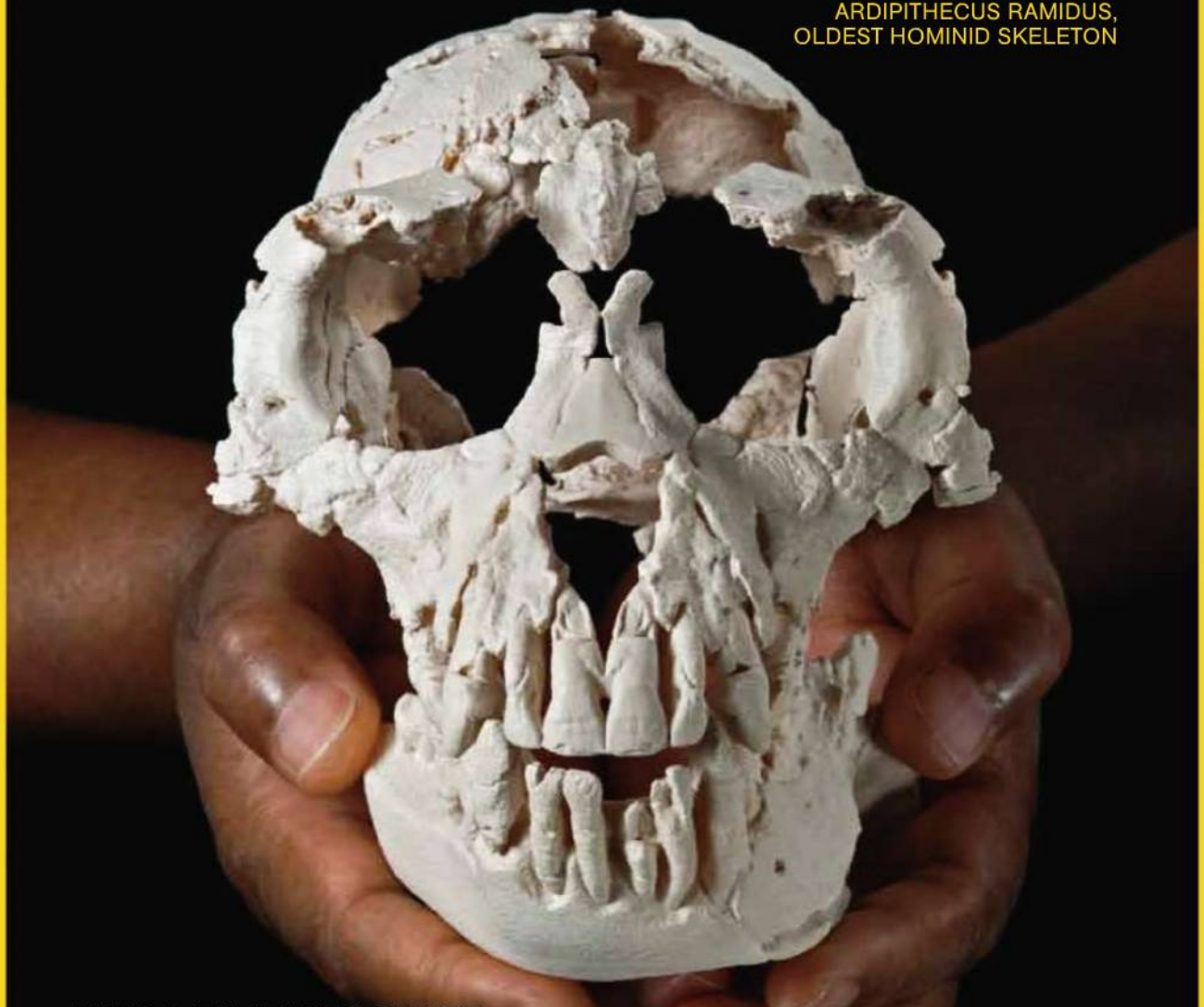
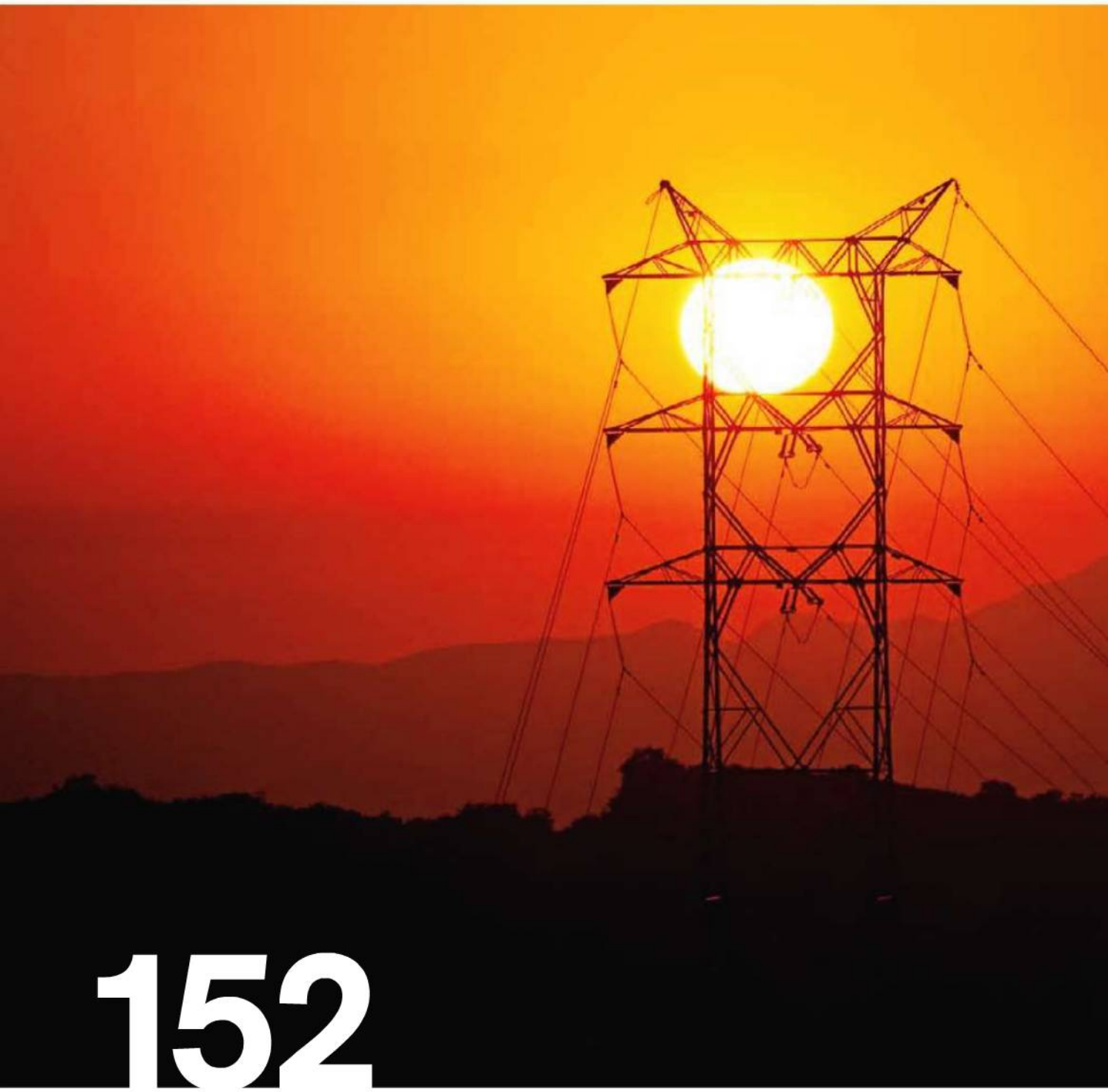
NGM.COM | JULY 2010

NATIONAL GEOGRAPHIC

4 Million Year Old Woman

ARDIPITHECUS RAMIDUS,
OLDEST HOMINID SKELETON





152

A transmission tower north of Los Angeles carries electricity to the grid.

JOE McNALLY

NATIONAL GEOGRAPHIC

JULY 2010 · VOL. 218 · NO. 1

OFFICIAL JOURNAL OF THE NATIONAL GEOGRAPHIC SOCIETY

NATIONAL GEOGRAPHIC

Departments

Interactives

On the Cover

CT scanning and digital technology re-create in resin the 4.4-million-year-old skull of *Ardipithecus ramidus,* held by National Museum of Ethiopia technician Alemu Ademassu.
Photo by Tim D. White

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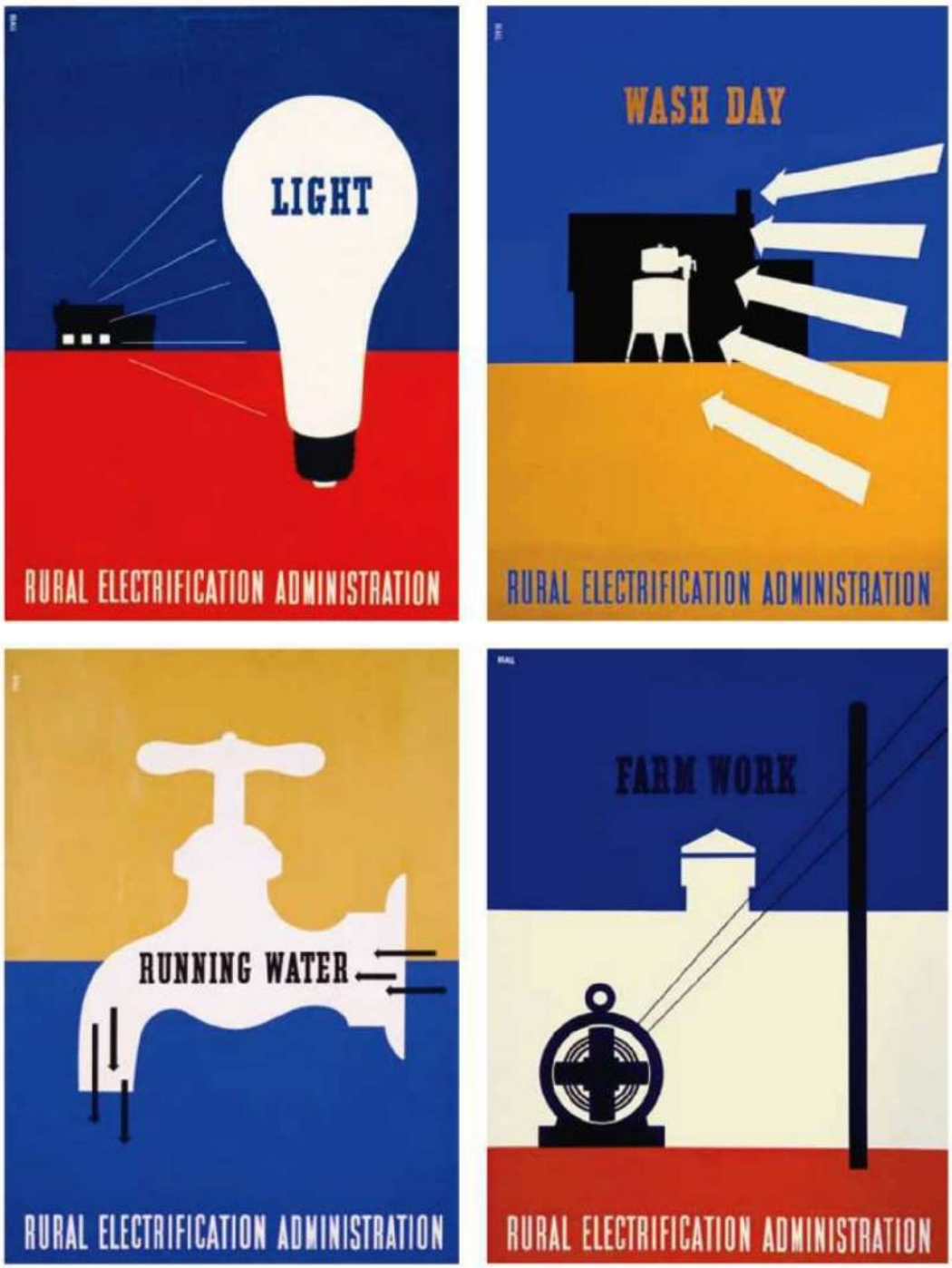


Posters helped publicize the benefits of the Rural Electrification Administration in 1937.

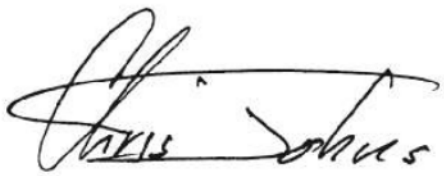
POSTERS: "LIGHT," "WASH DAY," "FARM WORK," AND "RUNNING WATER" BY LESTER BEALL, 1937; ART © LESTER BEALL, JR., TRUST/LICENSED BY VAGA, NY; LESTER BEALL COLLECTION, GRAPHIC DESIGN ARCHIVES, CARY GRAPHIC ARTS COLLECTION, RIT ("WASH DAY" AND "FARM WORK")

My grandfather must have been thinking ahead. As a young man in the 1920s, George C. Johns built a house in Vernonia, Oregon. The town was headquarters for the Oregon-American Lumber Company, then one of the largest lumber firms in the Pacific Northwest. There wasn't much of an electrical grid in those days. Smaller towns (like Vernonia) near industrial centers were more likely to have electrical access than those that were more isolated. Rural folks had it even harder. Only 10 percent of American farms were electrified. Private electric companies had little interest in extending power lines to the countryside.

All that changed in 1935 when Franklin Roosevelt established the Rural Electrification Administration. The REA provided low-interest loans to farmers, who formed their own cooperative groups to bring in lines and manage the power. By the end of the 1940s some 90 percent of farms had electricity. The grid was finally in place.

The drudgery of life before electrification is a rapidly vanishing memory, as Joel Achenbach makes clear in this month's story about the grid. Though perhaps you can remember—for a price. The other day I saw a real estate listing for a rural Oregon property near where I grew up. The log A-frame had one bedroom, two baths, and antique furniture that conveyed with purchase. Its big selling point seemed to be a promise of luxury living off the grid. It was priced at more than a million and a half dollars.

I wonder what my grandfather would have thought of that?



Wolf Wars

Although I was happy to see a wolf on the cover this month, I was disappointed in the article's coverage. To state that "humans are at war with wolves. It is an ancient dispute" is both sensational and ethnocentric. Nowhere in your article did you include perspectives from tribal members in wolf country, who are the only people who have anything to say about a truly ancient relationship with wolves. The Nez Perce tribe would have been a good place to start since its government has partnered with the Department of the Interior to initiate wolf recovery in the region.

DAVID MOEN
Oregon City, Oregon

It is shocking that ranchers hate wolves when wolves take only one percent of reported sheep losses compared with coyotes taking 25 percent, and wolves kill or drive away coyotes. How can hunters hate wolves when wolves cull the sick and weak from elk herds, improving the conditions for the trophy bucks? Author Douglas Chadwick quotes one rancher as acknowledging that "the general U.S. population wants wolves." Yes, we do. The wolves belong to all of us, not just the hunters of Idaho or the ranchers of Wyoming. The Statue of Liberty does not belong to me just because I live in New York. It also belongs to those hunters and ranchers. And it will be here when they want to come see it. But will

March 2010

Wolf reintroduction is an amazing success in terms of sheer wolf numbers. But just as wolves were purportedly reintroduced to control elk numbers in Yellowstone, wolf numbers must also be controlled.

Corrections, Clarifications

March 2010:
Africa's Last Frontier
Page 104: Ethiopia was incorrectly described as the only African nation never colonized by Europeans. Liberia was never a European colony.

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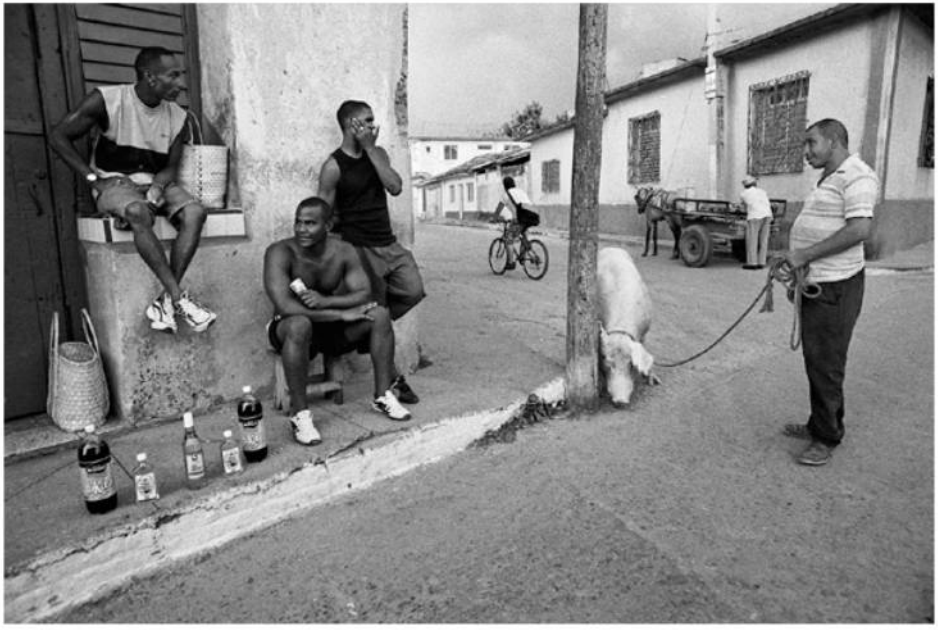







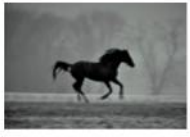




EDITORS' CHOICE **Luis Zilhão** Neuberg, Germany
Visiting Cuba, the 41-year-old Zilhão hoped to "meet ordinary Cubans and get into their way of life." He got his wish while chatting with locals in the town of Trinidad—except the ordinary became extraordinary when "a man came along with a huge pig on a rope!"

Getting Real

We get a lot of letters at *National Geographic.* We received several from readers insisting that William Lascelles's photograph on the February 2010 Your Shot page was a fake. Our readers were right.

The Your Shot rules specify, "Please provide only the original, unmodified camera image." Lascelles submitted a picture of a dog against a background of jets in the sky (right). After he learned that it had been chosen for the magazine, Lascelles told our writer the frame was a "once in a lifetime" shot. He confirmed that statement for our researcher. When Senior Photo Editor Susan Welchman asked him, prior to publication, to verify the image with the next photo in his shooting sequence, Lascelles sent her another picture of the dog—head turned this time—with the same jets above.

It turned out to be a fake too.

Lascelles has now admitted that he fabricated both images he sent us. We apologize for publishing his work. And we thank you for speaking up.

Now we're looking more closely at all Your Shot pictures. We recently discovered that Ivan Dobrev's December 2009 Your Shot photo of a window of bright blue sky in a dim warehouse was faked as well. We're sorry for publishing that one too.

"Your Shot shooters hunt down images that mean something to them," says Welchman, who looks at some 300 Your Shot photographs every day. "That's what Your Shot is supposed to be. It's real moments of real people in real life."So go on out and capture what you see. It'll be better than anything you can make up and paste together on a computer screen. We hope you'll keep sending us your shots. We want to see what is real.

Namibia Its bright po
Walvis Bay sets its sig

uch agape and two-tone wings spanning perhaps ten feet, a great white pelican in
hts on a fish breakfast. These migratory birds are found in Africa, Asia, and Europe.

PHOTO: LAURENT MERCEY

Iceland Lightning veins the Eyjafjallajökull volcano's ash plume, which roiled air travel this spring. Such "dirty thunderstorms" may occur when rock and ice particles loosed by exploding magma collide in the atmosphere.

PHOTO: SIGURDUR HRAFN STEFNISSON

United States Big city, short game: Resident Charlie Bernhaut works on his stroke 34 stories above 63rd and Broadway, on his condominium's 18-by-32-foot putting green—one of several now lining rooftops in Manhattan.

