NATIONALGEOGRAPHIC.COM/MAGAZINE SEPTEMBER 2007

NATIONAL GEOGRAPHIC

Islam's Fault Line
Pakistan

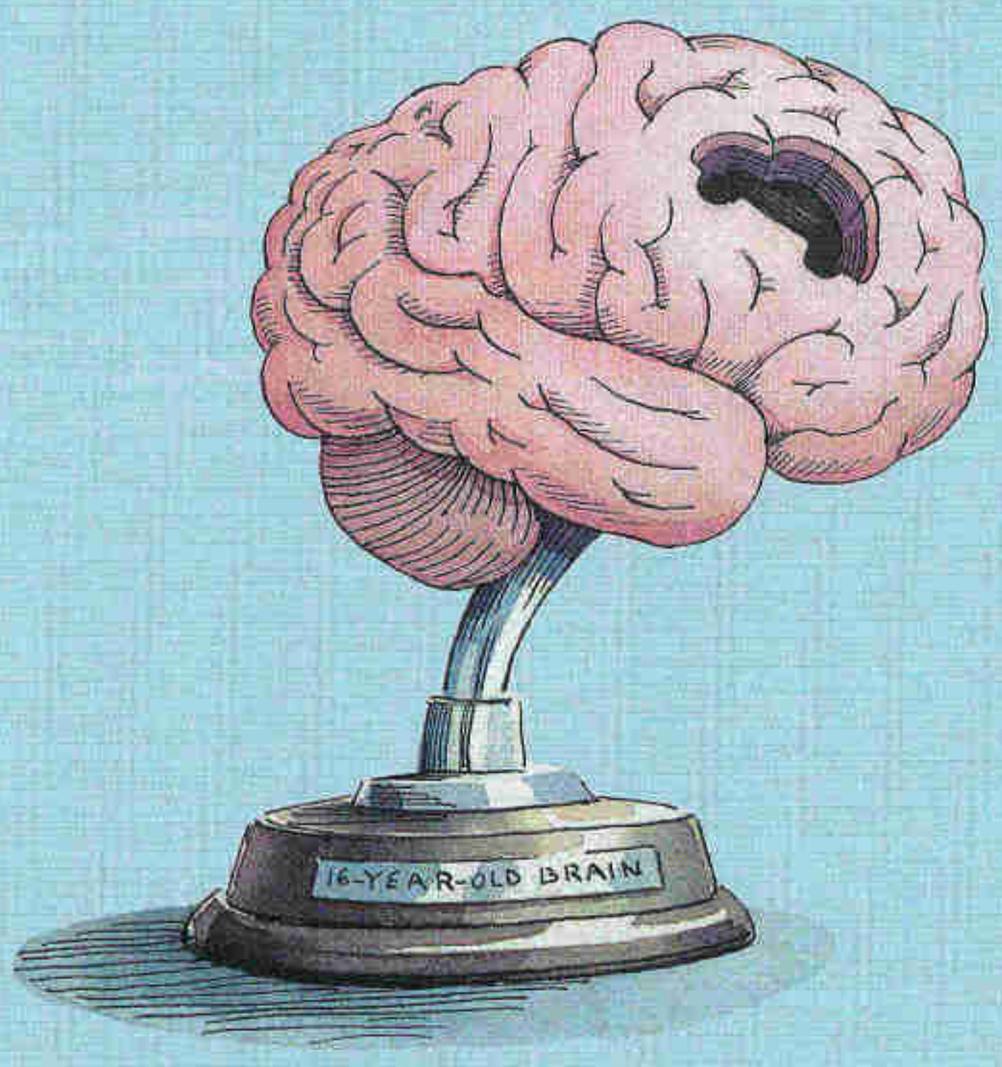
If Carlos knows he is half Irish, one quarter Spanish, and one quarter Chinese, how is it possible that he is also 100% Tanzanian?*

* ibm.com/dna

IBM®

Why do most 16-year-olds drive like they're *missing a part of their brain?*

BECAUSE THEY ARE.



EVEN BRIGHT, MATURE TEENAGERS SOMETIMES DO THINGS THAT ARE "STUPID."

But when that happens, it's not really their fault. It's because their brain hasn't finished developing. The underdeveloped area is called the dorsal lateral prefrontal cortex. It plays a critical role in decision making, problem solving and understanding future consequences of today's actions. Problem is, it won't be fully mature until they're into their 20s.

It's one reason 16-year-old drivers have crash rates three times higher than 17-year-olds and five times higher than 18-year-olds. **Car crashes injure about 300,000 teens a year. And kill nearly 6,000.** Is there a way for teens to get their driving experience more safely—giving their brains time to mature as completely as their bodies? Allstate thinks so.

Graduated Driver Licensing (GDL) laws are one approach that's been proven effective at reducing teen crashes. These laws restrict the more dangerous kinds of driving teens do, such as nighttime driving and driving with teen passengers. Since North Carolina implemented one of the most comprehensive GDL laws in the country, it has seen a 25% decline in crashes involving 16-year-olds.

To find out what the GDL laws are in your state, visit Allstate.com/teen. Help enforce them—and if they aren't strong enough, ask your legislator to strengthen them.

Let's help our teenagers not miss out on tomorrow just because they have something missing today.

It's time to make the world a safer place to drive.
THAT'S ALLSTATE'S STAND

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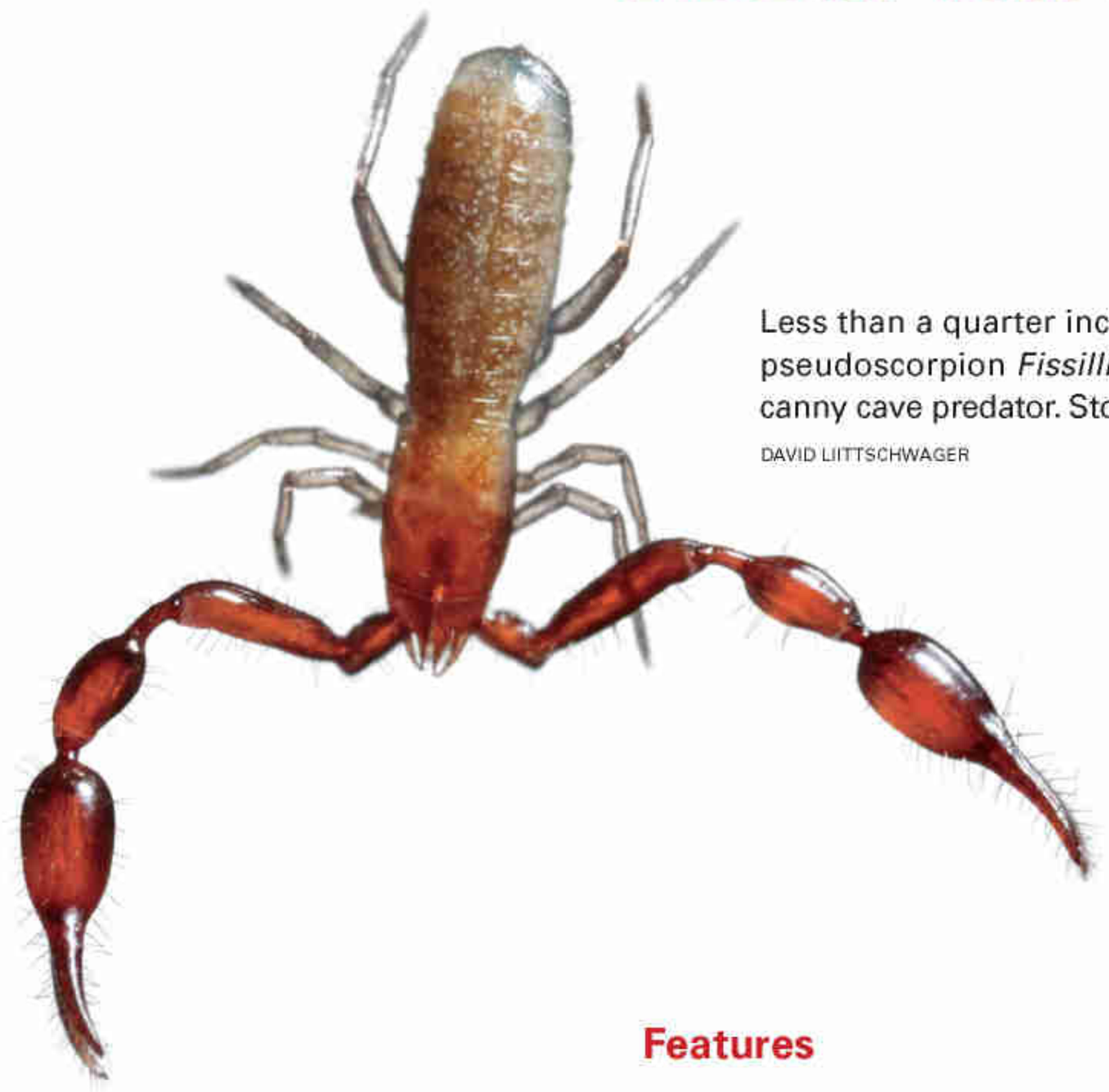
Life
Retirement

NATIONAL GEOGRAPHIC

SEPTEMBER 2007 • VOL. 212 • NO. 3



Less than a quarter inch long, the pseudoscorpion *Fissilliercreagris* is a canny cave predator. Story on page 134.

DAVID LIITTSCHWAGER

Features

COVER In Lahore, Pakistan, a pilgrim pauses in his meditation at the shrine of Data Ganj Bakhsh, an 11th-century Sufi saint. **PHOTO BY REZA**

Cover printed on recycled-content paper

OFFICIAL JOURNAL OF THE NATIONAL GEOGRAPHIC SOCIETY

Football Shields

Gasping Aspens

Tree Kangaroos

On the Web

ngm.com/0709

More of Your Shot
Look for your photographs in an expanded version of *Your Shot,* which features images sent in by readers. For the gallery and for submission guidelines, go to *ngm.com/yourshot.*

Second Helpings
A wider menu of State Fare serves up more dishes and recipes, and lets you nominate your favorite local food.

Keeping Up With the Climate
Check in with *Climate Connections,* an ongoing collaboration between National Geographic and National Public Radio, at *ngm.com/climate connections* and *npr.org/climate connections.*

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Gas-friendly to gas-free. What does gas-friendly to gas-free mean to Chevy? It means making cars and trucks that get better fuel economy than ever before. It means taking advantage of alternative fuels by offering more models than any other brand that can run on cleaner-burning, mostly renewable E85 ethanol. It also means advanced technologies like our hybrids coming this fall and the eventual production of an affordable extended-range electric car. Not to mention developing a hydrogen fuel cell that is both gas-free and emissions-free. Do more. Use less. Find out how at chevy.com

AN AMERICAN REVOLUTION

FUEL EFFICIENCY

The environment and your commute. Can't we all just get along? It's as simple as driving a more fuel-efficient car. Chevy™ currently offers eight 2007 models that get an EPA estimated 30 MPG highway or better.[1] But fuel efficiency is not reserved for cars. Chevy Silverado® offers the best V8 fuel economy of any full-size pickup.[2] And the full-size Tahoe® SUV has better standard highway fuel economy than 12 smaller SUVs.[3] We can thank new technology for helping us achieve greater fuel economy. Our Active Fuel Management™ system deactivates half the engine cylinders when they are not needed and seamlessly reactivates them when you need extra power.

