypix.com/glowworms

PHOTOS: STEVE IRVINE; NORBERT WU, SCIENCE FACTION (TOP)

They don't make buildings like they used to.

ANCIENT MEGASTRUCTURES, CHECK LOCAL LISTINGS

From the dreams that inspired them, to the blood and sweat that built them, discover the full story behind six magnificent structures that forever changed the landscape of architecture: Petra, Alhambra, St. Paul's Cathedral, Hagia Sophia, Machu Picchu and Angkor Wat.

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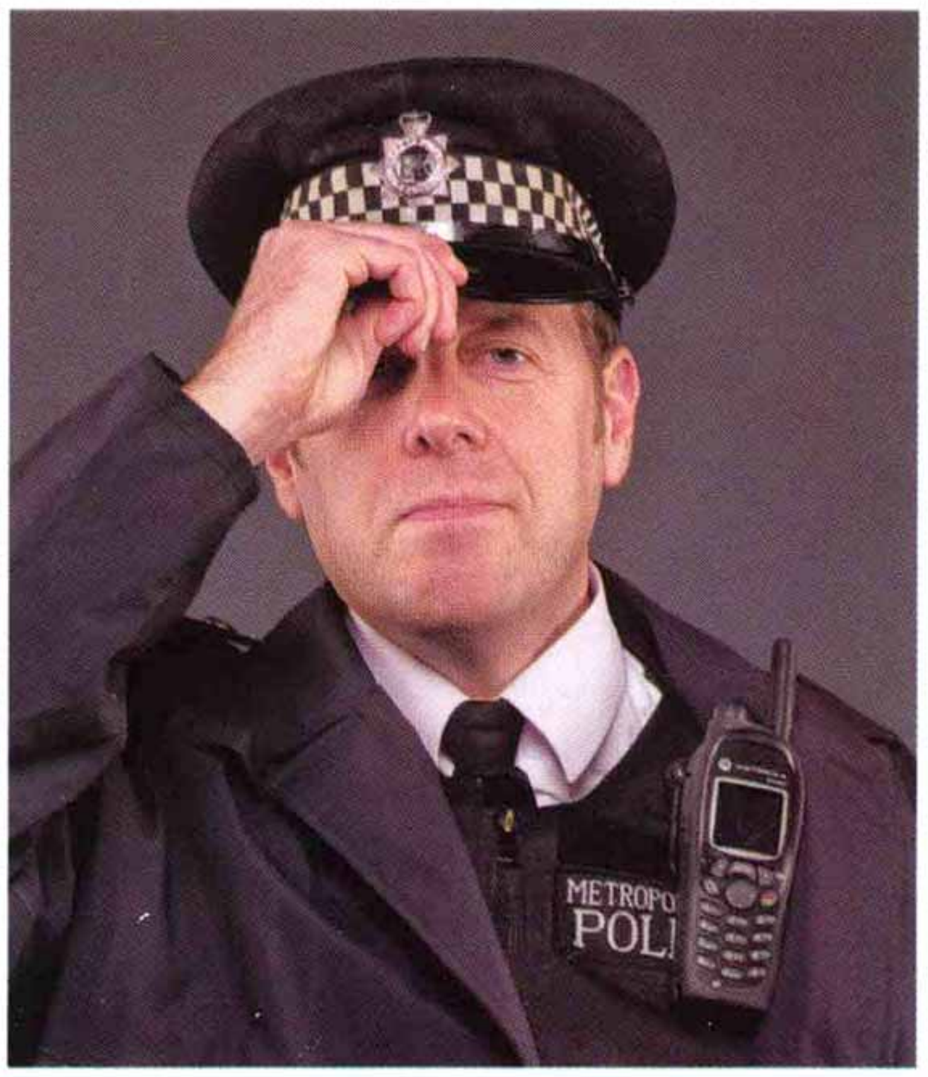
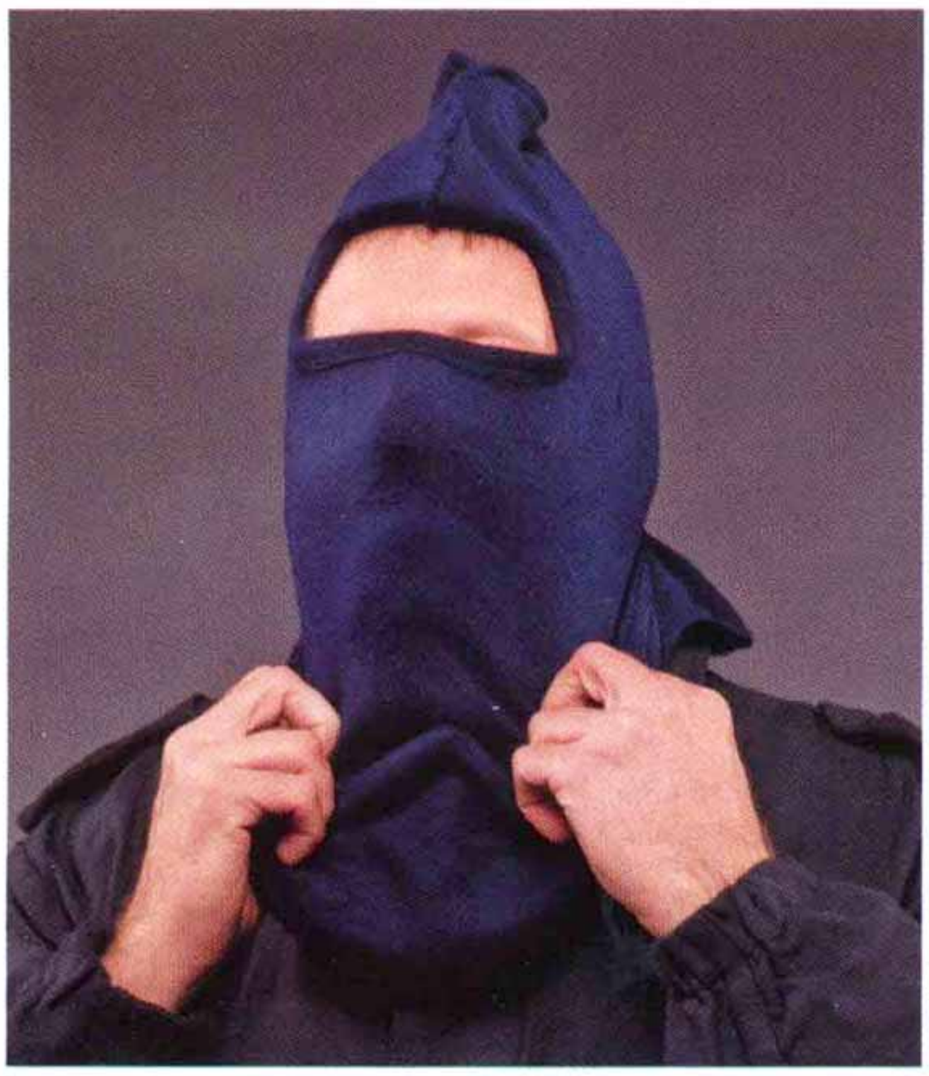
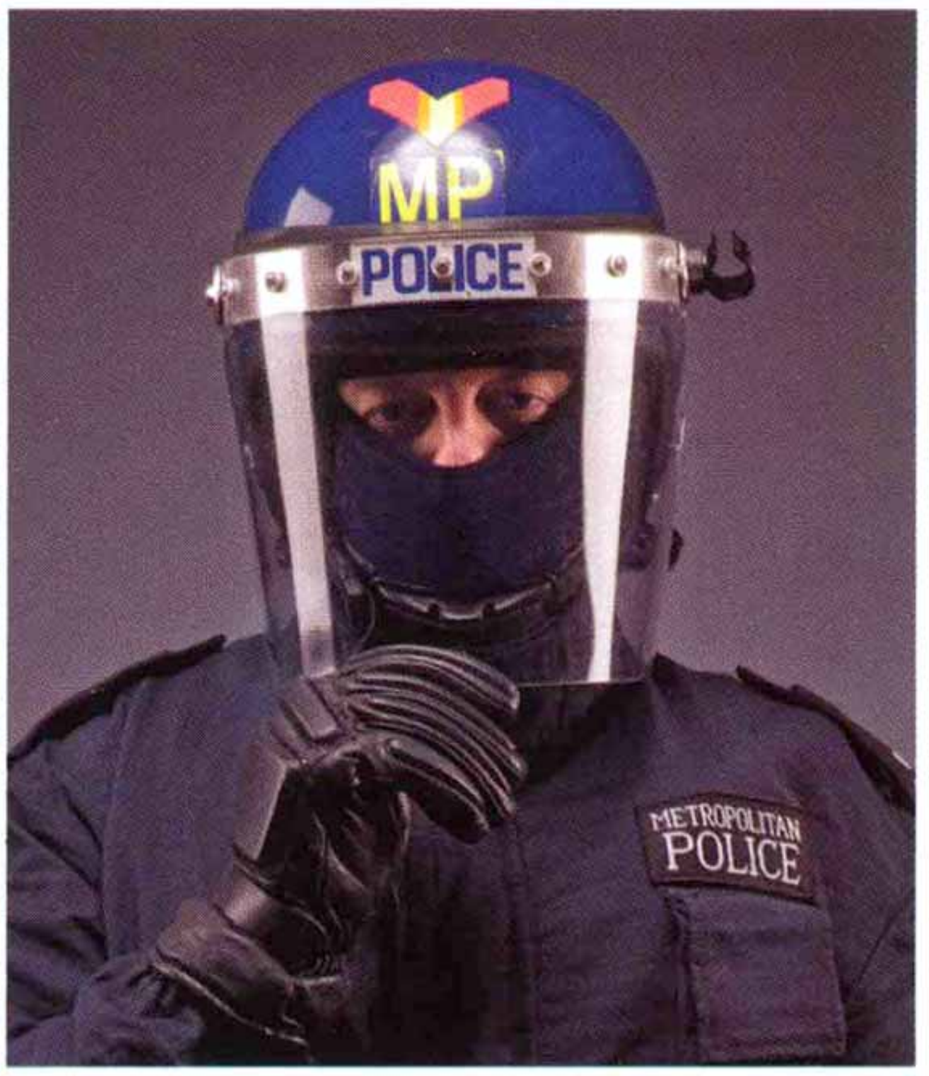
Think again.







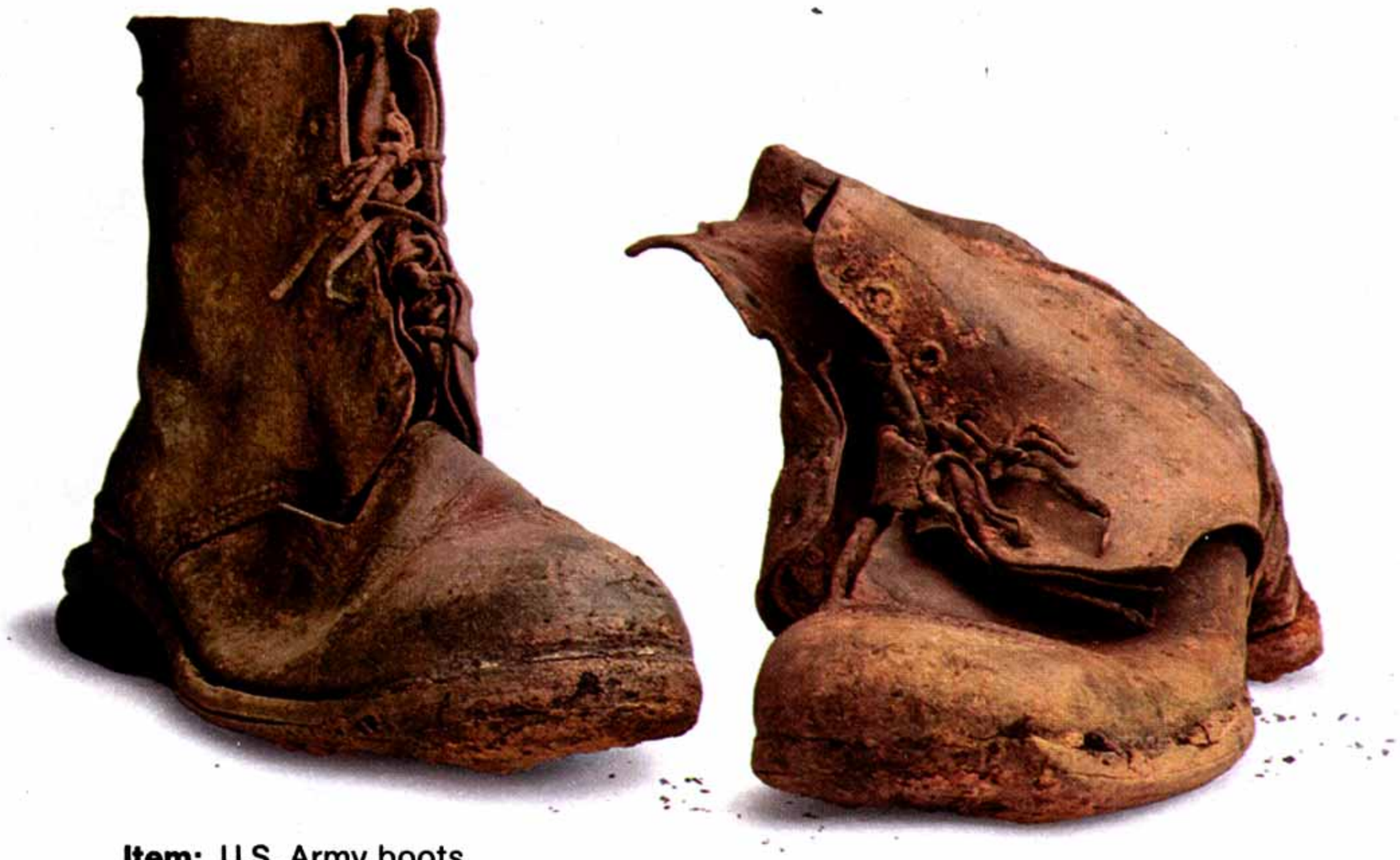
London cop Richard Broadhurst shows off uniform options. In some cases, low-key garb can defuse tensions.

Riot Tact After Israel invaded Gaza last winter, protests sprang up in Europe. Firebombs and tear gas were part of the mix—though not in Sweden, thanks to a new kind of crowd control.

Actually, "crowd control" is the wrong phrase, says Ola Österling, coordinator of the Stockholm police's four-year-old "dialogue group." Rather than focus on cowing a crowd, officers look at its members. If a person acts criminally, the cops step in. They also encourage organizers to monitor their events. "We are nervous every time," says Österling. But the approach is promising. In Stockholm, Gaza protesters wanted to crowd Israel's embassy, but listened when their leaders called for restraint.

Clifford Stott helps teach this tactic to Sweden's police. A social psychologist at the University of Liverpool, he studies soccer riots (local fans are famously wild). His conclusion? If teams of officers are embedded in a crowd, they aren't seen as a threat and can quietly nab hooligans. Last season police tried his method on fans of England's national team at away games. For fun, Stott asks folks to guess the arrest tally—6, 60, 600, or 6,000? Most say 6,000. The answer: 6. *—Marc Silver*

PHOTOS: CHRIS FLOYD



Item: U.S. Army boots
Conflict: World War II
Location: Germany
Case status: In progress

Finding the Fallen A mud-caked pair of size nine combat boots (above) is among the latest World War II artifacts to emerge from Germany's Hürtgen Forest, scene of a bloody battle that saw some 31,000 U.S. casualties. Found with the boots last summer were the bones of two soldiers. The task of identifying the men falls to the Joint POW-MIA Accounting Command (JPAC), established in 2003 to consolidate Pentagon efforts to find missing military personnel, including 84,711 soldiers, airmen, sailors, and marines from World War II onward whose fates remain uncertain.

Every year JPAC dispatches forensic teams to long-quiet battlefields throughout Europe, Southeast Asia, and the South Pacific as well as sites of plane crashes and sunken vessels. When remains are recovered, they are sent to JPAC's laboratory in Hawaii, the world's largest forensic anthropology lab. There scientists analyze bones, teeth, and DNA, which can be compared with samples from relatives of the missing. They also search for clues among personal effects. A wallet was found with the boots.

A case ends with family notification. Sharon Bannister was five years old in 1972 when the jet carrying her father, Stephen A. Rusch, crashed in Laos. At JPAC, 35 years later, she was shown two fragments of his teeth and presented with her father's dog tag, found at the crash site by a JPAC team. She accompanied his flag-draped coffin to Arlington National Cemetery. "It was just two tiny teeth," she said. "But they answered so many questions." *—Peter Gwin*

THE MISSING

Since 1941 nearly 85,000 men and women from the U.S. military have been declared missing in action. The Pentagon works on some 700 active cases at any given time, solving about seven each month.

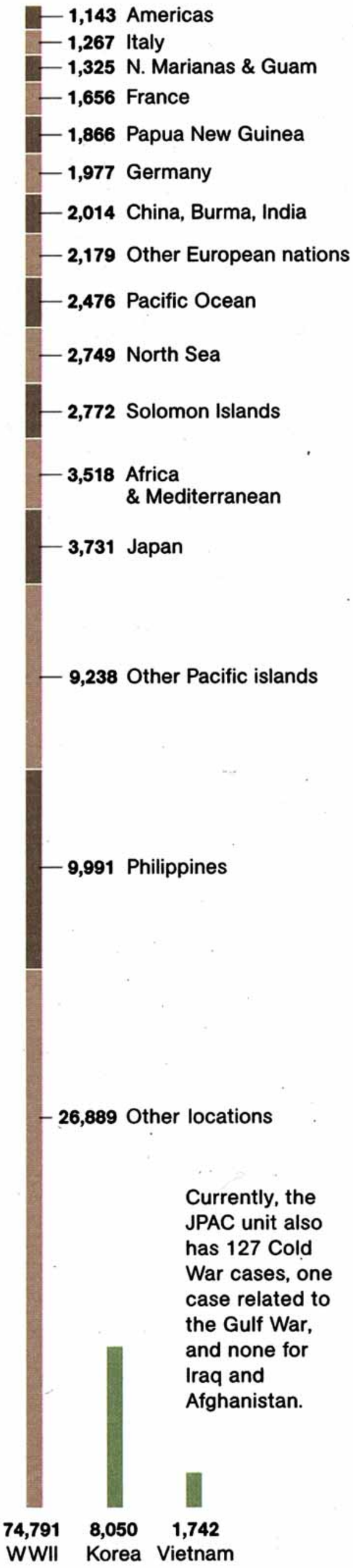


PHOTO: JONATHAN KINGSTON
GRAPHIC SOURCE: DEPARTMENT OF DEFENSE, MARCH 2009

THE END OF PLENTY

SPECIAL REPORT THE GLOBAL FOOD CRISIS

EGYPT Stung by soaring food prices, angry Egyptians throng a kiosk selling government-subsidized bread near the Great Pyramid at Giza. Across the globe, rising demand and flat supplies have rekindled the old debate over whether production can keep up with population.

WE'VE BEEN CONSUMING MORE FOOD THAN FARMERS HAVE BEEN PRODUCING FOR MOST OF THE PAST DECADE. WHAT WILL IT TAKE TO GROW MORE?

BRAZIL A mountain of soybeans rises in the hold of a cargo ship bound for China, where they will be crushed for cooking oil and animal feed. Though China has managed to meet most of the food needs of its growing population, its imports of soybeans have soared.

BANGLADESH A woman sweeps a harvested rice field, gleaning leftover grains to feed her family. One of the world's largest consumers of rice, Bangladesh needs more each year to feed its burgeoning

A SURGING POPULATION, TO EIGHT BILLION BY 2025, IS THE MAJOR DRIVER OF INCREASED FOOD DEMAND.

population. A near doubling of rice prices over the past two years—exacerbated by flooding and a major cyclone that devastated crops in 2007—brought the nation's total number of starving people to 35 million.

FOOD VERSUS FUEL: THE CORN USED TO MAKE A 25-GALLON TANK OF ETHANOL WOULD FEED ONE PERSON FOR A YEAR.

U.S.A. Jason Hinson, a sixth-generation corn farmer near Kingston, Iowa, keeps an eye on his auger as he unloads his combine on the fly. Federal mandates for corn-based ethanol soaked up 30 percent of the

2008 U.S. crop, helping send corn prices over eight dollars a bushel last year—triple the 2005 price.
As long as energy prices remain high, biofuels will compete with food for land and water across the globe.

CHINA Every imaginable cut of pork is on display at a busy butcher stall in Guangzhou, a sign of prosperity in China's growing cities. A rare treat for most Chinese just a couple of decades ago, pork

HUNGRY FOR MEAT: 35 PERCENT OF WORLD GRAIN IS USED TO FEED LIVESTOCK INSTEAD OF PEOPLE.

is showing up on more dinner tables, though the United States' per capita meat consumption is still more than twice as high. China now raises about half the world's pigs and must import grain to feed them.

THE POOREST OF THE POOR ARE THE MOST VULNERABLE TO HIGH FOOD PRICES— STILL NEAR HISTORIC LEVELS.

ETHIOPIA The sorghum porridge at this refugee camp lacks the protein and fat needed for an Afari mother to produce enough milk to breast-feed her malnourished son. Thousands of pastoral Afaris have fled here from

nearby Eritrea to escape war and drought. The green revolution that brought high-yield grain to Asia in the 1960s never reached sub-Saharan Africa, where crop production per capita has declined in recent decades.

BY JOEL K. BOURNE, JR.
PHOTOGRAPHS BY JOHN STANMEYER

IT IS THE SIMPLEST, MOST NATURAL OF ACTS, akin to breathing and walking upright. We sit down at the dinner table, pick up a fork, and take a juicy bite, oblivious to the double helping of global ramifications on our plate. Our beef comes from Iowa, fed by Nebraska corn. Our grapes come from Chile, our bananas from Honduras, our olive oil from Sicily, our apple juice—not from Washington State but all the way from China. Modern society has relieved us of the burden of growing, harvesting, even preparing our daily bread, in exchange for the burden of simply paying for it. Only when prices rise do we take notice. And the consequences of our inattention are profound.

Last year the skyrocketing cost of food was a wake-up call for the planet. Between 2005 and the summer of 2008, the price of wheat and corn tripled, and the price of rice climbed five-fold, spurring food riots in nearly two dozen countries and pushing 75 million more people into poverty. But unlike previous shocks driven by short-term food shortages, this price spike came in a year when the world's farmers reaped a record grain crop. This time, the high prices were a symptom of a larger problem tugging at the strands of our worldwide food web, one that's not going away anytime soon. Simply put: For most of the past decade, the world has been consuming more food than it has been producing. After years of drawing down stockpiles, in 2007 the world saw global carryover stocks fall to 61 days of global consumption, the second lowest on record.

"Agricultural productivity growth is only one to two percent a year," warned Joachim von Braun, director general of the International Food Policy Research Institute in Washington, D.C., at the height of the crisis. "This is too low to meet population growth and increased demand."

High prices are the ultimate signal that demand is outstripping supply, that there is simply not enough food to go around. Such agflation hits the poorest billion people on the planet the hardest, since they typically spend 50 to 70 percent of their income on food. Even though prices have fallen with the imploding world economy, they are still near record highs, and the underlying problems of low stockpiles, rising population, and flattening yield growth remain. Climate change—with its hotter growing seasons and increasing water scarcity—is projected to reduce future harvests in much of the world, raising the specter of what some scientists are now calling a perpetual food crisis.

So what is a hot, crowded, and hungry world to do?

That's the question von Braun and his colleagues at the Consultative Group on International

Workers in India's fertile Punjab pull an overstuffed load of rice stalks to a farm where they will be used as animal feed. High-yielding varieties, along with subsidized fertilizer and irrigation, have helped India stave off famine for decades.

Agricultural Research are wrestling with right now. This is the group of world-renowned agricultural research centers that helped more than double the world's average yields of corn, rice, and wheat between the mid-1950s and the mid-1990s, an achievement so staggering it was dubbed the green revolution. Yet with world population spiraling toward nine billion by mid-century, these experts now say we need a repeat performance, doubling current food production by 2030.

In other words, we need another green revolution. And we need it in half the time.

EVER SINCE OUR ANCESTORS gave up hunting and gathering for plowing and planting some 12,000 years ago, our numbers have marched in lockstep with our agricultural prowess. Each advance—the domestication of animals, irrigation, wet rice production—led to a corresponding jump in human population. Every time food supplies plateaued, population eventually leveled off. Early Arab and Chinese writers noted the relationship between population and food resources, but it wasn't until the end of the 18th century that a British scholar tried to explain the exact mechanism linking the two—and became perhaps the most vilified social scientist in history.

Thomas Robert Malthus, the namesake of such terms as "Malthusian collapse" and "Malthusian curse," was a mild-mannered mathematician, a clergyman—and, his critics would say, the ultimate glass-half-empty kind of guy. When a few Enlightenment philosophers, giddy from the success of the French Revolution, began predicting the continued unfettered improvement of the human condition, Malthus cut them off at the knees. Human population, he observed, increases at a geometric rate, doubling about

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Joel K. Bourne, Jr., is a contributing writer. John Stanmeyer's photographs on malaria for National Geographic *won a 2008 National Magazine Award.*

Continuing a 2,000-year-old tradition, women harvest rice by hand on the Banaue terraces in the Philippines. Even record harvests haven't been able to support the nation's 90 million people, forcing it to become the leading rice importer.

every 25 years if unchecked, while agricultural production increases arithmetically—much more slowly. Therein lay a biological trap that humanity could never escape.

"The power of population is indefinitely greater than the power in the earth to produce subsistence for man," he wrote in his *Essay on the Principle of Population* in 1798. "This implies a strong and constantly operating check on population from the difficulty of subsistence." Malthus thought such checks could be voluntary, such as birth control, abstinence, or delayed marriage—or involuntary, through the scourges of war, famine, and disease. He advocated against food relief for all but the poorest of people, since he felt such aid encouraged more children to be born into misery. That tough love earned him a nasty cameo in English literature from none other than Charles Dickens. When Ebenezer Scrooge is asked to give alms for the poor in *A Christmas Carol,* the heartless banker tells the do-gooders that the destitute should head for the workhouses or prisons. And if they'd rather die than go there, "they had better do it, and decrease the surplus population."

The industrial revolution and plowing up of the English commons dramatically increased the amount of food in England, sweeping Malthus into the dustbin of the Victorian era. But it was the green revolution that truly made the reverend the laughingstock of modern economists. From 1950 to today the world has experienced the largest population growth in human history. After Malthus's time, six billion people were added to the planet's dinner tables. Yet thanks to improved methods of grain production, most of those people were fed. We'd finally shed Malthusian limits for good.

Or so we thought.

ON THE 15TH NIGHT of the ninth month of the Chinese lunar calendar, 3,680 villagers, nearly all with the surname "He," sat beneath a leaking tarp in the square of Yaotian, China, and dived

into a 13-course meal. The event was a traditional banquet in honor of their elders. Tureens of steaming soup floated past, followed by rapidly dwindling platters of noodles, rice, fish, shrimp, steamed vegetables, dim sum, duck, chicken, lily root, pigeon, black fungus, and pork cooked more ways than I could count.

Even with the global recession, times are still relatively good in the southeastern province of Guangdong, where Yaotian sits tucked between postage-stamp garden plots and block after block of new factories that helped make the province one of the most prosperous in China. When times are good, the Chinese eat pigs. Lots of pigs. Per capita pork consumption in the world's most populous country went up 45 percent between 1993 and 2005, from 53 to 77 pounds a year.

An affable businessman in a pink-striped polo shirt, pork-industry consultant Shen Guangrong remembers his father raising one pig each year, which was slaughtered at the Chinese New Year. It would be their only meat for the year. The pigs Shen's father raised were pretty low maintenance—hardy black-and-white varieties that would eat almost anything: food scraps, roots, garbage. Not so China's modern pigs. After the deadly protests of Tiananmen Square in 1989, which topped off a year of political unrest exacerbated by high food prices, the government started offering tax incentives to large industrial farms to meet the growing demand. Shen was assigned to work at one of China's first pig CAFOs, or concentrated animal feeding operations, in nearby Shenzhen. Such farms, which have proliferated in recent years, depend on breeds that are fed high-tech mixtures of corn, soy meal, and supplements to keep them growing fast.

