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NATIONAL GEOGRAPHIC

Can We Fly?



Saving Orphan Elephants 40

Forever Wild in the Adirondacks 80

Girl Power in Brazil 96

The Race to the South Pole 122

Lords of the Sahara 136

The 2011 Guide to Automotive Advancements

Electric Vehicles, Hybrids, Plug-in Hybrids and Fuel Cells – How to Navigate New Driving Technology

By M. Desmond Roth

The numbers drive home the stakes: by 2035, there will be an estimated 1.6 billion cars on the road throughout the world.¹ If every one of these cars was fueled by a gas engine, CO₂ emissions would reach an estimated 8.2 billion metric tons per year.²

Yet it's been estimated that if every one of those cars was powered by hybrid technology, combining an electric motor with a gas engine, those emissions could be cut nearly in half.³

Scientists today can agree that reducing gas consumption and relying on alternative fuel technology are critical to reducing greenhouse emissions and stabilizing the climate.

At the core of the latest advances is hybrid technology, which forms the foundation for next-generation cars powered by electricity, hydrogen and biofuels.

The Next Big Thing: Plug-in Hybrid

There will soon be a hybrid for nearly every driver's needs as costs and performance metrics compete with conventional gas engine vehicles. Toyota is launching 11 different hybrid models globally in two years starting from 2011, seven of which will be all-new, not merely the next generation of an existing model.

Going one step further is the Prius Plug-in Hybrid (PHV) which is currently the subject of an international 600-vehicle demonstration

program which began about a year ago and will run until the vehicle goes on sale approximately this time next year.

Offering the latest technological innovations of the current Prius, the Prius PHV currently being demonstrated adds a high-capacity lithium-ion battery that enables the vehicle to travel up to 13 miles on electric energy only, and can be recharged by plugging into a standard 110v home electric outlet or a 220v charging station. The Prius Plug-in can operate in all-electric mode at highway speeds of up to 60 mph, producing zero emissions during

short commutes. When the EV-only portion of the battery is drained of power, the vehicle defaults into Prius-mode, with conventional hybrid gas-electric power delivery and a combined fuel economy of approximately 50 mpg.⁴

Emissions-Free in EV Mode, Stress-Free in Hybrid (HV) Mode

The Prius Plug-in Hybrid demonstration vehicle can be fully recharged with a household electric outlet of 110v in just 3 hours. With a 220v outlet, it takes just one and a half hours to fully recharge – ultimately allowing for emissions-free driving in EV mode and stress-free driving during out-of-town weekend trips in HV mode.

Now imagine driving an SUV that can drive 430 miles⁵ per fueling, and releases nothing more than water. That's what current U.S. test drivers are experiencing

with the Fuel Cell Hybrid Vehicle (FCHV-adv).

Relying solely on batteries and hydrogen, the FCHV-adv car is powered by the electrical energy created by the chemical reaction between hydrogen and oxygen, which forms zero-emissions water vapor that is passed out the tailpipe.

"It's no longer a question of will these plug-in and hydrogen vehicles happen or not. It's about how quickly the market will grow, and how big their numbers will get," says Tim Lipman, co-director of the University of California - Berkeley's Transportation Sustainability Research Center (TSRC).

Toyota plans on launching its fuel cell model no later than 2015, once all testing of safety and reliability features are complete.

Not Just Greener – Better

While the ecological benefits of the Plug-in Hybrid and Fuel Cell

Hybrid Vehicle are generating excitement among environmentalists and government officials, the technology and practical advantages are helping build enthusiasm among test drivers around the world.

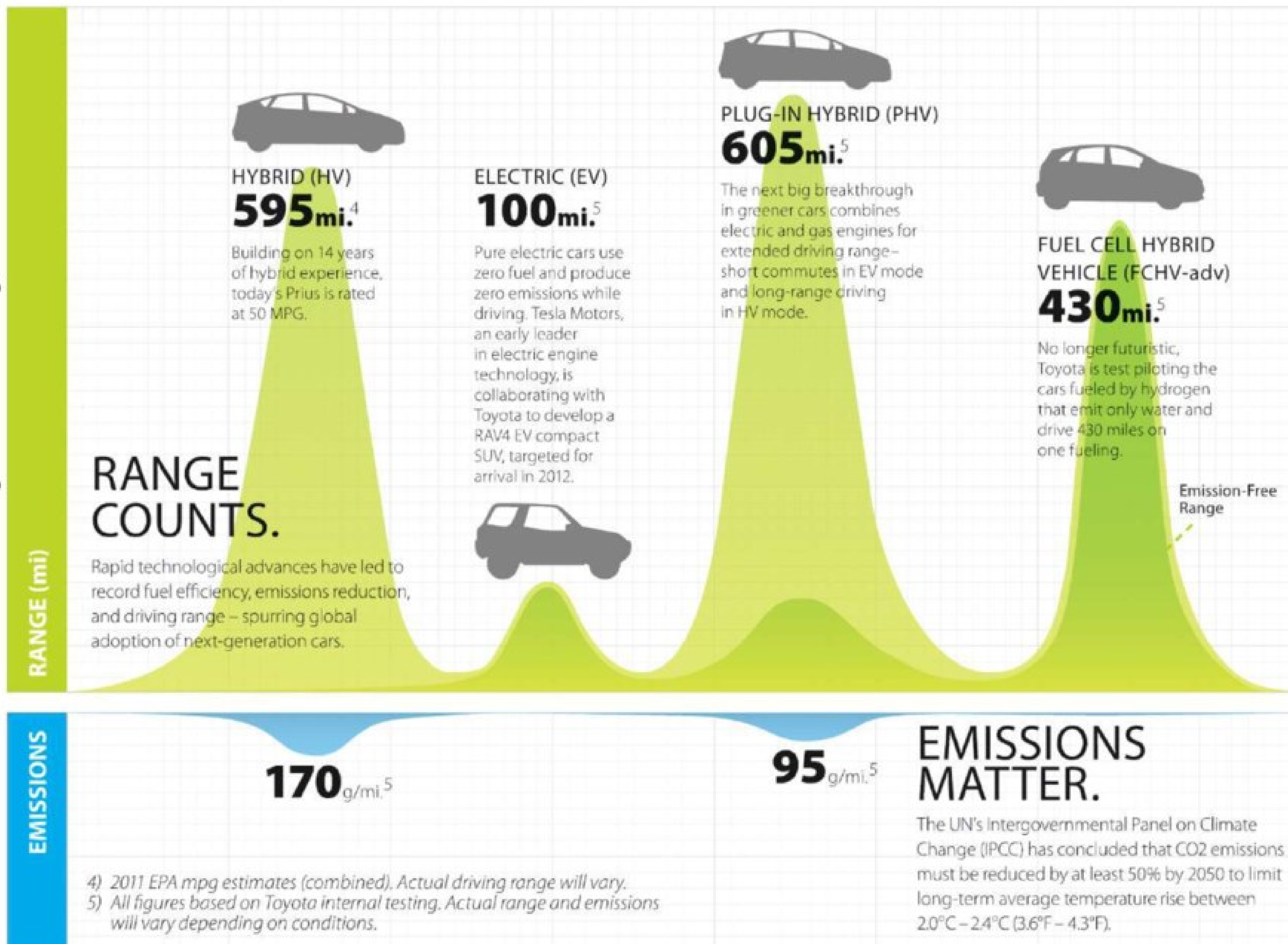
"Our studies tend to show that once people are exposed to these next-generation cars, their general impressions go up," says Lipman, who oversees a pilot program for the Prius Plug-in Hybrid and Fuel Cell Hybrid Vehicle.

After experiencing the fuel efficiency, quiet engines and smooth acceleration, test drivers report that the cars are not just greener – they're better.

"There's a market segment that will buy a clean car, but a much bigger market segment will buy a better car. That's where the prospects are good for these greener cars."

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The Road Ahead: Meeting the Needs of

It may be hard to imagine, but over a century ago, sales of electric vehicles outstripped gas-driven car sales in the U.S.

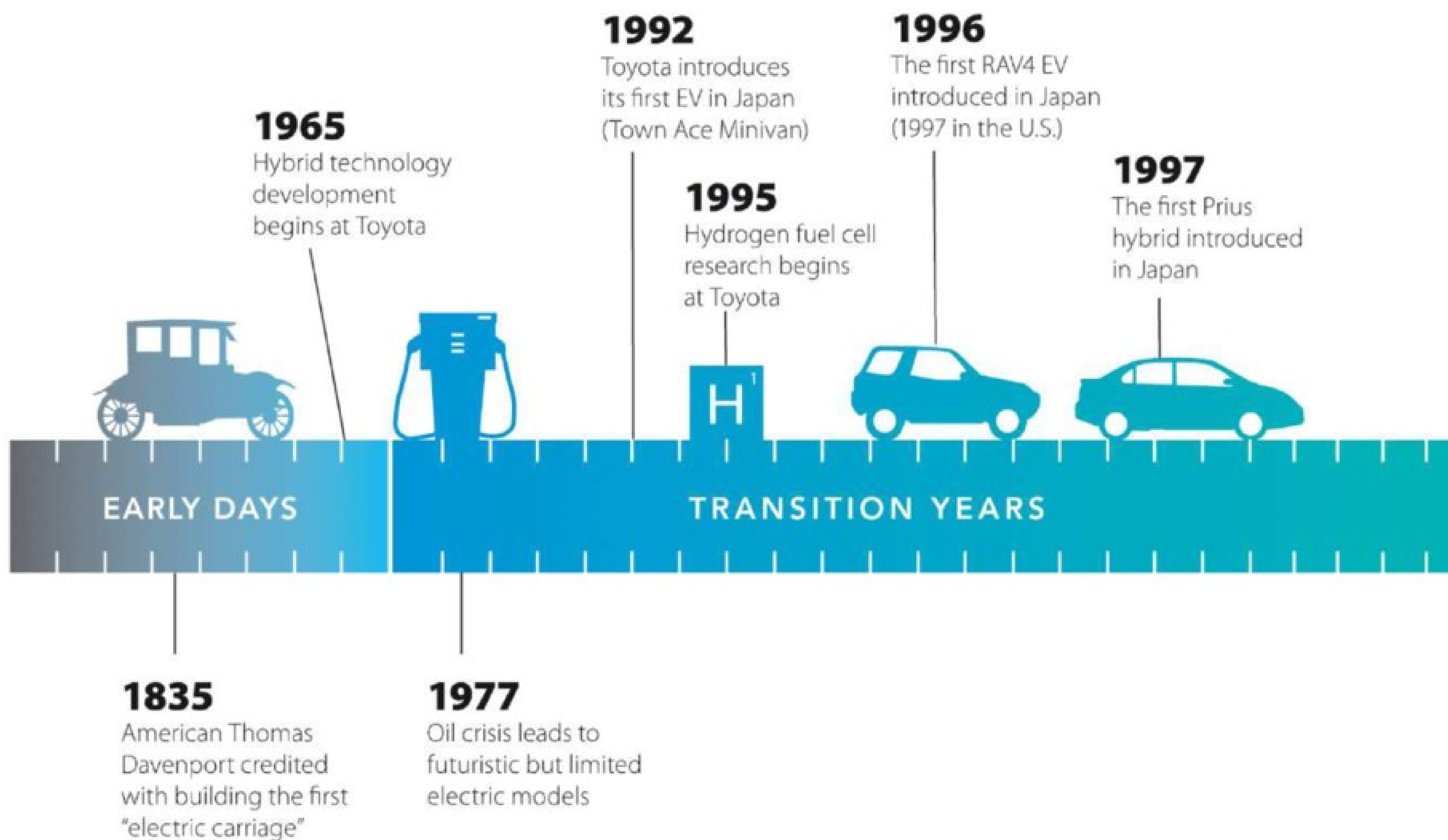
It would take six decades before electric cars would make their comeback, driven by the oil crisis of the 1970s, which set in motion two decades of experiments and futuristic new model launches. But the cars all came with limitations and costs that prevented them from catching on.

It wasn't until 1997, when the first Prius hybrid rolled onto the streets of Japan, that a practical eco-conscious car finally arrived. By bridging the gap between

At the turn of the 20th century, as many as 30,000 electric cars took to the roads, including a fleet of New York taxis. But when mass production of petroleum cars

began in the early 1900s, electric cars simply couldn't compete. Gas-fueled cars cost half as much and could travel further and at faster speeds.

The Evolution of Greener Cars:



SOURCES: 1) International Energy Agency (IEA). World Energy Outlook 2010, "Policies Scenario." Estimate is for total "passenger light-duty vehicles" on the road worldwide. 2) U.S. Environmental Protection Agency (EPA) estimates 5.10–5.20 metric tons CO₂ per vehicle-year for the average vehicle on the road today. Calculation: 1.6 billion cars multiplied by 5.15 metric tons equals 8.2 billion metric tons. 3) Estimates based on U.S. De-

Tomorrow's Driver

electric and gas engines, the Prius became an immediate hit – selling more than 100,000 units with its first model and reaching the two million mark by 2009. The car soon became an international symbol of environmental progress.

Today, the electrification of the passenger car is moving rapidly in many directions. Recent advances in lithium-ion battery technology have helped re-launch electric cars. Tesla Motors, an early leader in

electric engine technology, is collaborating with Toyota to develop a RAV4 EV compact SUV, targeted for arrival in 2012.

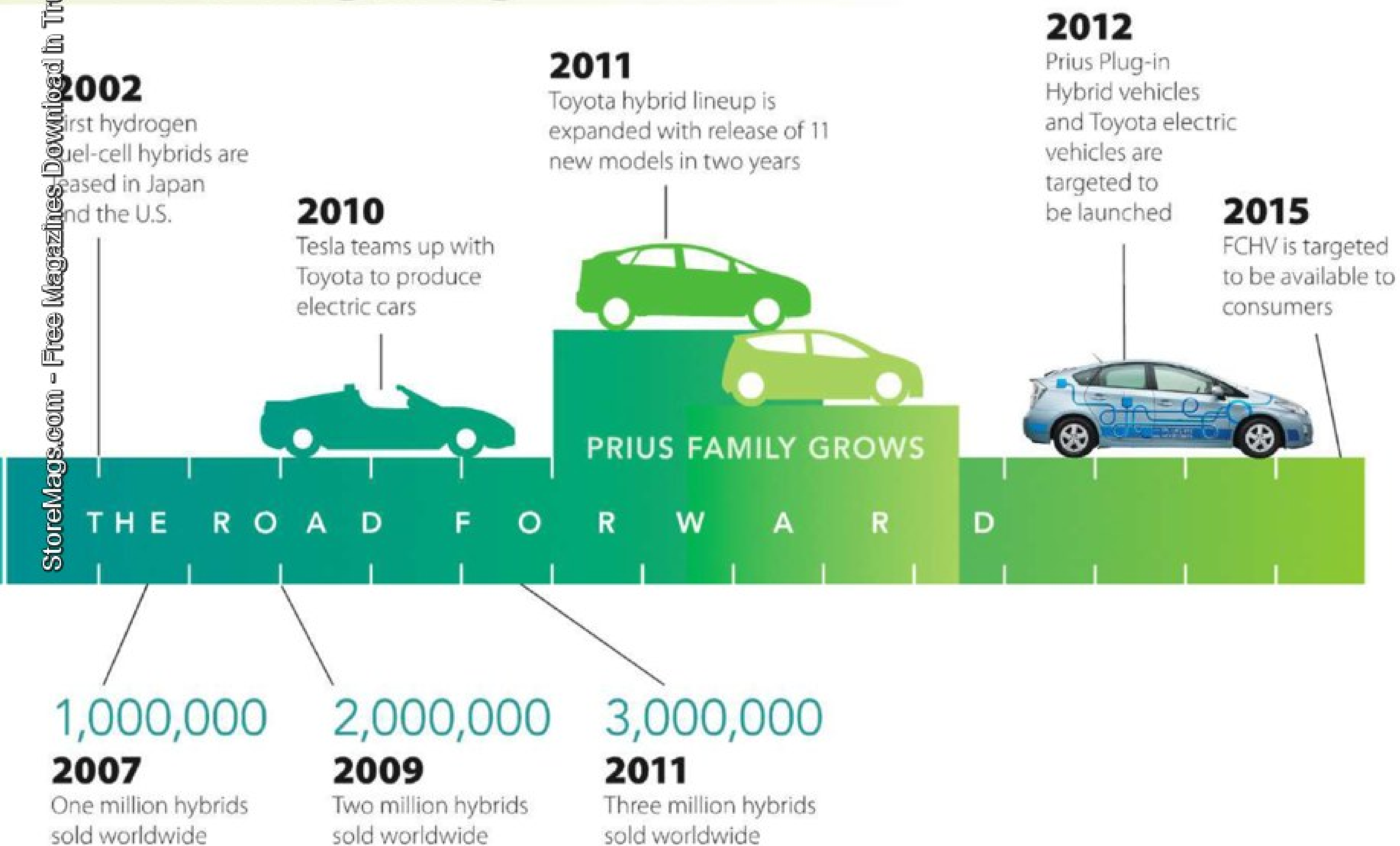
Clearing the Horizon

In the end, in order to meet international fuel efficiency standards, "there has to be a massive global adoption of hybrids," says Bradley Berman, editor of HybridCars.com. For mass adoption to happen, consumers must have choices that are accessible and meet their daily needs.

Building on 14 years of advances in hybrid car technology, Toyota continues to pioneer the technological advances that expand choices to meet the needs of all people. The company's complete range of hybrid technology is at the core of plans to create eco-conscious cars across its lineup, each one moving us further away from dependency on gasoline, and each one improving the air we breathe. That will mean a clearer horizon for everyone.

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A Timeline



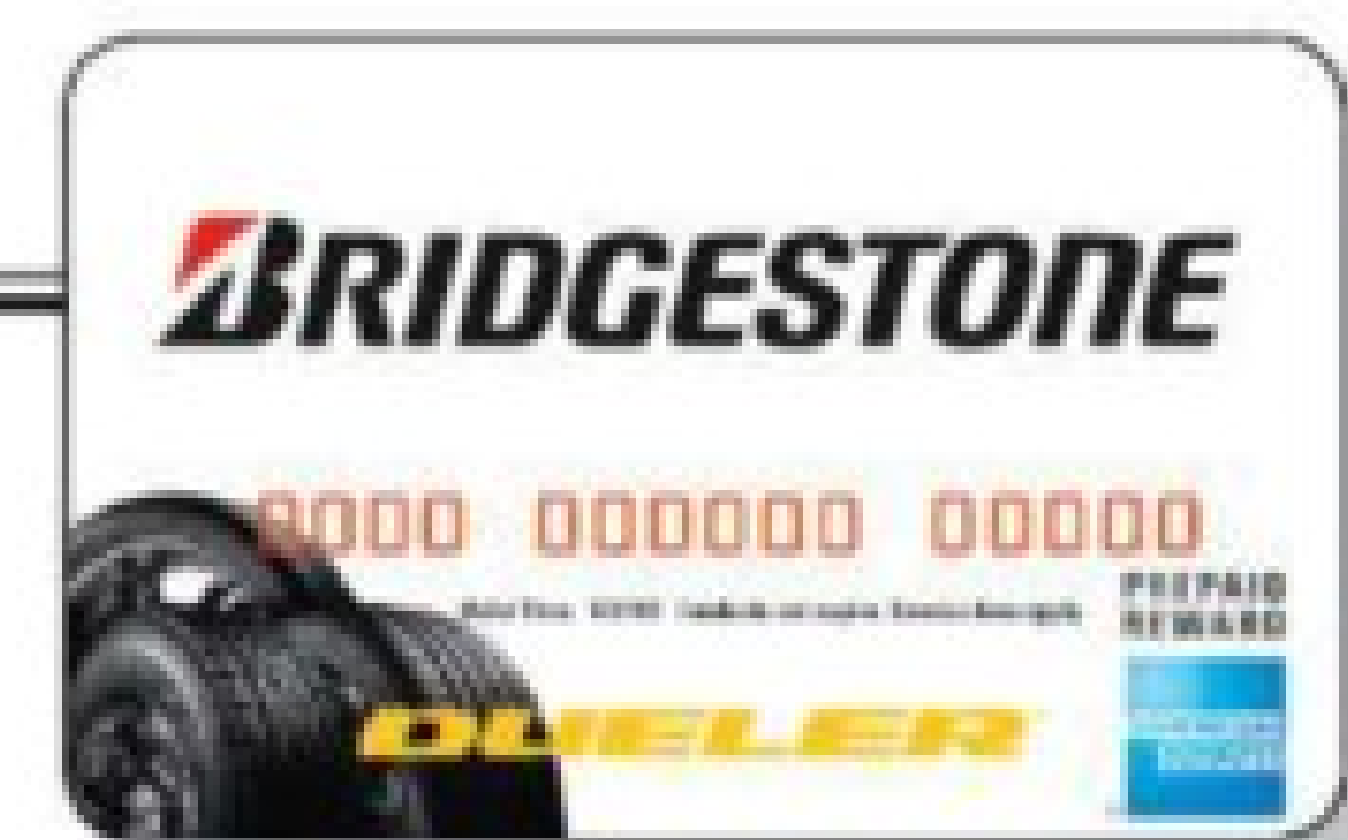
Department of Energy (DOE), Argonne National Lab, GREET 2010 figures. 4) 2011 EPA mpg estimates (combined). Actual driving range will vary. 5) All figures based on Toyota internal testing. Actual range and emissions will vary depending on conditions. ©2011 Toyota Motor Sales & Marketing Corporation



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DUELER



HERBERT PONTING, NATIONAL GEOGRAPHIC STOCK

To entertain the men, Captain Robert Scott took a gramophone on his South Pole expedition. Chris, one of his dogs, was apparently also a fan.

September 2011

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40 Joy for Orphan Elephants

With the right kind of milk (and the right kind of love), a traumatized calf can make it.

By Charles Siebert Photographs by Michael Nichols

66 If We Only Had Wings

From da Vinci to NASA scientists, humans dream up schemes to soar like a bird. Are we there yet?

By Nancy Shute

80 Miracle of the Adirondacks

New York's park is blessedly remote, divinely beautiful, and unbelievably complicated.

By Verlyn Klinkenborg Photographs by Michael Melford

96 Birth of a New Brazil

Big families are out. Credit strong-willed women—and the steamy soap operas that inspired them.

By Cynthia Gorney Photographs by John Stanmeyer

122 The Race to the South Pole

A century ago Scott lost and Amundsen won—partly because he knew when to turn back.

By Caroline Alexander

136 Lost Lords of the Sahara

The fiercely independent Tuareg struggle to survive amid the turmoil of North Africa.

By Peter Gwin Photographs by Brent Stirton

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An Adélie penguin jumps off an iceberg.

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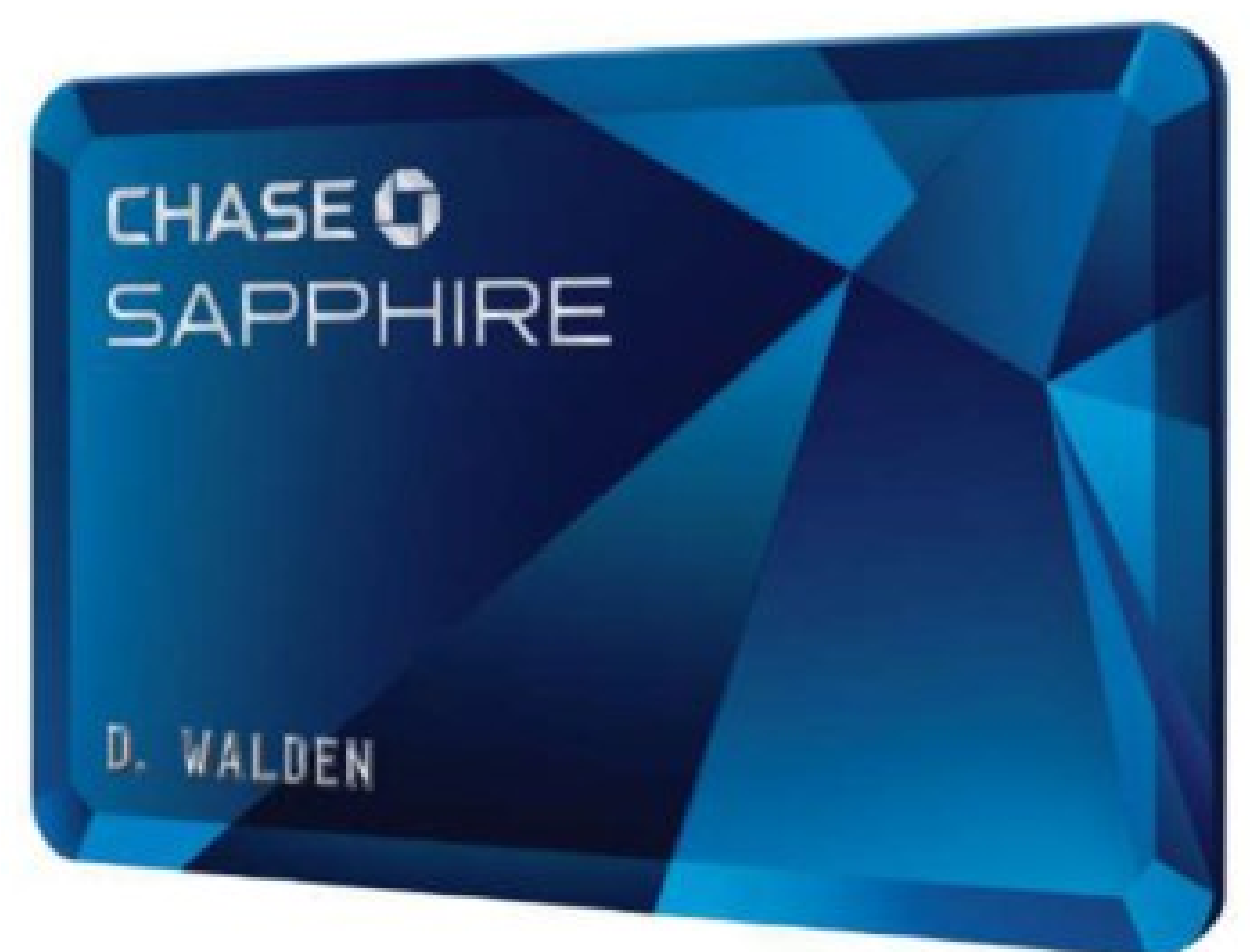
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DEPARTMENTS

- 4 **Editor's Note**
- 6 **Letters**
- 8 **National Geographic on TV**
- 10 **Voices of 9/11**



12 **VISIONS**

- 18 **Your Shot**
- 20 **Photo Journal** ▶

24 **NOW**

Green Medicine ▶

DNA analysis of pills from an ancient shipwreck shows traces of veggies.

China's Perfect Mummy

A mysterious fluid may be the beauty secret of a Ming dynasty woman.

◀ **March of the Stinkbugs**

First seen in Pennsylvania, they're now in 34 states. Can they be quashed?

Shake It Off

A twist of the head is the start of a dog's elegant, effective drying mechanism.

Smart Girls

One extra year of school can be transformative for girls in the developing world.

Starry Skies in Sark

Sark, in the English Channel, is the first island to be named a Dark Sky Place.



34 **NEXT**

Playing With Fire

Simulated wildfires can reveal the weak spots in a home's defenses.

A Suit Made for Walking ▶

A wearable robot called eLEGS could put paraplegics back on their feet.

Packing for Deep Space

It's a one-way trek. Don't forget zippers, ringtoss, and birthday presents.



- 154 **NG Connect**
- 156 **The Moment**
- Flashback**

E-GEOGRAPHIC

Here are the coolest extras in our electronic editions.

Starting From Ground Zero

Read the stories of survivors—and the objects they kept from that day. ngm.com

Bringing Up Baby Elephants

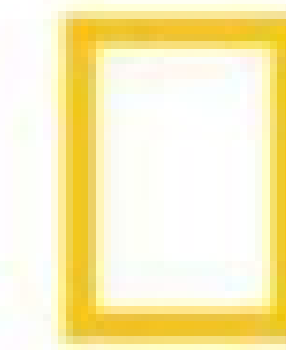
Our video shows how the keepers nurse their charges back to health. ngm.com

New Orleans, Then and Now

See photographer Tyrone Turner's portrait of a street in 2006, a year after Katrina hit, and in 2011. ngm.com + iPad

Mush With the Polar Men

An interactive map takes you along Scott's and Amundsen's routes to the South Pole. ngm.com + iPad



On the Cover

"I steer myself in space with only my body," says pilot Yves Rossy, who invented his jet-powered wings. *Photo by Alain Ernoult*

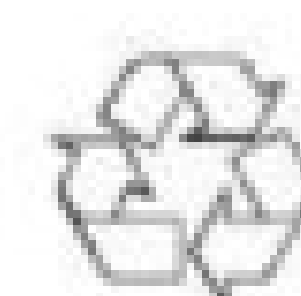
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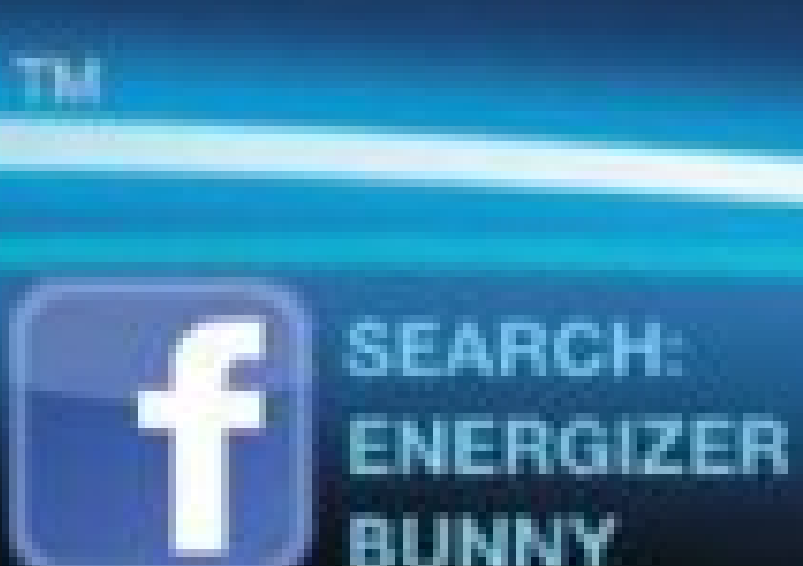


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EDITOR'S NOTE

Baby Elephant Walk

One chilly evening some years ago in Zambia, I met a baby elephant wrapped in a red blanket. At first Lilundu didn't like me. She seemed to feel I had inserted myself between her and the lodge owner who'd rescued her. If I stepped between the two of them while we were all walking along the Zambezi River, she'd push me out of the way. She had no intention of sharing him. She knew somehow that he'd saved her after she'd lost her mother to poachers. When locals brought Lilundu to the lodge, the owner agreed to care for her.

How do you heal a traumatized orphan elephant? Only one person had the answer: Daphne Sheldrick, who runs an elephant orphanage in Nairobi National Park. She sent a recipe for baby elephant formula, along with advice for Lilundu's care. In a few days, Daphne's expertise and the lodge owner's care transformed the youngster. She began to thrive.

This month, writer Charles Siebert and photographer Michael Nichols explore Daphne's orphan elephant rehabilitation center, the Nairobi nursery of the David Sheldrick Wildlife Trust. "Elephants are very human animals," Daphne says. "Their emotions are exactly the same as ours, right down to the post-traumatic stress they suffer."

I now understand why the little elephant under the red blanket was so possessive of the man who had rescued her. Lilundu eventually accepted me too, but on her own terms, and allowed me to accompany her on long walks—just the two of us along the Zambezi River.



How do you heal a traumatized orphan elephant?

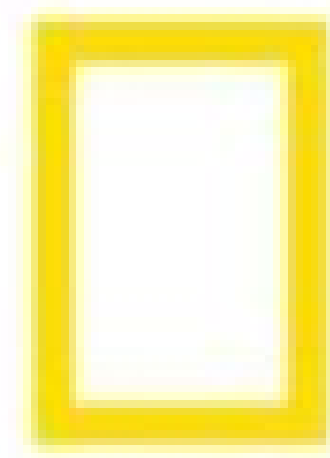
Lilundu the orphan elephant found a safe place after her mother was killed.

Charles Siebert

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Yosemite

Your story emphasizes the new breed of rock climbers who consider El Capitan an “international proving ground.” You note that many are superb athletes who train like Olympic gymnasts. Yet approximately 20 parties require evacuation by search-and-rescue teams in Yosemite each year. Given the fatalities and injuries involved, I wonder how search-and-rescue personnel feel about BASE jumpers who leap illegally from Half Dome because it’s faster and more fun than having to hike “all the way down the back of the mountain.”

EDWARD DAVIS
Oscoda, Michigan

climbing techniques to protect the park’s iconic big walls.

JONATHAN B. JARVIS
Director
National Park Service
Washington, D.C.

I was dismayed to see you feature the so-called free soloists. They are amazing climbers, but they are certainly not free. It is obsession, not challenge, that they pursue. The proof of this is that they engage in their sport without safety and therefore without regard to the grief their deaths would inflict on their fellow climbers, their families, and their friends—not to mention the loss of such obviously able people to society. These “free” soloists are playing Russian roulette with rocks.

JEFF BARRY
Acton, Massachusetts

The elite climbers in your article are a rarity among the thousands of recreational climbers Yosemite welcomes every year. Even rarer—since it’s illegal—are the BASE jumpers pictured. BASE jumping has nothing to do with the sport of rock climbing. And while you note that it is illegal, including the photo and the comment that it is “more fun” than hiking all the way down the mountain suggests you condone this activity, which is prohibited in the park and

poses serious safety concerns. Conservation and climbing have been inextricably connected since John Muir first ascended Cathedral Peak in Yosemite Valley in 1869. Your article missed an opportunity to share the story of the cooperation between climbers and park managers to preserve Yosemite’s vertical wilderness. Many climbers return to Yosemite yearly and have worked with the National Park Service to develop and improve low-impact

Corrections

MAY 2011: A FRAGILE EMPIRE
Page 45: The turtle shown is a loggerhead, not a hawksbill.
Pages 46-7: R. J. Beaman and David Hopley, both of James Cook University, should have been credited on the map.

FEEDBACK *These numbers reflect opinions found in your letters about our Yosemite coverage.*

14

Thought
dangerous behavior shouldn’t be glorified

10

Took offense
at the BASE-jumping photo

7

Found
the article unsettling

6

Disagreed
that Yosemite forges “heroes”



Asked
“What if they get a cramp?”

EMAIL ngsforum@ngm.com **TWITTER** @NatGeoSociety **WRITE** National Geographic Magazine, PO Box 98199, Washington, DC 20090-8199. Include name, address, and daytime telephone. Letters may be edited for clarity and length.



Mexican Prairie Dog (*Cynomys mexicanus*)

Size: Head and body length, 38.5 - 40 cm (15.2 - 15.7 inches); tail, 8 - 11.5 cm (3.1 - 4.5 inches)

Weight: Males approx. 1.2 kg (2.6 lbs); females approx. 0.9 kg (2 lbs) **Habitat:** Endemic to the valleys and flat areas of a small region in Mexico's northeastern plateau **Surviving number:** Unknown; population declining



Photographed by Carlos J. Navarro

WILDLIFE AS CANON SEES IT

Who are the top dogs in town? In the case of the Mexican prairie dog, it is the dominant males who rule their family groups. These groups form a colony, or "town," that covers about seven square miles on average. Members of this southernmost prairie dog species spend their lives in close contact, whether foraging for grasses or sharing living quarters. When a bird of prey, coyote or badger appears, a lookout posted at the burrow entrance

calls out and the colony rushes to safety underground. But when it comes to the dire threat of habitat loss, there is no such simple escape: some 80% of its habitat has already disappeared.

As we see it, we can help make the world a better place. Raising awareness of endangered species is just one of the ways we at Canon are taking action—for the good of the planet we call home. Visit canon.com/environment to learn more.

I am a BASE jumper, and I felt it was necessary to chime in. I have spent thousands of dollars on countless trips to Europe so that I can play on the cliffs that the Alps and Dolomites offer. This is money and travel I could have directed to Yosemite. Of course there are many places in Europe where a BASE jumper can easily hike in the daytime, enjoy his or her surroundings, and launch into that most favorable state, free fall. But not so much in America. Why is it that Yosemite allows activities that are more risky than BASE jumping (free climbing and slacklining) but not BASE jumping? BASE jumpers are not bad people. We are not crazy, nor do we have a death wish. We're doctors, lawyers, geographers, students. We are good people who appreciate our sport and want to continue to see it grow in the right

We are not crazy, nor do we have a death wish. We're doctors, lawyers, geographers, students.

environment. The majority of us feel we have the right to use our national parks in the same capacity as others do—from the weekend hiker to the free-soloist climber. We respect the motto "Leave No Trace" and respect our exit points more than the typical American families I see littering in such pristine places.

COREY OCHSMAN
Arlington, Virginia

I was saddened and frankly stunned that there was not one picture of a woman at work in the high world. While the article credits the accomplishments of Lynn Hill and mentions Kate Rutherford and Madeleine Sorkin by name, there is no real attention given to the fact that women have become a significant presence in the valley, pushing limits to the same degree as their male counterparts. Come on! It's no longer a man's world. Sadly, in 2011 women must still look for images that inspire them rather than objectify them. Next time please don't leave us out.

CATHERINE JOHNSON
Vashon, Washington

Camera Obscura

Seeing images from Abelardo Morell's camera brought me back to 1988 and my freshman year at Boston University. An English major in pursuit of any easy science elective, I signed on for Astronomy 101. My visions of identifying constellations en route to an easy A quickly dissolved. In the middle of one lecture on the

behavior of light our professor, without explanation, closed off the snug wooden shutters over the windows and continued his monologue. A few minutes later he called our attention to a small hole in one shutter, then asked us to look at the white walls of the lecture hall. There, cars moved along Storrow Drive. The Charles River and the Esplanade were on view, and if you looked hard enough,

tiny joggers moved along paths on the wall. Result? A standing ovation and lasting admiration from 300 previously somnolent 18-year-olds.

ALLEN LITTLE
Portland, Maine

The article on camera obscura reminded me of my time serving with the Royal Air Force in Egypt. Near the airfield was a brick camera obscura about ten feet square, which was used to train bomber pilots in the correct angle of approach to the target and bomb-release timing. In the center of the building was a map of the surrounding area. By seeing the approach of an aircraft reflected onto the map, the controllers could, by radio contact, instruct the aircrew of the correct approach. When not in use, the camera obscura gave a wonderful reflection of the bright blue Egyptian sky.

ROBERT LOUIS SMITH
Aldridge, England

Bangladesh

The resilience of the Bangladeshi people in adapting to global warming is admirable. However, there are limits to strategies that the poor can devise to cope with the rise in sea and river levels. While Bangladesh has reduced fertility rates in recent years, its family planning programs need greater resources, especially from United Nations agencies that have been slow in recognizing the impact of overpopulation on climate change.

ALOK BHARGAVA
Houston, Texas



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Like Bangladesh, India has much to worry about with rising sea levels. The threat is not only to megametropolises like Mumbai. India has been the catch basin for Bangladeshi refugees. Already estimates have up to 20 million Bangladeshis living in India. Corrupt politicians have used them as vote banks by providing them with food ration cards, which serve as proof of citizenship in India. Not only has this caused strains on already poor infrastructures, it has also masked the successes of India's family planning efforts—and enhanced Bangladesh's. The pressure of climate change refugees will tax India the most. The world would do well to recall the backlash seen in the United States to similar numbers of Spanish-speaking migrants, even though the host country is larger and richer than India.

SUBHASH BHAGWAT
Urbana, Illinois

I always thought that Yogi Bear was male, but you have proved me wrong.

In 1963 I was assigned to East Pakistan, now Bangladesh, as a member of the Pakistan Army's Special Operations Group. At that time the population of East Pakistan was 55 million. The crowding and poverty in Dhaka were so great that beggars traveled in groups of 20 or so. They would occupy a shop until the proprietor gave them

something to be rid of them. I met a USAID agricultural engineer who told me that in spite of the childhood death rate from disease and malnutrition and the deaths from cyclone-induced floods, there seemed to be another million or so mouths to feed every year. Now you report that there are 164 million people in Bangladesh. I don't know how they can possibly survive.

WELLS B. LANGE
Lafayette, Colorado

Bangladesh has been written off ever since it gained independence from Pakistan after a civil war 40 years ago. The simple genius of converting contaminated rice fields to shrimp beds, floating gardens, and floating schools is a testimony to the notion that human beings have an endless capacity to survive despite an increasingly inhospitable environment. The amazing people of Bangladesh probably see overpopulation as a resource rather than a crisis.

MICHAEL G. BUITING
Ottawa, Illinois

The story's premise is that we can learn much from the people of Bangladesh. I fail to see one lesson in the article that could be applied by a resident of a flooding Miami or New York. However, there is a lesson there. It's that I don't want to embrace the Bangladeshi lifestyle.

THOMAS GEISLER
Hayward, California

Visions of Earth

I always thought that Yogi Bear

was male, but you have proved me wrong. Your picture on pages 18-19 shows a female bear obviously practicing a yoga pose. Hence she is a yogi, and thus she is Yogi Bear.

JOHN PATTERSON
Cross Village, Michigan

I suggest that Mimmi the brown bear of Finland is far more interested in putting insulating fur between herself and the intense summer-heated rocks on which she's seated than she is in performing tricks.

DIANE BEDELL
Oakley, Utah

Wild: A Clear Danger

I have an easy solution to the problem of birds hitting window glass. Purchase a package of garden netting, the thin, black mesh used to protect plants from birds. Then cut a piece of mesh the size of your window and tape it directly to the exterior of the glass. I use a two-inch piece of clear packing tape in each corner to hold it in place. That's it. You have now created a "visual fence," which breaks up the reflection that birds see. They won't fly into the window. The mesh is fairly inconspicuous to humans when viewed from the inside or outside. It lasts for years without having to be replaced. I have used this method for five years and have had no bird kills the entire time. Previously we had many, especially during spring and fall migrations.

LINDSAY SOVIL
Ely, Minnesota

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This photo was taken last March, during the reconstruction of ground zero in lower Manhattan. This month the site of the 2001 terrorist attacks is open to the public and features a park, fountains, a museum, and more.



THIS MONTH

Inside 9/11: The War Continues

Osama bin Laden's life came to an end this year, but the fight against terrorism is clearly not over. Now, ten years after the September 11 attacks, the National Geographic Channel takes us back to the days before and after that grim event. Terrorism experts and former CIA analysts examine the continued evolution of radical Islam in the United States and abroad over the past decade and shed light on the many perpetrators who carried out bin Laden's orders.



Border Wars

Season five of this hit series finds Department of Homeland Security agents facing new challenges along the U.S.-Mexico border.

For complete listings go to natgeotv.com.

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"...Bose's new click pad...is the most user-friendly universal remote we've ever tried." - **The Wall Street Journal**



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Starting From Ground Zero

In the decade since September 11, 2001, thousands of survivors have walked the difficult path of recovery. At New York City's World Trade Center alone, epicenter of the terrorist attacks, an estimated 12,000 people emerged from the twin towers alive. A sampling of their stories tells of courage, healing, and fateful timing, from a duffel bag that saved one man's life to the enduring faith of the last survivor pulled from the rubble. For their reflections on that day and the ten years since, go to ngm.com/911.

A SURVIVOR'S TALE



New York firefighter Matt Komorowski survived the north tower's collapse with 15 others due to a staircase that withstood the fall. He keeps his helmet from that day, still covered with shattered concrete and drywall, in a glass case in his living room.

"It's difficult for me to constantly look at it and not go into a downward spiral. But I feel it's important for my own therapy to

leave it there, to work through it, and to deal with that day without falling into those depths. I've learned to get out of them, so things are a lot better.

"I had thoughts of leaving my profession, but being a firefighter is really a part of you. I wanted to give the decision time, and after I felt mentally OK, I realized this is what I was meant to do. So yes, I had thoughts of leaving, but I'm so happy I got back on the horse."

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*Ready for some rough stuff?
We recently found a rare cache of
extremely large uncut diamonds at
an extraordinary price.*

Sometimes it's impossible to improve on perfection. When the world's most desired stone is pulled from the ground, why not just brush off the earth and leave it alone? White cut diamonds may be nice for a polite kiss on the cheek, but extra large uncut diamonds can really ignite some raw passion. And isn't that what a great piece of jewelry is all about? These few rare 2 carat plus natural stones will certainly turn up your thermostat.