Five things Chevy is doing to help us all do more and

E85 ETHANOL

Why pump fuel when you can grow it? For the last seven years, Chevy has been producing vehicles capable of running on a fuel that grows from the good earth and remembers its roots. That fuel is E85 ethanol.[4] E85 is a mostly renewable fuel source made from U.S.-grown biomaterial such as corn and other grain products. It's a fuel that decreases our dependence on petroleum and burns cleaner than gasoline. E85 fuel generally has a higher octane rating than regular gas, which can result in slightly higher horsepower and torque levels. Chevy has over 1.5 million E85 FlexFuel vehicles on the road today, and that's more vehicle choices than any other brand.[5]

chevy.com

1 Based on 2007 EPA estimates and segmentation. **2** 2007 Silverado 2WD with available 5.3L engine has an EPA est. MPG 16 city/22 hwy. **3** 2007 Tahoe 4x4 with standard 5.3L V8 **6** Based on 2007 GM segmentation and 2008 EPA estimates. Tahoe 2WD with available 5.3L V8 has an EPA est. MPG 14 city/20 hwy. **7** 2008 Tahoe Hybrid limited availability 2008 Tahoe Hybrid not available at time of printing. **9** Equinox Fuel Cell test vehicles not available for sale. **10** Assumes fully charged battery. Actual range may vary depending

HYBRID

The 2007 Chevy Tahoe already has best-in-class fuel economy.[6] So why mess with a good thing? To make it better, of course. That's why, this fall, Chevy is introducing the Tahoe Hybrid,[7] America's first full-size hybrid SUV. The 2008 Tahoe Hybrid provides the power and capability you'd expect from a utility vehicle, while delivering fuel efficiency you'd never imagine. When you pair the two-mode technology with our Active Fuel Management™ system, the Tahoe Hybrid is 25% more fuel-efficient[8] than our already superior Tahoe. **And joining our Tahoe Hybrid this fall will be the new Malibu® Hybrid.**

right now use less.

FUEL CELL

Chevy is launching a test fleet of 100 hydrogen-powered fuel cell Equinox® SUVs.[9] This fleet will hit the streets of New York City; Washington, D.C.; and Los Angeles. "Project Driveway" is the first large-scale market test of fuel cell vehicles with real drivers in the real world. Why? Because hydrogen fuel cells use zero gasoline and produce zero emissions. And they ultimately reduce our dependence on petroleum.

ELECTRIC

Imagine: A daily commute without a drop of gas. We have put tremendous design and engineering resources in place to make the Concept Chevy Volt™ a reality. The Volt, with its revolutionary GM® E-Flex Propulsion System, is different than any previous electric vehicle because it will use a High-Energy Battery and range-extending onboard power source that can run on gas, ethanol, or biodiesel to recharge the battery while driving. For someone who drives less than 40 miles a day, Chevy Volt will use zero gasoline and produce zero emissions.[10]

AN AMERICAN REVOLUTION

has an EPA est. 21 MPG hwy. **4** E85 is 85% ethanol, 15% gasoline. For more information or to find an E85 station near you, go to chevy.com/e85. **5** Based on EPA segmentation. in select markets starting fall 2007. See chevy.com/hybrid for details. **8** Based on EPA est. MPG 14 city/19 hwy. for the 2008 Tahoe with Vortec 5.3L engine. EPA estimates for on driving habits and conditions. Information subject to change without notice. Not available for sale.

EDITOR'S NOTE

This sphagnum tuft grew on a peat bog in Tollund, Denmark, one of the sites where ancient bodies were discovered.

A bog is as subtle as landscape gets. At first glance, it might present as a monochrome horizon, a brown soup of unrelieved dullness. Look closely. The careful eye can tease out paisleys of color and form. There are blue and green lichens in shapes like antler horns or tiny trumpets. Bogs are home to purple moor grass, vermilion cranberries, beetles, badgers, skylarks, and red deer, which bathe in peat to shed flies.

In addition to a startling array of life, bogs harbor mystery and death. Hundreds of bog bodies have turned up in northern Europe. In 1952, a peat digger in Denmark found a man who died at age 34—throat slit from ear to ear—in a bog. Conditions in the sodden sphagnum moss had preserved the body, hair and nails intact, for 2,300 years. Experts now suspect that Grauballe Man, as he is known, was a victim of ritual sacrifice, not murder as once thought.

About 990 million acres of peatlands remain on five continents. They are disappearing fast. Large-scale cutting of peat for fuel, harvesting of sphagnum for horticulture, and draining of wetlands threaten most of Europe's remaining bogs.

The potential loss extends beyond the evidence of past civilizations and distinctive plants. Not only do bogs help control water levels in surrounding areas, they also collect and store carbon from the atmosphere. The world's peatlands may contain more carbon than is currently in Earth's entire atmosphere. As bogs disappear, carbon is released. Destruction of Siberian bogs alone could unleash billions of tons of greenhouse gases. There is little mystery about the consequences of that.

PHOTO: ROBERT CLARK

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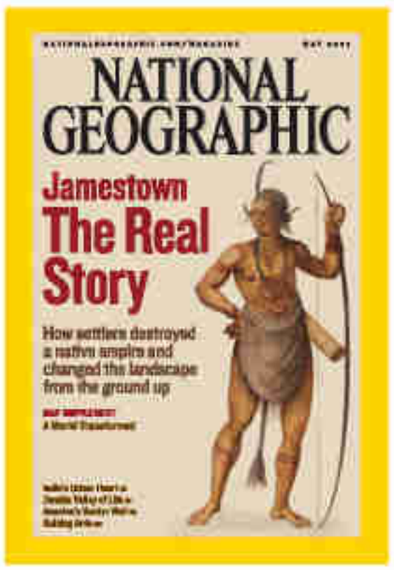
LETTERS



May 2007 *Articles generating the most mail this month were the story on Jamestown, "America, Found & Lost," and "Our Wall," about the barrier between Mexico and the U.S. Steven R. Van Laer of Battle Ground, Washington, wrote to say, "I can see the irony. Suppose Native Americans had walls to keep out the influx of Europeans in the 17th century?"*

Comment on September stories at **ngm.com.**

America, Found & Lost

I am so weary of Europeans being blamed for every ill in the Western Hemisphere. You can't judge cultures and mores of 500 years ago by today's standards. I doubt that Columbus or the English colonists intended to spread diseases among the Indians. Little was known about how diseases were spread. So quit blaming our ancestors for everything that has gone wrong on this continent. Would we be better off if no one had ever emigrated from Europe? Maybe we should have kept hands off and left the hemisphere to the Indians.

EVELYN CAMPBELL
Nashville, Tennessee

I was proud to see the veil of hypocrisy lifted from the storybook accounts of our early history. Our forefathers brought torment upon native civilizations. We wanted their lands and wealth, and we were ruthless. History is recorded by the victorious, not the victims. I applaud your courage.

TOM C. BLOUNT
Cotopaxi, Colorado

I think I stumbled across a clue to Jamestown's difficulties. On your map, you credit John Smith with the policy, "No work or no food." Maybe he should have rephrased this.

DON STRANDBERG
Colorado Springs, Colorado

Surely the arrival of Europeans profoundly and, in most instances, disastrously changed or ended the ways of life of native North Americans. But just as it is foolish to portray all Native Americans as bloodthirsty, scalping savages, it is fallacious to pretend that they were noble, perfect peace-loving people.

MICHAEL F. SCHULTZ
Danville, Pennsylvania

I was wondering why the Union Jack was depicted in the map of Jamestown. Usually the flag with the combined crosses of St. Andrew and St. George is associated with the legislative union of the two countries in 1707 and not the union of the monarchy in the 17th century. What is the basis for your conclusion that the Union Jack would have flown over the fort at Jamestown?

CHRISTOPHER N. FRITSCH
Fort Worth, Texas

William Kelso, the director of archaeology at Historic Jamestowne, confirms that the original Union flag (created by King James I in April 1606) shown on our supplement map was the version of the British flag that would have flown over the fort.

I take opposition to the article's opening statement: "Much of what we learned in grade school about the New World encountered by the colonists at Jamestown is wrong." As an elementary teacher, I am offended. Nothing that I read in that article contradicts anything I teach to my fifth graders.

DAVE COLBURN
Surprise, Arizona

An "empire"? They were barely a hunter-gatherer tribe. Once again, an eco-freak takes us on a flight of fancy to undermine American pride and depict generations of immigrants in this land as the big, bad invaders. Did we change the landscape? Yes! And hooray, to become the breadbasket of the world.

DEBORAH DEE VOLLUZ
Mt. Vernon, Washington

It should be noted that the Columbian exchange resulted in the globalization of the human family as well as ecosystems. Jamestown gave birth to a political system nurturing African slavery and Native American oppression. The founding of Jamestown colony was an apocalypse for both Native Americans and Africans.

HELEN H. GENTRY
Detroit, Michigan

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THERE AT EVERY TURN.

LETTERS

Our Wall

While a wall is certainly not the cure, it seems the only solution in the short term that can help stem illegal immigration. So how do we solve the problem? It will require effort, legislation, and money on both sides of the border. Immigration to the United States needs to be accessible for people who have skills, talents, or pending jobs that would contribute to the U.S. economy. On the other side of the border, work needs to be done to create an economy that can support those people who are willing to work. If the millions of people here illegally were working in Mexico, think of all that could be done. I hold no disdain for the Mexican people or for those in this country, illegally or otherwise. I do have disdain for those who do not take action, or who choose to support, with their voices, actions, or legislation, illegal immigration.

SEAN SANDERSON
Jacksonville, Vermont

The current wall-building along the U.S.-Mexico border seems intended to secure our wealth, not our lives. A better solution would be to address the economic disparity that is at the root of the problem of illegal immigration. This wall represents a moral failure and is an embarrassing spectacle—the richest nation in the world building a wall to keep its poor neighbors out. Shame on us.

FERDI BUSINGER
Anacortes, Washington

Author Charles Bowden commented on a volleyball game that had been played until recently by townsfolk from both Sonora and Arizona. I am one of the organizers of the game and the fiesta. The game is ongoing; the last one was held in April. It's a neighborhood party that draws about 400 families. The next fiesta will likely be next April. Perhaps Bowden can attend. If so, he should bring food to share.

EMILIE VARDAMAN
Naco, Arizona

Illegal aliens are breaking the law. We are only now finding out how much illegal immigration costs the U.S. in welfare and medical and school costs. The competition for low-wage jobs also hurts low-skilled American workers and keeps minimum wage artificially low.