That's good news for the average pork-loving Chinese—who still eats only about 40 percent as much meat as consumers in the U.S. But it's worrisome for the world's grain supplies. It's no coincidence that as countries like China and India prosper and their people move up the food ladder, demand for grain has increased. For as tasty as that sweet-and-sour pork may be, eating meat is an incredibly inefficient way to feed oneself. It takes up to five times more grain to get the equivalent amount of calories from eating pork as from simply eating grain itself—ten times if we're talking about grain-fattened U.S. beef. As more grain has been diverted to livestock and to the production of biofuels for cars, annual worldwide consumption of grain has risen from 815 million metric tons in 1960 to 2.16 billion in 2008. Since 2005, the mad rush to biofuels alone has pushed grain-consumption growth from about 20 million tons annually to 50 million tons, according to Lester Brown of the Earth Policy Institute.

Even China, the second largest corn-growing nation on the planet, can't grow enough grain to feed all its pigs. Most of the shortfall is made up with imported soybeans from the U.S. or Brazil, one of the few countries with the potential to expand its cropland—often by plowing up rain forest. Increasing demand for food, feed, and biofuels has been a major driver of deforestation in the tropics. Between 1980 and 2000 more than half of new cropland acreage in the tropics was carved out of intact rain forests; Brazil alone increased its soybean acreage in Amazonia 10 percent a year from 1990 to 2005.

Some of those Brazilian soybeans may end up in the troughs of Guangzhou Lizhi Farms, the largest CAFO in Guangdong Province. Tucked into a green valley just off a four-lane highway that's still being built, some 60 white hog houses are scattered around large ponds, part of the waste-treatment system for 100,000 hogs. The city of Guangzhou is also building a brand-new meatpacking plant that will slaughter 5,000 head a day. By the time China has 1.5 billion people, sometime in the next 20 years, some experts predict they'll need another 200 million hogs just to keep up. And that's just China. World meat consumption is expected to double by 2050. That means we're going to need a whole lot more grain.

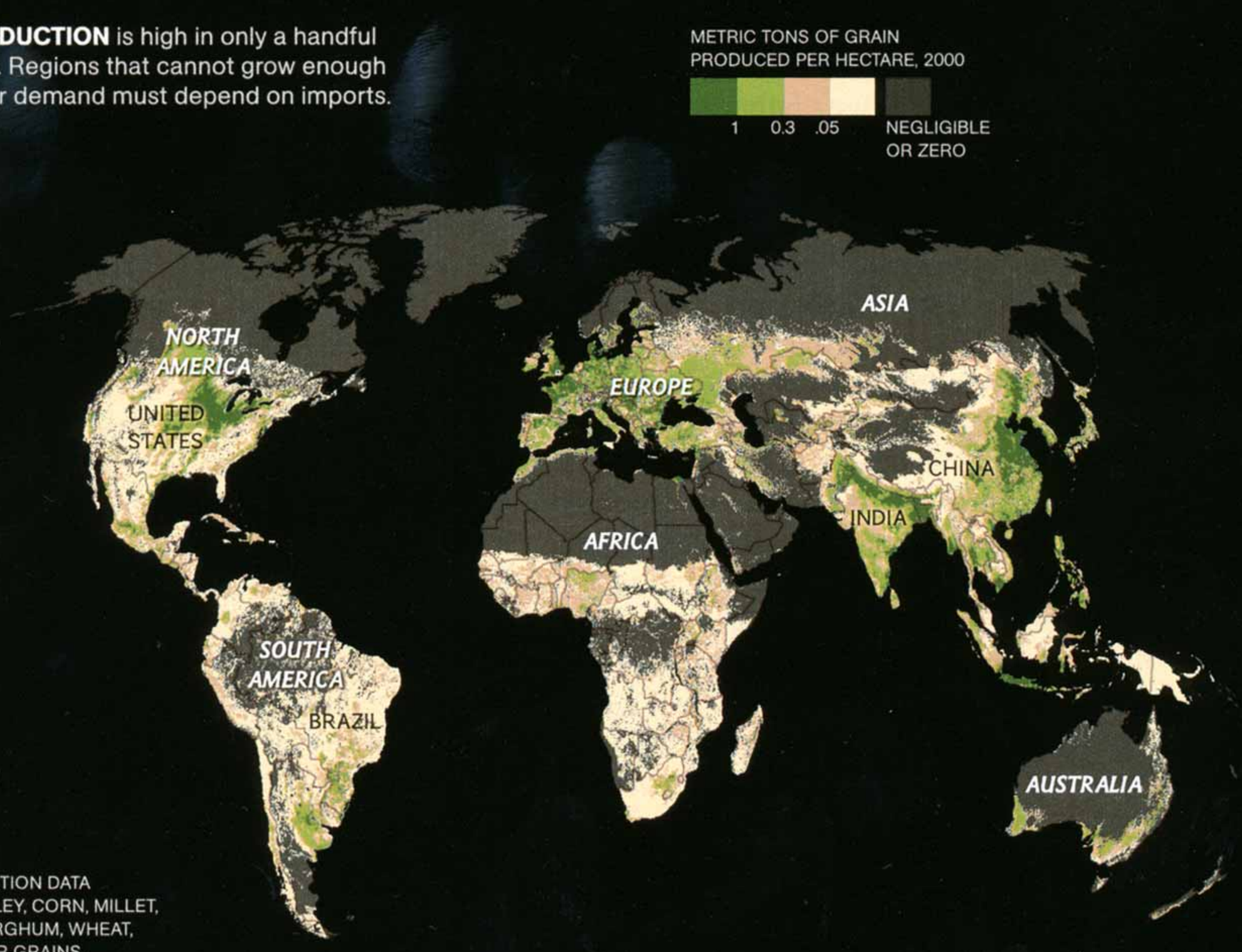
THIS ISN'T THE FIRST TIME the world has stood at the brink of a food crisis—it's only the most recent iteration. At 83, Gurcharan Singh Kalkat

IN AN ERA OF TIGHTENING FOOD SUPPLIES AND RISING PRICES, GLOBAL WARMING COULD PUSH THE PLANET BEYOND ITS LIMITS.

OUR FRAGILE FOOD WEB

The global food crisis didn't happen overnight. For the past decade, grain production has struggled to keep pace with consumption, causing stockpiles to dwindle. Clearly we need to grow more food, but there's limited new land to be brought under the plow. Increasing yields on existing farmland requires irrigation, yet new sources of fresh water can be as scarce as fertile land. In coming decades, climate change is predicted to cause crop losses in some of the poorest regions. The challenge today is not to deal with a short-term rise in grain prices, but to find ways to avoid a perpetual food crisis.

GRAIN PRODUCTION is high in only a handful of countries. Regions that cannot grow enough to meet their demand must depend on imports.



GRAIN PRODUCTION DATA INCLUDES BARLEY, CORN, MILLET, OATS, RICE, SORGHUM, WHEAT, RYE, AND MINOR GRAINS.

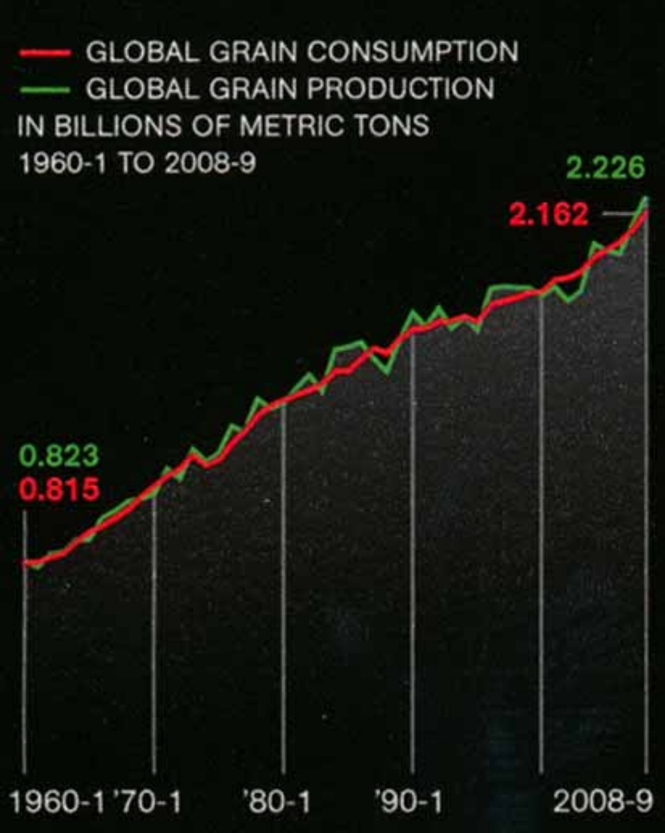
MAPS: VIRGINIA W. MASON, NG STAFF. SOURCES: PROGRAM ON FOOD SECURITY AND THE ENVIRONMENT, STANFORD UNIVERSITY; UN FOOD AND AGRICULTURE ORGANIZATION (FAO); CONSORTIUM FOR SCIENCE, POLICY & OUTCOMES, ARIZONA STATE UNIVERSITY; DEPARTMENT OF GEOGRAPHY, McGILL UNIVERSITY; INSTITUTE ON THE ENVIRONMENT, UNIVERSITY OF MINNESOTA

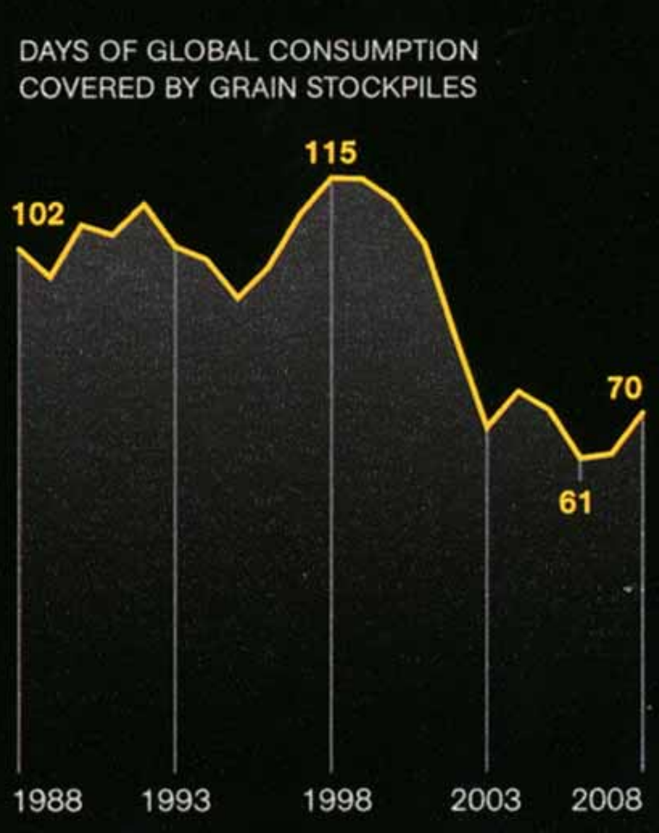
CHARTS: SEAN McNAUGHTON, NG STAFF. SOURCES: USDA "PRODUCTION, SUPPLY AND DISTRIBUTION ONLINE"; FAO; WORLD BANK

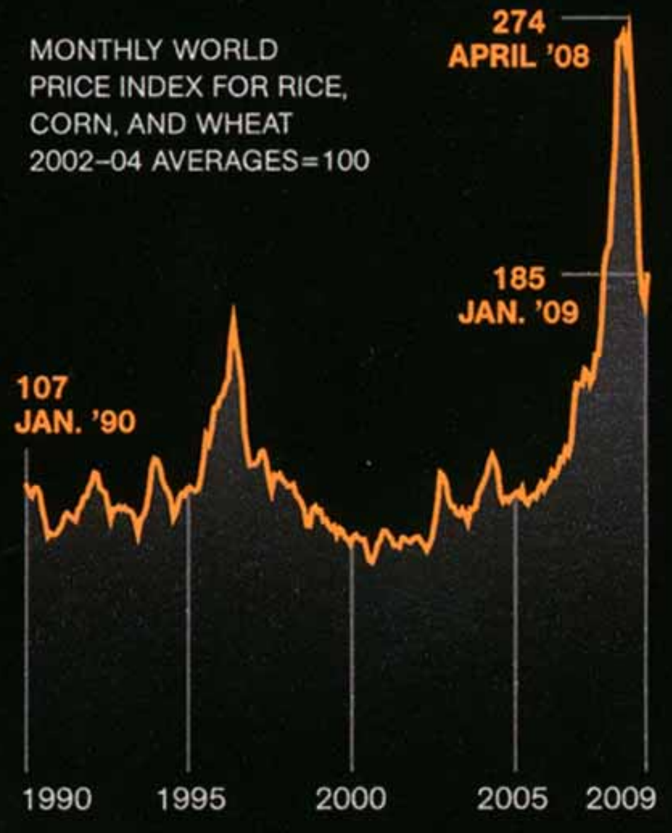
GRAIN PRODUCTION has easily kept up with demand—until recently. Global consumption has outstripped production in seven of the past nine years.

THE LOWEST STOCKPILES in decades mean there is less grain to buffer the impact of drought, floods, and crop failures, making prices more volatile.

GRAIN PRICES SPIKED last year, fueled by strong demand, speculation, high fuel costs, and fear of shortages. Prices dropped as the economy slowed, but remain high.







CLIMATE CHANGE could hit yields hard in the hungriest places, as shifts in temperature and precipitation cause sizable decreases in the crops most vital to food security.

WORST-CASE-SCENARIO PROJECTIONS FOR THE TOP-PRIORITY CROP IN EACH DATA REGION ARE SHOWN. DARK GRAY AREAS WERE NOT EVALUATED IN THIS STUDY.

PHILIPPINES Skilled fingers separate good seed from bad at the International Rice Research Institute in Los Baños. “Miracle rice” varieties developed here in the 1960s doubled yields in Asia. Further growth has

stalled since the mid-1990s, as investment in agriculture has declined. “Governments thought we’d won the war on food security,” says IRRI Director General Robert Zeigler. “So they put money elsewhere.”

has lived long enough to remember one of the worst famines of the 20th century. In 1943 as many as four million people died in the "Malthusian correction" known as the Bengal Famine. For the following two decades, India had to import millions of tons of grain to feed its people.

Then came the green revolution. In the mid-1960s, as India was struggling to feed its people during yet another crippling drought, an American plant breeder named Norman Borlaug was working with Indian researchers to bring his high-yielding wheat varieties to Punjab. The new seeds were a godsend, says Kalkat, who was deputy director of agriculture for Punjab at the time. By 1970, farmers had nearly tripled their production with the same amount of work. "We had a big problem with what to do with the surplus," says Kalkat. "We closed schools one month early to store the wheat crop in the buildings."

Borlaug was born in Iowa and saw his mission as spreading the high-yield farming methods that had turned the American Midwest into the world's breadbasket to impoverished places throughout the world. His new dwarf wheat varieties, with their short, stocky stems supporting full, fat seed heads, were a startling breakthrough. They could produce grain like no other wheat ever seen—as long as there was plenty of water and synthetic fertilizer and little competition from weeds or insects. To that end, the Indian government subsidized canals, fertilizer, and the drilling of tube wells for irrigation and gave farmers free electricity to pump the water. The new wheat varieties quickly spread throughout Asia, changing the traditional farming practices of millions of farmers, and were soon followed by new strains of "miracle" rice. The new crops matured faster and enabled farmers to grow two crops a year instead of one. Today a double crop of wheat, rice, or cotton is the norm in Punjab, which, with neighboring Haryana, recently supplied more than 90 percent of the wheat needed by grain-deficient states in India.

The green revolution Borlaug started had nothing to do with the eco-friendly green label in vogue today. With its use of synthetic fertilizers and pesticides to nurture vast fields of the same crop, a practice known as monoculture, this new method of industrial farming was the antithesis of today's organic trend. Rather, William S. Gaud, then administrator of the U.S. Agency for International Development, coined the phrase in 1968 to describe an alternative to Russia's red revolution, in which workers, soldiers, and hungry peasants had rebelled violently against the tsarist government. The more pacifying green revolution was such a staggering success that Borlaug won the Nobel Peace Prize in 1970.

Today, though, the miracle of the green revolution is over in Punjab: Yield growth has essentially flattened since the mid-1990s. Overirrigation has led to steep drops in the water table, now tapped by 1.3 million tube wells, while thousands of hectares of productive land have been lost to salinization and waterlogged soils. Forty years of intensive irrigation, fertilization, and pesticides have not been kind to the loamy gray fields of Punjab. Nor, in some cases, to the people themselves.

In the dusty farming village of Bhuttiwala, home to some 6,000 people in the Muktsar district, village elder Jagsir Singh, in flowing beard and cobalt turban, adds up the toll: "We've had 49 deaths due to cancer in the last four years," he says. "Most of them were young people. The water is not good. It's poisonous, contaminated water. Yet people still drink it."

Walking through the narrow dirt lanes past pyramids of dried cow dung, Singh introduces Amarjeet Kaur, a slender 40-year-old who for years drew the family's daily water from a hand pump in their brick-hard compound. She was diagnosed with breast cancer last year. Tej Kaur, 50, also has breast cancer. Her surgery, she says, wasn't nearly as painful as losing her seven-year-old grandson to "blood cancer," or leukemia. Jagdev Singh is a sweet-faced 14-year-old boy whose spine is slowly deteriorating. From his wheelchair, he is watching *SpongeBob SquarePants* dubbed in Hindi as his father discusses his prognosis. "The doctors say he will not live to see 20," says Bhola Singh.

Employees of a waterworks plant in Foshan, China, toast their good fortune at a 13-course banquet served to 3,000 people. Such feasts are a public testament to new wealth in Guangdong Province, once renowned for its long history of hardship.

There's no proof these cancers were caused by pesticides. But researchers have found pesticides in the Punjabi farmers' blood, their water table, their vegetables, even their wives' breast milk. So many people take the train from the Malwa region to the cancer hospital in Bikaner that it's now called the Cancer Express. The government is concerned enough to spend millions on reverse-osmosis water-treatment plants for the worst affected villages.

If that weren't worrisome enough, the high cost of fertilizers and pesticides has plunged many Punjabi farmers into debt. One study found more than 1,400 cases of farmer suicides in 93 villages between 1988 and 2006. Some groups put the total for the state as high as 40,000 to 60,000 suicides over that period. Many drank pesticides or hung themselves in their fields.

"The green revolution has brought us only downfall," says Jarnail Singh, a retired schoolteacher in Jajjal village. "It ruined our soil, our environment, our water table. Used to be we had fairs in villages where people would come together and have fun. Now we gather in medical centers. The government has sacrificed the people of Punjab for grain."

Others, of course, see it differently. Rattan Lal, a noted soil scientist at Ohio State who graduated from Punjab Agricultural University in 1963, believes it was the abuse—not the use—of green revolution technologies that caused most of the problems. That includes the overuse of fertilizers, pesticides, and irrigation and the removal of all crop residues from the fields, essentially strip-mining soil nutrients. "I realize the problems of water quality and water withdrawal," says Lal. "But it saved hundreds of millions of people. We paid a price in water, but the choice was to let people die."

In terms of production, the benefits of the green revolution are hard to deny. India hasn't experienced famine since Borlaug brought his seeds to town, while world grain production has more than doubled. Some scientists credit

Qi Nianhua, a Guanzhang noodlemaker, carefully separates *gua mian,* or hanging noodles, a staple in China's Henan Province that has become more expensive as wheat prices have climbed. The drought in China's wheat belt could drive costs even higher.

increased rice yields alone with the existence of 700 million more people on the planet.

Many crop scientists and farmers believe the solution to our current food crisis lies in a second green revolution, based largely on our newfound knowledge of the gene. Plant breeders now know the sequence of nearly all of the 50,000 or so genes in corn and soybean plants and are using that knowledge in ways that were unimaginable only four or five years ago, says Robert Fraley, chief technology officer for the agricultural giant Monsanto. Fraley is convinced that genetic modification, which allows breeders to bolster crops with beneficial traits from other species, will lead to new varieties with higher yields, reduced fertilizer needs, and drought tolerance—the holy grail for the past decade. He believes biotech will make it possible to double yields of Monsanto's core crops of corn, cotton, and soybeans by 2030. "We're now poised to see probably the greatest period of fundamental scientific advance in the history of agriculture."

AFRICA IS THE CONTINENT where *Homo sapiens* was born, and with its worn-out soils, fitful rain, and rising population, it could very well offer a glimpse of our species' future. For numerous reasons—lack of infrastructure, corruption, inaccessible markets—the green revolution never made it here. Agricultural production per capita actually declined in sub-Saharan Africa between 1970 and 2000, while the population soared, leaving an average ten-million-ton annual food deficit. It's now home to more than a quarter of the world's hungriest people.

Tiny, landlocked Malawi, dubbed the "warm heart of Africa" by a hopeful tourism industry, is also in the hungry heart of Africa, a poster child for the continent's agricultural ills. Living in one of the poorest and most densely populated countries in Africa, the majority of Malawians are corn farmers who eke out a living on less than two dollars a day. In 2005 the rains failed once again in Malawi, and more than a third of its population of 13 million required food aid to

survive. Malawi's President Bingu wa Mutharika declared he did not get elected to rule a nation of beggars. After initially failing to persuade the World Bank and other donors to help subsidize green revolution inputs, Bingu, as he's known here, decided to spend $58 million from the country's own coffers to get hybrid seeds and fertilizers into the hands of poor farmers. The World Bank eventually got on board and persuaded Bingu to target the subsidy to the poorest farmers. About 1.3 million farm families received coupons that allowed them to buy three kilograms of hybrid corn seed and two 50-kilogram bags of fertilizer at a third of the market price.

What happened next has been called the Malawi Miracle. Good seed and a little fertilizer—and the return of soil-soaking rains—helped farmers reap bumper crops for the next two years. (Last year's harvests, however, were slightly down.) The 2007 harvest was estimated to be 3.44 million metric tons, a national record. "They went from a 44 percent deficit to an 18 percent surplus, doubling their production," says Pedro Sanchez, the director of the Tropical Agriculture Program at Columbia University who advised the Malawi government on the program. "The next year they had a 53 percent surplus and exported maize to Zimbabwe. It was a dramatic change."

So dramatic, in fact, that it has led to an increasing awareness of the importance of agricultural investment in reducing poverty and hunger in places like Malawi. In October 2007 the World Bank issued a critical report, concluding that the agency, international donors, and African governments had fallen short in helping Africa's poor farmers and had neglected investment in agriculture for the previous 15 years. After decades of discouraging public investment in agriculture and calling for market-based solutions that rarely materialized, institutions like the World Bank have reversed course and pumped funds into agriculture over the past two years.

Malawi's subsidy program is part of a larger movement to bring the green revolution, at long last, to Africa. Since 2006 the Rockefeller Foundation and the Bill and Melinda Gates Foundation have ponied up nearly half a billion dollars to fund the Alliance for a Green Revolution in Africa, focused primarily on bringing plant-breeding programs to African universities and enough fertilizer to farmers' fields. Columbia's Sanchez, along with über-economist and poverty warrior Jeffrey Sachs, is providing concrete examples of the benefits of such investment in 80 small villages clustered into about a dozen "Millennium Villages" scattered in hunger hot spots throughout Africa. With the help of a few rock stars and A-list actors, Sanchez and Sachs are spending $300,000 a year on each small village. That's one-third as much per person as Malawi's per capita GDP, leading many in the development community to wonder if such a program can be sustained over the long haul.

Phelire Nkhoma, a small whipcord of a woman, is the agricultural extension officer for one of Malawi's two Millennium Villages—actually seven villages with a total of 35,000 people. She describes the program as we ride in a new UN pickup from her office in Zomba District through fire-blackened fields dotted with the violet flush of jacaranda trees. Villagers get hybrid seeds and fertilizers for free—as long as they donate three bags of corn at harvesttime to a school feeding program. They get bed nets and antimalarial drugs. They get a clinic staffed with health workers, a granary to store their harvests, and safe-drinking-water wells within a kilometer of each household. Good primary schools, improved road systems, and connection to the power grid and the Internet are on the way in these villages, and in the "Madonna" village, which is farther north.

"*The* Madonna?" I asked.

"Yes. I hear she's divorcing her latest husband. Is that true?"

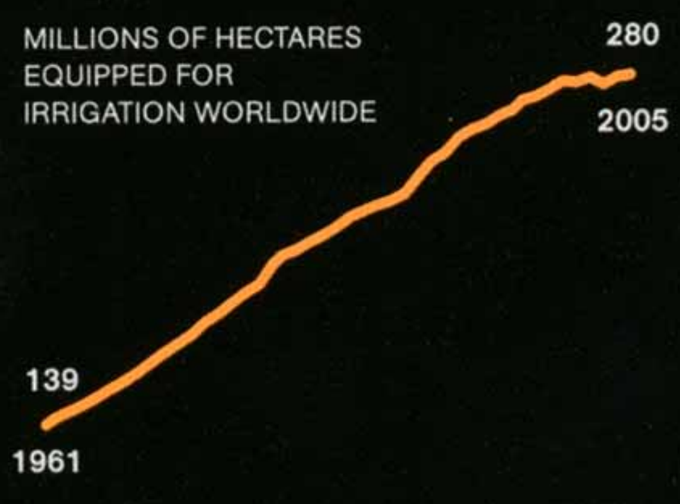
Good times are apparent in the Millennium Village, where Nkhoma shows me new brick houses topped with shiny corrugated-steel roofs, a grain bank full of seed and fertilizer, and beneath a shade tree, a hundred or more villagers patiently listening *(Continued on page 56)*

TO MEET RISING FOOD DEMAND, WE NEED ANOTHER GREEN REVOLUTION, AND WE NEED IT IN HALF THE TIME.

HOW WE DID IT BEFORE

Few agricultural achievements have been as profound as the green revolution, the farming system of irrigation, high-yield varieties, pesticides, and fertilizers that more than doubled yields in Asia during the 1960s and '70s, lowering prices of the staple crops that feed most of the world today. But these breakthroughs have come with ecological costs.

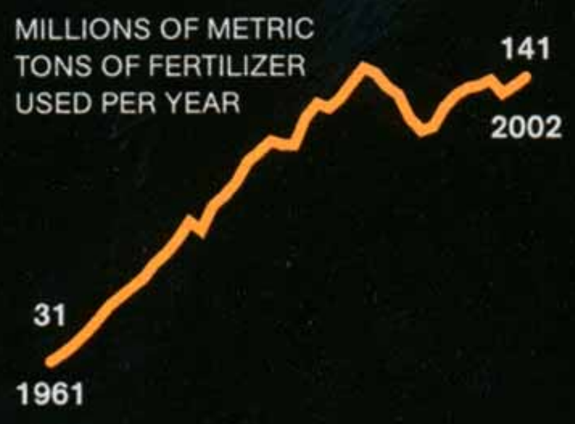
IRRIGATION can double yields compared with those in rain-fed fields. India subsidized more than a million tube wells, resulting in higher production but also aquifer depletion and salinized soils.



DWARF VARIETIES of wheat and rice allowed farmers to use large amounts of fertilizer and water to produce more grain without the plants getting top-heavy and falling over.

CHEMICAL PESTICIDES were needed because densely planted fields were more susceptible to insects and diseases. Overuse may result in 39 million poisonings a year.

SYNTHETIC FERTILIZERS helped the new varieties hit record yields. But they require huge amounts of fossil fuels to produce and apply, so their cost skyrockets with the price of oil. Nitrogen fertilizers also pollute aquifers and streams.



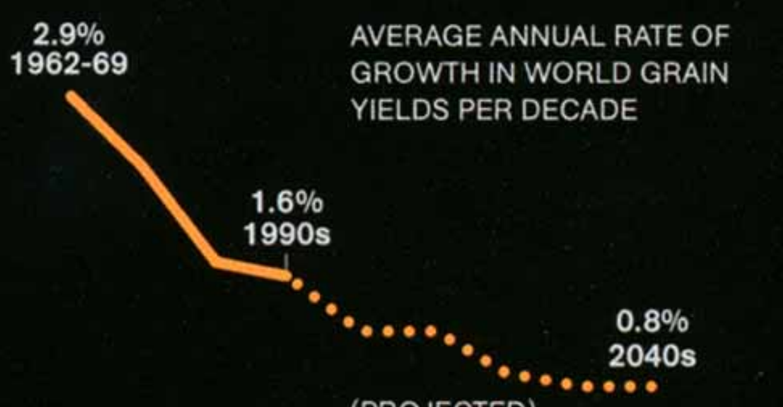
THIS TIME: A GREENER REVOLUTION?