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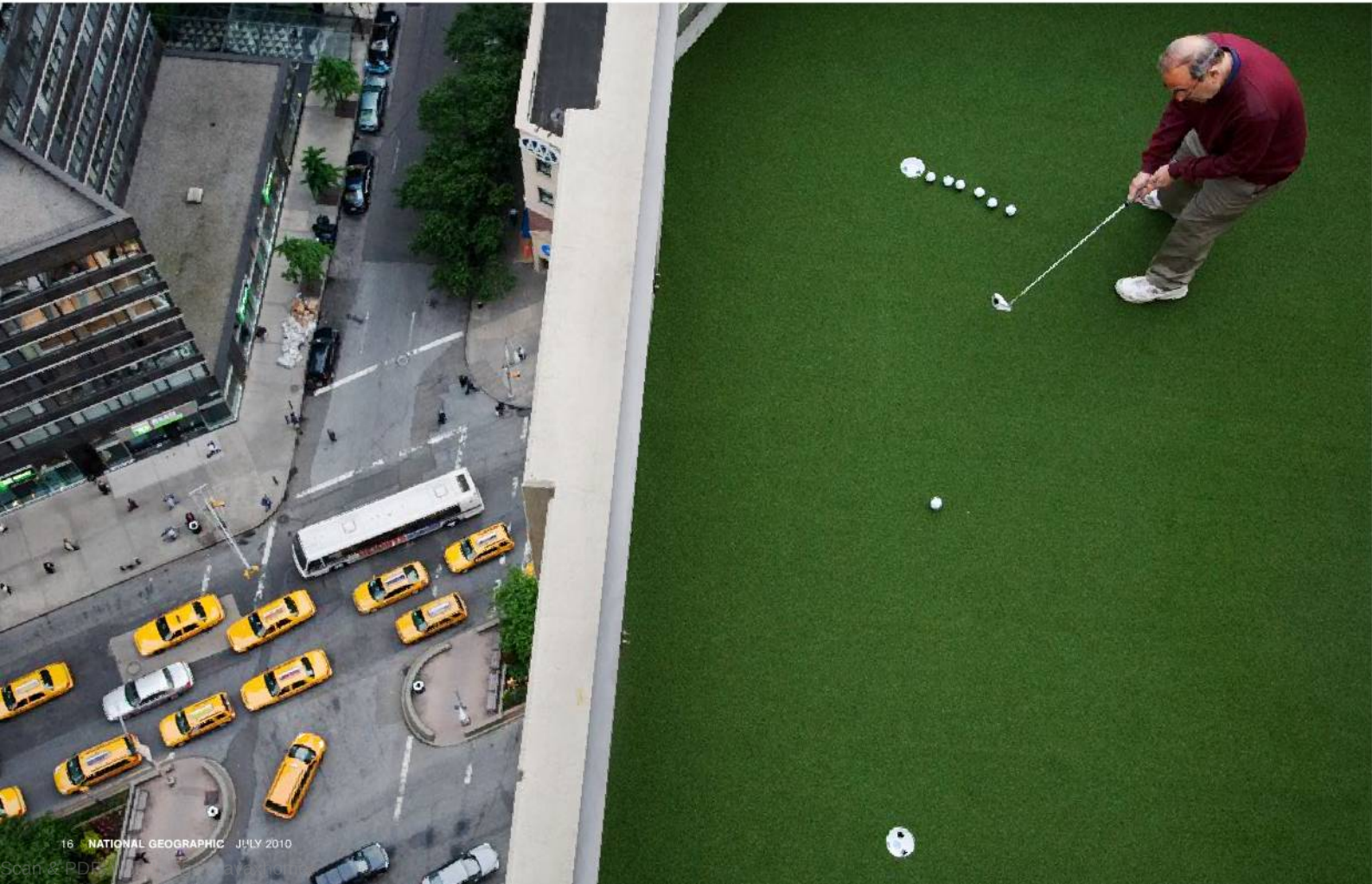
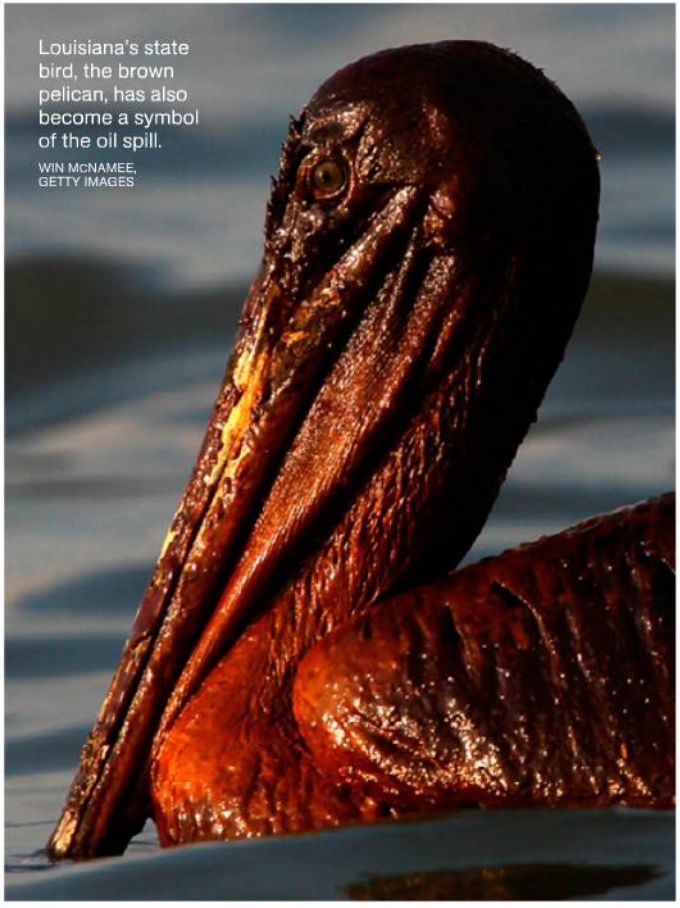
PHOTO: LANDON NORDEMAN



An Indelible Stain

By now the images are all too familiar: the darkly coated birds, the grainy underwater plume of spewing oil, the coppery streaks atop the blue ocean. Since the April 20 explosion that sank the oil drilling rig *Deepwater Horizon* off the coast of Louisiana, millions of gallons of oil have poured into the Gulf of Mexico, threatening delicate ecosystems and local livelihoods.

As scientists and politicians struggle to assess and contain the damage from America's worst oil spill, one thing's for sure: The toll, environmentally or otherwise, will be felt for years to come. Here a pictorial gallery captures key moments in the unfolding crisis. An in-depth report from *National Geographic*'s team at the scene will appear in the October issue. *—Luna Shyr*



Louisiana's state bird, the brown pelican, has also become a symbol of the oil spill.

WIN McNAMEE, GETTY IMAGES

Scroll to the next page, where we map the next three solar eclipses.

Mooning Over Solar Eclipses As day plunges into night, the faithful gaze skyward, murmuring in awe. They wear Mylar glasses, hoist cameras, join hands. They are "eclipse chasers," and their numbers have been growing since the 1970s.

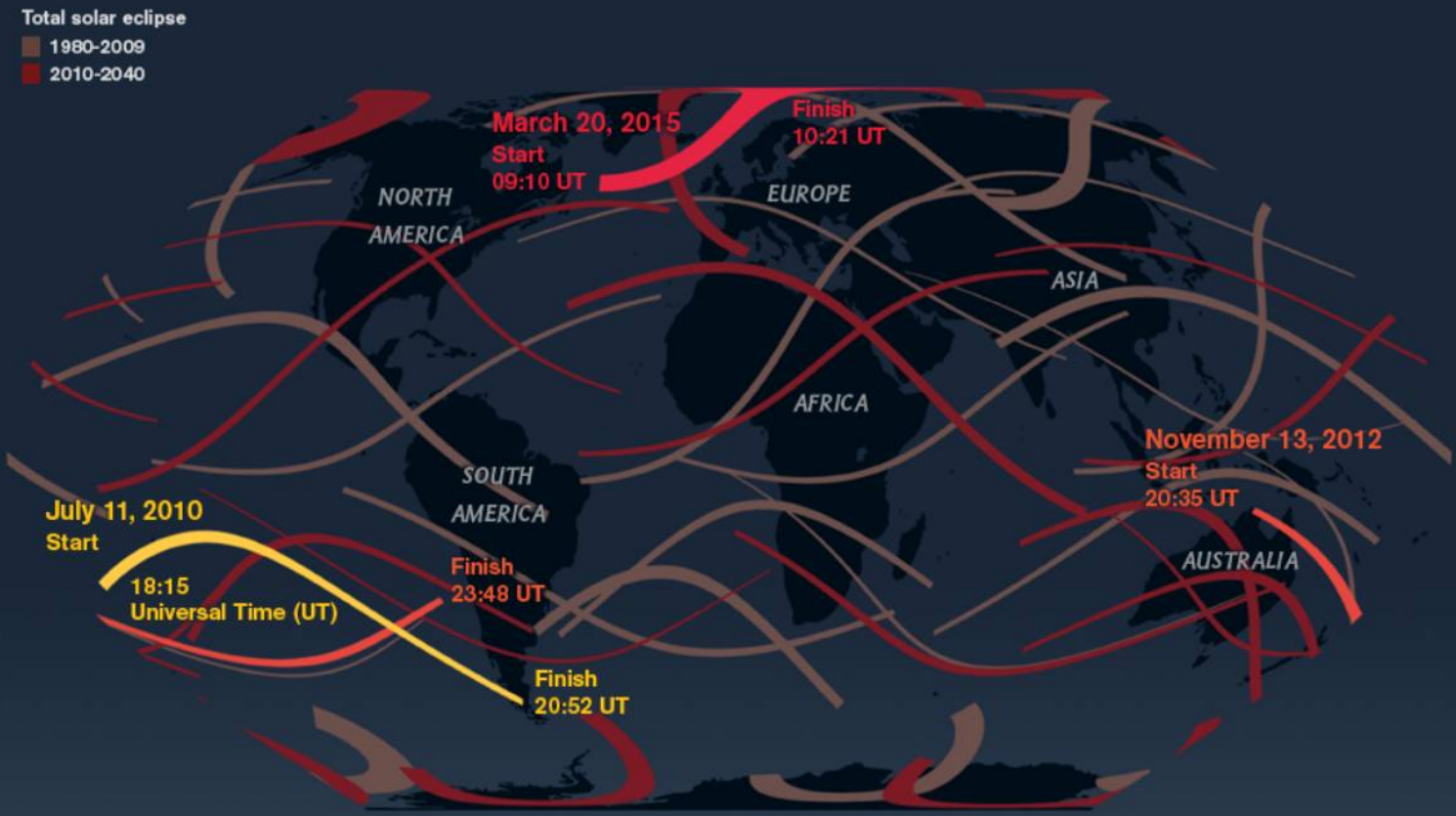
Total solar eclipses occur every 18 months or so and are visible for just a few minutes from any one spot. As knowledge about them has trumped superstition, legions of fans have been flocking to the narrow strips on Earth where the moon can best be seen obscuring the sun. The reward for these so-called umbraphiles, says Williams College astronomy professor Jay Pasachoff, is "the most dramatic natural phenomenon ever visible. It's spectacular and fills you with awe. A primal feeling comes over you."

This year Melita Thorpe, owner of an astronomy-themed travel agency, saw a hundred slots fill up by spring for a $6,000 July freighter trip to the South Pacific; dozens more devotees signed up for a sunset viewing of the same eclipse in Patagonia. Her biggest crowd in the agency's 26 years: the 700 people she ferried to view a 1991 eclipse off the coast of Mazatlán, Mexico.

For most enthusiasts, one experience is not enough. But don't ask them to pick a favorite. Says Bill Kramer, editor of the popular website *eclipse-chasers.com,* "The most important one is the one I'm about to see." *—Jeremy Berlin*

PHOTO (COMPOSED OF 55 CALIBRATED IMAGES): MILOSLAV DRUCKMÜLLER, PETER ANIOL, VOJTECH RUŠIN

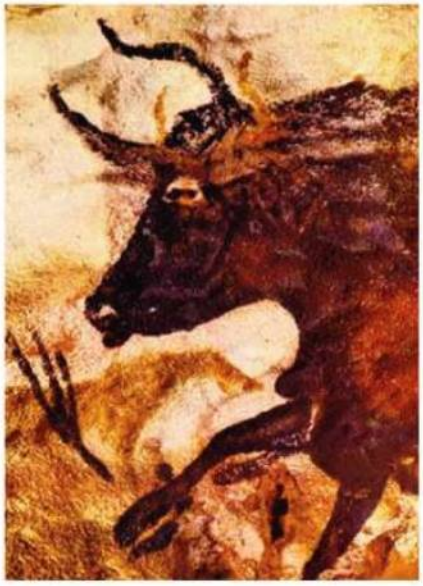
Paths of the next three solar eclipses



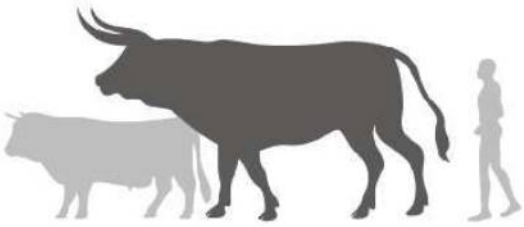
MAP: SAM PEPPLE, NGM STAFF. SOURCES: NASA; XAVIER M. JUBIER

Ox Redux For centuries they roamed Europe's forests—massive bovines called aurochs that were depicted on cave walls by Paleolithic artists (inset) and prized as hunting trophies. They died out nearly 400 years ago. Now genetics may bring them back to life.

Sound like a Jurassic Park sequel? It's actually the real-life plan of Project Tauros, a consortium of European scientists using DNA sequenced from aurochs teeth to steer a novel breeding program. Project researchers are currently identifying living cattle—including Spanish Limiana and Italian Maremmana—that still carry aurochs genes. Then breeders will cross those cattle to retain the pertinent DNA, jettison the rest, and make bovines that, in about a decade, are expected to look and act just like their extinct ancestors.



Aurochs were herbivorous behemoths, and in the past they browsed on beech, a type of tree now choking Europe's woods. Today such housecleaning would help regrow native flora—as one resurrected species gives other, threatened ones a shot at survival. *—Juli Berwald*



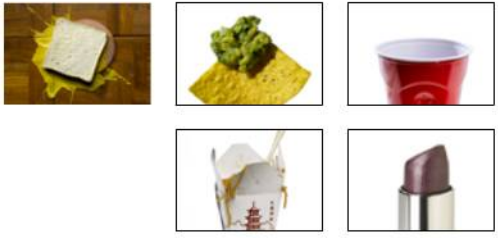
Scottish Highland

Aurochs

Aurochs stood some six feet high at the shoulder, two feet taller than many modern bovines. Scottish Highland cattle, such as this bull in the Netherlands, will be used in early efforts to bring back aurochs.

PHOTOS: ADRI HOOGENDIJK, FOTO NATURA/MINDEN PICTURES (ABOVE); VISPIX. NGM ART

The Zero-Second Rule Everyone knows the drill: Your tasty treat falls to the floor. You quickly pick it up, pretend nothing happened, and continue eating. Commonly known as the five-second rule, the notion that it takes time to contaminate food is a bunch of baloney, says food-science professor Paul Dawson. His research discovered that salmonella and other bacteria can survive up to four weeks on dry surfaces and transfer to food immediately upon contact. Dawson concluded from more recent experiments that repeated dunking into a dip or sauce using the same edible vehicle, aka double-dipping, is another routine practice that can spread bugs. Although illness may not result, "it's like you're kissing someone," he explains, "and it's not just a peck on the cheek." *—Catherine Barker*



PHOTOS: REBECCA HALE, NGM STAFF

Sun-Loving Slugs Plants, you aren't so special. That's the message from the marine mollusk *Elysia chlorotica* (right), which not only looks like a leaf but acts like one too. The slug can live on sunlight its entire life, up to a year; all it needs is a little yellow-green algae.

Capturing energy from the sun by photosynthesis is best known as a plant thing. But decades ago marine biologists realized that sea slugs steal cellular bits called chloroplasts from the algae they eat and use them to turn CO_2 into sugar. In 2007 the slugs were shown to incorporate algal genes into their own DNA. This lets them make the plant proteins needed to keep chloroplasts in their cells long-term.

Now University of South Florida biologist Sidney Pierce and colleagues report that the Atlantic-dwelling *E. chlorotica* filches enough plant genetics that it can churn out its own chlorophyll, the pigment that chloroplasts exhaust during photosynthesis. That means the green slug can use the sun to refuel without ever eating again.

Pierce says it's an intriguing evolutionary shortcut: "Movement of genes between species can make big and rapid changes. Evolution doesn't always need to wait for a mutation." *—Jennifer S. Holland*

E. chlorotica's leafy, two-inch-long body lets it efficiently capture sunlight for photosynthesis. The chlorophyll in its cells makes the slug green.

PHOTO: NICHOLAS CURTIS AND RAYMOND MARTINEZ

The spotlight on pomegranates may shift from seeds to rind.

Packing a Punch Pomegranates are famous for their jewel-like seeds, whose rich antioxidant stores may help prevent heart disease and certain types of cancer. But some of their most promising health benefits could dwell within their inedible rinds.

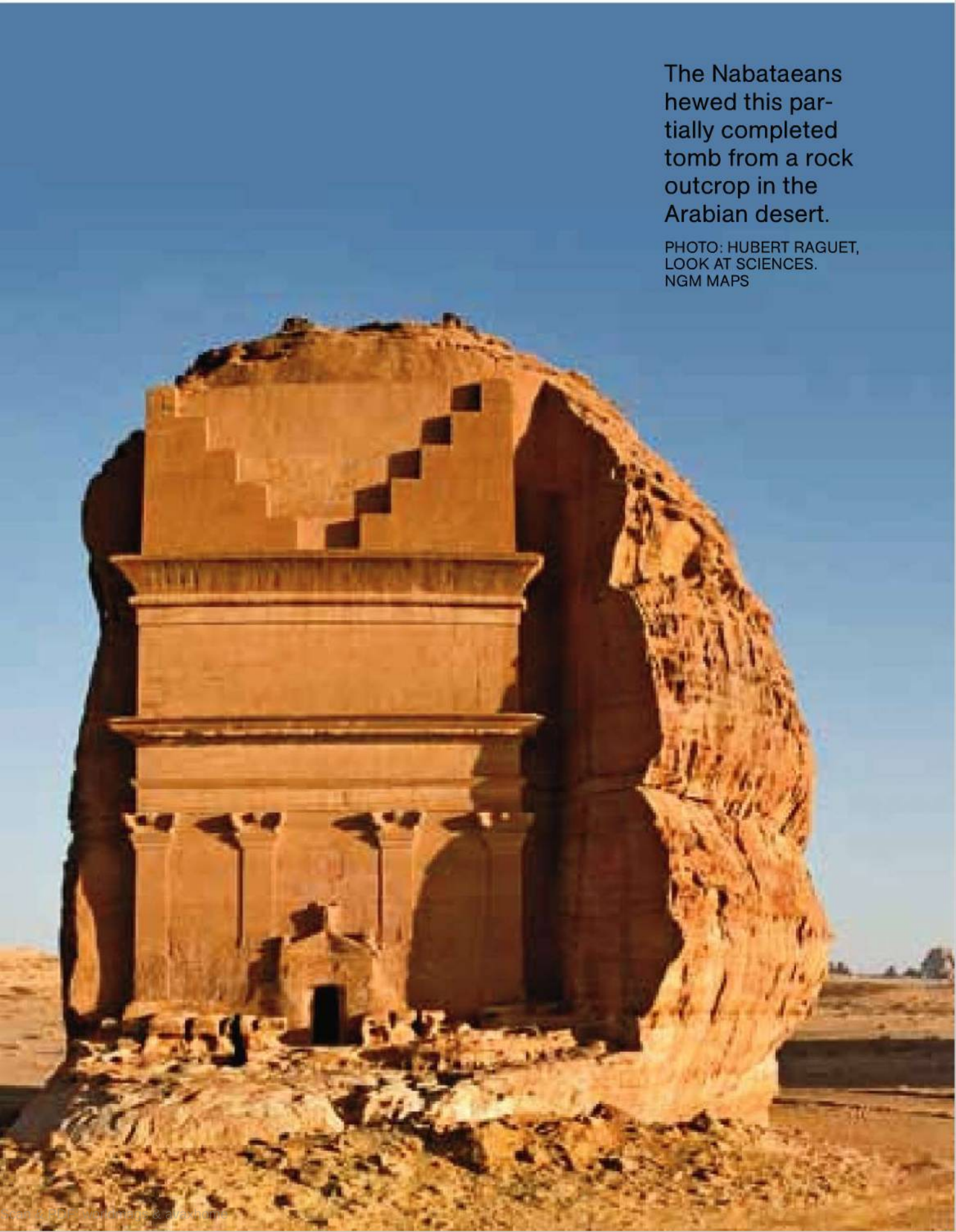
A group of Kingston University researchers in London found that a mixture of pomegranate-rind extract, copper salts, and vitamin C can significantly reduce the growth of some common hospital bacteria. Declan Naughton, head of the study, says the fruit could be a new weapon in the battle against methicillin-resistant *Staphylococcus aureus* (MRSA), which can cause serious skin, blood, and soft-tissue infections. Ironically, the antibiotics used to banish MRSA have spawned even heartier strains—and more people outside of hospitals are catching it.

The high levels of antimicrobials in pomegranate rind that protect the fruit's flesh from harmful bacteria might do the same for humans, says Naughton. An ideal application, with further research, could be an ointment for cuts, abrasions, or surgical wounds. "Once something gets inside your bloodstream, it's difficult to treat," he notes. Another potential benefit: "We don't think it would have major side effects, because we've looked to nature to show the way." *—Cara Birnbaum*

PHOTO: REBECCA HALE, NGM STAFF

At Last, Tomb Tourism Lots of people know of Petra, capital of the long-lost Nabataeans. It's the red sandstone city, carved into Jordan's cliffs, where Indiana Jones found the Holy Grail.