GEORGE EYNON
Humble, Texas

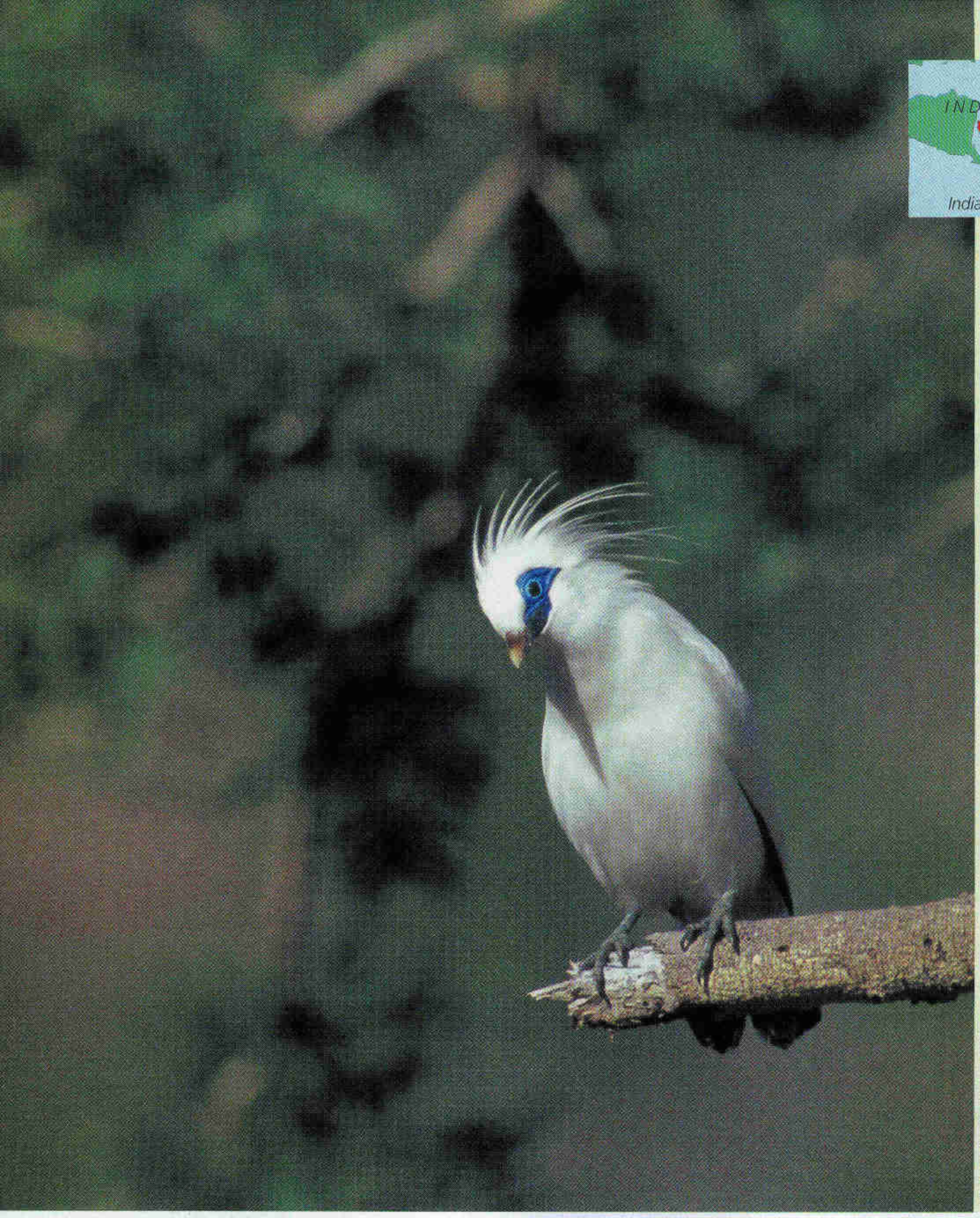
Borders are necessary political lines of demarcation, nothing more. Are the boundaries between the U.S. and Canada, for instance, a source of violence? Do they say something unpleasant about us or our neighbors? Do they exist to create fear and the desire for control? Every nation has laws that govern immigration. The U.S. is no different. When those laws are violated by individuals and governments, then there must be a response. Walls, unfortunately, are the easiest, yet most ineffective, response.

R. LARRY BINGHAM
Shoreline, Washington

Corrections, Clarifications

May 2007:

America, Found & Lost (page 50)
The quote attributed to Jean de Crèvecoeur came from his 1801 book, *Journey Into Northern Pennsylvania and the State of New York.*



Bali Starling
(Leucopsar rothschildi)

Size: Length, 9 - 10 inches

Weight: 3 - 3.2 oz.

Habitat: Tropical moist deciduous forest in Bali Barat National Park

Surviving number: Estimated at fewer than 30 in the wild

Photographed by Roland Seitre

WILDLIFE AS CANON SEES IT

Free as a bird? Hardly. The Bali starling is constantly monitored and closely guarded in an effort to keep persistent poachers from capturing the last few birds remaining in the forest. The pet trade is just one of the threats hovering over Bali's only endemic bird. The little arboreal feeder—which makes its nest in abandoned woodpecker holes—is also facing competition with the much more numerous black-winged starling and the constraints of living within an extremely restricted range. An aggressive captive breeding and release program may well be the only chance the Bali starling has left at a life of freedom.

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LETTERS

Bowden's article refers to the United States as "fortifying its border" with a wall. A remark often attributed to Gen. George Patton states that fixed fortifications are monuments to the stupidity of man. History repeatedly shows us, through the Great Wall of China, Hadrian's Wall, the Maginot Line, and the Berlin Wall, that such delimitations are harbingers of the demise of nations. Needs, requirements, laws, and priorities change with time. The border wall is nothing more than an expensive political exercise in frustration.

JOHN D. SEARLE
Spokane, Washington

Building a fence between us and Mexico has to rank right up there with putting our Japanese citizens in camps during World War II. It's something we're going to be embarrassed to remember. Our southern neighbors deserve better.

MAC BRYANT
Saratoga Springs, New York

I need someone to tell me how spending billions on a border wall with Mexico will make me feel safer. There are roughly 12 million illegal immigrants here now. Two million are from Asia. What wall is going to stop them? The same goes for the half million from across the Atlantic. Up to five million from south of the border came legally and overstayed or never left. Then there is the possibility that half of those who go over the wall may succeed. I feel safer already.

STEVE PARKS
Paso Robles, California

Dharavi

I am Indian by origin and am extremely familiar with the slum situation in India. Even when I was a child, I passed one such slum on my way to school and was flabbergasted by the conditions. This slum, like Dharavi, has been presented with various development schemes, and it seems that all of them have been resisted by residents. The reason for such resistance seems twofold. One, due to the lack of education, it is possible that they do not see the peril in living in conditions with no sanitation. As even acquiring education in India requires one to be economically stable, many children growing up in such slums do not get access to formal education. The second reason slums continue to exist is culture. Dharavi did not spring up overnight but has developed over generations. Families who live there consider that ancestral property, although they might not have legal rights. Such beliefs are hard to change, and therefore residents resist change even though it might be for their own good. If any improvements are to be made to the plight of people in India's slums, they can only arise from a compound of increased education and compromise.

History repeatedly shows us, through the Great Wall of China, Hadrian's Wall, the Maginot Line, and the Berlin Wall, that such delimitations are harbingers of the demise of nations.

EVERT BORGIA
Valley Stream, New York

Dharavi is a slum of hope, not despair. The tremendous energy and hope of the people living there has to be experienced to be believed. A government-imposed solution has been presented in your article. It is necessary to evolve a government-assisted solution, where the enterprise of the people can be tapped to provide alternatives that are less invasive and less disturbing to the lifestyles and livelihoods.

NEETIN KHEDKAR
Mumbai, India

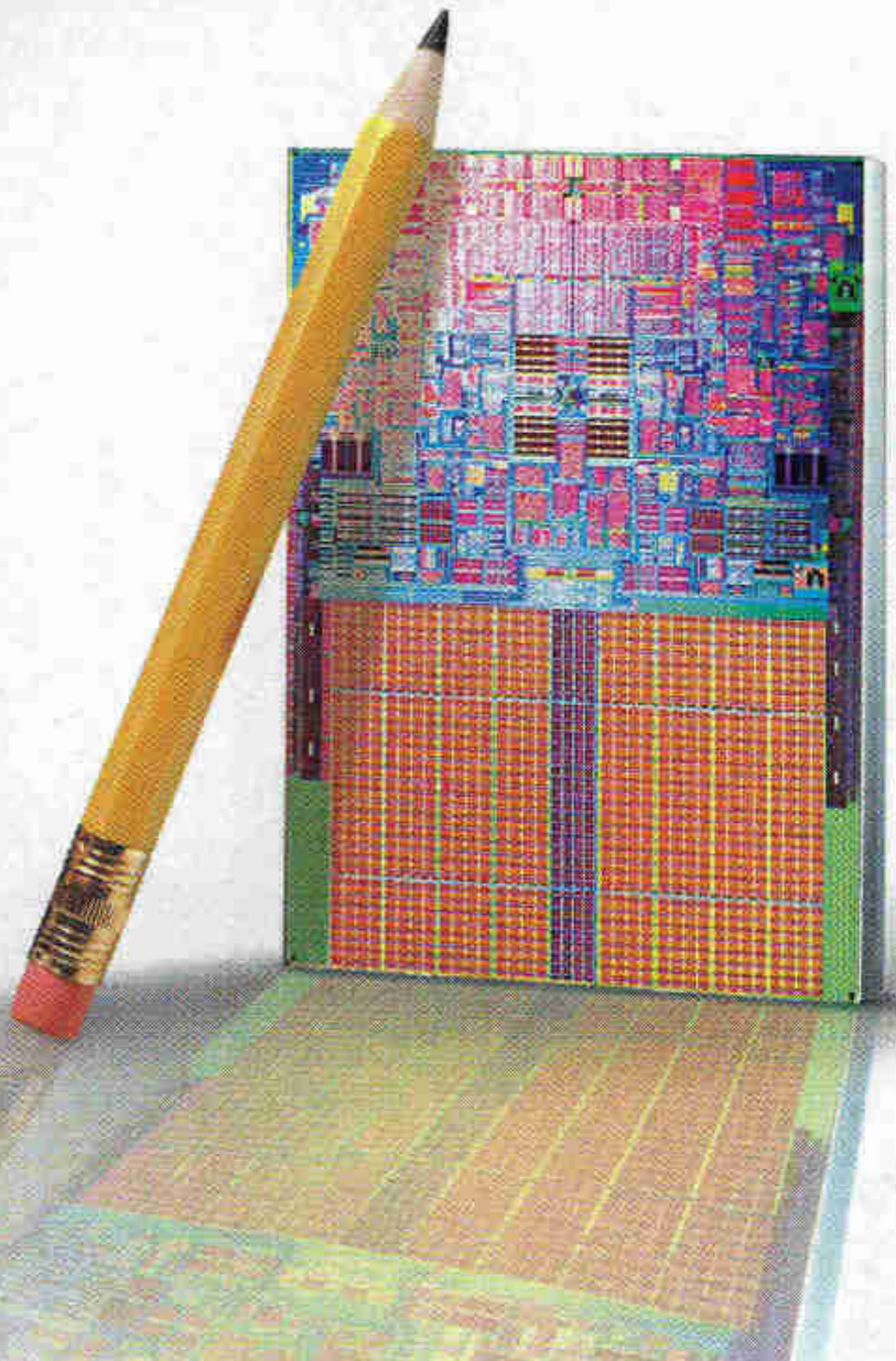
The statement that up to 18,000 people may live on one acre boggles my mind. We Americans take for granted the enormousness of our living space and privacy. I live in a three-bedroom house on three acres with two horses, two dogs, a cat, and one wife. Up until now I felt cramped. Never again.

PAUL D. MESSIER
Uxbridge, Massachusetts

Bulldog Ants

They are known in Australia as bull ants. It is a pity that Mark Moffett did not know of the proven treatment for their stings. Bracken fern *(Pteridium esculentum)* is widespread in the same sandy soils the ants prefer for nesting. The juice from the roots rubbed onto a sting relieves the pain and reduces the swelling.