Last year a United Nations panel concluded that "the way the world grows its food will have to change radically…to cope with growing population and climate change." With growth in grain yield flattening and demand on the rise, some experts see genetic engineering as our best hope to produce more food and have a smaller ecological impact. Others believe we can boost productivity with sustainable methods like organic farming and smarter irrigation.

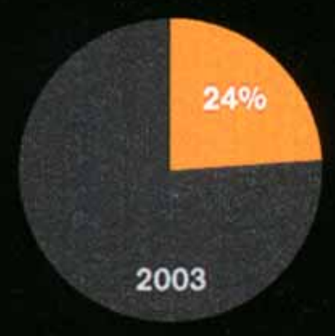
TARGETED BREEDING—with both traditionally bred plants and genetically modified crops—could help reverse the decline in yield growth by increasing drought tolerance, nitrogen efficiency, pest resistance, and photosynthesis rates.

SUSTAINABLE FARMING methods such as composting, agroforestry, and interplanting with legumes have been shown to improve degraded soils, increase yields, and reduce reliance on synthetic fertilizers and pesticides. Raising fertility on existing cropland is key, since there's little left to put into production without destroying vital rain forests and wetlands.

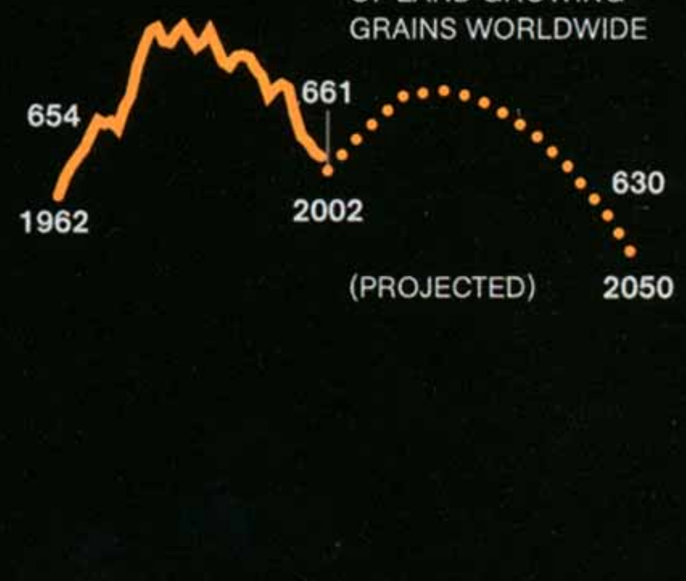
SMARTER IRRIGATION could increase yields on the 80 percent of cropland that is currently not irrigated, with water-saving techniques such as soil-moisture monitoring and drip irrigation. Mulching and cover crops are good, lower cost solutions.



AVERAGE ANNUAL RATE OF GROWTH IN WORLD GRAIN YIELDS PER DECADE



PERCENTAGE OF THE WORLD'S LAND AREA WITH LONG-TERM DECLINE IN PRODUCTIVITY



MILLIONS OF HECTARES OF LAND GROWING GRAINS WORLDWIDE

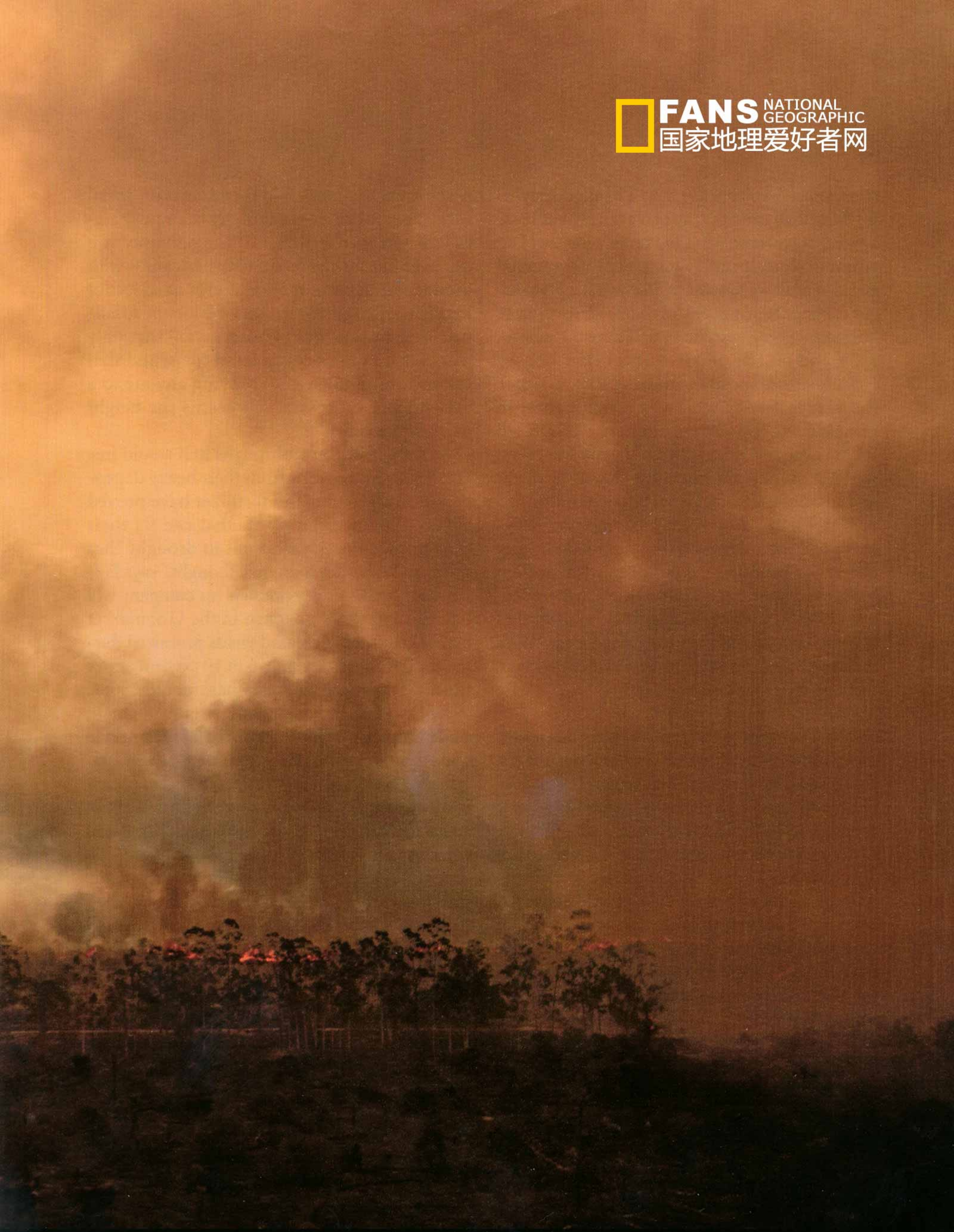
SEAN McNAUGHTON, NG STAFF. ART BY CHARLES GRIAK

SOURCES: FAO; INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE (YIELD PROJECTIONS AND LAND AREA); INTERNATIONAL SERVICE FOR THE ACQUISITION OF AGRI-BIOTECH APPLICATIONS; Z. G. BAI AND OTHERS, "GLOBAL ASSESSMENT OF LAND DEGRADATION AND IMPROVEMENT," ISRIC–WORLD SOIL INFORMATION, NOVEMBER 2008

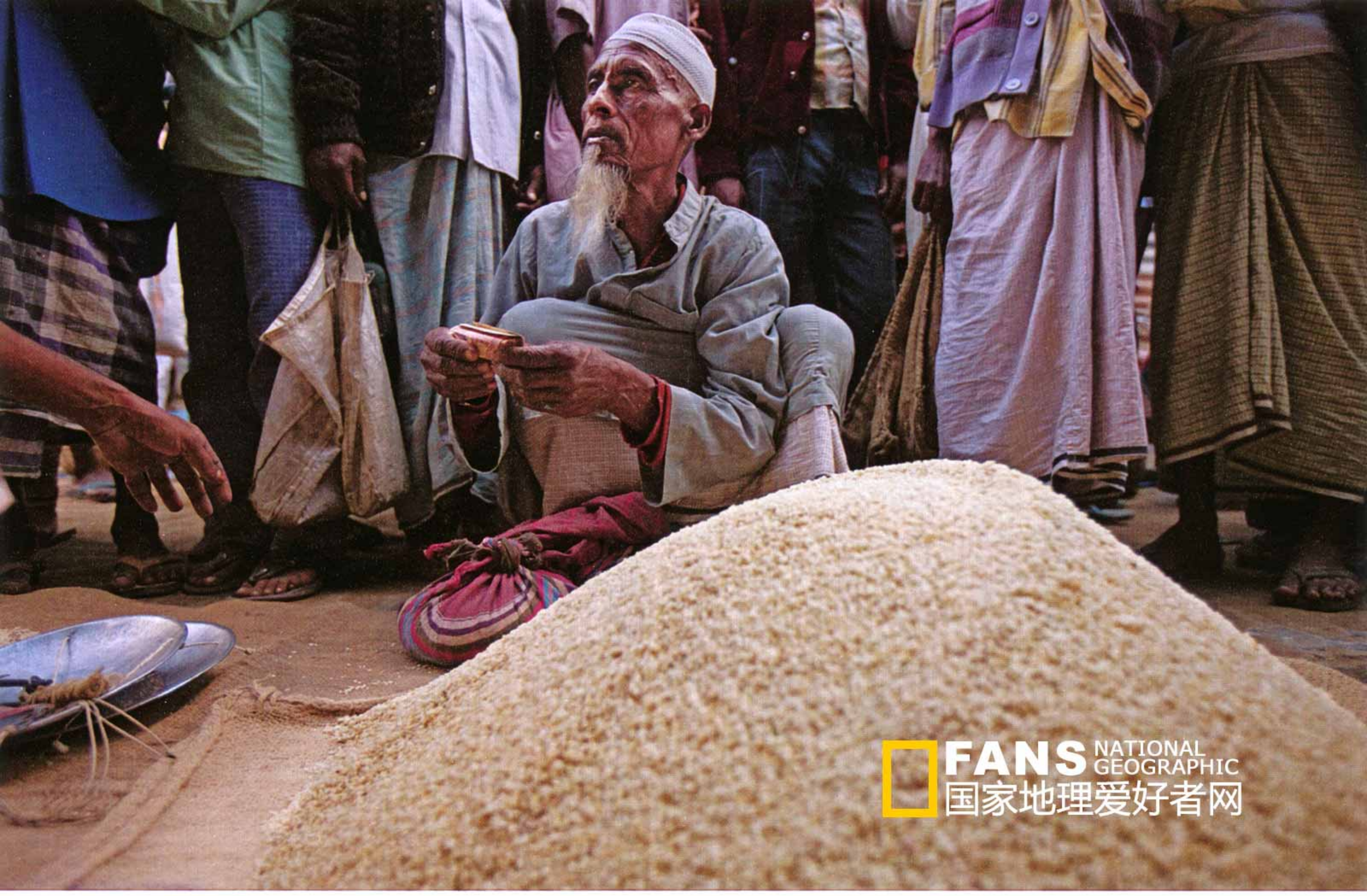
INDIA A hidden cost of the green revolution is evident in the plight of Gurjiwan Singh: Doctors say his birth defects are the result of pesticide poisoning. Supported by U.S. foundations in the mid-1960s,

the use of high-yielding seeds, intensive irrigation, fertilizers, and pesticides turned Singh's Punjab homeland into India's breadbasket, but left depleted, poisoned aquifers in its wake.

BRAZIL Set ablaze by farmers, trees go up in flames in Mato Grosso state, where the rate of rain forest conversion to farmland has marched in lockstep with the price of soybeans since 2000. More than nine



million acres of forest were damaged or destroyed last year. Turning forest into fields has increased food production throughout history, but doing so can take a heavy toll on the environment.



One of the world's billion people who survive on less than a dollar a day, Mahabbat Ali Sheikh buys rice for his family at the Shaghata bazaar, in northern Bangladesh. The food crisis has pushed 75 million more into poverty, a place where food is never cheap.

many of the same results as the Millennium Villages project, at a fraction of the cost. There are no hybrid corn seeds, free fertilizers, or new roads here in the village of Ekwendeni. Instead the Soils, Food and Healthy Communities (SFHC) project distributes legume seeds, recipes, and technical advice for growing nutritious crops like peanuts, pigeon peas, and soybeans, which enrich the soil by fixing nitrogen while also enriching children's diets. The program began in 2000 at Ekwendeni Hospital, where the staff was seeing high rates of malnutrition. Research suggested the culprit was the corn monoculture that had left small farmers with poor yields due to depleted soils and the high price of fertilizer.

The project's old pickup needs a push to get it going, but soon Boyd Zimba, the project's assistant coordinator, and Zacharia Nkhonya, its food-security supervisor, are rattling down the road, talking about what they see as the downside of the Malawi Miracle. "First, the fertilizer subsidy cannot last long," says Nkhonya, a compact man with a quick smile. "Second, it doesn't go to everyone. And third, it only comes once a year, while legumes are long-term—soils get improved every year, unlike with fertilizers."

At the small village of Encongolweni, a group of two dozen SFHC farmers greet us with a song about the dishes they make from soybeans and pigeon peas. We sit in their meetinghouse as if at an old-time tent revival, as they testify about how planting legumes has changed their lives. Ackim Mhone's story is typical. By incorporating legumes into his rotation, he's doubled his corn yield on his small plot of land while cutting his fertilizer use in half. "That was enough to change the life of my family," Mhone says, and to enable him to improve his house and buy livestock. Later, Alice Sumphi, a 67-year-old farmer with a mischievous smile, dances in her plot of young knee-high tomatoes, proudly pointing out that they bested those of the younger men. Canadian researchers found that

(Continued from page 49) to a banker explaining how they can apply for an agricultural loan. Several are queued up at the teller window of an armored truck from Opportunity International Bank of Malawi. Cosmas Chimwara, a 30-year-old cabbage seller, is one of them. "The cabbage business is going well," he says. "I have three bikes, a TV and mobile phone, and a better house."

Such stories warm the heart of Faison Tipoti, the village leader who was instrumental in bringing the famous project here. "When Jeff Sachs came and asked, 'What do you want?' we said not money, not flour, but give us fertilizer and hybrid seed, and he will do a good thing," says Tipoti in a deep voice. No longer do villagers spend their days walking the road begging others for food to feed children with swollen bellies and sickness. He gazes over to where several children are frolicking as they wash clothes and gather water at the new village well. "With the coming of the project, everywhere is clear, fresh water," Tipoti says.

BUT IS A REPRISE of the green revolution—with the traditional package of synthetic fertilizers, pesticides, and irrigation, supercharged by genetically engineered seeds—really the answer to the world's food crisis? Last year a massive study called the "International Assessment of Agricultural Knowledge, Science and Technology for Development" concluded that the immense production increases brought about by science and technology in the past 30 years have failed to improve food access for many of the world's poor. The six-year study, initiated by the World Bank and the UN's Food and Agriculture Organization and involving some 400 agricultural experts from around the globe, called for a paradigm shift in agriculture toward more sustainable and ecologically friendly practices that would benefit the world's 900 million small farmers, not just agribusiness.

The green revolution's legacy of tainted soil and depleted aquifers is one reason to look for new strategies. So is what author and University of California, Berkeley, professor Michael Pollan calls the Achilles heel of current green revolution methods: a dependence on fossil fuels. Natural gas, for example, is a raw material for nitrogen fertilizers. "The only way you can have one farmer feed 140 Americans is with monocultures. And monocultures need lots of fossil-fuel-based fertilizers and lots of fossil-fuel-based pesticides," Pollan says. "That only works in an era of cheap fossil fuels, and that era is coming to an end. Moving anyone to a dependence on fossil fuels seems the height of irresponsibility."

So far, genetic breakthroughs that would free green revolution crops from their heavy dependence on irrigation and fertilizer have proved elusive. Engineering plants that can fix their own nitrogen or are resistant to drought "has proven a lot harder than they thought," says Pollan. Monsanto's Fraley predicts his company will have drought-tolerant corn in the U.S. market by 2012. But the increased yields promised during drought years are only 6 to 10 percent above those of standard drought-hammered crops.

And so a shift has already begun to small, underfunded projects scattered across Africa and Asia. Some call it agroecology, others sustainable agriculture, but the underlying idea is revolutionary: that we must stop focusing on simply maximizing grain yields at any cost and consider the environmental and social impacts of food production. Vandana Shiva is a nuclear physicist turned agroecologist who is India's harshest critic of the green revolution. "I call it monocultures of the mind," she says. "They just look at yields of wheat and rice, but overall the food basket is going down. There were 250 kinds of crops in Punjab before the green revolution." Shiva argues that small-scale, biologically diverse farms can produce more food with fewer petroleum-based inputs. Her research has shown that using compost instead of natural-gas-derived fertilizer increases organic matter in the soil, sequestering carbon and holding moisture—two key advantages for farmers facing climate change. "If you are talking about solving the food crisis, these are the methods you need," adds Shiva.

In northern Malawi one project is getting

after eight years, the children of more than 7,000 families involved in the project showed significant weight increases, making a pretty good case that soil health and community health are connected in Malawi.

Which is why the project's research coordinator, Rachel Bezner Kerr, is alarmed that big-money foundations are pushing for a new green revolution in Africa. "I find it deeply disturbing," she says. "It's getting farmers to rely on expensive inputs produced from afar that are making money for big companies rather than on agroecological methods for using local resources and skills. I don't think that's the solution."

Regardless of which model prevails—agriculture as a diverse ecological art, as a high-tech industry, or some combination of the two—the challenge of putting enough food in nine billion mouths by 2050 is daunting. Two billion people already live in the driest parts of the globe, and climate change is projected to slash yields in these regions even further. No matter how great their yield potential, plants still need water to grow. And in the not too distant future, every year could be a drought year for much of the globe.

New climate studies show that extreme heat waves, such as the one that withered crops and killed thousands in western Europe in 2003, are very likely to become common in the tropics and subtropics by century's end. Himalayan glaciers that now provide water for hundreds of millions of people, livestock, and farmland in China and India are melting faster and could vanish completely by 2035. In the worst-case scenario, yields for some grains could decline by 10 to 15 percent in South Asia by 2030. Projections for southern Africa are even more dire. In a region already racked by water scarcity and food insecurity, the all-important corn harvest could drop by 30 percent—47 percent in the worst-case scenario. All the while the population clock keeps ticking, with a net of

Empty cubbyholes in a wall of rice bowls at a Chinese electronics factory signal the layoffs that have sent many workers back to the countryside. While food prices have dipped with the worldwide recession, experts say the food crisis is far from over.

2.5 more mouths to feed born every second. That amounts to 4,500 more mouths in the time it takes you to read this article.

Which leads us, inevitably, back to Malthus.

ON A BRISK FALL DAY that has put color into the cheeks of the most die-hard Londoners, I visit the British Library and check out the first edition of the book that still generates such heated debate. Malthus's *Essay on the Principle of Population* looks like an eighth-grade science primer. From its strong, clear prose comes the voice of a humble parish priest who hoped, as much as anything, to be proved wrong.

"People who say Malthus is wrong usually haven't read him," says Tim Dyson, a professor of population studies at the London School of Economics. "He was not taking a view any different than what Adam Smith took in the first volume of *The Wealth of Nations*. No one in their right mind doubts the idea that populations have to live within their resource base. And that the capacity of society to increase resources from that base is ultimately limited."

Though his essays emphasized "positive checks" on population from famine, disease, and war, his "preventative checks" may have been more important. A growing workforce, Malthus explained, depresses wages, which tends to make people delay marriage until they can better support a family. Delaying marriage reduces fertility rates, creating an equally powerful check on populations. It has now been shown that this is the basic mechanism that regulated population growth in western Europe for some 300 years before the industrial revolution—a pretty good record for *any* social scientist, says Dyson.

Yet when Britain recently issued a new 20-pound note, it put Adam Smith on the back, not T. R. Malthus. He doesn't fit the ethos of the moment. We don't want to think about limits. But as we approach nine billion people on the planet, all clamoring for the same opportunities, the same lifestyles, the same hamburgers, we ignore them at our risk.

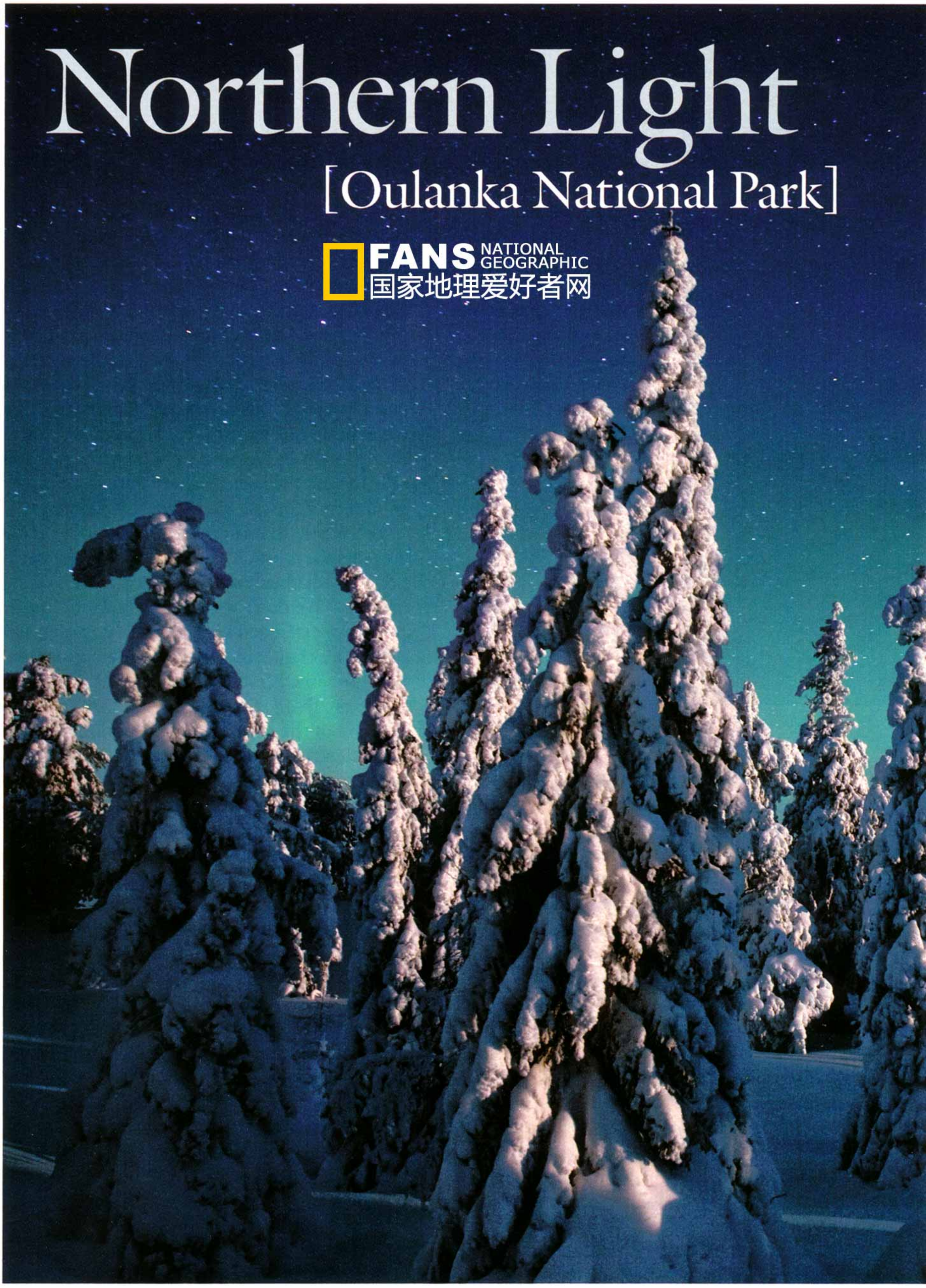
None of the great classical economists saw the industrial revolution coming, or the transformation of economies and agriculture that it would bring about. The cheap, readily available energy contained in coal—and later in other fossil fuels—unleashed the greatest increase in food, personal wealth, and people the world has ever seen, enabling Earth's population to increase sevenfold since Malthus's day. And yet hunger, famine, and malnutrition are with us still, just as Malthus said they would be.

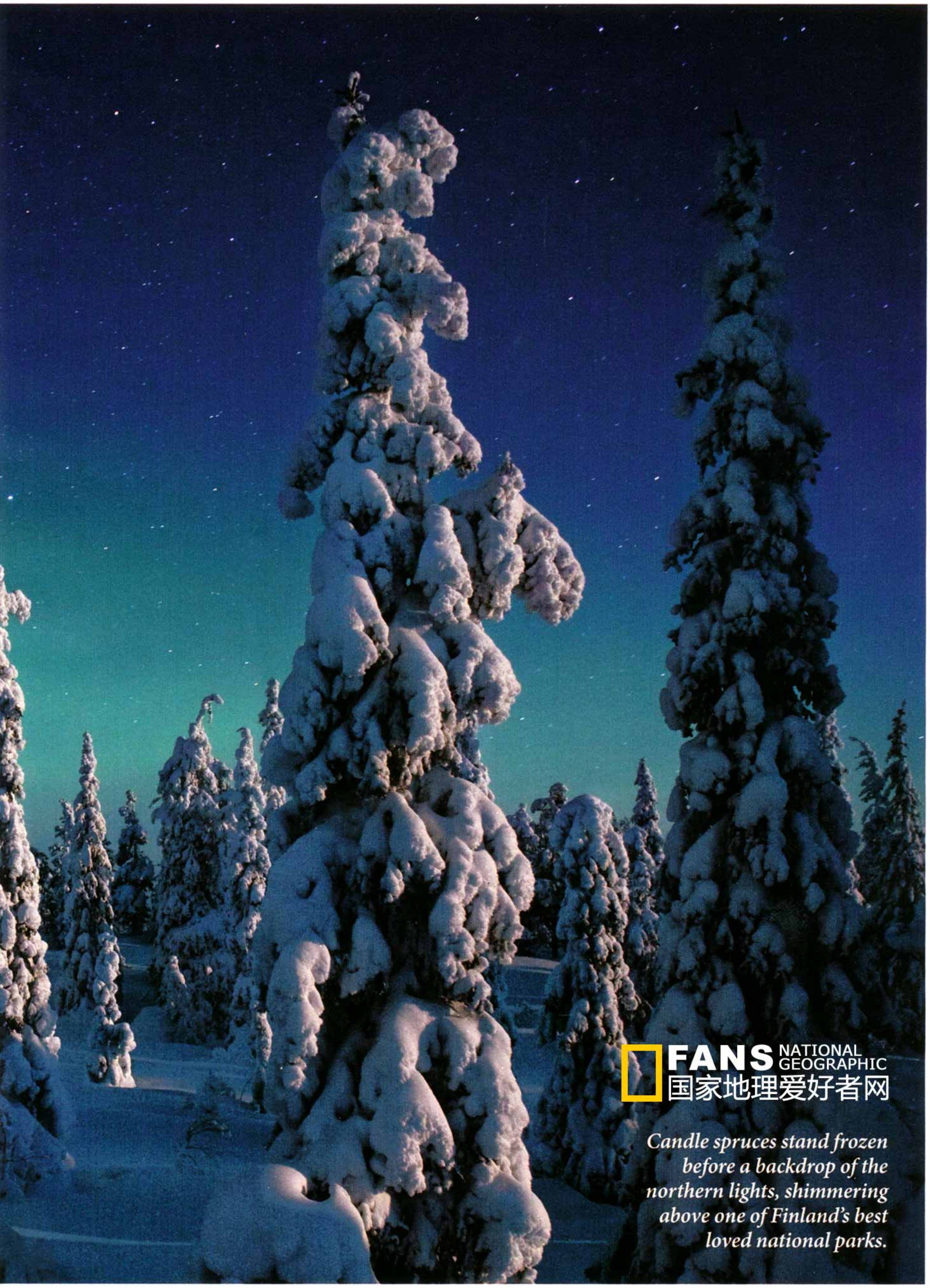
"Years ago I was working with a Chinese demographer," Dyson says. "One day he pointed out to me the two Chinese characters above his office door that spelled the word 'population.' You had the character for a person and the character for an open mouth. It really struck me. Ultimately there has to be a balance between population and resources. And this notion that we can continue to grow forever, well it's ridiculous."