A real diamond in the rough

For centuries, large raw diamonds were treasured without a hint of facet or polish. We believe the early artisans were on to something. After a search through countries on four continents, we have found a cache of rare, very large, 2 carat plus uncut diamonds at a



Similar rough diamonds sell elsewhere for thousands! Please compare the size and price of our raw diamond in the Stauer Raw Diamond Necklace with those at your local jewelry store.

spectacular price from our Belgium dealer. Major gemstone experts across the globe have commented that rough diamonds will be the fastest growing trend on "the red carpet" this year and our long love affair with flawless cut white gemstones may have some competition. All one has to do is flip through the world's most exclusive catalog to find that "rough is all the rage." Our luxury retail friends in Texas recently featured a raw solitaire for \$6,000, but they buy in such small quantities that they cannot compete with us on price. You see, Stauer is one of the largest gemstone buyers in the world and last year bought over 3 million carats of emeralds. No regular jewelry store can come anywhere close to that volume.

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Our *Raw Diamond Necklace* is a balanced blend of



geology and geometry. Each one-of-a-kind raw diamond is fitted by hand into its "cage," a crisscross embrace of gold vermeil over the finest .925 sterling silver, bead-set with 18 round diamonds. The caged diamond hangs from a triangular bail with an additional 8 diamonds (26 total). The pendant is suspended from an 18" gold vermeil rope chain with spring ring clasp. Each raw diamond is naturally unique. This is an extremely limited edition since it took us 3 years to find this small cache of stones.

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MISSION *To expand the first girls primary school in her Maasai village in Kenya*

Dream Girls When I was a child in Enoosaen, a south Kenyan village with no roads or electricity, girls didn't leave. At age five, I was promised to a six-year-old boy, expected to marry at 13 and lead a traditional life. But I wanted a different life. I loved school and had a dream of becoming a teacher. My mother was denied an education, and she wanted to make sure I wasn't. We worked on other people's farms planting sugarcane to earn money for my uniforms and books.

By seventh grade, there were hardly any girls in my class. They were all getting married after being circumcised—a horrible practice. In eighth grade, just two of us were left. I told my father I'd get married if I didn't do well

on the exams for secondary school. I did better than the boys, but he still tried to force me to marry. He gave up only when I threatened to run away. I finished high school, went to college, and will earn my Ph.D. in education this year from the University of Pittsburgh.

I opened the Academy for Girls in Enoosaen in 2009. We have 94 girls enrolled in grades four to six. We're giving back to the community in a way no man has ever done. We're challenging traditions many years old. We're telling girls, "You don't have to be cut or married off. You have the right to get an education and be free." Every father and mother wants the best for their daughters. We are working together to redefine what is best. —Kakenya Ntaiya



Ntaiya reads with fourth-grade girls at her boarding school. "Each one has a dream and reminds me of me," she says.



DIABETES DAMAGES NERVES

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Artist depiction

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†Those who have had a drug or alcohol problem may be more likely to misuse Lyrica.

Prescription Lyrica is not for everyone. Tell your doctor right away about any serious allergic reaction that causes swelling of the face, mouth, lips, gums, tongue, throat or neck or any trouble breathing or that affects your skin. Lyrica may cause suicidal thoughts or actions in a very small number of people. Call your doctor right away if you have new or worsening depression, suicidal thoughts or actions, or unusual changes in mood or behavior. Lyrica may cause swelling of your hands, legs and feet. Some of the most common side effects of Lyrica are dizziness and sleepiness. Do not drive or work with machines until you know how Lyrica affects you. Other common side effects are blurry vision, weight gain, trouble concentrating, dry mouth, and feeling "high." Also, tell your doctor right away about muscle pain along with feeling sick and feverish, or any changes in your eyesight including blurry vision or any skin sores if you have diabetes. You may have a higher chance of swelling, hives or gaining weight if you are also taking certain diabetes or high blood pressure medicines. Do not drink alcohol while taking Lyrica. You may have more dizziness and sleepiness if you take Lyrica with alcohol, narcotic pain medicines, or medicines for anxiety. If you have had a drug or alcohol problem, you may be more likely to misuse Lyrica. Tell your doctor if you are planning to father a child. Talk with your doctor before you stop taking Lyrica or any other prescription medication.

Please see Important Risk Information for Lyrica on the following page.

To learn more visit www.lyrica.com or call toll-free 1-888-9-LYRICA (1-888-959-7422).

You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.FDA.gov/medwatch or call 1-800-FDA-1088.

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IMPORTANT FACTS



(LEER-i-kah)

IMPORTANT SAFETY INFORMATION ABOUT LYRICA

LYRICA may cause serious, even life threatening, allergic reactions. Stop taking LYRICA and call your doctor right away if you have any signs of a serious allergic reaction:

- Swelling of your face, mouth, lips, gums, tongue, throat or neck
- Have any trouble breathing
- Rash, hives (raised bumps) or blisters

Like other antiepileptic drugs, LYRICA may cause suicidal thoughts or actions in a very small number of people, about 1 in 500.

Call your doctor right away if you have any symptoms, especially if they are new, worse or worry you, including:

- New or worsening depression
- Suicidal thoughts or actions
- Unusual changes in mood or behavior

Do not stop LYRICA without first talking with your doctor.

LYRICA may cause swelling of your hands, legs and feet.

This swelling can be a serious problem with people with heart problems.

LYRICA may cause dizziness or sleepiness.

Do not drive a car, work with machines, or do other dangerous things until you know how LYRICA affects you.

Ask your doctor when it is okay to do these things.

ABOUT LYRICA

LYRICA is a prescription medicine used in adults 18 years and older to treat:

- Pain from damaged nerves that happens with diabetes or that follows healing of shingles
- Partial seizures when taken together with other seizure medicines
- Fibromyalgia (pain all over your body)

Who should NOT take LYRICA:

- Anyone who is allergic to anything in LYRICA

BEFORE STARTING LYRICA

Tell your doctor about all your medical conditions, including if you:

- Have had depression, mood problems or suicidal thoughts or behavior
- Have or had kidney problems or dialysis
- Have heart problems, including heart failure
- Have a bleeding problem or a low blood platelet count
- Have abused prescription medicines, street drugs or alcohol in the past
- Have ever had swelling of your face, mouth, tongue, lips, gums, neck, or throat (angioedema)
- Plan to father a child. It is not known if problems seen in animal studies can happen in humans.
- Are pregnant, plan to become pregnant or are breastfeeding. It is not known if LYRICA will harm your unborn baby. You and your doctor should decide whether you should take LYRICA or breast-feed, but not both.

Tell your doctor about all your medicines. Include over-the-counter medicines, vitamins, and herbal supplements.

LYRICA and other medicines may affect each other causing side effects. Especially tell your doctor if you take:

- Angiotensin converting enzyme (ACE) inhibitors. You may have a higher chance for swelling and hives.

BEFORE STARTING LYRICA, continued

- Avandia® (rosiglitazone)*, Avandamet® (rosiglitazone and metformin)* or Actos® (pioglitazone)** for diabetes. You may have a higher chance of weight gain or swelling of your hands or feet.
- Narcotic pain medicines (such as oxycodone), tranquilizers or medicines for anxiety (such as lorazepam). You may have a higher chance for dizziness and sleepiness.
- Any medicines that make you sleepy

POSSIBLE SIDE EFFECTS OF LYRICA

LYRICA may cause serious side effects, including:

- See "Important Safety Information About LYRICA."
- Muscle problems, pain, soreness or weakness along with feeling sick and fever
- Eyesight problems including blurry vision
- Weight gain. Weight gain may affect control of diabetes and can be serious for people with heart problems.
- Feeling "high"

If you have any of these symptoms, tell your doctor right away.

The most common side effects of LYRICA are:

- Dizziness
- Blurry vision
- Weight gain
- Sleepiness
- Trouble concentrating
- Swelling of hands and feet
- Dry mouth

If you have diabetes, you should pay extra attention to your skin while taking LYRICA and tell your doctor of any sores or skin problems.

HOW TO TAKE LYRICA

Do:

- Take LYRICA exactly as your doctor tells you. Your doctor will tell you how much to take and when to take it. Take LYRICA at the same times each day.
- Take LYRICA with or without food.

Don't:

- Drive a car or use machines if you feel dizzy or sleepy while taking LYRICA.
- Drink alcohol or use other medicines that make you sleepy while taking LYRICA.
- Change the dose or stop LYRICA suddenly. You may have headaches, nausea, diarrhea, or trouble sleeping if you stop taking LYRICA suddenly.
- Start any new medicines without first talking to your doctor.

NEED MORE INFORMATION?

- Ask your doctor or pharmacist. This is only a brief summary of important information.
- Go to www.lyrica.com or call 1-866-459-7422 (1-866-4LYRICA).

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Give her proof that marrying you was the best idea she ever had. The DiamondAura® *Dearly Beloved Ring Set* capture the thrill of old-fashioned romance with over 2½ carats of dazzling, lab-created DiamondAura set in fine sterling silver. The ring boasts a brilliant, 2-carat round-cut that sparkles with even more fire and clarity than a "D" flawless natural diamond. And its shoulders shimmer with brilliant, channel-set rounds. The happy couple is

made complete with a stunning companion band of fine .925 sterling silver, lavished in elegant heirloom detail and channel-set with more than a dozen white DiamondAura dazzlers.

Your satisfaction is 100% guaranteed. If for any reason you're not completely smitten with your DiamondAura *Dearly Beloved Set*, return the rings within 30 days for a full refund of your purchase price.

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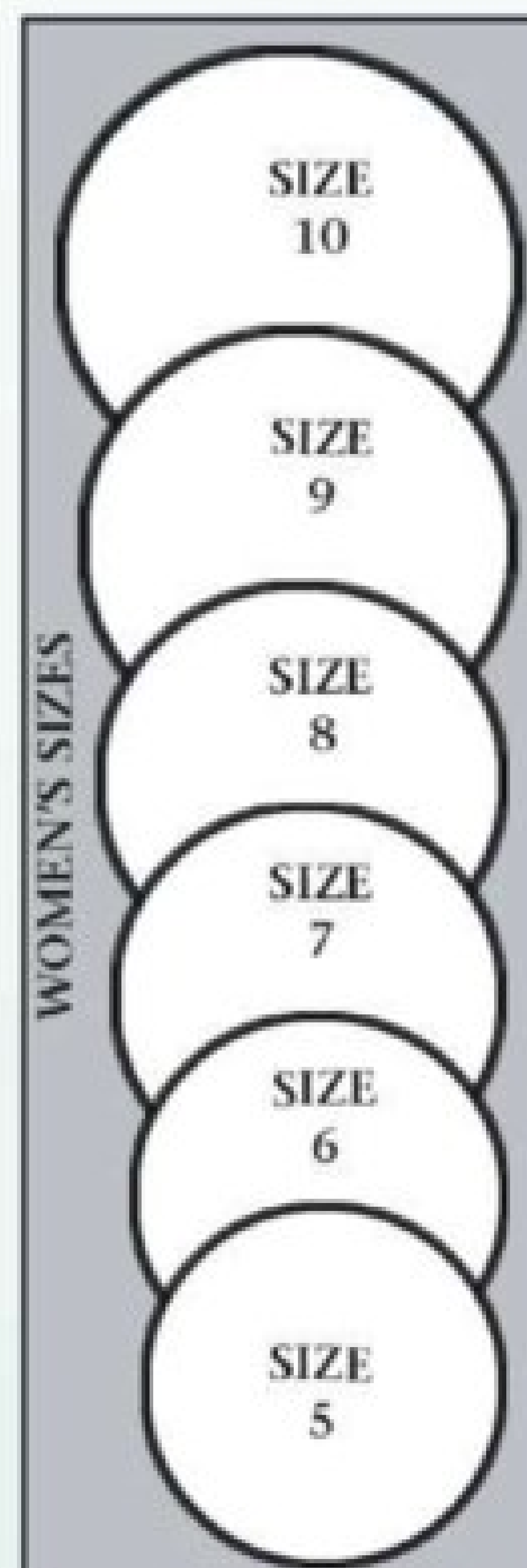
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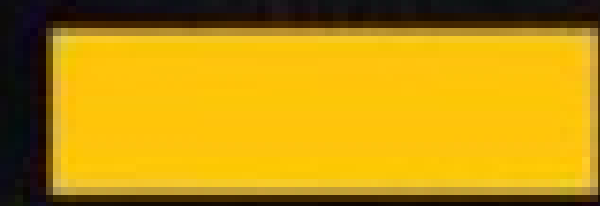
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VISIONS



United States

From his underwater perch, Claude, an albino American alligator, slips through the looking-glass waterline. Although his condition causes poor eyesight, he relies on other senses to navigate his abode in a San Francisco aquarium.

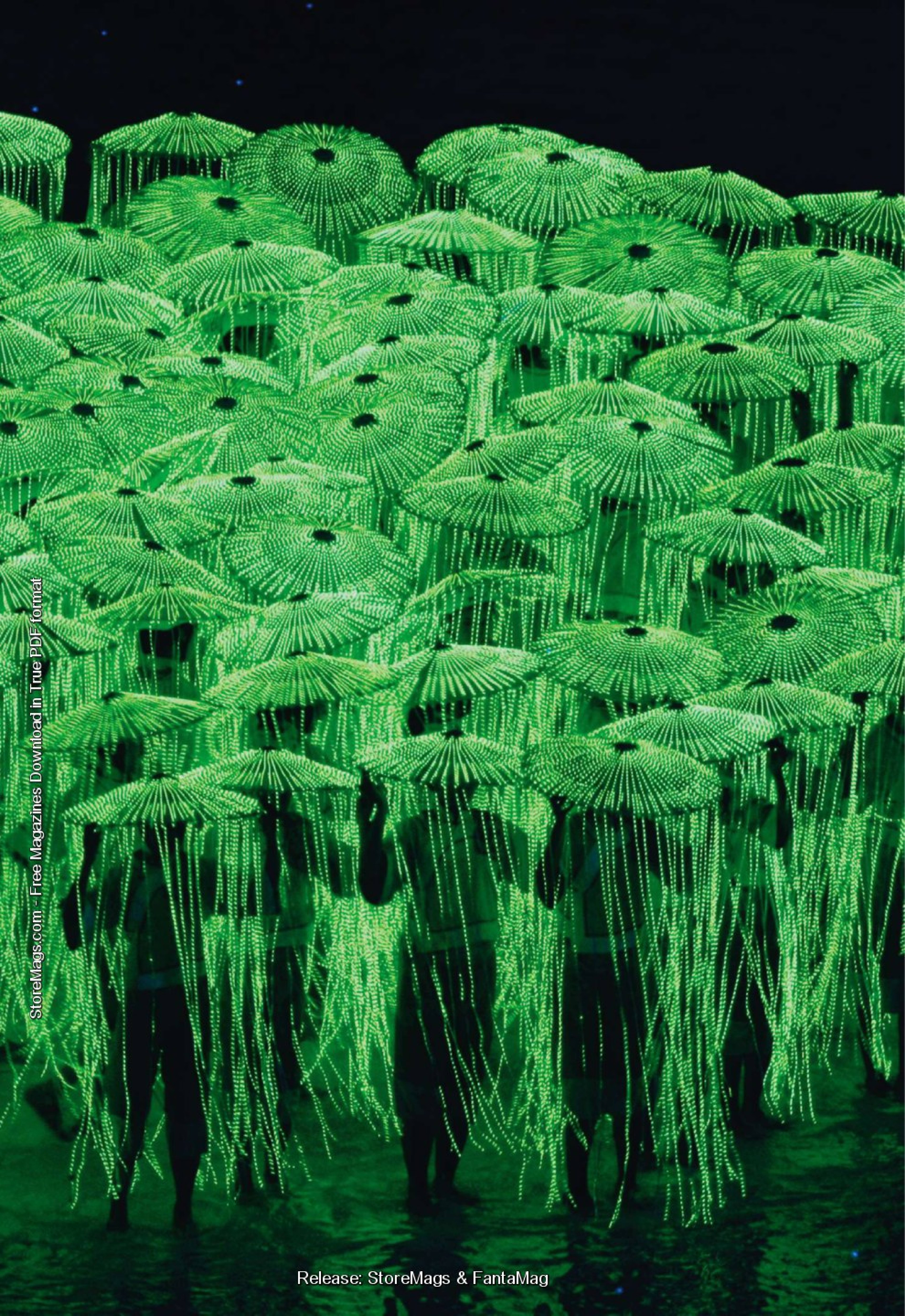
PHOTO: JAK WONDERLY



China

An emerald forest of light comes alive as dancers perform at the opening of last year's Asian Games in the south-eastern city of Guangzhou. More than 40 countries participate in the regional sporting event, held every four years.

PHOTO: MENAHEM KAHANA, AFP/GETTY IMAGES



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Russia

Sunshine and freshly laundered sheets invite shadow plays in the yard of a special boarding home in the Pskov region. Here mentally disabled children from ages 4 to 18 learn to live independently—cooking, cleaning, and taking care of the wash.

PHOTO: DMITRY MARKOV

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StoreNags.com





EDITORS' CHOICE **Regina Nicolardi** White Haven, Pennsylvania

Paddling on Florida's Crystal River, Nicolardi, 32, and a friend (above) found a temporary traveling companion at Three Sisters Springs, near a manatee sanctuary. "Before continuing on its way," says Nicolardi, "this one swam peacefully alongside our canoe, gently sharing the water."



READERS' CHOICE

Peter Stanley

Dar es Salaam, Tanzania

On a holiday trek in the highlands of Ethiopia, the 37-year-old Stanley and his wife met farmers harvesting, "separating the wheat grain from the chaff. Every so often the wind would shift, and I would get covered in straw, making the men smile and laugh."

gravity defyer™
VERSOSHOCK REVERSE TRAMPOLINE SOLE

Defy Pain, Defy Aging, Defy Fatigue

This is my story

I used to be more active. I used to run, play basketball, tennis, football... I was more than a weekend warrior. I woke up every day filled with life! But now, in my late 30's, I spend most of my day in the office or sacked out in front of the TV. I rarely get to the gym – not that I don't like working out, it's the nagging pain in my knees and ankles. Low energy and laziness has got me down. My energy has fizzled and I'm embarrassed to admit that I've grown a spare tire (I'm sure it's hurting my love life). Nowadays I rarely walk. For some reason it's just harder now. Gravity has done a job on me.



Wear them and you'll know

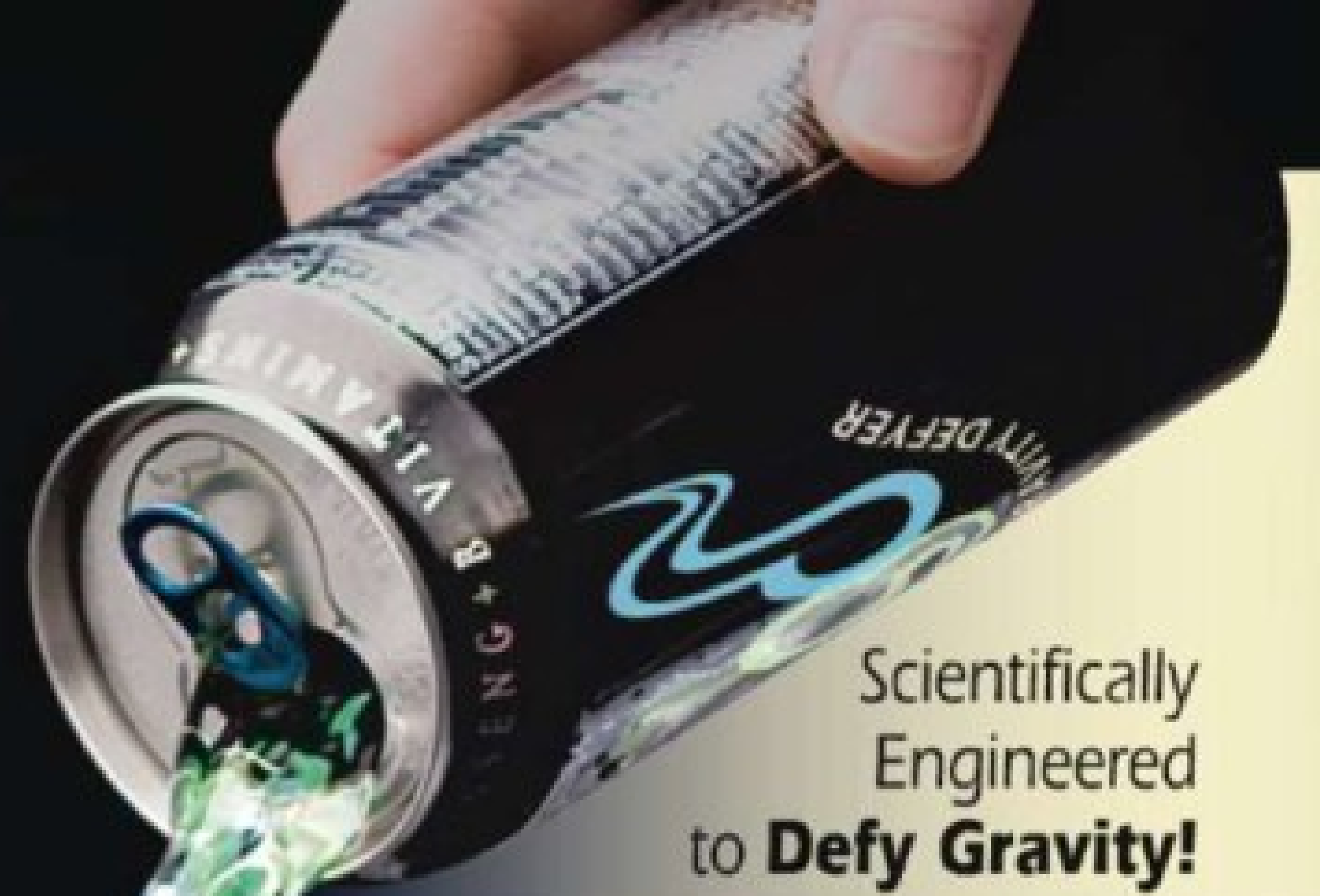
That's what my doctor recommended. He said, "Gravity Defyer shoes are pain-relieving shoes." He promised they would change my life—like they were a fountain of youth. "They ease the force of gravity, relieving stress on your heels, ankles, knees and back. They boost your energy by propelling you forward." The longer he talked, the more sense it made. He was even wearing a pair himself!

Excitement swept through my body like a drug

I received my package from GravityDefyer.com and rushed to tear it open like a kid at Christmas. Inside I found the most amazing shoes I had ever seen – different than most running shoes. Sturdy construction. Cool colors. Nice lines... I was holding a miracle of technology. This was the real thing.

GDefyer Benefits

- Relieve pain
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- Be more active
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- Jump higher, walk and run faster
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- Cool your feet & reduce foot odor
- Elevate your performance

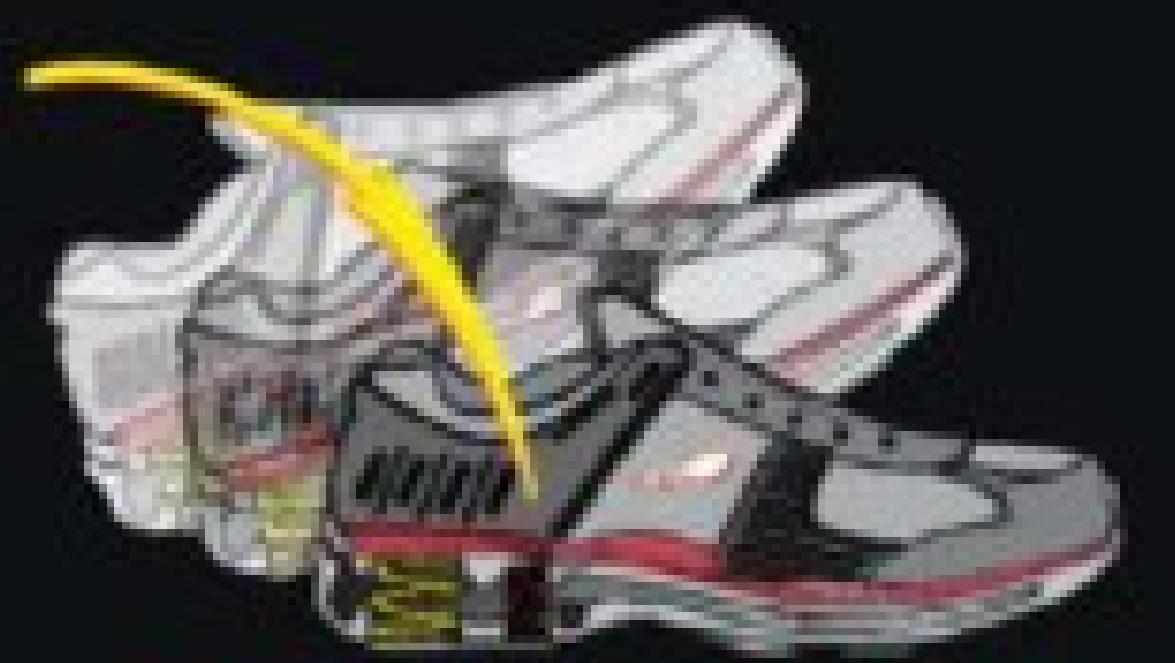


Scientifically Engineered to **Defy Gravity!**

I put them on and all I could say was, "WOW!" In minutes I was out the door. I was invincible; tireless in my new Gravity Defyer shoes. It was as if my legs had been replaced with super-powered bionics. What the doctor promised was all correct. No more knee pain. I started to lose weight. At last, I was pain free and filled with energy! I was back in the game. Gravity had no power over me!

Customer Satisfaction Speaks for Itself!

4 out of 5 customers purchase a 2nd pair within 3 months.



ABSORB SHOCK
Eliminate pain from every step.



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Nothing to lose: Start your 30 Day Trial Today!

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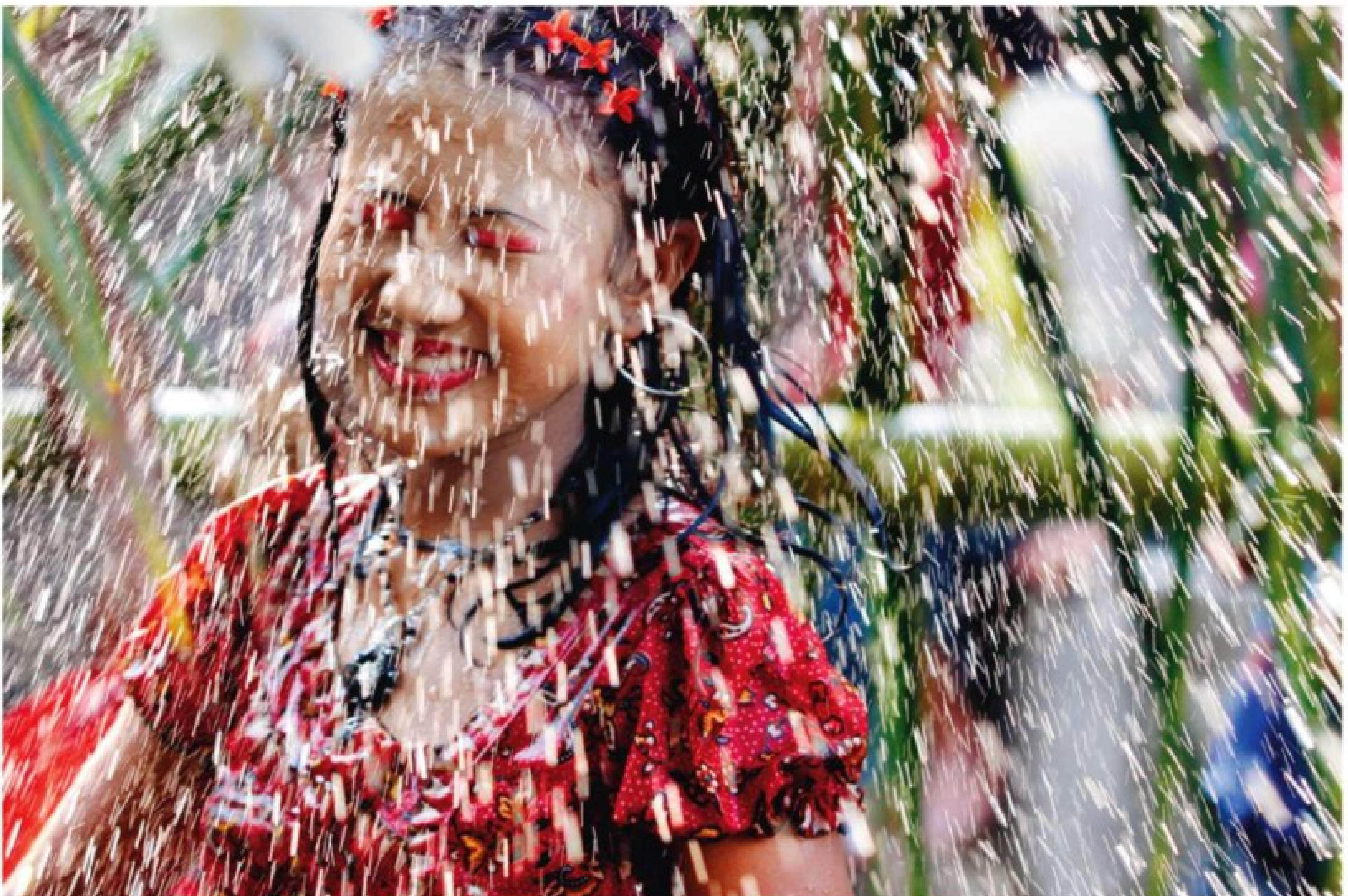
SOUTHERN CALIFORNIA AND ARIZONA

VISIONS | YOUR SHOT

**Agnes Montanari**

Paris, France

When Montanari, 56, was in Sanaa, Yemen, this year, she visited several hammams, or community bathhouses. When she returned to one with her camera, to document its architecture and atmosphere, she saw this young man in a steam room. "I was moved by the beauty of the scene," she says.

**Mustafiz Mamun** Dhaka, Bangladesh

Each April the ethnic Rakhine community in Cox's Bazar—a port city in southern Bangladesh—celebrates its new year with an exuberant three-day water festival. Mamun, 30, traveled from his home in the country's capital to witness the wild scene.

ZELDA

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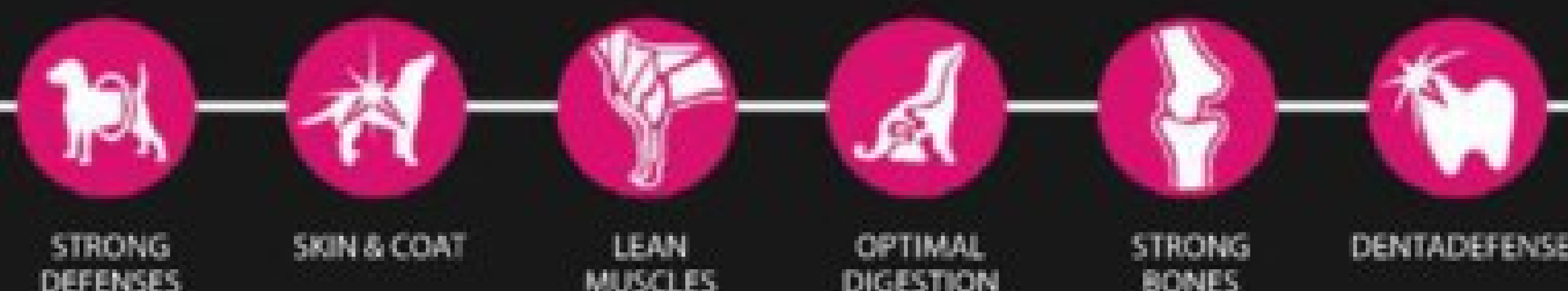
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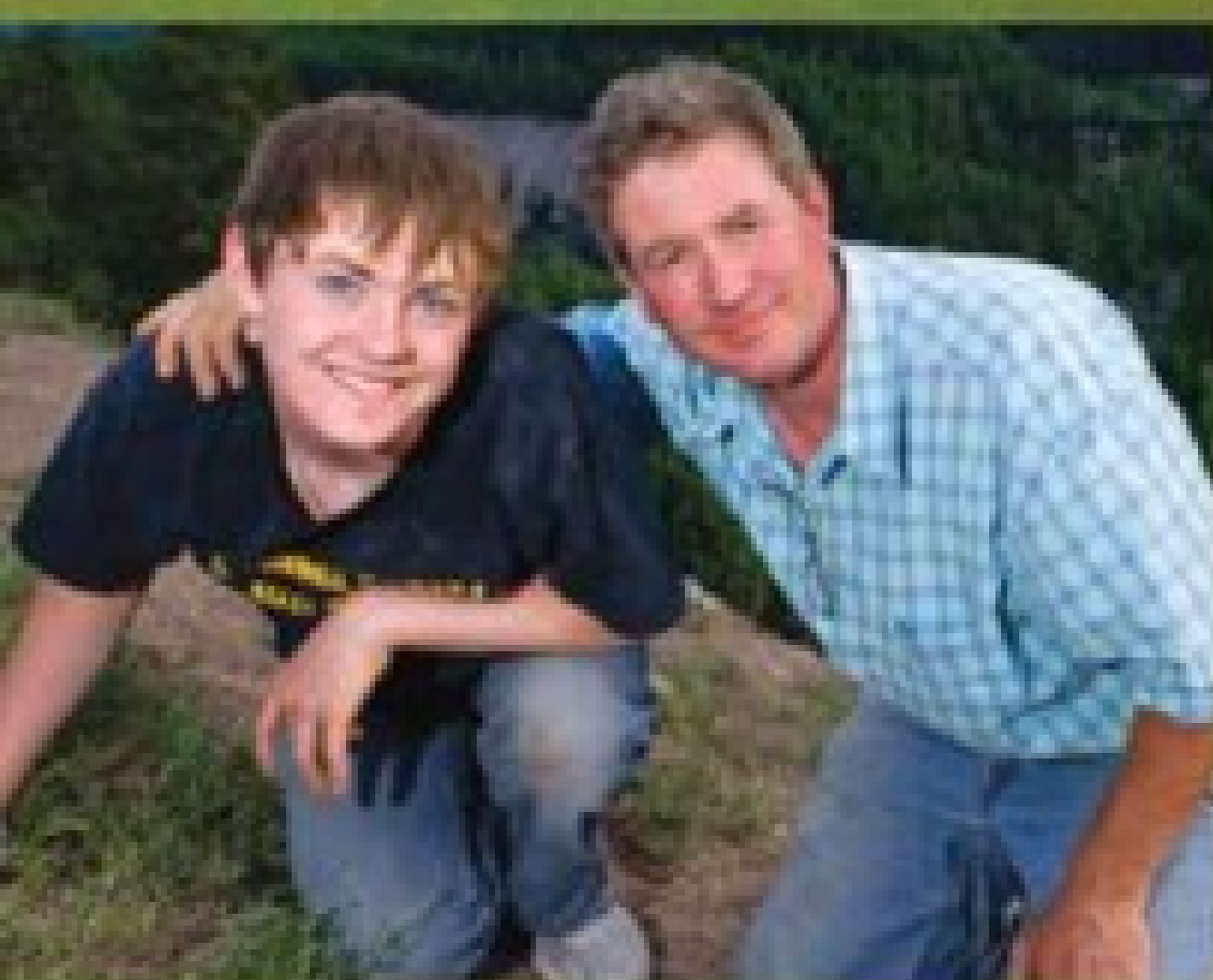


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Photo by Joel Sartore; inset photo (Joel and son Cole on assignment for National Geographic) by Cole Sartore

A caribou cow and calf in Denali National Park's tundra landscape.



JOEL SARTORE

NATIONAL GEOGRAPHIC PHOTOGRAPHER, ON

America's National Parks

"My parents started taking me to the national parks when I was a kid, and we looked forward to it all year. We'd take these huge trips—half the two weeks were just driving. My parents knew it was important, and you don't see geysers, mountains, or oceans in Nebraska.

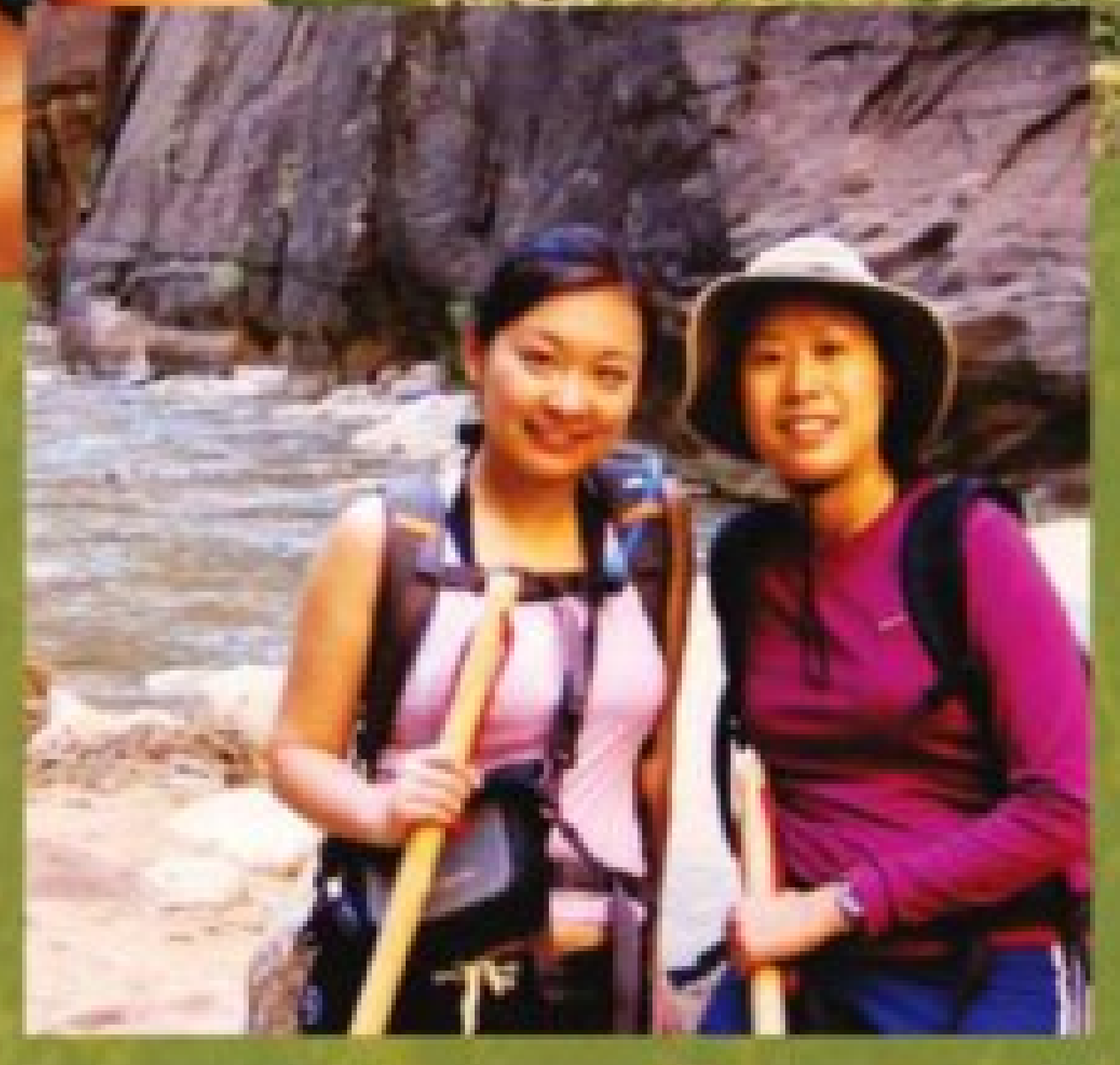
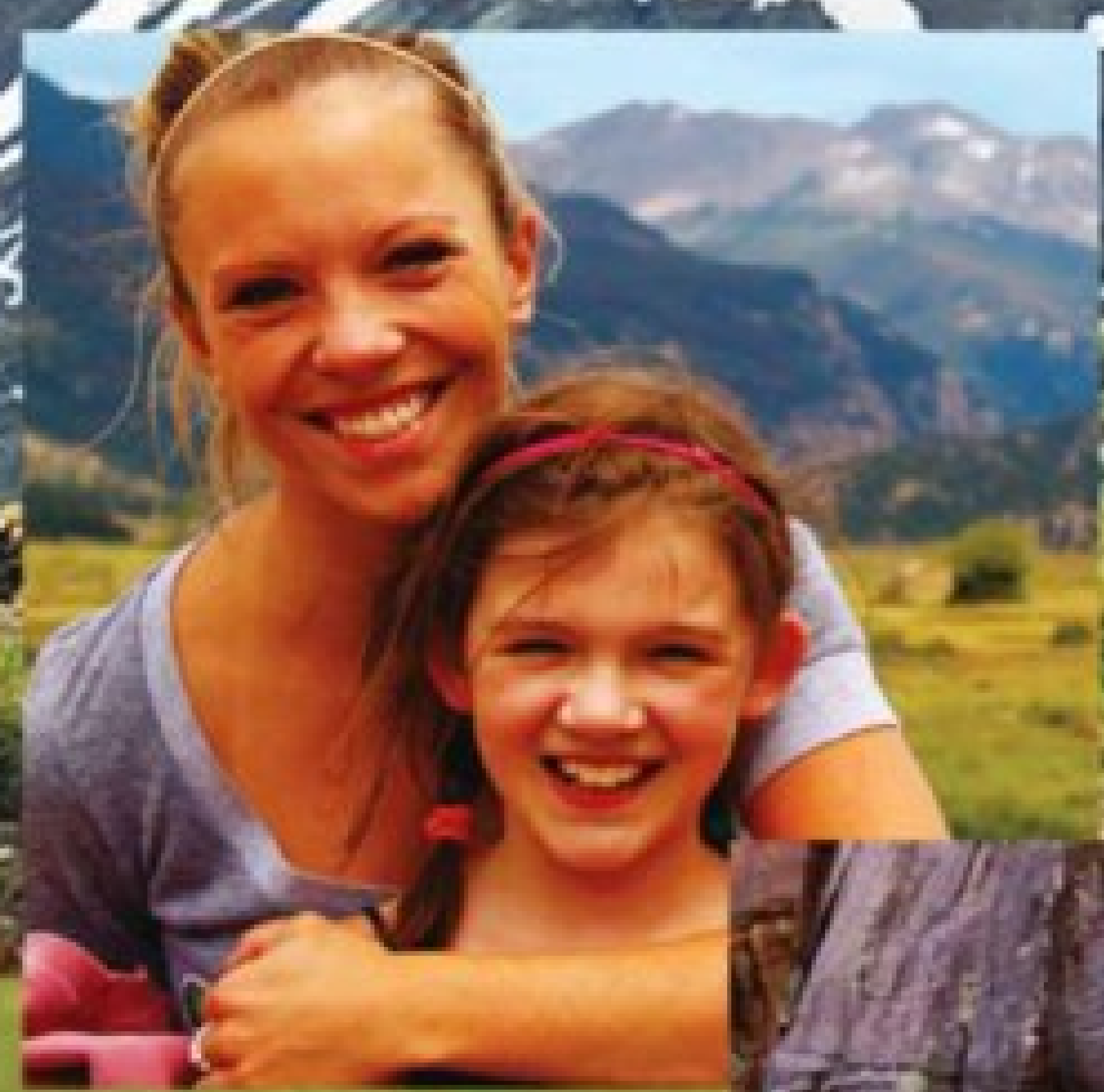
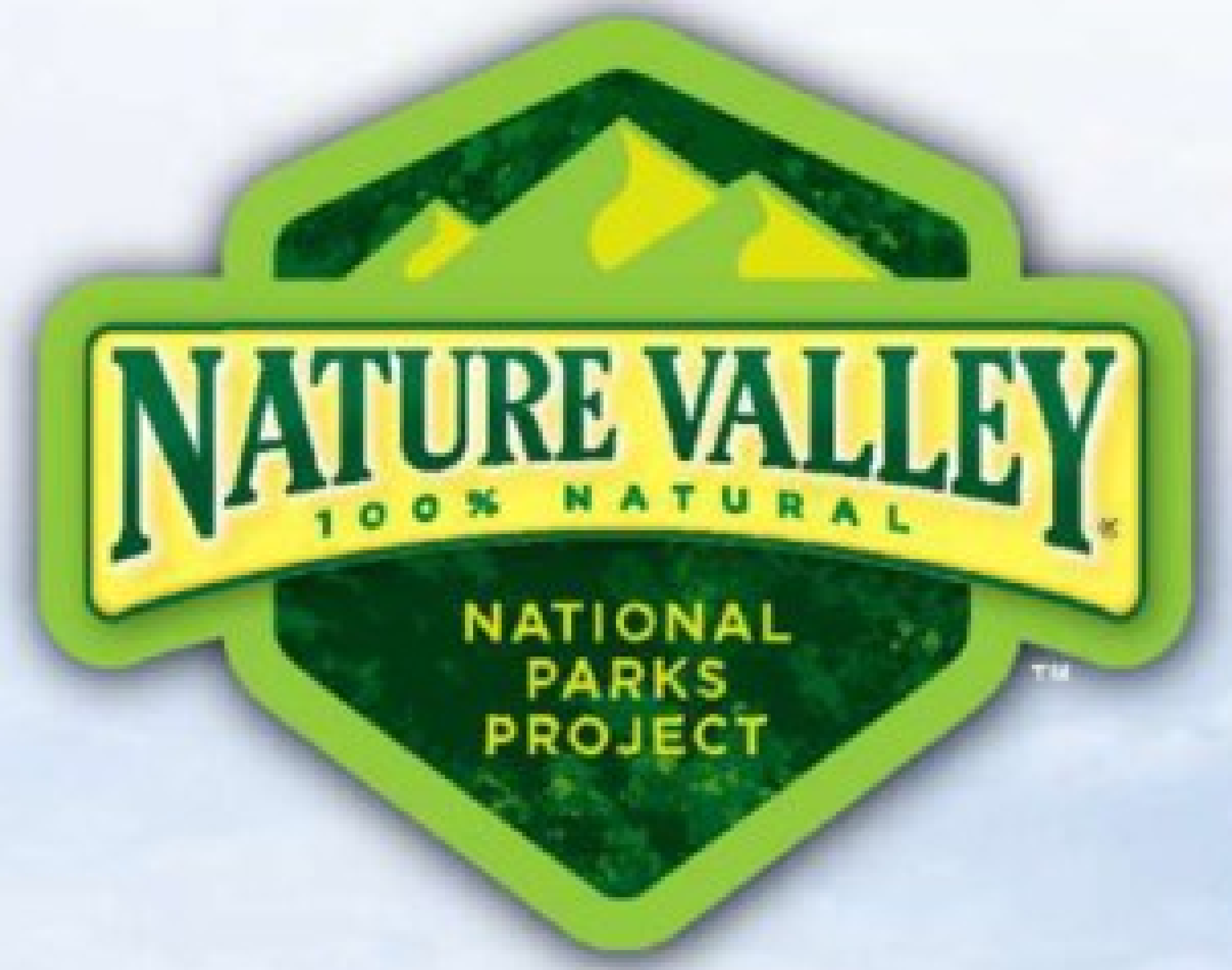
We saw Mount Rushmore and went to Glacier, Bryce Canyon, Grand Canyon—if you name a national park in the west, my family went there. One memorable moment was when a

bear climbed on top of our brand-new car in Yosemite Park in the '60s. When I go to these places on assignment for National Geographic, it feels like home to me. The parks represent the very best of the American landscape, preserved for all time."