But Hegra, another large city of this ancient civilization of caravan traders, is far less known. Called Al Hijr in Arabic, it is in northwestern present-day Saudi Arabia. Twenty-nine of its 111 monumental tombs have dated inscriptions; most of Petra's are curiously bare. The Hegra carvings allowed archaeologists to date both cities to about 2,000 years ago. Later the Nabataeans vanished into the Roman Empire, and Hegra lapsed into ruin. Locals, believing the pre-Islamic city cursed, long discouraged visitors, as did the restrictive Saudi government. But the Saudis relented, and in 2008 Al Hijr became Saudi Arabia's first UNESCO World Heritage site. Archaeologists are now welcome, and tourists are too. *—Chris Carroll*



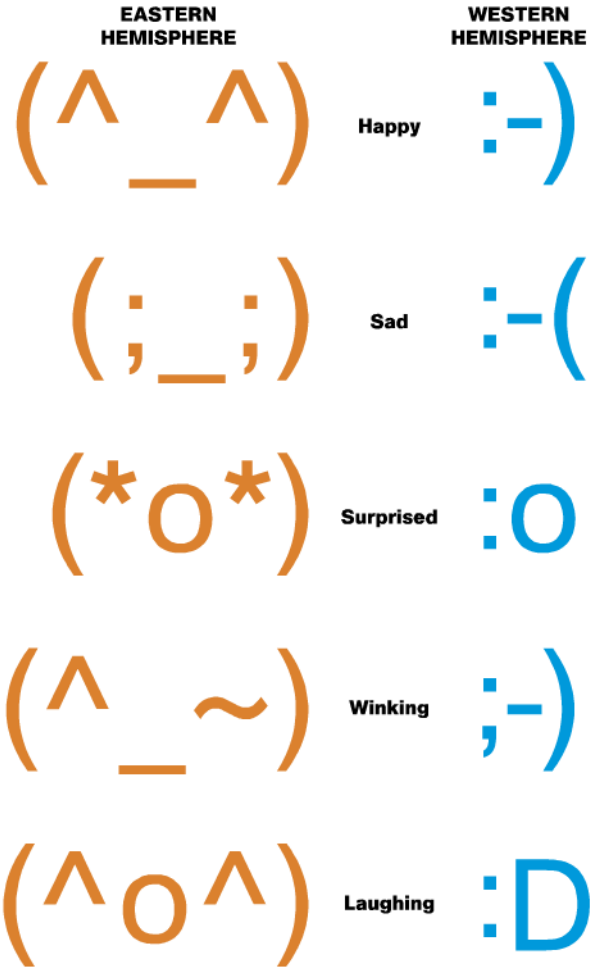
The Nabataeans hewed this partially completed tomb from a rock outcrop in the Arabian desert.

PHOTO: HUBERT RAGUET, LOOK AT SCIENCES. NGM MAPS

Say It With Parentheses Teasing a friend over email? Add a wink at the end by typing ;-). That's an emoticon—a keyboard-made character used to convey feeling.

Ubiquitous today, the cute and clever icons were actually born long before the digital age. In 1881 the American magazine *Puck* ran a piece titled "Typographical Art," in which four facial expressions—melancholy, indifference, astonishment, and joy—were depicted with keystrokes. A century later Carnegie Mellon University professor Scott Fahlman introduced the "smiley" on the school's online message boards as a gentle way to note sarcasm.

The world gets it. In Japan, cell phones have hundreds of emoticons, which Fahlman says with a :-), "are only a modest threat to literacy and civilization in general." —*Catherine Barker*

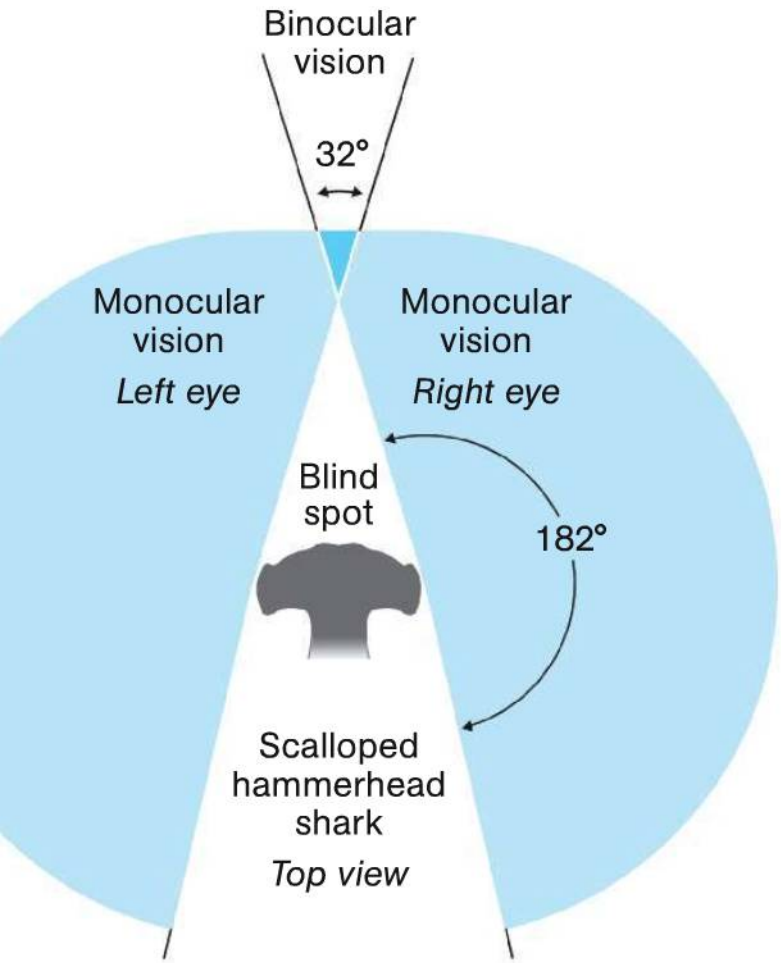


In Eastern emoticons, eyes are the focus. In Western ones, which require a tilt of the head to be read, the mouth is central. Both use QWERTY keys.

A Shark's-eye View Why are hammerhead sharks' eyes so widely separated on their bizarrely shaped heads? Whatever the evolutionary reason for the placement, scientists have debated whether it was to provide good vision.

Florida Atlantic University marine biologist Michelle McComb has settled that vision question by studying three of the eight types of hammerheads. She found that hammerheads see not only directly ahead with binocular vision similar to that of humans; they also see up, down, and behind themselves simultaneously. "Their eyes are canted forward, and that is the key," McComb says. Their eye separation gives hammerheads great binocular vision and depth perception—a bonus when pursuing fast-moving prey.

Although hammerheads do have a particularly big blind spot in front of their widely spaced eyes, other senses compensate for this hole in their visual field. Sensors on the sharks' heads help them detect electrical fields emitted by fish, and the placement of nostrils near their eyes could mean they use what McComb calls "enhanced stereo smell" to monitor the blind spot. *—Jim Dawson*



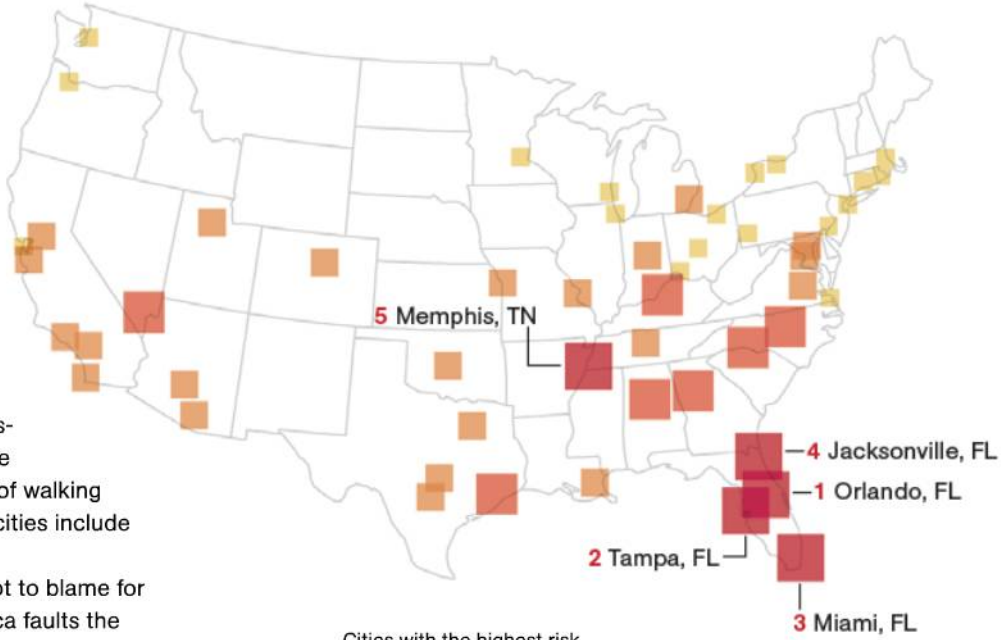
Forward fields of the shark's vision overlap beyond a wedge-shaped blind spot. A great hammerhead shark (below) prowls the waters of the northern Bahamas.

PHOTO: BRIAN SKERRY, NATIONAL GEOGRAPHIC STOCK
GRAPHIC: JOHN TOMANIO, NGM STAFF

Don't Walk in Memphis

The worst city for walkers in the U.S.? Not New York, which ranks among the safest in a 2009 study of pedestrian-unfriendly cities. The four deadliest metropolitan areas are all in Florida: Orlando, Tampa, Miami, and Jacksonville. True, New York has a higher number of fatalities, but with 2.86 deaths per 100,000 people a year, Orlando has a pedestrian fatality rate almost double that of the Big Apple, according to the nonprofit group Transportation for America. When devising its "pedestrian danger index," which measures risk, the organization took into account the amount of walking people do in each location. Other problem cities include Memphis, Houston, and Atlanta.

Florida's abundance of older drivers is not to blame for its dubious status. Transportation for America faults the state's urban sprawl and roads designed to move high volumes of cars as quickly as possible. Still, there's hope for walkers: In Florida and other states the addition of sidewalks, crossing signals, and speed humps has helped lower the number of pedestrian deaths. *—Vikki Valentine*



Cities with the highest risk of fatality to pedestrians often lack sufficient sidewalks and crosswalks.

Pedestrian danger index* (2007-2008) for metropolitan areas of one million people or more

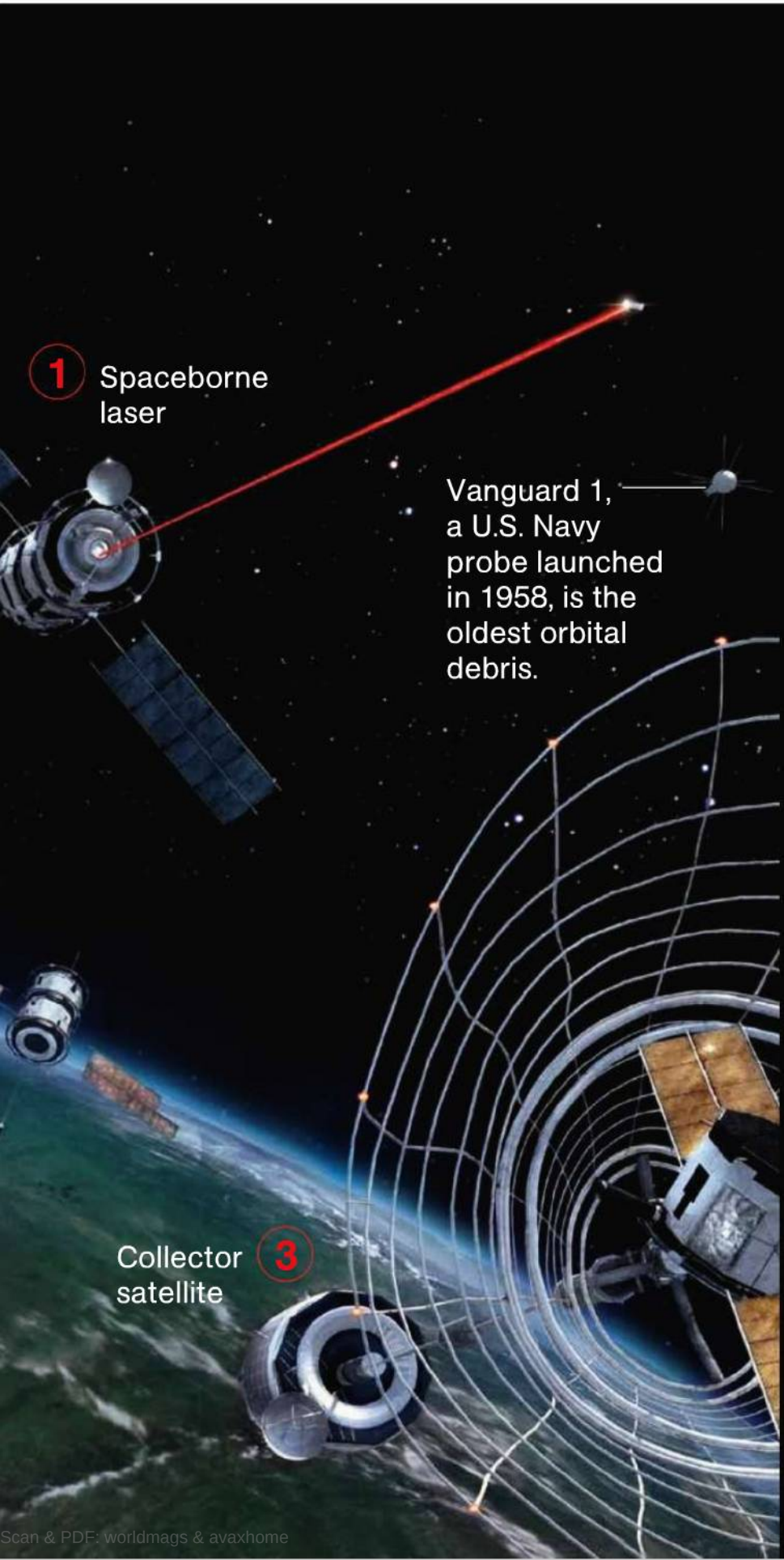
Less risk — More risk

*INDICATES RISK OF FATALITY

NGM MAPS

Clearing Space

The final frontier is littered with dead spacecraft and shrapnel. It's a hypervelocity menace. How can we clean it up?



THREE IDEAS for clearing space of junk—including the debris of two satellites that collided in 2009 (far left)—would speed the rate at which the debris falls into the atmosphere and burns.

1 **Space lasers** could nudge small bits of junk into decaying orbits.

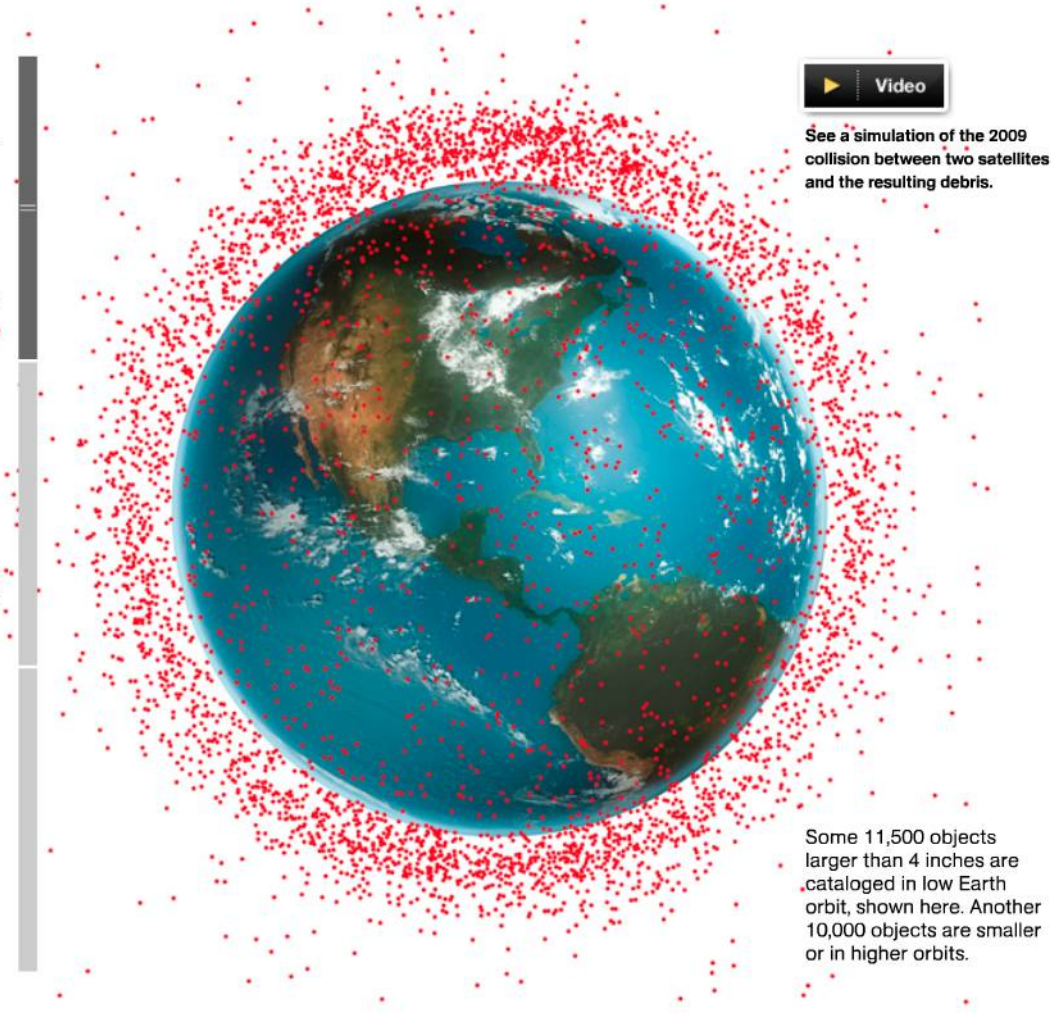
2 **Electric tethers** attached by microrovers could drag space junk down as the current in the tether interacts with Earth's magnetic field.

3 **Collector satellites** could capture large junk in nets and release it into lower orbit, from which it would reenter the atmosphere.

ART: STEFAN MORRELL
SOURCE: NASA ORBITAL DEBRIS PROGRAM OFFICE

Other NASA scientists worry about getting astronauts off the ground or sending interplanetary probes to Pluto. Nicholas Johnson worries about a nightmare scenario called the Kessler syndrome, named for his colleague Donald Kessler, who first described it in the 1970s. The scenario begins in an overcrowded orbit. Two massive pieces of hardware—satellites, say, or spent booster rockets—slam together at more than 20,000 miles an hour, smashing each other into hundreds of pieces. One piece then collides with another spacecraft, creating hundreds more pieces—and so on in a slowly building chain reaction that culminates in a belt of space shrapnel too dense for anything to traverse safely.

Until last year, says Johnson, chief scientist at NASA's Orbital Debris Program Office, "the danger was purely academic." But on February 10, 2009, the world witnessed its first full-blown hypervelocity crack-up. An Iridium communications satellite collided with a defunct Russian satellite 500 miles above Siberia. That one alarming



▶ Video

See a simulation of the 2009 collision between two satellites and the resulting debris.

Some 11,500 objects larger than 4 inches are cataloged in low Earth orbit, shown here. Another 10,000 objects are smaller or in higher orbits.

ART: SEAN M.NAUGHTON, NGM STAFF. SOURCE: NASA ORBITAL DEBRIS PROGRAM OFFICE

THE EVOLUTI

ONARY ROAD

by Jamie Shreeve

The Middle Awash area of Ethiopia is the most persistently occupied place on Earth. Members of our lineage have lived, died, and been buried there for almost six million years. Now their bones are eroding out of the ground. Step by step they record how a primitive, small-brained primate evolved to conquer a planet.

Where better to learn how we became human?

DIGITAL RECONSTRUCTION OF *ARDIPITHECUS RAMIDUS* MODELED IN RESIN. PHOTO: TIM D. WHITE

SCOUTING FOR FOSSILS under the gaze of an Afar tribesman, an international team scours sediments near the Awash River, beyond the trees on the horizon. The area has yielded key specimens illuminating the course of human evolution, including the oldest known skeleton. Called Ardi, the skeleton belongs to the species *Ardipithecus ramidus*.

DAVID L. BRILL

ARDI'S TEETH, some still embedded in her jaws, are more precious than jewels for paleoanthropologist Berhane Asfaw, who cradles them in his hands. The thin enamel, wear patterns, and chemical composition testify to a woodland diet of fruits and nuts.

TIM D. WHITE

ALL ORIGINAL FOSSILS COURTESY
NATIONAL MUSEUM OF ETHIOPIA, ADDIS ABABA

ARDI'S HAND, shown here actual size and recomposed from bones of both her left and right hands, is similar in size to a modern human's, despite her small body size.