Perhaps somewhere deep in his crypt in Bath Abbey, Malthus is quietly wagging a bony finger and saying, "Told you so." □

Northern Light

[Oulanka National Park]





Candle spruces stand frozen before a backdrop of the northern lights, shimmering above one of Finland's best loved national parks.

Rising with the morning mist, a whooper swan tries its wings along the shallows of the Oulanka River. The park is a nesting ground for more than a hundred bird species.

BY VERLYN KLINKENBORG

PHOTOGRAPHS BY PETER ESSICK

The next time I visit Oulanka National Park in the far north of Finland, I want to be two feet tall. That way the autumn mushrooms will come up to my knees, and I'll find myself walking in a waist-high forest of heather and lingonberries and crowberries and lichens. At that height, too, the wood-ant nests will tower over me. I will have to keep a sharp lookout for moose and reindeer, it's true.

Not that there's anything wrong with Oulanka at my normal height. Young Scotch pines grow on the slopes like closely spaced lances, and the old ones tower overhead, outgrowing the red of their bark as they age. The long winters and deep snows have trimmed the candle spruces into the slenderest of columns. In summer and fall the quiet northern light flickers on the leaves and the bark of silver and downy birches. This is the boreal forest, the forest that covers nearly all of Finland.

Here in Oulanka there is an uncharacteristic richness underfoot, a striking biodiversity, especially for a landscape that lies just a few miles south of the Arctic Circle. The main reason is limestone, an extrusion of youngish dolomitic rock—composed largely of carbonates—overlying the older granites and gneisses that make up the bedrock in so much of the rest of Scandinavia. The carbonate helps neutralize what would otherwise be acidic soils, and it adds critical nutrients. "Without the limestone," says Pirkko Siikamäki, head of the University of Oulu's Oulanka Research Station, at the heart of the park, "Oulanka would be just like the rest of Finland."

Instead, Oulanka is unlike almost anything else in the Finnish landscape, a place where a surprising number of biological zones converge. Because of its topographical diversity—high fells and low river valleys, mires, bogs, and

A Siberian jay, perched on a skeletal spruce, surveys a feast of blueberries. Underlaid by limestone, the forest floor is unusually rich for Finland's far north, abounding with berries, mushrooms, lichens, and rare orchids.

alluvial grasslands—it is a kind of crossroads for species that normally do not overlap. Here is one of the few places where European, Arctic, and even Siberian species come together, mingling at the very edge of their ranges.

I came to Oulanka, as so many visitors do, to witness the grandeur of its glacial landforms—especially the canyons carved by the Oulanka River, which flows eastward through the park toward the border of Russia, just a few miles away. But the farther I hiked along the park's popular footpath, the Karhunkierros (Bear's Ring) Trail, the less I found myself noticing the major features of this landscape: the kettle holes—basins created by melting boulders of ice left behind by glaciers—or the gaping crevices worn away by the Oulanka River, or even the canopy of pine and spruce boughs overhead. Instead, I found myself lost in contemplation of the forest floor.

The word "floor" does not capture the intricacy, the complexity of this terrain. The word is too two-dimensional, too dismissive. This is not the flat, dry mat of needles you often find in the conifer forests of the American West. The needles you do see on the surface here—thrust aside by upspringing mushrooms or caught up in the leaves of a lingonberry—are like a roof of thatch on an interconnected, underground city. This is a place where the years can be measured in voles, especially the bank vole and field vole, which bore through the mass of low-lying plants at ground level. Some years vole numbers boom, thanks to abundant food and few disease outbreaks. A good vole year—plenty of voles everywhere—is good for just about every meat-eating member of the food chain: foxes, stoats, weasels, owls and other birds of prey. A bad vole year—and the past few years have been disappointing—is a bad year for predators in general.

In a sense, the forest in Oulanka is not made up of trees. The trees are woven together into a forest by the biotic community at their roots, by the stunning variety of beetles, plants, lichens, and mushrooms. These species are all sheltered by the canopy of branches above them, and in turn they help break down and circulate nutrients in the soil.

Above all, the forest is woven together by wood ants. One afternoon, near the *aapa* mires—the wet peatlands—on the sandy northern edge of the park, I sat and watched an ant colony at work. Its mound, some three feet tall, looked like the great shoulder hump of a brown bear with pine needle fur. The mound swarmed with small red ants making their way in and out of several entrances. The movement was so constant, so determined, that the entire mound seemed to be shifting in and out of focus before my eyes.

And yet this was just the superficial activity of these ants. In fact, their trails lead all over the forest: underground, aboveground, up the trunks of the trees, and out onto the highest branches. The ants recycle everything around them, including dead insects. They farm aphids for their honeydew. Wherever there are wood ants there are also richer populations of earthworms and richer nutrients in the soil. Brown bears tear the nests apart, foraging for grubs, and they have been known to hibernate in the soft earth inside the mounds.

In themselves, the ant colonies—some of which may be as old as Oulanka's mature trees—constitute large-scale organisms that suppress the presence of other insects. If all the biomass in an ant colony were concentrated into a single individual capable of wandering over the landscape and showing its true biological proportions, it would tower over even the biggest bear. In short, wood ants play a vital role in regulating the economy of the forest in Oulanka. They are its keystone species.

National parks preserve more than the life and scenery within them. They also preserve the cultural assumptions of the nations that create them. Like the rest of Finland's parks, Oulanka helps preserve an intense cultural bond with the forest, part of the annual, and deeply beloved, Finnish retreat to the countryside in summer and fall.

Throughout Oulanka—in its campgrounds, on its swinging bridges and well-groomed trails—I met hikers carrying bags of edible mushrooms they had gathered along the way. In an American national park such as Yellowstone

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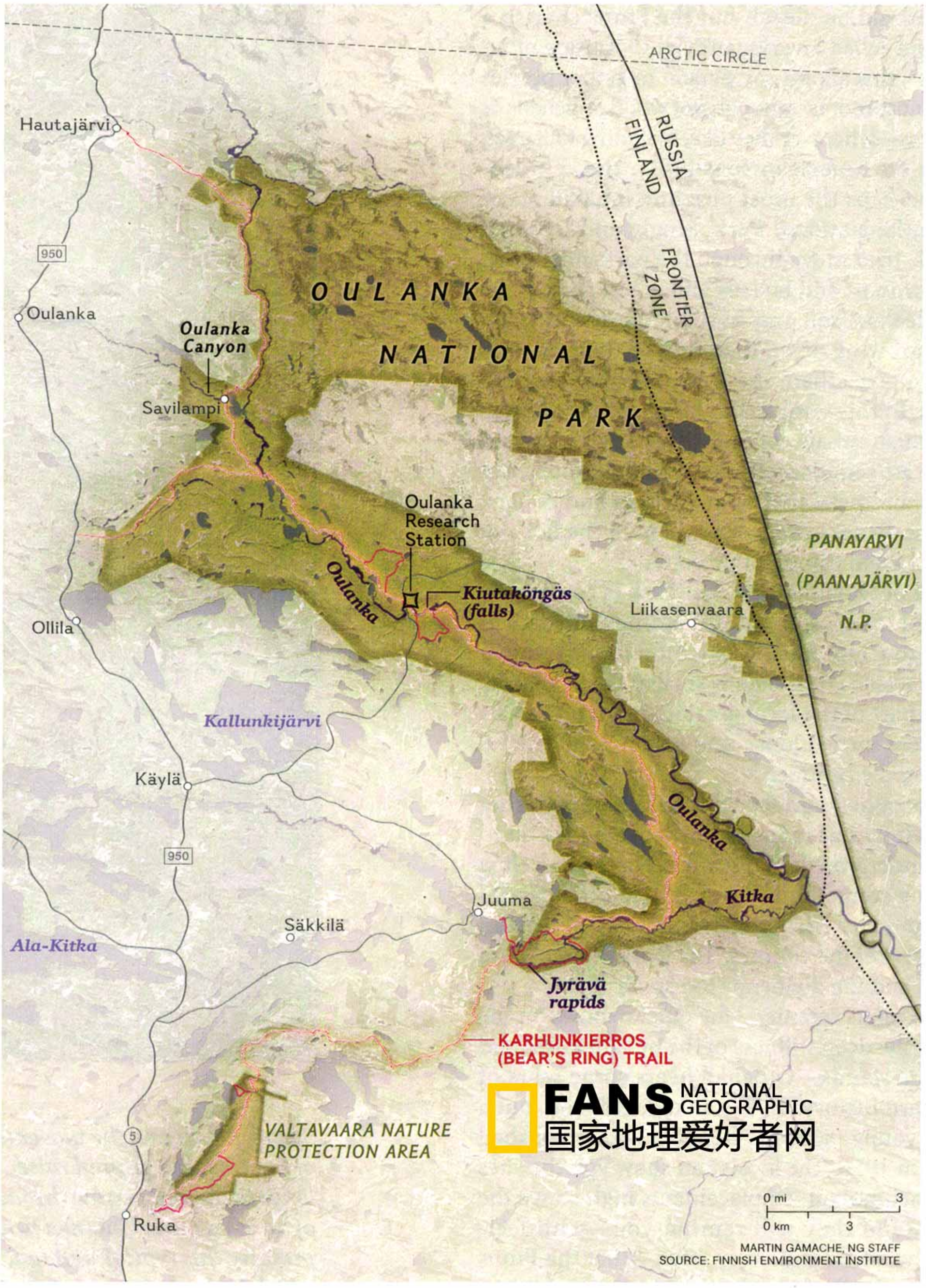
Verlyn Klinkenborg's most recent book is Timothy, or Notes of an Abject Reptile. *Photographer Peter Essick covered Canada's oil sands for the March issue.*



BOREAL BORDERLAND *Meeting Russia's Paanajärvi National Park along a political boundary, Oulanka also occupies an ecological crossroads. Plants and animals of forest and tundra converge here, as do birders and other nature enthusiasts. The 50-mile-long Karhunkierros (Bear's Ring) Trail is Finland's most popular footpath.*

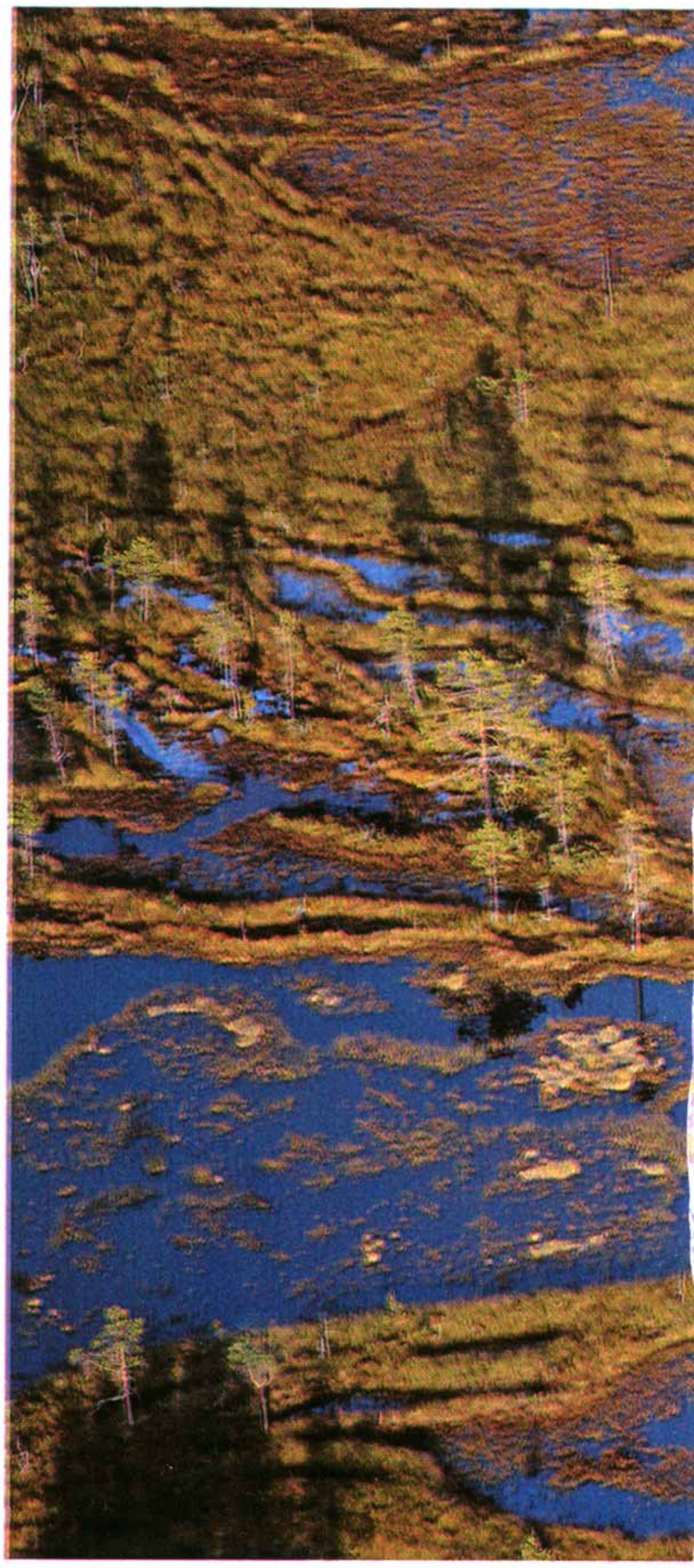
this would be illegal. But the Finns cherish a custom called "everyman's right." Among other things, this allows any person to gather berries and mushrooms—though not wood or lichens or mosses—wherever they like, including Oulanka.

To an American sensibility, the reindeer are perhaps the most puzzling inhabitants of Oulanka National Park. Singly and in small herds, they move through the park grazing on mushrooms and lichens and green plants. The reindeer are soft gray in color, often with white hair growing down their legs to their hooves, which gives them the appearance of wearing spats. In this setting they look entirely natural, a Finnish version of mule deer or elk. And yet these are semidomesticated reindeer, sources of meat and pelts that wear ear tags and collars, whose owners will gather them in the fall and corral them through the winter.

All of Oulanka National Park is considered part of the local reindeer herding range. It's as though Colorado's Rocky Mountain National Park, which is just slightly smaller than Oulanka, were part of the local grazing district, and cattle were turned loose into its alpine meadows during the summer.

Corralling and feeding the reindeer during the winter has reduced the damage they do to the undergrowth in Oulanka. There is a feeling among some Finns, however, that the days of the reindeer herder are numbered, at least in this part of the country. The work is simply too hard, and the dividends too small.

For all its serenity—the quiet oxbows on the river, the deep stillness of the upland mires and spruce stands—Oulanka bears some scars of modern history. This is an old, old land, but a very young park, for Oulanka was established only in 1956. The locals can show you the sites of machine-gun emplacements high above the river, and they will remind you—with feeling that still seems very fresh—that the Finns fought the Russians bitterly in the early days of World War II. If you drive to the boundary zone, a metal gate blocks the road. But it does not block the geology or the biological communities that make Oulanka so rich. They continue



Spring floods and the movement of frost-heaved ground raise long ridges that furrow the face of an* aapa *mire. Oulanka helps preserve this type of wetland, which is slowly being destroyed elsewhere in Scandinavia.

across the border into what was once Finnish territory but is now a Russian national park called Paanajärvi.

Kari Lahti, the director of Oulanka National Park, talks to his Russian counterpart in Paanajärvi almost every week. Together they are trying to find a way to make the two parks one, from the visitor's perspective at least. Perhaps someday it will be possible to step into a canoe, slip away from the sandy banks of the Oulanka River, and drift into Russia, uninterrupted by anything more than a family of goosanders taking flight.

But you might not want to. Once you've seen a wood-ant nest, or the autumnal uprising of mushrooms, or the ground white with reindeer lichens, you may find yourself wandering among them in your mind, two feet tall in a realm where voles are the size of sheep and an acre of Oulanka is a whole world. □

Rising from a thick carpet of blueberry shrubs, spruce trees bask in the brief warmth of summer. The late June sun never fully sets. This 11-frame panorama, shot over two and a half hours, captures light that lingers even in the middle of the night.


FANS NATIONAL GEOGRAPHIC
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Strewn with rapids and waterfalls, the Kitka River twists through the landscape in a rush (above) before joining the broader, more serene Oulanka flowing to the White Sea. In icy twilight (right) the Kitka traces an eddy above Jyrävä rapids.

Mirroring the warm light of sunrise, a still pool (above) offers counterpoint to the ceaseless turmoil of water and rock that carved Oulanka's canyons. At Kiutaköngäs falls (right), where the Oulanka River tumbles through a gorge, the Big Dipper hangs low, ladling the darkness of a September sky.

LEBANON *Christian foot soldiers in east Beirut, ground zero in Lebanon's armed conflict, deploy religious symbols as a warning to neighboring Shiite militias.*

THE FORGOTTEN FAITHFUL

ARAB CHRISTIANS

FOLLOWERS OF JESUS FOR NEARLY 2,000 YEARS, NATIVE CHRISTIANS TODAY ARE DISAPPEARING FROM THE LAND WHERE THEIR FAITH WAS BORN.

JERUSALEM *Bearing the burden of the cross, Arab Christian residents join throngs of foreigners on Good Friday, tracing Jesus' route through the Old City. Once the majority, Arab Christians today are outnumbered and often overlooked.*

SYRIA *In the desert north of Damascus, the monastery of Deir Mar Musa dates from the sixth century, when hundreds of churches and monasteries dotted the region. Today its monks say they are "witnesses for peace," fostering Muslim-Christian dialogue.*

BY DON BELT

PHOTOGRAPHS BY ED KASHI

EASTER IN JERUSALEM is not for the faint of heart. The Old City, livid and chaotic in the calmest of times, seems to come completely unhinged in the days leading up to the holiday. By the tens of thousands, Christians from all over the world pour in like a conquering horde, surging down the Via Dolorosa's narrow streets and ancient alleyways, seeking communion in the cold stones or some glimmer, perhaps, of the agonies Jesus endured in his final hours. Every face on Earth seems to float through the streets during Easter, every possible combination of eye and hair and skin color, every costume and style of dress, from blue-black African Christians in eye-popping dashikis to pale Finnish Christians dressed as Jesus with a bloody crown of thorns to American Christians in sneakers and "I [heart] Israel" caps, clearly stoked for the battle of Armageddon.

They come because this is where Christianity began. Here in Jerusalem and on lands nearby are the stony hills where Jesus walked and taught and died—and later, where his followers prayed and bled and battled over what his teaching would become. Huddled alongside Jewish converts in the caves of Palestine and Syria, Arabs were among the first to be persecuted for the new faith, and the first to be called Christians. It was here in the Levant—a geographical area including present-day Syria, Lebanon, Jordan, Israel, and the Palestinian territories—that hundreds of churches and monasteries were built after Constantine, emperor of Rome, legalized Christianity in 313 and declared his Levantine provinces holy land. Even after Arab Muslims conquered the region in 638, it remained predominantly Christian.

Ironically, it was during the Crusades (1095-1291) that Arab Christians, slaughtered along with Muslims by the crusaders and caught in the cross fire between Islam and the Christian West, began a long, steady retreat into the minority. Today native Christians in the Levant are the envoys of a forgotten world, bearing the fierce and hunted spirit of the early church. Their communities, composed of various Orthodox, Catholic, and Protestant sects, have dwindled in the past century from a quarter to about 8 percent of the population as the current generation leaves for economic reasons, to escape the region's violence, or because they have relatives in the West who help them emigrate. Their departure, sadly, deprives the Levant of some of its best educated and most politically moderate citizens—the people these societies can least afford to lose. And so, for Jerusalem's Arab Christians, there is a giddiness during Easter, as if, after a long and lonely ordeal, much needed reinforcements have arrived.

In a small apartment on the outskirts of the city, a young Palestinian Christian couple I will call Lisa and Mark are preparing to enter the fray. Lisa, still in jeans and a T-shirt, is struggling to get their 18-month-old daughter, Nadia, into a white Easter dress. Mark, in his pajamas, is trying without success to prevent their three-year-old son, Nate, whose mood ricochets between Spiderman and Attila the Hun, from trashing the brand new pants-and-vest outfit they've wrestled him into—or the TV, or the painting of child Jesus on the wall, or the vase of flowers on the table. Mark, a big, hot-running guy, grimaces in exasperation. It's eight o'clock on a chilly morning in March, and he's already sweating profusely. Yet it's Easter, a time of optimism and hope, and a special one at that.

JERUSALEM *In high spirits, churchgoers rock the Christian Quarter at Easter.*

This is the first Easter, ever, that Mark has been allowed to spend with the family in Jerusalem. He is from Bethlehem, in the West Bank, so his identity papers are from the Palestinian Authority; he needs a permit from Israel to visit. Lisa, whose family lives in the Old City, holds an Israeli ID. So although they've been married for five years and rent this apartment in the Jerusalem suburbs, under Israeli law they can't reside under the same roof. Mark lives with his parents in Bethlehem, which is six miles away but might as well be a hundred, lying on the far side of an Israeli checkpoint and the 24-foot-high concrete barrier known as the Wall.

Mark finds it depressing that "80 percent of the Christian guys I grew up with have left for another country to find work." Yet he understands why. A trained social worker with a degree in sociology, Mark has been looking for a job, any job, for almost two years. "You're surrounded by this giant wall, and there are no jobs," he says. "It's like a science experiment. If you keep rats in an enclosed space and make it smaller and smaller every day and introduce new obstacles and constantly change the rules, after a while the rats go crazy and start eating each other. It's like that."

For anyone living in Israel or the Palestinian territories, stress is the norm. But the 196,500 Palestinian and Israeli Arab Christians, who dropped from 13 percent of the population in 1894 to less than 2 percent today, occupy a uniquely oxygen-starved space between traumatized Israeli Jews and traumatized Palestinian Muslims, whose rising militancy is tied to regional Islamist movements that sometimes target Arab Christians. In the past decade, "the situation for Arab Christians has gone rapidly downhill," says Razek Siriani, a frank and lively man in his 40s who works for the Middle East Council of Churches in Aleppo, Syria. "We're completely outnumbered and surrounded by angry voices," he says. Western Christians have made matters worse, he argues, echoing a sentiment expressed

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Don Belt is the magazine's senior editor for foreign affairs. He and photographer Ed Kashi reported on India's superhighways in the October 2008 issue.

WEST BANK *Christian farmers lost their olive groves when Israelis built a fence around a settlement.*

by many Arab Christians. "It's because of what Christians in the West, led by the U.S., have been doing in the East," he says, ticking off the wars in Iraq and Afghanistan, U.S. support for Israel, and the threats of "regime change" by the Bush Administration. "To many Muslims, especially the fanatics, this looks like the Crusades all over again, a war against Islam waged by Christianity. Because we're Christians, they see us as the enemy too. It's guilt by association."

Mark and Lisa, like Arab Christians everywhere, conduct an ongoing argument about whether to leave their homeland for good. Mark has one brother in Ireland, another in San Diego, and he lived in the U.S. for a few years. He got his green card and was working in California when he and Lisa were married, in Jerusalem, in 2004. She tried living in San Diego for a while but was homesick for her family, so the couple moved back after Nate was born.

Living as Arabs in the U.S. after 9/11 was an eye-opener for them. "It's funny," Mark says, "what Americans think about things. They've never heard of Arab Christians. They assume all Arabs are Muslim—terrorists, that is—and that Christianity was invented in Italy or something. So when you say, I'm an Arab Christian, they look at you funny, like you just said, The moon is purple. I had one lady ask me, 'What does your family think about you being a Christian? I suppose they must have been very upset!'"

ON A MOUNTAIN overlooking the Mediterranean near Beirut, a hermit rises at three in the morning, reaching for a flashlight amid the lumpy familiarity of books that are both his life's work and his lifelong bedmates. The hermit, who's 73, long-bearded, and known by the name Father Yuhanna, works there until dawn, translating ancient Christian hymns from Aramaic, the language of Jesus, into modern Arabic, copying them into a giant, leatherbound volume the size of a seat cushion. Then he prays, eats a piece of fruit, pulls on his black habit and cloak, and merrily sets off to deliver 10,000 blessings to every place in the world.

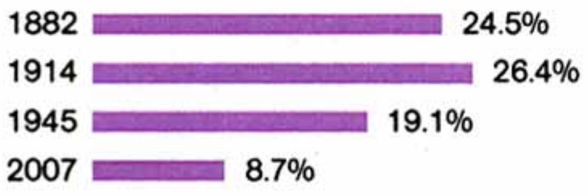
His first stop, always, is Alaska, where he "stocks up on fresh air." Then he drifts down

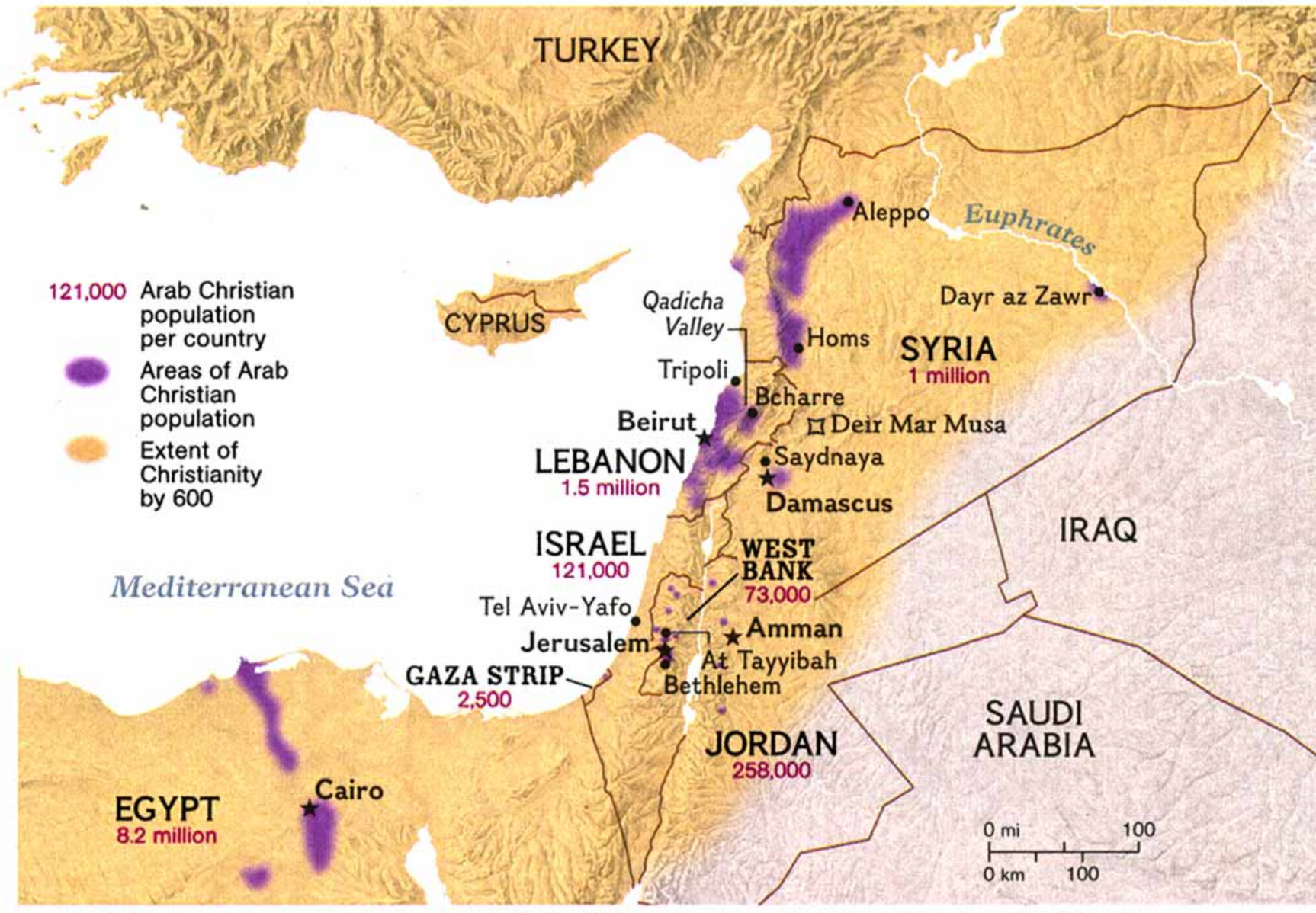
ARAB CHRISTIAN EXODUS

Christians once dominated from Syria to Egypt. But since the Crusades—and especially over the past century—they've been marginalized, reduced to small, embattled communities by social, political, and economic pressures.