Nature Valley wants to ensure that our national parks will be preserved for generations to come. Learn more at PreserveTheParks.com.

See more of Joel Sartore's photographs at
nationalgeographic.com/naturevalleyparks

Find your happy place.
Preserve it forever.



preserve the parks

Anyone who's visited one of America's National Parks knows not only how special they are, but also how important it is to preserve them. We do too. That's why we are committed to ensuring they're around for generations to come. Go to NatureValley.com now to learn about all the ways we're trying to make a difference and how you can too. The National Parks belong to all of us. Let's see to it that our children's grandchildren can enjoy them as much tomorrow as we do today.

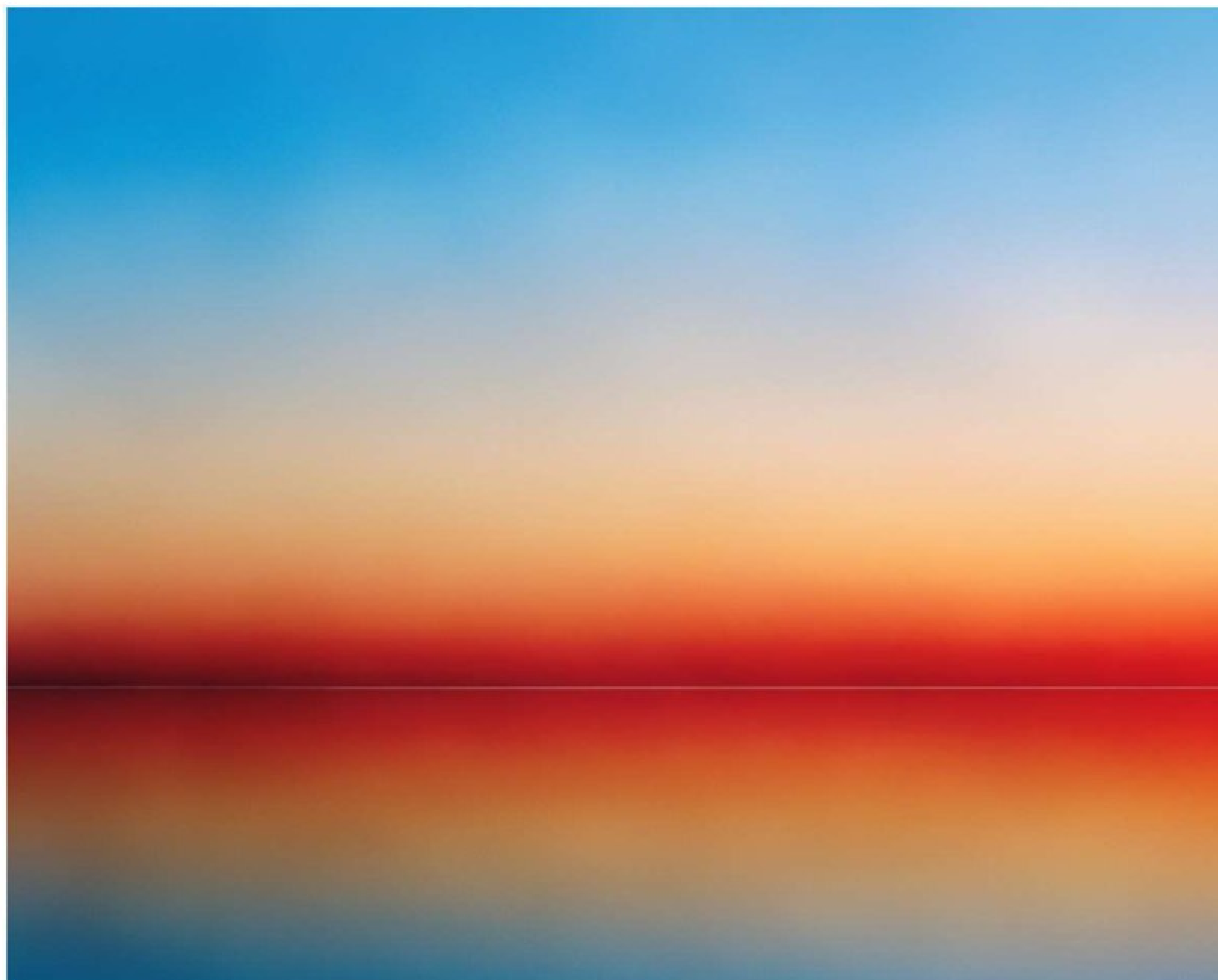


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At first light, predawn colors are reflected and distorted by a rare rain puddle in Australia's highly saline Lake Eyre.

Salt Flats Lake Eyre might be the bleakest, most featureless place on Earth—a flat, arid salt sink in Australia with only the horizon to define its 3,700 square miles. Yet I went there 16 times in eight years. Why? To create a series of photographs out of infinite space.

I've always been drawn to multiyear projects in remote locations, like the series I shot in Patagonia, Tasmania, and the Himalaya. After that I went back to art school and studied the history and language of my field. It was then that I decided to “remove” the landscape from landscape photography. Lake Eyre was the perfect canvas.

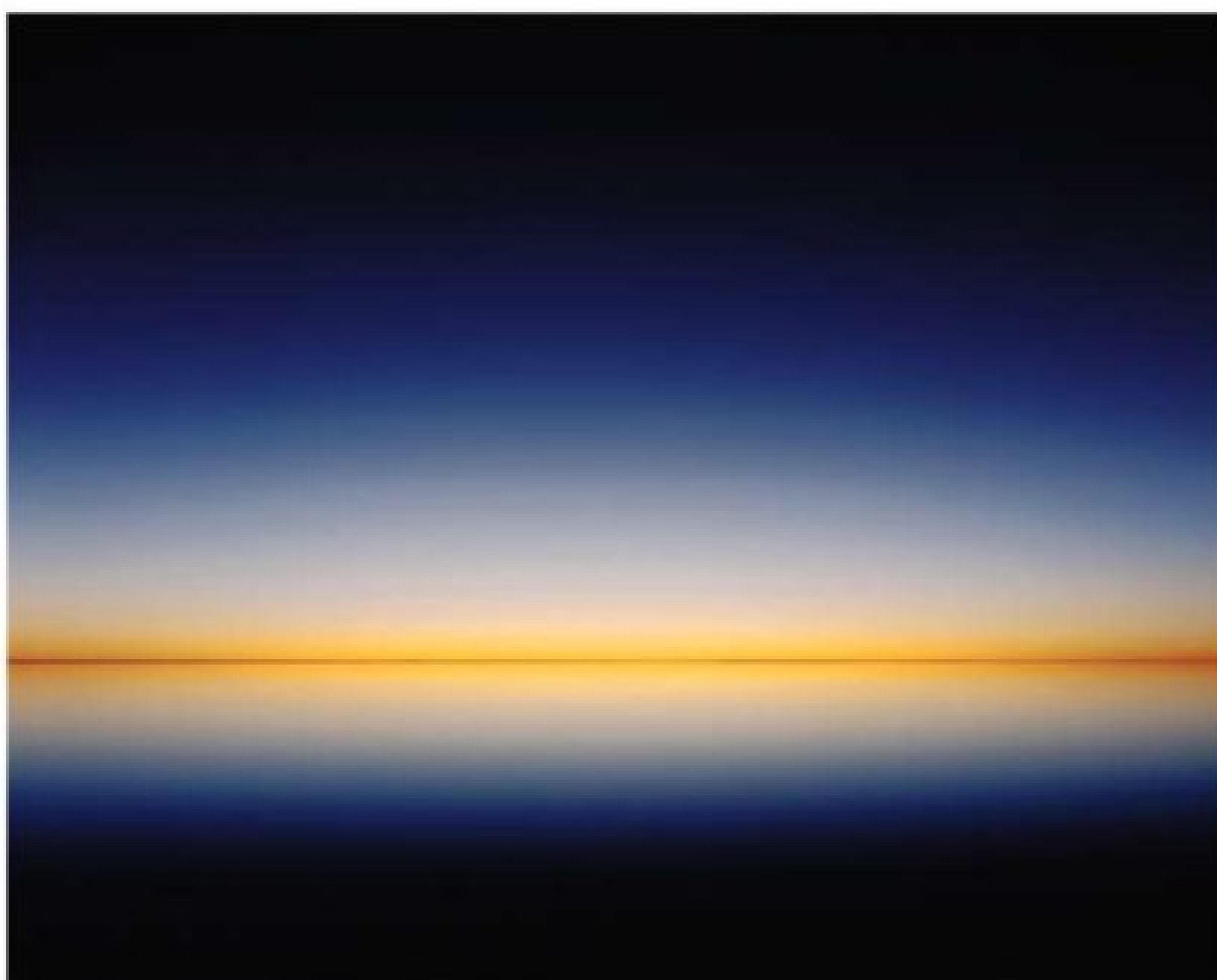
Each winter I would ride my bike to the dried heart of the lake and camp for five weeks, working every day in the harsh sun, wind, and cold. Somehow I never got lonely out there. It was only when I got back to civilization, and sat at a quiet bar, that I felt truly alone.

All artists are interpreters of the world. This series is my attempt to translate the visual power of extreme desolation.

THE PHOTOGRAPHER

Murray Fredericks

The Sydney, Australia-based photographer's website is murrayfredericks.com.au. For a video version of this series, go to saltdoco.com.

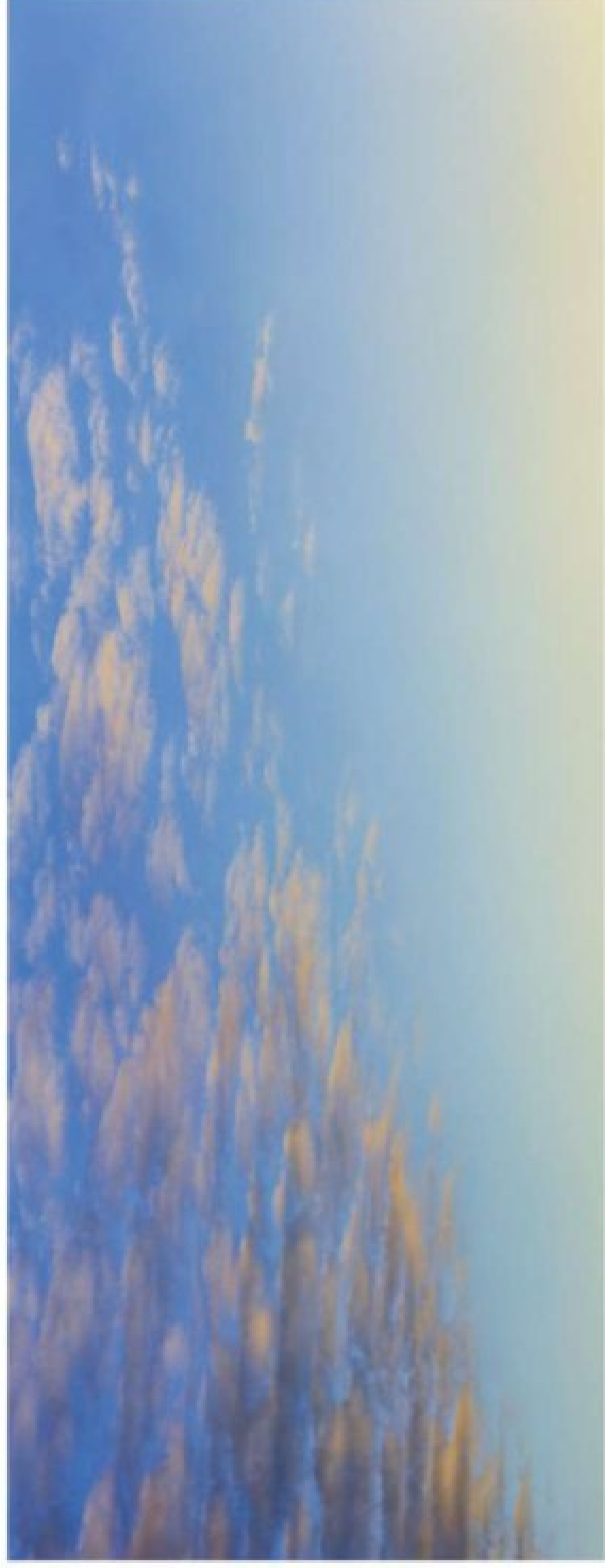


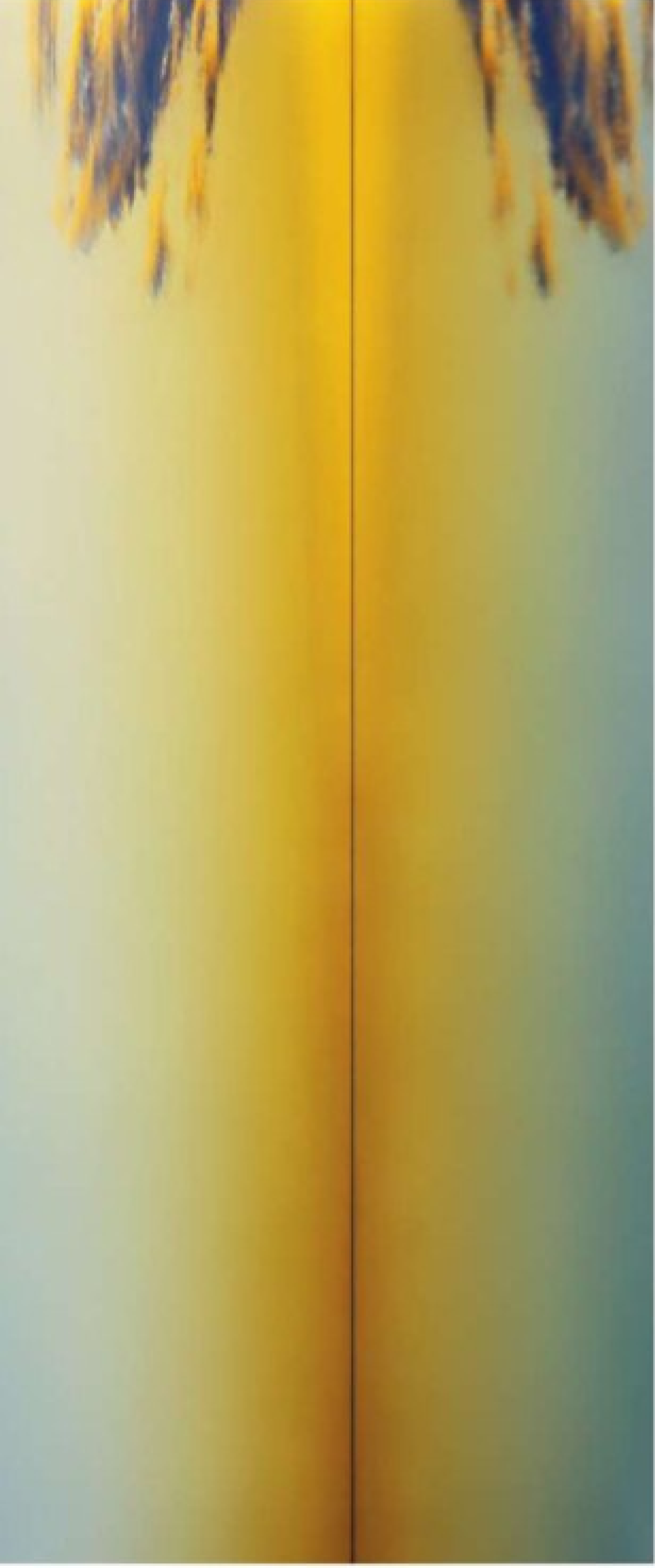
Cleanly divided by the horizon line (above), this frame was shot half an hour after sunset. Seen here through my 8-by-10-inch view camera, the clear light of the desert blends right into its reflection on a bit of salty rainwater.

The black line (left) is the edge of the lake, miles away from where I was standing. Working in such a space, I was keenly aware of variations in hue. In this shot, taken just after dusk, I was fixated on the subtle transition of orange to deep blue.



Pilots who fly over Lake Eyre had told me about a red hue that sometimes appears when the bed dries. I later learned that it's caused by an organism that lives only in supersaline environments.





I took this shot as dawn was breaking, focusing my camera on the black line, which is the lake's edge. I had never seen this shade of yellow before—nor have I seen it since.



In this three-hour exposure during a full moon, the two brightest stars in the sky are described as arcing lines. The cracked bed of Lake Eyre, meantime, resembles nothing so much as a lunar landscape.



 NATIONAL
GEOGRAPHIC

In the midst of a massive drought, two storms—thunder and dust—appeared and painted an apocalyptic portrait over Australia's Lake Eyre. I used a digital camera and stitched together multiple images to capture this panorama.

MURRAY FREDERICKS
COPYRIGHT © SEPTEMBER 2011 NATIONAL GEOGRAPHIC SOCIETY



NOW

Health for the Ages

The plants pictured on this page might add up to a tossed salad. They might also be used to make remedies for serious intestinal disorders—just as they did in antiquity.

Medical historian Alain Touwaide says new DNA analysis of clay-bound pills from a Roman shipwreck confirms traces of the same dried plants (including carrot, radish, cabbage, celery, wild onion,* and parsley) described in ancient Greek medical texts. The brownish, coin-size pills—preserved in tin boxes for two millennia—are the first proof that the writings were “not just theoretical but actually applied.”

Could such knowledge inform today’s research? Touwaide says the second-century physician Galen referred to broccoli, a relative of cabbage, as an intestinal cancer treatment. Studies today confirm the plant’s anticancer properties—making “eat your vegetables” a timeless prescription. —Jeremy Berlin



Used by a physician around 140 to 120 B.C., this boxwood vial (left) was among the medical artifacts found 22 years ago on a Roman shipwreck off Italy’s coast.

Goldman
Sachs

10,000 WOMEN

"My biggest dream is for the company to continue through someone else in my family. We have put 26 years of work put into it, and we can make it better every day."

— Evania, Brazil
Goldman Sachs
10,000 Women Scholar

HOW ONE WOMAN CAN EMPOWER GENERATIONS

Evania owns a company that sells mechanical and motorized tools in Brazil. She is a 2009 graduate of Goldman Sachs' *10,000 Women* initiative, a five-year effort to provide 10,000 underserved women with a business and management education.

The program gives participants an accelerated education to help them develop practical business management skills.

Now in its third year, *10,000 Women* is in more than 20 countries and is showing promising early results—70% of graduates surveyed have increased their revenues, and 50% have added new jobs. To date, more than 4,000 women have participated in the program.

Evania's business has benefited from her new knowledge. In 2009, she was able to purchase two vehicles to improve the company's sales services. In 2010, annual sales increased by 33%. Today, she is expanding her business to the Internet. In doing so, Evania is working hard to ensure that her business, which she started in 1985, can provide economic sustenance to future generations of her family.

goldmansachs.com/10000women



PROGRESS IS EVERYONE'S BUSINESS

Release: StoreMags & FantaMag



The average school year among 17 nations lasts 193 days.



A Perfect Mummy

In the Chinese city of Taizhou, workers digging a new roadbed recently uncovered a remarkable burial from the Ming dynasty (1368-1644). The deceased was a five-foot-three-inch-tall woman whose skin, hair, eyebrows, and more than 20 items of cotton clothing were all fully preserved. Three thick layers of plaster sealed her wooden coffin, keeping out oxygen and bacteria. When she was found, she lay in a mysterious fluid, which may have served to further stave off decay. Once the mummy is stabilized and studied, the city's museum plans to make her one of the star attractions of a new exhibit. —A. R. Williams



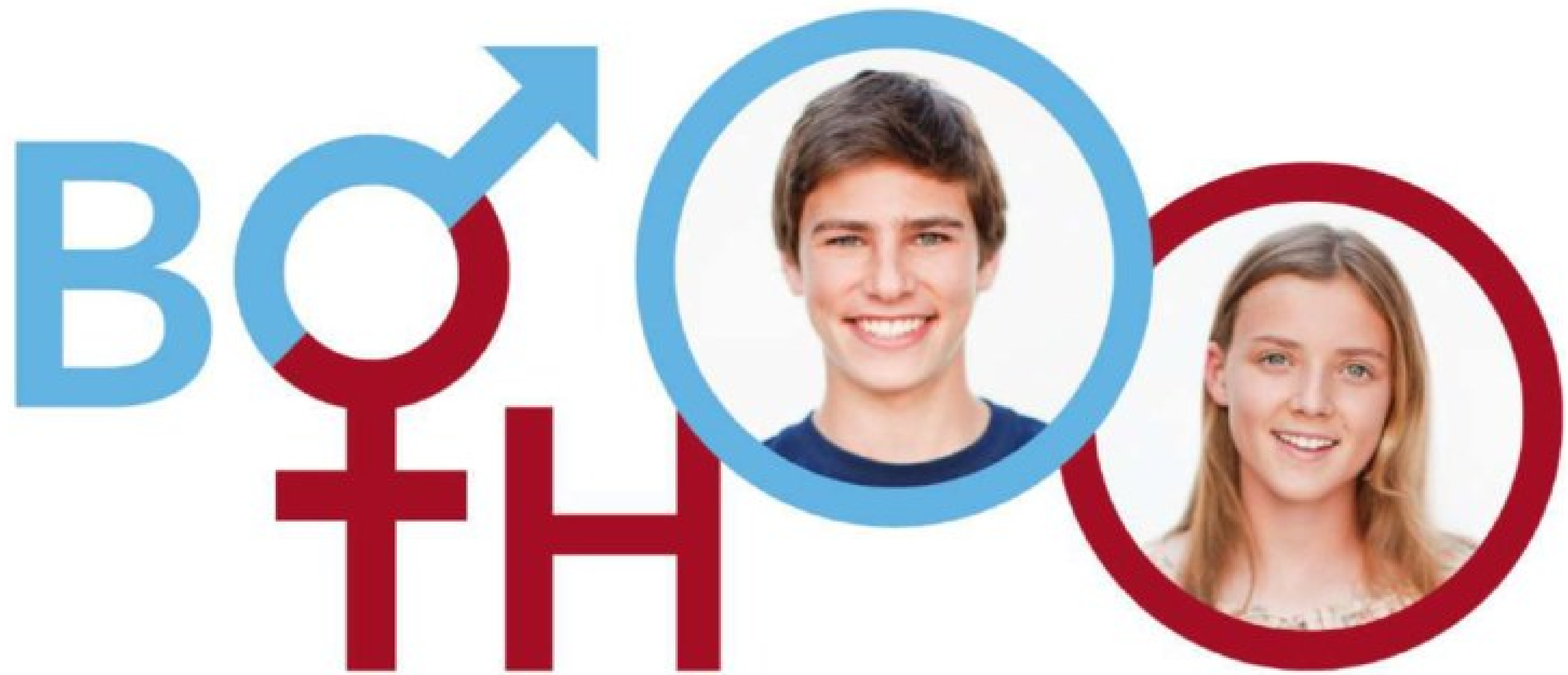
Dressed to prevent contamination, staff from the Taizhou Museum prepare to ease ropes under a quilt-wrapped mummy to lift her from her coffin.

THAT STINKS They are resilient through winter, latch skillfully on to vehicles, and have few natural checks on their U.S. population. These factors have enabled an Asian native, the brown marmorated stinkbug (left), to thrive in the eastern U.S. First noted in 1996 in Allentown, Pennsylvania—and since spotted in 33 other states—the tenacious insect feasts on crops and creeps into homes, particularly in Maryland and Virginia. Squashing it unleashes a pungent odor. Now researchers hope a tiny wasp can help by attacking stinkbug eggs, but safety tests will take a few years. Smells like trouble in the meantime. —Catherine Zuckerman



Boys can be affected by HPV disease too.

GARDASIL HELPS PROTECT BOTH YOUR SON AND DAUGHTER.



When it comes to human papillomavirus (HPV), females are only half the equation. There are 30 to 40 types of HPV that will affect an estimated 75% to 80% of males and females in their lifetime. For most, HPV clears on its own. But, for others who don't clear certain types, HPV could cause cervical cancer in females and other types of HPV could cause genital warts in both males and females. And there's no way to predict who will or won't clear the virus.

GARDASIL is the only HPV vaccine that helps protect against 4 types of HPV. In girls and young women ages 9 to 26, GARDASIL helps protect against 2 types of HPV that cause about 75% of cervical cancer cases, and 2 more types that cause 90% of genital warts cases. In boys and young men ages 9 to 26, GARDASIL helps protect against 90% of genital warts cases.

GARDASIL may not fully protect everyone, nor will it protect against diseases caused by other HPV types or against diseases not caused by HPV. GARDASIL does not prevent all types of cervical cancer, so it's important for women to continue routine cervical cancer screenings.

GARDASIL does not treat cervical cancer or genital warts. GARDASIL is given as 3 injections over 6 months.

IMPORTANT SAFETY INFORMATION

Anyone who is allergic to the ingredients of GARDASIL, including those severely allergic to yeast, should not receive the vaccine. GARDASIL is not for women who are pregnant.

The side effects include pain, swelling, itching, bruising, and redness at the injection site, headache, fever, nausea, dizziness, vomiting, and fainting. Fainting can happen after getting GARDASIL. Sometimes people who faint can fall and hurt themselves. For this reason, your child's health care professional may ask your child to sit or lie down for 15 minutes after he or she gets GARDASIL. Some people who faint might shake or become stiff. This may require evaluation or treatment by your child's health care professional.


Only a doctor or health care professional can decide if GARDASIL is right for your child.

You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.fda.gov/medwatch or call 1-800-FDA-1088. Please read the Patient Information on the next page and discuss it with your child's doctor or health care professional.



Help your **son** or **daughter** be one less person affected by HPV disease.

Talk to your child's doctor about GARDASIL today.


GARDASIL®
 [Human Papillomavirus Quadrivalent
 (Types 6, 11, 16, and 18) Vaccine, Recombinant]

USPPI

Patient Information about
GARDASIL® (pronounced "gard-Ah-sill")

Generic name: [Human Papillomavirus Quadrivalent (Types 6, 11, 16, and 18) Vaccine, Recombinant]

Read this information with care before getting GARDASIL¹. You (the person getting GARDASIL) will need 3 doses of the vaccine. It is important to read this leaflet when you get each dose. This leaflet does not take the place of talking with your health care provider about GARDASIL.

What is GARDASIL?

GARDASIL is a vaccine (injection/shot) that is used for girls and women 9 through 26 years of age to help protect against the following diseases caused by Human Papillomavirus (HPV):

- Cervical cancer
- Vulvar and vaginal cancers
- Anal cancer
- Genital warts
- Precancerous cervical, vaginal, vulvar, and anal lesions

GARDASIL is used for boys and men 9 through 26 years of age to help protect against the following diseases caused by HPV:

- Anal cancer
- Genital warts
- Precancerous anal lesions
 - The diseases listed above have many causes, and GARDASIL only protects against diseases caused by certain kinds of HPV (called Type 6, Type 11, Type 16, and Type 18). Most of the time, these 4 types of HPV are responsible for the diseases listed above.
 - GARDASIL cannot protect you from a disease that is caused by other types of HPV, other viruses, or bacteria.
 - GARDASIL does not treat HPV infection.
 - You cannot get HPV or any of the above diseases from GARDASIL.

What important information about GARDASIL should I know?

- You should continue to get routine cervical cancer screening.
- GARDASIL may not fully protect everyone who gets the vaccine.
- GARDASIL will not protect against HPV types that you already have.

Who should not get GARDASIL?

You should not get GARDASIL if you have, or have had:

- an allergic reaction after getting a dose of GARDASIL.
- a severe allergic reaction to yeast, amorphous aluminum hydroxyphosphate sulfate, polysorbate 80.

What should I tell my health care provider before getting GARDASIL?

Tell your health care provider if you:

- are pregnant or planning to get pregnant. GARDASIL is not recommended for use in pregnant women.
- have immune problems, like HIV infection, cancer, or you take medicines that affect your immune system.
- have a fever over 100°F (37.8°C).
- had an allergic reaction to another dose of GARDASIL.
- take any medicines, even those you can buy over the counter.

Your health care provider will help decide if you should get the vaccine.

How is GARDASIL given?

GARDASIL is a shot that is usually given in the arm muscle. You will need 3 shots given on the following schedule:

- Dose 1: at a date you and your health care provider choose.
- Dose 2: 2 months after Dose 1.
- Dose 3: 6 months after Dose 1.

Fainting can happen after getting GARDASIL. Sometimes people who faint can fall and hurt themselves. For this reason, your health care provider may ask you to sit or lie down for 15 minutes after you get GARDASIL. Some people who faint might shake or become stiff. This may require evaluation or treatment by your health care provider.

Make sure that you get all 3 doses on time so that you get the best protection. If you miss a dose, talk to your health care provider.

Can other vaccines and medications be given at the same time as GARDASIL?

GARDASIL can be given at the same time as RECOMBIVAX HB®¹ [hepatitis B vaccine (recombinant)] or Menactra [Meningococcal (Groups A, C, Y and W-135) Polysaccharide Diphtheria Toxoid Conjugate Vaccine] and Adacel [Tetanus Toxoid, Reduced Diphtheria Toxoid and Acellular Pertussis Vaccine Adsorbed (Tdap)].

What are the possible side effects of GARDASIL?

The most common side effects with GARDASIL are:

- pain, swelling, itching, bruising, and redness at the injection site
- headache
- fever
- nausea
- dizziness
- vomiting
- fainting

There was no increase in side effects when GARDASIL was given at the same time as RECOMBIVAX HB [hepatitis B vaccine (recombinant)].

There was more injection-site swelling at the injection site for GARDASIL when GARDASIL was given at the same time as Menactra [Meningococcal (Groups A, C, Y and W-135) Polysaccharide Diphtheria Toxoid Conjugate Vaccine] and Adacel [Tetanus Toxoid, Reduced Diphtheria Toxoid and Acellular Pertussis Vaccine Adsorbed (Tdap)].

Tell your health care provider if you have any of the following problems because these may be signs of an allergic reaction:

- difficulty breathing
- wheezing (bronchospasm)
- hives
- rash

Tell your health care provider if you have:

- swollen glands (neck, armpit, or groin)
- joint pain
- unusual tiredness, weakness, or confusion
- chills
- generally feeling unwell
- leg pain
- shortness of breath
- chest pain
- aching muscles
- muscle weakness
- seizure
- bad stomach ache
- bleeding or bruising more easily than normal
- skin infection

Contact your health care provider right away if you get any symptoms that concern you, even several months after getting the vaccine.

For a more complete list of side effects, ask your health care provider.

What are the ingredients in GARDASIL?

The ingredients are proteins of HPV Types 6, 11, 16, and 18, amorphous aluminum hydroxyphosphate sulfate, yeast protein, sodium chloride, L-histidine, polysorbate 80, sodium borate, and water for injection.

This leaflet is a summary of information about GARDASIL. If you would like more information, please talk to your health care provider or visit www.gardasil.com.

Manufactured and Distributed by: Merck Sharp & Dohme Corp., a subsidiary of Merck & Co., Inc. Whitehouse Station, NJ 08889, USA

Issued April 2011

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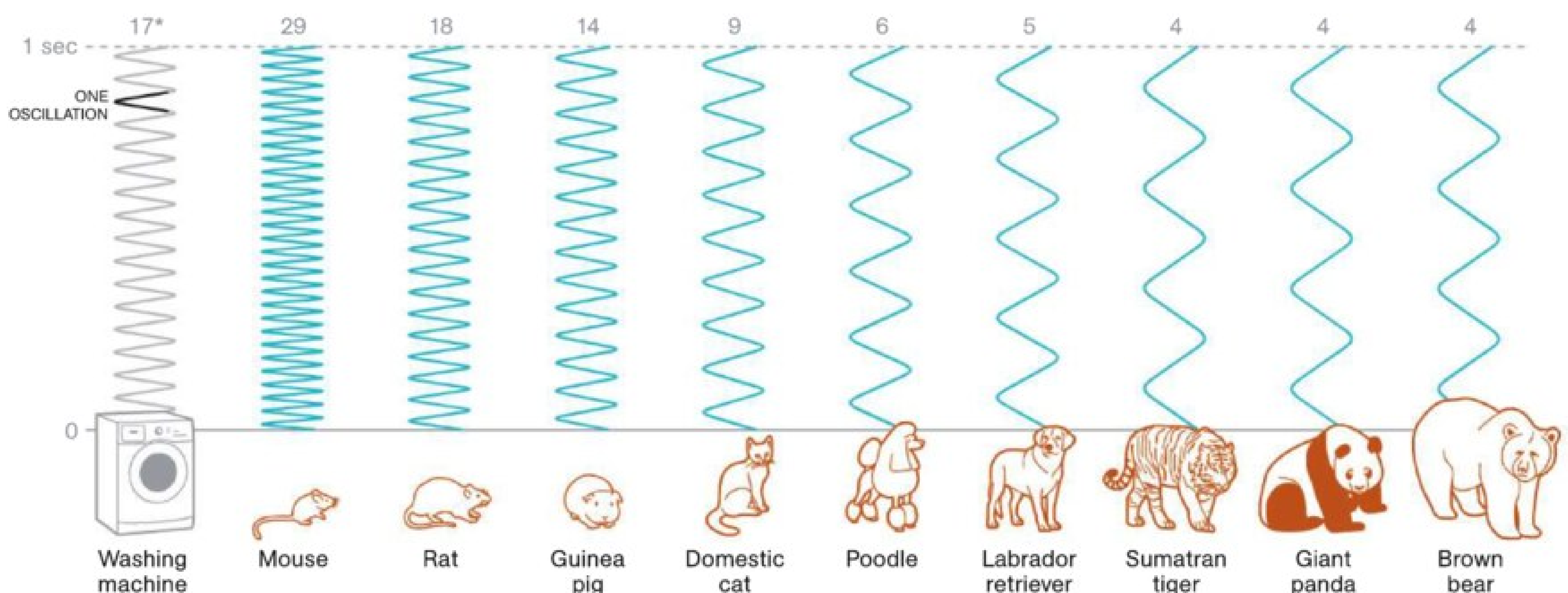
Shake It Off

It all begins with a twist of the head—one so powerful it leads to full-body, high-speed oscillations that whip water in all directions. Although hazardous to nearby humans, the wet-dog shake is an elegant, effective drying mechanism, says Andrew Dickerson, an engineering student at Georgia Tech who analyzed the mechanics of this everyday canine act. In taking less than a second to disperse half the water in a hound's fur, the motion is "more efficient than a washing machine's spin cycle," he says.

Using slow-motion video, Dickerson measured rates of oscillation in other animals too and found that the smaller they are, the faster they shake. Being wet adds weight, notes veterinarian Nicholas Dodman, and that makes it harder to run—perhaps one reason speed drying evolved. —Hannah Bloch

Furry mammals like dogs dry off with split-second oscillations. The looser the animals' skin, the more water they shed with each shake.

HOW FAST DOES IT SHAKE? Smaller animals must shake faster than large ones in order to throw off a comparable amount of water. As animal size increases, shaking frequency levels off.



Animals not drawn to scale

*Oscillation averages have been rounded to the nearest whole number.

PHOTO: TIM FLACH. GRAPHIC: LAWSON PARKER, NGM STAFF
SOURCE: ANDREW DICKERSON AND DAVID HU, GEORGIA TECH

FOUR OUT OF FIVE
VENZA OWNERS
WERE TOO BUSY
TO ANSWER OUR
SURVEY.



AVAILABLE WITH ALL-WHEEL DRIVE.
VENZA. KEEP ON ROLLING.

NOW

7
SEVEN
BILLION

Girl Power

The developing world holds an overlooked resource: millions of adolescent girls. Often forced to leave school and start families by their mid-teens, many fall prey to violence, disease, and complications of childbirth. Studies show that keeping these girls in school and delaying marriage benefits both them and their communities by reducing infant mortality, increasing family income, and slowing the spread of HIV. Groups including the World Bank, the UN Adolescent Girls Task Force, and movements such as the Girl Effect are looking at ways to make girls more valuable to their families as breadwinners than as child brides. —Margaret G. Zackowitz



Eva Nkirote, a student at Saint Annmona School in rural eastern Kenya, participates in a tree-planting program at the school. Says Esther Muthoni, Saint Annmona's founder, "If you educate a girl, you educate a nation."

Making a Better Life *The poverty cycle can be broken when girls stay in school.*

The Poverty Cycle

EARLY MARRIAGE

In developing nations (China excepted) about one in seven girls marries before age 15. If their daughters do the same, many will be grandmothers before 30.

PREGNANCY

Complications of pregnancy are the leading cause of death for girls ages 15-19 worldwide. Adolescent girls are also more likely to die in childbirth.

The Education Cycle

EDUCATION

Education creates its own cycle. According to the World Bank, a child remains in school four to six months longer for each completed year of a mother's formal education.

INCOME

Completion of secondary school can increase a girl's average future earnings by as much as 18 percent.

“When women and girls have rights and opportunities,

their families, communities, and nations prosper.

Unleashing the potential of half of humanity—our mothers, daughters, sisters, and wives—is one of the most critical challenges of the 21st century.”

*DR. BABATUNDE OSOTIMEHIN
Executive Director, UNFPA*



Collecting water in India; Photo by Mark Tuschman



Dr. Osotimehin at an Ethiopian women's shelter; Photo by UNFPA

Women and Girls Are Counting on Us

Each of us is created equal, but we face vastly different realities. In a world of great inequities, educated and healthy women and girls are powerful agents of positive change.

UNFPA, the United Nations Population Fund, works to ensure that every child is wanted, every birth is safe, every young person stays healthy, and every girl and woman is treated with dignity and respect. We support countries in using population data to formulate policies and programs to reduce poverty, improve sexual and reproductive health, and promote equality.

UNFPA. Because everyone counts.

And 7 billion people are counting on each other.



United Nations Population Fund
unfpa.org

Empowering Girls

Accelerates Progress

As youth populations reach their peak in developing countries, a historic opportunity to advance development and prosperity is created. With the right policies, investments, and social support, young women can live healthier lives, free of poverty, and so can their families. Now is the time to act: more than 500 million young women are depending on us.



Ghanaian children;
Photo by Mark
Tuschman



Young Afghani women; Photo by Lynsey Addario/VII Network

RESTORING DIGNITY Treating Obstetric Fistula

Since 2003, when the Fistula Center was established in Dhaka, Bangladesh, some 2,500 women have been treated through corrective surgery. Hundreds of doctors and nurses have been trained to treat others, and vocational training has expanded.

Obstetric fistula is a preventable and treatable childbearing injury that leaves women incontinent, ashamed, and isolated. This condition often makes women outcasts in their own families and communities.

With support from UNFPA, the Campaign to End Fistula (endfistula.org) was founded in 2003 to give these women and girls the care needed to prevent and treat the condition, eliminate shame, and help them return to productive lives. At \$300-\$400, the cost of treatment is inexpensive by American standards, but far beyond the means of impoverished families.

The campaign is now active in 49 countries, bringing hope to women and girls whose lives were characterized by despair.

An estimated two million women live with obstetric fistula, and at least 50,000 new cases occur each year.

Ajanta (not her real name), from northern Bangladesh, was married at 14, became pregnant, and suffered prolonged obstructed labor. Afterward, she noticed urine running down her legs.

Her husband soon asked her to leave the house because he couldn't stand the smell. She found shelter at her mother's home.

"I was so ashamed, I did not leave the house anymore, I did not speak to anyone, I could not even help with the housework, she said. This operation means so much to me, and I can't wait to have a normal life again."



Fistula survivor, Bangladesh;
Photo by GMB Akash/Panos Pictures



Guatemalan schoolgirls; Photo by Mark Tuschman

OPENING HORIZONS Educating Girls in Rural Guatemala

Guatemala's fertility and poverty rates are among the highest in Latin America. Its most disadvantaged group, indigenous Maya, live in remote rural areas without adequate food, clean water, and sanitation. Girls are especially vulnerable—to early pregnancy, disease, even violence.

But a new grassroots effort founded by indigenous Guatemalan physician Dr. Marta Julia Ruiz and supported by UNFPA has helped nearly 5,000 girls ages 8 to 18 flourish. Abriendo Oportunidades (Opening Doors) is a network of girls' clubs that combines education and services with a peer mentoring system.

Girls in the program are taught new skills, given reproductive health information, and have a safe place to go play sports, make crafts—and be girls.

Marcia is a successful peer leader who now plans to continue her education and become a health-care professional. "I stopped going to school when I was 14. I've seen how programs that invest in girls can change lives."

DELIVERING HOPE A Fresh Start for a New Nation

"Walk like a midwife," students of a UNFPA-supported community midwifery program in Kajo Keji, South Sudan, tell each other. "A midwife walks fast on her way to save lives!"

For midwives in South Sudan, the world's newest country and most dangerous place to give birth, this is not simply an expression. Just 100 midwives and fewer than 500 doctors cover a population of 8.3 million people and an area nearly

the size of Texas. Contraception is rare, families are large, and women face a one-in-seven lifetime risk of dying from complications of pregnancy and childbirth.

UNFPA is working with South Sudan's Ministry of Health to train midwives and set up basic health systems. The Fund has also deployed 15 international UN Volunteer midwives from all over the world to South Sudan, with more to come.

Working at the primary health-care level and within local communities, these volunteer midwives are providing culturally sensitive midwifery care, counseling, and support, including information about voluntary family planning.

While excited at the prospect of helping to shape a new nation, midwifery students also acknowledge the challenges that lie ahead. "South Sudan is like a newborn baby," says Helen Amal, one of these students. "To grow and learn to stand on its own, it needs support."

And off she goes, walking fast.



South Sudanese family; Photo by Roza Freriks/UNFPA

7 BILLION ACTIONS



Tajikistan maternity hospital; Photo by Mark Williams/Panos

A Global
Collaboration
7BillionActions.org



Vietnamese children;
Photo by Mark Tuschman

Late in 2011, the global population will reach 7 billion—more than double the number of people living just 50 years ago. The increasing stress on our resources is staggering. But in a world that is more interconnected than ever before, challenges related to poverty, the environment, and women's rights belong to all of us.

UNFPA, the United Nations Population Fund, and its partners have launched **7 BILLION ACTIONS**, a global movement showcasing the stories of people making a difference in their communities and beyond. Learn how you can get involved.

7 BILLION ACTIONS will highlight individuals and organizations who are contributing to our common future in many ways:

POVERTY AND INEQUALITY
Breaking the Cycle

WOMEN AND GIRLS
Empowerment and Progress

YOUNG PEOPLE
Forging the Future

REPRODUCTIVE HEALTH & RIGHTS
The Facts of Life

ENVIRONMENT
Healthy Planet, Healthy People

AGING
An Unprecedented Challenge

URBANIZATION
Planning for Growth

National Geographic and UNFPA have teamed up to raise awareness of the 7 billion population milestone in 2011.