JOHN MOLINE
Melbourne, Victoria



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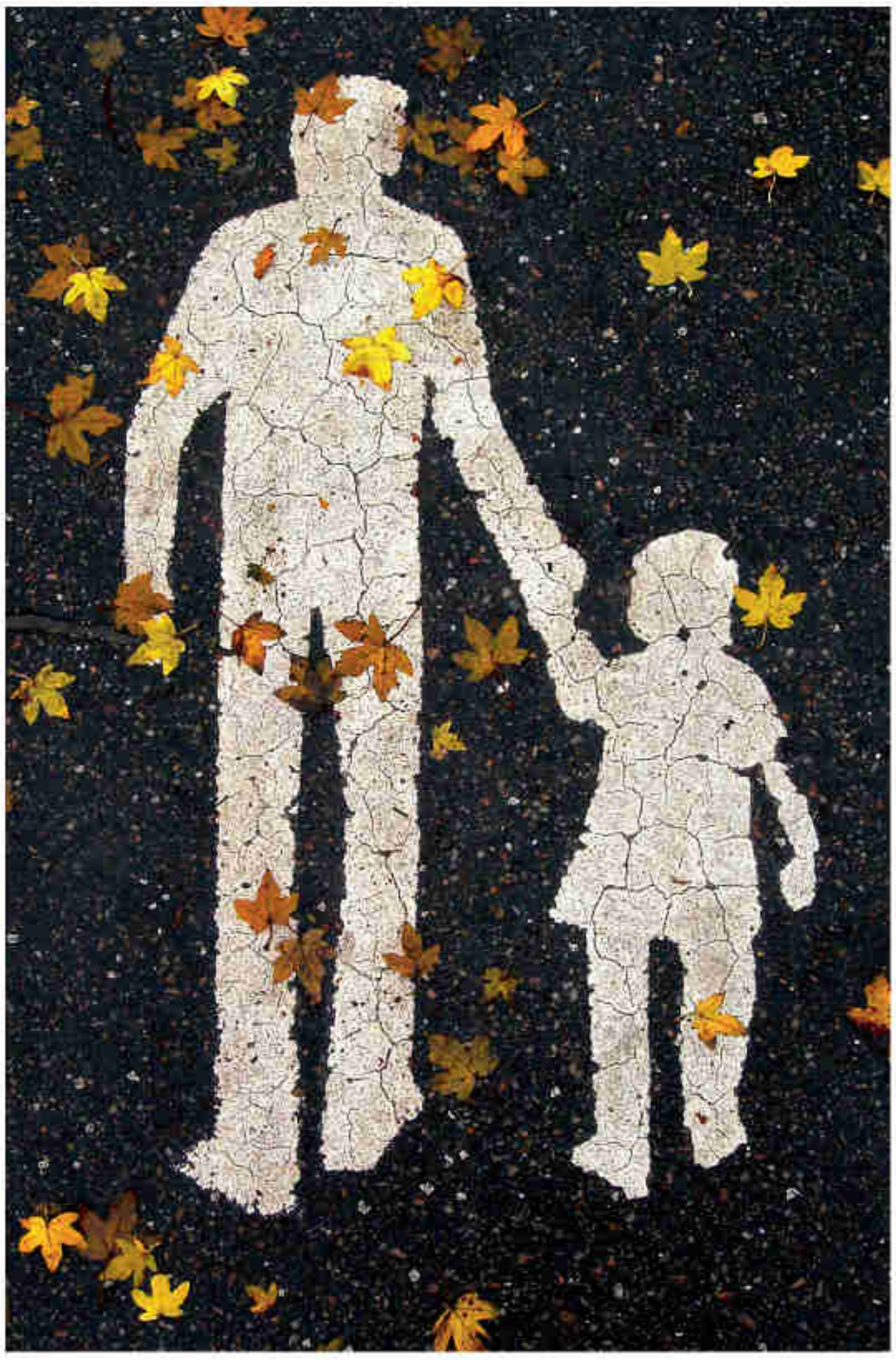
OPPORTUNITY STARTS WITH INTEL INSIDE.

Hello, Yellow Flashes of gold from fallen leaves and fading flowers helped put the Your Shot editors in the mood for early autumn. What colors make you want to grab your camera? Take some pictures, and send us your best. One of them just might turn up in NATIONAL GEOGRAPHIC. For Your Shot guidelines, a submission form, and more information, go to *ngm.com/yourshot.*



Stephen Kelly Bristol, England

On holiday in Malmö, Sweden, photographer Stephen Kelly, 38, saw more than just the figures painted on the ground to show the pedestrian route. "I saw an adult leading a child not down the sidewalk, but crossing space with the last of the fall leaves scattered like suns and stars."

Alessandro Zocchi Verona, Italy

A petal dangling from a strand of spider's silk caught Alessandro Zocchi's attention in Italy's Bosco della Fontana. The 43-year-old scientist studies birds on that reserve—but does not limit himself to subjects on the wing. "I spend most of my spare time here. I have the opportunity to photograph many creatures."

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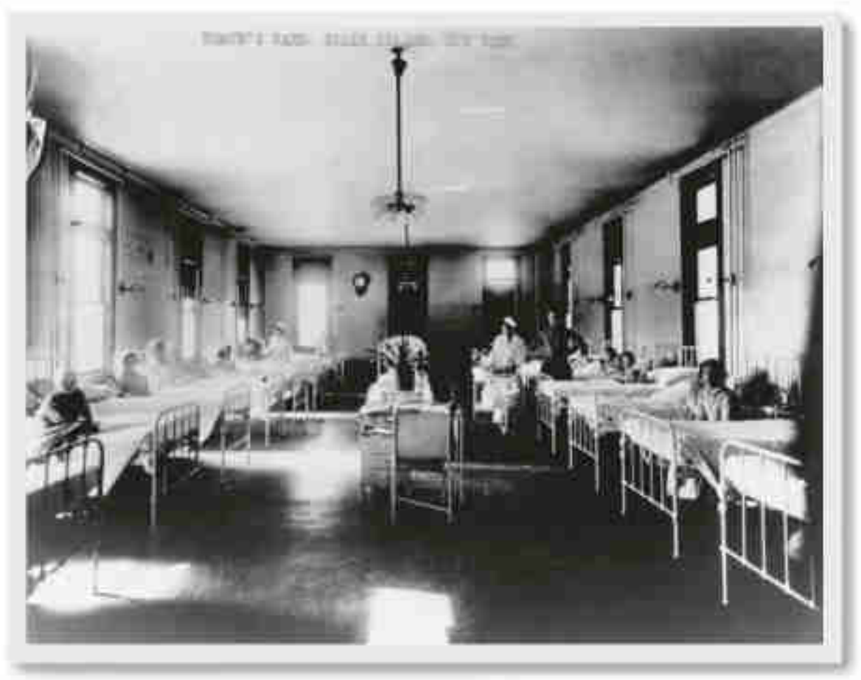
A century ago, tens of thousands of immigrants were treated in Ellis Island hospital wards like this one.



Ellis Island: Ghosts of Freedom, *published by W. W. Norton, features more of Wilkes's work. His website is* ellisislandghosts.com.

Waiting Rooms I identify with immigrants. My mother was one. In 1939, nine-year-old Ruth Landau arrived in America from Austria, speaking no English and carrying a few family treasures sewn inside a teddy bear.

She did not arrive through Ellis Island—the great immigrant gateway in New York Harbor—but 12 million others did. They all had to pass a medical inspection intended to exclude the diseased and the mentally ill. Most passed. Those who failed were held for quarantine and treatment. Between 1892 and 1954, a quarter million were deported, roughly half for health reasons. Some 3,500 others died here, within sight of their dream.

For five years I photographed the ruins of Ellis Island's sprawling medical complex every chance I got. Drifts of crumbled plaster gave one ward the character of a desert (above). Months after I made that image I found an old photograph shot from the same vantage point (left). They're identical—except that one is alive with immigrant children and the nurses who watched over them. In the other, only dust and memory remain.

INSET PHOTO: STATUE OF LIBERTY NATIONAL MONUMENT, NATIONAL PARK SERVICE

LIFE TAKES VISA

Things to do while you're alive:

- ☐ Tour MoMA with a personal guide
- ☐ Go to the Olympic Games
- ☐ Go scuba diving in Belize
- ☐ Write a screenplay
- ☐ Drive on the autobahn
- ☐ Watch *Aida* in Verona
- ☐ Ride the Orient Express
- ☐ Visit an uninhabited island
- ☐ Swim in all five oceans
- ☐ Take your parents on a vacation
- ☐ Heli-ski in British Columbia
- ☐ Bungee jump
- ☐ Read and finish *Moby-Dick*
- ☐ Experience Mongolia's Naadam Festival
- ☐ Visit the Taj Mahal
- ☐ Celebrate Mardi Gras in New Orleans
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PHOTO JOURNAL | STEPHEN WILKES

Stephen Wilkes calls the Ellis Island ruins "50 percent the work of man, 50 percent the triumph of nature." A video he produced of "vines, leaves, and moss, mingled with shattered plaster, curling paint, and rusted iron," has helped secure millions of dollars of state and federal funding to stabilize the historic buildings. The work has already begun. "The place will never again look as it does in these photographs," Wilkes says.

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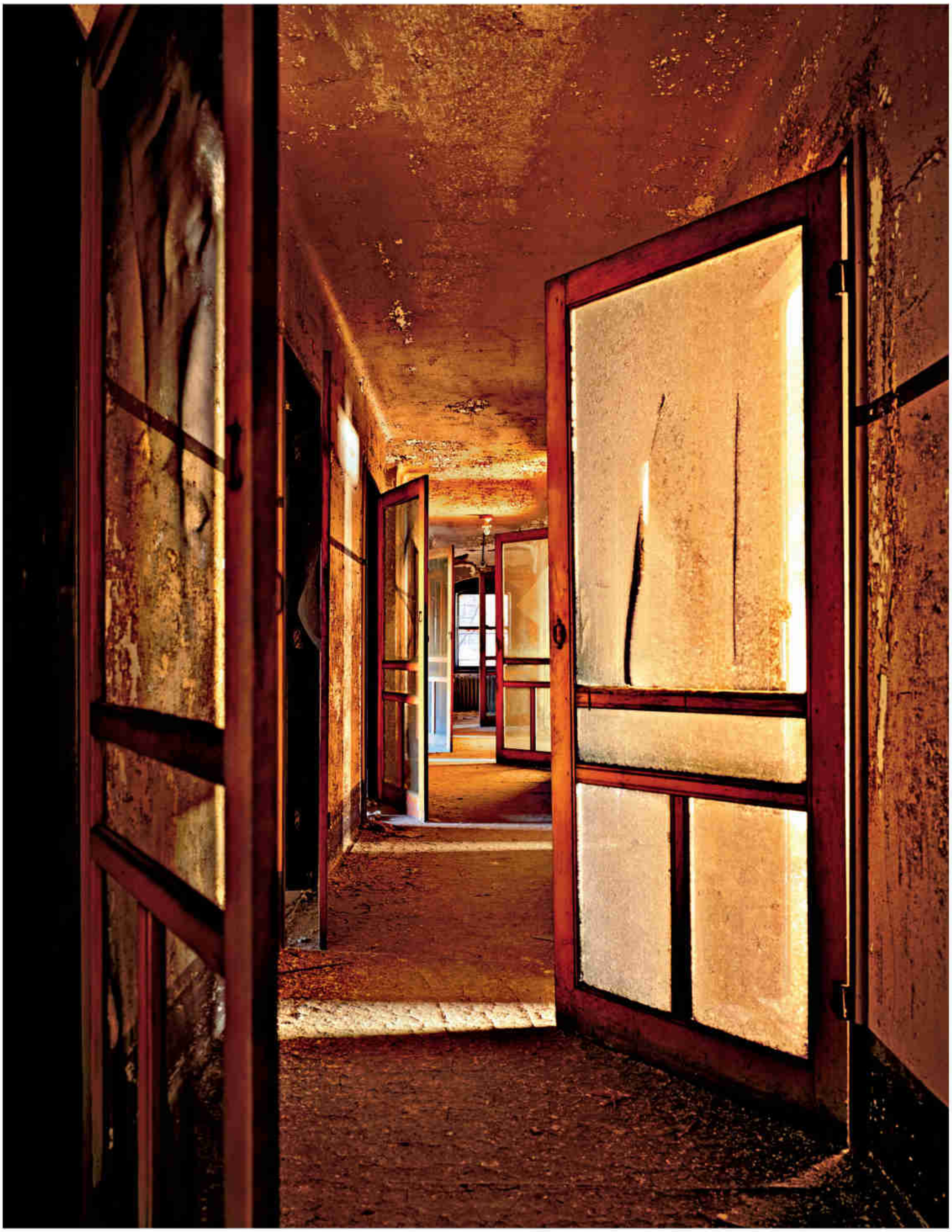

Coming up a dark stairway into quarters where nurses from the U.S. Public Health Service once slept, Stephen Wilkes was struck by the pattern of the angled doors, the tattered screens, and the low, golden sunshine. "I added no light of my own," the photographer says. "I wasn't interested simply in graphics born from the patina of ruin. I wanted to record the place as I found it."