PHOTO: TIM D. WHITE

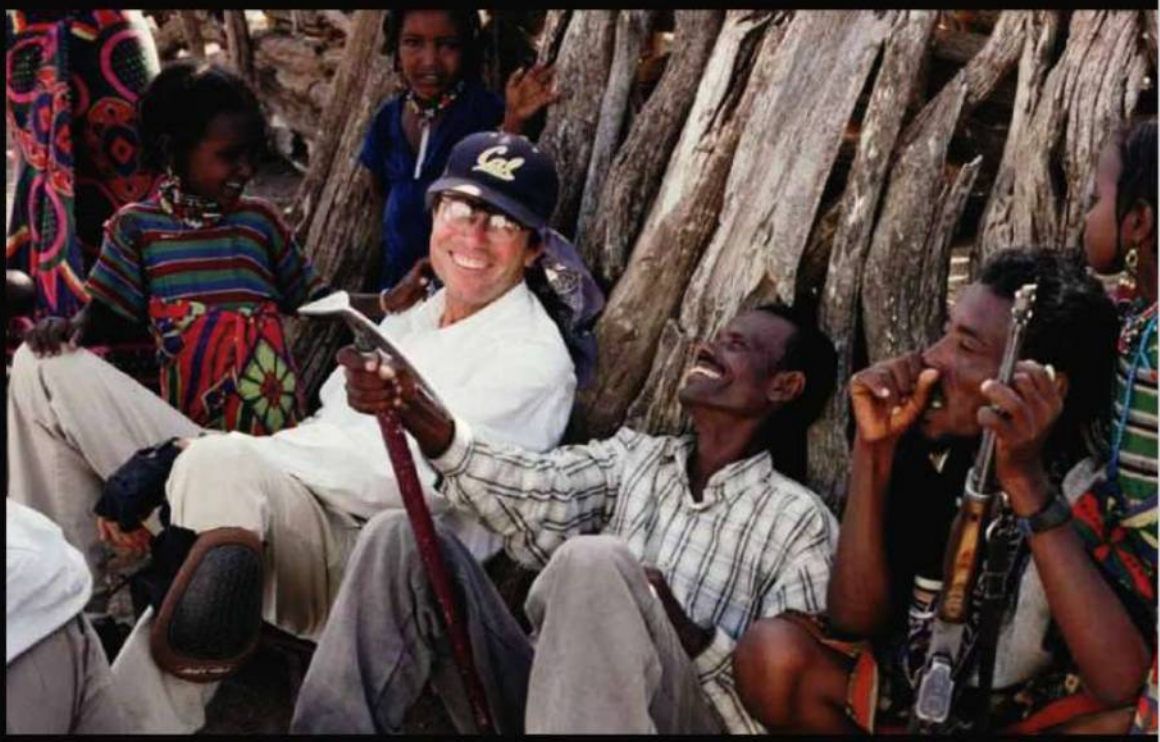
IN THE AFAR DESERT OF ETHIOPIA, THERE ARE A LOT OF WAYS TO DIE. THERE IS DISEASE, OF COURSE. ONE CAN ALSO PERISH FROM WILD ANIMAL ATTACK,

ARDIPITHECUS RAMIDUS

snakebite, falling off a cliff, or in a shoot-out between one of the Afar clans and the Issa people across the Awash River to the east.

But life is fragile all over Africa. What is special here is the occasional durability of the deceased's remains. The Afar Basin sits smack atop a widening rip in the Earth's crust. Over time, volcanoes, earthquakes, and the slow accumulation of sediments have conspired to bury bones and then, much later, disgorge them to the surface as fossils. The process is ongoing. In August 2008 a young boy was taken by a crocodile in Yardi Lake, in an area of the Afar known as the Middle Awash. Three months later, Tim White, a paleoanthropologist at the University of California, Berkeley, stood at the lakeshore near where the child had died. Blanketed by lake sediments, he said, the boy's bones had a decent chance of becoming fossils someday too. "People have been dying out here for millions of years," said White. "Occasionally we get lucky and find what's left."

The Middle Awash research project, which White co-directs with his Ethiopian colleagues Berhane Asfaw and Giday WoldeGabriel, announced its greatest good fortune last October: the discovery, 15 years earlier, of the skeleton of a member of our family that had died 4.4 million years ago at a place called Aramis, less than 20 miles north of today's Yardi Lake. Belonging to the species *Ardipithecus ramidus,* the adult female—"Ardi"



OUR PLAN WAS TO WALK BACKWARD THROUGH TIME, PEELING AWAY THE TRAITS THAT MAKE US HUMAN, TO WHERE WE BEGAN.

SHARED LAUGHS are part of a day's work in the Middle Awash for project co-leader Tim White and Afar clan chief Ahamed Elema (center). In the discovery process co-leaders Berhane Asfaw (bottom) and Giday WoldeGabriel (top, with graduate student Leah Morgan) focus near and far.

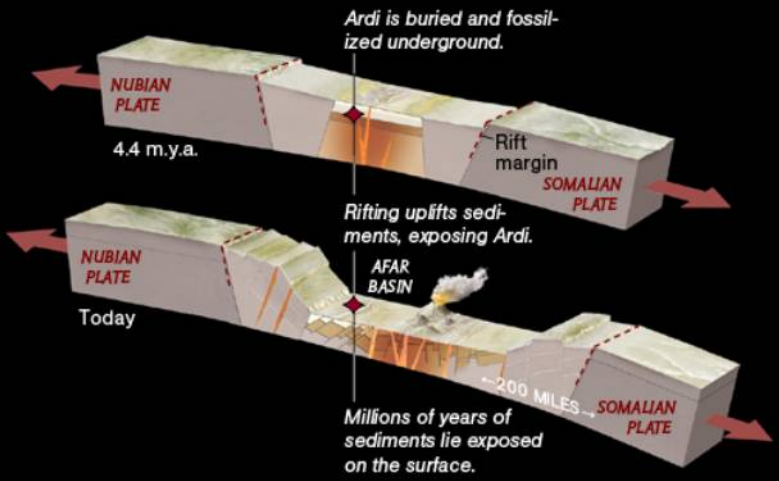
DAVID L. BRILL (ALL)

TIME TRAVEL

The Great Rift Valley of eastern Africa is uniquely suited to create and preserve fossils. Beneath the surface, continental plates are pulling apart (map, right). Millions of years of tectonic activity and sedimentation have buried, preserved, and brought back to the surface the remains of hominids that once inhabited the region. Associated volcanic material can often be dated.

ARDI'S JOURNEY

After Ardi died, her bones were quickly buried. Minerals began to replace organic materials. As rifting continued, the Afar Basin sank and filled with sediments. Faulting, uplifting, and erosion conspired to reexpose her fossilized bones.



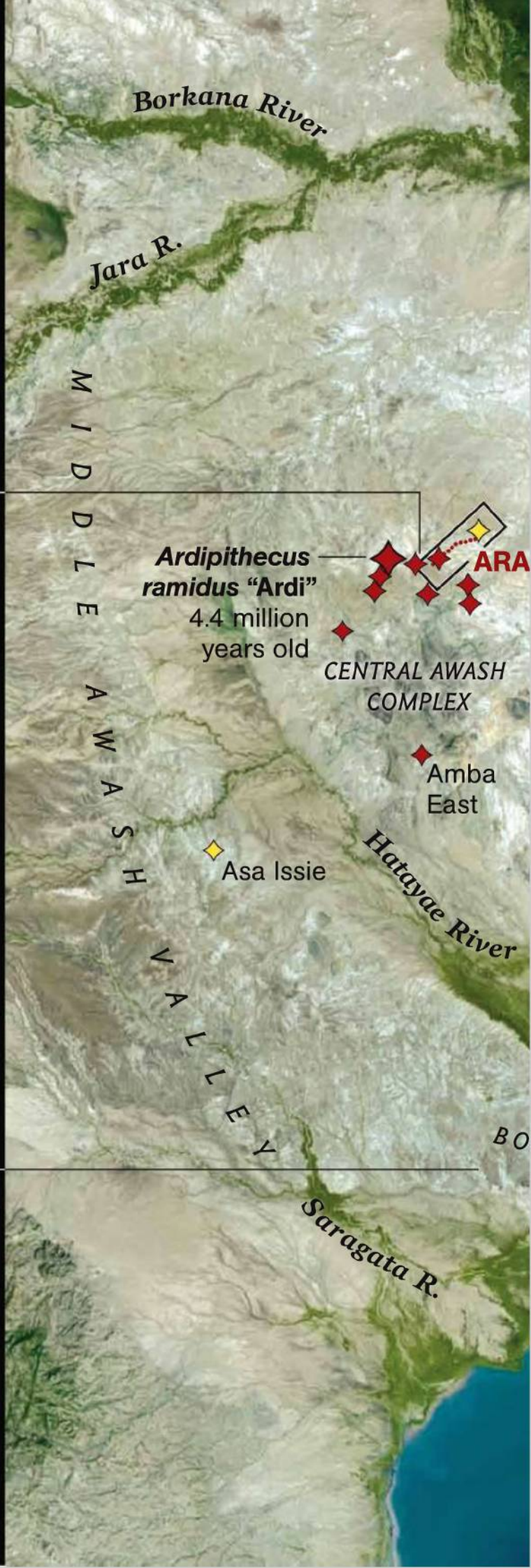
WILLIAM E. McNULTY, NGM STAFF. ART: GARY HINCKS
SOURCES: GIDAY WOLDEGABRIEL, LOS ALAMOS NATIONAL LABORATORY AND TIM D. WHITE, UNIVERSITY OF CALIFORNIA, BERKELEY. SATELLITE IMAGE: NASA/JPL

THE MIDDLE AWASH

The sediment in which Ardi was found is exposed along a five-and-a-half-mile arc that has yielded more than 6,000 vertebrate fossils, including at least 35 other *Ar. ramidus* individuals.

Sediment deposition continues today in lakes and rivers (blue) and floodplains and deltas (green). Bones buried quickly may become the fossils of the future.

Faulting 250,000 years ago lifted up the Bouri Peninsula, forming a natural dam to the ancestral Awash River and creating Yardi Lake.



Select hominid localities

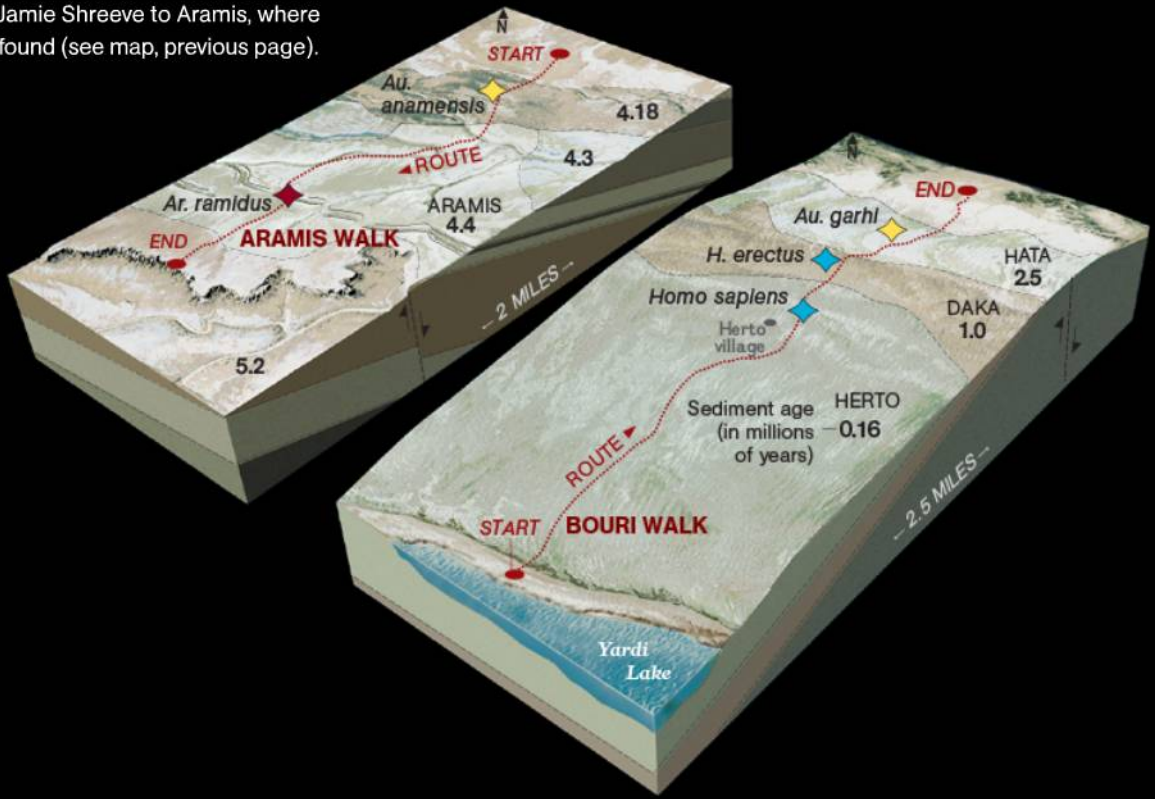
- *Ardipithecus*
- *Australopithecus*
- *Homo*

0 mi 2
0 km 2

Dark gray basalts to the east of the Awash River can be used to date sediments lying beneath them.

AUTHOR'S ROUTE

A two-day hike in the Middle Awash embraced some five million years of time. The first day's walk crossed the Bouri Peninsula. Day two brought author Jamie Shreeve to Aramis, where *Ar. ramidus* was found (see map, previous page).



DUST FLIES as researchers comb a Middle Awash site called Halibee, where fragments of a 100,000-year-old *Homo sapiens* skeleton have turned up. Loose surface material is swept up for sifting in shaker boxes (at rear). Blue flags define the excavation perimeter, while yellow ones mark the location of fossils or stone tools.

TIM D. WHITE

THE FIRST INKLING WAS AN ENIGMATIC MOLAR WITH JUST ENOUGH DETAIL TO REVEAL IT WAS HOMINID.

HUNDREDS OF FRAGMENTS of bone, teeth, wood, seeds, and other biological material are sorted by the research crew on a rainy day. When the ground is muddy and streambeds swollen, the crew can't visit the *Ar. ramidus* sites, so they tend to objects they have collected during surface crawls.

DAVID L. BRILL

RETRIEVED FROM OBLIVION, Ardi's fragmented and crushed skull (left) was too fragile and incomplete to pick apart and reassemble. Instead, Gen Suwa of the University of Tokyo digitally reconstructed a partial skull using micro-computed tomography (CT). From more than 5,000 CT images of the fossils, he pieced together 64 digital fragments. Checking his work against other ancient and modern primates, Suwa rebuilt a virtual skull and made a mirror image of part of the face to create its missing left side (brown section). He assigned colors to the rest of the pieces to differentiate them.

DAVID L. BRILL (LEFT); GEN SUWA

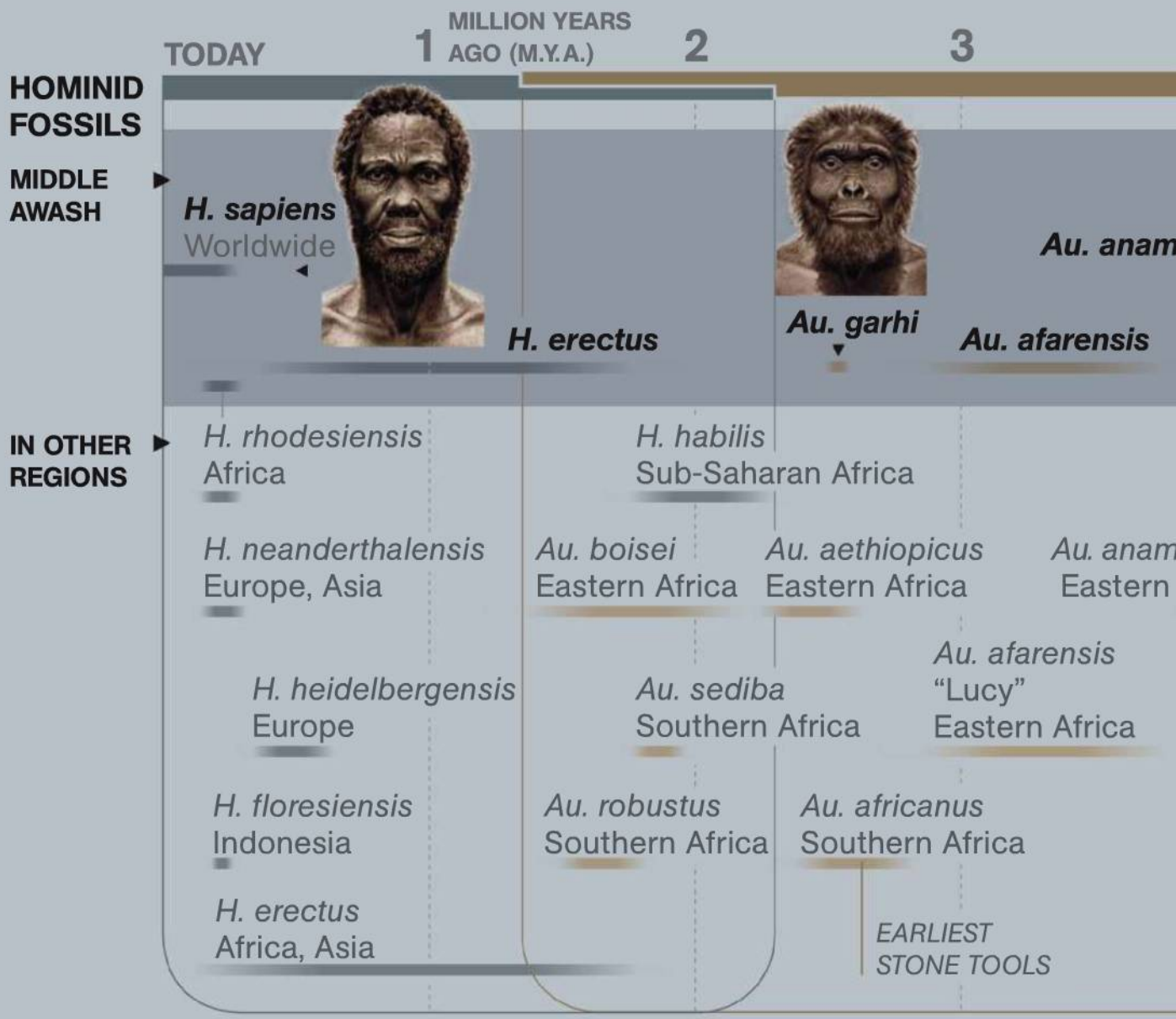
"WE THOUGHT LUCY WAS PRIMITIVE," TIM WHITE SAID. "WE HAD NO IDEA WHAT PRIMITIVE MEANT."

LUCY AND ARDI (right, at left and right, respectively) lived more than a million years apart. With the discovery of Ardi, 3.2-million-year-old fossil Lucy is no longer the oldest hominid skeleton known. Found in 1974 some 40 miles north of the Middle Awash, Lucy's pelvis and limbs testify to a fully bipedal gait—an evolutionary breakthrough Ardi had yet to make.

DAVID L. BRILL (LEFT); TIM D. WHITE

BACK TO THE FIRST ANCESTOR

The record of our lineage in Africa now extends over six million years. The Middle Awash of Ethiopia has yielded fossils of all three major phases in hominid evolution—*Ardipithecus, Australopithecus,* and *Homo.*



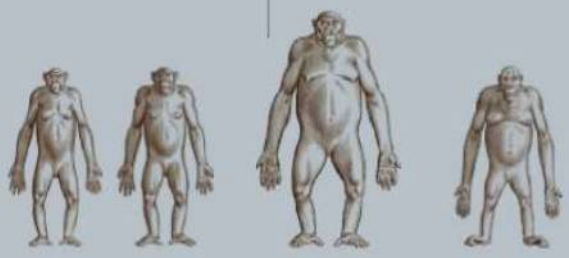
Homo

- Large brain
- Reduced teeth and jaws
- Extensive tool use
- Old World range

Australopithecus

- Striding terrestrial biped
- Large chewing teeth
- Wide environmental niche
- Pan-Africa range

TODAY'S APES*



8-6 M.Y.A.
BONOBOS AND CHIMPANZEES

11-8 M.Y.A.
GORILLAS

20-14 M.Y.A.
ORANGUTANS

DATES OF DIVERGENCE OF HUMANS FROM LIVING APE SPECIES**

4 5 6

ensis

Ar. kadabba

***Ar. ramidus* "Ardi"**

Last common ancestor with chimpanzees

Ar. ramidus
Eastern Africa

ensis
Africa

Sahelanthropus tchadensis
Chad

Orrorin tugenensis
Kenya

*AVERAGE FEMALE BODY SIZE SHOWN.