Countdown to 7 Billion

For more insights on what it means to live in a world of 7 billion people and to explore *National Geographic* magazine's year-long coverage on the topic, go to ngm.com/7-billion.



United Nations Population Fund
unfpa.org

Visit 7BillionActions.org today,
"like" the campaign on Facebook,
and follow it on Twitter.





NOW

Firefly flashes aren't random. Some species have distinct patterns of call-and-response.



Photinus marginellus
P. pyralis
P. greeni

1 sec

4

7

■ Male (flashes first)
● Female (responds)



Sark Is the Night

They say on a clear day you can see forever. What about a clear night? If you're on the isle of Sark (above), meteors, constellations, and a horizon-spanning Milky Way are on view. The tiny, rustic Channel Island—2.1 square miles, 600-some residents, no cars or public lighting—has long been a haven for naked-eye astronomy. This year it became the first island in the world deemed a Dark Sky Place by the International Dark-Sky Association, a U.S.-based nonprofit promoting solutions to light pollution.

Sark joins about a dozen places worldwide recognized by the group for their commitment to night-sky clarity. Steve Owens, the astronomer who led Sark's application process, says the designation came after a six-month "light audit" led to the retrofitting of 30 fixtures causing an orange glow. For mid-winter stargazers, that means 12 hours of darkest night await. —Jeremy Berlin

ET CETERA

A new species of **UNISEXUAL LIZARD** has been bred by Kansas City researchers. The all-female population reproduces by cloning. • A study of the rice genome puts the origin of **DOMESTICATED RICE** at around 8,200 years ago in China. • Turkey announced plans to build **CANAL ISTANBUL**, a roughly 30-mile waterway that will bypass the Bosphorus, linking the Black Sea to the Sea of Marmara. • A fossil found in Wyoming shows a **GIANT QUEEN ANT** that was the size of a small hummingbird.

PHOTO: SUE DALY. GRAPHIC: KISS ME I'M POLISH. SOURCES: SARA LEWIS, TUFTS UNIVERSITY; CHRISTOPHER CRATSLY, FITCHBURG STATE UNIVERSITY. NGM MAPS

Release: StoreMags & FantaMag

NEXT

SIMULATING WILDFIRES

Researchers seek the weak spots in a home's defenses.

FOUR DECADES of studying fires have led Jack Cohen of the U.S. Forest Service to one conclusion: When it comes to wildfires, the greatest threat to homes isn't from walls of flame sweeping through residential areas. It's from the houses themselves—their construction, materials, even landscaping—and their susceptibility to embers, the tiny bits of burning material he calls firebrands.

Cohen has seen thousands of homes succumb to fire, including some of the approximately 5,500 consumed in the California infernos of 2003 and 2007. The following year the Department of Homeland Security agreed to fund development of software that will eventually enable homeowners and fire agencies to evaluate vulnerabilities in houses and other structures. This, says Cohen, is a vital step toward preventing disaster. To prove his point, he's enlisted an impressive tool: a full-scale house that can be set afire, refitted with different materials, and then set aflame again.

Call it playing with fire for a purpose. The simulations take place in a giant facility situated on 90 acres in the South Carolina countryside. Here the Insurance Institute for Business & Home Safety, with funding from some 60 insurance companies, re-creates the conditions of wildfires, hurricanes, and the like in order to study their impact on buildings and to develop protection guidelines. "There's nothing else (Continued)



Built for burning, a test house (left) faces a simulation of an ember storm typical of wildfires.

- 1** To generate the fiery bits of material, bins of bark mulch soaked in lighter fluid are set aflame.
- 2** Fans blow embers up metal tubes and at the house, simulating winds of 10 to 20 miles an hour.
- 3** The house sits on a turntable and can be fitted with different roofs, sidings, windows, and vegetation.

NEXT

The simulation showed that embers can easily ignite debris like pine needles caught in a house gutter.

like this lab,” says President and CEO Julie Rochman. “Our number one obsession is that the science be right.”

The challenges are enormous. Fire chiefs and forestry experts attest to the scientific accuracy of the fire simulations, but in the course of that achievement, ember machines have burst into flames, and metal pipes have buckled. The 105 “wind” fans devour so much energy that the nearly year-old facility has its own power substation. The tests, however, have yielded valuable information that is documented on video and in photographs.

To isolate vulnerable spots on a building in the midst of a blaze, the 1,400-square-foot test house is bombarded with embers generated by igniting bins of mulch. The structure can be fitted with different kinds of siding, windows, gutters, and roofs. Among the lessons learned: Vinyl gutters readily melt, and embers can infiltrate homes through vents, windows, and roofs. “We were a little surprised how quickly things happened once embers blew onto the roof,” says Rochman. “We saw ignition in seconds.”

That’s the point Cohen hopes the software based on his research will drive home. “When wildfires burn intensely, they produce millions of firebrands that come down like a blizzard,” he says. Once inside a house, they can potentially burn it from the inside out. The software will help users pinpoint areas prone to igniting. At the lab, meantime, another test will look at how radiant heat from a burning structure can cause its neighbor to combust. And on deck as the next great simulation challenge: creating the perfect hailstorm. —Luna Shyr



Protecting Your Home

- 1 Roof** Install class A-rated coverings. Shape and age also affect a roof’s vulnerability to fire.
- 2 Windows** Dual-pane, tempered glass is more resistant to breakage from heat exposure.
- 3 Gutters** Keep gutters clean of combustible debris such as pine needles and leaves.
- 4 Plants** Remove dry, dead vegetation. Prune overhanging trees or branches.

PHOTO: MARK THIESSEN, NGM STAFF. ART: JASON LEE



"A working art piece that will be appreciated for a very long time. Even the ticking sounds like music to my ears."

— A.C. FROM KANSAS CITY

The Watching Machine

Put a masterpiece on your wrist with the Stauer Machina Skeleton.

Let's begin with the man who couldn't keep a secret. In 1760, a Paris watchmaker craved attention for his small watch shop. According to history, he removed watch faces to reveal the delicate inner workings of his 18th century time machines. A fascinated public flocked to his door and the skeleton timepiece was born.

Clearly different. You can find rare skeleton wristwatches selling in excess of \$2500. But not the limited edition Stauer® *Machina Watch*. Today you can put this manual-wind masterpiece on your wrist *for under \$200!*



You get a clear view of all the expertly-crafted mechanics at work inside the Stauer Machina

At Stauer we removed the hood. We tore down the curtains and put everything out in the open. What you are left with is the beating heart of time itself.

A mechanical symphony. The Stauer *Machina* pumps the energy of the coiled spring through dozens of impossibly tiny parts. Flywheels as thin as an eyelash. Screws smaller than a grain of rice. Seventeen glistening rubies. All working precisely together. When you glance at the Stauer *Machina*, you don't just check the time, you watch it being made.

Every work of art deserves a frame. The square, gold-toned stainless steel case of the *Machina* frames the watchworks between panels of wafer-thin crystal. Ornate details in each corner add a touch of artistry. And a genuine brown leather band accents the glint of the metal-work perfectly.

Your satisfaction is 100% guaranteed. If for any reason you are not completely delighted with your Stauer Machina, simply return it within 30 days for a complete refund of your purchase price. But once you wear it, we're sure you'll fall in love with watching your life created one second at a time.

WATCH SPECS:

- Manual wind - 17-jeweled movement - Gold-layered case
- Genuine leather band fits wrists 6 3/4"-8 1/4"

A Stauer Exclusive

Stauer Machina Watch—~~\$395~~

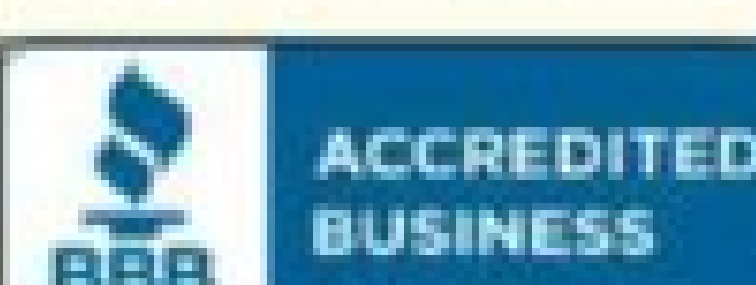
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Fitness Beat

If the prospect of getting fit propels many of us to hit the gym, then what motivates us to power *through* a workout? All those headphones might be a clue. When it comes to exercise, music is a driving force; songs can make our adrenaline surge.

But it's not as basic as cranking up the volume on a favorite tune. According to Brunel University sport psychologist Costas Karageorghis, pacing is also key. Tempo, or the rate of speed in a song, can have a positive effect on performance. When the two are synced up—as they would be when, say, jogging and listening to a song with 115 to 120 beats per minute—an average person's endurance is prolonged.

Some argue that listening to music while working out diverts focus, a notion that intrigues Karageorghis. "Next," he says, "we intend to investigate whether silence really is golden."
—Catherine Zuckerman

Both heart rates and song tempos are measured in beats per minute (BPM).





Made of titanium and carbon fiber, eLEGS weighs 45 pounds and can operate for six hours on a single charge.

This Suit Is Made for Walkin'

Pentagon-funded research has enabled the lost to pinpoint their locations, the night blind to see in the dark, and old lovers to keep tabs on each other online. Now it may help paraplegics to walk.

Last fall California-based Berkeley Bionics unveiled a "wearable robot" called eLEGS, an exoskeleton adapted from technology currently being tested for U.S. foot soldiers. Users strap on a backpack containing a battery and microprocessor, then bionic legs with motorized joints at the hips and knees. Sensors in handheld crutches issue instructions to the backpack computer, which relays them to the legs. Walking is simple: Shifting weight to the left crutch, for example, initiates a step forward with the right foot.

Trials begin this year. For now eLEGS is limited to patients under six feet two and 220 pounds with good upper-body strength. By 2013 a more rugged, versatile model may be afoot. —Bruce Falconer

THE LIST

What to Pack for Deep Space

Mission: Send humans to seek life near Alpha Centauri, a roughly 75,000-year trek.

Anthropologist John Moore, who's written on space colonies, thinks you'd need at least 60 folks for friendship and genetic diversity—plus this list. —Marc Silver



- Wrapped gifts**
Bring 50 boxes from family or friends, so you have a birthday present each year.
- Zip or flash drive with great books**
There's a lifetime of reading ahead of you.
- Ears of corn**
Grow for food; make a (floating) corn-stalk chair—it'll hold your weightless posterior.
- Mini hand fan**
To propel yourself through the craft.
- Geckos**
They're small, easy to care for, and a means to study how life in space affects the body.
- Rings for a round of ringtoss** Only they'd waft toward pegs on a wall, not the floor.
- Zippers**
To repair clothes. Zippered garb hugs the body and thus won't float off in zero gravity.



ORPHANS NO MORE

After the trauma of attack and loss comes healing—and a richer understanding of the emotions and intelligence of elephants.



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from the cold and rain, and the risk of pneumonia, with a custom-made raincoat.



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Even orphaned babies out for their morning walk from the nursery seem to understand the complex structure of

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elephant society. Here the oldest orphans lie down to invite the younger ones to play on top of them.




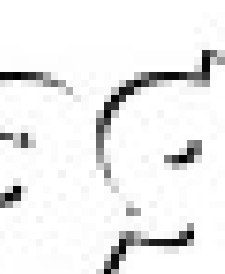
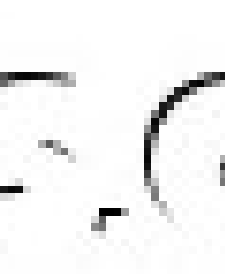

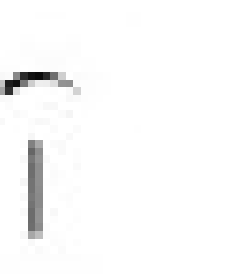


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Many men were needed to lift this rescued two-year-old into her stall. She died the next day. "It's hard if they've spent

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much time with their wild family," says Angela Sheldrick, who heads the trust. "They just give up." www.wwf.org       



The introduction of orphan elephants to Tsavo National Park is bringing wild herds back to a region devastated by



poaching decades ago. Ithumba mountain is near the park's northern border.



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Elephants enjoy their midday ablutions near the Voi stockades in Tsavo National Park. Daily mud baths are key to

Release: StoreMags & FantaMag



By Charles Siebert

Photographs by Michael Nichols



long the northern rim of Kenya's Nairobi National Park, a mysterious array of brightly colored wool blankets can be seen draped over the gnarled branches of some of the forest's upwardly braiding croton trees. Set against the region's otherwise drab browns and greens, the hanging blankets could be construed as remnants of some

ancient tribal ritual—until shortly before five each evening, when their function as part of a new interspecies experiment becomes apparent.

Off in the distance a few upright figures in bright green coats and crumpled white safari hats appear, calling out names in trilling, high-pitched voices: “Kalama!” “Kitirua!” “Olare!” All at once baby elephants emerge from the brush, a straggled procession of 18 flap-eared brown heads, their long trunks steering their bulbous heft with a heavily hypnotic grace. They come to rest beneath the color-draped trees, where the keepers tie a blanket around each one for warmth before resuming the trek home.

Home is the Nairobi nursery of the David Sheldrick Wildlife Trust, the world's most successful orphan-elephant rescue and rehabilitation center. The nursery takes in orphan elephants from all over Kenya, many victims of poaching or human-wildlife conflict, and raises them until they are no longer milk dependent. Once healed and stabilized at the nursery, they are moved more than a hundred miles southeast to two holding centers in Tsavo National Park. There, at their own pace, which can be up to eight to ten years, they gradually make the transition back into the wild. The program is a cutting-edge experiment in cross-species empathy that only the worst extremes of human insensitivity could have necessitated.

These are sad and perilous days for the world's

largest land animal. Once elephants roamed the Earth like waterless whales, plying ancient migratory routes ingrained in their prodigious memories. Now they've been backed into increasingly fragmented territories. When not being killed for their tusks or for bush meat, they are struggling against loss of habitat due to human population pressures and drought. A 1979 survey of African elephants estimated a population of about 1.3 million. About 500,000 remain. In Asia an estimated 40,000 are left in the wild. And yet even as the elephant population dwindles, the number of human-elephant conflicts rises. In Africa, reports of elephants and villagers coming into conflict with each other appear almost daily.

A recent arrival at the Nairobi nursery was an elephant named Murka, rescued near Tsavo National Park with a spear lodged deep between her eyes and gaping spear and axe wounds along her back and sides. The spear had penetrated ten inches, rupturing her sinuses, which prevented her from using her trunk to drink. Her deep wounds were filled with maggots. Most likely orphaned by poachers who killed her mother for profit, the one-year-old baby is believed to have been subsequently attacked by local Maasai tribesmen who were angry about losing their traditional grazing land to the park. A mobile vet unit was able to tranquilize her, clean her wounds, and extract the spear.



Daphne Sheldrick, who founded the Nairobi Elephant Nursery, makes her evening rounds. In 1987 Sheldrick, a pioneer of wild animal rehabilitation, became the first person to rear a newborn orphan African elephant.

The plight of elephants has become so dire that their greatest enemy—humans—is also their only hope, a topsy-turvy reality that moved a woman named Daphne Sheldrick to establish the nursery back in 1987. Sheldrick is fourth-generation Kenya-born and has spent the better part of her life tending wild animals. Her husband was David Sheldrick, the renowned naturalist and founding warden of Tsavo East National Park who died of a heart attack in 1977. She’s reared abandoned baby buffalo, dik-diks, impalas, zebras, warthogs, and black rhinos, among others, but no creature has beguiled her more than elephants.

Orphan infant elephants are a challenge to raise because they remain fully dependent on their mother’s milk for the first two years of life and partially so until the age of four. In the decades the Sheldricks spent together in Tsavo, they never succeeded in raising an orphan younger than one because they couldn’t find a formula that matched the nutritional qualities of a mother’s milk. Aware that elephant milk is high in fat, they tried adding cream and butter to the mix, but found the babies had trouble digesting it and

soon died. They then used a nonfat milk that the elephants could digest better, but eventually, after growing thinner and thinner on that formula, these orphans succumbed as well. Shortly before David’s death, the couple finally arrived at a precise mixture of human baby formula and coconut. This kept alive a three-week-old orphan named Aisha, helping her grow stronger every day.

It was Aisha that revealed to Daphne another essential ingredient for raising an orphan elephant. When Daphne traveled to Nairobi to prepare for a daughter’s wedding, she left Aisha, then six months old, in the care of an assistant. In the two weeks she was away, Aisha stopped eating and died, apparently overcome with grief at the loss of another mother. “When Aisha died, I realized the mistake I’d made,” says Daphne, still pained by the memory. “She missed me too much. You mustn’t let an elephant get too attached

Charles Siebert wrote about efforts to preserve the diversity of our food supply in the July issue. Michael Nichols is an editor at large for the magazine. His upcoming elephant book is Earth to Sky.

After a death, elephant family members show signs of grief, covering the body with dirt and brush. They may revisit the bones of the deceased for months, even years, touching them with their trunks.

to one person. It was stupid of me to think I could do it without substituting a larger family. I mean, I knew wild elephants. I had watched the elephants in Tsavo my entire married life, so I should have known better. One just has to look at an elephant group to understand the importance of family. So we have to replace what the elephant would have in the wild.”

ANY WILD ELEPHANT GROUP is, in essence, one large and highly sensitive organism. Young elephants are raised within a matriarchal family of dotting female caregivers, beginning with the birth mother and then branching out to include sisters, cousins, aunts, grandmothers, and established friends. These bonds endure over a life span that can be as long as 70 years. Young elephants stay close to their mothers and extended family members—males until they are about 14, females for life. When a calf is threatened or harmed, all the other elephants comfort and protect it.

This cohesiveness is enforced by a complex communication system. When close to each other, elephants employ a range of vocalizations, from low rumblings to high-pitched screams and trumpets, along with assorted visual signals. They express a range of emotions using their trunk, ears, head, and tail. When they need to communicate over longer distances, they use powerful low-frequency, rumbling calls that can be heard by others more than a mile away.

After a death, family members show signs of grief and exhibit ritualistic behavior. Field biologists such as Joyce Poole, who has studied Africa's elephants for more than 35 years, describe elephants trying to lift the dead body and covering it with dirt and brush. Poole once watched a female stand guard over her stillborn baby for three

days, her head, ears, and trunk drooped in grief. Elephants may revisit the bones of the deceased for months, even years, touching them with their trunks and creating paths to visit the carcass.

What has amazed Sheldrick most since establishing the Nairobi nursery is how readily even severely traumatized babies begin to reweave the elaborate social fabric of the wild group. “They are born with a genetic memory and are extremely social animals,” she says. “They intuitively know to be submissive before elders, and the females are instinctively maternal, even from a very young age. Whenever we get a new baby here, the others will come around and lovingly put their trunks on its back to comfort it. They have such big hearts.”

Standing amid a group of orphans one afternoon as they browsed on croton tree branches, I was struck by their distinct personalities. Kalama, a female found at five weeks old in a water well in northern Samburu, was cheeky and playful. Kitirua, found abandoned at around 18 months old near a swamp in Amboseli National Park, was a recent arrival and still shy and aloof. Tano, a four-month-old suspected poaching victim from the Laikipia region of central Kenya, had become so close to the keepers that she kept pushing other orphans away out of jealousy. Yet another suspected poaching victim, Chemi Chemi, was a mischievous male elephant. “We call him al Qaeda,” explained Edwin Lusichi, the nursery's head elephant keeper. “He's always shoving us and the other orphan elephants around.”

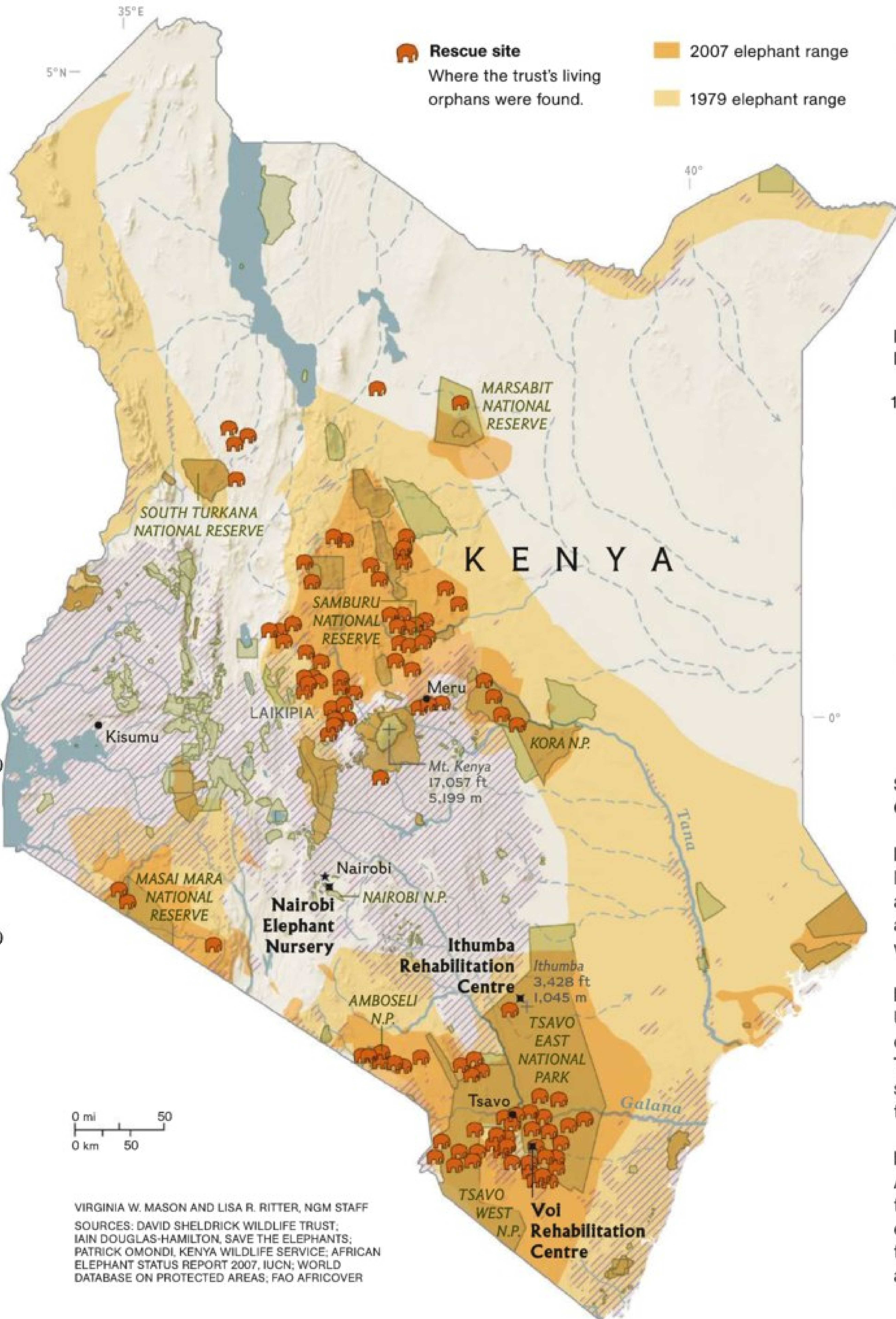
It was as though I were hanging out with a group of precocious schoolkids vying to establish their standing and make an impression on the new kid on the playground. When I approached an achingly adorable two-month-old female named Sities, I soon found myself deposited in a nearby bush by the cracked-leather rump of another elephant, getting a parting stomp on my foot for good measure.

“That's Olare,” Lusichi called out, gesturing toward the one-year-old that had just put me in my place. “She's practicing to be a matriarch.”

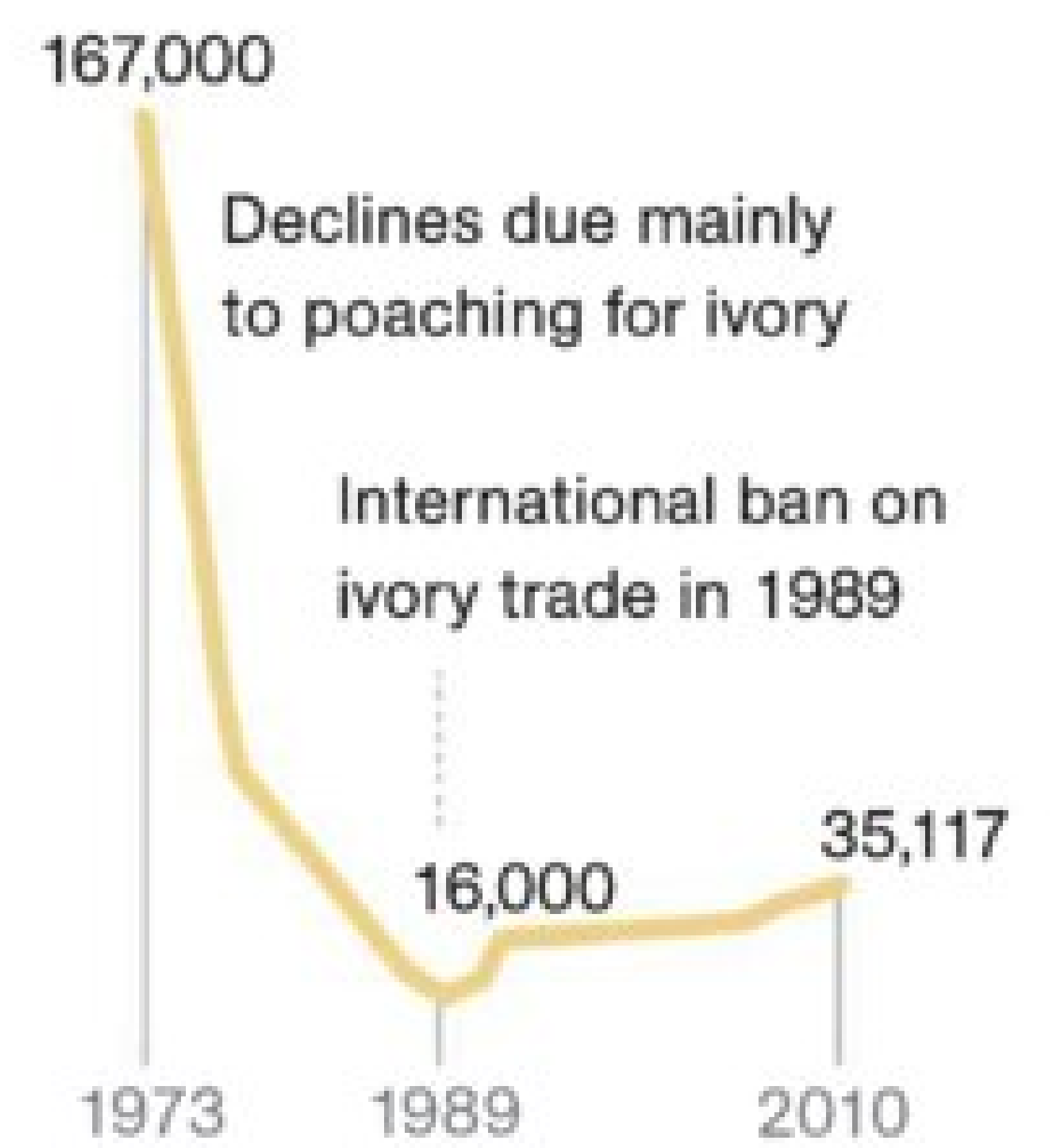
When it was time to head toward the nursery stables, I positioned myself along one flank of

Saving Orphans

The David Sheldrick Wildlife Trust raises orphan elephants from across Kenya in stages that mirror maternal care in the wild. Most were orphaned by poachers or by farmers protecting crops. Many were separated from their families after falling into wells dug for livestock. Even as Kenya's decimated elephant numbers rise, a growing human population means that problems of sharing land will persist.



KENYA ELEPHANT POPULATION



STAGES OF ORPHAN CARE

Nairobi nursery
Milk-dependent orphans are fed by keepers who are in physical contact with them 24 hours a day.

Rehabilitation centers
Usually by age two, orphans are moved to Tsavo, where keepers slowly expose them to the bush.

Back to the wild
An orphan chooses when to join one of the park's elephant families, a transition that may take as long as eight to ten years.

VIRGINIA W. MASON AND LISA R. RITTER, NGM STAFF
SOURCES: DAVID SHELDRIK WILDLIFE TRUST; IAIN DOUGLAS-HAMILTON, SAVE THE ELEPHANTS; PATRICK OMONDI, KENYA WILDLIFE SERVICE; AFRICAN ELEPHANT STATUS REPORT 2007, IUCN; WORLD DATABASE ON PROTECTED AREAS; FAO AFRICOVER

Young elephants that have experienced assaults on their psyches may exhibit signs of post-traumatic stress, just like orphaned children in the wake of war or genocide.

the pachyderm procession. I'd started off toward the trees of blankets, when an elephant trunk suddenly struck my midsection with such force that I dropped to my knees.

"I forgot to warn you," Lusichi said, helping me up with a broad smile. "Tumaren doesn't like it when anyone walks ahead of her."

SPEND ENOUGH TIME around elephants and it's difficult not to anthropomorphize their behavior. "Elephants are very human animals," says Sheldrick, sitting one afternoon on the back porch of her house at the edge of the nursery grounds, the wide, acacia-dotted plains of Nairobi National Park sprawling in the distance. "Their emotions are exactly the same as ours. They've lost their families, have seen their mothers slaughtered, and they come here filled with aggression—devastated, broken, and grieving. They suffer from nightmares and sleeplessness."

What makes this particular moment in the fraught history of elephant-human relations so remarkable is that the long-accrued anecdotal evidence of the elephant's extraordinary intelligence is being borne out by science. Studies show that structures in the elephant brain are strikingly similar to those in humans. MRI scans of an elephant's brain suggest a large hippocampus, the component in the mammalian brain linked to memory and an important part of its limbic system, which is involved in processing emotions. The elephant brain has also been shown to possess an abundance of the specialized neurons known as spindle cells, which are thought to be associated with self-awareness, empathy, and social awareness in humans. Elephants have even passed the mirror test of self-recognition, something only humans, and some

great apes and dolphins, had been known to do.

This common neurobiology has prompted some scientists to explore whether young elephants that have experienced assaults on their psyches may be exhibiting signs of post-traumatic stress disorder (PTSD), just like orphaned children in the wake of war or genocide. Gay Bradshaw, a psychologist and the director of the Kerulos Center in Oregon, has brought the latest insights from human neuroscience and psychology to bear on startling field observations of elephant behavior. She suspects that some threatened elephant populations might be suffering from chronic stress and trauma brought on by human encroachment and killing.

Before the international ivory trade ban in 1989, poaching took a steep toll on many elephant populations and in some instances significantly altered their social structure because poachers tended to target older elephants. Field biologists found that the number of older matriarchs, female caregivers, and bulls in vulnerable groups had fallen drastically. In Uganda, for instance, one study reported that many females between the ages of 15 and 25 had no close family members whatsoever.

In the decades since the ban, some populations have stabilized, though most elephants remain threatened by human encroachment. As poaching has flared up in the past five years in the Congo Basin and large swaths of central and eastern Africa, many elephant families there have lost most of their adult females. Where such social upheaval exists, calves are being raised by ever more inexperienced females. An increasing number of young orphaned elephants, many of which have witnessed the death of a parent through culling or at the hands of poachers, are coming of age in the absence of the traditional support system. "The loss of older elephants," says Bradshaw, "and the extreme psychological and physical trauma of witnessing the massacres of their family members interferes with a young elephant's normal development."

Bradshaw speculates that this early trauma, combined with the breakdown in social structure, may account for some instances of aberrant



Emily, now 17 years old and the matriarch of her herd, greets head keeper Joseph Sauni a day after he helped remove a poacher's arrow from her side. Elephants released into the wild often come back for help, says Sauni, "or to show off babies."

elephant behavior that have been reported by field biologists. Between 1992 and 1997, for example, young male elephants in Pilanesberg Game Reserve in South Africa killed more than 40 rhinoceroses—an unusual level of aggression—and in some cases had attempted to mount them. The young elephants were adolescent males that had witnessed their families being shot in cullings at Kruger National Park—sanctioned killings to keep elephant populations under control. At that time it was common practice for such orphaned elephant babies to be tethered to the bodies of their dead relatives until they could be rounded up for translocation to new territories. Once moved to Pilanesberg, the orphans matured without the support of any adult males. “Young males often follow older, sexually active males around,” says Joyce Poole, “appearing to study what they do. These youngsters had no such role models.”

For Allan Schore, an expert on human trauma disorders at UCLA who has co-authored papers with Bradshaw, the behavior of these elephants conforms to a diagnosis of PTSD in humans. “A

large body of research shows that the neurobiological mechanisms of attachment are found in many mammals, including humans and elephants,” he explains. “The emotional relationship between the mother and her offspring impacts the wiring of the infants’ developing brain. When early experiences are traumatic, there is a thinning down of the developing brain circuits, especially in areas that process emotional information and regulate stress. That means less resilience and an enduring deficit in aggression regulation, social communication, and empathy.”

One effort to repair the torn fabric of an elephant group lends further support to the idea that early trauma and a lack of role models can lead to aggression: After Joyce Poole suggested that park rangers in South Africa introduce six older bull elephants into Pilanesberg’s population of about 85 elephants, the aberrant behavior of the marauding adolescent males—and their premature hormonal changes—abruptly stopped.

IF ELEPHANTS CAN WOUND LIKE US, they can heal like us as well, perhaps more readily. With

Most of the orphans recover

to become wild elephants again.

They return in wary, halting,

half measures at first, caught

between a deep devotion to their

human caregivers and the irre-

sistible call of their true selves.

humans acting as stand-ins for their mothers, along with the help of the other nursery elephants, the majority of the orphans that survive recover to become fully functional wild elephants again. To date, Sheldrick's nursery has successfully raised more than a hundred orphan elephants. They have returned to the wild in wary, halting, half measures at first, having become "homo-pachyderms," caught between a deep devotion to their human caregivers and the irresistible call of their true selves.

One evening during the dry season a huge group of wild elephants emerged from the bush to drink at the water trough at the Ithumba compound in Tsavo, one of two locations where the orphans transition to the wild. There were 25 to 30 elephants—massive, long-tusked bulls and matriarchs, adolescent males and females, some ex-orphans, and several newborn calves. Directly alongside the trough were the open-air stockades where the Ithumba orphans had already gathered for the night, staring over at their wild counterparts, which, between sips, stared back. The keepers and I were standing no more than 30 yards from the wild group, much closer than one usually would get. And the elephants were much closer to humans than wild ones normally venture. The dreamlike scene was dictated by the presence of the orphans and their conversations with the wild group. "They have let the wild ones know it is OK," explained Benjamin Kyalo, Ithumba's head elephant keeper. "The word is clearly being spread around Tsavo: Good humans. Good water. Let's go!"

By day the keepers lead the orphans into the bush to browse. They deliver midday bottles of formula at a designated mud-bath venue. When a cluster of wild elephant heads appears in the

distance, the keepers keep the milk-dependent orphans close, not allowing them to leave with the group. But by the age of five or seven, the orphans may go off with the wild ones. Some will stay out for a few nights before returning to the stockades, as though they'd been away at a sleepover. Some will go for good, becoming full-fledged members of their own wild families.

One orphan named Loijuk was so eager to join a wild group that she twice opened the Ithumba gate with her trunk and let herself out. Months after the second breakout she had become a member of a wild ex-orphan group. Another precocious orphan named Irima was just over three years old and still milk dependent when he insinuated himself into a wild group near Voi, the other stockade where orphans are introduced to the wild. After five days the Voi keepers heard a series of frantic, high-pitched elephant trumpets coming from the direction of an electrified fence. "Irima must have told the group that he still needed his milk and orphan family and wanted to go back, so Edo [a former orphan] escorted him home," Voi's head keeper, Joseph Sauni, recalls. "The keepers opened the gate, and Edo escorted Irima all the way back to the stockades. Edo drank some water from the well, ate some food, and took off again. Mission accomplished."

Even fully "repatriated" orphans like Edo will return to the stockades to visit their human family. In December 2008 Emily, a matriarch that had been brought to the Nairobi nursery in 1993, showed up at the Voi stockades one afternoon with her group and a surprise guest. "She'd given birth the day before, about a mile away," says Sauni. "She led the baby here to show us her newborn. We named her Eve."

BACK AT THE NAIROBI NURSERY the baby elephants return for their six o'clock feeding, breaking into a full sprint once they see the line of keepers holding up huge bottles of milk before each of the stables. A major ruckus ensues when they arrive—some stable assignments have changed to make room for a new arrival, and elephants hate alterations to their routine. The nursery's most veteran keeper, Mishak Nzimbi—



A keeper indicates the depth to which this spear penetrated the head of 20-month-old Murka. More than a year after her rescue, Murka has left the nursery and is one step closer to rejoining a wild elephant group.

known as the “elephant whisperer” and the clear favorite of all the orphans—steps into the fray. Heeding little more than an upheld hand and one stern utterance, the residents settle into place, sucking down gallons of formula in seconds.

“The control the keepers have over these elephants, without even a stick or anything!” marvels Daphne’s younger daughter, Angela, the current executive director of the David Sheldrick Wildlife Trust. “It all stems from the elephants’ desire to please someone they love. It’s amazing and beautiful to see. With elephants you reap what you sow, and the way you get the most out of them is through love.”

We walk over to the stable marked Murka—the orphan that had been found with a spear lodged in her head. “Now look at her,” Daphne says, as Murka, with only the slightest indent in her forehead to show for her brutal ordeal, approaches the half-opened door of her stable and takes two of my fingers to suckle on. “The vets didn’t expect her to make it through the first night.”

“And she’s healed psychologically,” Angela

adds. “She was one extremely traumatized little elephant when she first woke up, lashing out at everyone—and rightly so. But slowly she began to trust again, and after about a month she wasn’t just fine about people, she was seeking them out. And it wasn’t just our doing. She would never have recovered so quickly without the input of other elephants.”

All around us orphans and keepers are settling in for the night. Each elephant sleeps with a different keeper every night to prevent it from getting too attached to a particular person—and perhaps vice versa. Leaning on the stable door, Nzimbi, Murka’s overseer for the night, recalls first visiting the nursery 22 years earlier. He immediately asked Daphne for a job. “I understand these animals,” he says. “I love them so much.”

Directly above Murka’s straw-and-blanket bed is Nzimbi’s bunk, with a small radio perched by his pillow. I ask if he has an alarm clock to wake him for the elephants’ feedings.

“Oh no,” he says. “Every three hours you feel a trunk reach up and pull your blankets off. The elephants are our alarms.” □



Too young and fragile to be integrated with the other orphans, two-week-old Wasin was swaddled in a blanket, its

STORY/KEGG.COM



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heft and warmth a poor substitute for her slain mother. Weeks later Wasin abruptly died of unknown causes.



Orphans playfully vie for a bottle of formula not finished by little Sities, the blanketed baby at the keeper's feet.

PHOTOGRAPHY BY
SOPHIE GIBSON



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Every three hours the orphans are fed the formula, which was developed over decades.



Mzima, a poaching victim, greets schoolchildren visiting Tsavo National Park. "To poachers," says Daphne Shelbrick,





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An orphan lies down for a post-feeding nap at the Nairobi nursery. Elephants, among the most intelligent creatures

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If we only had



wings

THE DARING DREAM OF PERSONAL FLIGHT

In 2008 Yves Rossy flies over Bex, Switzerland, borne by jet-powered wings he designed.

FABRICE COFFRINI, AFP/GETTY IMAGES



ON THE BRINK Australian Jim Mitchell leaps off Ottawa Peak on Canada's Baffin Island while wearing a wing suit in April 2010. He died weeks later when a jump from a nearby mountain went tragically awry.

KRYSTLE WRIGHT



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By Nancy Shute

Perched on the edge of a cold, windswept dune in North Carolina, I was about to fulfill a dream I shared with Leonardo da Vinci: To fly. The Renaissance genius spent years deciphering the flight of birds and devising personal flying machines. On his deathbed in 1519, Leonardo said one of his regrets was that he had never flown. Five hundred years of innovation since then had produced the hang glider I held above my head, simple and safe enough to be offered as a tourist entertainment. But despite those centuries of adventure and experimentation, personal flight—the ability to bound from Earth like a skylark, swoop like a falcon, and dart as blithely as a hummingbird—remains elusive.



WE
HAVE
LIFTOFF

Our human longing to mimic birds has often proved painful. Greek mythology mourns the melted dreams of Icarus (above). Arab poetry relates a crushing crash by ninth-century inventor Abbas ibn Firnas. Medieval British monk Eilmer became lame after leaping from an abbey on homemade wings. But as technology takes off, the dream of personal flight seems closer than ever.

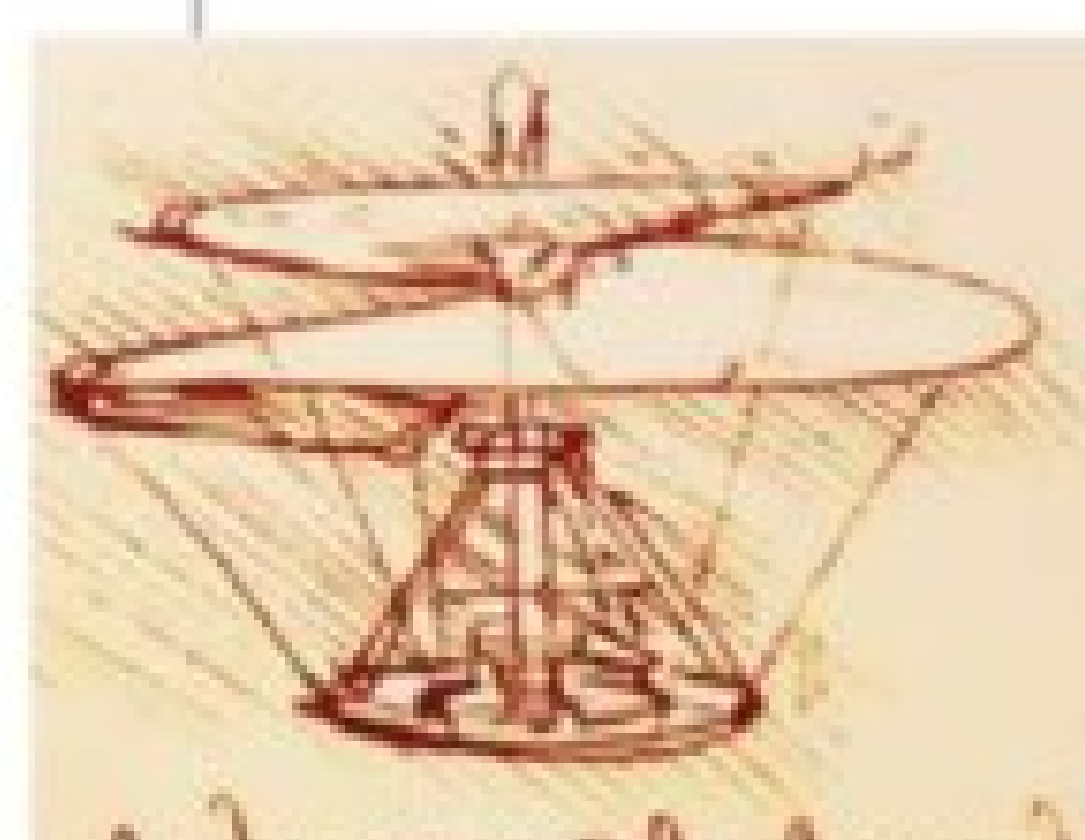


1783

A taffeta hot-air balloon carries two men over Paris. Its inventors were said to be inspired by paper—or underwear—floating in a fire's updraft.

1480s

The "aerial screw," one of several flying devices sketched by Leonardo da Vinci, hints at the whirling motion of the modern helicopter.



That's not for lack of trying. Many lives have been lost and fortunes squandered pursuing the dream of flight, and even today scientists, inventors, and adventurers persist in the quest.

Leonardo drew hundreds of images of birds on the wing, trying to decode their secrets, and drafted meticulous plans for flying machines not unlike today's gliders and helicopters. But he never figured out the physics of flight. It took more than 300 years and many more failed experiments until Sir George Cayley, a British engineer, determined that flight required lift, propulsion, and control. He built a glider with a curved wing to generate lift. Then he ordered his coachman into it and had farmworkers pull it down a slope until it gained enough speed to fly. Control, alas, was lacking. The craft crashed after flying a few hundred yards. The coachman survived, but reportedly was not amused.