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As he stood up from studying dead leaves on the floor of this hospital room, Wilkes remembers that his head reached a point about five feet, two inches off the floor—and he saw the Statue of Liberty reflected in the mirror over the sink. "I suddenly imagined a petite eastern European woman rising out of her bed every morning," the photographer says. "That reflection would have been the closest she would ever come to freedom."

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AMBIEN CR is a treatment option you and your healthcare provider can consider along with lifestyle changes and can be taken for as long as your provider recommends. Until you know how AMBIEN CR will affect you, you shouldn't drive or operate machinery. Be sure you're able to devote 7 to 8 hours to sleep before being active again. Sleepwalking, and eating or driving while not fully awake, with amnesia for the event, have been reported. If you experience any of these behaviors contact your provider immediately. In rare cases, sleep medicines may cause allergic reactions such as swelling of your tongue or throat, shortness of breath or more severe results. If you have an allergic reaction while using AMBIEN CR, contact your doctor immediately. Side effects may include next-day drowsiness, dizziness and headache. It's non-narcotic; however, like most sleep medicines, it has some risk of dependency. Don't take it with alcohol.

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INFORMATION FOR PATIENTS TAKING AMBIEN CR

Your doctor has prescribed Ambien CR to help you sleep. The following information is intended to guide you in the safe use of this medicine. It is not meant to take the place of your doctor's instructions. If you have any questions about Ambien CR tablets be sure to ask your doctor or pharmacist.

Ambien CR is used to treat different types of sleep problems, such as:

- trouble falling asleep
- waking up often during the night

Some people may have more than one of these problems.

Ambien CR belongs to a group of medicines known as the "sedative/hypnotics", or simply, sleep medicines. There are many different sleep medicines available to help people sleep better. Sleep problems are usually temporary, requiring treatment for only a short time, usually 1 or 2 days up to 1 or 2 weeks. Some people have chronic sleep problems that may require more prolonged use of sleep medicine. However, you should not use these medicines for long periods without talking with your doctor about the risks and benefits of prolonged use.

SIDE EFFECTS

Most common side effects:

- headache
- somnolence (sleepiness)
- dizziness

You may find that these medicines make you sleepy during the day. How drowsy you feel depends upon how your body reacts to the medicine, which sleep medicine you are taking, and how large a dose your doctor has prescribed. Daytime drowsiness is best avoided by taking the lowest dose possible that will still help you sleep at night. Your doctor will work with you to find the dose of Ambien CR that is best for you.

To manage these side effects while you are taking this medicine:

- When you first start taking Ambien CR or any other sleep medicine until you know whether the medicine will still have some carryover effect in you the next day, use extreme care while doing anything that requires complete alertness, such as driving a car, operating machinery, or piloting an aircraft.
- NEVER drink alcohol while you are being treated with Ambien CR or any sleep medicine. Alcohol can increase the side effects of Ambien CR or any other sleep medicine.
- Do not take any other medicines without asking your doctor first. This includes medicines you can buy without a prescription. Some medicines can cause drowsiness and are best avoided while taking Ambien CR.
- Always take the exact dose of Ambien CR prescribed by your doctor. Never change your dose without talking to your doctor first.

SPECIAL CONCERNS

There are some special problems that may occur while taking sleep medicines.

"Sleep-Driving" and other complex behaviors: There have been reports of people getting out of bed after taking a sleep medicine and driving their cars while not fully awake, often with no memory of the event. If you experience such an event, it should be reported to your doctor immediately, since "sleep-driving" can be dangerous. This behavior is more likely to occur when Ambien CR is taken with alcohol or other drugs such as those for the treatment of depression or anxiety. Other complex behaviors such as preparing and eating food, making phone calls, or having sex have been reported in people who are not fully awake after taking a sleep medicine. As with "sleep-driving", people usually do not remember these events.

Memory problems: Sleep medicines may cause a special type of memory loss or "amnesia." When this occurs, a person may not remember what has happened for several hours after taking the medicine. This is usually not a problem since most people fall asleep after taking the medicine.

Memory loss can be a problem, however, when sleep medicines are taken while traveling, such as during an airplane flight and the person wakes up before the effect of the medicine is gone. This has been called "traveler's amnesia."

Be sure to talk to your doctor if you think you are having memory problems. Although memory problems are not very common while taking Ambien CR, in most instances, they can be avoided if you take Ambien CR only when you are able to get a full night's sleep (7 to 8 hours) before you need to be active again.

Tolerance: When sleep medicines are used every night for more than a few weeks, they may lose their effectiveness to help you sleep. This is known as "tolerance". Sleep medicines should, in most cases, be used only for short periods of time, such as 1 or 2 days and generally no longer than 1 or 2 weeks. If your sleep problems continue, consult your doctor, who will determine whether other measures are needed to overcome your sleep problems.

Dependence: Sleep medicines can cause dependence, especially when these medicines are used regularly for longer than a few weeks or at high doses. Some people develop a need to continue taking their medicines. This is known as dependence or "addiction."

When people develop dependence, they may have difficulty stopping the sleep medicine. If the medicine is suddenly stopped, the body is not able to function normally and unpleasant symptoms may occur (see *Withdrawal*). They may find that they have to keep taking the medicines either at the prescribed dose or at increasing doses just to avoid withdrawal symptoms.

All people taking sleep medicines have some risk of becoming dependent on the medicine. However, people who have been dependent on alcohol or other drugs in the past may have a higher chance of becoming addicted to sleep medicines. This possibility must be considered before using these medicines for more than a few weeks.

If you have been addicted to alcohol or drugs in the past, it is important to tell your doctor before starting Ambien CR or any sleep medicine.

Withdrawal: Withdrawal symptoms may occur when sleep medicines are stopped suddenly after being used daily for a long time. In some cases, these symptoms can occur even if the medicine has been used for only a week or two.

In mild cases, withdrawal symptoms may include unpleasant feelings. In more severe cases, abdominal and muscle cramps, vomiting, sweating, shakiness, and rarely, seizures may occur. These more severe withdrawal symptoms are very uncommon.

Another problem that may occur when sleep medicines are stopped is known as "rebound insomnia." This means that a person may have more trouble sleeping the first few nights after the medicine is stopped than before starting the medicine. If you should experience rebound insomnia, do not get discouraged. This problem usually goes away on its own after 1 or 2 nights.

If you have been taking Ambien CR or any other sleep medicine for more than 1 or 2 weeks, do not stop taking it on your own. Always follow your doctor's directions.

Changes in behavior and thinking: Some people using sleep medicines have experienced unusual changes in their thinking and/or behavior. These effects are not common. However, they have included:

- more outgoing or aggressive behavior than normal
- confusion
- strange behavior
- agitation
- hallucinations
- worsening of depression
- suicidal thoughts

How often these effects occur depends on several factors, such as a person's general health, the use of other medicines, and which sleep medicine is being used.

It is also important to realize that it is rarely clear whether these behavior changes are caused by the medicine, an illness, or occur on their own. In fact, sleep problems that do not improve may be due to illnesses that were present before the medicine was used. If you or your family notice any changes in your behavior, or if you have any unusual or disturbing thoughts, call your doctor immediately.

Pregnancy: Sleep medicines may cause sedation of the unborn baby when used during the last weeks of pregnancy.

Be sure to tell your doctor if you are pregnant, if you are planning to become pregnant, or if you become pregnant while taking Ambien CR.

SAFE USE OF SLEEPING MEDICINES

To ensure the safe and effective use of Ambien CR or any other sleep medicine, you should observe the following cautions:

1. Ambien CR is a prescription medicine and should be used ONLY as directed by your doctor. Follow your doctor's instructions about how to take, when to take, and how long to take Ambien CR. Ambien CR tablets should not be divided, crushed, or chewed, and must be swallowed whole.
2. Never use Ambien CR or any other sleep medicine for longer than directed by your doctor.
3. If you develop an allergic reaction such as rash, hives, shortness of breath or swelling of your tongue or throat when using Ambien CR or any other sleep medicine, discontinue Ambien CR or other sleep medicine immediately and contact your doctor.
4. If you notice any unusual and/or disturbing thoughts or behavior during treatment with Ambien CR or any other sleep medicine, contact your doctor.
5. Tell your doctor about any medicines you may be taking, including medicines you may buy without a prescription. You should also tell your doctor if you drink alcohol. DO NOT use alcohol while taking Ambien CR or any other sleep medicine.
6. Do not take Ambien CR unless you are able to get a full night's sleep before you must be active again. For example, Ambien CR should not be taken on an overnight airplane flight of less than 7 to 8 hours since "traveler's amnesia" may occur.
7. Do not increase the prescribed dose of Ambien CR or any other sleep medicine unless instructed by your doctor.
8. When you first start taking Ambien CR or any other sleep medicine, until you know whether the medicine will still have some carryover effect in you the next day, use extreme care while doing anything that requires complete alertness, such as driving a car, operating machinery, or piloting an aircraft.
9. Be aware that you may have more sleeping problems the first night after stopping Ambien CR or any other sleep medicine.
10. Be sure to tell your doctor if you are pregnant, if you are planning to become pregnant, or if you become pregnant while taking Ambien CR or any other sleep medicine.
11. As with all prescription medicines, never share Ambien CR or any other sleep medicine with anyone else. Always store Ambien CR or any other sleep medicine in the original container that you received it in and store it out of reach of children.
12. Ambien CR works very quickly. You should only take Ambien CR right before going to bed and are ready to go to sleep.

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Papua New Guinea Like a fireworks factory struck by lightning, Tavurvur—an active cone in the massive Rabaul caldera—spews incandescent, fist- to football-size bombs of glowing-hot volcanic material.

PHOTO: OLIVIER GRUNEWALD

Italy Jutting 11,000 feet into the Sicilian sky, Mount Etna ranks among the planet's most active volcanoes. This eruption photographed last December was part of a cycle of activity that began in July 2006.

PHOTO: OLIVIER GRUNEWALD

Ethiopia The infernal glow of a lava lake in the Ertale volcano rivals moonrise over the Danakil Desert. Molten surface temperatures range from 550°F near the 262-foot-high walls to nearly 1000° at the center of the pit.