CHRISTIAN POPULATION

Percentage of total population in present-day Jordan, Syria, Lebanon, Israel, and Palestinian territories



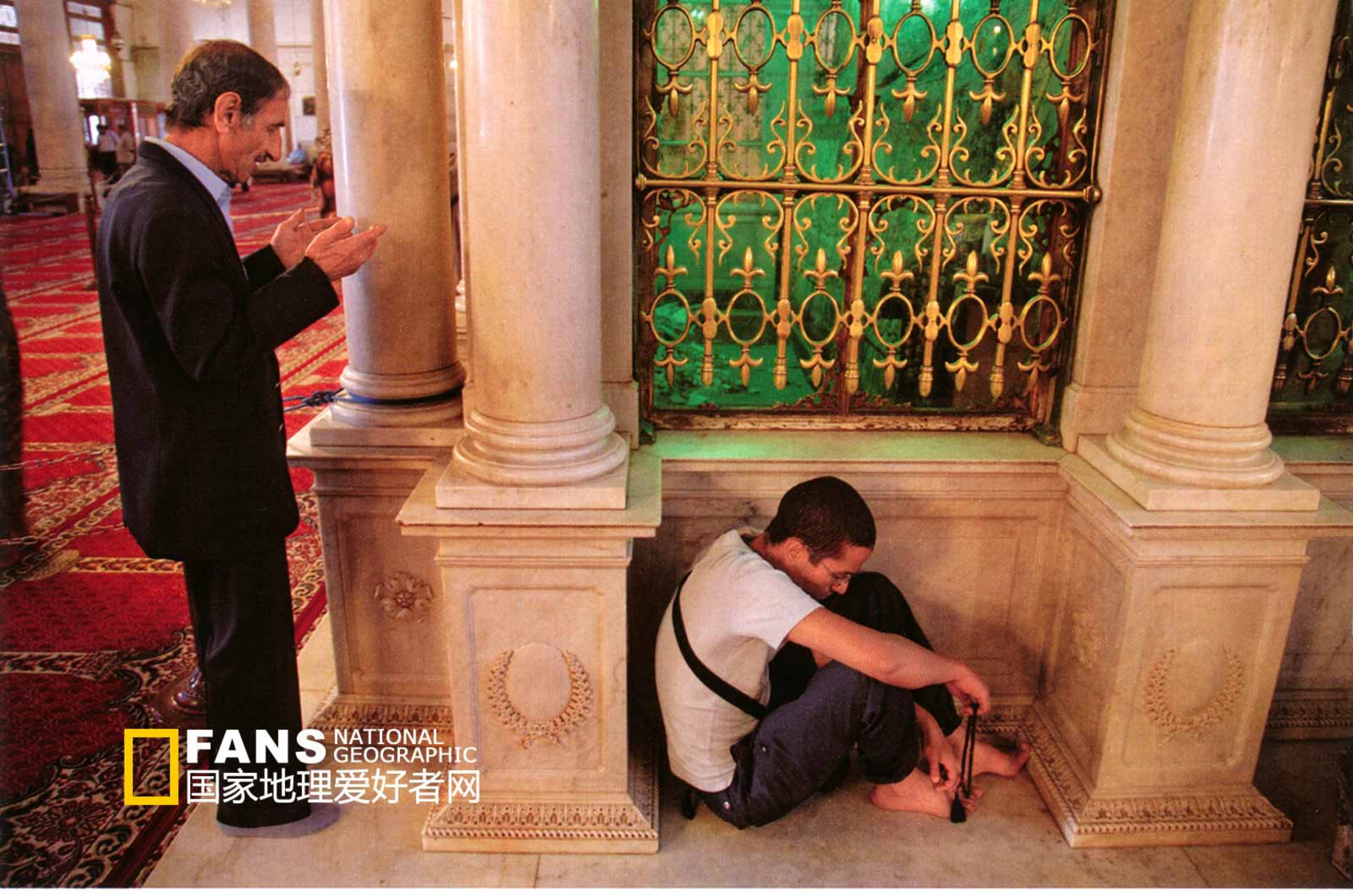


JEROME N. COOKSON AND MARGUERITE B. HUNSIKER, NG STAFF. SOURCES: M. R. IZADY (MAP); PHILIPPE FARGUES (GRAPH)

through North and South America, jumps to Africa, moves up through the Middle East, sweeps across Europe, then heads east into Russia and Asia before working his way south to Australia. Everywhere he goes, he distributes blessings, counting them off one by one on a string of woven rosary beads that fly through his fingers like doves. This daily trip takes three or four hours, and most days—if he doesn't linger too long over the trouble spots—he's back home by noon. To the untrained eye, he's just an old man walking around in a garden. To his friends and followers, who come by the hundreds to hear his teachings about Jesus, he's a saintly figure, a descendant of influential hermits like Simeon the Elder—a fifth-century ascetic who lived atop a stone pillar in the Syrian countryside for more than 30 years, attracting the pious devotion of locals.

Maronite Christians are not usually thought of as candidates for sainthood. Followers of a fourth-century hermit named Maron, the sect seemed destined from the beginning to battle its way through history. When St. Maron died in 410, a bitter feud broke out among his followers over custody of his body. Within a generation the Maronites were also battling rival Christian sects over theological issues, and after the arrival of Islam they opposed the Muslims too. Fleeing persecution, they pushed over the mountains from Syria into Lebanon, where they sought out the most inhospitable valleys, fortified their caves and craggy monasteries, and set about defending themselves from the caliph's army. In the late 11th century, when French crusaders marched through on their way to Jerusalem, Maronites poured out of the mountains to greet their fellow Christians. Some 800 years later, when France took charge of Syria (including Lebanon) at the end of World War I, it repaid the Maronites by shaping the future nation of Lebanon to their advantage. Speaking French and nurturing a cultural affinity for Europe, the Maronites, alone among Arab Christians, were the majority in a Middle Eastern country when Lebanon gained its independence in 1943.

More recently, Maronite Christians have been among the most feared militia fighters in



Lebanon's civil war, waging fierce campaigns against Lebanese factions—Shiite, Sunni, Druze, and Palestinian—in the combat zones of Beirut between 1975 and 1990. But today Lebanon's Christians, once the majority, find themselves increasingly relegated to the same role that Christians elsewhere in the Middle East know so well. After decades of emigration, their numbers have fallen below 40 percent of the population. To cope, Maronite leaders have forged new alliances: one with the ascendent Shiite group, Hezbollah; another with a coalition of Sunnis and Druze. Meanwhile, the Christian militias have gone underground—but that doesn't mean they've gone soft.

Milad Assaf is a genial, middle-aged tile contractor who serves as a foot soldier in the Lebanese Forces (LF), a powerful Maronite political party. From the balcony of his bullet-riddled fifth-floor apartment in east Beirut, Milad has a clear shot at the sprawling Shiite neighborhoods that lie just beyond a busy thoroughfare marking the "red line" between Christian territory and that of the Shiite militias fighting for Hezbollah and its ally, Amal. "It's kind of like living in a shooting gallery," he says, laughing.

Milad was six years old in April 1975, when a gang of Christians ignited Lebanon's civil war by opening fire on a bus full of Palestinian refugees; they did it to send a message to the Palestinian fighters then roaming the streets of Beirut, who wanted to turn Lebanon into a base for the Palestinian Liberation Organization (PLO). The bus attack, which killed 27 people, went down a block from Milad's house, in front of a life-size statue of the Virgin Mary. Despite hailstorms of small arms fire, rocket-propelled grenades, and Israeli bombs that have whistled through the air here since 1975, the statue doesn't have a scratch on it. "Think about that for a minute," says Milad. "Tell me that's not a miracle!"

Milad's neighborhood, Ain al-Rumaneh, is a tough place, full of bullet-pocked apartment buildings and small shops. Every flat surface, it seems, is branded with the symbol of the Lebanese Forces, a cross with its base sliced off at an angle, like a sword. After recent clashes with Shiites, Milad and his buddies raised a 15-foot

ARAB CHRISTIANS ARE THE GO-BETWEENS, A VITAL LINK BETWEEN THE CHRISTIAN WEST AND THE ARAB MUSLIM WORLD.

SYRIA *Muslims worship at the tomb of John the Baptist in Damascus—a reminder that Islam reveres Jesus, Mary, and prophets of the Old and New Testaments. In Syria the faiths have mingled since the seventh century, when Arab Muslims conquered lands of the Christian Byzantine Empire. Some church fathers even mistook early Islam for a form of Christianity.*

wooden cross on the sidewalk and plastered a plywood wall behind it with huge posters of Jesus. Then they installed floodlights so that Hezbollah fighters across the road would get the following message 24 hours a day: "Ain al-Rumaneh is Christian. Keep the hell out."

By age 12, when he joined the LF, Milad had the swagger of a *shabb*, or tough guy. He has no idea how many men he killed during the war. He's been in and out of jail dozens of times and even now, at 40, hasn't given up the adrenaline-fueled life of a fighter. His thinning hair is slicked back, Elvis style, and he wears the big LF cross on a gold chain around his neck and tattooed on his left forearm. Like many Arab Christian guys, Milad pumps a lot of iron, and though carrying a slight paunch, he has a powerlifter's chest that he's proud of, wrapped tightly in a white Armani T-shirt. He flexes his biceps and chest constantly. He carouses in a souped-up SUV, drinks too much, breaks a lot of hearts. Since the July 2006 war with Israel, which ruined the Lebanese economy and strengthened Hezbollah, his tile business has taken a hit, but Milad is hoping to ride this crisis out, just like all the others.

Countrywide, this chronic instability has pushed unemployment to 20 percent, scared away foreign investors, and dimmed the nation's once vibrant commercial life. A week before, in the Maronite heartland along the Qadicha Valley, I'd stopped at a shop in Bcharre, a town on the edge of a cliff that was home to the poet Khalil Gibran. "First customer of the day," said the dark-haired woman behind the counter, whose name was Liliane Geagea. It was 11 a.m. on a sunny Saturday in April, prime tourist season, but the place was empty. "With all the troubles, people have just stopped coming," she said. "Everybody's saving their money so they can leave this crazy place. I know I am. I've given this country 45 years of my life, most of them in a war, and that's enough. I'm exhausted, and so is my family. My daughter is studying at Beirut University. When she graduates, my advice to her is: Go to America, go to Europe or Australia, it doesn't matter where. Just get out and take me with you."

Milad doesn't have the option of leaving, and neither do thousands of other tough guys just like him who meet in militia clubhouses to discuss the "situation" and abide by their party's decision to make political alliances instead of war. But if there's anything that makes them nervous, it's being outgunned. Milad flexes his biceps, pats the stock of his rifle, and grins. "We still have our weapons," he says, fingering one of the M16s he keeps oiled and ready in his basement. "But these days the Shiites have more." He gestures out the window, to shot-up apartment complexes just beyond the four-lane road that might as well be a hostile international border. "Hezbollah controls everything on the other side of that road," he says. "And those guys are crazy. They've got rocket launchers, RPGs, you name it, all supplied by Iran. We'll always protect our neighborhoods and our families, no questions asked. But these days, if it turned into a shooting war, we'd lose. So now we believe in peace."

A FEW HOURS EAST of the battle lines between Muslim and Christian in Beirut, communities

SYRIA *Playing pop songs in a reverent key, Christian scouts parade in the village of Saydnaya on Palm Sunday, climbing to an ancient church, Our Lady of Saydnaya, also revered by Muslims.*

in Syria offer a reminder, beneath the hostilities of today, of how closely related the two religions really are. There are oases of tolerance—once widespread, now less so—where Christians and Muslims attend one another's weddings and funerals and worship at one another's shrines. In some monasteries Christians still prostrate themselves in prayer—a Byzantine-era practice that early Muslims may have admired and adopted. Some churches still conduct services in Aramaic or Syriac, languages that predate Islam.

One afternoon I climb to Our Lady of Saydnaya, a cliff-top Greek Orthodox convent in Syria that has weathered the storms of empire since 547. Once inside I find myself not among Christians but in a crowd of Muslim families who've come seeking the blessings of the Virgin Mary, whose powers of healing and fertility have drawn people in need for nearly 1,500 years.

As my eyes adjust to the gloom of the candlelit inner sanctum, I watch as a woman in a head scarf offers her baby, wrapped in a blanket, to the centerpiece of the shrine. There, surrounded by soot-blackened icons, a brass template covers the image of Mary, said to be painted by St. Luke, which inspires even though hidden from view. With her eyes closed and lips moving in silent prayer, the baby's mother presses his face gently against the metal plate for a long moment. Later, outside, I meet the woman and her family, who'd driven up from Damascus after Friday prayers at their mosque.

Wary of strangers, they would offer only the name of their sick child, Mahmoud. Just seven months old, swaddled in a green blanket, he lay still as death with his eyes closed, barely breathing. His face was a dark grayish brown. "The doctor said he can't do anything for Mahmoud and that we should send him to America for an operation," his mother says. "That's impossible, so we need a miracle instead. I'm a Muslim, but a long time ago my family used to be Christian. I believe in the prophets—Muslim, Jewish, and Christian—and I believe in Mary. I've come here so that my boy will be healed."

Such scenes reflect the Levant's history of

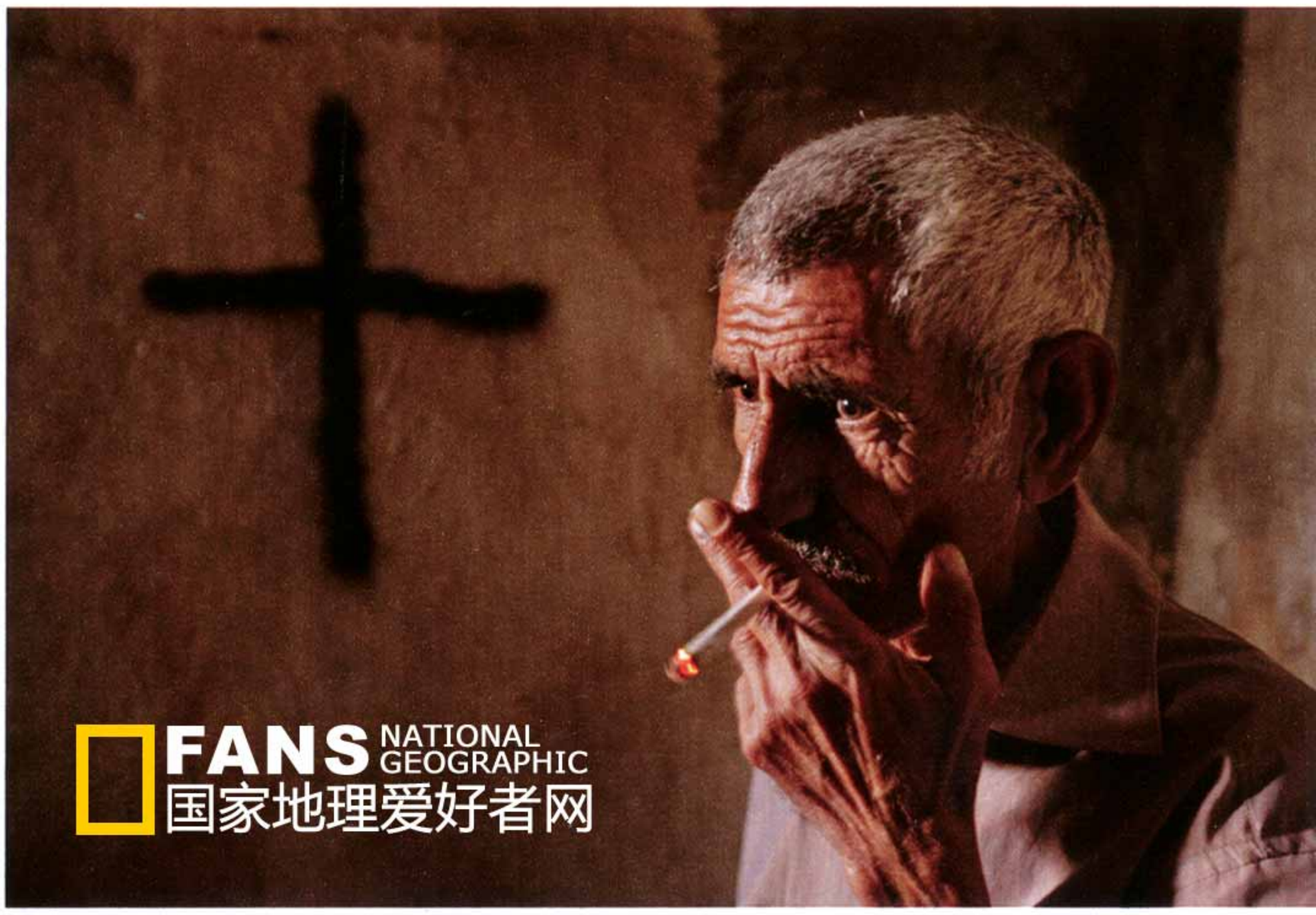
WEST BANK *The exodus of Christians continues in Bethlehem, where Tony Rashmawi, his wife, Jeeda, and daughter, Zeina, pack for Canada. "Under Israeli occupation, normal life is impossible," says Jeeda. "We must give Zeina a future."*

coexistence between Muslims and people of other faiths, which dates from the earliest days of Islam. When the Muslim Caliph Omar conquered Syria from the Byzantine Empire around 636, he protected the Christians under his rule, allowing them to keep their churches and worship as they pleased. But many Christians converted to Islam anyway, preferring its emphasis on a personal connection with God to the oppressive hierarchies of the Byzantine Church. The grandson of the last Christian governor of Damascus, who grew up to be the theologian St. John Damascene, listened to the newcomers talk about Islam—its acceptance of the Old and New Testaments, its esteem for Jewish prophets, its veneration of Jesus and Mary—and concluded that it was another of the many Christian heresies making the rounds of the Byzantine Empire, beyond the reach of church authorities in Constantinople. It never occurred to him, even writing many years later, that Islam might be a separate religion. When later caliphs imposed heavy taxes on Christians, conversions soared among poor villagers. For those early Arab Christians, whose word for God was (as it still is today) Allah, accepting the tenets of Islam was more like stepping over a stream than vaulting a chasm.

"You can't live alongside people for a thousand years and see them as the children of Satan," observes Paolo Dall'Oglio, an earthy, bear-size monk who hosts Muslims in interfaith dialogue at Deir Mar Musa, the sixth-century desert monastery he and his Arab followers restored between Damascus and Homs. "On the contrary, Muslims are us. This is the lesson the West has yet to learn and that Arab Christians are uniquely qualified to teach. They are the last, vital link between the Christian West and the Arab Muslim world. If Arab Christians were to disappear, the two sides would drift even further apart than they already are. They are the go-betweens."

BACK IN JERUSALEM Mark and Lisa are acutely aware of the role that Arab Christians might play in the geopolitical dramas of today. But they live

CHRISTIANS ARE THE ENVOYS OF A FORGOTTEN WORLD, BEARING THE FIERCE AND HUNTED SPIRIT OF THE EARLY CHURCH.



LEBANON *Fight or flight? For many Iraqi Christians targeted by jihadists for death or kidnapping, the answer was flight to Syria or Lebanon, where Faraj Hermez (right), of Kirkuk, sought refuge for his wife and ten children. In east Beirut, Milad Assaf (left) is a proud member of the Lebanese Forces, a Maronite Christian political party backed by well-armed volunteers.*

in a hothouse world, where go-betweens are in constant danger of being trampled—by Muslims, by Jews, or by Western Christians, who (not unlike the crusaders) look right through them as they race past to stake their claim on God's holy ground.

On Easter morning, Mark and Lisa make a handsome couple in their Sunday clothes, leading Nate and Nadia by the hand up the sidewalk to the family car, a middle-aged, maroon Honda. It's a proud moment, their first Easter together in the Holy Land, and Lisa, noticing the thick coat of dust on the car, asks Mark to give it a rinse. He fetches a hose and connects it to a faucet they share with their neighbors, who come out on the porch and stand, watching, in their kaffiyehs and head scarves. In an animated voice, Lisa explains to the kids that Daddy's giving the car a bath for Easter. Right on cue, with a playful flourish, Mark squeezes the nozzle on the hose. Nothing comes out. He checks the faucet, squeezes again. Still nothing. So there he stands, empty hose in hand, in front of his kids, his neighbors, and a visitor from overseas. "I guess they've opened the pipes to the settlements," he says quietly, gesturing to the hundreds of new Israeli housing units climbing up the hills nearby. "No more [water] for us." Lisa is still trying to explain this to the kids as the car pulls away from the curb.

"I hate the Israelis," Lisa says one day, out of the blue. "I really hate them. We all hate them. I think even Nate's starting to hate them."

Is that a sin? I ask.

"Yes, it is," she says. "And that makes me a sinner. But I confess my sins when I go to church, and that helps. I'm learning not to hate. In the meantime, I go to confession."

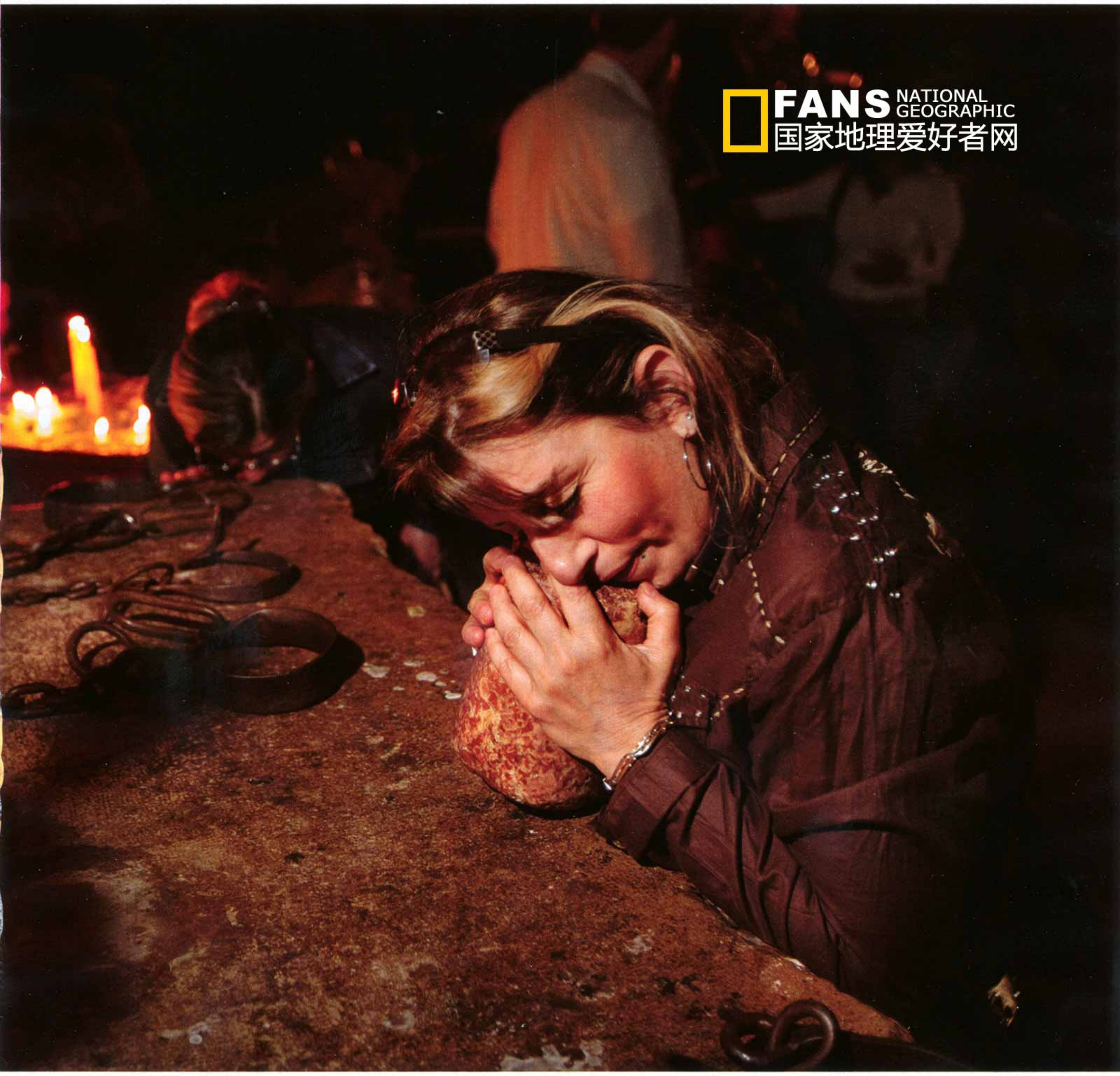
"Hate destroys the spirit of those who hate," says Father Rafiq Khoury, a soft-spoken Palestinian priest who hears his share of confessions at the Latin Patriarchate in Jerusalem. "But even in the midst of all these troubles, all this violence and despair driving Christians away, you can see new life in the faces of young people and experience the hope that is God's gift to humanity. That is the message of Easter."

Yet even at Easter, Arab Christians seem

to be the forgotten ones. One night in East Jerusalem, I accompanied Lisa and Mark to Good Friday services at the huge Church of All Nations next to the Garden of Gethsemane. Mark, who can't stand crowds, stayed outside with Nate in the cool night air, but Lisa has celebrated this Mass since she was a child and wanted to go inside. The crowd was sparse, and we took a position well back from the pews, standing a few yards inside the church doors. Lisa had Nadia in a stroller. As we stood there admiring the church's ornate altar and vestibule, the Christian hordes circulating through Jerusalem suddenly descended, like an Old Testament plague, on the church.

Hundreds of pilgrims churned through the church's double doors, filling the cavernous space with warm bodies and pushing us deeper into the church. The temperature rose rapidly, and air was suddenly in short supply. I checked Lisa's face and saw a look of alarm as she gripped the stroller and tried to anchor herself against the river of humanity flowing into the church. Dutch, German, Korean, Nigerian, American, French, Spanish, Russian, Filipino, Brazilian, the crowd surged forward, searching hungrily for a greater proximity to God.