My student hang glider was almost as low concept as Cayley's, and though I knew it could

fly, control clearly remains an issue. The instructors at Kitty Hawk Kites, at Kill Devil Hills a couple of miles from where the Wright brothers flew the first powered aircraft in 1903, explained that piloting requires just five simple motions: lean left or right to turn; push the control bar up or down for speed; push the bar up to land. But students in my class still augered into the sand. One fell hard enough to break the glider's sturdy aluminum strut. That made me more determined to succeed.

I have always loved to fly, even in lumbering jumbo jets. When the Kitty Hawk Kites school quoted Leonardo as saying, "For once you have tasted flight, you will walk the Earth with your eyes turned skywards," I sighed in recognition.

Some years back I learned to fly a single-engine plane, but flying a small plane is about as thrilling as sitting at a card table. I hoped hang gliding would deliver the unencumbered essence of flight. It certainly delivered the fear. My grip



1853

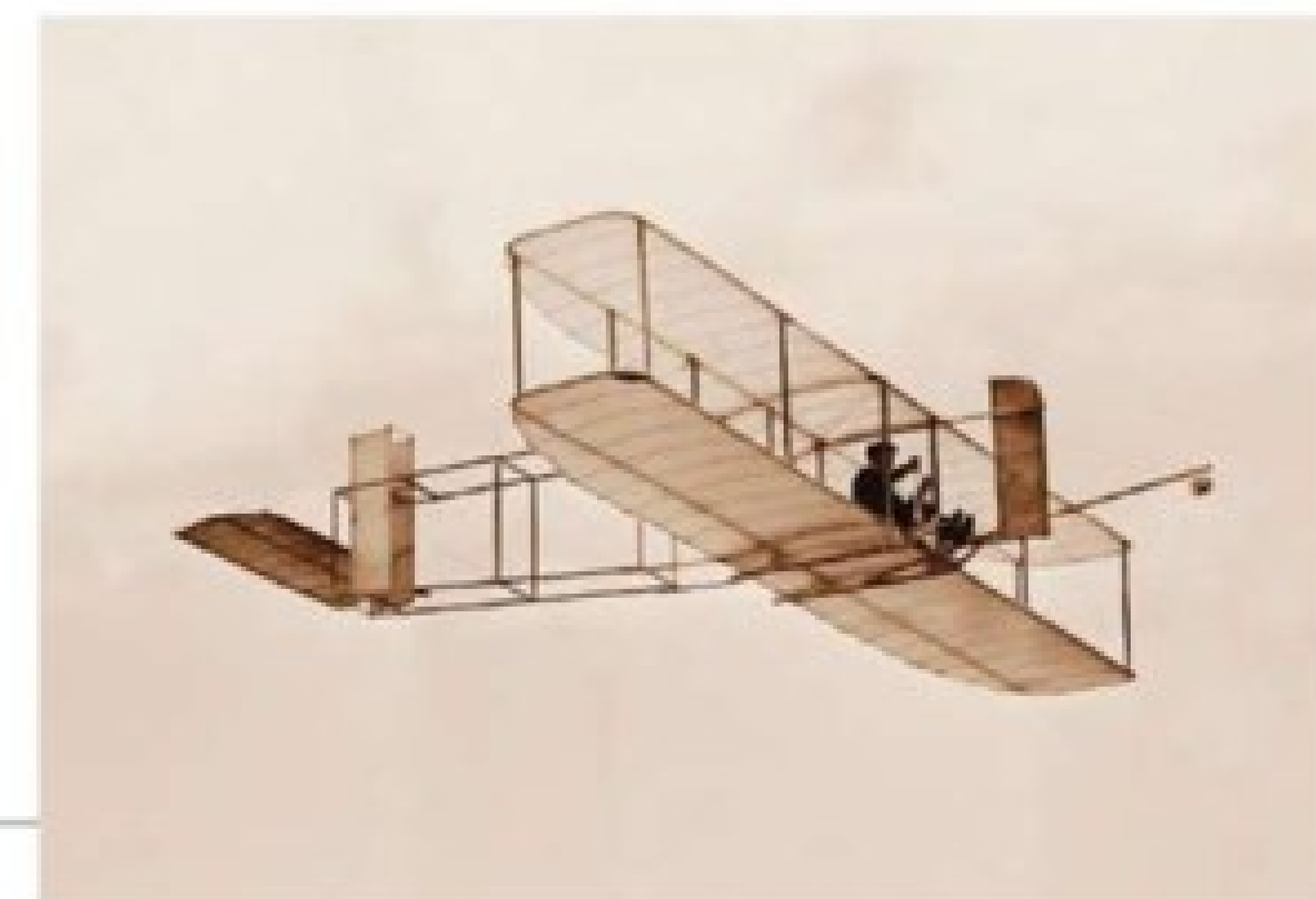
Sir George Cayley, 79, sees his "governable parachute" briefly glide through what he calls "an uninterrupted navigable ocean that comes to... every man's door"—the sky.

1891-1896

To prove hang gliders are more than a passing fancy, German engineer Otto Lilienthal flies his own versions some 2,000 times before a fatal fall.

1900-1911

The Wright brothers pioneer the airplane and develop better gliders. Orville's 1911 model soars nearly ten minutes, the longest unpowered flight yet.



"If a human had [a hummingbird's] mass of muscles, it would stick out like a 55-gallon drum. It would be freakin' enormous."

on the control bar was painfully tight as I ran down the lip of the dune. Suddenly I was running in thin air. Flying! After a few seconds the instructor shouted "Flare!" I pushed the control bar over my head and landed, unsteady but on my feet—then headed back uphill. I wanted to feel again that strange, lovely moment aloft.

A glider wing is an efficient way to generate lift, but my seconds-long flight proved that running off a dune doesn't generate much speed. Glider flight is a controlled descent; pilots gain altitude only if they catch rising air and ride it aloft. Birds don't have that problem; they fly with great efficiency and more precision than any aircraft. Sooty shearwaters log almost 40,000 miles migrating from New Zealand to Alaska and back, while ruby-throated hummingbirds can fly 20 hours without stop migrating across the Gulf of Mexico. Scientists still struggle to understand the physiology of avian flight, but light bones and an intricate collaboration

among chest and wing muscles appear essential. A hummingbird's chest muscles account for 20 percent of its mass, according to Bret Tobalske, a University of Montana physiologist. "If a human had that mass of muscles, it would stick out like a 55-gallon drum," he says. "It would be freakin' enormous."

Legend has it Icarus fell from the sky because hubris led him too close to the sun, melting the wax that held the feathers on his wings. More likely, his arms just gave out. Uncounted numbers of "birdmen" have died over the centuries after leaping from tower or cliff, not realizing



1935
Spreading homemade canvas wings at 10,000 feet, "Bird-man" Clem Sohn rides the wind for 75 seconds. Two years later, a horrified crowd sees the stunt artist's parachute fail.



1948
Aerospace engineer Francis Rogallo and his wife invent the flexible "paraglider" wing as a sort of parachute for space capsules. Human fliers latch on to it.

1955
On the Hiller Flying Platform, a pilot stands atop twin fans and steers by leaning. It proves too unwieldy for military use.



they could never flap homemade wings hard or fast enough to stay aloft. Their modern heirs, BASE jumpers, leap from buildings, cliffs, and bridges, plunge for a few exhilarating moments, then throw out a parachute to slow their fall. Some don wing suits, with baffled fabric wings that generate enough lift to propel the wearer forward at up to 160 miles an hour while falling. J. T. Holmes of Squaw Valley, California, who has made about a thousand wing-suit jumps, says, "It's as close as human beings can get to flying like a bird." It's also extraordinarily dangerous: About 12 BASE jumpers die each year. Hitting the mountain while free-falling or after the parachute deploys is a common cause.

The best success in purely human-powered flight came in 1988, when the *Daedalus*, a lightweight aircraft built by a team at the Massachusetts Institute of Technology, flew 71.5 miles from the Greek island of Crete to Santorini. The 69-pound



craft, pedaled by a Greek Olympic cyclist, got caught in turbulence as it approached the beach at Santorini. It crashed in the sea, a few yards from the shore.

To solve such problems, Wilbur and Orville Wright had fitted a motor and propeller on a glider. That clanking, smoky machine may have ushered in modern aviation but apparently delivered little joy. The Wrights also returned to flying unpowered gliders off dunes. But powered aviation did offer hope of a personal aircraft that could soar into the air like a bird, something my glider could not do. Enter the rocket men.

After World War II, the American military funded a parade of personal-flight experiments, none of which fulfilled the mission of safe, maneuverable, or stealthy flight. Consider rocket belts. The wearer of the belt would fly less than a minute because of limits on the fuel a person can carry. Plus, the device is expensive, noisy,



1956
When the U.S. Army orders a dozen De Lackner Aerocycles, one journalist envisions a "cavalry on modern, sky-busting steeds." Test pilots deem the open-rotor craft unsafe.

1961
Bell engineer Harold Graham straps on a hydrogen peroxide-fueled Rocket Belt and flies for 13 seconds.



1960s
Modern hang gliding is born as pilots attach light frames to the Rogallo flexible wing.

1970-1983
The jet-powered Williams Aerial Systems Platform flies, but flops in the military market. Years later, the *New York Times* calls it "a flying garbage can."

BIRD'S VIEW A powered paraglider enabled photographer George Steinmetz to take this picture of his colleague sailing over a salt ridge in Kenya's Chalbi Desert. "With this thing I can get a perspective you can't get any other way."

GEORGE STEINMETZ



“Controlling the rockets’ power was the biggest challenge,” says Bill Suitor, who’s flown with a rocket belt for decades. “It’s like a fire-breathing dragon.”

and notoriously difficult to control. Just ask Bill Suitor. His neighbor Wendell Moore, a Bell Aerospace engineer, needed an average guy to test the Rocket Belt, which he was developing for the U.S. Army in the early 1960s, and recruited 19-year-old Suitor. Now 66, Suitor has flown more than 1,200 times. “Controlling the rockets’ power was the biggest challenge,” he says. “It’s like a fire-breathing dragon.”

Inventors continue to try to bring the comic book fantasy of personal jet flight to life, and Yves Rossy has come closest. This Swiss pilot flings himself out of an aircraft wearing a six-foot-wide carbon-fiber wing of his own invention, powered by four tiny jet engines. In May, Rossy leaped from a helicopter above the Grand Canyon and flew eight minutes before parachuting to Earth. The jets give him powered ascent and the oomph

Flying journalist Nancy Shute contributes to NPR, Scientific American, and other media outlets.

to do loops. That freedom doesn’t come easy; it took Rossy years to master his tiny craft. “I steer myself in space with only my body,” he explains. “To go left, I turn my shoulders left, and that’s it!” He says it’s like parachuting with a wing suit, whose panels between the body and limbs slow a skydiver’s fall, but with more liberty. “It’s awesome, it’s great, it’s fantastic!”

You won’t catch me jumping out of a plane with a wing strapped to my back. But I yearn for even a small measure of Rossy’s *joie de vol*. After five runs off the Outer Banks dune last April, I was getting closer—able to fly into the wind, then floating gently down onto my feet. It was as if the glider wasn’t there.

I wanted more. Sandra Vernon, a 47-year-old mother of three in my class on the dune, egged me on. She’d been flying towed tandem flights, pulled up to 2,000 feet behind an ultralight. This usually grants a hang glider a good ten-minute flight back down to Earth, even if there are no



1977

A British prize set up in 1959 for the first human-powered plane is finally claimed by the *Gossamer Condor*, which has Mylar wings and a furiously pedaling pilot.



1990s

French skydiver Patrick de Gayardon soars in his batlike nylon wing suit. He dies testing a new model in 1998.

rising thermals to help keep the craft aloft. “I’m short, I’m chubby, I’m not spry,” Vernon says. “I wish I had been doing this in my 20s. You can’t help but love it.”

Challenge accepted, I strapped myself into the harness of a tandem glider with instructor Jon Thompson. He warned that the moment when the towplane released us would remind me of going over the top of a roller coaster. I’m a coaster fan. This was nothing like that. It felt like falling headfirst off the top of a 2,000-foot-tall building. “You can fly now,” Thompson said, genially offering me the controls. “No!” I shouted over the wind. In a few moments the glider gained lift and leveled off. My terror waned, and I took control. I banked left, then right—more of a pigeon than a sooty shearwater but flying all the same.

In pursuit of flight, I’m also keeping my eye on the Puffin, a “personal air vehicle” that became an Internet sensation when NASA unveiled it

in 2010. Big advances in superefficient electric motors and control systems, which let the aircraft feel the intention of the pilot, may make it possible to fly a one-person craft like this safely without typical pilot training. “We are trying to create a horse-and-rider kind of experience,” says Mark Moore, a NASA aerospace engineer who developed the prototype. “A horse is an intelligent vehicle, but it’s only intelligent at certain things. The rider knows his intent better than the horse could ever discern.”

The Puffin may never fly, but other inventors are tinkering. Joe Ben Bevirt, an entrepreneur in Santa Cruz, California, has already flown a small-scale prototype of his version of a flying car. He envisions it as a sleek, red plane with eight electric motors. It would take off and land vertically and fly a hundred miles in an hour, zooming him to a San Francisco meeting in half the time it takes in his Prius. “I want one,” he says flatly.

Me too. □



2000
U.S. defense grants begin funding a program to develop a flying “exoskeleton.” The idea is to create a suit that soldiers can wear to take off and land vertically, with a propeller fan over each shoulder.

2006
Seeking the power of a plane without its confines, Swiss pilot Yves Rossy puts jet engines and carbon-fiber wings on his own body.

2008
Martin Aircraft tests its fan-powered “Jetpack” and says it plans to sell a recreational model. Flight time: 30 minutes. Price: \$100,000.

2010
NASA’s Puffin concept, a 300-pound electric “flying suit,” would stand on its stubby tail for takeoff, then level off to cruise on wings.

IMAGES (LEFT TO RIGHT): BETTMANN CORBIS; AP PHOTO; DEREK HENDERSON FOR TIME MAGAZINE; NASA LANGLEY/ANALYTICAL MECHANICS ASSOCIATES
TIME LINE RESEARCH: MEGAN CASSIDY. CONSULTANT: ALBION H. BOWERS, NASA DRYDEN FLIGHT RESEARCH CENTER





TESTING THE LIMITS Jeb Corliss tries a wing-suit prototype 12,000 feet above Perris, California. New designs make it possible to stay aloft longer. His ultimate goal is to glide to Earth without a parachute: "That's my Everest."

JEB CORLISS



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ADIRONDACK PARK

FOREVER WILD

*New York State's sprawling preserve
strikes an extraordinary balance between
modern interests and the forest primeval.*

Leaves float past a fallen birch.

Release: StoreMags & FantaMag

Sunlight dapples the shoulders of Algonquin and Wright, two of the more than 40 so-called High Peaks that rise above 4,000 feet. Once blighted by logging and industry, the region has undergone a renaissance of woods and waters.



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BY VERLYN KLINKENBORG

PHOTOGRAPHS BY MICHAEL MELFORD



From where I live a couple of hours north of New York City, I can feel the peculiar gravity of the Adirondacks, which lie another two hours to the north and west. It's a gravity as strong as Manhattan's but the opposite kind—the beckoning of few roads and few people, the pull of a wild region large enough to have an “interior.” Here, the outside world seems to vanish behind enfolding mountains, quarantined away by river, still water, and wetland. Crest one of the High Peaks, and all you see is Adirondacks.



Leaves of maple and birch make an art of dying on the dark surface of Lake Placid. With thousands of lakes and ponds, the park is a favorite of paddlers and the center of a century-old and still thriving boatbuilding tradition.

Visitors have been coming steadily to these mountains since the mid-19th century. In the early days they came by horse-drawn wagon, Lake George steamer, and train. Today you can get to the Adirondacks by making a left off the highway from Albany to Montreal. And yet some approaches still let you feel you're being devoured by remoteness.

The soil changes mile by mile on a drive up from the south. Soon a dark wall of trees—red spruce, balsam fir, beech, hemlock—surrounds you, and there's a sudden stony persistence. You're climbing onto the Adirondack dome, an exposure of ancient rock thrusting upward, rising faster than anything around it. Then comes water, some of it visible, much of it secret: ponds, lakes, creeks, rivers, and bogs too saturated to

bear the weight of anything much heavier than a beaver. Here is a place, as the philosopher William James wrote more than a century ago, to "aspire downwards."

Aspiring downwards for James, like so many visitors then and now, meant climbing upward, as he did in the summer of 1898, hiking up Mount Marcy and Gothics and Basin Mountains all on one memorable day. Others aspire downwards deep in the St. Regis Canoe Area, floating in a seam of light, a silent wake trailing behind their canoe. At such moments it's possible to pretend you're looking straight back into history, well past 1898, if not quite so far as 1609, when Samuel de Champlain came within eyeshot of these mountains.

It's easy to believe, even now, that almost nothing has changed in what James called the "primitive forest." But with few exceptions, almost everything has changed in the Adirondacks. The unbroken green of the summer landscape rolling out from the High Peaks hides a singular fact: New York's Adirondack Park may be the most complicated park on the planet.

The best way to grasp its complexity is by considering a simple question: How do you make a park? In Yellowstone—the first national park in the world—the land was set aside in a single, nearly virginal lump. But by the time Congress protected Yellowstone in 1872, portions of the Adirondacks had been industrial zones for more than half a century, especially along the tributaries of the Hudson River and Lake Champlain. The forest was being cut for charcoal to heat forges working iron from Adirondack mines, for hemlock bark used in local tanneries, and for sawlogs milled downstream. This was the logging of legend, before mechanization: breast-high stumps left by men swinging axes or wielding crosscut saws, horses skidding logs, rivers regulated as "public highways" for log driving.

By 1890, according to the *New York Times*, there was widespread fear that it was "too late to

Verlyn Klinkenborg writes for the New York Times and other publications. Michael Melford specializes in landscape and nature photography.

preserve the Adirondack forests.” The intrusion of railroads brought tourists but also extended the reach of loggers. There were “few live trees in sight” along the rail lines, and visitors passed through a country “still blackened from the fires that have passed over it.”

Part of the miracle of the Adirondacks is how quickly these abused lands healed. Just decades earlier, in the 1870s, the state had begun taking over parcels of cutover land forfeited for non-payment of taxes. By 1892 it was ready to make a park of them. The original boundary embraced 2.8 million acres, only half of which actually belonged to the state. (Private land today makes up roughly half the park.) New York enshrined its sprawling forest preserve in the state constitution, which protects the state-owned park as “forever wild.”

Since then the park has grown to almost six million acres—the largest park of any kind in the lower 48 states. It encompasses nearly every type of land classification imaginable: wilderness,

**THE UNBROKEN GREEN
OF THE SUMMER LANDSCAPE
HIDES A SINGULAR FACT:
THIS MAY BE THE MOST
COMPLICATED PARK
ON THE PLANET.**

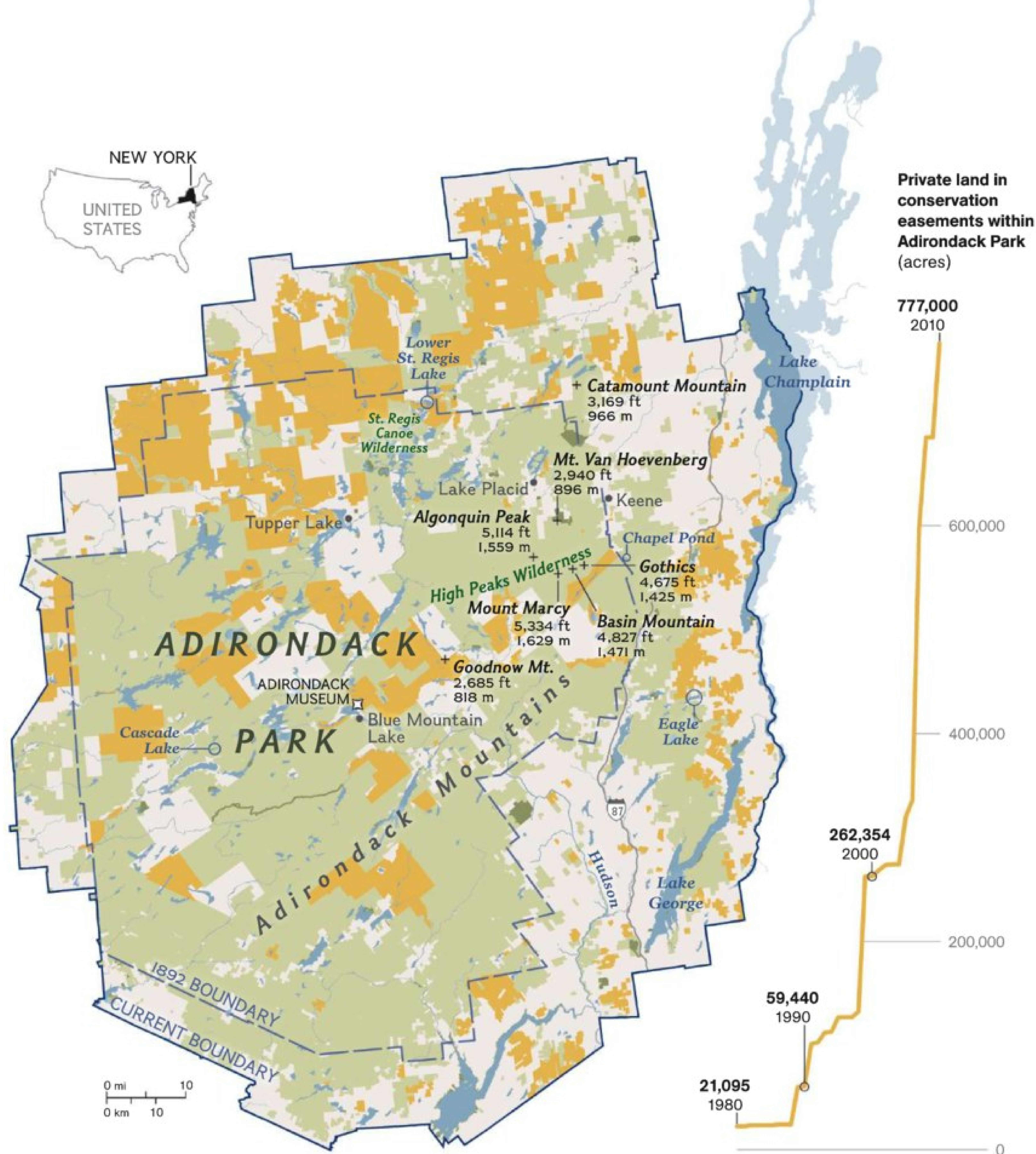
wild forest, primitive area, land owned by investment groups and private clubs, industrial land, land held in trust by environmental organizations, private land under state easement, and private land without easement, not to mention 103 municipalities within the park, including towns and villages like Tupper Lake, Lake Placid, and Keene. The result is an intricate mosaic of lands and an equally intricate mosaic of humans, all of whom influence the governance and direction of the park itself.

A warm August weekend. At the early morning trailheads, casual hikers are setting off on long and short loops. Climbers ready their gear impatiently, eager to get to the rock faces. Cyclists thread past them, heads down. On the grounds of the Adirondack Museum and along the highway leading to Blue Mountain Lake, crafts and antiques are being set out. Breakfast smoke rises from campfire villages deep in the woods. Canoes and kayaks work their way along the perch-colored shallows of Lower St. Regis Lake. Hikers are waking in lean-tos down the trails, and someone is surely drinking coffee over a laptop in a modern lodge modeled after one of the great Adirondack “camps”—vast log mansions that were once the pinnacle of rustic luxury.

While these capillaries of civilization reach far into the park, there’s an inescapable sense wherever you go in the Adirondacks that just a short distance away a wilderness begins—many wildernesses, in fact. What’s arresting about the Adirondacks isn’t the tantalizing promise of another view lying out of sight, though the park is an endless beaded chain of new perspectives. What’s arresting is the absence of a view, the dense enclosure of the eastern forest, the depth of the biotic floor you step across as you move deeper and deeper into a kind of Leatherstocking shade. It seems irrational to feel the trees closing behind you, as if the forest is cutting you off from the present. But the gravity you feel—drawing you over rock and moss, through small streams where the light opens overhead, across deadfalls, and into pure dim stands of hemlock—is the returning wildness of the place.

“The Adirondacks are the Eden of restoration,” says Bill McKibben, writer, environmentalist, and longtime Adirondacks resident. “This is probably the place on Earth that went brown to green most resoundingly over the 20th century. Many places in the park you need to be a silviculturist to know you’re not in virgin forest. Almost all the original species are back.”

When the Adirondack Park was established in 1892, it was intended to be a preserve, not an experiment. And yet *(Continued on page 94)*



PROTECTED STATE LAND

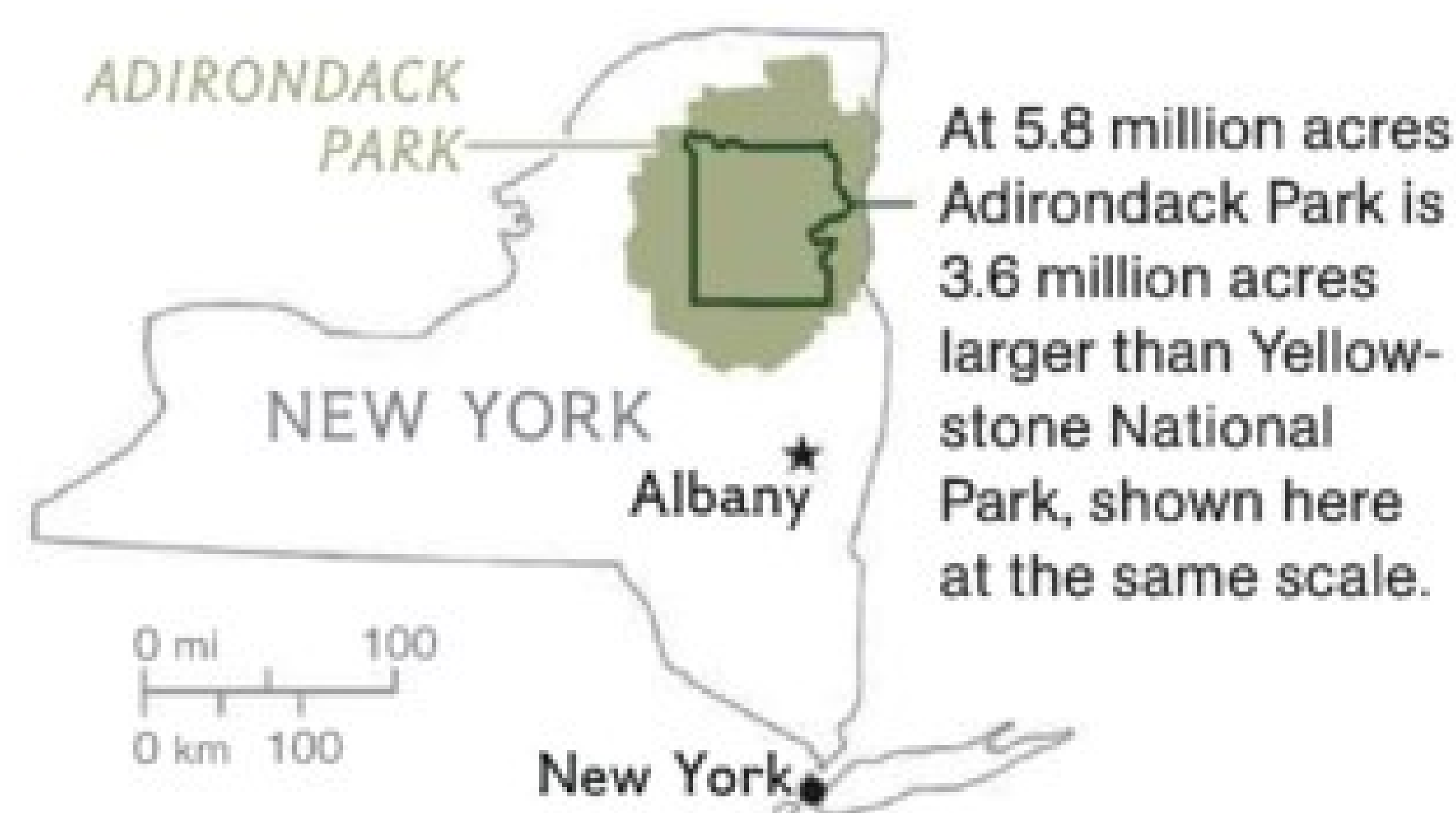
- Forest Preserve (managed for conservation)
- Intensive use (managed for recreation)

PRIVATE LAND

- In conservation easements (future development restricted)
- Other (wide range of land uses)

AN ADIRONDACK MOSAIC

Since its original boundary was drawn 119 years ago, the park has grown to nearly six million acres, less than half of which are state owned. In recent years more and more private land (graph, above right) has been placed under conservation easements—legal agreements that restrict development while allowing for recreation, farming, timber management, and other traditional uses.

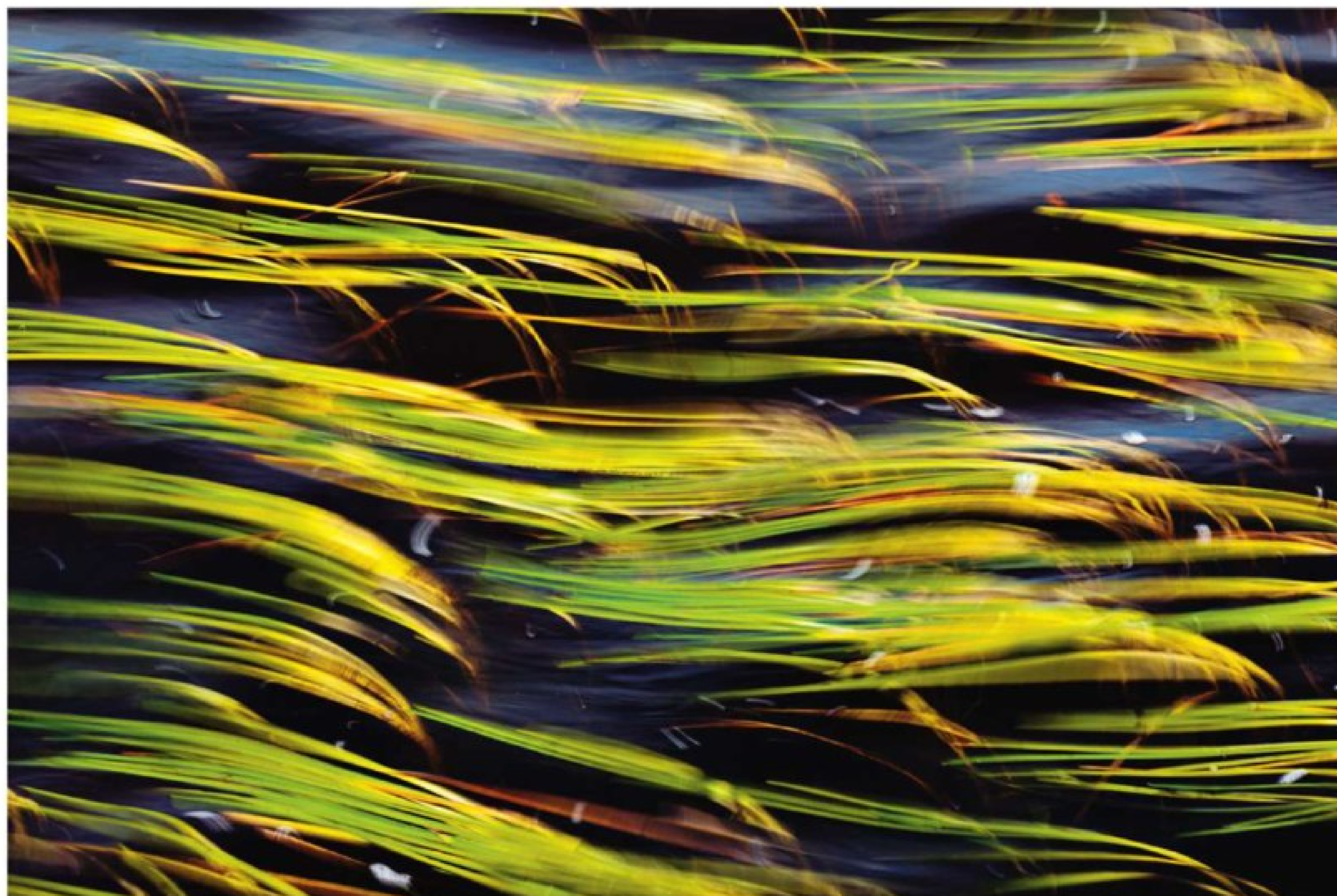




PART OF THE MIRACLE
OF THE ADIRONDACKS IS
JUST HOW QUICKLY
THESE ABUSED LANDS
HEALED.



The palette of the Adirondack forest shifts with the seasons. In the delicate tracery of a viburnum leaf (left), summer's green gives way to autumn's red as chlorophyll fades and underlying pigments emerge. The same seasonal chemistry brings a blush to a stand of fern (above). Meanwhile, vegetation along the shores of Lower St. Regis Lake bends to the will of the wind (right), while a leafless maple bears up under the onslaught of winter (above right).




Winter whitens Mount Van Hoevenberg, its 2,940-foot summit clad in balsam fir and spruce. Taller peaks that reach into the alpine zone are crowned with stunted evergreens called krummholz, from the German, "crooked wood."







An underwater camera provides a fish's-eye view of lily pads on Eagle Lake. The lily pads are illuminated from below, creating a dramatic, high-contrast scene. The leaves show a variety of colors, from bright yellow and orange to deep red and brown, indicating seasonal changes. The intricate vein structure of the leaves is clearly visible. The background is dark, making the illuminated leaves stand out prominently.

An underwater camera offers a fish's-eye view of lily pads on Eagle Lake. Sulfur dioxide from power plants made many Adirondack lakes so acidic they became fishless. Thanks to the Clean Air Act and other measures, some now show signs of recovery.

the park has become an inadvertent laboratory exploring the coexistence of a nature preserve with a resident population of some 130,000 humans and millions of summer visitors. The biological experiment has been an unqualified success—biodiversity is rebounding—but the social and economic experiment is ongoing.

That experiment is overseen by the Adirondack Park Agency, established by the New York legislature in 1971. Its commission is planning and policy for a park that embraces one-fifth of the state and a maddening puzzle of land types and uses, putting the agency at the center of tension between development and preservation.

“There’s almost nothing that’s strictly prohibited in the park,” says Curt Stiles, the agency’s chairman. “It’s just a matter of finding the right place for it.” Somewhere within the park there is provision, through land classification and environmental impact assessment, for nearly every kind of human activity, from industry to wilderness solitude. Judging by the political temperature in the park at the moment, there seems to be a tolerable, perhaps even sustainable, balance between protection and use. But the scales require constant adjustment in response to shifting conditions—not least of which is the threat posed by climate change.

There’s good evidence that climate change is manifesting itself in the park: Average summer temperatures have increased by about two degrees over the past hundred years, winter temperatures by about five. Lakes are freezing up later in the year, and spring is arriving earlier. The park is the southern limit for some plants, and rare alpine species that once thrived atop the High Peaks are now at risk of vanishing.

I find myself imagining a time-lapse photo of future changes, imagining, as well, a time-lapse of the past century and a half in these timeless mountains: the logging and mining and burning, the movement to protect the last fragments of untouched forest, the greening of this resilient landscape. The remembering is reassuring. For decades now, the stewards of this cherished park have been searching for balance. More often than not, it seems, they’ve found it. □





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On the trail to Goodnow Mountain, a yellow birch appears to be ingesting a boulder left behind by a glacier. With its tenacious trees and rebounding wildlife, Adirondack Park is a miracle of regeneration. Committed advocates and legal protections written into New York's state constitution offer hope that it will remain forever wild.

Cabdrivers know passengers don't want to miss a moment of Brazil's nightly soap operas, or *novelas*. In the popular *Ti-ti-ti*, Claudia Raia (on-screen) plays a strong-willed fashion designer.



MACHISMA

How a mix of female empowerment and steamy soap operas helped bring down Brazil's fertility rate and stoke its vibrant economy.



6.3



1960 2009

The Shrinking Family

The seven children of 61-year-old Maria do Livramento Braz (seated in their midst) of Rio are a reminder of Brazil's once high fertility rate. The number of kids per

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woman has plummeted since the 1960s. Working-class families now aspire to the middle-class lifestyle—and family size—of Maria Corrêa de Oliveira (seated), a Rio psychoanalyst. She and her husband have only Henrique, 8, and Diana, 12.

BY CYNTHIA GORNEY

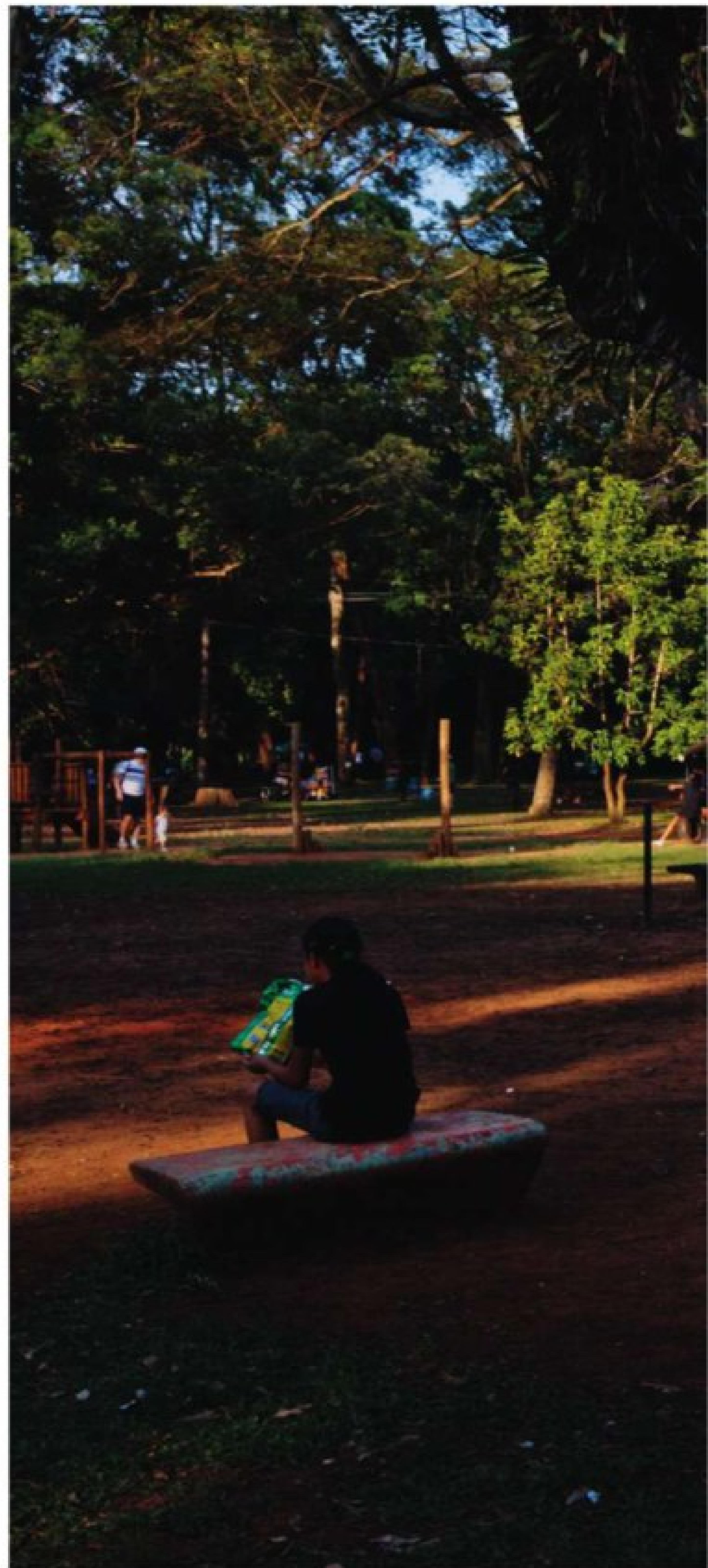
PHOTOGRAPHS BY JOHN STANMEYER

**José Alberto,
Murilo,
Geraldo,
Angela,
Paulo,
Edwiges,
Vicente,
Rita,
Lucia,
Marcelino,**

Teresinha. That makes 11, right? Not including the stillbirth, the three miscarriages, and the baby who lived not quite one full day. Dona Maria Ribeiro de Carvalho, a gravelly-voiced Brazilian lady in her 88th year, completed the accounting of her 16 pregnancies and regarded José Alberto, her oldest son, who had come for a Sunday visit and was smoking a cigarette on her couch. “With the number of children I had,” Dona Maria said mildly, her voice conveying only the faintest reproach, “I should have more than a hundred grandchildren right now.”

José Alberto, who had been fishing all morning at the pond on his ranch, was still in his sweat-pants. His mother’s front room in the mid-Brazil town of São Vicente de Minas was just big enough to contain three crowded-in armchairs, a television, numerous family photos, framed drawings of Jesus and the Blessed Virgin, and the black vinyl couch upon which he, Professor Carvalho, retiring head of his university’s School of Economics and one of the most eminent Brazilian demographers of the past half century, now reclined. He put his feet up and smiled. He knew the total number of grandchildren, of course: 26. For much of his working life, he had been charting and probing and writing about the remarkable Brazilian demographic phenomenon that was replicated in miniature amid his own family,

SEVEN BILLION is a yearlong series on global population.



A girl takes a solo spin on her shiny pink bicycle in São Paulo’s Ibirapuera Park. Among comparable populations, only China, with its one-child rule, has seen as dramatic a drop in its fertility rate as Brazil. The difference? Brazil’s decline was driven by women’s choices, not state policy.



who within two generations had crashed their fertility rate to 2.36 children per family, heading right down toward the national average of 1.9.

That new Brazilian fertility rate is below the level at which a population replaces itself. It is lower than the two-children-per-woman fertility rate in the United States. In the largest nation in Latin America—a 191-million-person country where the Roman Catholic Church dominates, abortion is illegal (except in rare cases), and no official government policy has ever promoted birth control—family size has dropped so sharply and so insistently over the past five decades that the fertility rate graph looks like a playground slide.

And it's not simply wealthy and professional women who have stopped bearing multiple children in Brazil. There's a common perception that the countryside and favelas, as Brazilians call urban slums, are still crowded with women having one baby after another—but it isn't true. At the demographic center Carvalho helped found, located four hours away in the city of Belo Horizonte, researchers have tracked the decline across every class and region of Brazil. Over some

Cynthia Gorney reported on child brides for our June issue. John Stanmeyer documented sacred rituals for our single-topic issue on water, which won a 2011 National Magazine Award.

The young woman loved her toddler son very much, she said, but she was finished with childbearing. The expression she used was one I'd heard from Brazilian women before: "A fábrica está fechada." The factory is closed.

weeks of talking to Brazilian women recently, I met schoolteachers, trash sorters, architects, newspaper reporters, shop clerks, cleaning ladies, professional athletes, high school girls, and women who had spent their adolescence homeless; almost every one of them said a modern Brazilian family should include two children, ideally a *casal*, or couple, one boy and one girl. Three was barely plausible. One might well be enough. In a working-class neighborhood on the outskirts of Belo Horizonte, an unmarried 18-year-old affectionately watched her toddler son one evening as he roared his toy truck toward us; she loved him very much, the young woman said, but she was finished with childbearing. The expression she used was one I'd heard from Brazilian women before: "A fábrica está fechada." The factory is closed.

The emphatic fertility drop is not just a Brazilian phenomenon. Notwithstanding concerns over the planet's growing population, close to half the world's population lives in countries where the fertility rates have actually fallen to below replacement rate, the level at which a couple have only enough children to replace themselves—just over two children per family. They've dropped rapidly in most of the rest of the world as well, with the notable exception of sub-Saharan Africa.

For demographers working to understand the causes and implications of this startling trend, what's happened in Brazil since the 1960s provides one of the most compelling case studies on the planet. Brazil spans a vast landmass, with enormous regional differences in geography, race, and culture, yet its population data are by tradition particularly thorough and reliable. Pieces of the Brazilian experience have been mirrored in scores of other countries, including those in which most of the population is Roman Catholic—but no other nation in the world seems to have managed it quite like this.

"What took 120 years in England took 40 years here," Carvalho told me one day. "Something *happened*." At that moment he was talking about what happened in São Vicente de Minas, the town of his childhood, where nobody under 45 has a soccer-team-size roster of siblings anymore. But he might as well have been describing the entire female population of Brazil. For although there are many reasons Brazil's fertility rate has dropped so far and so fast, central to them all are tough, resilient women who set out a few decades back, without encouragement from the government and over the pronouncements of their bishops, to start shutting down the factories any way they could.