**RECENT MOLECULAR STUDIES SUPPORT THE MORE RECENT DATES WITHIN EACH RANGE.

Ardipithecus

- Quadruped in trees, biped on ground
- Small canines in both males and females
- Woodland omnivore
- Restricted eastern Africa range

JUAN VELASCO AND LAWSON PARKER, NGM STAFF. ART: © J. H. MATTERNES

SOURCES: TIM D. WHITE, UNIVERSITY OF CALIFORNIA, BERKELEY; GEN SUWA, UNIVERSITY OF TOKYO AND TODD DISOTELL, NEW YORK UNIVERSITY (DIVERGENCE DATES)

160,000 YEARS AGO

Homo sapiens

BOURI-HERTO, ETHIOPIA A large-brained, early *Homo sapiens* skull found in 1997 reveals the imposing face of Herto man.

ART: © J. H. MATTERNES
PHOTO: DAVID L. BRILL

A Sign of Ritual

Altogether, three skulls of early *Homo sapiens* dating to between 160,000 and 154,000 years ago were found near the village of Herto on the Bouri Peninsula. One of a child had been defleshed after death, and may represent a remnant of an early human ritual (artist's conception, left). The polished surface of the child's skull suggests repeated handling: a treasured relic, perhaps, whose meaning we will never know.

Large cleavers such as this one, 7.5 inches long, and other flaked stone tools were used to butcher hippos.

ART: JON FOSTER
PHOTO: DAVID L. BRILL

2.5 MILLION YEARS AGO

Australopithecus garhi

BOURI-HATA, ETHIOPIA *Australopithecus garhi* is the name given a skull found in 1997. It was one of the earliest toolmakers (next page).

ART: © J. H. MATTERNES
PHOTO: DAVID L. BRILL

The Emergence of Tools

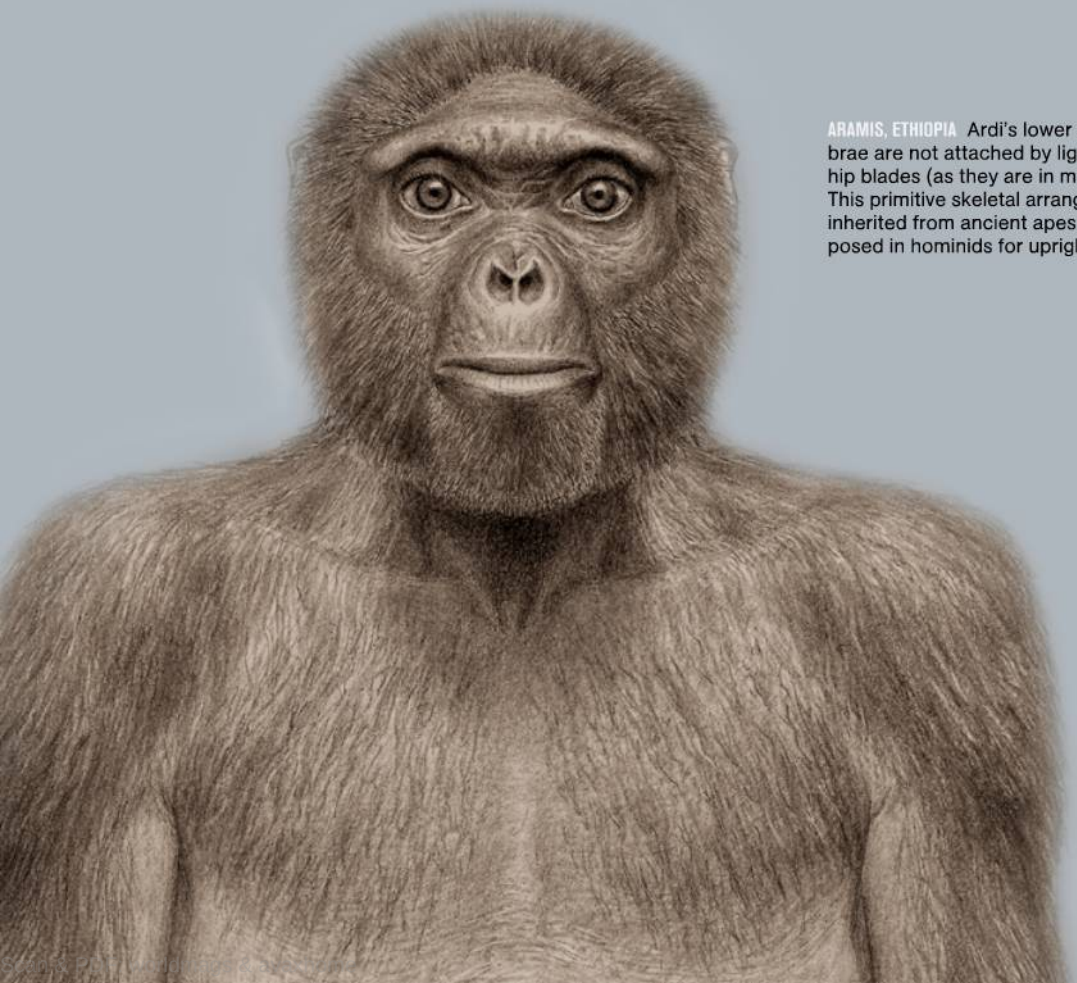
On open ground, our australopithecine ancestors were more likely to be prey for lions and hyenas than competitors for their kills. Then the game changed. Crude stone tools first appear 2.6 million years ago. Some 100,000 years later, hominids on the Bouri Peninsula used tools to scavenge meat and marrow from large mammal carcasses (artist's conception, right). Such high-energy foods would have been the perfect diet for evolving the metabolically expensive bigger brains characteristic of later *Homo.* The scavengers at Hata were only trying to feed themselves and stay alive another day. But up the evolutionary road, this expansion of diet may have had enormous consequences.

Cut marks on an antelope jaw indicate its tongue was sliced out with a sharp stone flake.

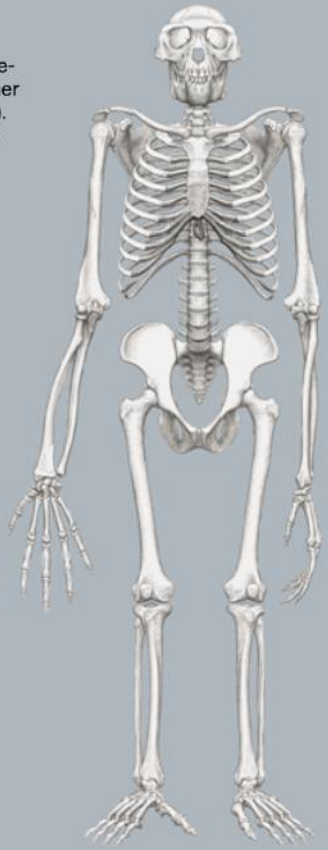
ART: JON FOSTER (RIGHT);
PHOTO: DAVID L. BRILL

4.4 MILLION YEARS AGO

Ardipithecus ramidus



ARAMIS, ETHIOPIA Ardi's lower lumbar vertebrae are not attached by ligaments to her hip blades (as they are in modern apes). This primitive skeletal arrangement was inherited from ancient apes and repurposed in hominids for upright walking.

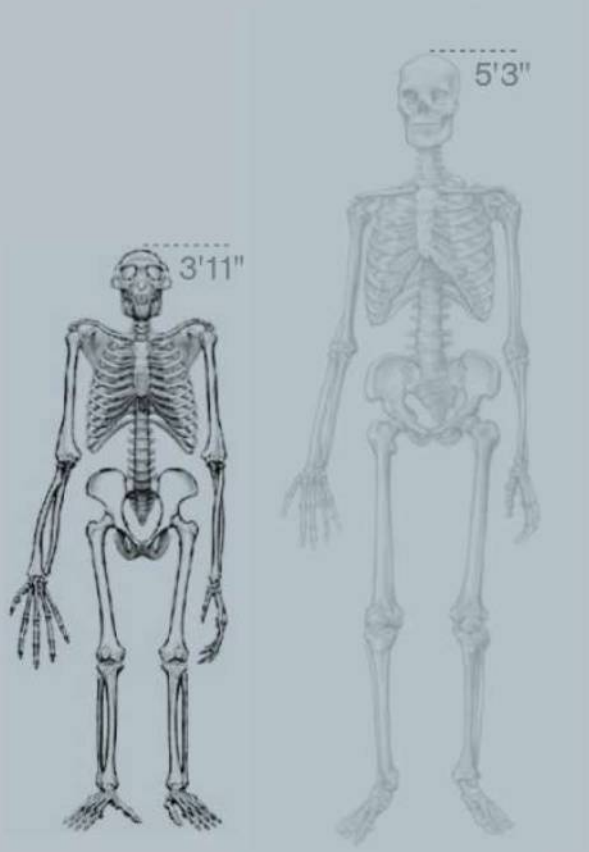


ART: © J. H. MATTERNES

ART: JON FOSTER

The Birth of Bipedalism

An *Ardipithecus ramidus* male (in tree) offers nuts to a female on the ground. The species' versatile skeletal anatomy allowed it to move safely on four legs along branches and on two legs on the ground, albeit ineffectively. A large brain came much later; Ardi had a brain no bigger than a chimp's.



ARDIPITHECUS RAMIDUS female

MODERN *HOMO SAPIENS* female

ART: © J. H. MATTERNES (LEFT); BRUCE MORSER (RIGHT)

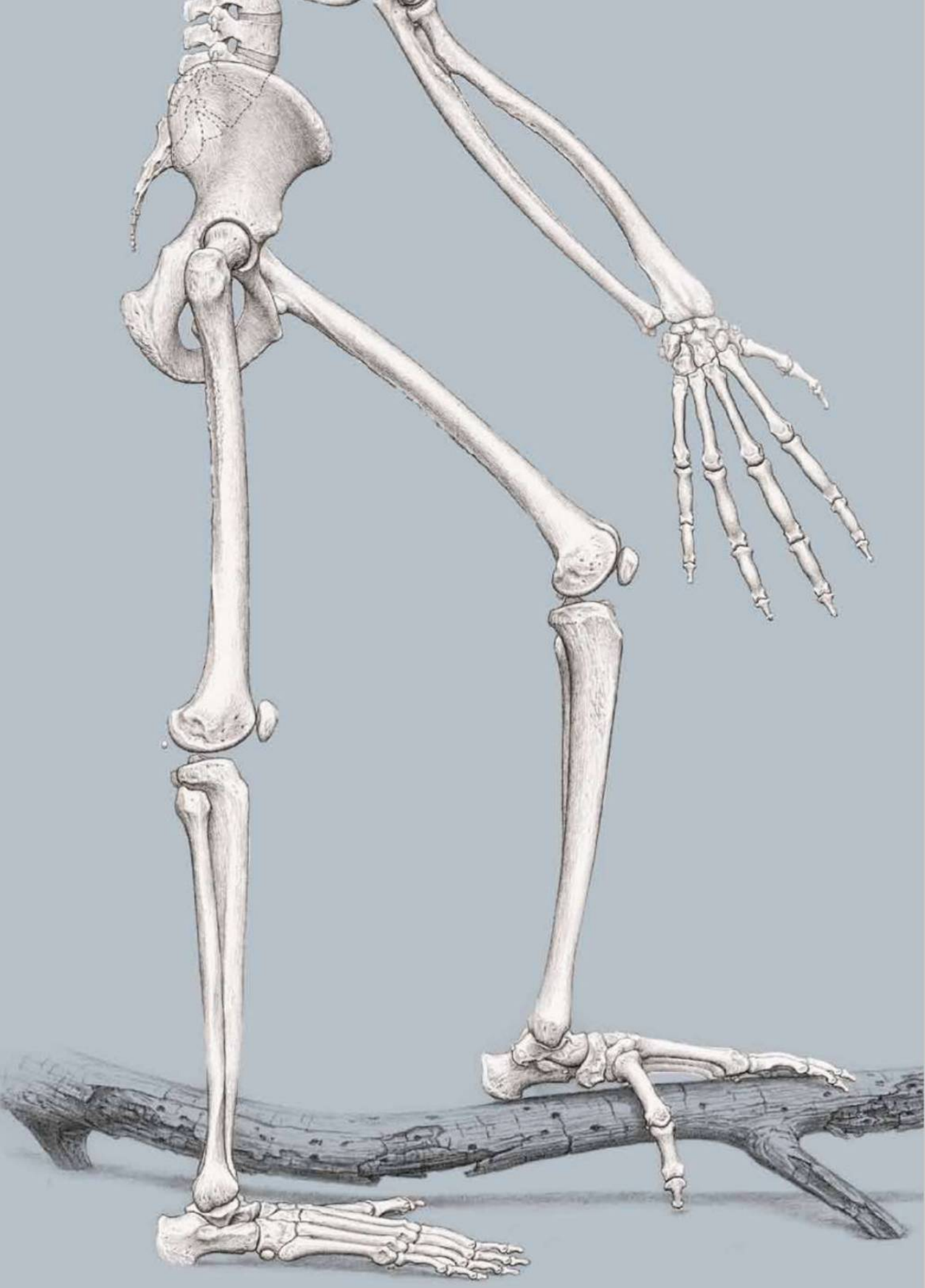
OWEN LOVEJOY'S first glimpse of the female who would preoccupy him for the next 14 years left him cold. It was 1995, and Lovejoy, a comparative anatomist at Kent State University in Ohio, was getting a privileged peek at the freshly excavated skeleton of *Ardipithecus ramidus* in the National Museum of Ethiopia in Addis Ababa. Some of the bones were badly squashed.

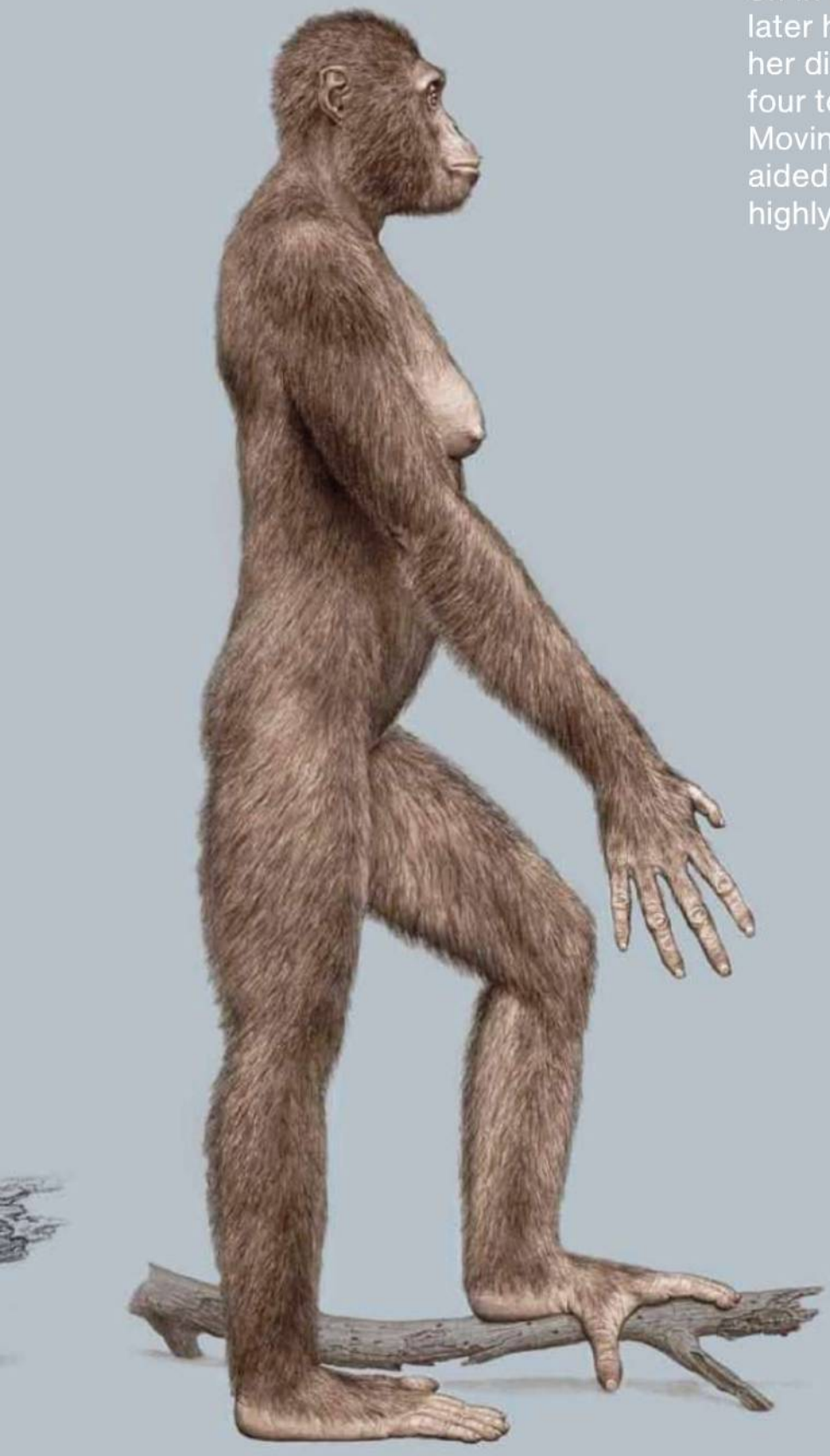
"My first thought was, Why did they bring us over here to look at roadkill?" Lovejoy recalls. "It took about ten minutes to realize that all the important parts were there. My second thought was, Jesus Christ, who could have predicted *this*?"

Over the years, as Ardi's bones were freed from their rock-hard matrix and reconstructed, Lovejoy's astonishment would only grow. It had long been assumed that the further one probed into the human evolutionary past, the more our ancestors would look like our closest living relatives, the chimpanzees. At 4.4 million years, Ardi was over a million years older than the famous Lucy skeleton, which Lovejoy had also analyzed.

Owen Lovejoy (in white shirt) confers with Bruce Latimer about Ardi's pelvis and hips, which would have enabled both bipedal walking and powerful climbing in the trees.

DAVID L. BRILL





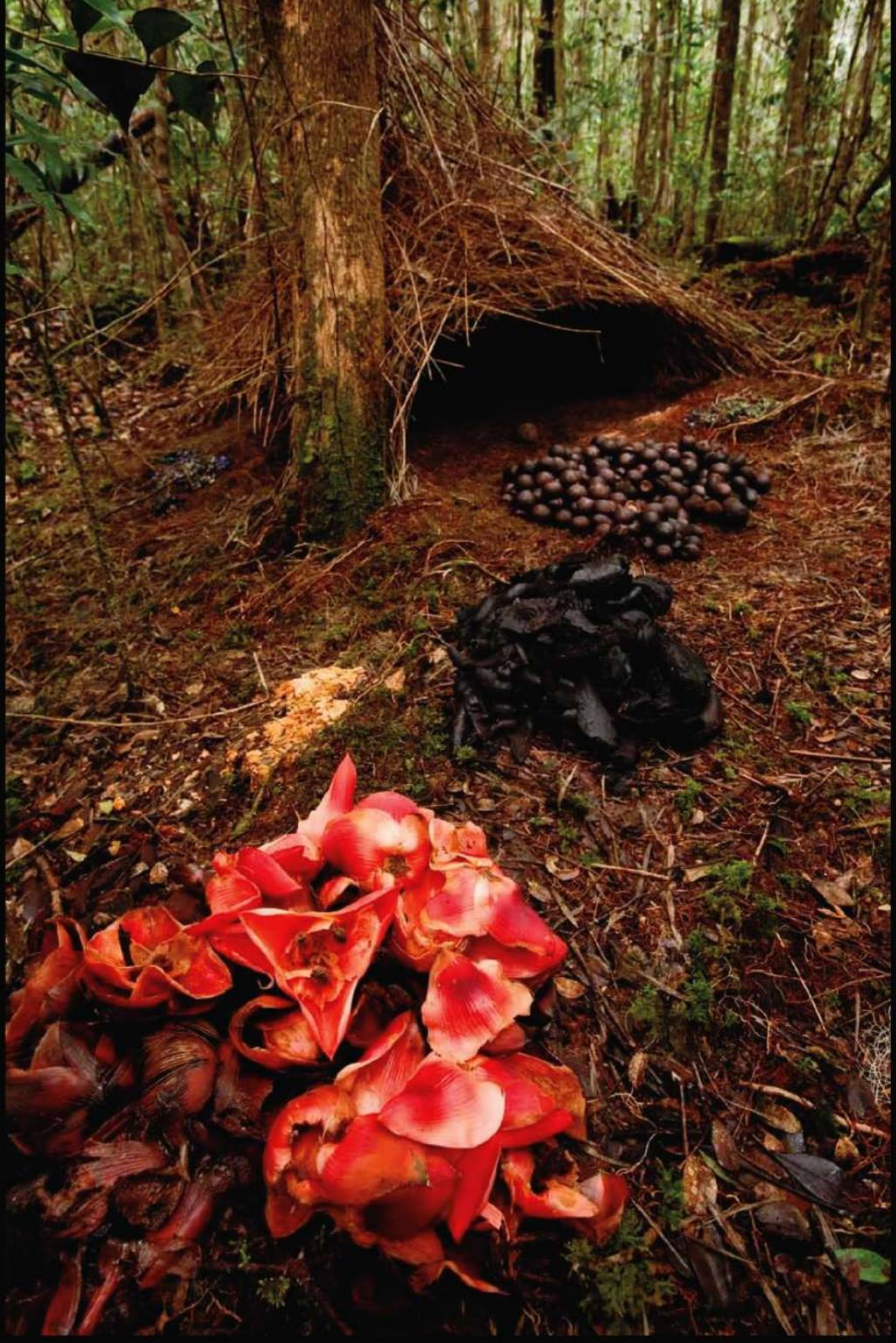
Ardi's foot features an opposable big toe: well suited for grasping branches but a poor arrangement for push off in a bipedal stride, as in later hominids. According to her discoverers, the other four toes carried that load. Moving in the trees was aided by long fingers and highly flexible wrists.