Suddenly Lisa's decision to bring Nadia along was looking like a mistake. At eye level, people were seeing the vacant space created by the stroller and aggressively pushing to fill it, not realizing there was a sleeping child down below until they were practically falling onto her. Lisa's eyes widened as we fought to protect Nadia from the crush of bodies. As if wading through chest-deep water, we tried to clear a path for the stroller to the church doors. A number of foreign pilgrims reacted poorly to this tiny Arab woman moving in the wrong direction, and things got a bit physical as we made our way through the crowd. As we passed through the doors, the crowd thinned out slightly. Lisa leaned in, straining to be heard over the chaos around us. "Do you see how it is?" she asked, gasping for air on the hill where Jesus spent his last night on Earth. "This is our home. And it's like we're not even here!" □

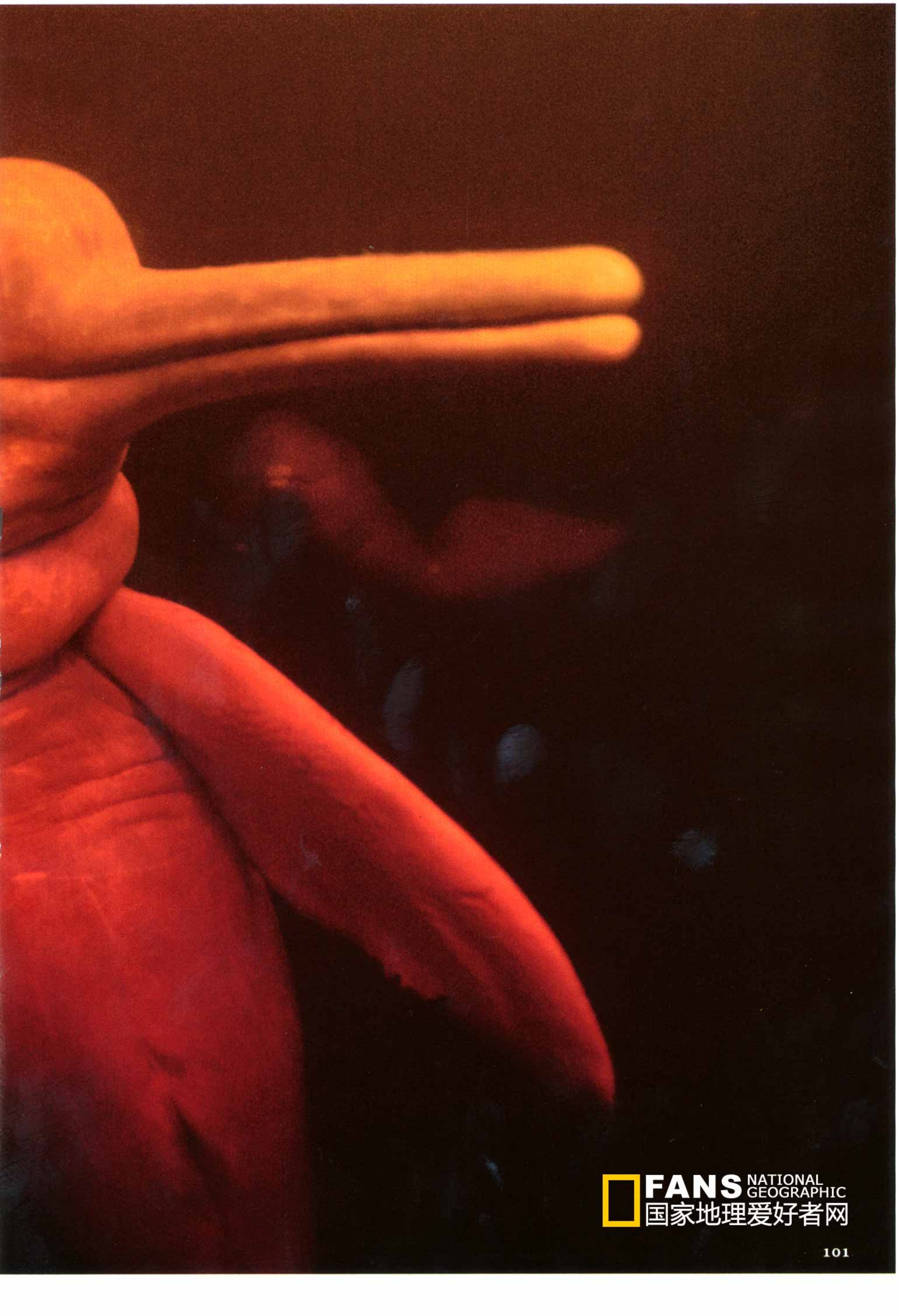


LEBANON *In the caves of Qadicha Valley, early Christians dreamed of what their religion would become; centuries later, monks bound the mentally ill in chains, seeking God's cure. Today Arab Christians come to fan the embers of faith.*

Tracking prey deep in the forest, freshwater dolphins make the most of the Amazon's prodigious annual flood.

RIVER SPIRITS

River dolphins navigating the Amazon Basin's tea-colored brew of silt and rotting vegetation seem to glow orange. Out of water they're pale gray, with some marked in pink. Called *botos* here in Brazil, they use high-frequency sonar clicks to build a 3-D echogram of their dark world.



BY MARK JENKINS
PHOTOGRAPHS BY KEVIN SCHAFER

The dolphins are swimming through the trees. Bending sinuous bodies, they glide through branches and curl like snakes around fluted trunks. As frog-green fish dart through the leaves, the dolphins, pink as bubble gum, snap at them with long, toothy beaks.

This is not some kaleidoscopic dreamscape from a novel by Gabriel García Márquez; this is the wet season in the upper Amazon, downstream from Iquitos, Peru. The river has flooded the rain forest, luring freshwater dolphins to hunt in the woods.

The Amazon dolphin, *Inia geoffrensis,* parted company with its oceanic ancestors about 15 million years ago, during the Miocene epoch. Sea levels were higher then, says biologist Healy Hamilton of the California Academy of Sciences in San Francisco, and large parts of South America, including the Amazon Basin, may have been flooded by shallow, more or less brackish water. When this inland sea retreated, Hamilton hypothesizes, the Amazon dolphins remained in the river basin, evolving into striking creatures that bear little resemblance to our beloved Flipper. These dolphins have fat, bulbous foreheads and skinny, elongated beaks suited

From March to July, the wet-season deluge expands the dolphins' range across inundated plains and into rain forest in the Anavilhanas Archipelago (below), a vast island chain in the Rio Negro. Botos forage among the trees (left) for fish, crabs, and turtles.

to snatching fish from a tangle of branches or to rooting around in river mud for crustaceans. Unlike marine dolphins, they have unfused neck vertebrae that allow them to bend at up to a 90-degree angle—ideal for slithering through trees. They also have broad flippers, a reduced dorsal fin (a larger one would just get in the way in tight spots), and small eyes—echolocation helps them pinpoint prey in muddy water.

At up to 450 pounds and eight feet in length, the Amazon dolphin, or *boto,* is the largest of the four known species of river dolphin. The others live in the Ganges in India and the Indus in Pakistan, in the Yangtze in China, and in the Río de la Plata between Argentina and Uruguay. All river dolphins are superficially similar, says Hamilton, yet the four species don't belong to the same family. DNA studies by Hamilton and others have shown that river dolphins evolved from archaic marine cetaceans (the order that also includes whales) on at least three separate occasions—first in India, later in China and in South America—before modern marine dolphins themselves had emerged as a distinct group. In an example of what's known as convergent evolution, geographically isolated and genetically distinct species developed similar characteristics because they were adjusting to similar environments.

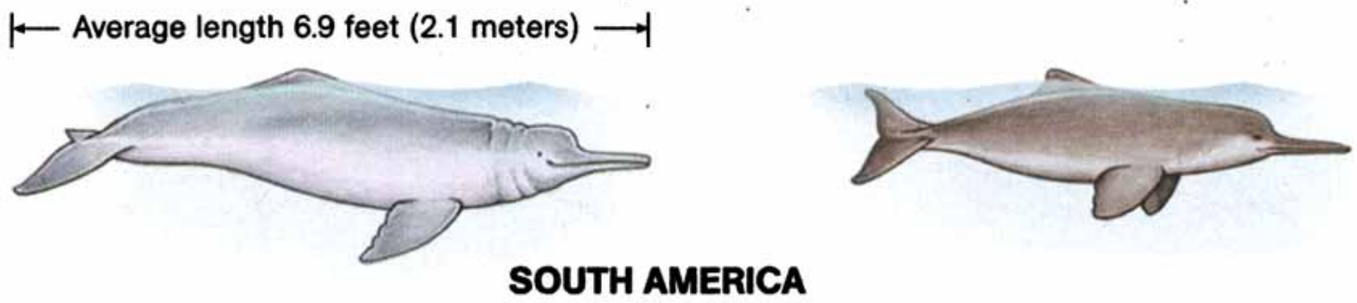
Every spring the Amazon dolphins get to leave the confines of their river channel for a taste of their former habitat. At the Mamirauá Reserve in western Brazil, where Tony Martin of the University of Kent in England has studied the dolphins for the past 16 years, two Amazon tributaries flood thousands of square miles of forest for half the year, converting it into a vast tree-canopied sea. Martin and his Brazilian colleague Vera da Silva have found that female dolphins in particular stray far into the forest—perhaps to take refuge from aggressive, bright pink males. The females are mostly gray; the males' pink color, Martin and da Silva believe, is scar tissue.

"The males beat the hell out of each other," says Martin. "They are brutal. They can snap each other's jaws, tails, flippers, lacerate blowholes. The large males are literally covered with scar tissue." Only a small percentage of males turn bright pink, Martin says, and those are the ones females are most attracted to—at least during the mating season, when the water retreats back into the river channel and both sexes are thrown together.

Being pink is not the only strategy males have for impressing females. They also sometimes pick up weeds or a piece of wood with their beaks, twirl in a circle, and smash the object on the water. Locals long believed the dolphins were just playing, but Martin discovered that only males carried objects, and only in the presence of females. What's more, they

RIVER DOLPHINS: A CURIOUS CLAN

Four far-flung species are loosely grouped as river dolphins because of their shared habitat and body traits. Long beaks, short dorsal fins, and other adaptations to river life distinguish them from their marine cousins.



SOUTH AMERICA

Amazon dolphin *(Inia geoffrensis)*
The largest of river dolphins, with an estimated population of at least 100,000, the *boto* ranges widely in the Amazon and Orinoco River systems.

Franciscana *(Pontoporia blainvillei)*
Also known as the La Plata dolphin, it lives in coastal Atlantic waters and brackish estuaries. Its population may be about 70,000.

HIRAM HENRIQUEZ AND LISA R. RITTER, NG STAFF

SOURCES: AMERICAN CETACEAN SOCIETY; GILLIAN BRAULIK, WWF; TONY MARTIN, UNIVERSITY OF KENT; RANDALL REEVES, IUCN; EDUARDO R. SECCHI, UNIVERSIDADE FEDERAL DO RIO GRANDE

were 40 times more likely to get into fights when engaged in such ostentatious behavior. No other mammals besides humans and chimps carry objects for display, says Martin. "It's like a guy showing off—the equivalent of having a Ferrari," he explains.

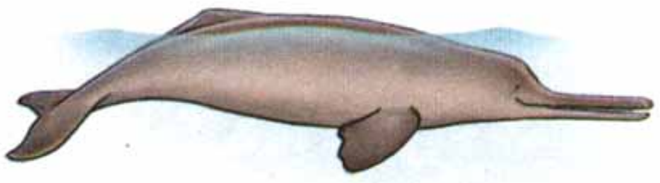
River dolphins have no predators, except for humans. In December 2006 the Yangtze river dolphin, called the *baiji,* succumbed to pollution, propeller blades, dams, and overfishing; it became the first cetacean to be declared "functionally" extinct—meaning the species cannot renew itself, even if a specimen or two still exist. "Losing the baiji is like taking a chain saw to the cetacean tree of life," says Hamilton. "We've lost 20 million years of independent evolution." The Ganges river dolphin is also in grave danger; only a few thousand remain, and they live in some of the most polluted rivers on Earth.

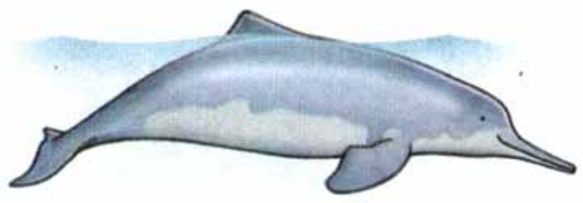
The Amazon species probably has the best prospects; though its numbers are uncertain, Martin thinks at least 100,000 are left. But the trend is worrisome. At the Mamirauá Reserve, Martin's study population has declined by half over the past seven years. Fishermen hunt dolphins for catfish bait, he says, and they also kill them accidentally in their gill nets.

Mark Jenkins wrote about western China in May. This is photographer Kevin Schafer's first article for the magazine. He specializes in endangered species.

A boto's jaw muscles can snap its elongated beak down on prey with crocodilian ferocity. "It's like an industrial guillotine," says University of Kent biologist Tony Martin.

Once that would have been unthinkable. In Amazonian folk wisdom the boto is an *encantado*—an enchanted being, a shape-shifter that sometimes takes on human form, coming out of the river to beguile men and women and lead them into its magical underwater city. Some say it wears a hat to hide its blowhole and its bulbous forehead. The stories are incredible to modern ears, and in a way, that's unfortunate. Because to survive in today's world, the boto may need to enchant a wider audience. □

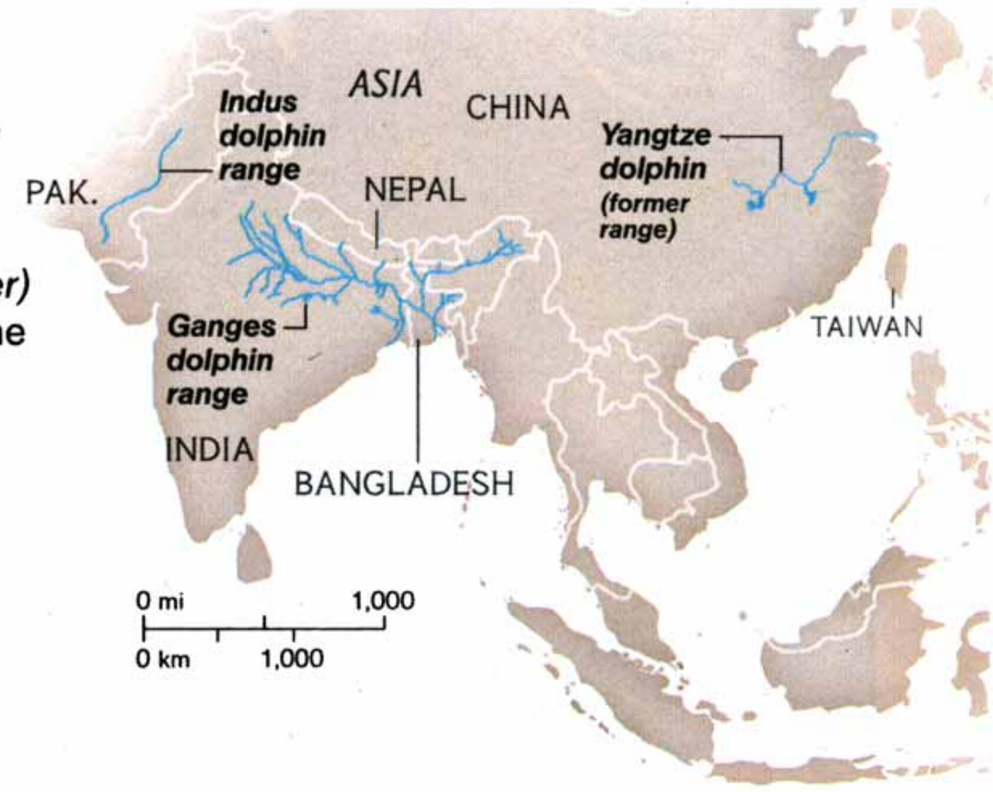


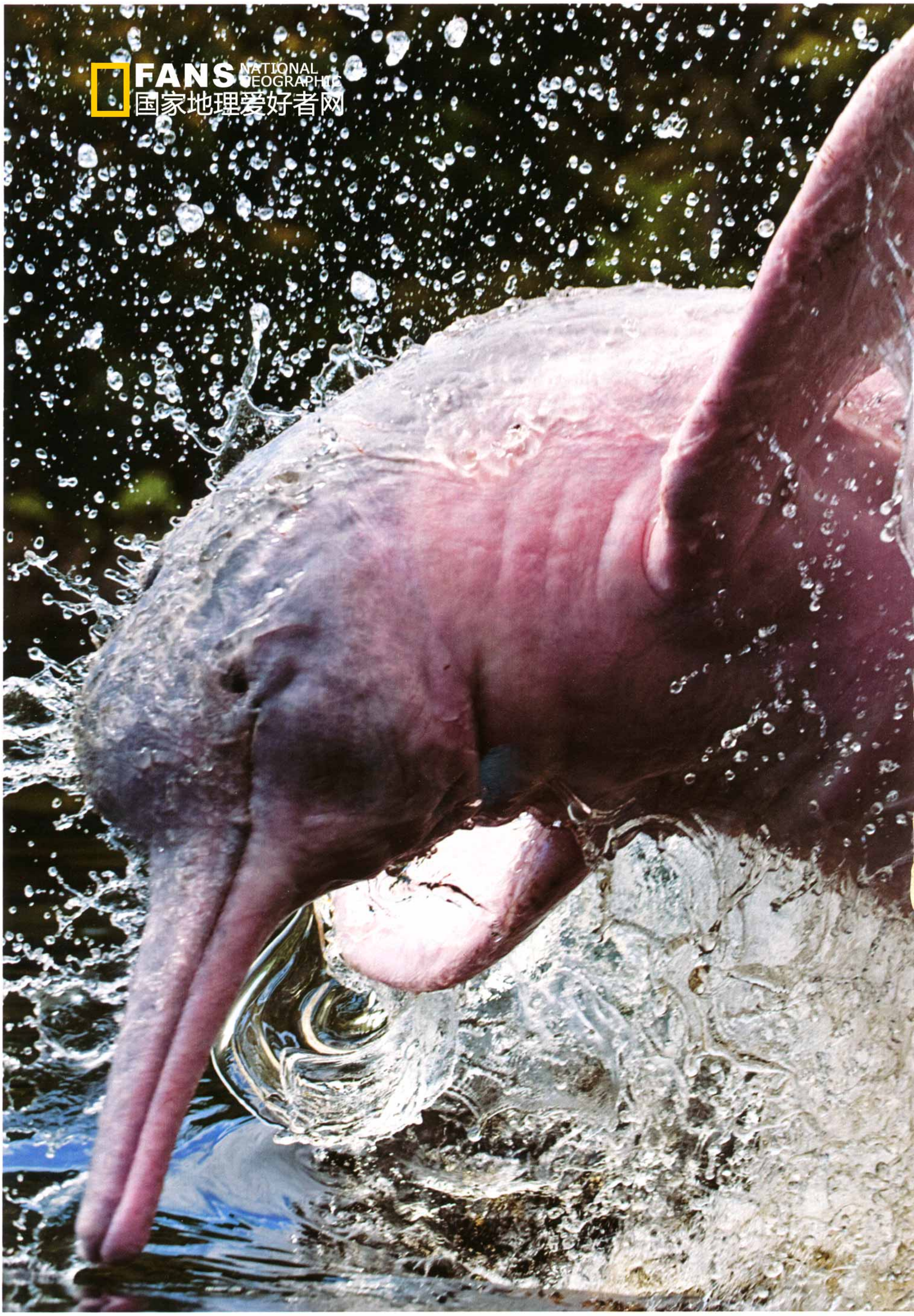


ASIA

Indus and Ganges dolphins *(Platanista gangetica)* Now classified as a single species, Pakistan's *bhulan* and the *susu* of India, Bangladesh, and Nepal are threatened: Only 3,000 to 4,000 remain.

Yangtze dolphin *(Lipotes vexillifer)* Development and fishing along the Yangtze River have all but wiped out the *baiji*. There have been no confirmed sightings since 2002.



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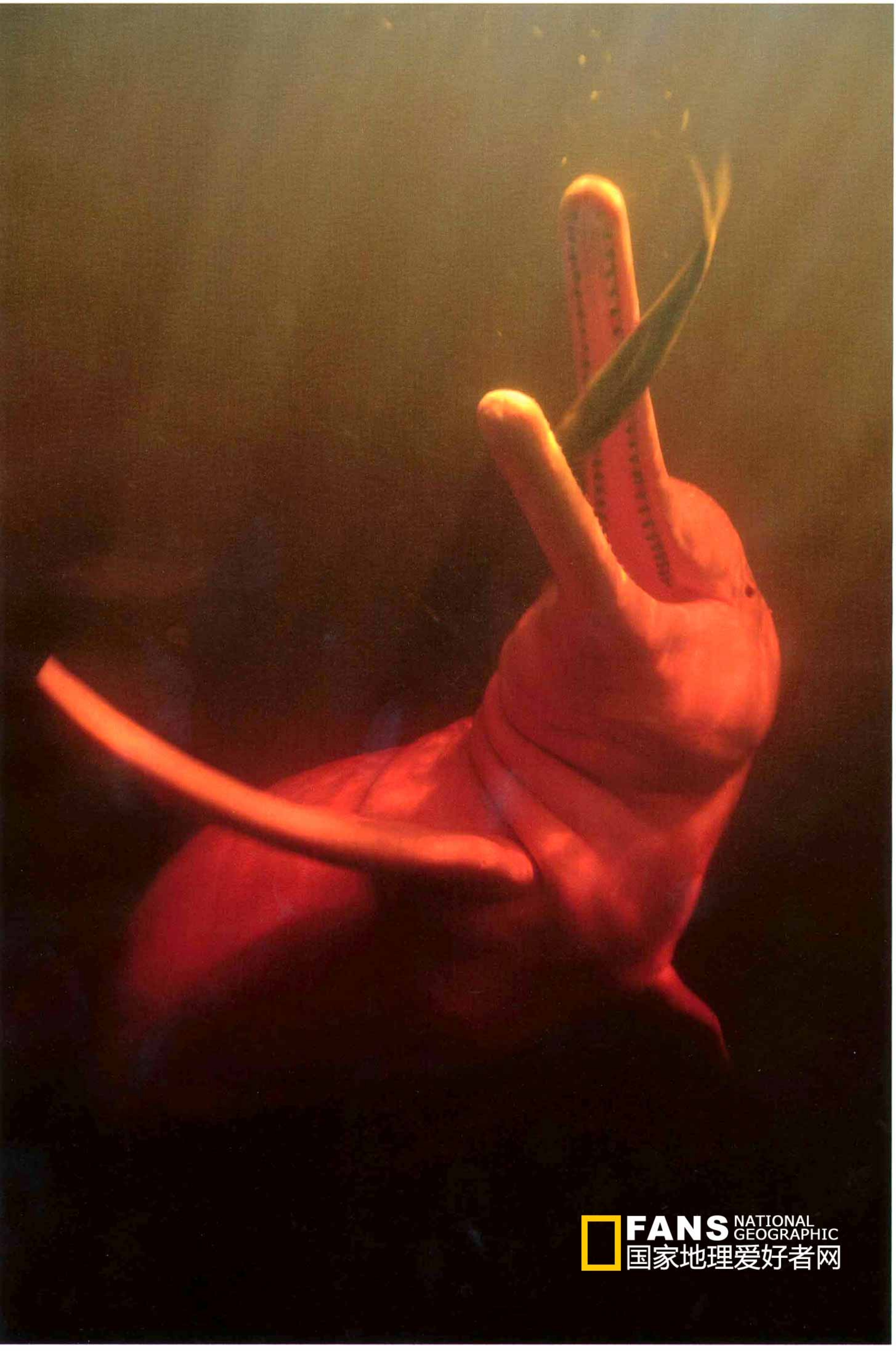
Mother and calf stay close amid drowned saplings. Youngsters nurse for more than a year. Females have just one calf at a time, with two to three years between births.

Previous pages: In an exuberant display of muscle and flexibility, a boto bursts from the floodwaters.

Imagined lords of a golden underwater city—the Encante—botos may have been shielded from exploitation by their mythical status. But as rain forests are felled and commercial fisheries move into their hunting range, people are shaping a daunting new world for these river masters.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MADE IN CHINA

A 1,200-year-old shipwreck opens a window on ancient global trade.

Crusted with sea life, this Tang dynasty stoneware jar was found off Indonesia's Belitung island.

BY SIMON WORRALL ▪ PHOTOGRAPHS BY TONY LAW

The world economy in the ninth century had two powerful engines. One was Tang dynasty China, an empire stretching from the South China Sea to the borders of Persia, with ports open to foreign traders from far and wide. The Tang welcomed diverse people to its capital, Changan, the site of modern-day Xian, and multiethnic groups lived side by side in a city of a million—a population unmatched by a Western city until London in the early 19th century. Then, as today, China was an economic powerhouse—and much of that power was built on trade.

The other economic engine was Baghdad, capital of the Abbasid dynasty from 762 onward. That dynasty inherited the Muslim world in the Middle East; by 750 it had spread as far as the Indus River to the east and Spain to the west, bringing with it trade, commerce, and the religion of Islam (the Prophet Muhammad himself had been a merchant).

Linking the two economic powerhouses were the Silk Road and its watery counterpart, the Maritime Silk Route. The overland road gets all the attention, but ships had likely been plying the seas between China and the Persian Gulf since the time of Christ. In tune with the cycle of the monsoon winds, this network of sea-lanes and harbors bound East and West in a continuous exchange of goods and ideas.

Tang China was hungry for fine textiles, pearls, coral, and aromatic woods from Persia, East Africa, and India. In return, China traded paper, ink, and above all, silk. Silk, light and easily rolled up, could travel overland. But by the ninth century, ceramics from China had grown popular as well, and camels were not well suited for transporting crockery (think of those humps). So increasing quantities of the dishes and plates that held the meals of wealthy Persian Gulf merchants arrived by sea in Arab, Persian, and Indian ships.

It was a long and perilous journey. And sometimes a ship just vanished, like a plane off a radar screen.

Since time immemorial, ships have come to grief in the Gelasa Strait, a funnel-shaped passage between the small Indonesian islands of Bangka and Belitung, where turquoise waters conceal a maze of submerged rocks and reefs. Despite the dangers, sea cucumber divers were working the area a decade ago when, 51 feet down, they came across a coral block with ceramics embedded in it. They pulled several intact bowls from inside a large jar, took them ashore, and sold them.

The divers had stumbled upon the most important marine archaeological discovery ever made in Southeast Asia: a ninth-century Arab dhow filled with more than 60,000 handmade pieces of Tang dynasty gold, silver, and ceramics. The ship and its cargo, now referred to as the Belitung wreck, were like a time capsule of proof that Tang China, like China today, mass-produced trade goods and exported them by sea. Working in shifts until the monsoon stopped them, a team of divers retrieved the ancient artifacts.

The treasure—much of it, anyway—turned out to be the Tang equivalent of Fiestaware: so-called Changsha bowls, named after the Changsha kilns in Hunan where they were produced. Tall stoneware jars served as ninth-century shipping containers; each could hold more than a hundred nested bowls that might originally have been padded with rice straw, a sort of organic bubble wrap. Scholars already knew that such simple, functional tea bowls had been exported worldwide from the eighth to the tenth centuries: Shards of them had been found at sites as far afield as Indonesia and Persia. But few of the bowls had ever been found intact.