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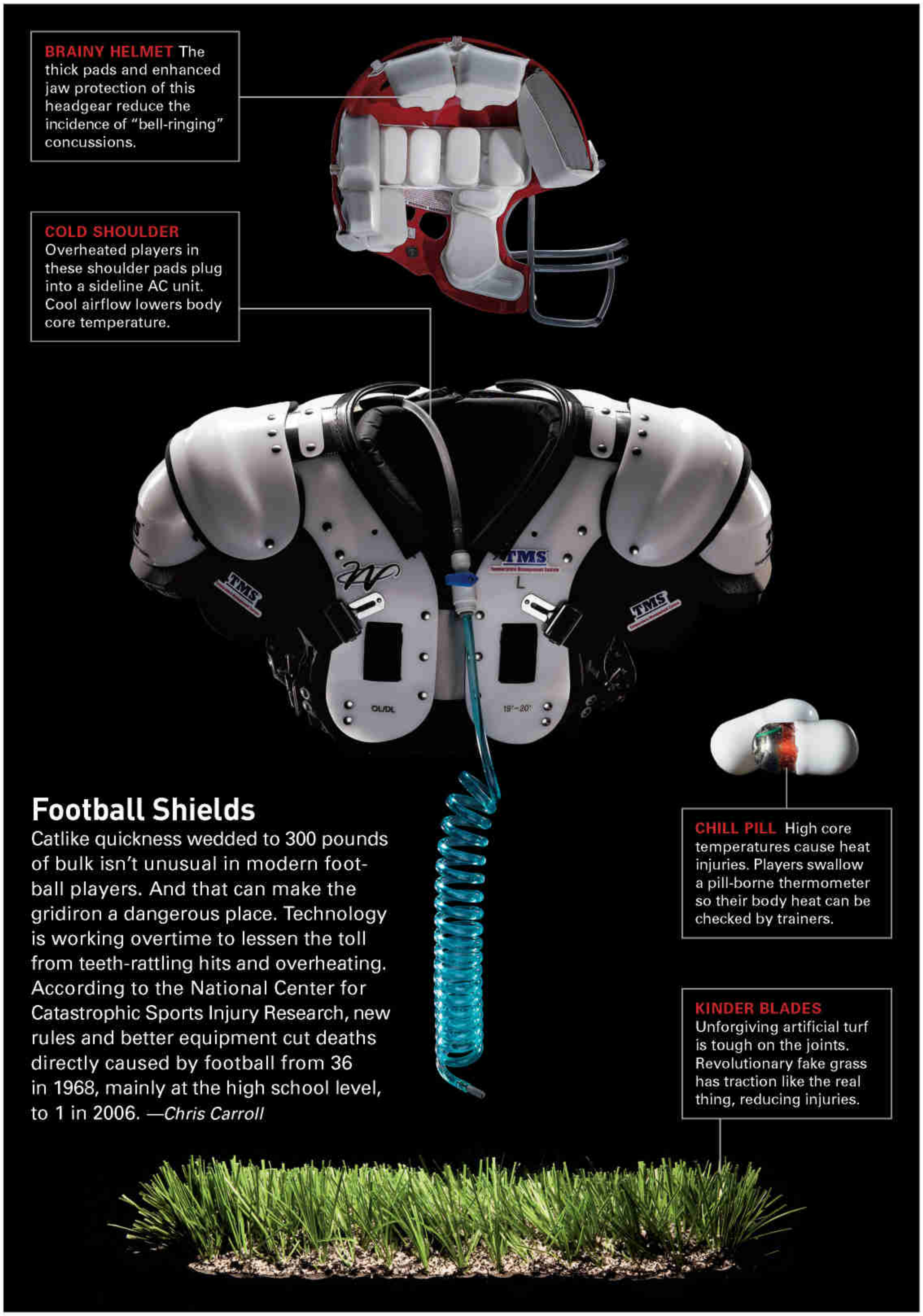

Football Shields

Catlike quickness wedded to 300 pounds of bulk isn't unusual in modern football players. And that can make the gridiron a dangerous place. Technology is working overtime to lessen the toll from teeth-rattling hits and overheating. According to the National Center for Catastrophic Sports Injury Research, new rules and better equipment cut deaths directly caused by football from 36 in 1968, mainly at the high school level, to 1 in 2006. *—Chris Carroll*

PHOTOS: NATIONAL GEOGRAPHIC PHOTOGRAPHER MARK THIESSEN

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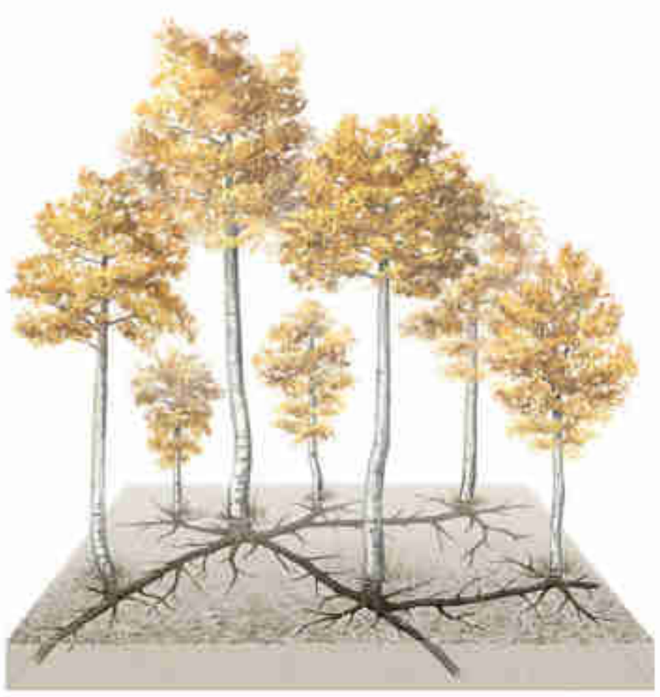

Aspens spread via dense root networks (simplified above), sending out sprouts to launch new trees.

Gasping Aspens Scientists are racing to find out what's killing the iconic white-bark aspen. Though the tree's numbers have shrunk steadily since the 1800s, researchers noted a drastic increase in deaths, especially in the West, in 2005. Last year Colorado, with the most aspens in North America, lost 138,000 acres of the trees, some 2 percent of its total. Silviculturist Wayne Shepperd says early data suggest that the dying aspens tend to be 80 to 150 years old. Possible causes include fewer forest fires and long droughts, leaving an aging population that's vulnerable to insects and disease. Foresters have reported limited diebacks in other western tree species, such as sugar pine and western white pine. Most diebacks are a natural part of forest ecology, although climate change may exacerbate them. The Forest Service is testing burns and selective logging on aspens to see if the health of ailing stands improves. *—Peter Gwin*

PHOTO: ANGIE FUHRMANN. ART BY JEN CHRISTIANSEN

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Please see brief summary of full Prescribing Information on reverse.

SPIRIVA does not replace fast-acting inhalers for sudden symptoms. Do not swallow the SPIRIVA capsule. The most common side effect of SPIRIVA is dry mouth. Others include constipation and problems passing urine. Tell your doctor about your medicines, including eye drops, and illnesses like glaucoma and urinary or prostate problems. These may worsen with SPIRIVA. If you have vision changes, eye pain, your breathing suddenly worsens, you get hives, or your throat or tongue swells, stop taking SPIRIVA and contact your doctor. For more information, call 1.877.SPIRIVA or visit spiriva.com

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Brief Summary of Prescribing Information

INDICATIONS AND USAGE

SPIRIVA HandiHaler (tiotropium bromide inhalation powder) is indicated for the long-term, once-daily, maintenance treatment of bronchospasm associated with chronic obstructive pulmonary disease (COPD), including chronic bronchitis and emphysema.

CONTRAINDICATIONS

SPIRIVA HandiHaler (tiotropium bromide inhalation powder) is contraindicated in patients with a history of hypersensitivity to atropine or its derivatives, including ipratropium, or to any component of this product.

WARNINGS

SPIRIVA HandiHaler (tiotropium bromide inhalation powder) is intended as a once-daily maintenance treatment for COPD and is not indicated for the initial treatment of acute episodes of bronchospasm, i.e., rescue therapy. Immediate hypersensitivity reactions, including angioedema, may occur after administration of SPIRIVA. If such a reaction occurs, therapy with SPIRIVA should be stopped at once and alternative treatments should be considered. Inhaled medicines, including SPIRIVA, may cause paradoxical bronchospasm. If this occurs, treatment with SPIRIVA should be stopped and other treatments considered.

PRECAUTIONS

General

As an anticholinergic drug, SPIRIVA (tiotropium bromide inhalation powder) may potentially worsen symptoms and signs associated with narrow-angle glaucoma, prostatic hyperplasia or bladder-neck obstruction and should be used with caution in patients with any of these conditions. As a predominantly renally excreted drug, patients with moderate to severe renal impairment (creatinin clearance of ≤50 mL/min) treated with SPIRIVA should be monitored closely (see **CLINICAL PHARMACOLOGY, Pharmacokinetics, Special Populations,** *Renally-impaired Patients*).

Information for Patients

It is important for patients to understand how to correctly administer SPIRIVA capsules using the HandiHaler inhalation device **(see Patient's Instructions for Use)**. SPIRIVA capsules should only be administered via the HandiHaler device and the HandiHaler device should not be used for administering other medications. Capsules should always be stored in sealed blisters. Remove only one capsule immediately before use, or its effectiveness may be reduced. Additional capsules that are exposed to air (i.e., not intended for immediate use) should be discarded. Eye pain or discomfort, blurred vision, visual halos or colored images in association with red eyes from conjunctival congestion and corneal edema may be signs of acute narrow-angle glaucoma. Should any of these signs and symptoms develop, consult a physician immediately. Miotic eye drops alone are not considered to be effective treatment. Care must be taken not to allow the powder to enter into the eyes as this may cause blurring of vision and pupil dilation.

SPIRIVA HandiHaler is a once-daily maintenance bronchodilator and should not be used for immediate relief of breathing problems, i.e., as a rescue medication.

Drug Interactions

SPIRIVA has been used concomitantly with other drugs commonly used in COPD without increases in adverse drug reactions. These include sympathomimetic bronchodilators, methylxanthines, and oral and inhaled steroids. However, the co-administration of SPIRIVA with other anticholinergic-containing drugs (e.g., ipratropium) has not been studied and is therefore not recommended.

Drug/Laboratory Test Interactions

None known.

Carcinogenesis, Mutagenesis, Impairment of Fertility

No evidence of tumorigenicity was observed in a 104-week inhalation study in rats at tiotropium doses up to 0.059 mg/kg/day, in an 83-week inhalation study in female mice at doses up to 0.145 mg/kg/day, and in a 101-week inhalation study in male mice at doses up to 0.002 mg/kg/day. These doses correspond to 25, 35, and 0.5 times the Recommended Human Daily Dose (RHDD) on a mg/m^2 basis, respectively. These dose multiples may be over-estimated due to difficulties in measuring deposited doses in animal inhalation studies. Tiotropium bromide demonstrated no evidence of mutagenicity or clastogenicity in the following assays: the bacterial gene mutation assay, the V79 Chinese hamster cell mutagenesis assay, the chromosomal aberration assays in human lymphocytes *in vitro* and mouse micronucleus formation *in vivo*, and the unscheduled DNA synthesis in primary rat hepatocytes *in vitro* assay. In rats, decreases in the number of corpora lutea and the percentage of implants were noted at inhalation tiotropium doses of 0.078 mg/kg/day or greater (approximately 35 times the RHDD on a mg/m^2 basis). No such effects were observed at 0.009 mg/kg/day (approximately 4 times than the RHDD on a mg/m^2 basis). The fertility index, however, was not affected at inhalation doses up to 1.689 mg/kg/day (approximately 760 times the RHDD on a mg/m^2 basis). These dose multiples may be over-estimated due to difficulties in measuring deposited doses in animal inhalation studies.