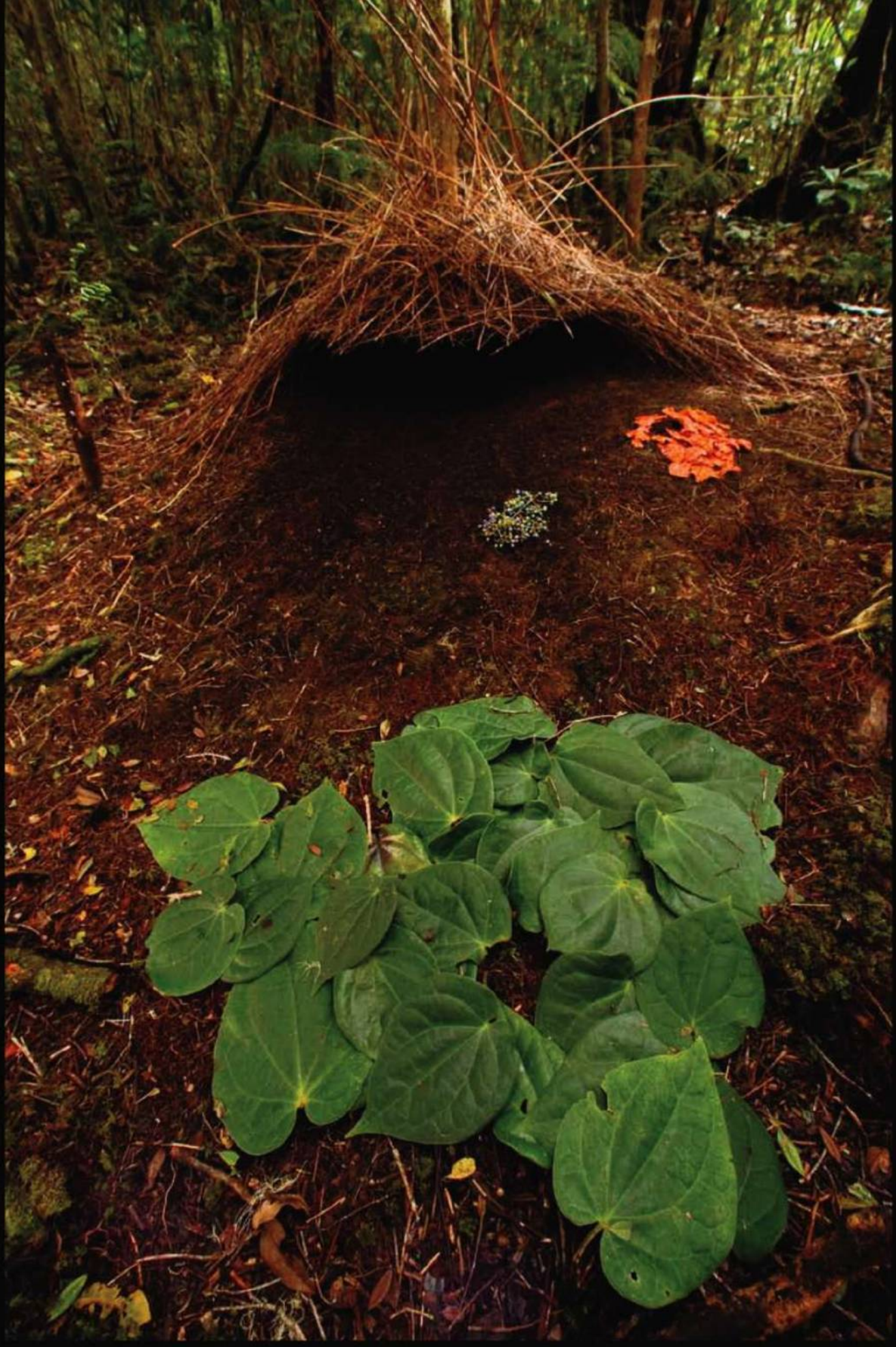
ART: © J. H. MATTERNES

BUILD IT { *and they will come* }

BOWERBIRDS

To win choosy females, male bowerbirds swagger, croon, and … decorate. In some species, only males with the most spectacular lairs, like this Vogelkop on New Guinea, succeed in passing on their genes.





Flowers, black fungi, and leaves are a few of the favorite things of rival Vogelkop males in the same vicinity. In bower decor, the Vogelkop expresses individual variation more than any other species. *AMBLYORNIS INORNATUS*

Two more Vogelkop male competitors make boldly different statements, one with a patio of acorns, the other with a vibrant garden of soda cans and trash. Nature-made items are common but not required. *AMBLYORNIS INORNATUS*

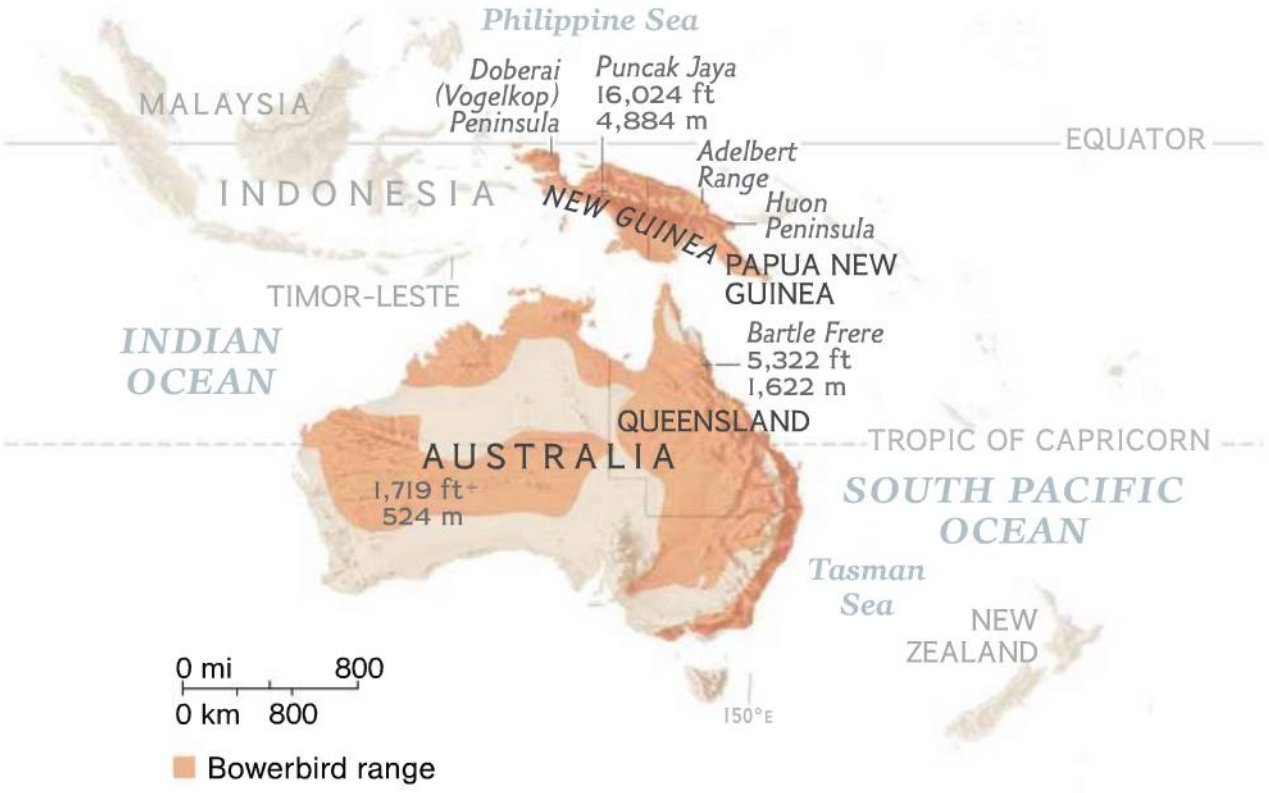
BY VIRGINIA MORELL
PHOTOGRAPHS BY TIM LAMAN

Master engineers, Macgregor's bowerbirds in New Guinea may spend weeks erecting, and years perfecting, a "maypole" bower up to seven feet high atop a ring of moss (above). A subspecies on the Huon Peninsula (right) adds white flowers to the base of its maypole for contrast and extra flair.
AMBLYORNIS MACGREGORIAE

DONALD *has the tallest tower in the forest.*

It isn't as grand as the other Donald's Trump Tower, but it is impressive nevertheless, built with the one tool at his disposal: his beak. Donald, a Macgregor's bowerbird, lives in the dark woods of the Adelbert Range of Papua New Guinea. Here, atop a mossy plat form and around a young sapling, he has woven his spire of sticks and twigs. At its base he has stacked piles of nuts, beetles, and cream-colored fungi; from its lower branches he has strung garlands of caterpil lar feces glistening with dew. Thus ornamented, his tower soars more than three feet above the forest floor, pointing skyward like a beacon. Donald perches on a nearby tree and aims his beak in the same direction. *Rat-a-tat-tat,* he calls into the air. *Rat-a-tat-tat.*

All of this—the elaborate tower, pretty offerings, and strident calls—have one purpose: to convince fe male Macgregor's bowerbirds that he, Donald, and not the guy down the way, is the best male in the neigh borhood, the one the gals should choose as a mate. Is Donald's fancy tower up to the task?



The 20 known species of bowerbirds, in the family Ptilonorhynchidae, have adapted to habitats from rain forest to mangrove swamp, and altitudes from sea level to 12,000 feet.

NGM MAPS
SOURCE: CLIFFORD AND DAWN FRITH

Not even the prettiest pink offering (right) guarantees the prize. Though males seem to do all the right things, females sometimes simply fly away.

CHLAMYDERA NUCHALIS

The gunk on the satin bowerbird's beak is plant matter, which he mashed up to paint his bower's inner sanctum in a rain forest in Queensland, Australia. The pulp adds a hint of color and perhaps flavor: Females sometimes take a taste during the male's display. *PTILONORHYNCHUS VIOLACEUS MINOR*

Video

See more amazing courtship behavior.

Flaunting an insect in his beak, a satin bowerbird makes noise, flaps his wings, and dances for the female sizing him up in the avenue of his bower. If the wooing works, he'll swoop to the rear and mate with her—a male's sole contribution to family. *PTILONORHYNCHUS VIOLACEUS MINOR*

Not every bower is a palace. A leaf-strewn court, meticulously created by a tooth-billed bowerbird in Australia, may represent an ancestral type from which the more elaborate maypole and avenue styles evolved. *SCENOPOEETES DENTIROSTRIS*

Like all bowers, a great bowerbird's twiggy avenue is used only for courtship and not as a nest. The outer pile of stones is the stage for his theatrics once an admirer is lured within.
CHLAMYDERA NUCHALIS

What turns on female great bowerbirds in a Queensland park? Big piles of stuff, some man-made bits like plastic toys, and a gray-green palette. A male's welcome mat may display thousands of items—found, filched, or inherited from a previous occupant. *CHLAMYDERA NUCHALIS*

Heightened security during Friday prayers means armed guards stand watch at Lahore's Badshahi Mosque. Completed in 1674, it can welcome 100,000 worshippers.

Pakistan's Heartland Under Threat

WEST MEETS EAST IN PROSPEROUS, POPULOUS PUNJAB. BUT THE TALIBAN WANTS TO CHANGE THE STATUS QUO.

FREE MEALS and lodging are provided by this madrassa in Gujranwala in northeastern Punjab. As in many such schools, the leaders are sympathetic to the Taliban and have resisted government pressure to modernize.

IDOL WORSHIP is what extremists call it. But Sufis call it love. Here in the town of Mithankot, women share a mystical moment at the shrine of Khwaja Ghulam Farid, a revered 19th-century poet they consider a saint.

A MASKED INTERPRETER shares checkpoint duty in a Pashtu-speaking region where the Punjabi-dominated army is not always welcome. The interpreter, a local man, fears Taliban retribution if he is seen helping the troops.

RELICS OF THE BRITISH EMPIRE include this clock tower in the southern city of Multan, accented with cupolas and keyhole arches borrowed from native styles. Multan is also known for its many Sufi shrines, like the 14th-century, white-domed tomb in the background.

BY JOHN LANCASTER
PHOTOGRAPHS BY ED KASHI

The Taliban would not be amused. On a sunny winter afternoon in Lahore, the local culturati have turned out in force for the annual show at the National College of Arts. In the main courtyard young men and women mingle easily, smoking and sipping from cans of Red Bull. Some of the men sport ponytails, and one has a pierced eyebrow.

Nearby is a life-size sculpture of a couple holding hands on a swing. Inside, the image of a male torso, viewed from one angle, morphs into a female breast. Yet there is no mistaking the stamp of the subcontinent. Women wear traditional thigh-length tunics over their jeans, and some cover their hair. There are also miniature paintings, which traditionally might capture a hunting scene; here they portray other scenes, as in one bold depiction of a bearded cleric reclining on a couch in front of a bombed-out school.

The jumble of styles and influences—the stew of peoples and faiths Rudyard Kipling captured so vividly in his novel *Kim*—is a hallmark of Lahore, Pakistan's second largest city and capital of Punjab Province. The

BOLD LIPSTICK and bawdy dancing are the trademarks of Nida Chaudhry, who performs to packed houses at Lahore's Al Falah theater. "Whatever we do is the demand of the public," she says. "We ourselves are all Muslims."

Join photographer Ed Kashi on assignment in Pakistan.

Punjab was the richest prize, and the largest share was amid a spasm of

and most bitterly contested awarded to Pakistan communal bloodletting.

LAND OF FIVE RIVERS

It's no accident that Punjab is the richest, most populous, and politically important province in Pakistan. Conquerors have long coveted the region for its fertile soil, abundant water, and trading routes between Central Asia and the Indian subcontinent. Foreign influence contributed to a diverse, fundamentally tolerant culture that today is reflected in the pervasiveness of Sufism. But encroachments by the Taliban are testing Punjab's civility and openness.

To view detailed map, scroll to the next page.

PUNJABI TALIBAN
Punjab's militants traditionally have focused on India, although some have joined the Pakistani Taliban in waging war against their own government.

PUNJAB, INDIA
Pakistan got the largest share of Punjab when the subcontinent was divided in 1947. Indian Punjab, however, still has much in common with its neighbor, including their languages.

IRRIGATION
Punjab's economy rests heavily on its irrigation system—more than 19,000 miles of canals. Most were built under British rule.

VICKIE TAYLOR, INTERNATIONAL MAPPING. JEROME N. COOKSON AND MARGUERITE B. HUNSIKER, NGM STAFF. RELIEF BY TIBOR G. TÓTH. IRRIGATED CROPLAND SOURCE: EUROPEAN SPACE AGENCY, ESA GLOBCOVER PROJECT LED BY MEDIAS-FRANCE

A ROCKY STREAM is no barrier in this remote tribal region of southwestern Punjab, where the people are as rugged as the land. Culturally more in tune with nearby Balochistan, they speak their own dialect and do not consider themselves Punjabi.

MORNING HAZE hangs over the fields as boys frolic outside their school in the village of Pipli in central Punjab, an area where the Taliban has few friends. "They are the enemies of our children," an elderly farmer says.

LEANING INTO HIS OARS, a youthful fisherman navigates the sluggish waters of the Ravi River near Lahore. The river feeds into a 19,000-mile canal network that is one of the world's largest. Massive headworks regulate the flow.

DANCING HORSES are trained by Faizal Abbas, a feudal landlord who pursues the hobby at his compound near Multan.

LIFE IS HARD for many Punjabis. On a policeman's land in Goraya, villagers thresh rice in exchange for a share of the crop.

TEN-GALLON HATS, waiters who slam drinks on tables, and Beyoncé videos set the tone at Gunsmoke, a cowboy-themed steak house that is one of the more conspicuous examples of Western influence in Lahore. Religious conservatism hasn't dimmed its popularity.

HIS BACK BLOODIED, a Shiite man in Lahore whips himself with blades in a ritual that symbolizes the suffering of Muhammad's grandson Husayn—and the Shiites' collective guilt at not having come to his aid.

A QUIET INTERLUDE between prayers is the best time to savor the majesty of the Badshahi Mosque. Its marble domes and graceful minarets rise above Lahore's Old City, evoking the glories of Punjab's imperial past.

A SEA OF DUNES

Conjured by wind and water, a magical sandscape on the no coast of Brazil is no mirage.

rtheastern

In a land still soaked from the rainy season, water plants float on swimming stems in a temporary pond.

A river stained with tannin from a nearby forest flows through the dunes.

BY RONALDO RIBEIRO

PHOTOGRAPHS BY GEORGE STEINMETZ

Seen from the air, the dunes look like white linens hung out to dry on a windy afternoon. In fact, the name of this place, Lençóis Maranhenses, means the "bedsheets of Maranhão," the state in Brazil on the tropical northeastern coast where the half-moon-shaped dunes are found. By any name it is a magical desert, with wave after wave of shimmering white sand. Shoals of silvery fish swim in brilliant blue and green pools left behind by the rains. Shepherds lead caravans of goats over towering dunes. And fishermen head out to sea, guided only by the stars and the ghosts of old shipwrecks.

"It feels like a parallel world," says Carolina Alvite, former director of the 600-square-mile national park created three decades ago to protect this unlikely ecosystem. It's as if the sea near the Bahamas suddenly appeared like a mirage in the middle of the Sahara.

Only in this desert the mirage is real.

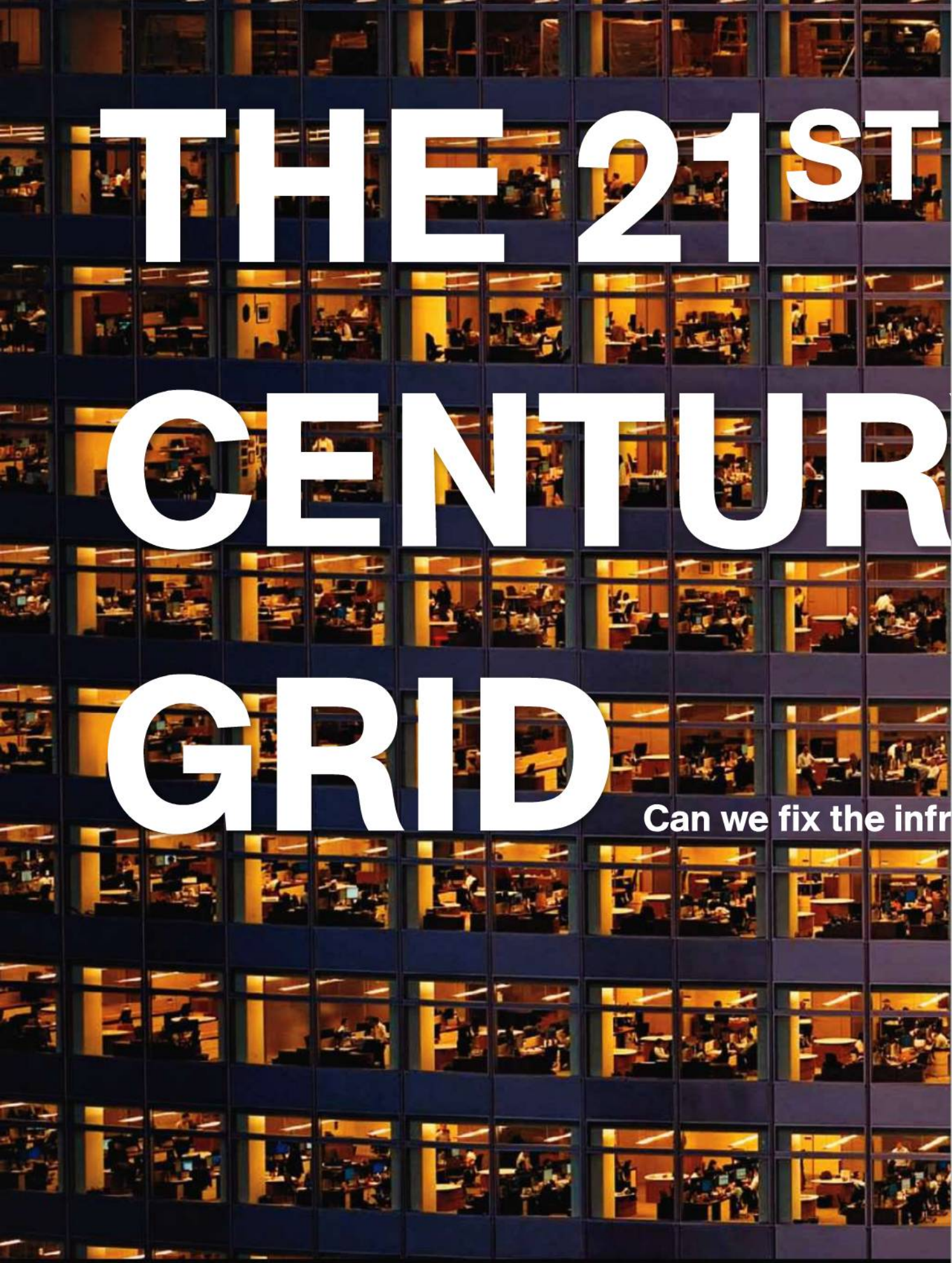
Actually, by the most technical of standards, the Lençóis isn't really a desert, says Antonio Cordeiro Feitosa, a

NGM MAPS. SATELLITE IMAGE: NASA

The park's dazzling sands stretch some 44 miles along Brazil's northeastern coast.