Now the Java Sea had yielded up a shipload, many perfectly preserved—protected in the

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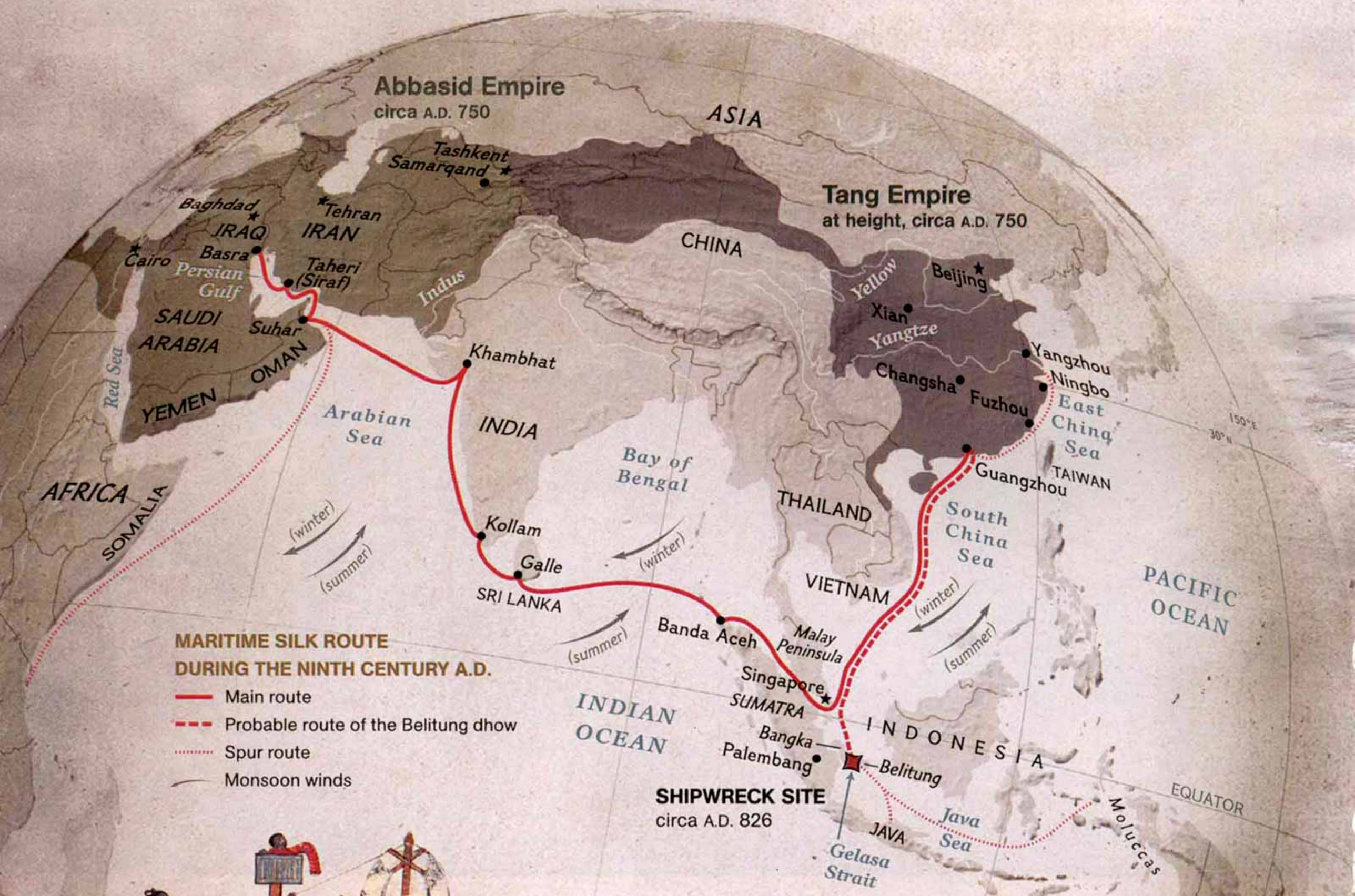
Simon Worrall has contributed to both National Geographic *and* National Geographic Traveler. *This is Tony Law's first assignment for this magazine.*

RARE ARTISTRY *Goods from the Belitung ship exemplify the creativity and craft that flourished in Tang dynasty China (clockwise from upper right): An intricately engraved gilt silver flask, an ornate bronze mirror already antique when the ship sailed, a wine cup and bracelet shaped from pure gold, and the oldest intact cobalt-blue-and-white ceramic from China ever discovered.*

TRADE ROUTE DISCOVERY

Heavy with Chinese cargo, the ship that sank off Belitung in the early ninth century was an Arab dhow (right). The wreck gives scholars an unprecedented time capsule of enterprise on the Maritime Silk Route, for centuries the nexus of international trade. Catching seasonal monsoon winds, merchants and mariners linked the Middle East to China through India and ports of call in between.



Middle Eastern dhows, here in an illustration from a 13th-century Arab manuscript, dominated the Maritime Silk Route. Chinese ships did not play a significant role until the 12th century.

SCALE VARIES IN THIS PERSPECTIVE. DISTANCE FROM KHAMBHAT TO KOLLAM IS 1,000 MI (1,609 KM).

PRESENT-DAY PLACE-NAMES AND BOUNDARIES SHOWN

FERNANDO G. BAPTISTA, NG STAFF. MAP BY VIRGINIA W. MASON AND LISA R. RITTER, NG STAFF

SHIP RECONSTRUCTION CONSULTANTS: NICK BURNINGHAM AND MICHAEL FLECKER

BIBLIOTHÈQUE NATIONALE DE FRANCE (LEFT)

ON BOARD THE DHOW

A multinational crew of 20 or more, including Arabs, Indians, and Malays, likely served an Arab or Persian captain and navigator, who steered by the sun and stars in this pre-compass era. A Chinese merchant may have been a passenger, judging from personal items found in the wreck.

21 feet wide (6.5 meters)

56 to 59 feet long (17 to 18 meters)

Captain

Rudder

Bamboo deck

Oars

Stoneware jars and rice-straw bales held bowls.

Lead ingots, for ballast and trade, covered 18 silver ingots.

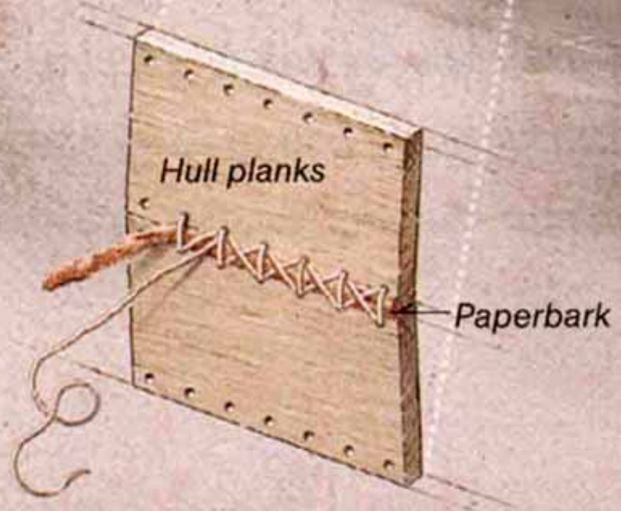
Frame

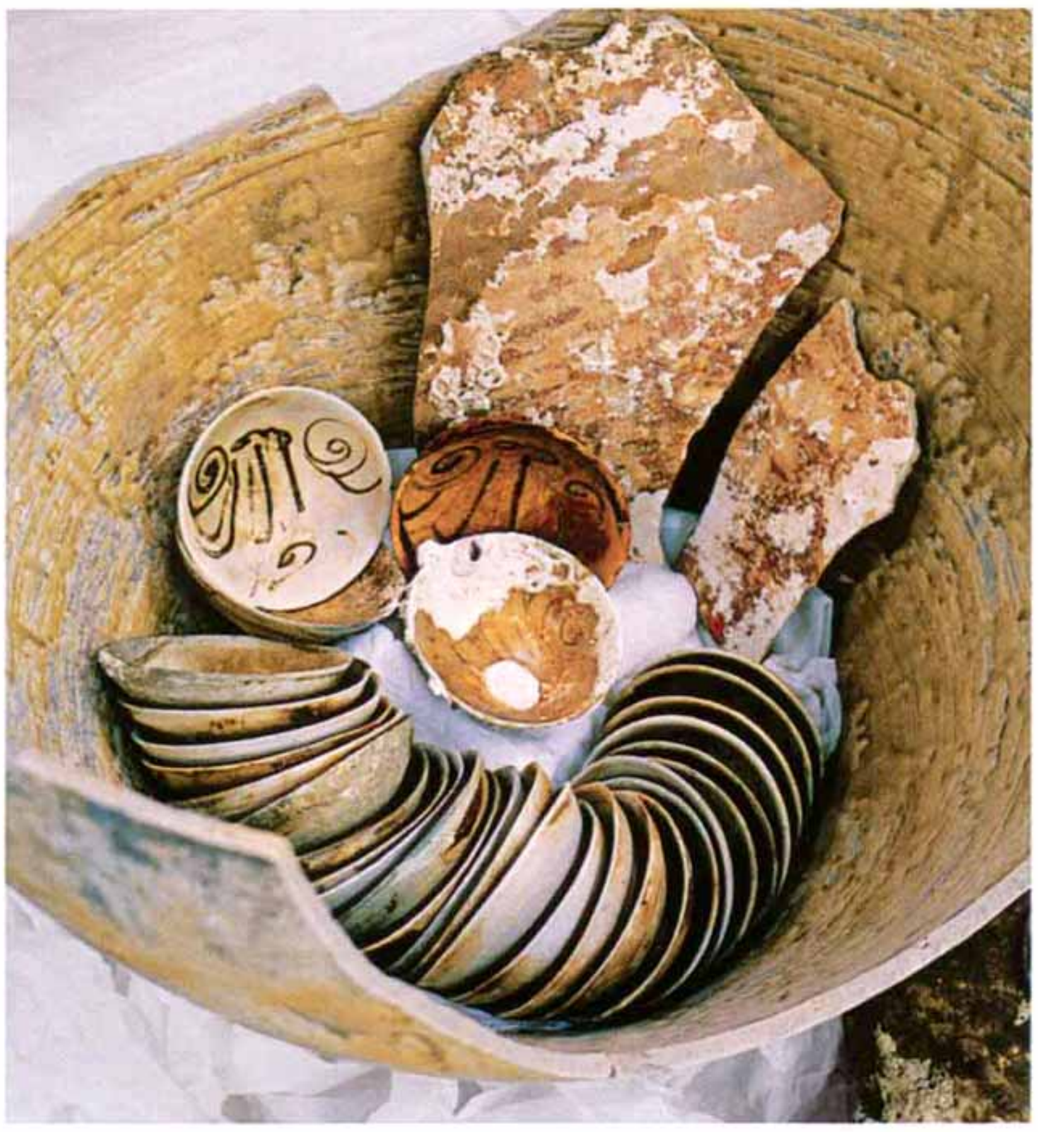
Keelson

Keel

Anchor constructed of iron and wood

Built perhaps in Oman, the ship was crafted from African hardwoods and Indian teak. Typical of dhows, no nails were used: Its planks and beams were sewn together, probably with coir, a coconut-husk fiber. Paperbark wadding helped seal the seams.





stoneware jars from the scouring action of sand on the seafloor. Sponged clean, their glazes shone as brightly as the day they were fired.

The handmade bowls give evidence of "factory-like production," says John Miksic, an American professor at Singapore's National University who is an expert on Southeast Asian archaeology. They are the earliest known exported examples of their kind. "The cargo also implies an organizer with managerial skill," Miksic says, "and huge quantities of imported raw materials." Cobalt for blue-and-white ceramics, for example, came from Iran; it was not recovered from ore in China until much later.

Although Arab mariners clearly plied the Maritime Silk Route, trading on a large scale over great distances, "this is the first Arab dhow discovered in Southeast Asian waters," says John Guy, senior curator of South and Southeast Asian Art at the Metropolitan Museum in New York, "and the richest and largest consignment of early ninth-century southern Chinese gold and ceramics ever discovered in a single hoard."

A reconstruction suggests the craft was similar to a kind of sailing vessel still found in Oman and known as a *baitl qarib.* Almost 60 feet long, with a raked prow and stern, it was built of African and Indian wood and fitted with a square sail. Its most distinctive feature was that instead of being held together with dowels or nails, its planks and beams were literally sewn together, probably with coir, a coconut-husk fiber.

The dhow's port of departure and destination are still uncertain. No logbooks survived, no bills of lading, no maps. But most scholars believe that it was bound for the Middle East, possibly the Iraqi port city of Al Basrah (now Basra). It probably set sail from Guangzhou, the largest of the ports linked by the Maritime Silk Route. In the ninth century an estimated 10,000 foreign traders and merchants, many of them Arabs and Persians, lived in Guangzhou.

Among the tens of thousands of Changsha bowls found in the wreck, one was inscribed with this message: "the 16th day of the seventh month of the second year of the Baoli reign," or A.D. 826 on the Western calendar. This is almost certainly when the bowl was fired. Then, as now, goods did not sit around on the wharf for long, so the ship probably embarked not long afterward.

The serial nature of the cargo (along with the bowls, it included 763 identical inkpots, 915 spice jars of various sizes, 1,635 ewers) and the geographic diversity of its production (from at least five kilns widely dispersed over China) suggest that these were export items made to order. Decorations show the eclecticism of the global market. There is something for everyone: Buddhist lotus symbols and motifs from Central Asia and Persia. Objects bearing geometric decorations and Koranic inscriptions were clearly aimed at the Islamic market. White ceramicware as well as green-splashed bowls and ewers are known to have been popular in Iran. One bowl was inscribed with five loose vertical lines, interpreted by some scholars as a symbol whose meaning resonates powerfully in today's world: Allah.

TRADE GOODS ***The ship carried some 55,000 bowls made for export in Hunan Province kilns. Most bowls are six to eight inches across, and many were packed in large jars (above). Fish, flowers, religious symbols, even poems, applied in copper- and iron-based glazes, decorate the stoneware.***

ARTFUL DESIGN *A tiny duck guards the inside opening of a drinking straw built into a 3.5-inch-tall cup, perhaps to keep out wine dregs. A splendid dragon-head stopper (right) may have been the original cap for this 35-inch-tall ornamental ewer of unique size and design.*

Like the shiploads of sneakers or electronics stamped "Made in China" today, most of the items recovered from the dhow were trade goods. But at the stern of the ship, divers found a trove of gold and silver and high-grade ceramics whose significance is more mysterious.

Peeling back a cloud of white, acid-free paper, Alvin Chia holds up a cup in gloved hands. "This is the largest Tang dynasty gold cup ever found," he says. Chia is an executive with Singapore's Sentosa Leisure Group, which joined with the Singapore government to beat out several museums and bought the entire cargo in 2005 for more than $30 million. It may one day be the core of a Maritime Silk Route museum.

Chia points out that two men depicted on the cup's thumb plate look Central Asian rather than Chinese, with long, curly hair and thick beards. On the cup's side panels are figures in motion: a Persian dancer clapping her hands above her head, musicians playing various instruments. In Tang China, Chia explains, music and dance from eastern Persia were all the rage.

A large, exquisitely decorated silver flask might offer a clue to the purpose of the hoard. "See the pair of mandarin ducks?" Chia asks. "They are a symbol of matrimonial harmony. On ornamental boxes everything is also in pairs: a pair of birds, a pair of deer, a pair of ibexes." Perhaps these were gifts for a royal wedding in the Persian Gulf—a bride's treasure of the sort rarely seen outside of China.

Since China first began trading with the world more than 2,000 years ago, it has opened and closed like a clamshell. During the Tang dynasty the clamshell was wide open and remained so for many centuries. A string of inventions—gunpowder, paper, printing, and cast iron—had set China on course to become the world's leading economic power. Trade with the West had steadily expanded, with Chinese seafarers taking an increasingly dominant role.

When the great admiral Zheng He set sail in 1405 with a fleet of 317 ships, China ruled the waves. "If you had been sitting in a spaceship looking down on Earth, and you had observed developments from the ninth to the 15th century," says John Miksic, "you would have thought that the Chinese would take the next step—explore the Atlantic and become the dominant world culture." But throughout Chinese history, there has been another, equally powerful force at work: a distrust of merchants and the foreign influences they import, dating back to Confucius, who believed trade and commerce should not dictate Chinese culture and values.

In A.D. 878, little more than half a century after the Belitung ship sank, a rebel leader named Huang Chao burned and pillaged Guangzhou, killing tens of thousands of Muslims, Jews, Christians, and Parsis. And not long after Zheng He's voyages, when Columbus reached the New World, the Confucian worldview won the day; China burned its fleet and turned inward. The Silk Road and the Maritime Silk Route, which had linked China to the world, lapsed into disuse. The Portuguese entered the Indian Ocean, and by the late 17th and early 18th centuries, Europe had begun to dominate world trade. "The whole of world history would have been different if the Chinese had not gone into their shell for 500 years," Miksic says.

Now China competes with India to be the world's workshop. China is open as never before and once again trading with its ancient partners in the Middle East. Iran, for instance, supplies 12 percent of China's oil. In return, Beijing provides machinery and locomotives, builds subways and railroads, and helps Tehran exploit its vast mineral resources, closing the loop from the ninth century, when cobalt was shipped from Persia to China for the blue-and-white ceramics found on the Belitung ship.

"The ancient networks are restored through industries and factories in a world that is now globalized," says Wang Gungwu, a historian at the National University of Singapore.

For how long this time is anybody's guess. □

SIGNS OF LIFE ***A bone die and inch-high ivory "acorns"—game pieces, perhaps—hint at amusements that helped pass idle hours for passengers and crew on the heavily laden vessel. The voyage ended as a total loss, but its remains enrich our vision of China's long trading history.***

DEEP SOUTH

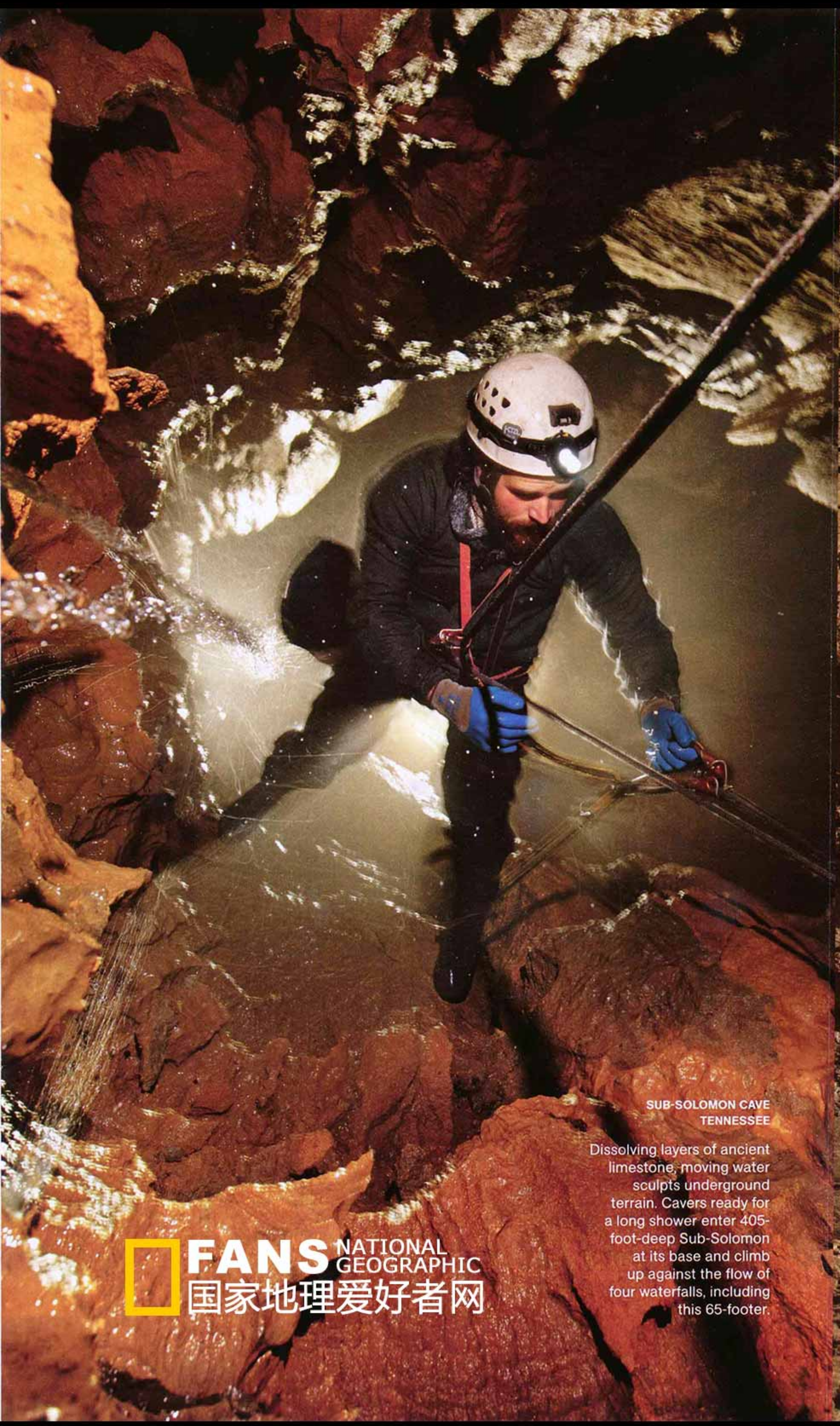
Hard-core cavers in three southern states stop at nothing to probe an underworld wilderness.

BY MARK JENKINS
PHOTOGRAPHS BY STEPHEN ALVAREZ

RUMBLING FALLS CAVE
TENNESSEE

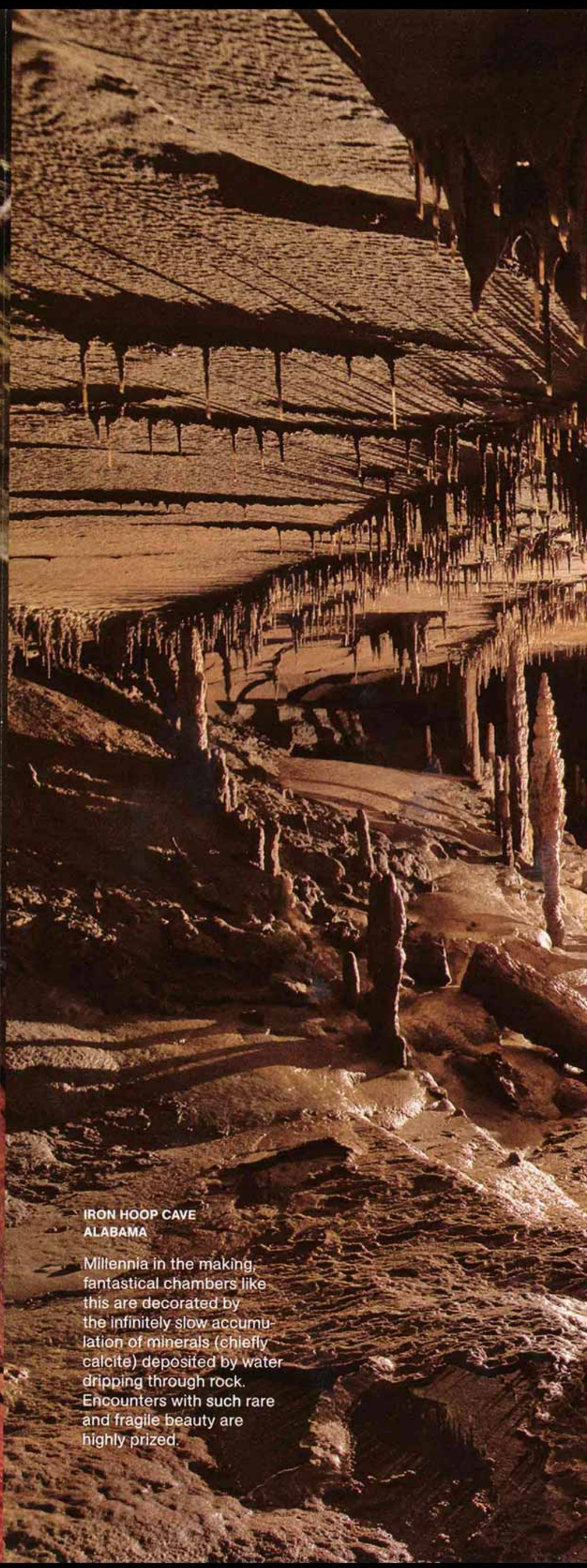
Far from the light of day, cavers illuminate the four-acre, 350-foot-high Rumble Room. Reaching the limestone cavern entails dropping down a 68-foot shaft, climbing up two 14-foot waterfalls, and stooping or crawling along 2,000 feet of passageways, some barely a foot wide.

PANORAMIC COMPOSITE OF FOUR IMAGES



SUB-SOLOMON CAVE
TENNESSEE

Dissolving layers of ancient limestone, moving water sculpts underground terrain. Cavers ready for a long shower enter 405-foot-deep Sub-Solomon at its base and climb up against the flow of four waterfalls, including this 65-footer.



IRON HOOP CAVE
ALABAMA

Millennia in the making, fantastical chambers like this are decorated by the infinitely slow accumulation of minerals (chiefly calcite) deposited by water dripping through rock. Encounters with such rare and fragile beauty are highly prized.


FANS NATIONAL GEOGRAPHIC
国家地理爱好者网

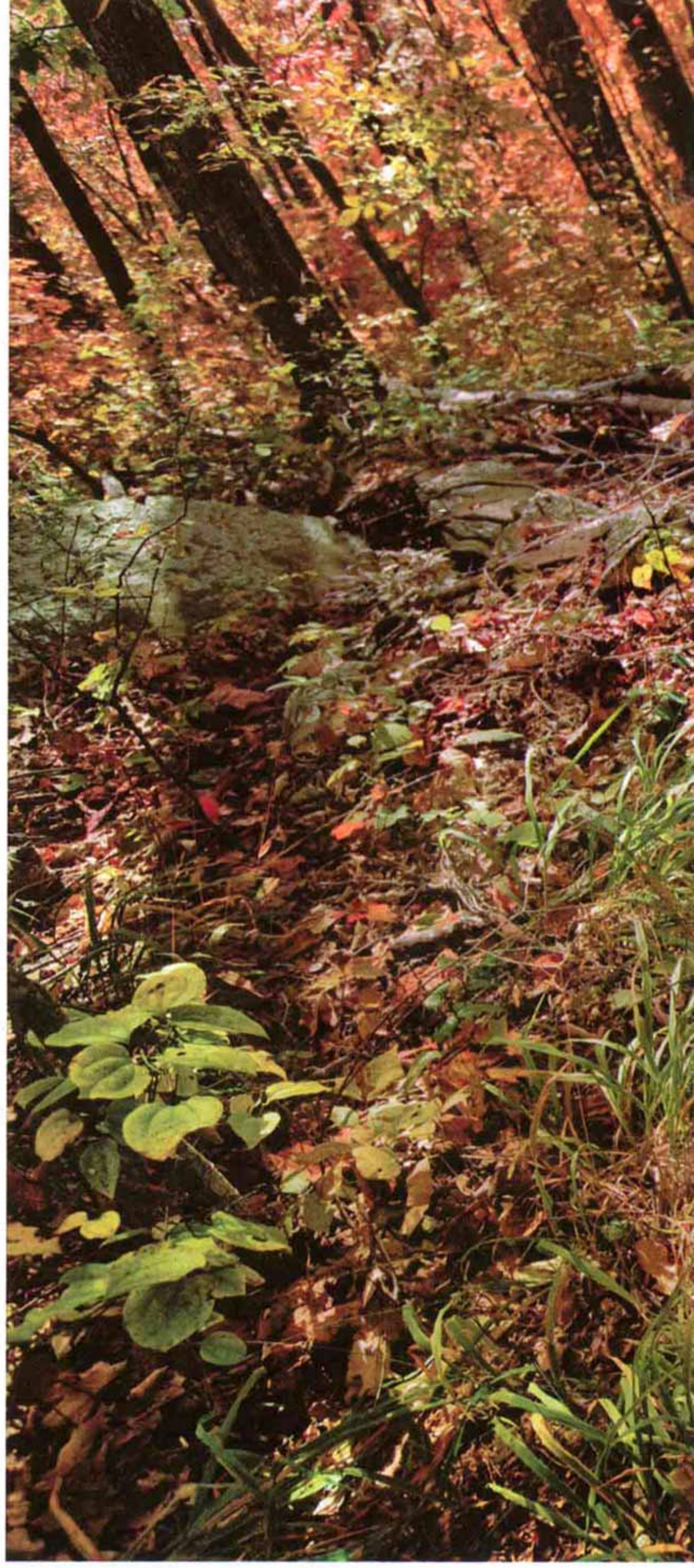
The Goat is squeezing through the Sphincter.

Groaning and clawing, neck twisted, white head scraping against the rock. To cram his body through this basketball-size hole requires yoga-like contortions—arms overhead as if diving, hips uncomfortably twisted the opposite of chest, legs cramped underneath. The Sphincter lies at the end of a kinked, intestinal tunnel, and Marion "the Goat" Smith is the last of our six-person exploratory team to wriggle through, a task he accomplishes with veteran agility and ceaseless cursing.

"Just so you know," Kristen Bobo turns to me, careful not to blind me with her headlamp, "the more Marion enjoys a cave, the more he cusses." Bobo, 38, is a master caver herself. Small as a child but strong as a miner, with big doe eyes that belie a will as unbendable as angle iron, she slithers through the Sphincter easy as a snake.

The Goat plops out into the dirt and proclaims in a croaky southern drawl, "What goes down must come up," which is Smith's wry way of saying that we're hundreds of feet under the hills of Tennessee, and we'll have to pass back through the Sphincter to get home.