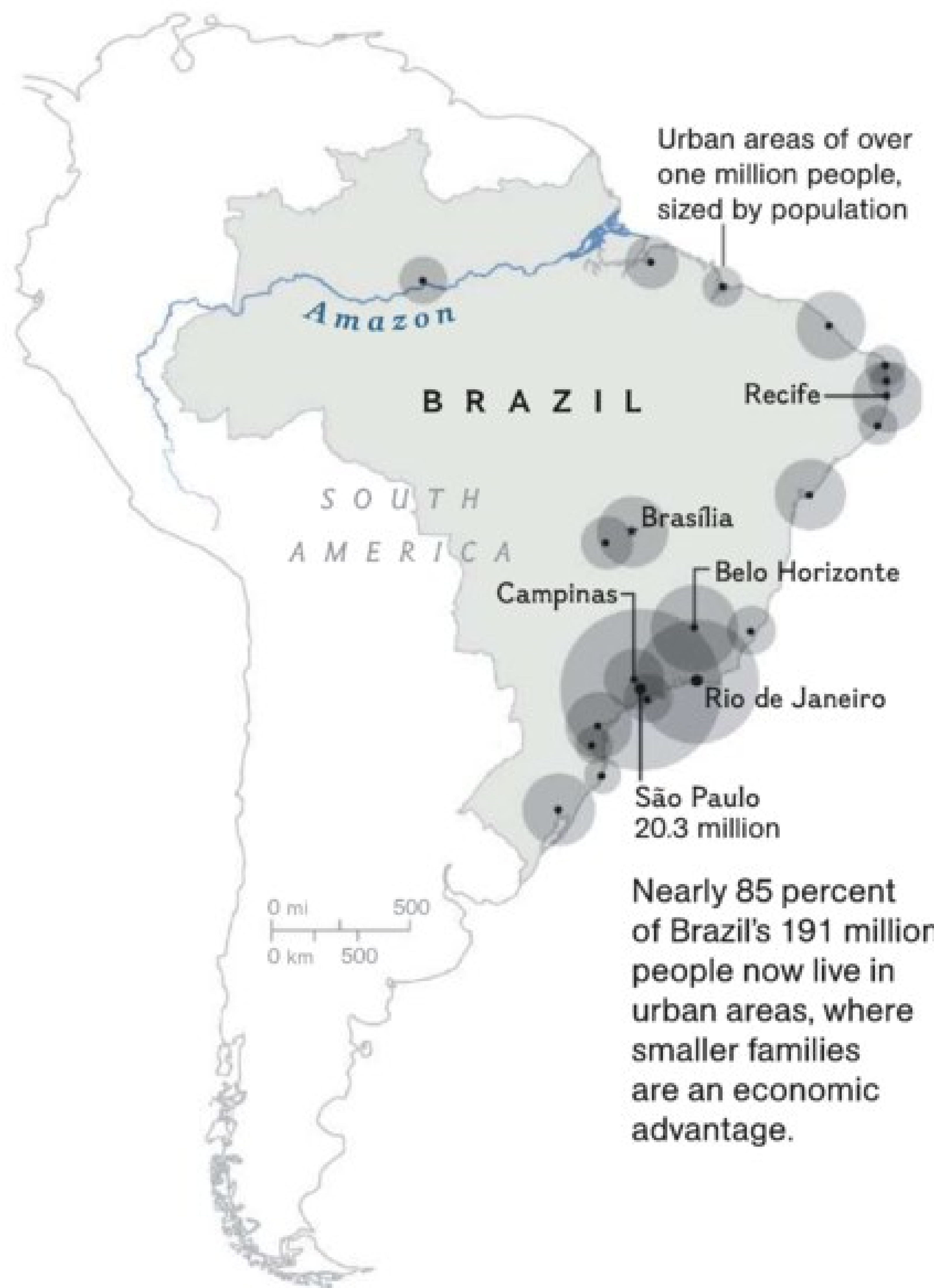
Encountering women under 35 who've already had sterilization surgery is an everyday occurrence in Brazil, and they seem to have no compunctions about discussing it. "I was 18 when the first baby was born—wanted to stop there, but the second came by accident, and I am *done*," a 28-year-old crafts shop worker told me in the northeastern city of Recife, as she was showing me how to dance the regional two-step called the *farró*. She was 26 when she had her tubal ligation, and when I asked why she'd chosen irreversible contraception at such a young age—she's married, what if she and her husband change their minds?—she reminded me of son number two, the accident. Birth control pills made her fat and sick, she said. And in case I'd missed this part: She was done.

So why two? Why not four? Why not the eight your grandmother had? Always the same answer—"Impossible! Too expensive! Too much work!" With the facial expression, the widened eyes and the startled grin that I came to know well: It's the 21st century, *senhora*, are you nuts?

Population scholars like José Alberto Carvalho maintain a lively argument about the multiple components of Brazil's fertility plunge. ("Don't let

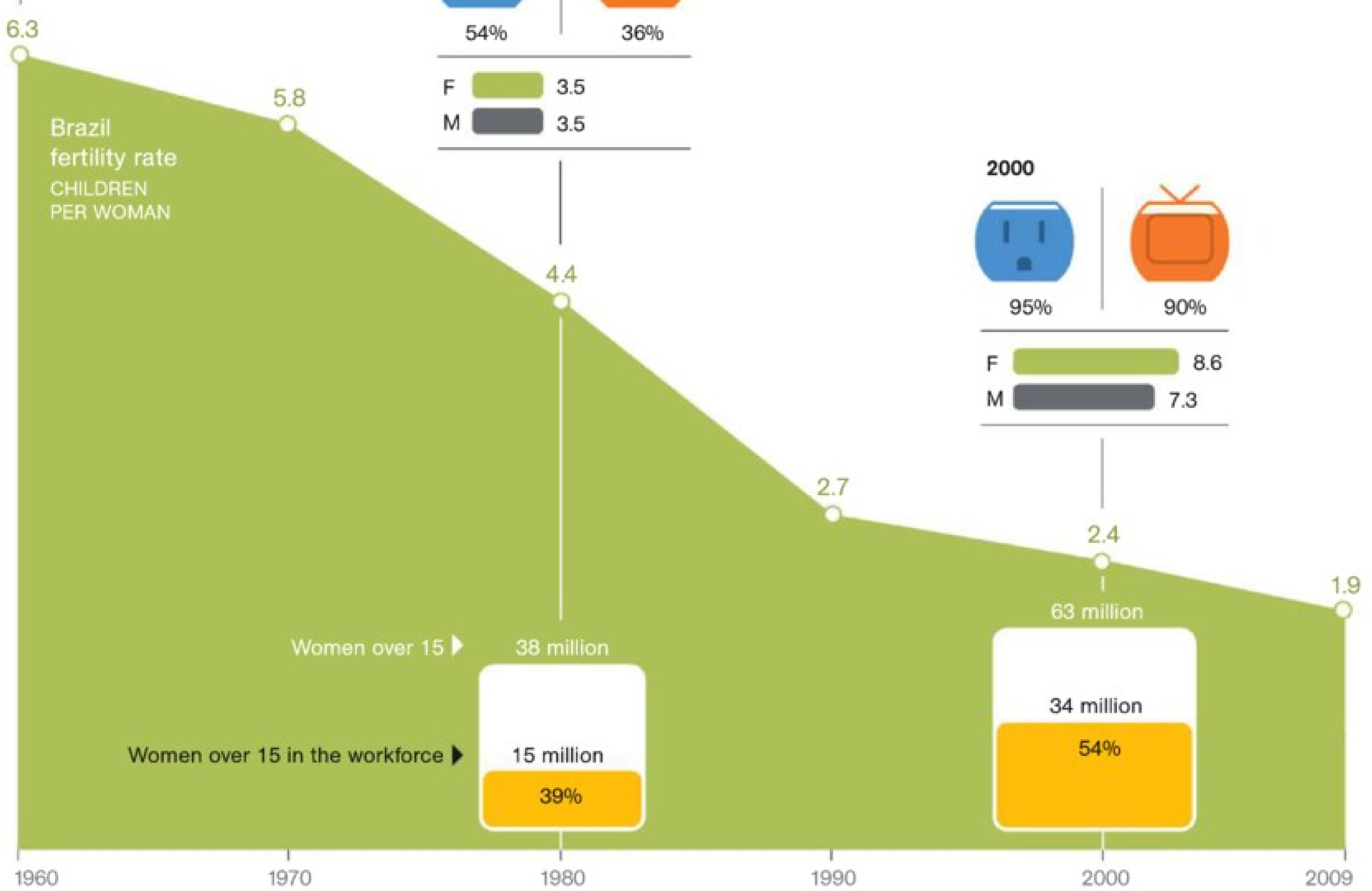
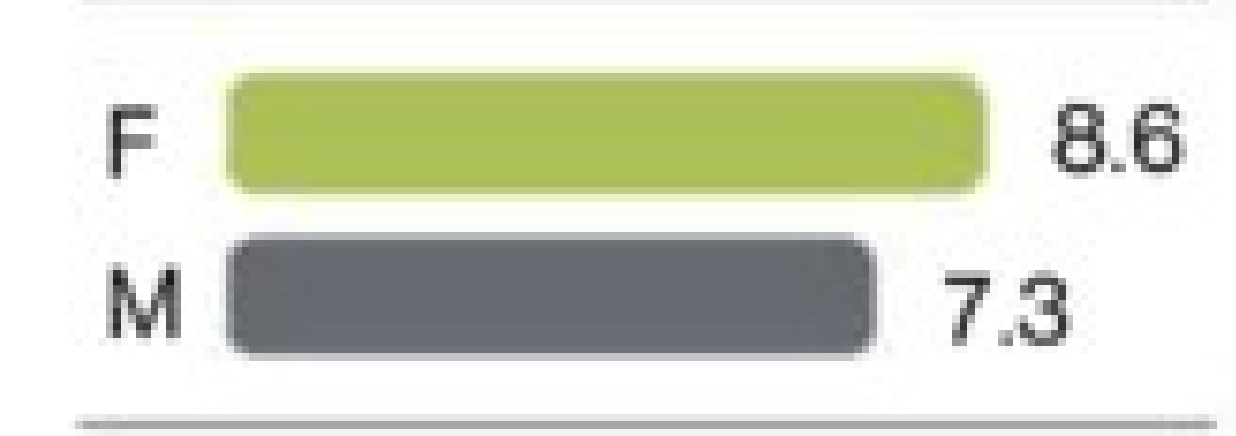
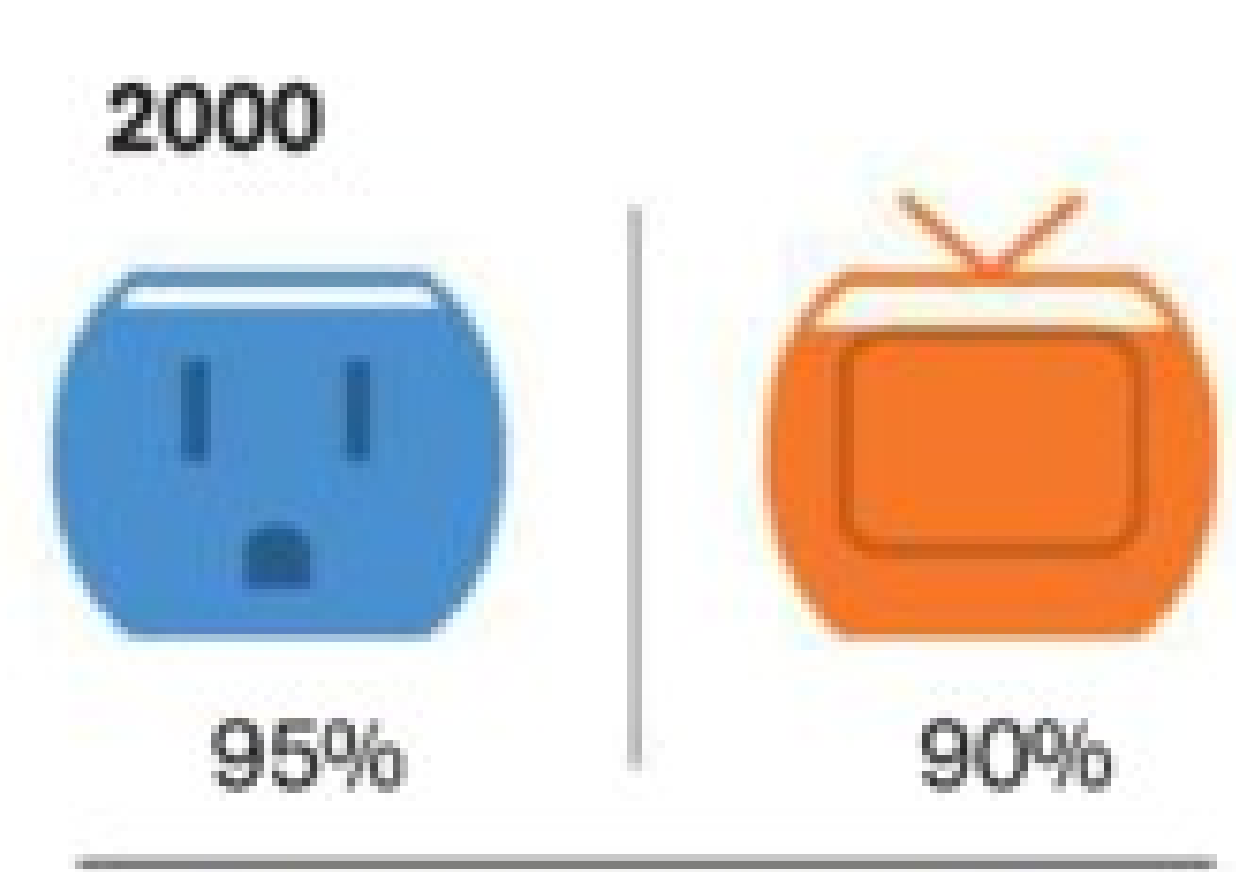
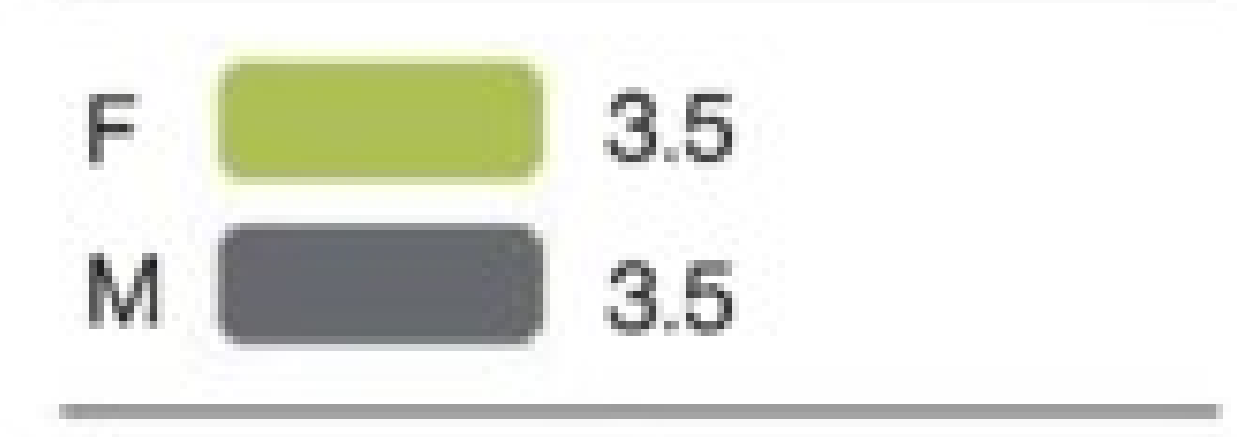
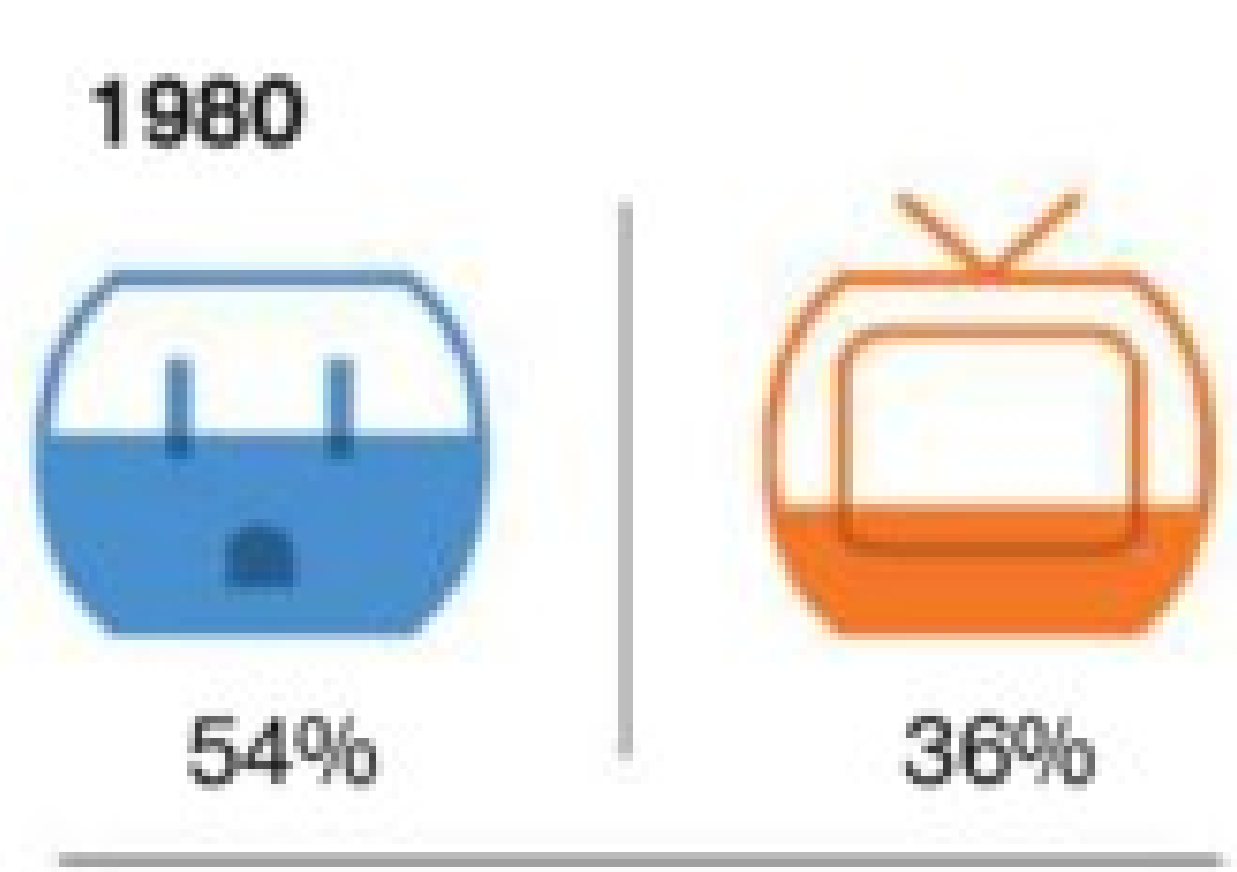
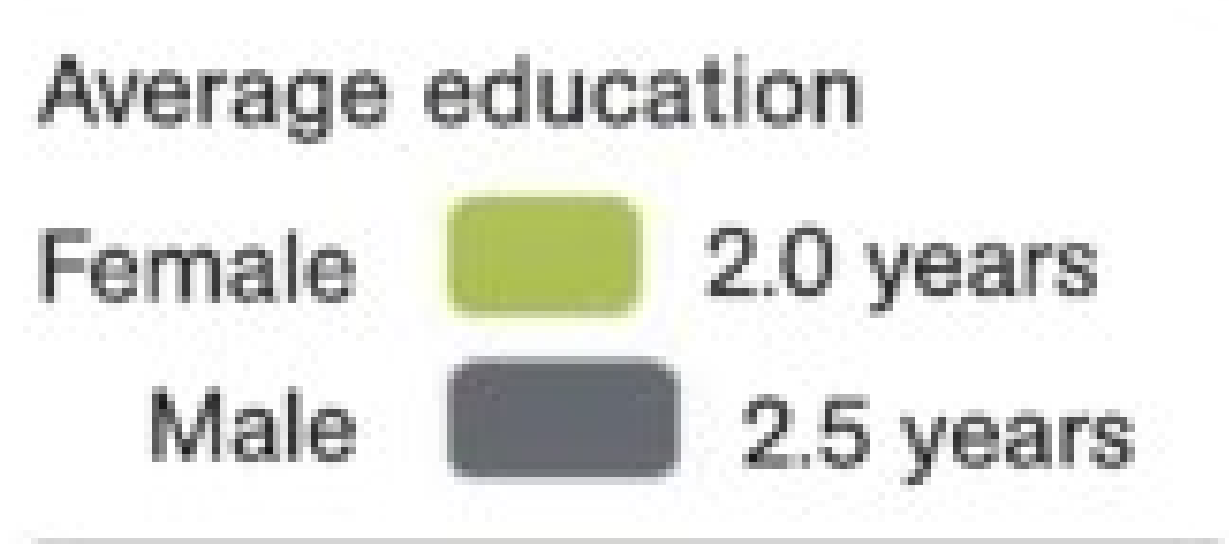
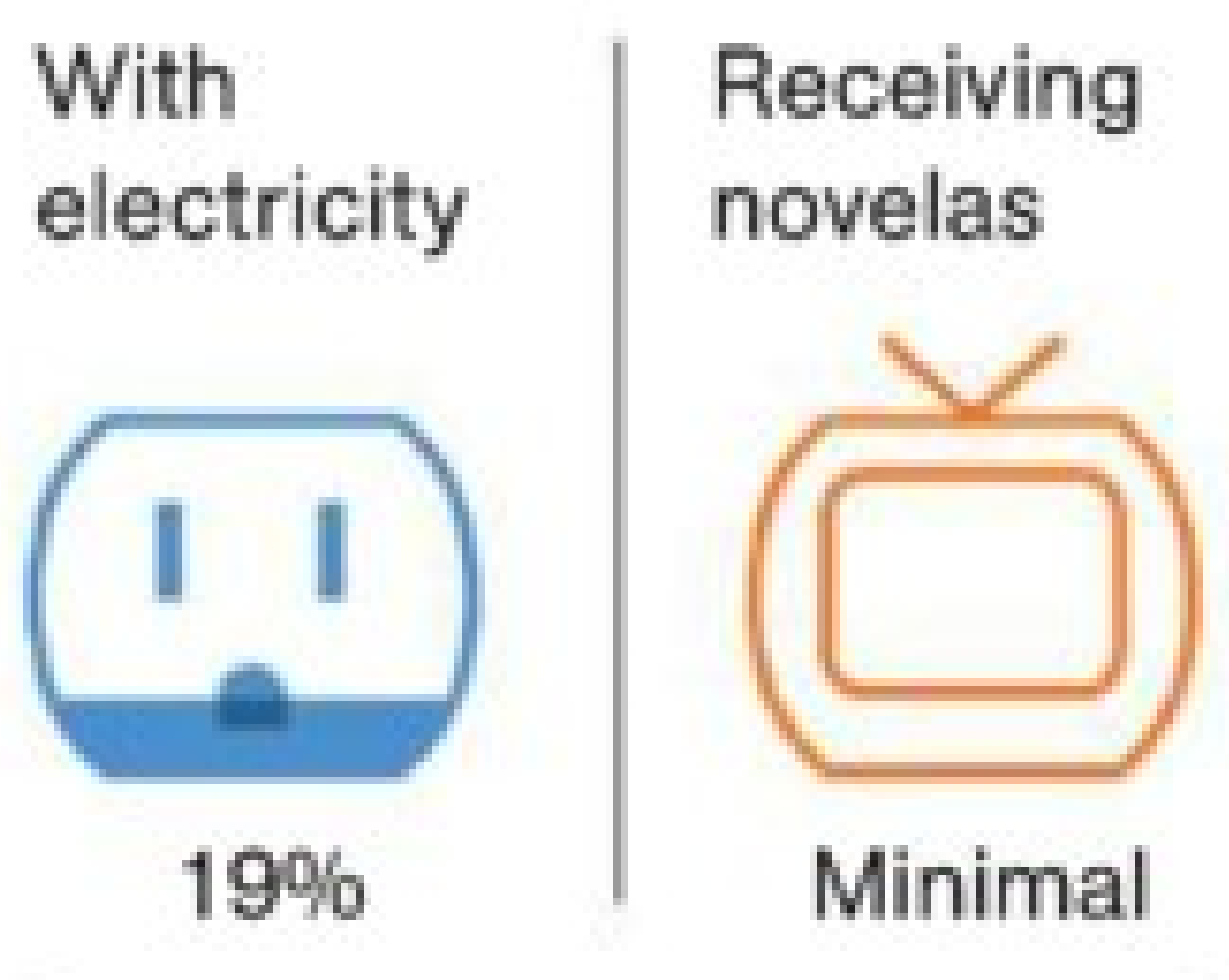
How Brazil's Fertility Fell

The number of children a woman bears on average is falling worldwide; it's the speed of Brazil's drop that intrigues demographers. Increased education for girls is a factor, as elsewhere, but there are decidedly Brazilian twists, including the spread of electricity and wildly popular evening TV soap operas called novelas, which usually feature small families. With fewer children, women are playing a stronger role in the workforce.



Nearly 85 percent of Brazil's 191 million people now live in urban areas, where smaller families are an economic advantage.

Households in 1960



Power Women

In a scene from *Ribeirão do Tempo*, a policewoman grills a development company's CEO. Like these TV characters, Brazilian women are gaining ground on male turf. The country elected Dilma Rousseff as its first female president last year.





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MARIA DUARTE DA SILVA WATCHES 7I-7I-7I WITH HER HUSBAND AND DAUGHTER IN THEIR HOME IN A RIO SLUM.



DEANA ALVES DA SILVA, 23, MOTHER OF TWO, WATCHES PASSIONE.

The Soap Opera Effect

Ninety percent of female characters in the average novela have just one child or none, which may have influenced Brazilian women to desire smaller families. But

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LUCIMAR LYRA AGUIAR, 44, WATCHES FOUR SOAP OPERAS EVERY DAY.



MARIA DE FÁTIMA ABREU—18, AND EIGHT MONTHS PREGNANT—WATCHES A 7 P.M. NOVELA WITH HER SISTER-IN-LAW AND TWO KIDS.

the scripts didn't intentionally encourage low fertility. Rather, early novela writers sought to subtly undermine the dictatorship that ran Brazil until 1985, using story lines that critiqued traditional values and empowered women.

So why two kids? Why not four? Why not the eight your grandmother had? Always the same answer—“Impossible! Too much work!” With the widened eyes and startled grin I came to know well: “It’s the 21st century, *senhora*, are you nuts?”

anybody tell you they know for sure what caused the decline,” a demographer advised me at Cedeplar, the university-based study center in Belo Horizonte. “We’ll never have a winner as the best explanation.”) But if one were to try composing a formula for crashing a developing nation’s fertility rate without official intervention from the government—no China-style one-child policy, no India-style effort to force sterilization upon the populace—here’s a six-point plan, tweaked for the peculiarities of modern Brazil:

1. Industrialize dramatically, urgently, and late, causing your nation to hurtle through in 25 years what economists used to think of as a century’s worth of internal rural-to-urban relocation of its citizens. Brazil’s military rulers, who seized power in a 1964 military coup and held on through two decades of sometimes brutal authoritarian rule, forced the country into a new kind of economy, one that has concentrated work in the cities, where the housing is cramped, the favela streets are dangerous, babies look more like new expense burdens than like future useful farmhands, and the jobs women must take for their families’ survival require leaving home for ten hours at a stretch.

2. Keep your medications mostly unregulated and your pharmacy system over-the-counter, so that when birth control pills hit the world in the early 1960s, women of all classes can get their hands on them, even without a doctor’s prescription, if they can just come up with the money. Nurture in these women a particularly dismissive attitude toward the Catholic Church’s position on artificial contraception. (See number 4.)

3. Improve your infant and child mortality statistics until families no longer feel compelled to have extra, just-in-case babies on the supposition that a few will die young. Compound that reassurance with a national pension program, relieving working-class parents of the conviction

that a big family will be their only support when they grow old.

4. Distort your public health system’s financial incentives for a generation or two, so that doctors learn they can count on higher pay and more predictable work schedules when they perform cesareans rather than waiting for natural deliveries. Then spread the word, woman to woman, that a public health doctor who has already begun the surgery for a cesarean can probably be persuaded to throw in a discreet tubal ligation, thus ensuring a thriving, decades-long publicly supported gray market for this permanent method of contraception. Brazil’s health system didn’t formally recognize voluntary female sterilization until 1997. But the first time I ever heard the phrase “a fábrica está fechada,” it was from a 69-year-old retired schoolteacher who had her tubes tied in 1972, after her third child was born. This woman had three sisters. Every one of them underwent a ligation. Yes, they were all Catholic. Yes, the church hierarchy disapproved. No, none of them much cared; they were women of faith, but in some matters the male clergy is perhaps not wholly equipped to discern the true will of God. The lady was pouring tea into china cups at her dining table as we talked, and her voice was matter-of-fact. “Everyone was doing it,” she said.

5. Introduce electricity and television at the same time in much of the nation’s interior, a double disruption of traditional family living patterns, and then flood the airwaves with a singular, vivid, aspirational image of the modern Brazilian family: affluent, light skinned, and small. Scholars have tracked the apparent family-size-shrinking influence of *novelas*, Brazil’s Portuguese-language iterations of the beloved evening soap operas, or *telenovelas*, that broadcast all over Latin America, each playing for months, like an endless series of bodice-ripper



Rising Consumerism

Not every Brazilian can indulge in expensive fashions (top, a boutique in Ipanema) and cosmetic dentistry (bottom, economist Renata Peixoto gets her teeth bleached at a São Paulo clinic). But a booming economy means more buying power for all.

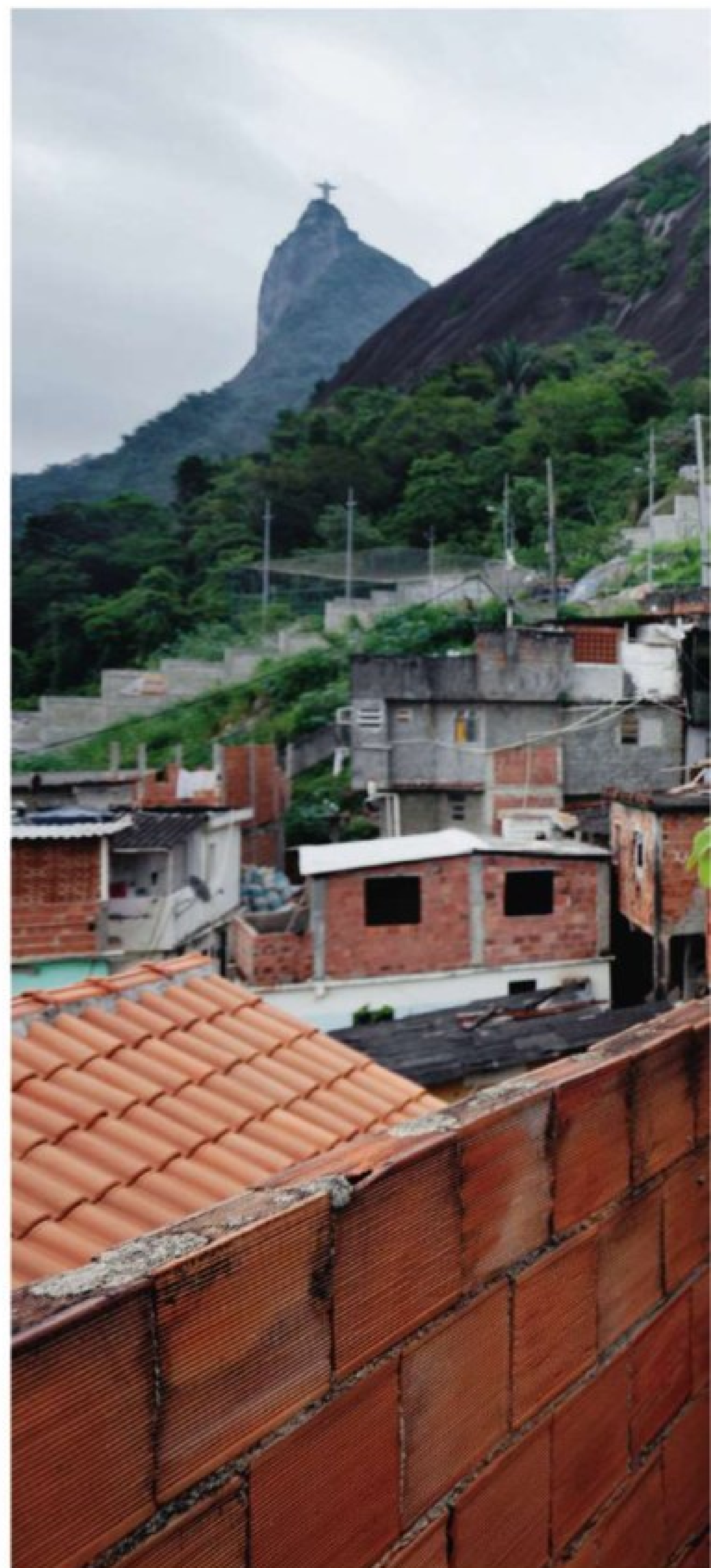
paperbacks. One study observes that the spread of televisions outpaced access to education, which has greatly improved in Brazil, but at a slower pace. By the 1980s and '90s all of Brazil was dominated by the Globo network, whose prime-time novelas were often a central topic of conversation; even now, in the era of multichannel satellite broadcasting, you can see café TVs turned to the biggest Globo novela of the season.

While I was there it was *Passione*, featuring the racked-by-secrets industrialist Gouveia family, who were all very good-looking and loaded up with desirable possessions: motorcycles, chandeliers, racing bicycles, airplane tickets, French high-heeled shoes. The widow Gouveia, resolute and admirable, had three kids. Well, four, but one was a secret because he was born out of wedlock and had been shipped off to Italy in infancy because...uh, never mind. The point is that there were not many Gouveias, nor were there big families anywhere else in the unfathomably complicated plotline.

“We asked them once: ‘Is the Globo network trying to introduce family planning on purpose?’” says Elza Berquó, a veteran Brazilian demographer who helped study the novelas’ effects. “You know what they answered? ‘No. It’s because it’s much easier to write the novelas about small families.’”

And, finally, number 6: Make all your women Brazilians.

This is volatile territory, Brazil and women. Machismo means the same thing in the Portuguese of Brazil as it does in the rest of the continent’s Spanish, and it has been linked to the country’s high levels of domestic violence and other physical assaults on women. But the nation was profoundly altered by the *movimento das mulheres*, the women’s movement of the 1970s and '80s, and no American today is in a position to call Brazil retrograde on matters of gender equity. When President Dilma Rousseff was running for office last year, the fiercest national debates were about her political ideas and affiliations, not whether the nation was ready for its first female president. One of Rousseff’s strongest competitors, in fact—a likely contender



Thirteen-year-old Rebeca da Silva’s violin hums with promise in a Rio slum, or favela, thanks to a scholarship program called Ação Social pela Música. Access to education is improving, with 85 percent of Brazilian teen girls now enrolled in high school.



in future elections—was a female senator.

Brazil has high-ranking female military officers, special police stations run by and for women, and the world’s most famous female soccer player (the one-name-only dazzling ball handler Marta). When I spent an evening in the city of Campinas with Aníbal Faúndes, a Chilean obstetrics professor who immigrated decades ago to Brazil and has helped lead national studies of reproductive health, Faúndes returned again and again to what he regards as the primary force pushing fertility change in his adopted country. “The fertility rate dropped because women decided they didn’t want more children,”

he said. “Brazilian women are tremendously strong. It was just a matter of them deciding, and then having the means to achieve it.”

The Cytotec episode offers sober but illuminating evidence. Cytotec is the brand name for a medication called misoprostol, which was developed as an ulcer treatment but in the late 1980s became internationally known as an early-abortion pill—part of the two-drug combination that included the medication known as RU-486. Even before the rest of the world received the news about pill-induced abortion, though—it entered the French and Chinese marketplaces in 1988, amid great controversy, and was subsequently approved in the U.S. for



One Woman's Dreams

Marcela Gonçalo Pessoa, 24, works as a maid for a wealthy woman whose extravagant Recife apartment looks like a set for one of the novelas she watches nightly (below, glued to *Ti-ti-ti* with her husband and sister). But Pessoa doesn't just wistfully admire the stylish lives of the characters; she's working hard to take charge of her own future. Each morning she dresses up for the hour-long bus





commute (above) from her one-bedroom apartment in the city's low-income outskirts, where she shares a bathroom with several families (below). So far, Pessoa and her husband of four years have no kids. Will they? "One, maybe two. To give them a proper education and a nice life, you can't have more," she says. "Right now, I want money to finish building our house and to buy nice things."



Working From Home

Money and space are tight in Rocinha, Rio's largest favela, but the Coopa-Roca crafts cooperative lets moms like Liliane Mineira da Silva (with Beatriz, 6, at right, and Vitória, 8) earn income while caring for their children.





It would be a gross oversimplification to suggest that Brazilians are having fewer children because they want to spend more money on each. But questions about material acquisition—how much everyone desires—troubled nearly every woman I met.

pregnancy termination—Brazilian women had figured it out on their own. No publicity campaign explained misoprostol; this was pre-Internet, remember, and Brazilian law prohibits abortion except in cases of rape or risk to the woman's life.

But that law is ignored at every level of society. “Women were telling each other what the dose was,” says Brazilian demographer Sarah Costa, director of the New York City-based Women's Refugee Commission, who has written about Brazil's Cytotec phenomenon for the medical journal the *Lancet*. “There were street vendors selling it in train stations. Most public health posts at that time were not providing family planning services, and if you are motivated to regulate your fertility, even if you have poor services and poor information, you'll ask somebody, What can I do? And the information *will* flow.”

The open availability of Cytotec didn't last long. By 1991 the Brazilian government had put restrictions on it; today it is available only in hospitals, although women assured me that packs of Cytotec could still be obtained over the Internet or in certain flea markets. But the public health service now pays for sterilizations and other methods of birth control. Illegal abortion flourishes, in circumstances ranging from medically reliable to scary. It may not be entirely easy or safe for a Brazilian woman to keep her family small, but there's no shortage of available ways to do so. And in every respect, women of all ages told me, this is what they now expect of themselves—and what contemporary Brazil, in turn, appears to expect from them.

“Look at the apartments,” said a 31-year-old Rio de Janeiro marketing executive named Andiará Petterle. “They're designed for a maximum of four people. Two bedrooms. In the supermarkets, even the labels on frozen foods—always for four people.”

The company Petterle founded specializes in sales research on Brazilian women, whose buying habits and life priorities seem to have been upended just in the years since Petterle was born. It wasn't until 1977, she reminded me, that the nation legalized divorce. “We've changed so fast,” she said. “We've found that for many young women, their first priority now is their education. The second is their profession. And the third is children and a stable relationship.”

So raising children hasn't vanished from these modern priorities, Petterle said—it's just lower on the list, and a tougher thing to juggle now. She has no children herself, although she hopes to someday. As Petterle talked, I heard what was becoming a familiar refrain: Contemporary Brazilian life is too expensive to accommodate more than two kids. Much of the public school system is *ruim*—useless, a disaster—people will tell you, and families scrape for any private education they can afford. The nationwide health system is *ruim* too, many insist, and families scrape for any private medical care they can afford. Clothing, books, backpacks, cell phones—all these things are costly, and all must somehow be obtained. And everything a young family might need is now available, as the mall windows relentlessly remind passing customers, with *financiamento*, short- or long-term.

Want your child to have that huge stuffed beagle, that dolly set in the fancy gift box, that four-foot-long, battery-powered, ride-on SUV? Buy it on the installment plan—with interest, of course. Consumer credit has exploded throughout Brazil, reaching middle- and working-class families that two decades ago had no access to these kinds of discretionary purchases paid off over time. While I was in Brazil, the business magazine *Exame* ran a cover story on the nation's new multi-class consumerism. The São Paulo journalist who wrote the story, Fabiane



Justice for Women

Because sexual harassment persists in Brazil's machismo culture, Rio's subway offers females-only cars (top), where a guard keeps men out. A Recife activist participates in a vigil demanding an end to violence against women (bottom).



Stefano, described the bustle she witnessed inside a travel agency that had recently opened in a downscale city neighborhood. “Every five minutes a new person came in,” she said. “Eighty percent of these people were going to the Northeast to see family. It takes three days to get there by bus, only three hours by plane.” This was each customer’s first time flying. “The guy had to explain to them that in an airplane they wouldn’t see their luggage for a while.”

It would be a gross oversimplification to suggest that Brazilians are having fewer children just because they want to spend more money on each one. But these questions about material acquisition—how much everything now

costs, and how much everyone now desires—both interested and troubled nearly every Brazilian woman I met. Smaller family size has been credited with helping boost the economies of rapidly developing countries, especially the mammoth five now referred to as BRICS: Brazil, Russia, India, China, South Africa. National economic growth brings no assurances of family well-being, though, unless that prosperity is managed thoughtfully and invested in coming generations. “This is something I’ve been thinking about, the way we’re dropping the fertility rate in Brazil and the other BRICS countries, but I don’t see any real work on getting more ethical,” says the marketer Andiarra Petterle. “We



Brazilian culture is famous for its sexuality—and for its bikinis, like these on display at an upscale Ipanema boutique. But with many women choosing sterilization after a couple of kids, sexuality and fertility have become uncoupled in Brazil.

could be just *one* billion people in the world, and with the mentality we have now, we could be consuming just as many resources.”

The morning I had coffee with a group of young São Paulo professional women, we sat at a sidewalk table across from a shop that carried eight different glossy parenting magazines. Each was thick with ads: the Bébé Confort Modulo Clip convertible stroller; the electronic “cry analyzer” to identify the reason your baby is crying; the wall-mounted DVD player that projects moving images over the crib (“Distracts better than a mobile!”). We studied the fashion photographs of beautiful toddlers in knits and aviator sunglasses and fake furs. “Look at these kids,” said Milene Chaves, a 33-year-old journalist, her voice hovering between admiration and despair. She turned the page. “And it seems you have to have a decorated room too. I don’t need a decorated room like this.”

Chaves had a long-term boyfriend but has no children, not yet. “And when I do, I want to simplify things,” she said. The half dozen friends around her agreed, the magazines still open on the table before us: attractive objects, they said, but so excessive, so disturbingly too much. These São Paulo women were in their 20s and 30s, with two children or one or none. They followed precisely the patterns described to me by national demographers. When I asked them whether they ever felt nostalgia for the less materialistic life of their elders, two generations back—eight children here, ten there, with nobody expecting decorators to gussy up the sleeping quarters—I was able to make out, among the hooting, the word *presa*. Imprisoned.

But their answers were nearly drowned out by their laughter. □



SEVEN BILLION IN NOVEMBER

As people crowd Africa's Rift Valley, the question arises: Does our populous planet have room for the wild?

The Pulitzer Center on Crisis Reporting and PBS NewsHour join us in reporting on population issues throughout the year.

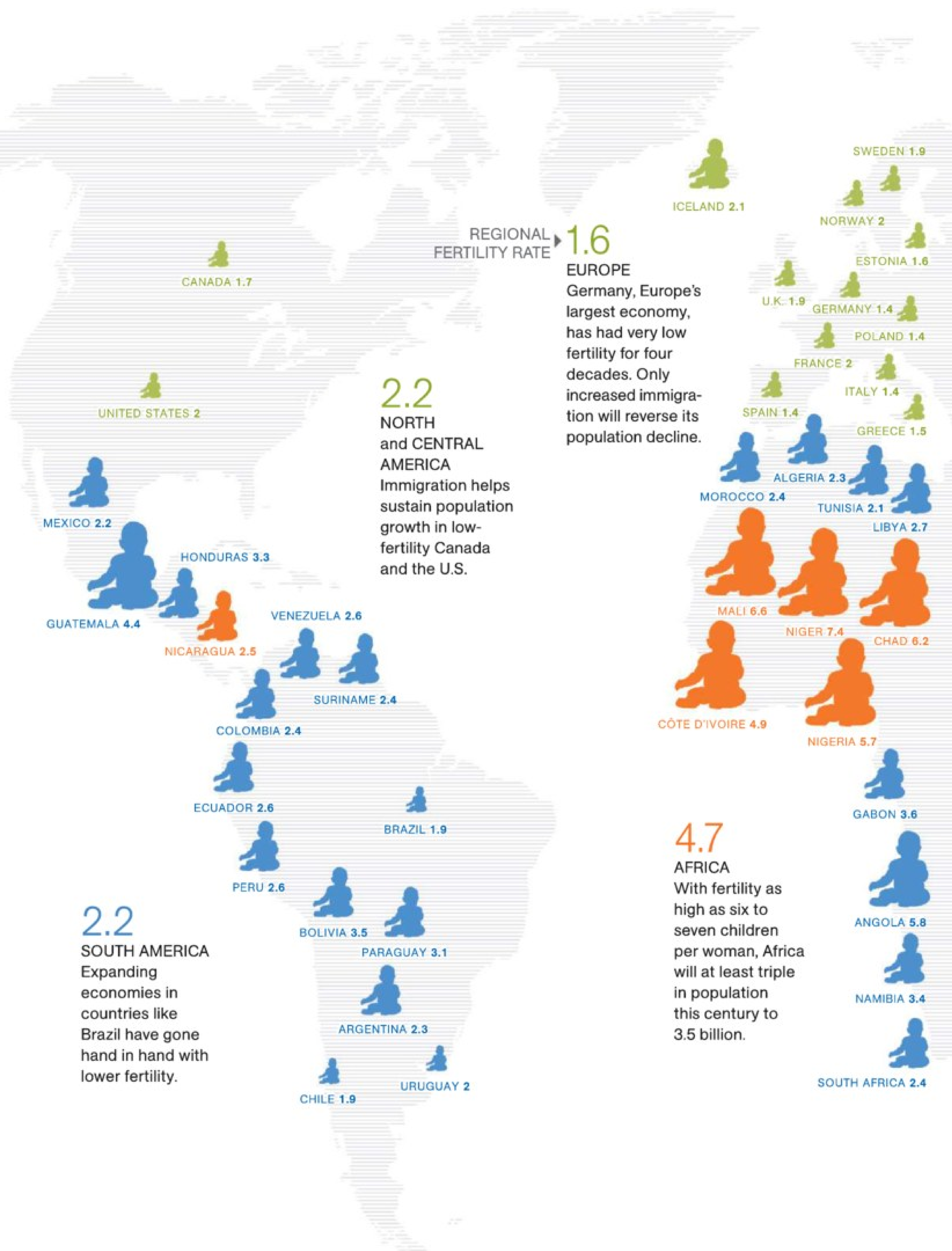
The magazine thanks the David and Lucile Packard Foundation, the Wallace Global Fund, and National Geographic Society members for their generous support.