Raised by residents of the park, goats graze freely on wild vegetation during the lush months of rain, then are rounded up when the dry season arrives.

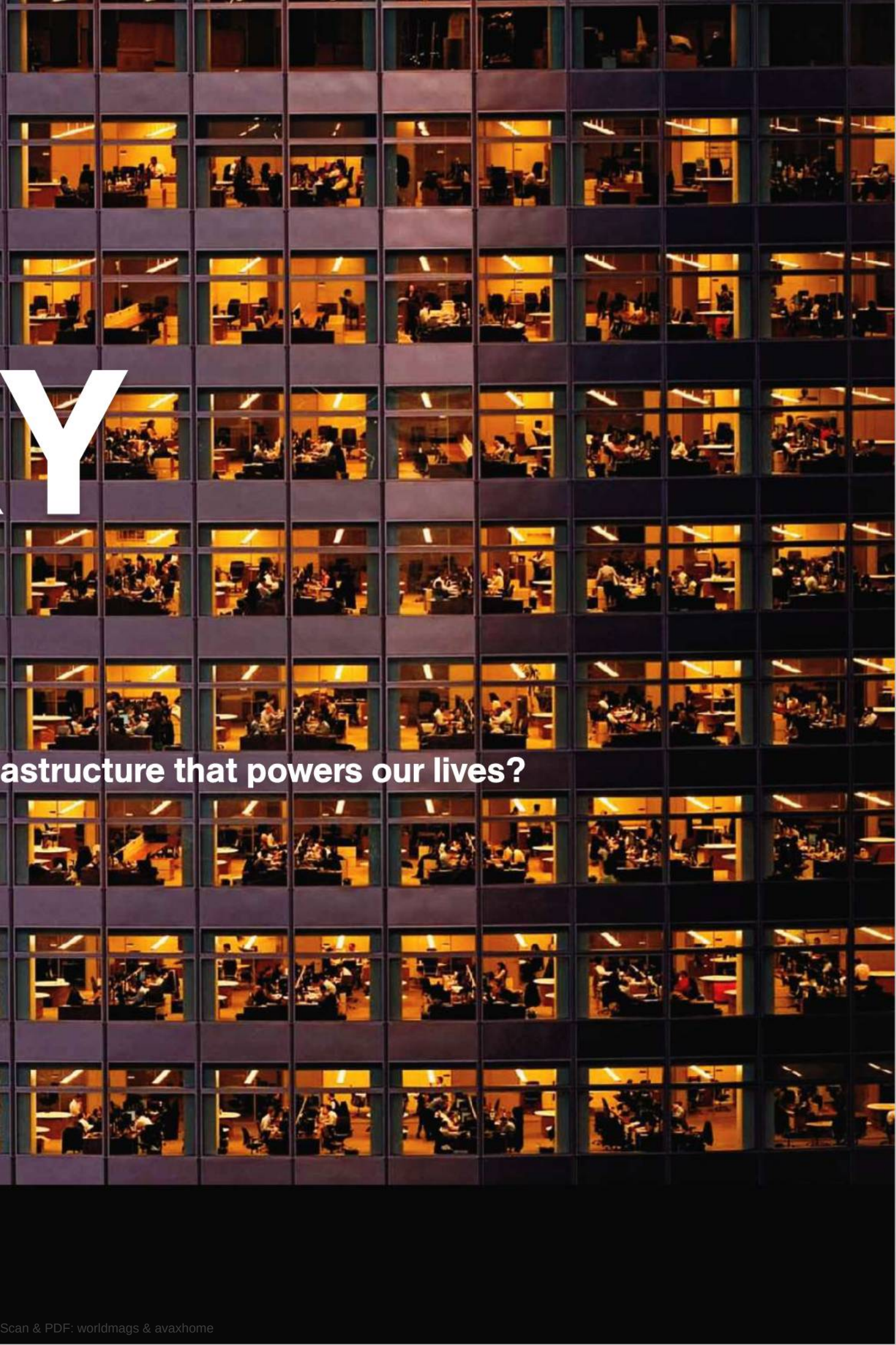
Waves of sand, firmed by an overnight rain, flow along the route of a fisherman pedaling his catch at dawn to trade it for supplies. When the dune dries in a day or so, the wind will begin to reshape it once again.



THE 21ST CENTUR GRID

Can we fix the infr

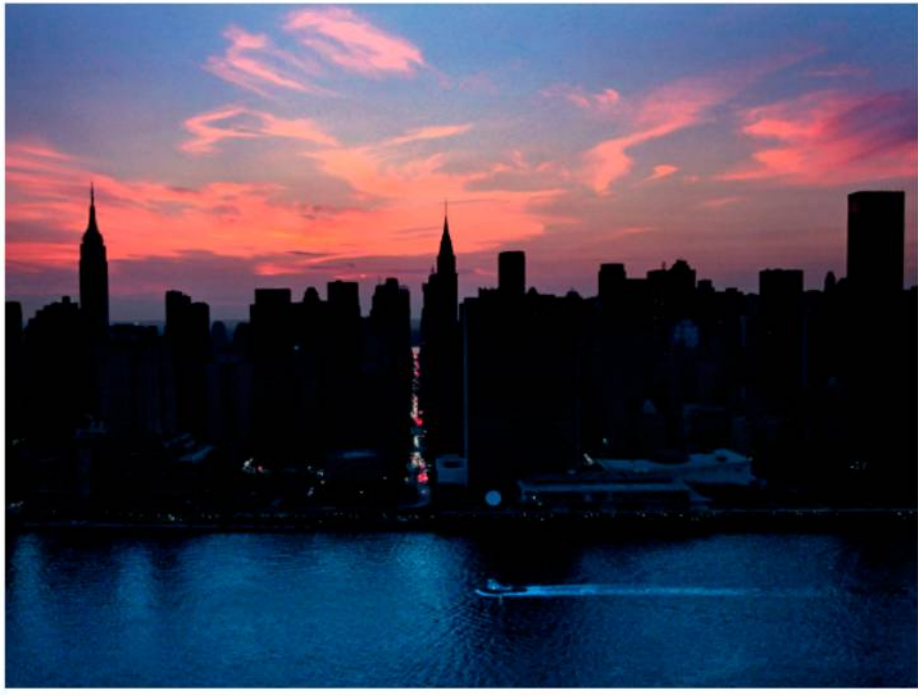
As daylight fades, Manhattan continues to gorge on power. New York City is tied to fuels like natural gas, with less than one percent of its electricity coming from wind or solar.



Helicopter drop-ins were the only way to build much of a new transmission line through southern California's Angeles National Forest. It will bring wind power to as many as three million homes.

BY JOEL ACHENBACH

PHOTOGRAPHS BY JOE McNALLY



The brains of the electrical grid, control centers match supply and demand to avoid a repeat of disasters like the 2003 blackout that struck New York and much of the Northeast.

WE ARE CREATURES OF THE GRID. We are embedded in it and empowered by it. The sun used to govern our lives, but now, thanks to the grid, darkness falls at our convenience. During the Depression, when power lines first electrified rural America, a farmer in Tennessee rose in church one Sunday and said—power companies love this story—"The greatest thing on earth is to have the love of God in your heart, and the next greatest thing is to have electricity in your house." He was talking about a few lightbulbs and maybe a radio. He had no idea.

Juice from the grid now penetrates every corner of our lives, and we pay no more attention to it than to the oxygen in the air. Until something goes wrong, that is, and we're suddenly in the dark, fumbling for flashlights and candles, worrying about the frozen food in what used to be called (in pre-grid days) the icebox. Or until the

On a windy day each of these turbines near Abilene, Texas, can power more than 500 homes. A transformer at the base of each 260-foot-tall tower feeds power to a substation and the grid.

From PlayStations to iMacs, the small electronic devices that appeal to Corbin Stafford (at right) and Aaron Bear Paul, of Boulder, Colorado, have a big impact. Worldwide they account for about 15 percent of residential electricity consumption.

In Pennsylvania, PJM Interconnection, a large regional operator, is replacing its old control room with two new ones—a safeguard against an emergency.

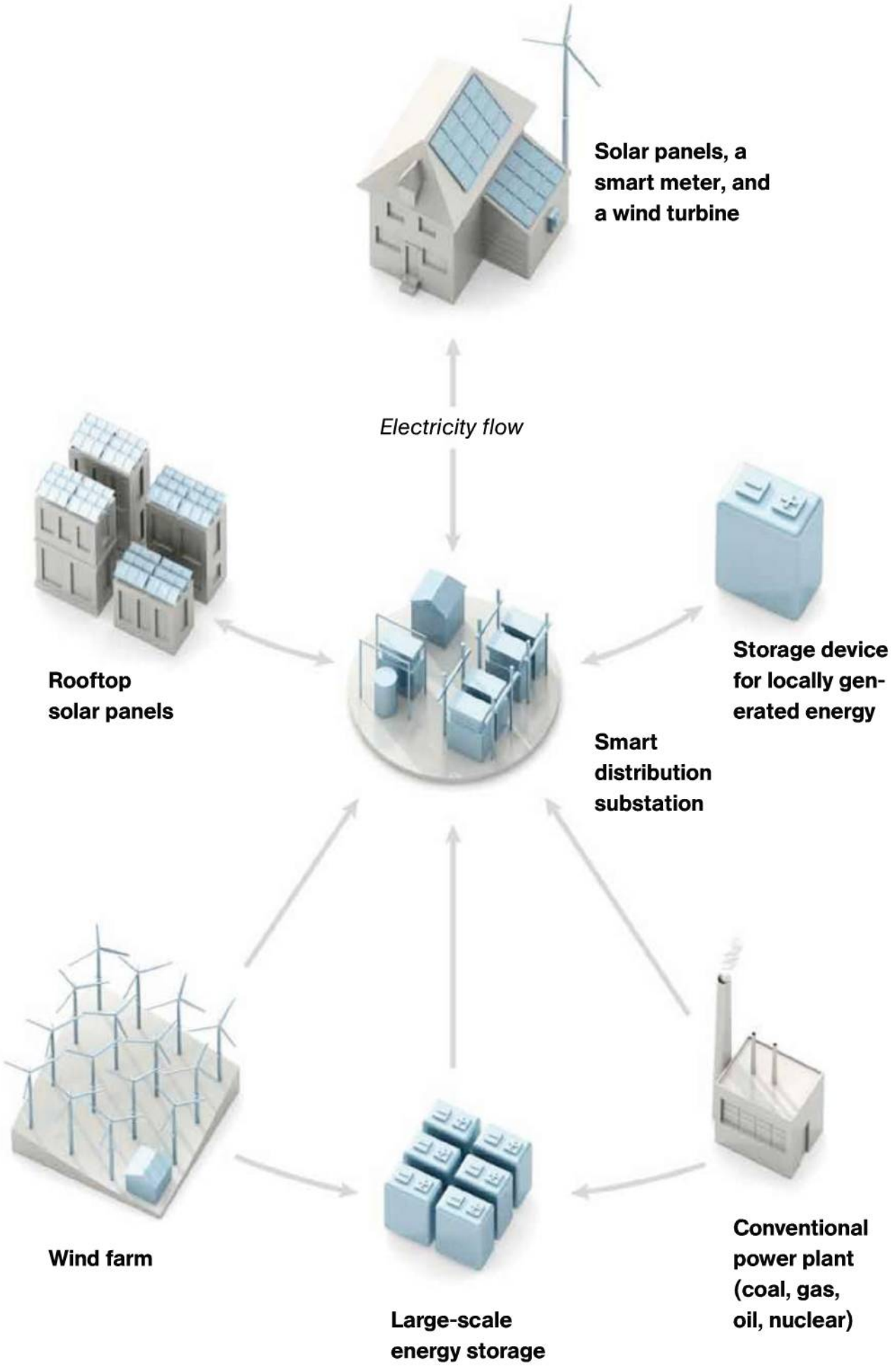
A GRID THAT WORKS BOTH WAYS

A smart grid will change how the average homeowner thinks about electricity by constantly sharing usage data with the power company, which juggles supply (and pricing) accordingly. Consumers are rewarded for not hogging energy at times of peak demand; utilities benefit because power usage is more predictable and they learn immediately of any outages. Other improvements will make it easier to incorporate intermittent renewable energy sources such as wind and solar.

At Home
Smart meters allow consumers to program their appliances to run (or their electric cars to charge) at off-peak hours, when electricity is cheap. Customers who generate energy on a small scale, say from a wind turbine or solar panels, can sell it back to the grid.

Locally
Using data transmitted from homes and offices, utilities can monitor electricity use and tweak the flow—adjusting thermostats, for instance, to flatten spikes in demand. Renewable energy generated locally can be distributed locally, with any surplus diverted into storage.

Regionally
To supplement fossil fuel plants, long-distance transmission lines are starting to stretch out from remote areas such as the Mojave Desert, which has plenty of sun and wind. New technology built into the grid will help by storing power during off-peak hours.



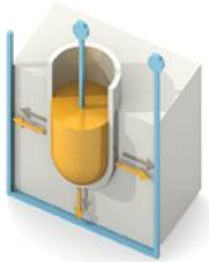
ART: BRYAN CHRISTIE. SOURCES: U.S. DEPARTMENT OF ENERGY; ENERGY STORAGE ASSOCIATION; ESKOM

ENERGY STORAGE

Because wind and solar power are intermittent, the quest is on to find ways to store energy for round-the-clock distribution—fueled in part by $185 million in stimulus money. Here are four promising technologies.

Superconducting cables at the Long Island Power Authority were turned on in 2008. They can move two to five times as much power as conventional cables of the same size, freeing valuable space in crowded transmission corridors and postponing or eliminating the need to upgrade transmission systems for higher voltages.

Compressed air, stored underground
An Iowa wind farm plans to pump air into sandstone formations when there's wind. Later the air can be released to make electricity.



Sodium-sulfur batteries
Pioneered in Japan, this technology can store a large amount of energy in a small space, as lithium-ion batteries do for electric cars.

Pumped-storage hydropower
Water is pumped uphill into a reservoir when electricity demand is low and released again to turn a turbine when demand is high.

Flywheel storage
In one town in Australia, electricity from wind turbines powers flywheels; their spinning motion is used to regenerate electricity when it's needed.

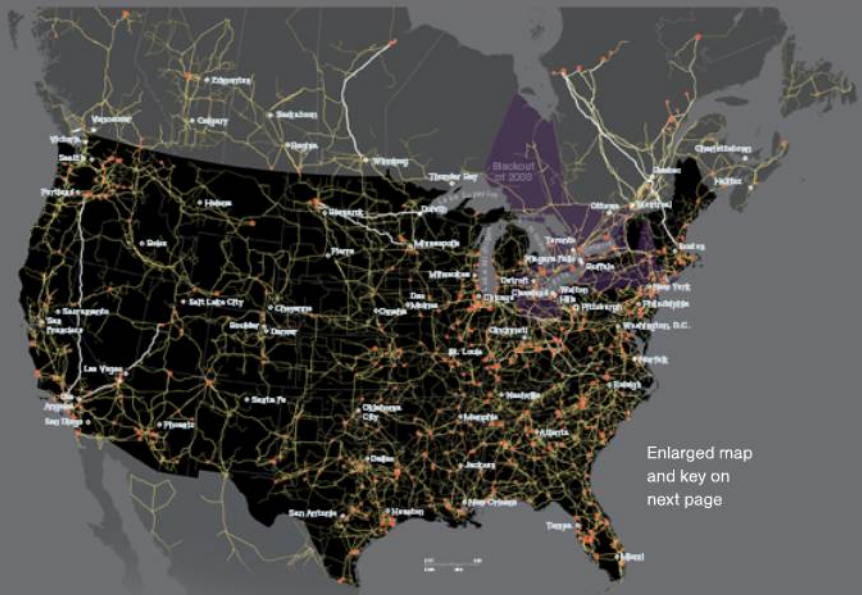
ART: BRYAN CHRISTIE. SOURCES: CENTER FOR AMERICAN PROGRESS; NATIONAL ENERGY TECHNOLOGY LABORATORY; DUKE ENERGY

OUR SPRAWLING, EVOLVING GRID

A map of the existing electrical grid (next page) may look at first glance like the interstate highway system, but the resemblance is superficial. Unlike the interstates, no one planned the grid. It consists of largely separate regional "interconnections" (right) that evolved from a patchwork of local utilities as they established links with their neighbors. Most of the grid is owned by those utilities; individual states regulate the construction of new transmission lines. Adding renewable energy to the grid and making it more reliable will require many new lines. That process is just beginning (see map on page 174), and it too is happening without a nationwide plan.

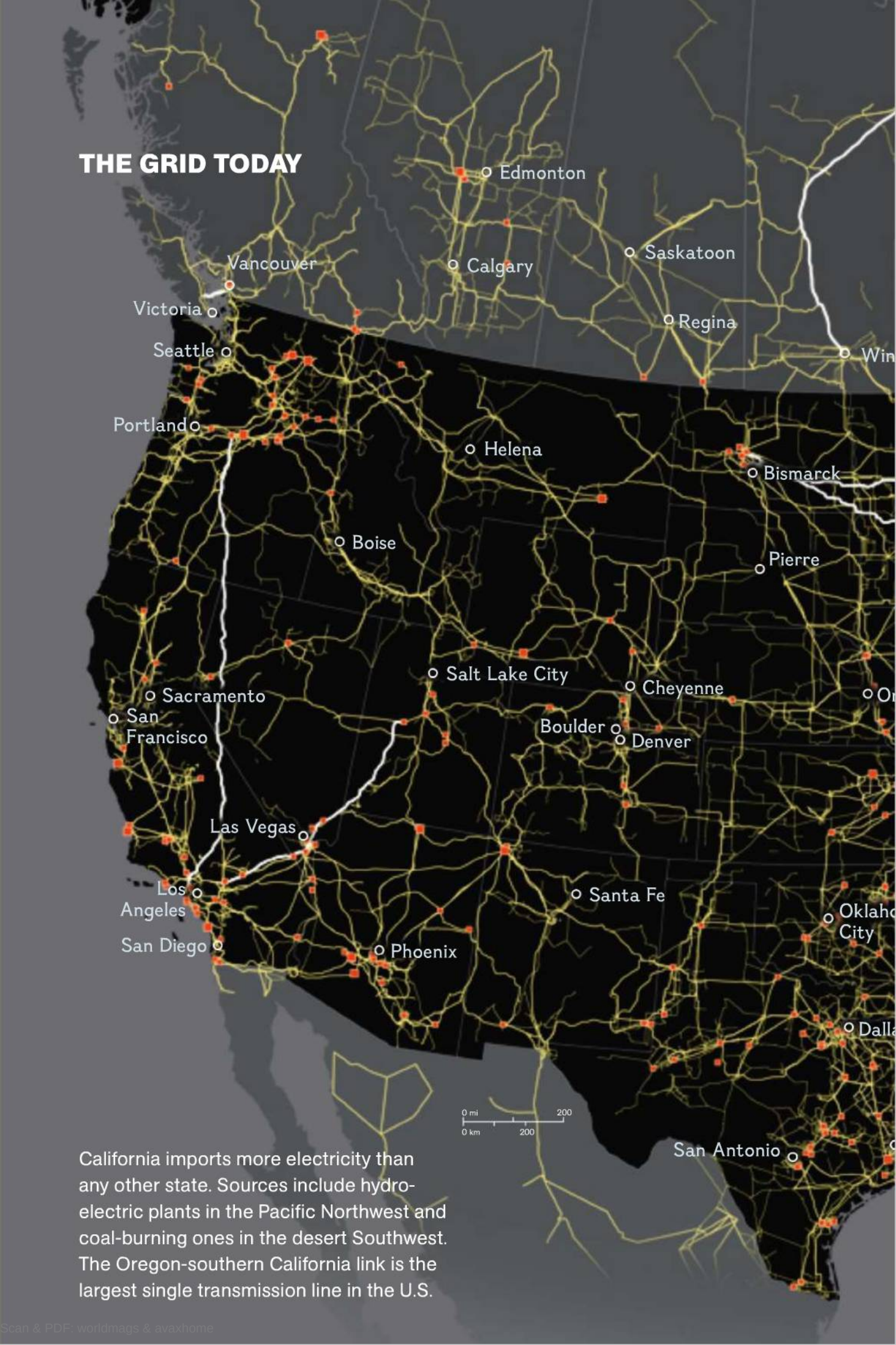
THE GRID TODAY

More than 150,000 miles of high-voltage transmission lines carry power from 5,400 generating plants owned by more than 3,000 utilities. Most of those lines carry alternating current (AC), but 1.9 percent of them carry direct current (DC), which loses less power over very long distances. The grid works 99.97 percent of the time—but power interruptions still cost the American economy about $80 billion each year. Moreover, our electricity is anything but clean. Most of it comes from burning fossil fuels, about half of it from coal. Hydroelectric, wind, and solar power account for less than 8 percent. The infrastructure perpetuates this: Texas currently has more wind-generation capacity than the grid can handle.