Pregnancy

Pregnancy Category C

No evidence of structural alterations was observed in rats and rabbits at inhalation tiotropium doses of up to 1.471 and 0.007 mg/kg/day, respectively. These doses correspond to approximately 660 and 6 times the recommended human daily dose (RHDD) on a mg/m^2 basis. However, in rats, fetal resorption, litter loss, decreases in the number of live pups at birth and the mean pup weights, and a delay in pup sexual maturation were observed at inhalation tiotropium doses of ≥0.078 mg/kg (approximately 35 times the RHDD on a mg/m^2 basis). In rabbits, an increase in post-implantation loss was observed at an inhalation dose of 0.4 mg/kg/day (approximately 360 times the RHDD on a mg/m^2 basis). Such effects were not observed at inhalation doses of 0.009 and up to 0.088 mg/kg/day in rats and rabbits, respectively. These doses correspond to approximately 4 and 80 times the RHDD on a mg/m^2 basis, respectively. These dose multiples may be over-estimated due to difficulties in measuring deposited doses in animal inhalation studies. There are no adequate and well-controlled studies in pregnant women. SPIRIVA should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

Use in Labor and Delivery

The safety and effectiveness of SPIRIVA has not been studied during labor and delivery.

Nursing Mothers

Clinical data from nursing women exposed to tiotropium are not available. Based on lactating rodent studies, tiotropium is excreted into breast milk. It is not known whether tiotropium is excreted in human milk, but because many drugs are excreted in human milk and given these findings in rats, caution should be exercised if SPIRIVA is administered to a nursing woman.

Pediatric Use

SPIRIVA HandiHaler is approved for use in the maintenance treatment of bronchospasm associated with chronic obstructive pulmonary disease, including chronic bronchitis and emphysema. This disease does not normally occur in children. The safety and effectiveness of SPIRIVA in pediatric patients have not been established.

Geriatric Use

Of the total number of patients who received SPIRIVA in the 1-year clinical trials, 426 were <65 years, 375 were 65–74 years and 105 were ≥75 years of age. Within each age subgroup, there were no differences between the proportion of patients with adverse events in the SPIRIVA and the comparator groups for most events. Dry mouth increased with age in the SPIRIVA group (differences from placebo were 9.0%, 17.1%, and 16.2% in the aforementioned age subgroups). A higher frequency of constipation and urinary tract infections with increasing age was observed in the SPIRIVA group in the placebo-controlled studies. The differences from placebo for constipation were 0%, 1.8%, and 7.8% for each of the age groups. The differences from placebo for urinary tract infections were −0.6%, 4.6% and 4.5%. No overall differences in effectiveness were observed among these groups. Based on available data, no adjustment of SPIRIVA dosage in geriatric patients is warranted.

ADVERSE REACTIONS

Of the 2,663 patients in the four 1-year and two 6-month controlled clinical trials, 1,308 were treated with SPIRIVA (tiotropium bromide inhalation powder) at the recommended dose of 18 mcg once a day. Patients with narrow angle glaucoma, or symptomatic prostatic hypertrophy or bladder outlet obstruction were excluded from these trials. The most commonly reported adverse drug reaction was dry mouth. Dry mouth was usually mild and often resolved during continued treatment. Other reactions reported in individual patients and consistent with possible anticholinergic effects included constipation, increased heart rate, blurred vision, glaucoma, urinary difficulty, and urinary retention. Four multicenter, 1-year, controlled studies evaluated SPIRIVA in patients with COPD. Table 1 shows all adverse events that occurred with a frequency of ≥3% in the SPIRIVA group in the 1-year placebo-controlled trials where the rates in the SPIRIVA group exceeded placebo by ≥1%. The frequency of corresponding events in the ipratropium-controlled trials is included for comparison.

Table 1: Adverse Experience Incidence (% Patients) in One-Year-COPD Clinical Trials

Body System (Event)	Placebo-Controlled Trials		Ipratropium-Controlled Trials	
	SPIRIVA [n = 550]	Placebo [n = 371]	SPIRIVA [n = 356]	Ipratropium [n = 179]
Body as a Whole				
Accidents	13	11	5	8
Chest Pain (non-specific)	7	5	5	2
Edema, Dependent	5	4	3	5
Gastrointestinal System Disorders				
Abdominal Pain	5	3	6	6
Constipation	4	2	1	1
Dry Mouth	16	3	12	6
Dyspepsia	6	5	1	1
Vomiting	4	2	1	2
Musculoskeletal System				
Myalgia	4	3	4	3
Resistance Mechanism Disorders				
Infection	4	3	1	3
Moniliasis	4	2	3	2
Respiratory System (upper)				
Epistaxis	4	2	1	1
Pharyngitis	9	7	7	3
Rhinitis	6	5	3	2
Sinusitis	11	9	3	2
Upper Respiratory Tract Infection	41	37	43	35
Skin and Appendage Disorders				
Rash	4	2	2	2
Urinary System				
Urinary Tract Infection	7	5	4	2

Arthritis, coughing, and influenza-like symptoms occurred at a rate of ≥3% in the SPIRIVA treatment group, but were <1% in excess of the placebo group. Other events that occurred in the SPIRIVA group at a frequency of 1–3% in the placebo-controlled trials where the rates exceeded that in the placebo group include: *Body as a Whole:* allergic reaction, leg pain; *Central and Peripheral Nervous System:* dysphonia, paresthesia; *Gastrointestinal System Disorders:* gastrointestinal disorder not otherwise specified (NOS), gastroesophageal reflux, stomatitis (including ulcerative stomatitis); *Metabolic and Nutritional Disorders:* hypercholesterolemia, hyperglycemia; *Musculoskeletal System Disorders:* skeletal pain; *Cardiac Events:* angina pectoris (including aggravated angina pectoris); *Psychiatric Disorder:* depression; *Infections:* herpes zoster; *Respiratory System Disorder (Upper):* laryngitis; *Vision Disorder:* cataract In addition, among the adverse events observed in the clinical trials with an incidence of <1% were atrial fibrillation, supraventricular tachycardia, angioedema, and urinary retention. In the 1-year trials, the incidence of dry mouth, constipation, and urinary tract infection increased with age (see **PRECAUTIONS, Geriatric Use**). Two multicenter, 6-month, controlled studies evaluated SPIRIVA in patients with COPD. The adverse events and the incidence rates were similar to those seen in the 1-year controlled trials. The following adverse reactions have been identified during worldwide post-approval use of SPIRIVA: dizziness, dysphagia, epistaxis, hoarseness, intestinal obstruction including ileus paralytic, intraocular pressure increased, oral candidiasis, palpitations, pruritus, tachycardia, throat irritation, and urticaria.

DOSAGE AND ADMINISTRATION

The recommended dosage of SPIRIVA HandiHaler (tiotropium bromide inhalation powder) is the inhalation of the contents of one SPIRIVA capsule, once-daily, with the HandiHaler inhalation device (see **Patient's Instructions for Use**). No dosage adjustment is required for geriatric, hepatically-impaired, or renally-impaired patients. However, patients with moderate to severe renal impairment given SPIRIVA should be monitored closely (see **CLINICAL PHARMACOLOGY, Pharmacokinetics, Special Populations** and **PRECAUTIONS**). SPIRIVA capsules are for inhalation only and must not be swallowed.

HOW SUPPLIED

The following packages are available:
carton containing 5 SPIRIVA capsules (1 unit-dose blister card) and 1 HandiHaler inhalation device (NDC 0597-0075-75)
carton containing 30 SPIRIVA capsules (3 unit-dose blister cards) and 1 HandiHaler inhalation device (NDC 0597 0075-41)
carton containing 90 SPIRIVA capsules (9 unit-dose blister cards) and 1 HandiHaler inhalation device (NDC 0597 0075-47)

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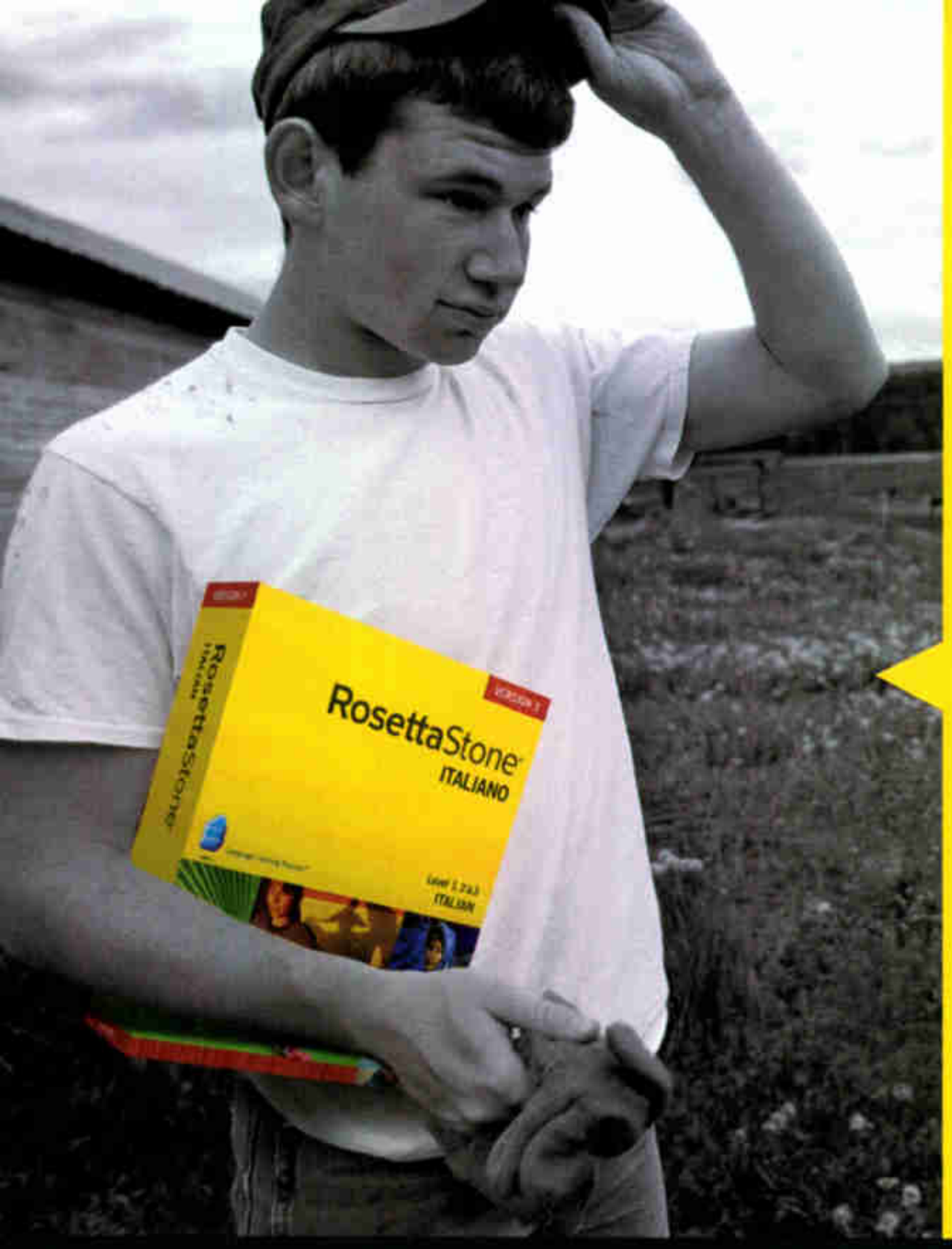

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FRY SAUCE
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Burger joints offer a thick dip of ketchup and mayo.