The Infant Formula

Family size and income are linked, but which drives the other?

As a country's prosperity rises, the number of children a woman has falls. But here's the demographic riddle: Do women bear fewer children because a country is prosperous? Or does a country's economy grow when women have fewer children? Either way, there's a clear relationship between fertility and income, as the countries highlighted here show.

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REGIONAL FERTILITY RATE **1.6**
EUROPE
 Germany, Europe's largest economy, has had very low fertility for four decades. Only increased immigration will reverse its population decline.

2.2
NORTH and CENTRAL AMERICA
 Immigration helps sustain population growth in low-fertility Canada and the U.S.

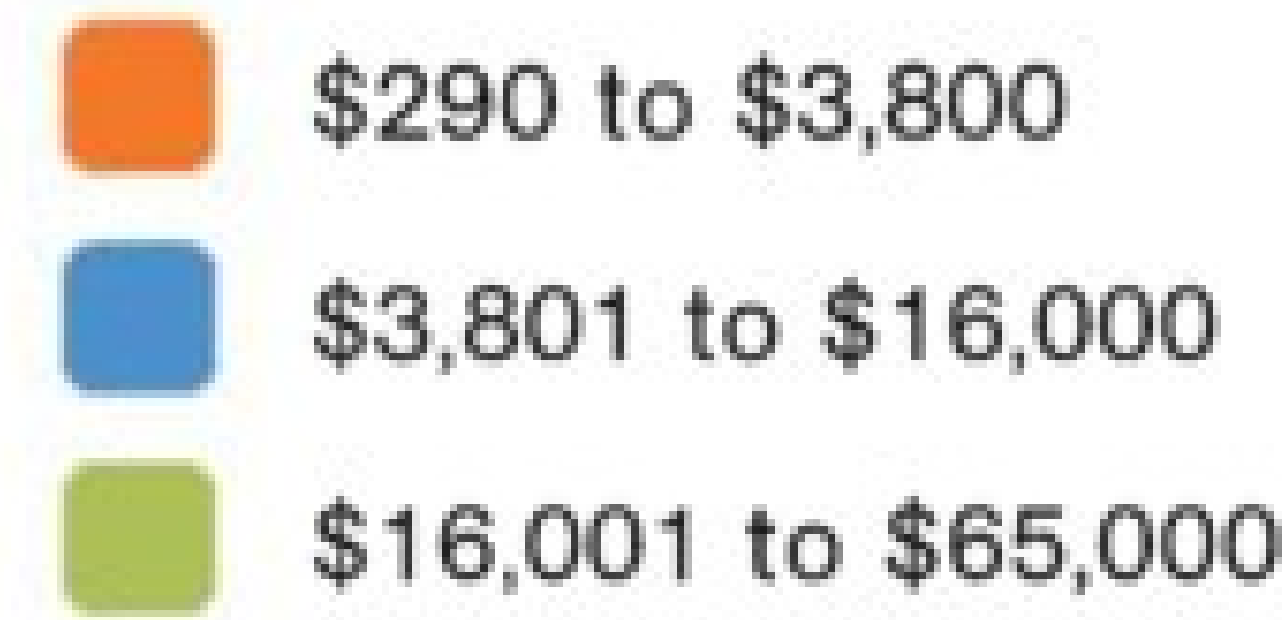
2.2
SOUTH AMERICA
 Expanding economies in countries like Brazil have gone hand in hand with lower fertility.

4.7
AFRICA
 With fertility as high as six to seven children per woman, Africa will at least triple in population this century to 3.5 billion.

National fertility rate
Children per woman



Gross national income per capita
U.S. dollars*



3.1

WESTERN ASIA
Iran owes its low fertility to state support for family planning. Elsewhere in the Middle East, a youthful population ensures growth.

1.5

EAST ASIA
Very low fertility is leading to an aging population with fewer working-age people to support it, a problem now facing Europe.

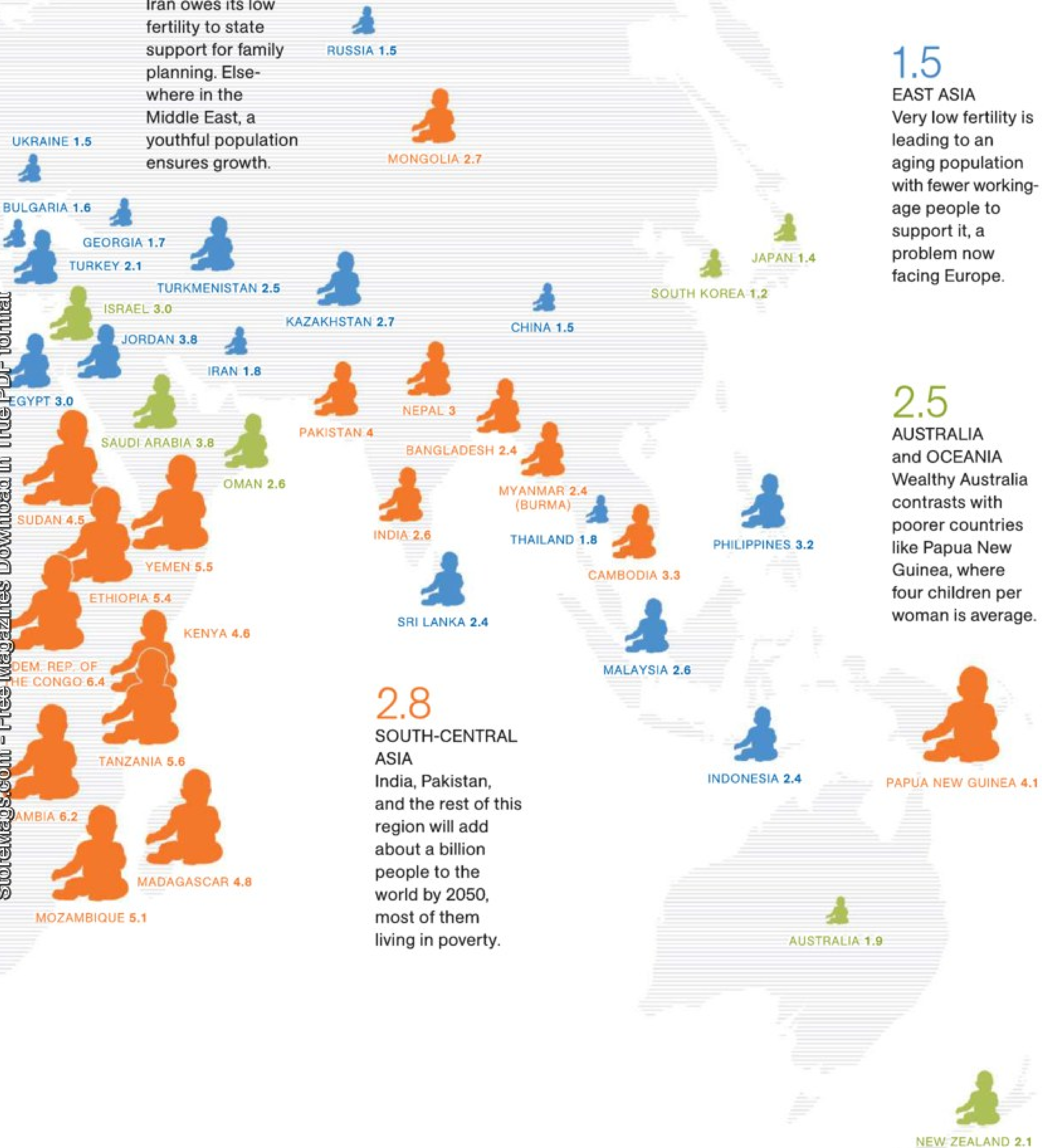
2.5

AUSTRALIA and OCEANIA
Wealthy Australia contrasts with poorer countries like Papua New Guinea, where four children per woman is average.

2.8

SOUTH-CENTRAL ASIA
India, Pakistan, and the rest of this region will add about a billion people to the world by 2050, most of them living in poverty.

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*EACH COUNTRY'S GNI IS CONVERTED TO U.S. DOLLARS USING PURCHASING POWER PARITY. COUNTRIES NOT DEPICTED BECAUSE OF SPACE ARE INCLUDED IN THE REGIONAL FERTILITY RATES. CHINA DATA DO NOT INCLUDE TAIWAN.




THE RACE BEGINS Norwegians led by Roald Amundsen arrived in Antarctica's Bay of Whales on January 14, 1911. With dog teams, they prepared to race the British to the South Pole. Amundsen's ship, *Fram*, loaned by renowned Arctic explorer Fridtjof Nansen, was the elite polar vessel of her time.

The Man Who Took The Prize



By Caroline Alexander



September 12—Tuesday. Not much visibility. Nasty breeze from S. -52°C. The dogs clearly affected by the cold. The men, stiff in their frozen clothes, more or less satisfied after a night in the frost... prospect of milder weather doubtful.”

The writer of this terse diary entry was Roald Amundsen, a Norwegian explorer who had won renown five years earlier for being the first to sail the Arctic's fabled Northwest Passage from the Atlantic to the Pacific. Now he was at the opposite end of the world, in the Antarctic, aiming for the most prestigious prize the world of exploration still offered: the South Pole. Planned with characteristic meticulousness, this bold venture was also the result of happenstance. Two years earlier Amundsen had been immersed in plans to extend his exploration of the Arctic Ocean and to drift over the North Pole, when he received news (later contested) that Robert Peary had already claimed the Pole. At that instant, Amundsen recalled later, “I decided on my change of front—to turn to the right-about, and face to the South.” As Amundsen reckoned, if he won the South Pole, fame as well as financing of future exploration would be secure. Ostensibly preparing for the north, he secretly planned for the south.

Winning the South Pole, however, was not to be taken for granted. Also heading south was

In a wolfskin anorak of Netsilik Eskimo design, Amundsen strikes a heroic pose in the snows near his Norwegian home. Used in his memoir and lectures, this was a favorite publicity photo.

the well-advertised British Antarctic Expedition, under the command of Captain Robert Falcon Scott. Amundsen was keenly conscious of his rival, as his September 12 diary entry shows. Tormented by the prospect that Scott might beat him, Amundsen had jumped the gun, starting before the arrival of polar springtime and manageable weather. The result was the death of valuable dogs and frostbite on the feet of his men that would require a month to heal. Racing back to his base, Framheim (named after his ship, the famous polar-going *Fram*, meaning “forward”), Amundsen abandoned two companions, who struggled into camp a day after his return. “I don't call it an expedition. It's panic,” Hjalmar Johansen, the most experienced polar explorer of the team, told Amundsen. Bitterly resented, Johansen's damning words cost him a place on the eventual Pole-seeking party.

These glaring errors are worth dwelling on not to find fault with Amundsen but to dispel a myth that has long claimed him: His attainment of the Pole was just a passionless application of expertise and cold ambition, and Amundsen himself, therefore, was a colorless professional. This characterization contrasts starkly with the perception of Scott, who, with his gallant British party, showed grit and courage, fighting for every mile, and who died tragically on the ice.

SCOTT'S MEN The British team (Robert Falcon Scott, center) wore wool clothing and windproof tunics for hauling sledges. But survival required better. "I will call any expedition...without fur clothing, inadequately equipped," Amundsen noted.



The false start of September 1911 is a reminder that there is no such thing as an inevitable outcome in the risky enterprise of polar exploration. Methodical and careful, Amundsen was also a man of towering ambition, prey to the same dangerous dreams and impulses that drive all explorers to risk their lives in wild places. Amundsen's greatness is not that he lacked such driving forces but that he mastered them—as his diary entries go on to show. Four days after his premature start Amundsen assessed his party's situation dispassionately and made the decision to "hurry back to wait for the spring. To risk men and animals by continuing stubbornly once we have set off, is something I couldn't consider. If we are to win the game, the pieces must be moved properly; a false move and everything could be lost." The ability to regain and maintain perspective in the pursuit of something as heady as a personal dream is a

*Contributing Writer Caroline Alexander is the author of *The Endurance* and most recently *The War That Killed Achilles*.*

rare asset. Like other great explorers, Amundsen knew when to turn back.

A DAZZLING RÉSUMÉ lay behind Roald Engelbregt Gravning Amundsen's South Pole venture. Born in 1872 into a well-to-do ship-owning, seafaring family, he sailed at the age of 25 as second officer on the *Belgica*, as part of a scientific expedition to the Antarctic. When the *Belgica* became stuck in pack ice, her crew achieved the unintended distinction of being the first humans to overwinter in the Antarctic. Demoralized and suffering ill health, the company was held together by the ship's surgeon, Frederick Cook (later infamous for unsubstantiated "firsts" at the North Pole and the summit of Mount McKinley), and by Amundsen, whose diary shows him to be wholly engaged in his surroundings. "As for the tent, with regard to shape and size it is comfortable but it is too susceptible to the wind," he observed in February 1898. Over the years he would make many resourceful improvements to polar equipment.

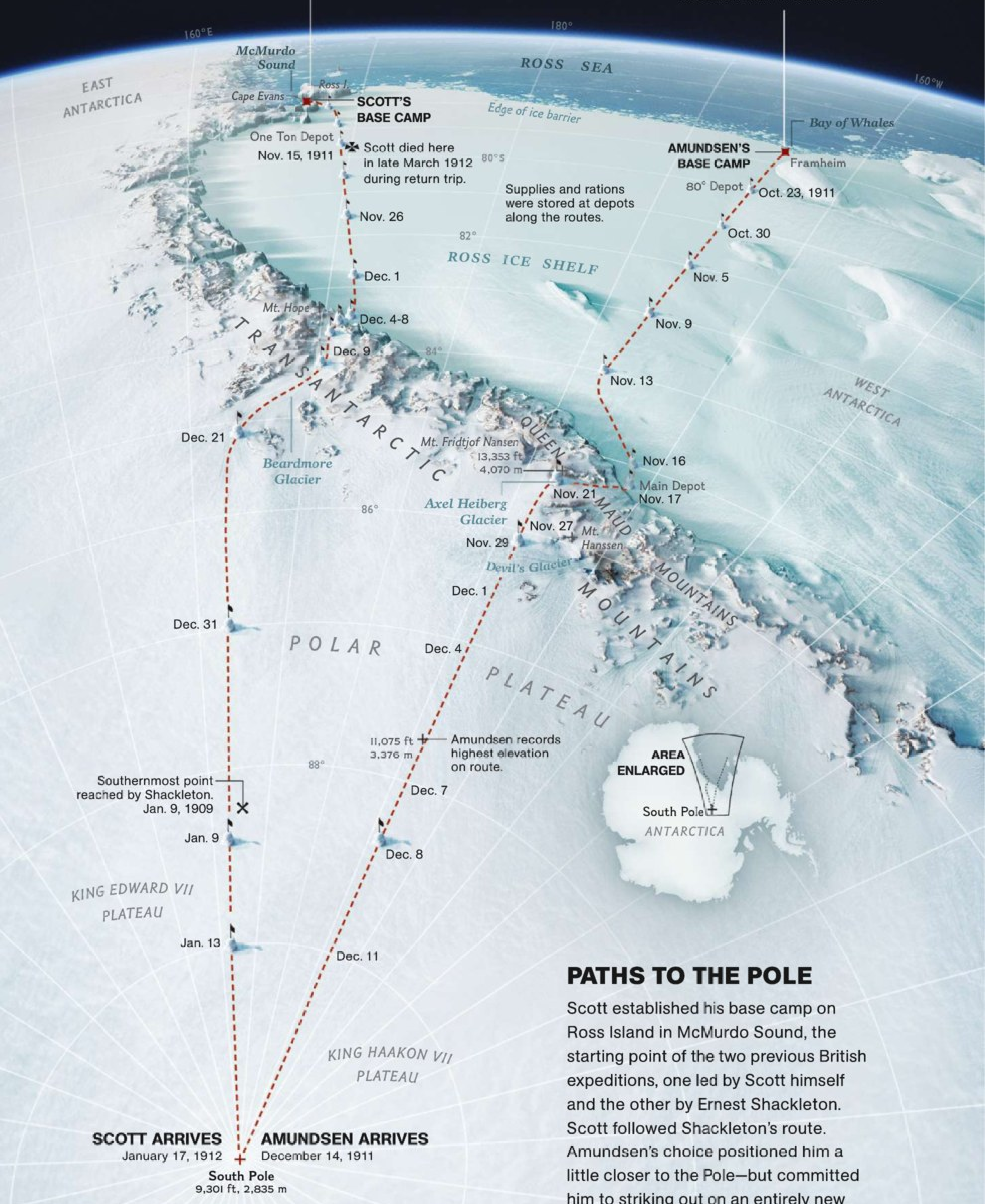
Since reading about it as a boy, Amundsen

SCOTT'S ROUTE

Departure: November 1, 1911
About 900 miles to the South Pole

AMUNDSEN'S ROUTE

First departure: September 8, 1911
Final departure: October 20, 1911
About 830 miles to the South Pole



PATHS TO THE POLE

Scott established his base camp on Ross Island in McMurdo Sound, the starting point of the two previous British expeditions, one led by Scott himself and the other by Ernest Shackleton. Scott followed Shackleton's route. Amundsen's choice positioned him a little closer to the Pole—but committed him to striking out on an entirely new route over unknown terrain. Both expeditions had earlier laid supplies.

SCOTT ARRIVES
January 17, 1912

AMUNDSEN ARRIVES
December 14, 1911

South Pole
9,301 ft, 2,835 m

SCALE VARIES IN THIS PERSPECTIVE.
VIRGINIA W. MASON, NGM STAFF. ART: STEPHEN TYSON
SOURCE: ROSS D. E. MACPHEE, AMERICAN MUSEUM OF NATURAL HISTORY





FATEFUL CHOICE Scott's ship, *Terra Nova*, carried Siberian dogs and Manchurian ponies, which required bulky fodder and close care. Scandinavian snowshoes of twisted cane helped some ponies; those without waded up to their knees in snow. The best means of transportation was much debated: Amundsen's original Arctic plans had included harnessing polar bears.



had been fascinated by Englishman John Franklin's disastrous search for the Northwest Passage. Although Amundsen continued his sea career, he also began planning for an Arctic venture. In 1903 he headed north in the ship *Gjøa* with a remarkably small crew of only six men (Franklin had taken 129) to seek the Northwest Passage and, possibly calculated to bestow scientific respectability, the current position of the north magnetic pole. Over three winters Amundsen lived and worked in the Arctic, eventually navigating a passage that threaded through the islands, shoals, and ice of Canada's Arctic archipelago to the Beaufort and then the Bering Sea—a historic first. "The North-West Passage was done," Amundsen wrote in his diary on August 26, 1905. "My boyhood dream—

at that moment it was accomplished. A strange feeling welled up in my throat; I was somewhat overstrained and worn—it was a weakness in me—but I felt tears in my eyes."

The *Gjøa* expedition gave Amundsen more than his first geographic prize. Through it he became closely acquainted with the Netsilik Eskimos and their superb adaptation to the rigors of the Arctic world. Amundsen was not the first European explorer to learn from indigenous people. The great polar explorer Fridtjof Nansen and others had learned how to dress and travel and eat from Norway's northern Sami people. Now Amundsen supplemented that wisdom with survival tools he had studied and experienced firsthand: loose reindeer skin clothing that provided warmth and ventilation,

The different approaches taken by the two explorers are highlighted by their assembled teams and equipment.

AMUNDSEN'S TEAM

■ Survived trip □ Did not survive



SCOTT'S TEAM



As planned, these men turned back before reaching the South Pole.

Total number of sledges is uncertain. Two were brought back by returning men.

DOG POWER For Scott, dogs robbed sledging of its “glory.” The ideal of “unaided” exploration was men hauling their supplies—yet he was willing to try motor sledges (left). Insufficiently tested beforehand, these broke down. Amundsen’s faith in dogs grew with their use. “Today we have had a lot of loose snow although it doesn’t affect our dogs,” he wrote in his diary. The dogs preferred the fan-shaped harnesses (right) used in Greenland over the Alaska style Amundsen had first chosen, which paired dogs along a central trace.



HERBERT PONTING, NATIONAL GEOGRAPHIC STOCK (LEFT); NATIONAL LIBRARY OF NORWAY, PICTURE COLLECTION

GRAPHIC (BELOW): LAWSON PARKER, NGM STAFF, ALEJANDRA PAREDES
SOURCE: ROSS D. E. MACPHEE, AMERICAN MUSEUM OF NATURAL HISTORY

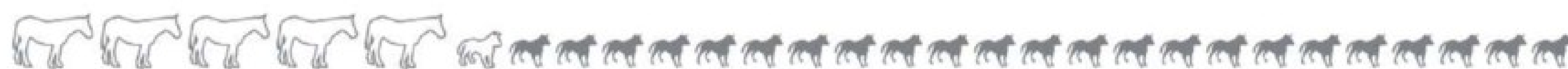
fur boots, dogsleds, snowshoes, ice caves, igloos.

“We are used to saying, Well, the Norwegians grow up on skis,” polar historian Harald Jølle says, “but we forget the other skills.” When Roald Amundsen set up his base camp in Antarctica’s Bay of Whales in January 1911, he was 38 years old and a seasoned polar veteran. He was in wholly unknown territory, but he was also in a familiar landscape of snow and ice.

Amundsen and his men used the months preceding the polar journey to lay down depots of supplies and to subject every article of food, clothing, and equipment to ruthless scrutiny and refinement. Every detail was considered with focused seriousness grounded in Amundsen’s profound respect for the environment he now confronted.

THE MORE THAN 800-MILE JOURNEY began at last on October 20, with Amundsen and his four companions on skis behind four loaded sledges, each weighing 880 pounds and pulled by 13 dogs. Ahead, across unknown terrain, lay an arduous slog over (and occasionally into) crevasses, around the abysses and ice of the Queen Maud range, and onto the Polar Plateau, through perilously unpredictable weather. Yet without any major mishap, the Norwegians reached their goal on schedule. “And so at last we reached our destination,” Amundsen wrote in his diary on December 14, 1911, “and planted our flag on the geographical South Pole, King Haakon VII’s plateau. Thank God!”

Before leaving Polheim, as the men had dubbed their polar camp, Amundsen left a letter



All surviving dogs were brought back by returning team members.



VITAL STORES Caches stocked with the food staples of polar exploration were key to the survival of the two parties when their march began. At 80° south, Amundsen noted, "stopped and laid a depot...of 12 cases of dog pemmican...about 30 kilos seal steaks & 50 kilos fat together with a 20 pk. chocolate. In addition, 1 box of margarine & 2 boxes of sledging biscuits."

NATIONAL LIBRARY OF NORWAY, PICTURE COLLECTION





for Norway's King Haakon VII on special note-paper he had brought, "and a few words to Scott, who I presume will be the first to come here after us." The letter ensured a report of his success in the event of some disaster and was an elegant way of telling Scott, I won. Scott's honorable safeguarding of this letter would be the proof of Amundsen's success.

On the return leg the men abandoned surplus stores (some of which would be gratefully collected by Scott's party). As throughout the journey, dogs were shot and, along with dogs that had died, consumed as food by both surviving dogs and the men. Early on January 26, 1912, the polar victors arrived back in Framheim. "Good morning, my dear Lindstrøm," Amundsen greeted his startled cook. "Have you any coffee for us?"

THE CONTRAST BETWEEN what Apsley Cherry-Garrard, the legendary chronicler of the British expedition, called Amundsen's "business-like" operation and Scott's "first-rate tragedy" is painful to draw, but it highlights issues that still concern adventurers and explorers today. Amundsen used dogs; Scott ponies and motor sledges.

Amundsen traveled by ski, a skill at which he and his men were brilliantly adept; Scott never learned to ski proficiently, so he and his men trudged, pulling their own sledges. Amundsen depoted three times the supplies Scott did; Scott starved and suffered scurvy. Some of Scott's fatal errors can be defended in terms of the precedents of his own times—after all, his compatriot and rival, Ernest Shackleton, had used ponies and almost reached the Pole. And some of Amundsen's tactics are troubling, such as his calculated slaughter of dogs that had been affectionately named and treated as companions.

At root, though, the contrast between Amundsen and Scott is not about details of management but broad outlooks—those of the professional and of the amateur. "In Norway there is *very* little tolerance for failure in expeditions," one historian says. "You go and you come back whole." The British, in contrast, emphasized the struggle, believing that character, not skill, would win out and that death was heroic—a view that would be judged irresponsible today. "I am inspired by how Amundsen prepared his expeditions," Børge Ousland, a

VICTORY AND DEFEAT

Amundsen and his four companions, expert skiers, reached their goal (left) on December 14, 1911. They spent three days “boxing the Pole”—taking observations to establish its exact location. Scott’s five-man party arrived 34 days later, having encountered the Norwegians’ tracks in the final miles. Slumped in defeat (right), they understood that their labor had been, in Scott’s words, “without the reward of priority.”



NATIONAL LIBRARY OF NORWAY, PICTURE COLLECTION (LEFT); H. R. BOWERS, ROYAL GEOGRAPHICAL SOCIETY

Norwegian explorer who made the first solo crossing of the Antarctic, says. “He always tried to learn from others. He identified the problem, then looked to solve the problem.”

Amundsen enjoyed celebrity until the end of his life, but unlike his compatriot and mentor—the multifaceted, charismatic Nansen—he never achieved the financial security he had hoped his books and lectures would bring. In July 1918 he returned to the Arctic to undertake the scientific work he had promised Nansen: following the ice drift in his ship *Maud*. In the 1920s, searching for new prizes, Amundsen turned to aviation, making several unsuccessful attempts to fly over the North Pole. In 1926 he commanded the airship *Norge*, flown by Italian pilot Umberto Nobile, for the first successful crossing of the Arctic by air.

Daring as these later adventures were, Amundsen participated more as passenger than leader, surrendering control to others. Financially strapped, he had become embittered, lashing out at old allies. Yet in May 1928, when Nobile’s airship went missing over the Arctic, Amundsen hastened to join the multinational rescue effort,

pushing friends to finance a rescue plane. He was poised to get married, and his determination to be involved suggests that, as an essentially solitary man, he was running from this commitment. It’s clear that he also missed the limelight his heroic feats had earlier won him. Like the confused start of his South Pole success, Amundsen’s last quest belies the workmanlike image imposed upon him, revealing instead a very human man.

In Tromsø, above the Arctic Circle, he boarded his plane, a Latham 47 fitted with floats, which had come from France. By then the pilots had been flying for three days and were operating on very little sleep. With difficulty the lumbering, heavily laden plane struggled to become airborne. The air was still, which often presaged banks of summer fog and dangerous visibility to the north. Under modern scrutiny, the accumulation of errors is foreboding.

The plane left Tromsø on June 18, and at 4 p.m. it was seen for the last time passing over Sommarøy, where the mountainous land abuts the sea. It was summer, and the land was green, but Amundsen was heading north, toward the ice. □

RUGGEDLY INDEPENDENT, THE **TUAREG**
STRUGGLE TO SURVIVE AMID
THE TURMOIL OF NORTH AFRICA.



LOST LORDS OF THE SAHARA

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*Evening winds stir
the robes of a Tuareg
striding across Algeria's
Tassili-n-Ajjer.*



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Their hands stained by the indigo dye in their new clothes, Tuareg women celebrate a birth. Tuareg females rarely cover their faces, while men traditionally wear turbans that conceal all but their eyes.

Release: StoreMags & FantaMag

THE REBEL COMMANDER, his face hidden behind a dark turban, leads the way over the soft sand, scorched black in places by exploded mortar shells and littered with detritus from a series of battles waged here, on a children's soccer field.

With nearly every stride, our feet crunch spent rifle cartridges. "Step in my steps," he cautions, noting that the Niger army had mined the area, where there had been a school for Tuareg. His men removed some of the devices; others remained lost in the shifting sands. "Maybe they are buried too deep to explode if you step on one."

It is late afternoon in the dry season, and the temperature has finally slipped below 100°F. The beige dunes stretching to the north begin to take on a pink hue, and the shadows from the steep ridges to the southwest are spreading across the valley floor. In this lonely valley called Tazerzait, where the Aïr Massif meets the great sand seas of the Sahara, the commander's men had won the greatest victory of their two-year rebellion against the Niger government.

The rebels, all ethnic Tuareg, descend from the fierce nomads who for several centuries dominated the lucrative caravan trade in gold, spices, and slaves that crisscrossed this desolate region of North Africa. Fighting under the banner of the Movement of Nigeriens for Justice (MNJ) and supported in part by Libyan leader Muammar Qaddafi, they had captured 72 government soldiers at Tazerzait and renewed their demands that the government share revenue derived from another source of treasure: uranium mined on Tuareg lands. In a show of goodwill the Tuareg released all of their prisoners—except one. "He is a war criminal," the commander says.

As we walk, the commander explains that local Tuareg built the school at Tazerzait because it is near a well central to the region's far-flung grazing areas, allowing families to visit their children as they moved their herds. Previously,



BY PETER GWIN
PHOTOGRAPHS BY BRENT STIRTON



Tuareg fighters survey a battle-scarred Tuareg school in northern Niger. In recent years Tuareg in Niger and Mali have rebelled, claiming their governments collect taxes but invest little in their impoverished regions.

FOR CENTURIES, TUAREG WARRIORS RULED THIS DESERT REALM, DEMANDING TRIBUTE FROM MERCHANTS PLYING THE LUCRATIVE CARAVAN TRADE.



locals who wanted their children educated had to send them to far villages and rarely saw them.

“My father only knew how to live in the desert,” the commander says. “He knew how to make the salt caravan to Bilma, how to find grazing in the desert, how to hunt antelope in the canyons and wild sheep in the mountains. And that is what I know, but the life of the desert is ending. Our children need school.”

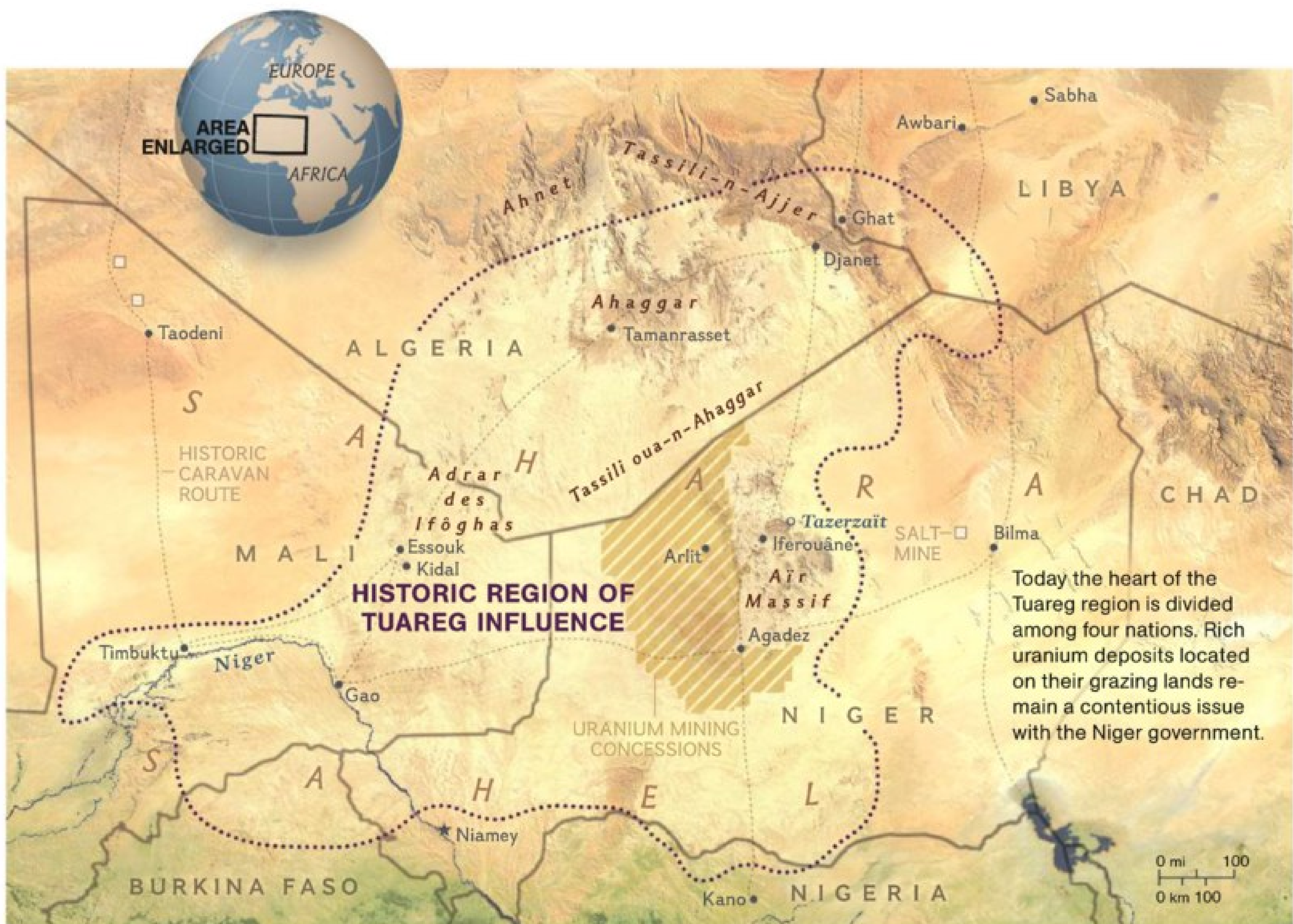
We reach the top of a small bluff where three mud-brick classrooms stand, their walls gouged with bullet holes, their roofs missing. The chalkboards are covered with graffiti left by the

Peter Gwin is a National Geographic staff writer and a Pulitzer Center on Crisis Reporting grantee. Brent Stirton is with Reportage by Getty Images.

Nigerien soldiers—French profanities and cartoons depicting Tuareg having sex with animals.

Four rebels with Kalashnikovs slung over their shoulders have brought the alleged war criminal down from the mountain cave where they are holding him. His posture is slumped, like a sulking teen, and he crosses and uncrosses his arms, eyes darting among the men. The sleeves of his camouflage shirt are cut off and his combat boots are untied. He claims to be 27 years old, but his round face and awkward manner make him look much younger.

It is growing late, and the rebels are edgy about lingering in this exposed position. The Niger army had countered its defeat on the ground by acquiring helicopters, and the rebels had recently been surprised by an assault



The camel caravans that once linked Saharan trading hubs are rapidly disappearing as trucks take over. Tuareg en route to Timbuktu with salt slabs from Taodeni (left) worry about the tradition's future. "Our sons have no interest," they say.

from the air that killed several men, including one of their leaders. The men squint toward the horizon, and periodically everyone goes silent to listen for the sounds of blades beating the air. "They buy helicopters to fight us, but they will not build schools or wells for us," the commander says, as he leads the way to the edge of the school grounds. The prisoner trails behind, his head bowed, bootlaces skipping along the ground. The commander stops at a place where stones set in the soft sand mark out three graves.

"Three old men are buried here," the commander says. "When the army attacked," he points to one of the graves, "this man, who was blind, refused to flee." He motions to the other graves. "These two refused to leave him." He describes how the soldiers accused the old men of

helping set land mines. "That night they tortured them behind the classrooms. We were hiding in the mountains, just there," he says, gesturing to a ridgeline above us. "We could hear the old men screaming." He spoke quietly. "This one," he points to the grave in the center, "is my father."

TO REACH THIS REMOTE CORNER of the world's largest desert requires traversing a vast primordial landscape—a place defined by salt pans that take the better part of a day to cross, dune fields that rise and fall like violent seas, and mammoth outcroppings of glassy marble and obsidian that breach the sand like extinct sea creatures. Countless generations of Tuareg warriors ruled this realm, demanding tribute from merchants plying the caravan routes and raiding sedentary





A caravanner of mixed Tuareg and Arab descent leads his camels in Mali. His Tuareg uncles taught him which plants can cure—or kill—his animals and how to navigate by the color, texture, and taste of sand.



tribes along the Niger River for animals and slaves. Guided by the proverb “Kiss the hand you cannot sever,” the Tuareg gained a reputation for brutality and treachery, often robbing the very caravans they were hired to protect and launching surprise attacks on their allies.

At the turn of the 20th century, the Tuareg were the last of the West African peoples to be pacified by the French, and their lands were absorbed into parts of Niger, Mali, Algeria, and Libya. Those governments generally ignored their fractious Tuareg minorities, leaving them to wander the desert with their flocks of camels and goats. But in recent decades, as less and less rain fell during the wet seasons, Tuareg families struggled to sustain sizable herds. “Animals are everything to a Tuareg,” an elderly nomad once

explained to me. “We drink their milk, we eat their meat, we use their skin, we trade them. When the animals die, the Tuareg dies.”

With their herds declining, many Tuareg in Niger began asking why the government wasn’t sharing the wealth derived from the rich uranium deposits that for decades have been mined from their grazing lands. During the 1990s a Tuareg militia, many of its members trained and armed by Qaddafi, fought the Niger army over the issue. A peace accord was signed, but little changed. In 2007 the government was negotiating contracts with France projected to make Niger the world’s second largest uranium producer. More deals allowed foreign companies to explore the desert for other resources. With the nation mired in poverty and the government

“ANIMALS ARE EVERYTHING TO A TUAREG. WE DRINK THEIR MILK, WE EAT THEIR MEAT, WE USE THEIR SKIN. WHEN THE ANIMALS DIE, THE TUAREG DIES.”



Beating back thirsty donkeys, a Tuareg boy (left) keeps order at a desert well. As the wet season fades, Moussa (above) faces hard months of finding enough grazing for his herds to survive until the rains return. “Water is life,” he says, reciting a Tuareg proverb.

refusing to make meaningful investments in Tuareg-dominated areas, the nomads rebelled again. Meanwhile, drug smugglers and a North African offshoot of al Qaeda established themselves in the region, and the Niger government accused the Tuareg of being involved with them.

THE REBELS MAKE CAMP for the night in a dune field a few miles from the school, hiding their battered pickups under the low canopies of acacia trees. Several men wash their hands and faces with water from teakettles and kneel toward Mecca for evening prayers. Then they gather in clusters of six or seven, each group taking shelter behind a small dune and kindling a meager fire.

A few of the rebels wait for full darkness to unwind their turbans. By tradition Tuareg

men cover their faces, though the women do not. The layers of cloth not only protect from the harsh sun and wind but also conceal their emotions. Like mummies coming back from the dead, their animated faces emerge in the firelight, revealing downy wisps of beard and boyish grins. Some of their cheeks are stained with indigo dye from their turbans, an age-old mark of the Tuareg that led early visitors to dub them the “blue men.”

The rebels’ medic invites me to join his group. They tease each other and light cigarettes as they boil macaroni and brew tea. Many appear barely old enough to have undergone the traditional postadolescent ceremony in which their uncles pronounce them ready for manhood and twist the first turban around their heads.





Women cook the evening meal by their tent, made from straw mats. Their herds decimated by droughts, many nomadic Tuareg have moved to towns to work as blacksmiths, leather artisans, and tour guides.

Supporters rally for a Tuareg candidate in Agadez before Niger's 2009 elections. History casts a shadow on politics, as the Tuareg minority face resentment from ethnic groups they once enslaved.



By the fire I notice that the medic and another man bear the common ethnic features of the African interior—dark brown skin, kinky hair, and broad noses. Two men have olive complexions, smooth black hair, and sharp Mediterranean noses. The other three are a mixture of all the traits. Regardless of skin color, a surprising number have topaz blue eyes. This genetic grab bag suggests one of the riddles of the Tuareg, who have always considered themselves a people apart yet for centuries took slaves from other desert tribes and intermarried with them. The result is an ethnic group distinguished primarily by its common language, Tamashek, which is related to Berber tongues spoken in Algeria and Morocco.

We huddle around a communal bowl, sharing spoons to dip out mouthfuls of salty

macaroni seasoned with desert herbs. The men eat hungrily but are careful to take only their portion. Between bites, the medic tells me he was a doctor's assistant before the rebellion. His left eye, a blank, milky orb, is a casualty of his very first battle. Next to him sits the group's thick-shouldered machine gunner, who mans a .50 caliber with a rusting barrel. He says he left engineering classes at a university in Nigeria to join the rebels. "I could not study while my Tuareg brothers were fighting," he tells me.

Hama, a lanky youth, has never gone to school. He grew up in an Air village, making the annual camel caravan with his father. He points to the brightest stars and describes how to use them to navigate to the Bilma oasis in the eastern desert, where they would trade onions and

**“YOU WILL SEE,” THE MAN SAYS.
“THERE IS ALWAYS DISAGREEMENT AMONG
THE TUAREG. IT IS OUR CURSE.”**

garlic for salt. “Thirty days by foot,” he says, noting that the first time, he made the trip barefoot.

I ask who is the youngest, and the medic points to a painfully shy boy named Bachir. Almost whispering, Bachir says he thinks he is about 17 but isn’t sure. He was tending his family’s animals in the mountains when a rebel convoy drove by, and he asked to join them. “He is good luck,” one of the men says. After gentle prodding, Bachir recounts how he was riding in the back of a pickup when it struck a mine. Two men died instantly, eight suffered serious wounds, but Bachir was hurled a hundred feet away into the top of an acacia tree. “It felt like I went to sleep and woke up in the branches, and everything was silent,” he says quietly.

The rebels were searching for his body among the smoking wreckage when he walked up. “He wasn’t even scratched by the branches,” the medic says, his good eye widening. “Allah has his hand on that one.” The other men click their tongues, using the Tuareg shorthand for agreement.

I ask Bachir what he will do after the rebellion, and he replies that he would like to be a soldier. “In the Niger army?” I ask. At the end of the last Tuareg rebellion in 1995, many former rebels were brought into the Niger military as part of the peace settlement. “You would join the people who have killed your friends and nearly killed you?” He shrugs: “I think it would be a good job.” Some of the others click their tongues.

Soon after dinner the prisoner is brought to me, and we are allowed to talk privately. He is a Fulani, one of the ethnic groups that the Tuareg once raided for slaves. He says he is Abdul Aziz, a lieutenant in the Niger army. He admits to shooting one of the old men in the leg. “It was wrong of me to do this,” he says. His superiors were angry that two of their vehicles had struck mines laid by the rebels, killing and wounding several men. To evacuate the injured, the army would have to pass through the rebel minefield again, and they were convinced that the old men knew where the explosives were laid.

“The officers asked the old men to talk, but two of them refused. The one who was shot was talking, but he wasn’t giving good information.

It was getting to be night. That’s when I left,” the prisoner says. “I will swear on the Koran that I did not kill any of them.”

After he and the other soldiers were captured, his superiors made him the scapegoat, he says. His Tuareg captors had never beaten him and had allowed him to receive a letter from his parents via the Red Cross at the end of Ramadan. “All of us are Nigeriens,” he says. “It is only Satan who creates a problem between people.”