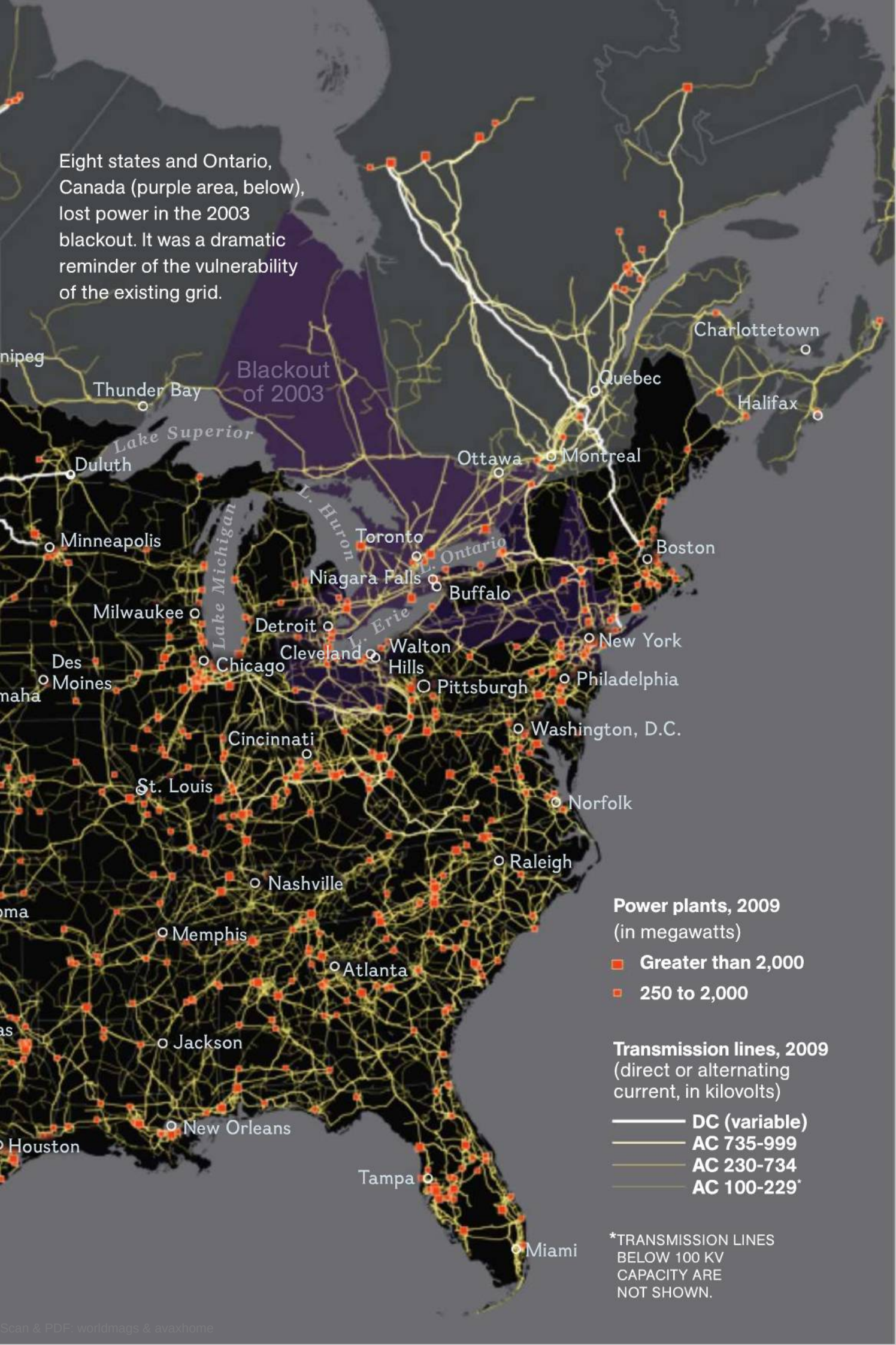


Enlarged map and key on next page

MARTIN GAMACHE AND SAM PEPPLE, NGM STAFF
SOURCES: NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION; PLATTS, A DIVISION OF MCGRAW-HILL COMPANIES (GENERATION AND TRANSMISSION INFRASTRUCTURE); U.S.-CANADA POWER SYSTEM OUTAGE TASK FORCE; U.S. DEPARTMENT OF ENERGY



California imports more electricity than any other state. Sources include hydroelectric plants in the Pacific Northwest and coal-burning ones in the desert Southwest. The Oregon-southern California link is the largest single transmission line in the U.S.



NEW LINES ON THE GRID

Superimposing the grid of the future on the current one will not be cheap. Nearly $30 billion in new generation plants and high-voltage transmission lines are planned in the West alone. Both federal subsidies and state-set goals for renewable energy—30 percent in New York by 2015; 33 percent in California by 2020—are encouraging the construction of new transmission lines, which in some cases are also needed to improve the reliability of the grid. Reliability should also rise, along with energy efficiency, as the grid gets "smarter"—that is, as utilities increase their ability to monitor the flow of electricity from generator to consumer.

Click for enlarged map and key

California's renewable energy law has led to a burst of wind and solar projects—as well as plans for high-voltage DC lines to bring renewable energy in from elsewhere. One idea: a 650-mile submarine cable to import hydroelectricity from Oregon.

Proposed new transmission lines, including the Tres Amigas project near Clovis, New Mexico, could help Texas deliver its abundant wind energy to far-flung cities in the East and West.

The federal government has defined two "national corridors" (pink, on map), in the mid-Atlantic and Southwest, where transmission lines are most in need of relief.

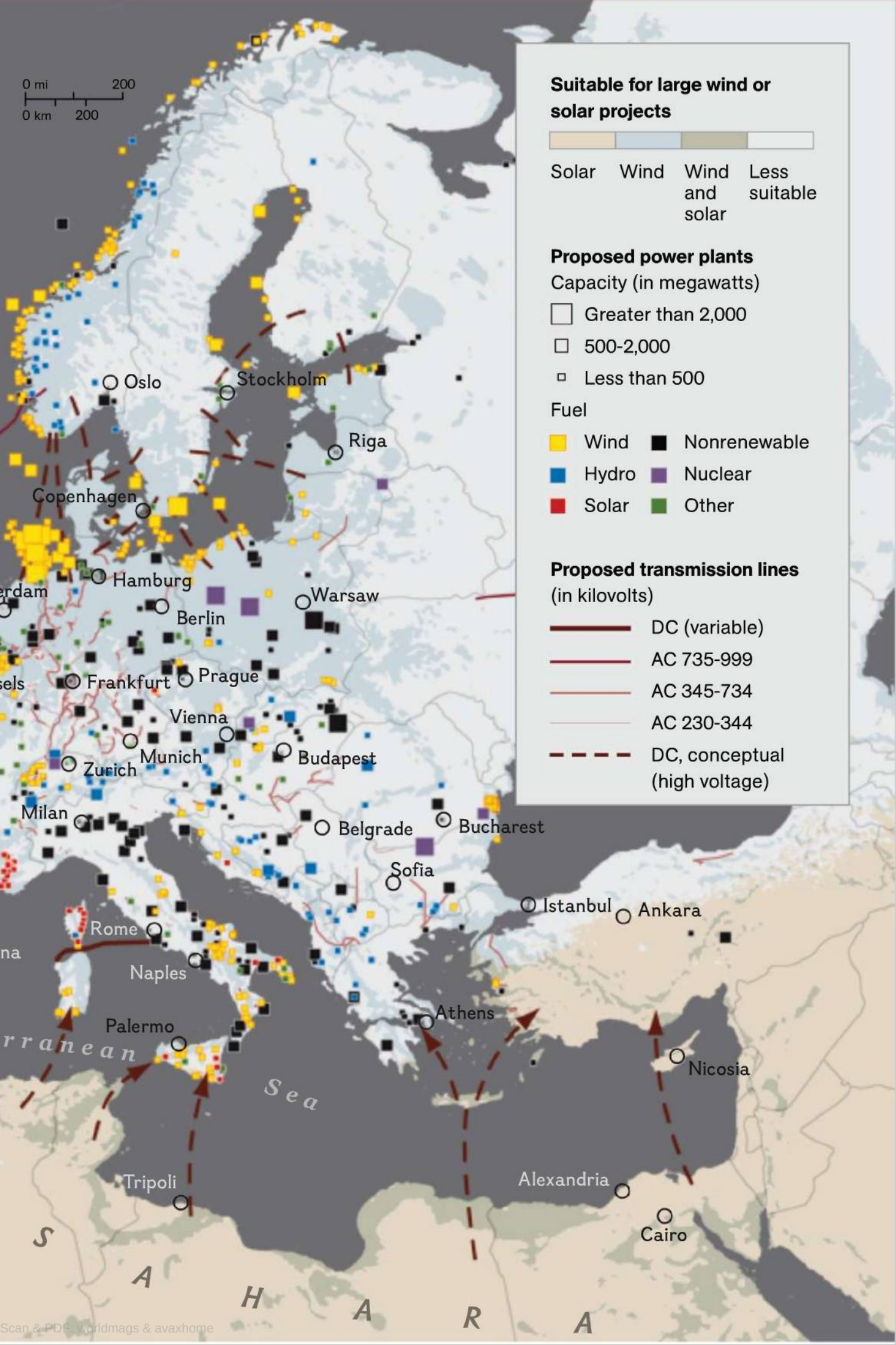
Turbines submerged along the Mississippi and its tributaries have been proposed as a way to generate hydroelectricity without dams.

MARTIN GAMACHE AND SAM PEPPLE, NGM STAFF
SOURCES: 3TIER (SOLAR AND WIND DATA ANALYSIS); VENTYX (GENERATION AND TRANSMISSION INFRASTRUCTURE); U.S. DEPARTMENT OF ENERGY

EUROPE'S GRID OF THE FUTURE

Last November 8, more than half of Spain's electricity was wind generated, and it even exported some to its neighbors—a hopeful sign, but one that lasted only a few hours. Europe's goal of getting 20 percent of its energy from renewables by 2020 will require "more of a revolution than an evolution," says Daniel Dobbeni of ENTSO-E, a grid operators association. Nine northern European countries agreed last year to link their grids by building transmission lines under the North Sea. A more futuristic vision: new lines under the Mediterranean to tap solar power from the Sahara.

NGM MAPS. SOURCES: 3TIER (SOLAR AND WIND DATA ANALYSIS); PLATTS, A DIVISION OF MCGRAW-HILL COMPANIES (PROPOSED GENERATION AND TRANSMISSION INFRASTRUCTURE); DESERTEC; SUPERSMART GRID (DC CONCEPTUAL NETWORK)



ON ASSIGNMENT

Electric Company

Two hundred feet above California's Angeles National Forest, photographer Joe McNally (right, at center) stepped from the top of a high-voltage tower onto the skid of a helicopter. He had spent five days commuting by air to cover the construction of the Tehachapi Renewable Transmission Project, parts of which can't easily be reached by road. When the work was complete, his pilot wanted to have a little fun. Says McNally: "He shouted, 'You want to do a dipsy doodle?'" Then they took a spin—literally. "It felt like we did two 360s," he recalls. "It was the best."

Joe McNally and crew go for a spin.

PHOTO: DREW GURIAN

Society Updates

AWARDS

For the third time in four years, *National Geographic* has won the "Ellie" award for general excellence in a publication with circulation over two million at the American Society of Magazine Editors' National Magazine Awards. The *Geographic* also took home the photojournalism win for last September's "Shattered Somalia" with photographs by Pascal Maitre. And Garrison Keillor's lively coverage of "Top Ten State Fair Joys," which ran in the July issue, won top prize in the essays category.

NG BOOKS

A celebration of a hundred of the world's most fascinating people, places, and things, *Nat Geo Amazing!* is the essential companion to the new National Geographic Channel series of the same name. It will be available in bookstores on June 29 ($19.95).

Winning ways: Garrison Keillor (above, in red shoes) strolls the Iowa State Fair grounds. Pascal Maitre (below, in white) takes a break in a Somali salon.

PHOTOS: JOEL SARTORE (TOP); PASCAL MAITRE

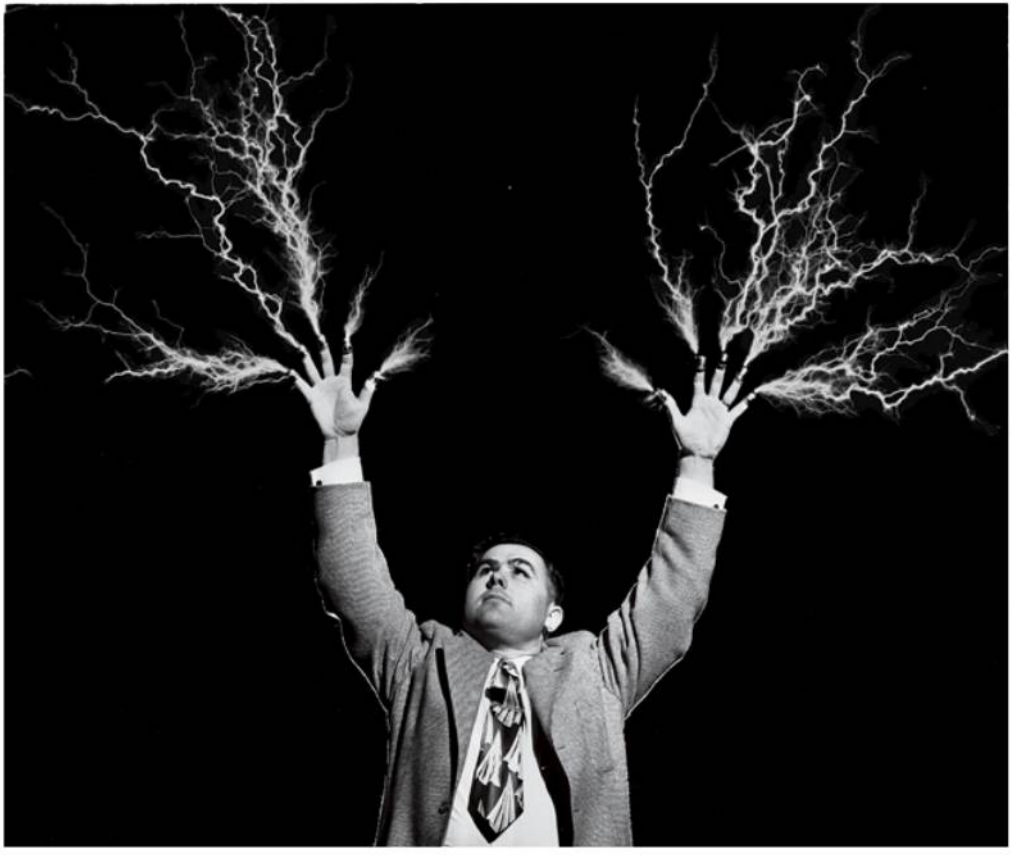


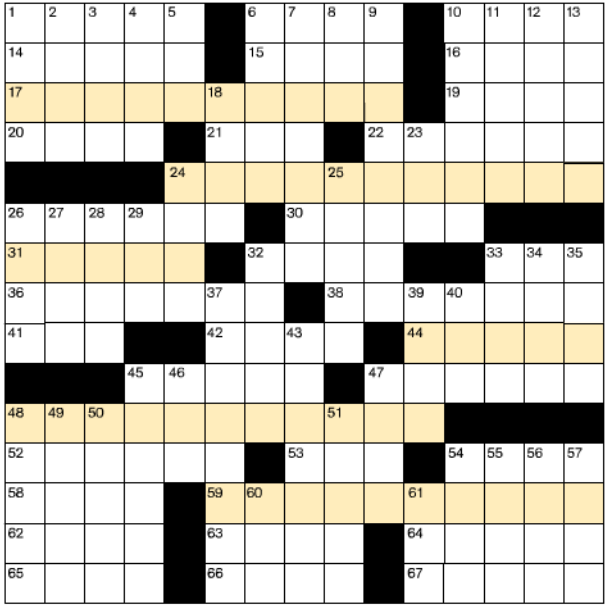
PHOTO: MOODY BIBLE INSTITUTE/
NATIONAL GEOGRAPHIC STOCK

Don't Try This at Home

Electricity flashes from the thimble-topped fingers of traveling "preacher-scientist" George Speake. From the 1940s into the '60s, he was one in a series of men affiliated with Chicago's Moody Bible Institute who demonstrated religious faith by demonstrating scientific principles. To create the lightning effect, Speake would stand atop an electric transformer coil. The room would darken. Then, at his command, a brief high-frequency current would travel over his skin, up from his feet and out of his fingertips. According to notes accompanying the image, Speake suffered no injury because "the high-frequency juice…is too fast to be felt." Another reason he stayed safe was his extreme care in setting up the trick: The photo's notes also warn that the practice was "for spectacle purposes only." *—Margaret G. Zackowitz*

GEO PUZZLE

Click here for the answers.



ACROSS

1 The electrical grid carries billions of them
6 Forgo
10 Say "Talk to the hand," say
14 Staggering
15 Mozart opera _ *Fan Tutte*
16 Actress's fan, perhaps
17 It sounds like the lament of an achy sexagenarian?
19 Prefix meaning "both"
20 Bald spot?
21 With 50 Down, lousy odds
22 Focus (on)
24 It sounds like what a zealous chick might give off?
26 Sound buy
30 Dweebs
31 With 44 Across, it sounds like a bigwig's suit material?
32 Italian wine district
33 _ *bien* ("Very well": Sp.)
36 Electrical connector
38 California gridiron group
41 There's a long and short of it
42 Sunscreen label abbr.
44 See 31 Across
45 Out, of sorts
47 Artful
48 It sounds like a survey on effectiveness?
52 Sung : cantata :: played : _
53 Thai neighbor
54 "Puppy Love" singer Paul
58 Aardvark's snack
59 It sounds like an order for a glimpse?
62 Dweeb
63 Fine-tune
64 Kashmir coin
65 Ferber of 12 Down fame
66 Taken in, in a way
67 Like a smart grid, ideally

DOWN

1 Small-waisted stinger
2 A Battle song
3 Let your fingers do the talking?
4 Beret holder
5 Furtive
6 Trailer part
7 They have Seoul
8 Environmental suffix
9 Where food is tossed
10 Hits some splits
11 Heavy metal garb
12 1925 Pulitzer-winning novel by Ferber
13 Having barbs or bristles
18 Jolly laugh
23 He might be tight?
24 Pt. of CPA
25 Ancient city in Jordan, literally "rock"
26 Quarrel
27 Household-list heading
28 Obi-Wan portrayer
29 Unit of ab crunches, e.g.
32 "The Sheik of ____"
33 First name in game-show production
34 Craving
35 Belgian river in WWI history
37 Dead language inscriptions?
39 An Aleutian
40 Expected
43 Sopwith Camel, for instance
45 Aleutians location
46 On, thanks to the grid
47 Lummox
48 Meter reader's finding
49 Firmed at the gym
50 See 21 Across
51 Like some wooden buckets
54 Russian-Chinese border river
55 Scruff
56 Kind of jerk
57 Yemeni port where the U.S.S. *Cole* was bombed
60 Job ad abbr.
61 .0000001 joule

NEXT MONTH

Otherworldly chamber in a flooded Bahamian cave

PHOTO: WES C. SKILES

August 2010

Deep Dark Secrets
Scientists dive into the deadly blue holes of the Bahamas.

The Iron Silk Road
A new Europe-to-Asia railway fuels trade—and tensions.

Reviving Native Lands
U.S. tribes strive to undo years of environmental abuse.

A Grassland Kingdom
India's Kaziranga park shelters tigers, buffalo, and rhinos.

Valley of the Whales
The origins of the marine mammal lie buried in Egyptian sand.