A historian by profession, Smith, now 62, is loose-jointed, long, and lean, with skin so white you'd think he had spent his entire life underground. Which is pretty much the case. He started spelunking in 1966 and has been caving hard nearly every week since. He has explored more than 50 miles of virgin passage, most of it on his hands and knees. Gristly, indefatigable, and garrulous, Smith has ventured into more caves than any person in America.



Resting after the wrestling match with the squeeze, we switch off our headlamps to save battery life. A palpable blackness envelops us. Surface people never experience such impenetrable darkness. Up on the fair skin of the planet, even in the dead of night, there's always some light coming from somewhere. Starlight or moonlight or firelight or a wedge of kitchen light beneath the bedroom door. Eyes adjust. But not inside the stygian colon of the Earth. Here the darkness is so thick you can hold your hand an inch from your face as long as you like and you won't see it. This is an ancient, undisturbed darkness, a darkness that has been here since the dawn of the world.

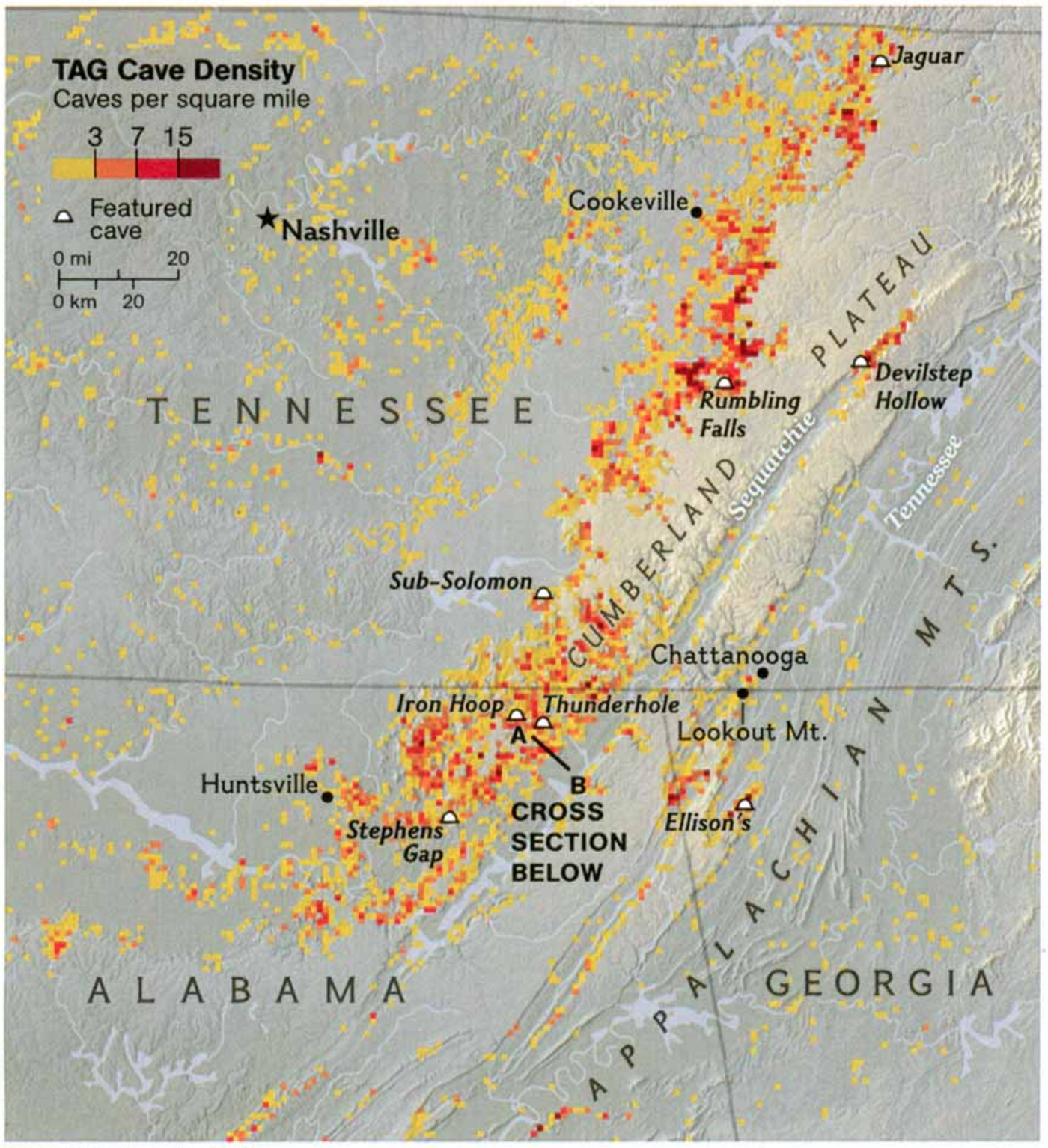
Marion "the Goat" Smith wriggles into an unexplored Tennessee cave.

We are in a newly discovered branch of Jaguar Cave, a maze of mad plumbing doglegging down through a thick layer of limestone beneath the farms and wooded ridges of north-central Tennessee. As pocked with holes as Swiss cheese, Tennessee is part of what cavers refer to as TAG, an acronym for Tennessee-Alabama-Georgia. These three states compose the southern end of a belt of limestone laid down hundreds of millions of years ago when the region was covered by an ancient sea. Where there's limestone there are bound to be caves, because limestone is susceptible to corrosion by slightly acidic water. Over millions of years this slow dissolution has riddled the bedrock with tunnels and chambers, creating a subterranean world in which the potential for exploration is almost limitless. There are more than 14,000 known caves in TAG—9,200 in Tennessee, 4,800 in Alabama, and 600 in Georgia—and there is a subculture of single-minded cavers eager to probe them all.

People have been exploring Jaguar Cave since prehistoric times, but the system is so vast that unknown conduits and million-year-old piping are still being discovered. Moving again, we crawl and climb and pull and push, eventually peeping out into a large cavern. Smith has a saying that "caves either drop, pop, or stop." This one pops. Even with our headlamps on high

STEPHENS GAP CAVE
ALABAMA

Two entrances beckon even novices: Walk in on the right, or learn rope skills and go vertical on the left. The sunlit pedestal drops three more stories to the cave floor.

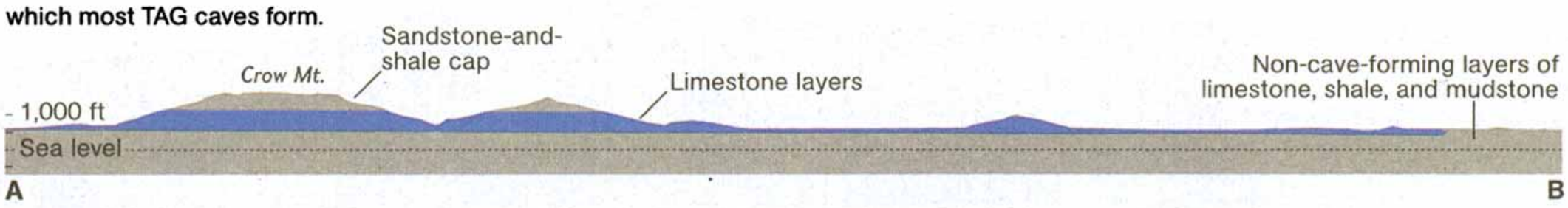


MARTIN GAMACHE, NG STAFF

SOURCES: ALAN CRESSLER, NATIONAL SPELEOLOGICAL SOCIETY; ALABAMA CAVE SURVEY; GEOLOGICAL SURVEY OF ALABAMA; GEORGIA SPELEOLOGICAL SURVEY; TENNESSEE CAVE SURVEY; USGS

Tennessee, Alabama, and Georgia—cavers call the area TAG—boast 14,665 known caves. The highest density of caverns (left) is found on the Cumberland Plateau. Generous rainfall and numerous rivers and streams meet layers of porous limestone lying under a sandstone cap (cross section below), creating textbook conditions for cave formation.

Cross section shows relative position of limestone layers in which most TAG caves form.



beam we can barely make out the walls around us. The chamber is the size of a small but very high-ceilinged gymnasium.

"Look up and right," directs Bobo. As we shine our headlamps onto a wet rock wall, a rope appears, dangling out of the upper blackness. One by one we ascend the rope. At the apex of the domed cavern we traverse along a sloping ledge over the invisible seven-story drop we've just climbed, then enter another tunnel. It's large enough that we can stand up and walk for more than a thousand feet before the passage is solidly plugged by a pile of boulders and dirt—a breakdown, where the ceiling has collapsed.

This is as far as any human has probed. Our team believes the passage continues on the other side of the breakdown, so our goal is to "push" the cave: Go beyond what is known into the invisible unknown. We divide into two parties, mappers and diggers. Smith and Bobo will survey the borehole; I volunteer to be a digger.

When it's my turn, I lie down on my belly and shimmy to the end of a hole beneath the breakdown. Flat on my stomach, the ceiling pressing down on my neck, walls forcing in on the sides, I hold the shovel stretched out in front of me and furiously jab at the dirt wall. Chunks of earth fall all around me as I dig like a berserk badger. Several times I fill a drag tray, pushing it beneath me and then backward with frog kicks, where it is emptied by the other cavers. But soon the hole is too narrow, and I dispense with the

The Tennessee River sculpts the east side of the Cumberland Plateau.

drag tray, instead using my hands as scoops to maneuver the dirt around my body.

After 30 minutes I've moved perhaps five feet forward, my arms are aching, and I'm soaked in sweat. I'm about to back out when my shovel breaks through. I feverishly round out the hole and cram my head through. There is a low, triangle-shaped crawlway ahead of me. Surging with adrenaline, I try dragging myself into this new passage, but my chest gets stuck.

From the beginning I have been hyperfocused on digging in order to stave off dark, horrifying feelings of claustrophobia. But now, stuck like a rat in the throat of a snake, a sickly anxiousness sweeps over me. I violently kick my legs, but to no avail: I'm swimming in dirt. I realize that by not using the drag tray to remove the dirt, I've buried myself.

I try to calm my racing thoughts, but my mind is preoccupied with the millions of tons of rock above me. I've been told that caves seldom collapse, and yet here I am, trapped at the bottom of a breakdown, in a cave that obviously did collapse. I try to slow my frantic breathing because I've also been told that hyperventilating expands one's lungs and only tightens the squeeze, which is exactly what's happening. Suddenly I'm thrashing shamelessly, kicking

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Mark Jenkins is a Geographic *contributing writer. Tennessee-based photographer Stephen Alvarez is completing a book on the world's greatest caves.*

and clawing and writing. I manage to knock off my headlamp, and everything goes black.

CAVERS AREN'T LIKE you and me. "I don't get claustrophobia," Kristen Bobo explains. It is twilight, and we're seated in wooden rocking chairs on her lush backyard lawn in Cookeville, Tennessee. "In fact, I'm very comfortable with a wall six inches or less in front of my face." Bobo, five feet four and 102 pounds, won the "squeeze box" competition in her age and weight class three years in a row. A fixture at caving festivals (bacchanals famous for cheap

Kristen Bobo knows caves, and steel. A gate helps control access to Tennessee's Devilstep Hollow Cave, protecting centuries-old Native American rock art from accidents and vandalism.

beer and champion bonfires), the squeeze box looks like a medieval torture device. Two sheets of plywood are placed one on top of the other like a sandwich, with the space in between adjusted in quarter-inch increments. Bobo can slide through a six-and-a-quarter-inch space.

Despite wearing a helmet, gloves, elbow pads, shin pads, kneepads, and a reinforced nylon suit, Bobo is covered with scrapes and bruises from our journey into Jaguar Cave. "That's the normal state of affairs," she says dismissively. "Cavers are too obsessed to worry about such trivial things. We all just want to go right back underground. We call it cave fever. You can see it in our eyes—a certain glow."

Bobo has explored more than 700 caves. In the process she has broken her back, torn muscles, snapped fingers and toes, and almost died from hypothermia. But what really hurts Bobo is when a cave is injured. In 2001 she visited a cave where the stalactites and stalagmites had been wantonly broken off.

"Hundreds and hundreds of formations that had taken a million years to form, destroyed. I looked around and was just overcome. I sat down and sobbed. For some reason man has the need to destroy things," she says with genuine sorrow. "Rare, very sensitive species not found anywhere else in the world live in the microclimates of caves. And there is archaeology! Like what we saw in Jaguar Cave."

We had entered the system through a secret hole high in the forest, rappelling 32 feet. After the rappel we slid down a jagged gully into the first of dozens of passageways, then followed the course of a swift underground river. As we moved along in a foot of water, Bobo pointed out the fauna: a cave cricket, pale and angular as a skeleton; a cave fish, an inch-long, pure white ghost; a slimy salamander, black as coal and covered in mucus.

In a large river passage with sandy banks on both sides, we examined prehistoric jaguar prints left by two animals as long ago as 35,000 years when they became trapped. Even more remarkable, 274 ancient human footprints have been discovered in a part of the cave called Aborigine Avenue, which is now closed to explorers. Dated at 4,500 years old, they are the oldest human cave prints in North America.

Sure enough, more recent visitors had also left their mark. Even though the ancient jaguar tracks had been surrounded by survey tape and stones, someone had intentionally tromped right through, obliterating most of them. The cave's main entrance is now barred by a massive steel gate—the first one Bobo helped to build. Her 2001 epiphany—that caves need protection—altered the course of her life. She enrolled in welding school, then apprenticed with Roy

Powers, a pioneering cave-gate designer. Today she is one of the leading cave-gate builders in the United States. Commissioned by state and federal conservation agencies, Bobo has built more than 50 cave gates, including the largest in the world, a steel barrier 84 feet wide by 32 feet high that spanned the entrance to Rocheport Cave in Boone County, Missouri, until it was destroyed in a flood a few years ago.

Bobo and her fellow TAG cavers are the equivalent of the climbers in Yosemite National Park: In the 1960s both groups developed skills and equipment that rocketed their recreation into a new realm of difficulty and danger. Marion Smith is one of the original TAG cavers. He freely admits that caving has not just been his pastime, it's been his life. Over the decades, he has explored more than 6,500 caves and kept meticulous records of them all.

Smith lives on Bone Cave Road in Rock Island, Tennessee. Ten caves are within walking distance of his home. "'At's why I moved here," he tells me the first time we meet. We settle in on his front porch, drink lemonade, and he talks without stopping about caves and caving. During his monologue I notice a green nylon loop around his ankle. Smith is barefoot, and it's evident that the loop cannot be removed.

"Call that a chicken loop," he explains, "after the coward in a group." Peering at me with liquid blue eyes over his thick, perpetually smudged glasses, Smith says that one time he got stuck in a "miserable crawlway, a big mushy mud passage that got too low for me to continue. I tried to back up, but the mud was so deep, I was just miring deeper. So I called out, 'Hey! Come in here and pull me out by my chicken loop.'"

EXPLORING THE UNDERWORLD below TAG's lush, low mountains and stream valleys is a struggle not just with rock and mud, but with water. For a lesson, Smith and two of his caving comrades take me into a wet cave with a river running through it. Heavy thunderstorms were predicted for the area. If a downpour happened to park itself over the top of us, we could be caught in a flooded cave. (In December 2007 two spelunkers in the Alum Pot cave system in Great Britain had died in exactly this scenario.) But Smith and his companions decide we should carry on. If the water starts to rise, we'll scramble to the ceiling of the highest cavern, hang out, and hope.

After three hours of traveling through passages coated in mud the color and texture of chocolate, we reach a vertical drop that requires climbing gear. No one has ever gone farther. We rig descent equipment and drop over a curtain of flowstone—the calcite substance that forms stalactites and stalagmites—into another, lower tunnel where the water and mud are deeper. Beyond lies a complex labyrinth of unexplored channels, and we set out to push to the end.

We explore perhaps 400 feet of virgin passage and come to a fissure that splits the floor. Shining our lights down through the crack, we can see water, but getting down to it will be difficult. Gung ho, I volunteer (as Smith knew I would). Chimneying, my back against one wall and knees against the other, I inelegantly slide down the crack into frigid water. My feet can't touch the bottom, so despite not having a wet suit, I'm obliged to swim. The farther I swim, the more the ceiling drops. Eventually my head is twisted sideways in a small airway. The water, black as ink, is malevolently slopping into my mouth. I go under, explore the wall with my hands to see if there is an opening, then burst back to the surface, banging my head on the ceiling, gasping for air and gulping instead.

"Guess you figured out TAG caving ain't for the weak of spirit," Smith says later, smiling like a giddy boy. "Most caves are flat out ugly, if you want to know the truth. They don't lead to grand flowstone formations or giant crystals or anything else beautiful you see in pictures. But we're always searching, and sometimes…sometimes you hit the mother lode…." Smith's voice trails off wistfully.

In 1998 Smith made one of the greatest discoveries in TAG in a quarter century. Pushing through a painful squeeze in Rumbling Falls Cave in central Tennessee, he broke out onto the lip of emptiness. The beam of his headlamp

THUNDERHOLE CAVE
ALABAMA

Prime qualification for cavers: tolerance for a tight squeeze. John Benson can make progress only with his helmet off and his head turned just so. He exhales, making his body as flat as possible, slides a few inches on his back, stops, inhales, and repeats.

ELLISON'S CAVE
GEORGIA

The 586-foot-deep pit dubbed Fantastic ranks as the longest single cave drop in the lower 48 states.

simply disappeared into the yawning darkness.

"I started throwing rocks off the edge and counting the seconds," Smith says. "I counted at least four seconds, which meant the drop was 200 feet or better."

Although Smith and his team didn't know it at the time, they had just discovered the Rumble Room, a cavern measuring some 350 feet, floor to ceiling, and four acres in size. Comprehensive records of cave sizes don't exist, but it's no stretch to say that the Rumble Room may well be the largest such chamber in the eastern United States and the second largest in the entire country. "It's the kind of discovery a caver dreams about his whole life," says Smith.

The itch to see what no one has ever seen before, "that's the main thing for most cavers," agrees Bobo. "There are so few places left up on the surface, but down here completely unexplored wildernesses still exist."

STUCK IN JAGUAR CAVE, I did calm down, eventually. I had no choice but to lie there and let my body go limp. My clothes were so slick with sweat I could slide inside them. With enormous effort I inched my chest forward inside my jacket and suddenly slipped into the far antechamber.

Crawling forward, I was soon stopped by another wall of dirt. I thought it was a dead end until the beam of my headlamp spotted a pinhole above me. Putting my face to the hole, I could feel air moving. Another of Smith's many caving maxims is "if it blows, it goes." I suddenly found myself digging fiendishly. I was awash with the overwhelming, visceral urge to push through and see what was on the other side—cave fever.

I hit rock immediately but managed to pull out several football-size pieces. Throwing my arms up through the hole, I twisted and turned and groaned and cursed, tore the skin on my chest and stomach, but, by God, popped out into an enormous chamber.

I was ecstatic, perhaps as much for getting through what we would eventually dub the Colonoscopy as for reaching a place no human had ever been. An hour later, with considerably more digging, the whole team made it through the Colonoscopy, and we began to properly explore the cavern. To the trained caver's eye, discoveries were everywhere: A pile of ancient bat bones. The skeleton of a prehistoric rodent. Stalactites of an unusual tubular form. An intact crinoid fossil, a seabed animal with feathery arms used for feeding.

A tiny hole beckoned at the far end of the new cavern, and Bobo, being the smallest, was eventually pushed through. We heard her screaming with delight. She had discovered helictites, pure white, spiderlike formations never before found in Jaguar Cave.

Lighting up the night with a massive bonfire, avid TAG cavers gather every fall on Georgia's Lookout Mountain. They celebrate adventure and the lure of the undiscovered country waiting underfoot.

"They are utterly gorgeous," Bobo exclaimed when she reemerged from the hole. "Tiny, delicate, like rare flowers frozen in time. And…" She was trembling with excitement and obviously had something else she couldn't hold inside. I looked over at the Goat, and he had a wild gleam in his eyes, like some nocturnal animal you catch a glimpse of just beyond the campfire. He knew what Bobo was going to say.

"The cave goes! I could see a passage continuing, I just couldn't fit through the hole." □

Fieldwork

National Geographic Society programs support scientific research, geographic exploration, and environmental conservation around the globe.

AFGHANISTAN Search for Buddha When the Taliban blew up two colossal Buddha statues in Bamian in 2001, Afghan-born archaeologist Zemaryalai Tarzi was devastated. He'd safeguarded them with steel reinforcements as the country's director of archaeology in the 1970s. Now Tarzi is determined to bring Bamian's other ancient riches to light. He returned there to begin new excavations in 2002, after 23 years in exile. His quest is for a third giant Buddha, one that's reclining and is believed to extend a thousand feet. Along the way, Tarzi is unearthing and restoring important reminders—such as this fourth-century Buddha head—of a diverse heritage and a more peaceful past. He hopes these discoveries will help his shattered country heal from decades of violence.

Find more at **news.nationalgeographic.com/fieldwork.**

MADAGASCAR
The lemur is the best known animal in this island nation. But conservationist Luke Dollar protects the fossa, a mongoose cousin that eats lemurs. The feared predator is crucial to the balance of shrinking forests.

SPAIN
El Castillo is home to prehistoric cave art dating back some 28,000 years. By analyzing stencils of hands adorning its walls, archaeologist Dean Snow found that many of the cave's Paleolithic-period artists were women, suggesting their role in prehistoric culture may have been greater than thought.

PERU
A rain-starved village outside Lima is coaxing water out of the air, with help from biologist Kai Tiedemann. The method: harvesting fog. Condensed on nets, fog provides enough water for nearly 700 fruit trees.

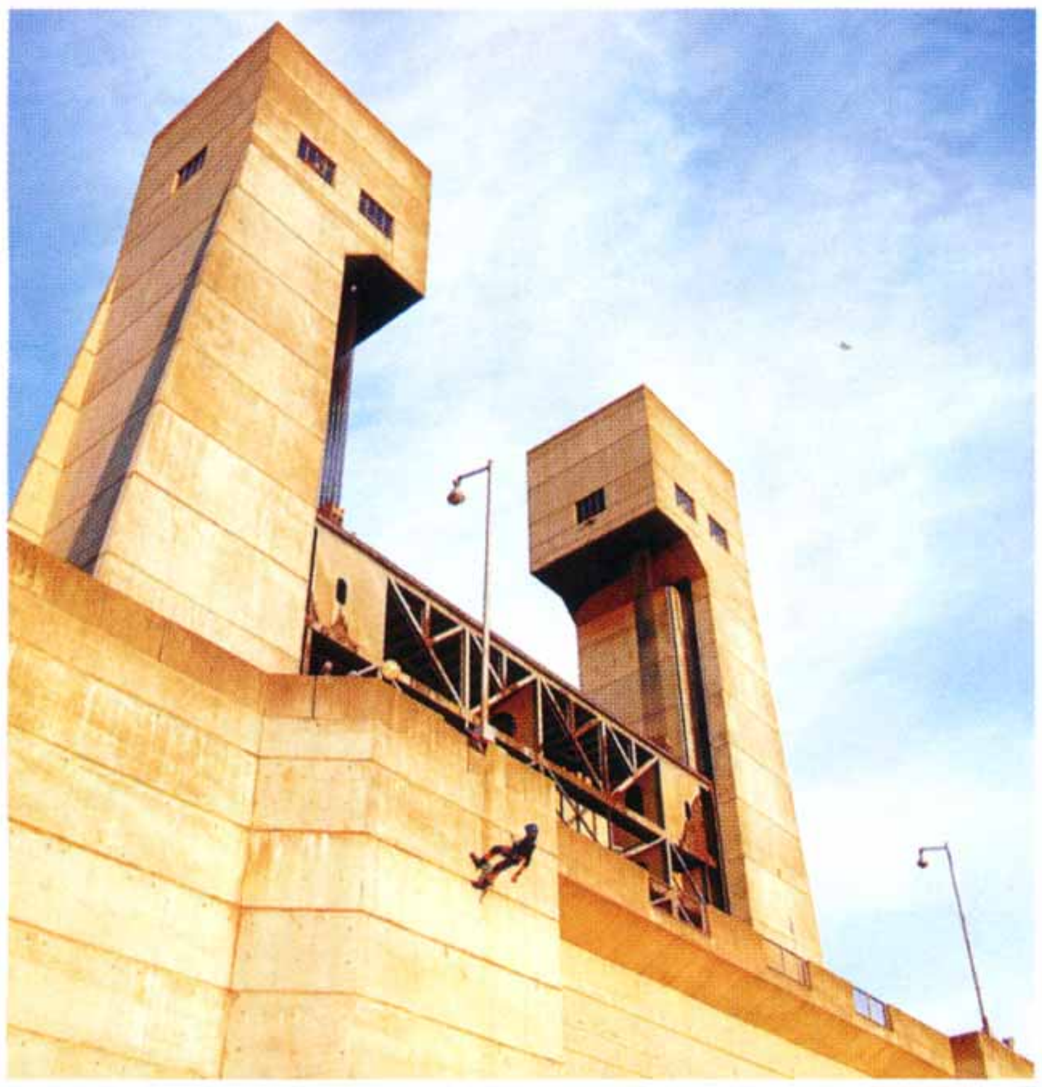
U.S.A.
A paradegoer's '50s skirt at the 2008 Mud Bowl in North Conway, New Hampshire, caught the eye of NGS Young Explorer Ross McDermott. He's documenting offbeat festivals for glimpses into small-town life.

This Year in NGS History

1968

Biologist Fred Urquhart gets funding to study monarch butterflies. He eventually solved the mystery of their migration: Hundreds of millions fly more than 2,000 miles to the same mountain range in Mexico every year.

PHOTOS: ZEMARYALAI TARZI (LEFT); ROSS McDERMOTT



Host Sean Riley rappels down Oregon's John Day Dam.

NATIONAL GEOGRAPHIC CHANNEL

Repair Mandates If a hurricane tosses a 300-ton barge onto shore, imperiling safety and the vital Mississippi River economy, you might need the "salvage cowboys." These inventive industrial crews, who say they "love the smell of demolition in the morning," do the work needed to fix big industry when it breaks down. No matter how great the challenge, they always get the job done. Join host Sean Riley on Thursdays at 9 p.m. to meet these unsung heroes. Upcoming new episodes of the *World's Toughest Fixes* series look at repair work on an Oregon dam (left), a Utah bridge, and the Alaska pipeline.

ON ASSIGNMENT **Rice Racket** John Stanmeyer took more than just pictures for this issue's "The End of Plenty" story—he also captured sounds. Field noise intrigues him, so after photographing Bangladeshi farmers beating rice stalks against wood to free the grains (above), he paused to record the din. "Photographs create sounds to the mind, and sounds produce images in our consciousness," he says. "The two have a brilliant dance together."

PHOTOS: NATIONAL GEOGRAPHIC CHANNEL (TOP); ADNAN, DRIKNEWS

INSIDE GEOGRAPHIC

Here are two of the winners chosen from 222,932 entries in the National Geographic International Photography Contest. More images are at *ngm.com.*

PLACES

Aleš Kreže Slovenia

After walking around Paris on a long August day, he came to the amusement park in the Jardin des Tuileries just as the sun was setting.

PEOPLE

Ilvy Njiokiktjien Netherlands

In pursuit of a photo, she waited 45 minutes by the wall of a mosque in Mozambique. Her reward: two women walking by, as if in sync.

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FLASHBACK

Eyes on the Pies Patrons line up "like payday depositors" in a bank, waiting to drop a few nickels in a slot for favorites like baked beans and Salisbury steak, freshly made each day and kept in "post-officelike boxes." This New York City Automat, described in the March 1942 *National Geographic,* was part of an East Coast chain that sold 72,000 pieces of pie a day. Inspired by German "waiterless restaurants," Joseph V. Horn and Frank Hardart opened the first U.S. Automat in Philadelphia in 1902 and soon built an empire. But by the '60s, other fast-food joints were luring customers; the last Manhattan outlet closed in 1991. Automats live on in Amsterdam and returned to New York in 2006 at an East Village locale. *—Marc Silver*

Flashback Archive Find all the photos at **ngm.com.**

PHOTO: J. BAYLOR ROBERTS, NATIONAL GEOGRAPHIC STOCK

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