AS THE NIGHT DEEPENS, the older rebels gather at the commander’s fire, where the flames have dwindled to coals. The men stretch out on quilts and pass around cigarettes and small glasses of hot sugared tea. The air is cool and sweet, and the dunes glow under the oval moon. One man produces a guitar. The lowest bass string was broken and replaced with a motorcycle brake cable, giving certain chords a resonant buzz. “Do you know Tinariwen?” the guitar player asks, referring to a Tuareg band whose founders had trained together in Libyan military camps during the 1980s. He begins to play one of their songs. “It is about the Tuareg struggle,” another rebel says.

A few at the fire had trained in the Libyan camps. As teenagers they had heard radio broadcasts of Qaddafi sympathizing with the plight of the Tuareg and exhorting them to come to Libya, where he would help them fight for their rights. But soon after joining one of his training camps, they realized the Libyan dictator was using them. Some were sent to fight in Lebanon; others saw action when Libya invaded Chad.

“We also used Qaddafi,” one rebel says, noting that Tuareg from Mali and Niger had smuggled weapons from the camps to fight their governments at home. In recent years Qaddafi sent millions in economic aid to leaders in Mali and Niger while funneling support to Tuareg groups fighting against them. “Our leader is in Tripoli now,” the commander says, referring to Aghali Alambo, the MNJ’s president.

I ask the commander about the Niger government’s charges that the rebels are an ally of al Qaeda and involved in drug smuggling. He motions at his bedraggled platoon. “Do we

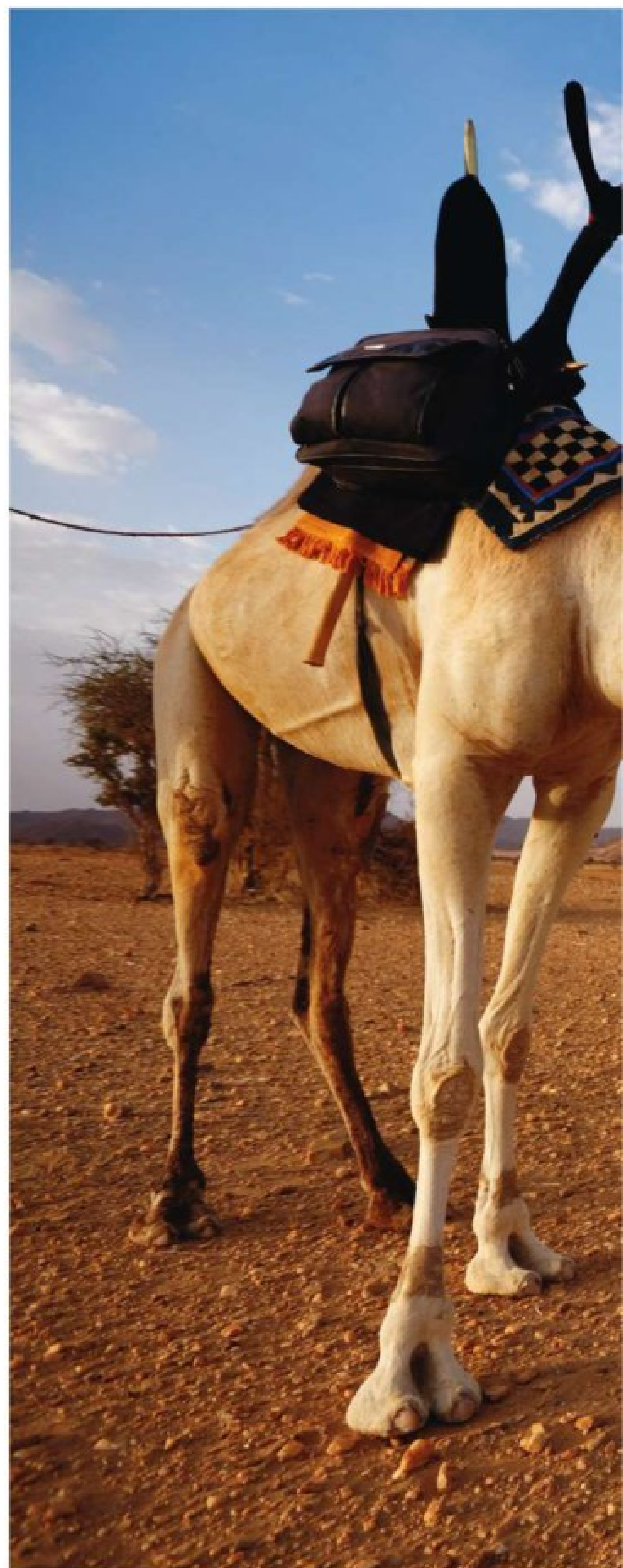
look like rich smugglers?” The other men click their tongues.

The singing continues, more glasses of tea are poured, and stories are told. One rebel quietly confides that the men are suspicious of their leader, Alambo. “There are rumors he has a villa in Tripoli,” the man says. “We have strong vehicles and many weapons. We want to fight, but when we make a plan to attack, Alambo always says no. No one understands what he is waiting for.”

The next day I am to travel farther into the mountains to join another group of Tuareg rebels. “You will see,” the man says. “The Tuareg there will say bad things about us—that we are not fighting, that we will betray them, that our leaders are corrupt.” He sighs. “There is always disagreement among the Tuareg. It is our curse.”

SEVERAL WEEKS AFTER I left the Aïr, the commander released the prisoner. In the ensuing months the rebels and the government announced a cease-fire, and not long afterward the Niger army overthrew the country’s strongman president, Mamadou Tandja, and held free elections. Last February, with democracy protests mounting in Tripoli, Qaddafi sent recruiters to Niger and Mali with offers, reportedly as high as a thousand dollars a day, to any Tuareg who would come fight for his regime in Libya. Tuareg sources in Niger say that some former members of the MNJ have taken the offer.

Upon hearing this news, I recalled one of my last conversations with the rebel commander. He had driven me to a place in the desert where I would depart from his territory. He gave me some dried sheep’s cheese and said he wanted to send me with the message that if the world wanted to stop the growing threats of al Qaeda and drug smuggling in the Sahara, they needed to enlist the Tuareg. “The desert has no secrets from the Tuareg,” he said, repeating a favorite local aphorism. “We know how to fight here better than anyone.” Yes, I said, but given the Tuareg history of betrayal and infighting, could the West trust them? He answered with a click of his tongue. I couldn’t gauge his expression because his face was completely obscured by his turban. □





Tuareg rebels encounter one of their nomadic kinsmen. They give him tea and sugar and ask what he has seen. “To know what is happening here,” the rebel leader says, “you must find a Tuareg. We are the eyes of this desert.”

LECTURE

Brian Skerry's Undersea World

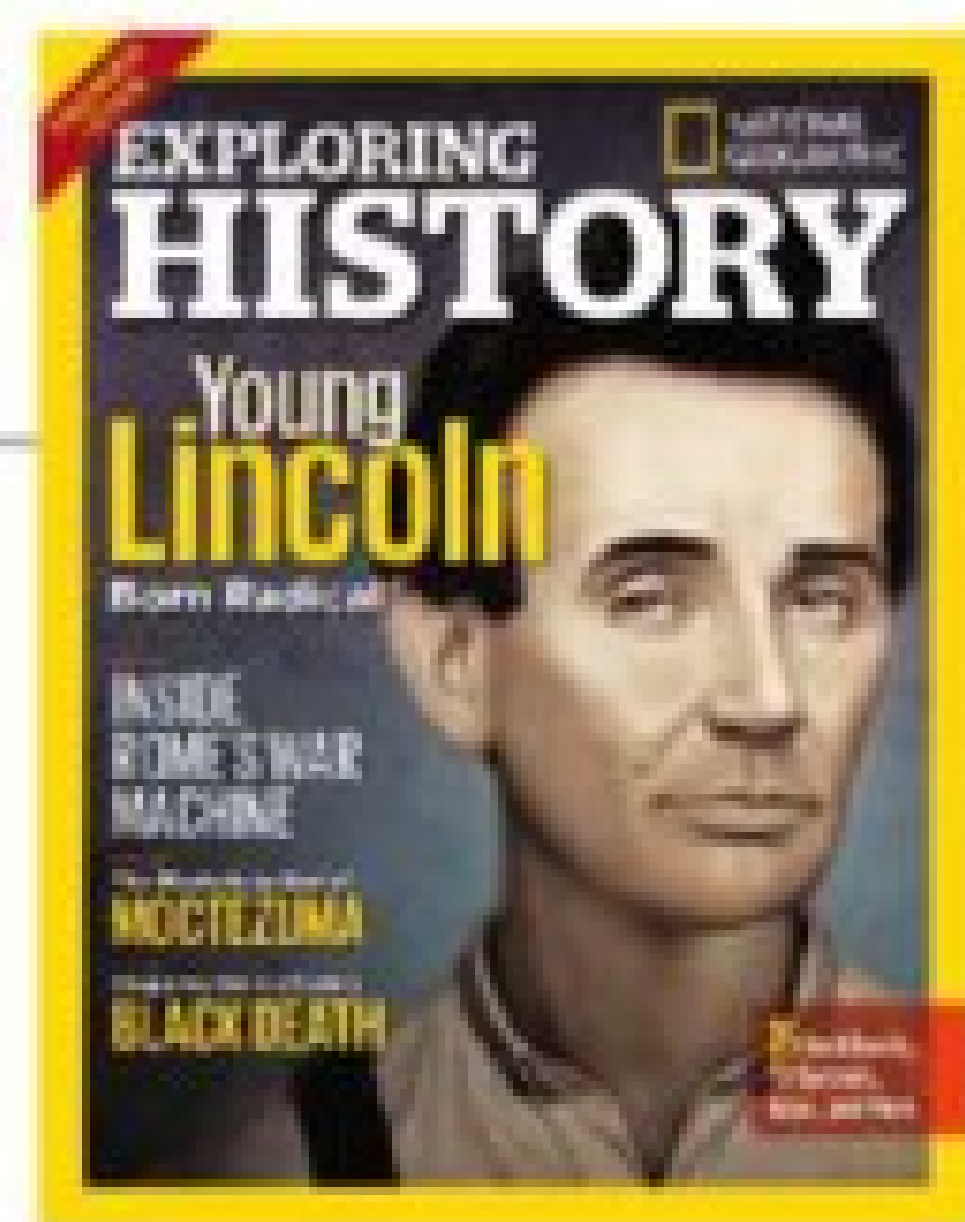
National Geographic photographer Brian Skerry (right) is famous for getting face-to-face with creatures from the deep. Catch him on tour in the United States and Canada as he shares a presentation tied to his upcoming book, *Ocean Soul*. For tickets and tour dates go to nationalgeographic.com/events.



EXHIBIT

CRITTERCAM Swim with turtles, hunt with sharks, and romp with lion cubs via National Geographic's Crittercam. Safely affixed to wildlife, these devices let us glimpse the animal world. An encounter with a penguin rounds out the exhibit. At Connecticut's Mystic Aquarium through January 2012. See mysticaquarium.org.

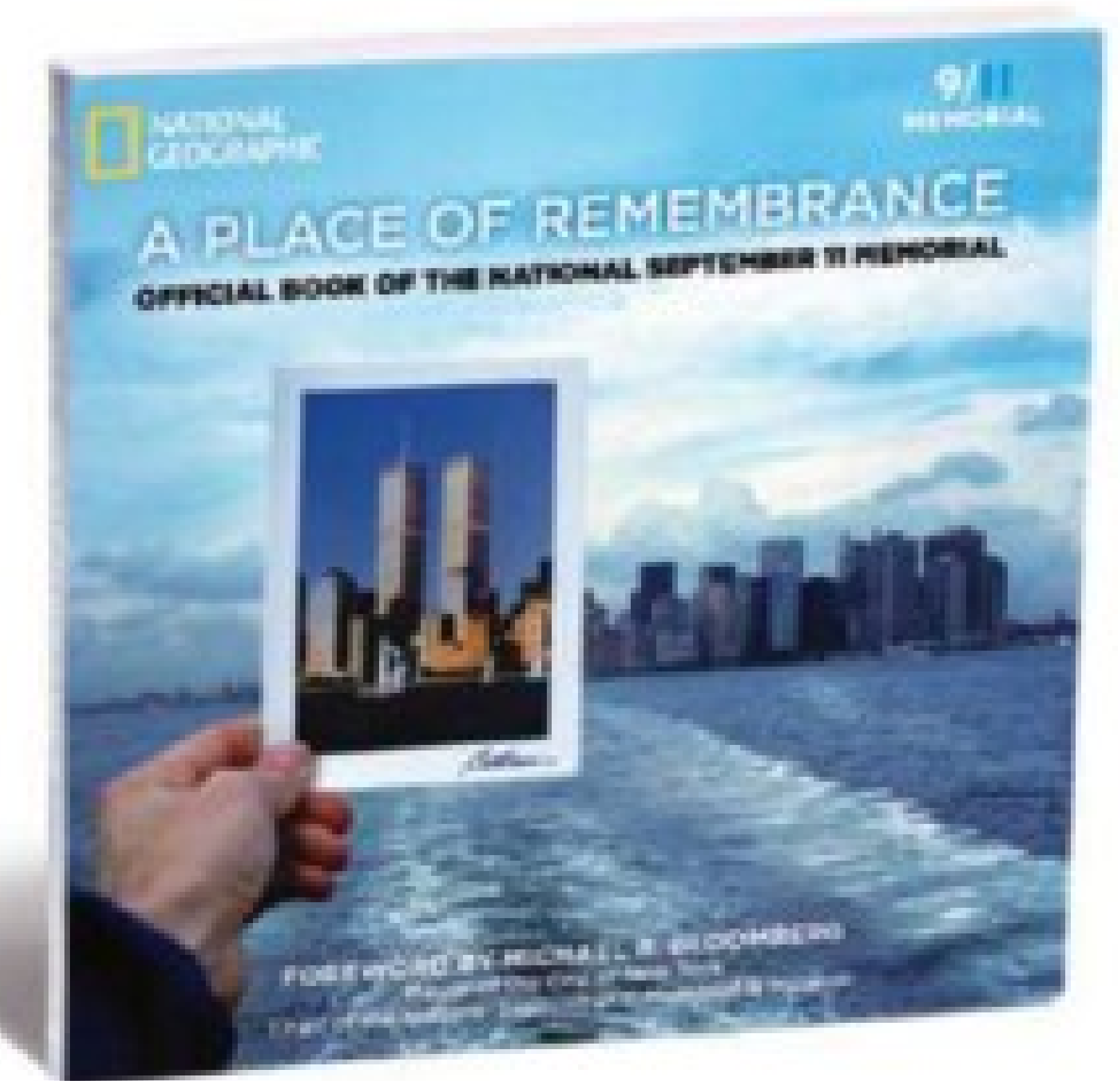
MAGAZINE



PREMIER ISSUE Brimming with colorful maps and illustrations, *Exploring History* delves into subjects and people including Abraham Lincoln, Joan of Arc, and Moctezuma. Available September 9 wherever magazines and books are sold or at ngm.com/history (\$6.99).

BOOK

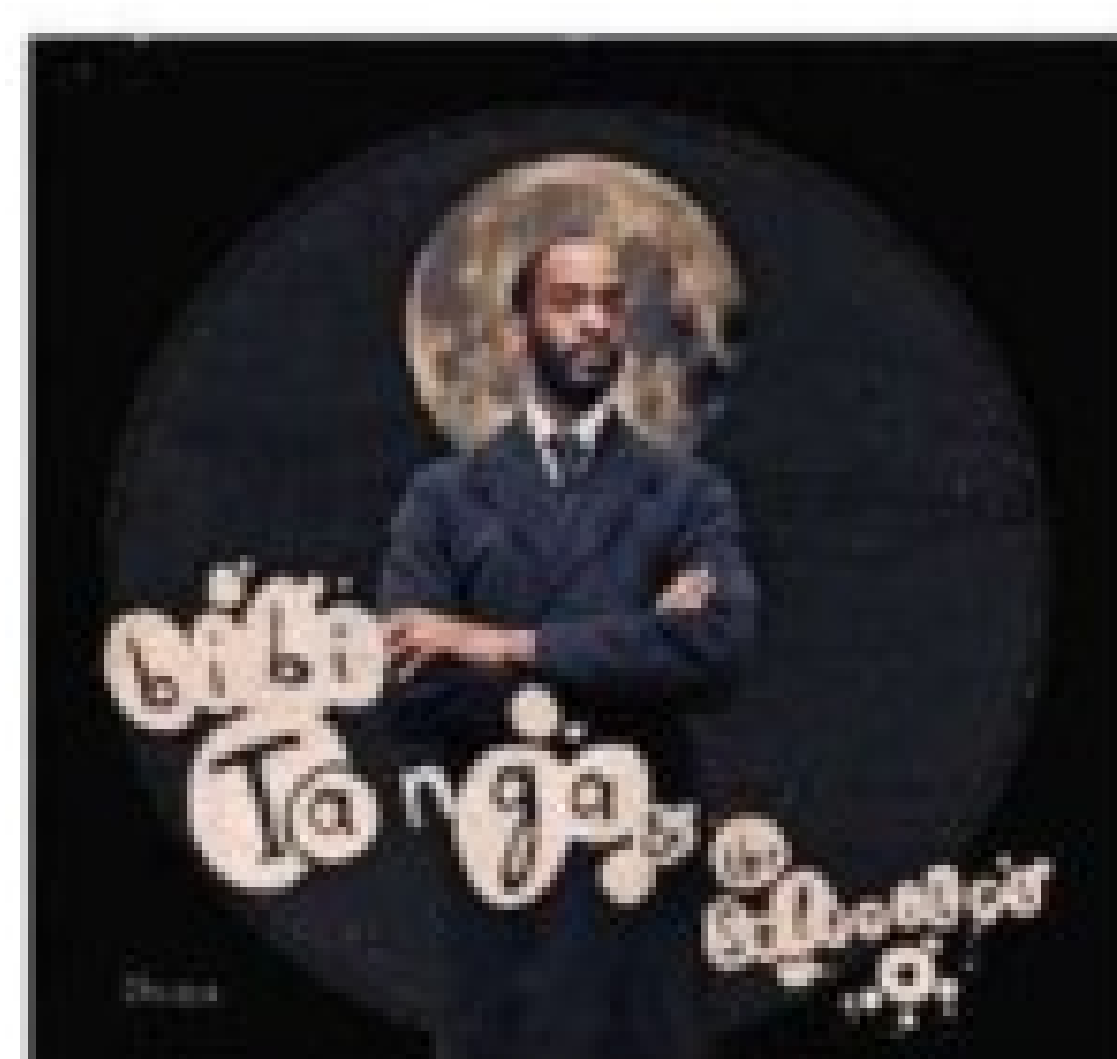
A PLACE OF REMEMBRANCE This official keepsake book of the National September 11 Memorial reveals a story of loss and celebrates the spirit of hope as we mark the tenth anniversary of 9/11. Available now (\$19.95).



DVD

9/11 DVD COLLECTION National Geographic's coverage of the 2001 terrorist attacks is a compelling tribute to those who were lost. Browse the DVD sets at shopng.com/911.

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LEGAL NOTICE

A class action settlement involving Farmers automobile insurance may provide payments to those who submitted medical claims and medical providers who were assigned benefits if such claims were reduced.

Para una notificación en Español, visite nuestro sitio de Internet.

A settlement has been reached with Farmers Insurance Company, Inc., Farmers Insurance Exchange, Truck Insurance Exchange, Fire Insurance Exchange, Mid-Century Insurance Company, Farmers Group, Inc., and Illinois Farmers Insurance Company, and certain related entities (collectively, "Farmers") about the payment of medical bills related to automobile accidents under (1) medical expense payment ("Med-pay") coverage or (2) Personal Injury Protection ("PIP") coverage. The settlement provides for payments to eligible Class Members.

The District Court of Canadian County, Oklahoma will have a hearing to decide whether to give final approval to the settlement, so that payments can be issued. Potential Class Members have legal rights and options, such as submitting claims for payments or excluding themselves from or objecting to the settlement. Additional information can be obtained from the Detailed Notice, which is available at the website listed below or by calling 1-877-846-0588.

WHAT IS THIS ABOUT?

The lawsuit claims that Farmers failed to pay reasonable expenses for necessary medical services related to automobile accidents under Med-pay and PIP coverage based on Farmers' use of certain claim adjustment systems and procedures. Farmers denies all of the claims.

WHO IS INCLUDED?

Generally, the Class includes persons who submitted claims to Farmers for payment of medical bills related to an automobile accident under Med-pay or PIP coverage if (a) the claim was adjusted from January 1, 2001 to February 9, 2009 based upon a recommended reduction from Zurich Services Corporation ("ZSC"), (b) the claim was paid at less than the amount billed, and (c) total Med-pay or PIP payments were less than the respective limits of coverage. The Class also includes medical providers who were assigned the right to assert these claims.

WHAT DOES THE SETTLEMENT PROVIDE?

Eligible Class Members who submit a valid claim form will receive 60% of the difference (up to policy limits) between the amount of the medical bills submitted to Farmers and the amount paid by Farmers based upon a recommended reduction from ZSC related in any way to reasonable expenses for necessary medical services.

HOW DO YOU ASK FOR BENEFITS?

Call 1-877-846-0588 or visit the website listed below to get a Claim Form, then fill it out, sign it, include any required documentation and mail it to the address on the Form. Claims must be postmarked by **October 29, 2011**.

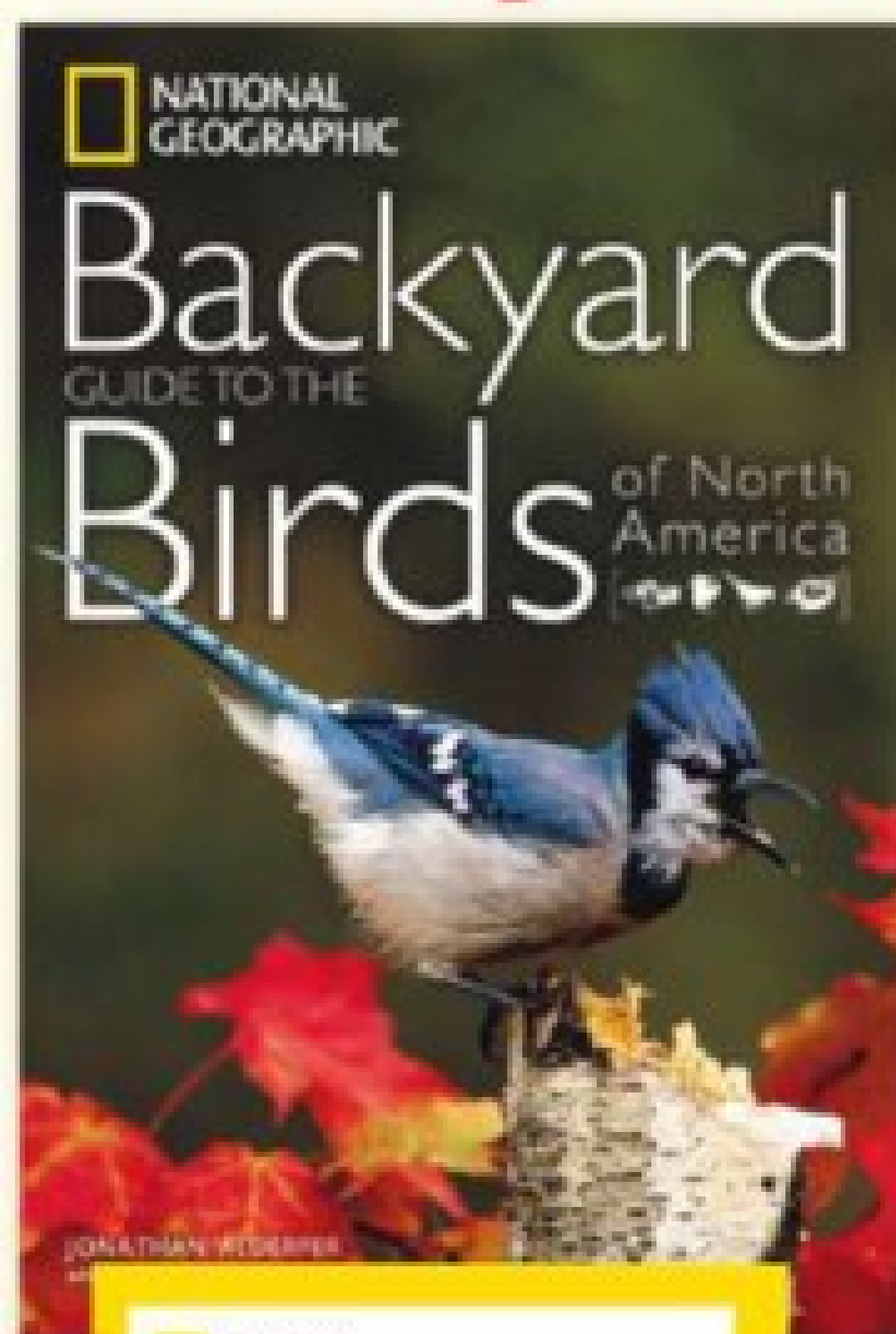
WHAT ARE MY OTHER OPTIONS?

If you do not want to be legally bound by the settlement, you must exclude yourself from the Class by **October 29, 2011**, or you will not be able to sue, or continue to sue, Farmers about the legal claims this settlement resolves, ever again. If you stay in the Class, you may object to the settlement by **October 29, 2011**. The detailed Notice explains how to exclude yourself or object.

The Court will hold a hearing in this case, known as *In re Farmers Med-Pay Litigation*, No. CJ-2004-559, on **November 29, 2011** to consider whether to approve the settlement and a request by Class Counsel for fees and costs of up to \$6.5 million and \$7,500 to each class representative for representing the Class. These fees and costs will not reduce the amount distributed to Class Members. You or your own lawyer may ask to appear and speak at the hearing at your own cost, but you do not have to.

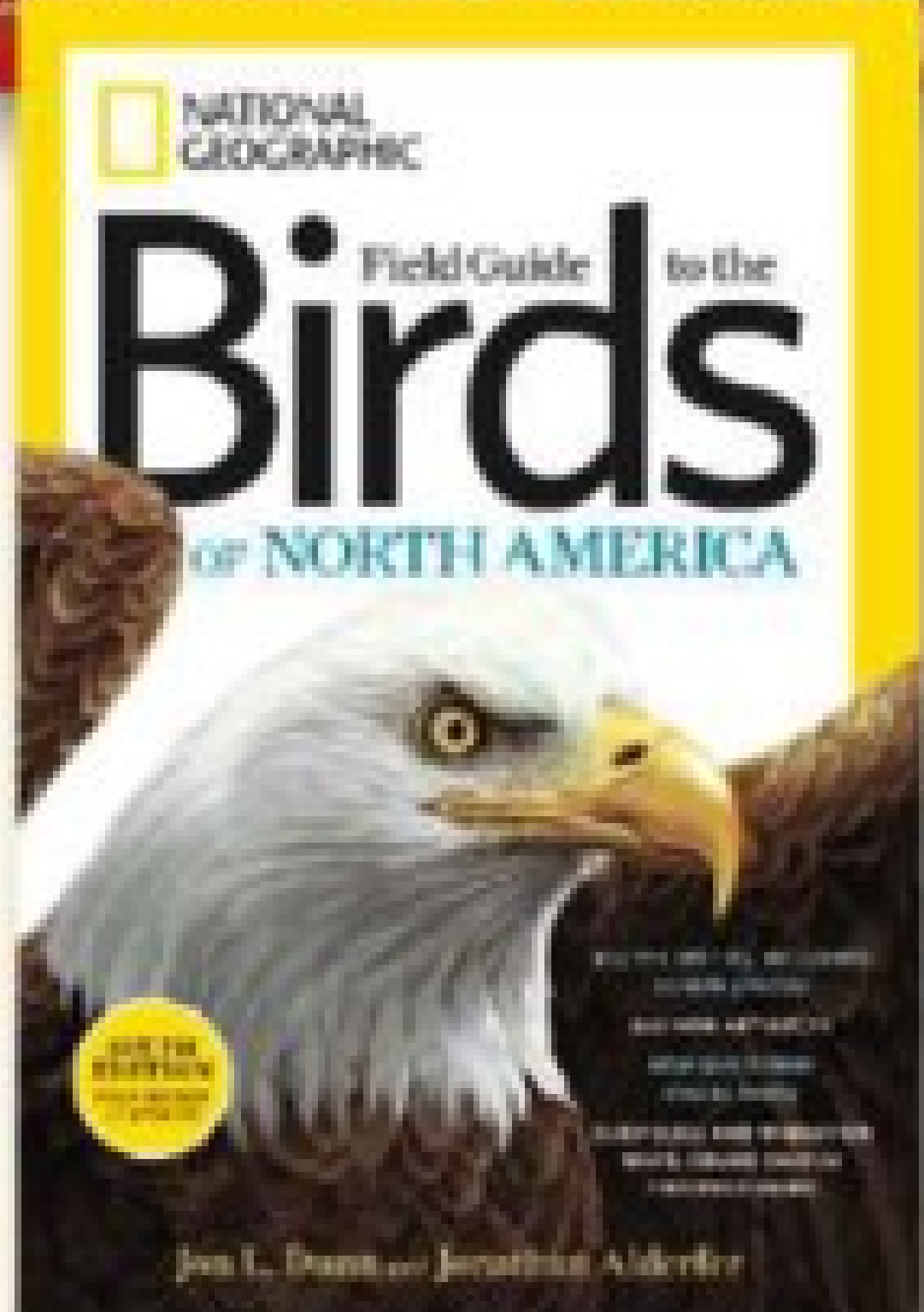
For more information, visit the website or call 1-877-846-0588.

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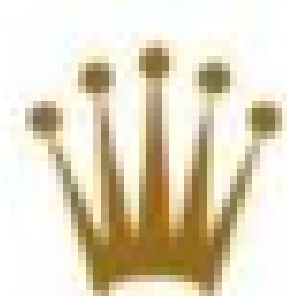
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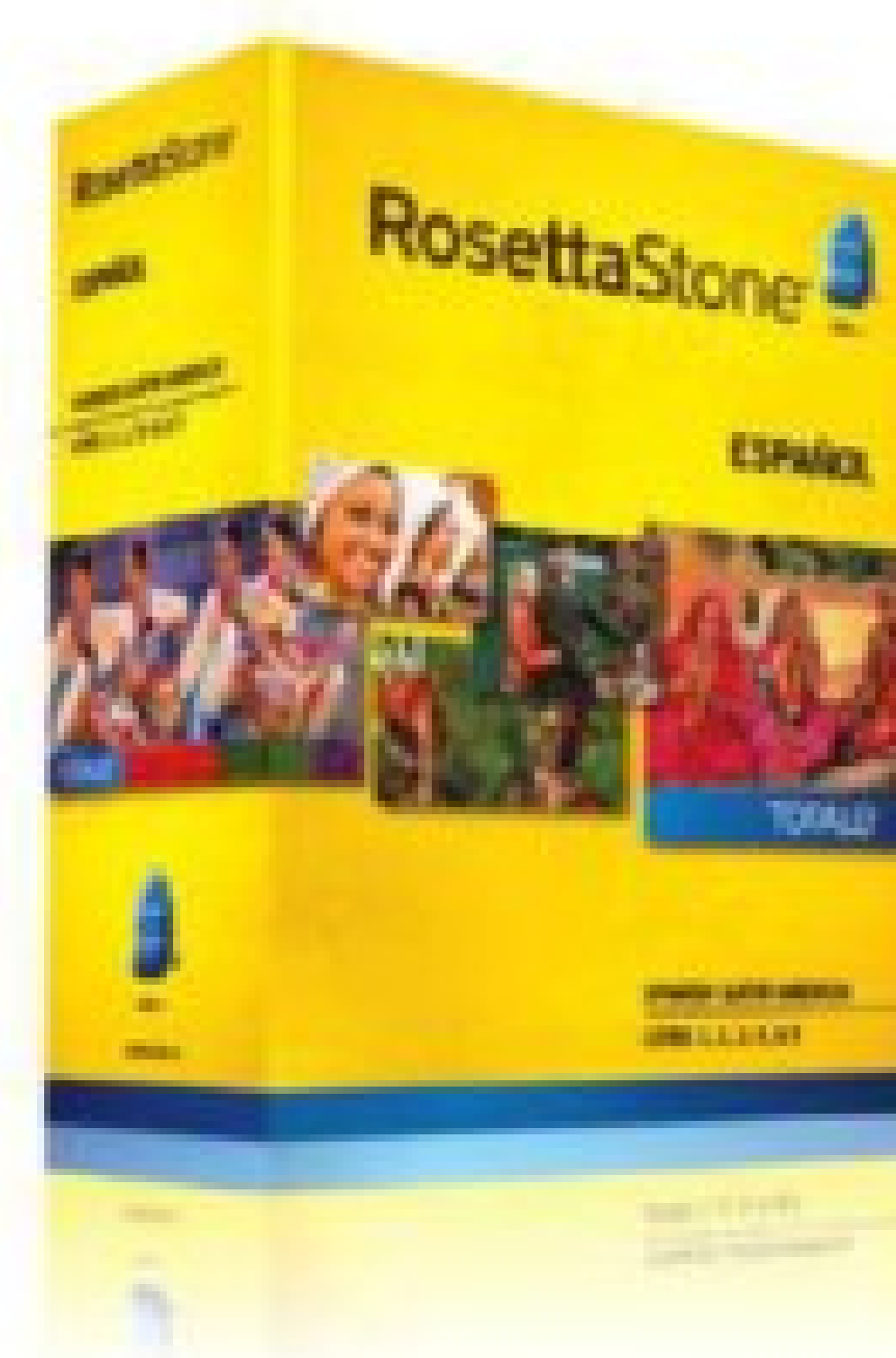


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Quiet Time Getting too attached to animals is something Michael Nichols tries to avoid when he's on assignment. As a journalist, he says it's important to appear neutral. Still, certain subjects—like the orphaned elephants of Kenya that he photographed for this issue—tug at his heart. One example is Shukuru, pictured below at seven months old, settling down for the night with her keeper. “For me,” says Nichols, “elephants represent an important level of nature that we need to understand better.” —*Catherine Zuckerman*



BEHIND THE LENS

This photograph feels very private. What is happening in this scene?

MN: It's dusk at the nursery. Shukuru has had her evening milk and is now getting ready for bed. Her keeper, Jiba Galgallo, will spend the night with her; orphan elephants are never left alone. The blanket is for warmth and comfort—it's meant to mimic the feel of Shukuru's mother. Young elephants are extremely tactile, so the blanket is essential.

Why does this image have special meaning to you?

An elephant's ears are so important. They indicate if danger is afoot, and they also regulate body temperature—but you rarely get to see the backs of them like this. Here

you can see all of Shukuru's blood vessels. It might not be apparent from this angle, but she is a total sweetheart. As for Galgallo, what he's doing is not just a job. It's much more spiritual than that. I like the light in his eyes. Many African

tribesmen are pastoralists, and they love animals. I was trying to capture that feeling. Shukuru was rescued from death. This picture talks softly, but it says what I wanted it to say: that these two really love each other.

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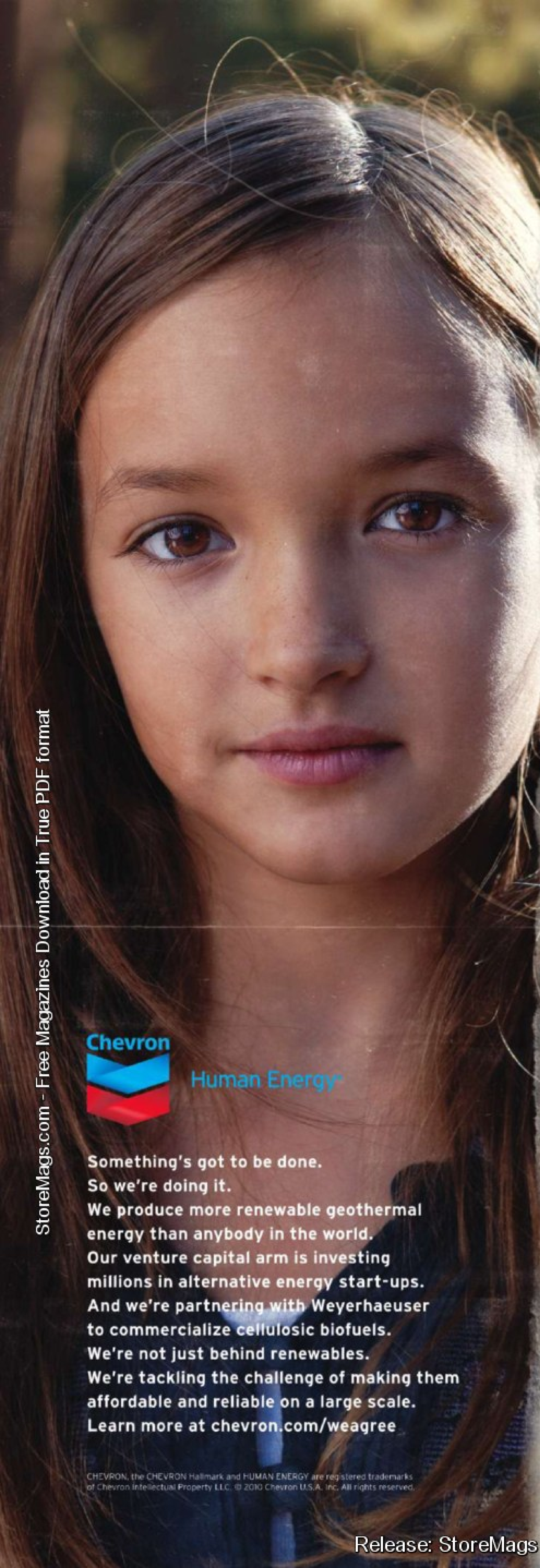
Hen Party

Recruits of the Women's Land Army take poultry care in stride while training in Northamptonshire, England, in 1940. During World War II "land girls" from all over Britain were asked (and eventually conscripted) to work on farms as replacements for men who'd left to fight. By 1944 around 80,000 women had been enlisted to grow the country's food. In recent years the U.K.'s Department for Environment, Food and Rural Affairs has recognized more than 34,000 former land girls for their wartime service. Some of these honorees—a long way from the farm—even had tea with the Queen.

—Margaret G. Zackowitz

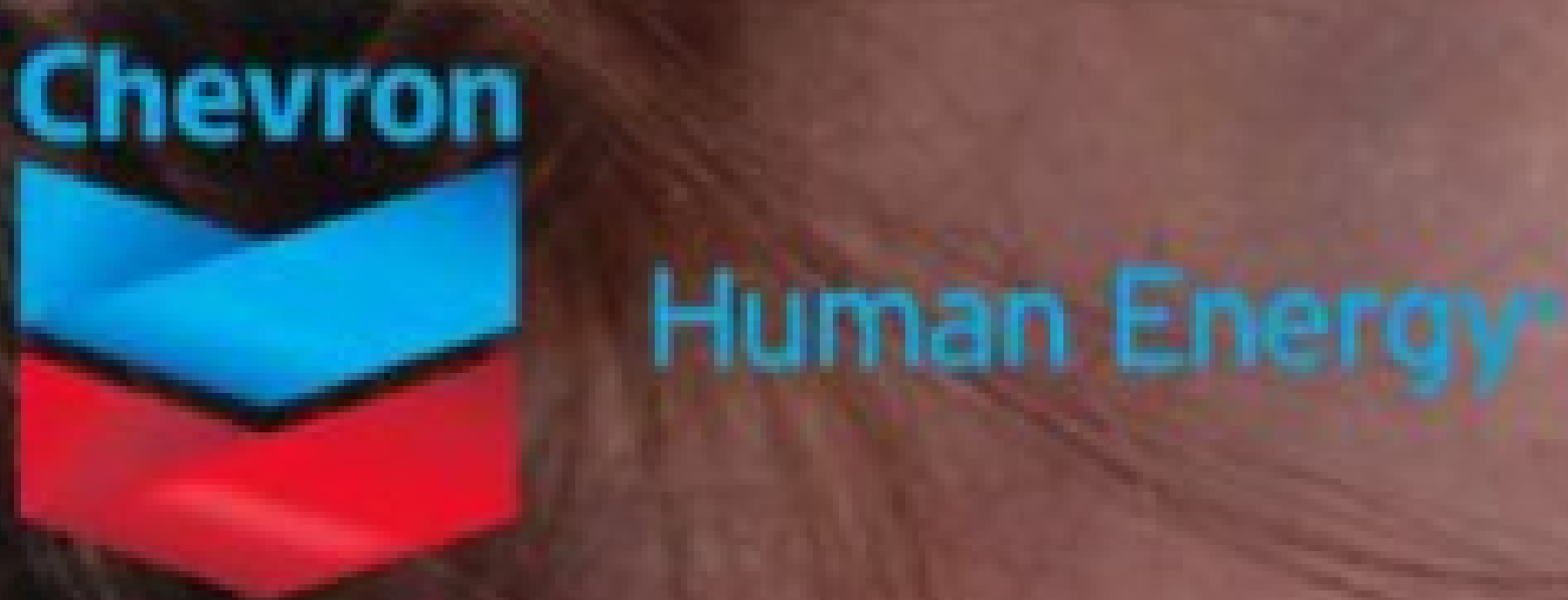
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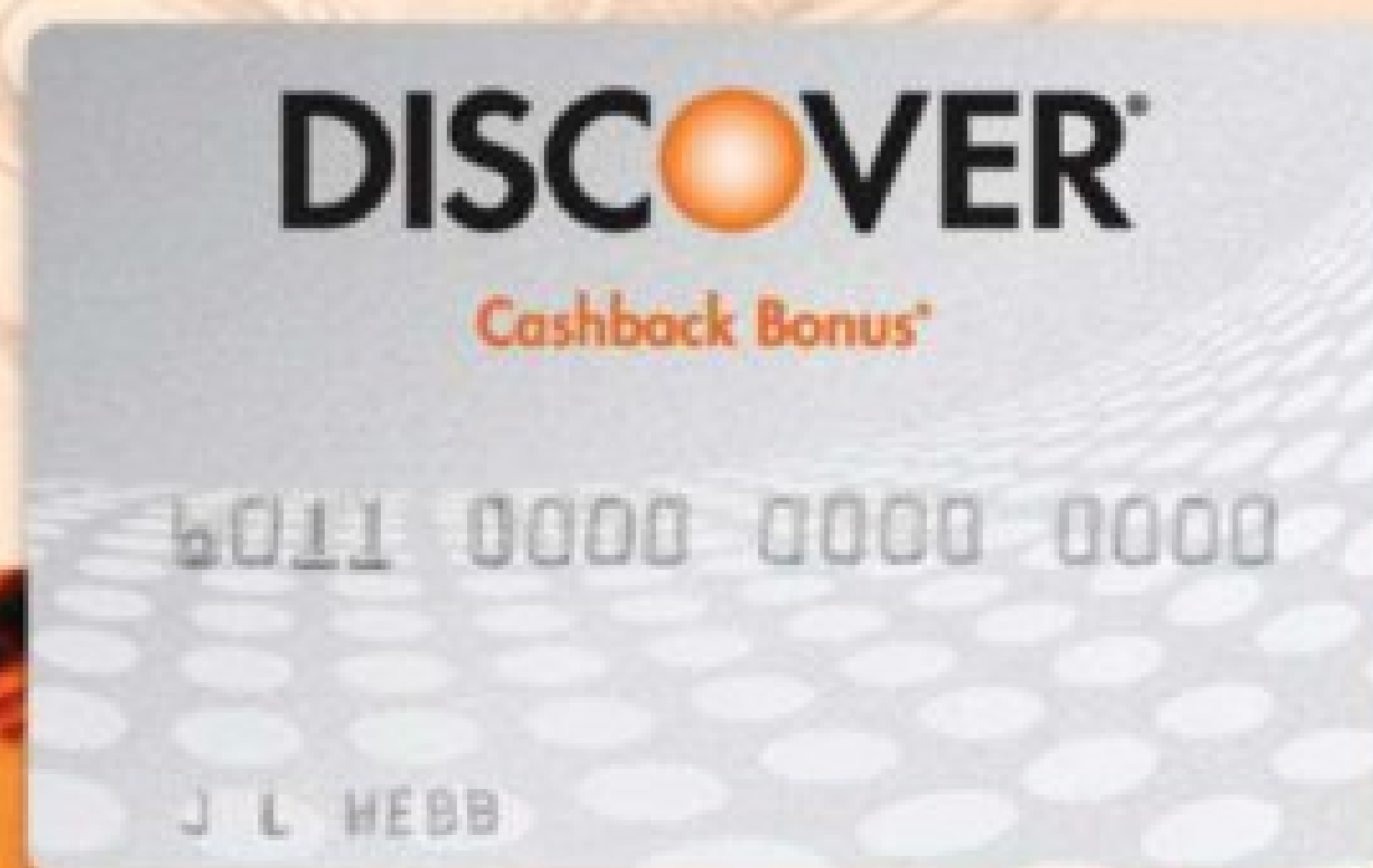
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