KRINGLE
Racine, Wis.
Circumference: 36 inches. Filling: fruit, cheese, or nuts.

BEEF ON WECK
Buffalo, N.Y.
Salty, seed-studded kummelweck rolls are a German vehicle for sliced beef.

COFFEE MILK
New England
It's milk with coffee syrup. Rhode Islanders add ice cream and call it a coffee cabinet.

BUCKEYES
Ohio
Chocolate and peanut butter mimic the state tree's nut.

CODDIES
Baltimore, Md.
A poor man's crab cake: lots of potato, a pinch of cod.

DATE SHAKES
California
Shredded dates add a hint of health to milk and ice cream.

GREEN CHILI STEW
New Mexico
A version of beef stew, with pork, lots of roasted chilies.

TOASTED RAVIOLI
St. Louis, Mo.
Breaded and deep-fried pasta pockets are a crispy counterpart to marinara.

LIVERMUSH
North Carolina
Pig parts and cornmeal fried in a block. Nearby states love it, too.

HALF-SMOKE
Washington, D.C.
Bigger, coarser, and spicier than a hot dog, the beef-pork combo is sold by street vendors and a few local eateries.

TEXAS CAVIAR
Texas
It's black-eyed peas, all dressed up with vinegar, veggies, and spices.

SPAM MUSUBI
Hawaii
The number one Spam-eating state fries it up for sushi.

Philly cheesesteaks have made it all the way to Oregon. But other local eats are confined to what food historians call micro-regions. The kringle, aka the "Danish oval pastry," is pretty much sold only in Racine, Wisconsin, where folks love its 86 layers of hand-folded dough. And Honesdale, Pennsylvania, is home to garage mix, a blend of chewy chocolate and peanuts that was once warmed on a Studebaker manifold. Now the mix is sold in a tin, and customers heat it up themselves. "If you grew up eating one of these dishes," says Michael Stern, author of 42 books on memorable American meals, "it's a part of your personality." St. Louis native Amanda McDougall agrees. "It's not a trip home unless you get toasted ravioli," she says. If a new boyfriend doesn't like it, he's toast. *—Catherine L. Barker*

Second Helping For more food, recipes, and a chance to add to our list, go to **ngm.com/localfoods.**

PHOTOS: NATIONAL GEOGRAPHIC PHOTOGRAPHER MARK THIESSEN

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NG GRANTEE

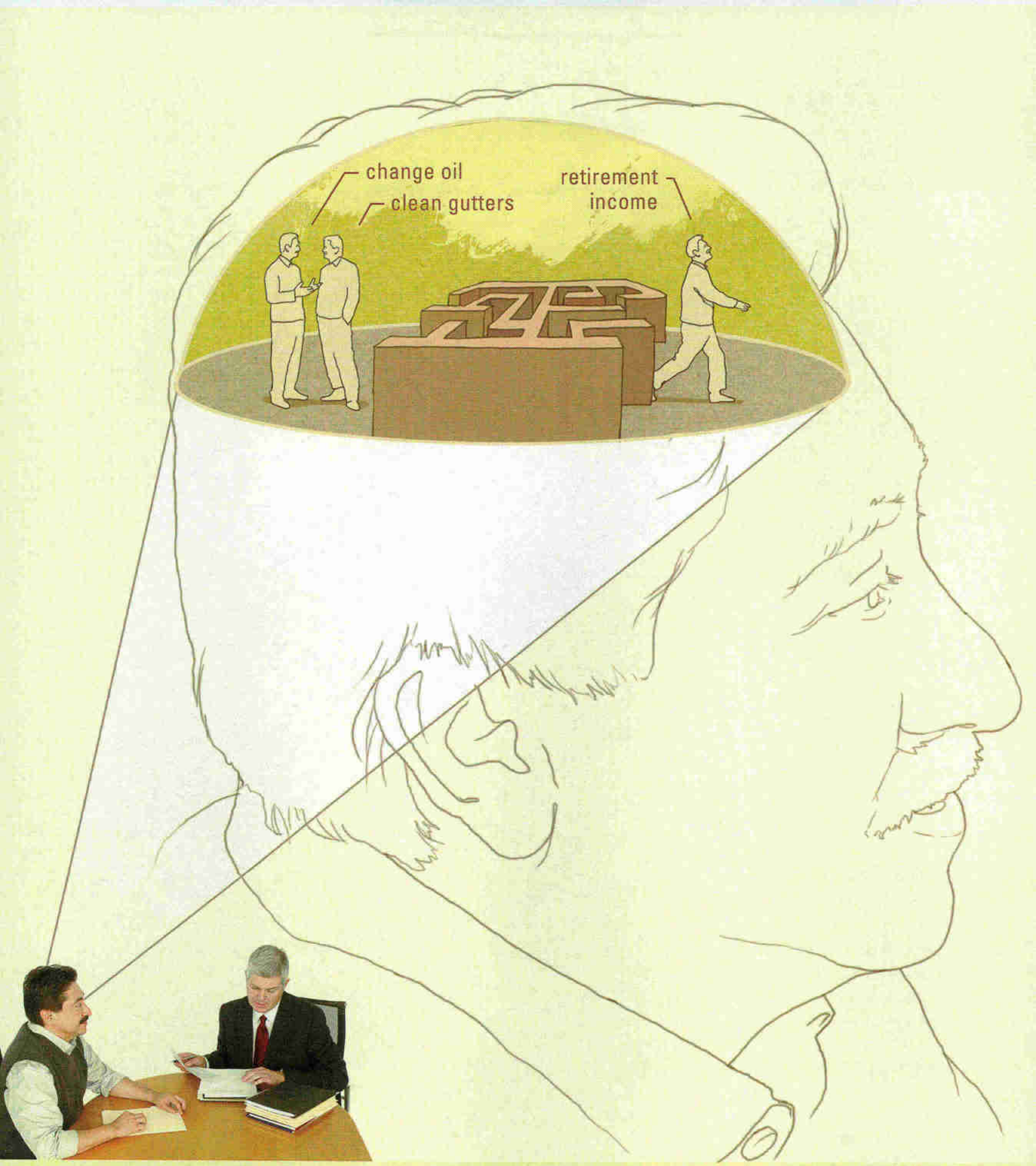
These Kangaroos Are Up a Tree

Tree kangaroos inspire two reactions. First: Awww, so cute! Second: They can't be real kangaroos! But they are, right down to their pouches. In parts of Australia, kangaroos developed an arboreal lifestyle, their legs adapting for climbing and walking in addition to hopping. And some of them moved to New Guinea.

Too bad those versatile limbs can't protect tree roos from danger. In Papua New Guinea, logging and mining are eroding their rain forest habitat; villagers hunt them for meat and for their tails, worn as headdresses in celebrations. Conservation biologist and Society grantee Lisa Dabek leads the community-based Tree Kangaroo Conservation Program in the Huon Peninsula. Local clans pledged 150,000 acres as a haven where the 15-to-18-pound Matschie's tree kangaroo (left), one of ten species, can laze in a favorite tree, chew leaves whose tannin boosts its camouflaging red hue, and raise babies, which spend up to 18 months with mom. A radio-collar project is gathering data about the elusive but well-adapted rain forest residents. When they curl up to sleep, whorls in their back fur let water run right off. *—Marc Silver*

The tree kangaroo's long tail is a vital balancing tool 150 feet up a tree.

PHOTO: TIM LAMAN. NGM MAPS



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IN THE RED

2%
of the world's population are estimated to be natural redheads.

13%
of Scotland's population are redheads. Two out of five carry the gene.

$123 million
was spent on red hair dye in the U.S. in 2006.

Red Alert

Does Britain's Prince Harry have endangered roots? This year, news reports buzzed that true redheads will be extinct by 2100, since carriers of the carrot-top gene are less and less likely to pair up in an age of global intermingling (a child usually needs a copy from each parent to get the red result). But while redheads may decline, the potential for red isn't going away. When a mutation created the special gene in northern Europe millennia ago, its effect on hair and skin pigments—causing red to build up instead of brown—was beneficial, upping the body's ability to make vitamin D from sunlight. Today, the gene's carriers are often prone to skin cancer and, oddly, some are more sensitive to heat- and cold-related pain. Only about 4 percent of people possess the gene, so fewer show the red trait. Still, it's hiding in the genome, rearing up far from its frigid origins, in far-flung places like Jamaica, a tip of the hat from a fiery Scottish forebear. *—Jennifer S. Holland*

PHOTO: REBECCA HALE, NGS STAFF. RED-DYE DATA: NIELSEN, COURTESY CLAIROL/PROCTER & GAMBLE

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ENVIRONMENT

The shortnose sturgeon grows to about three feet in length and can live for 60 years.

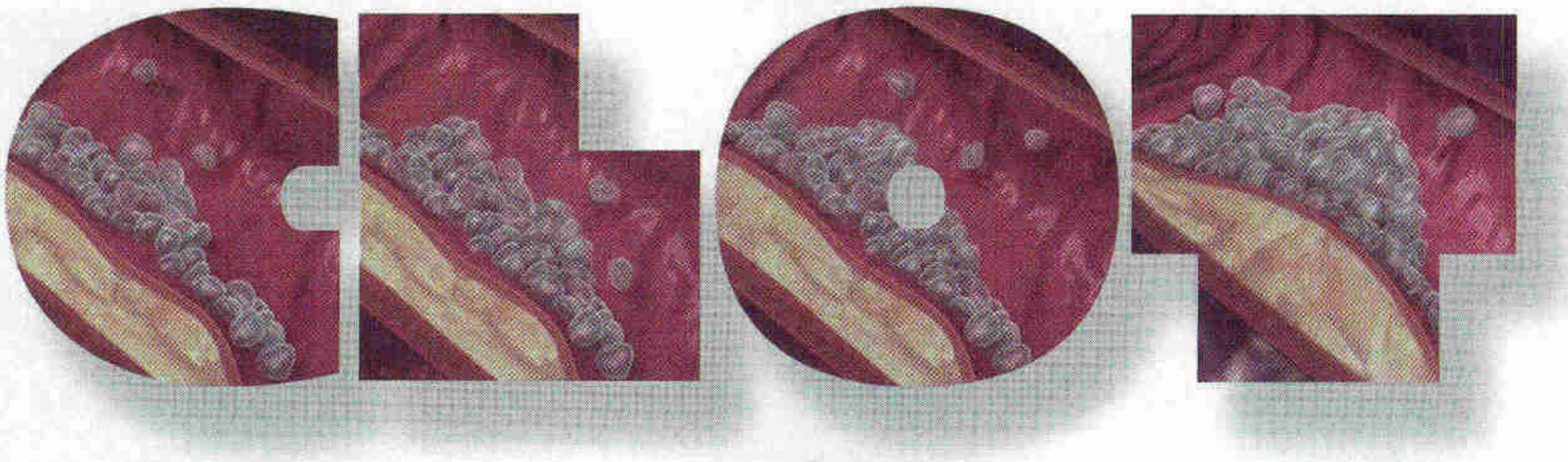
Resurgent Sturgeon In an amazing reversal, one of North America's most primitive fish has leaped back from the lip of extinction—at least in part of its range. Mark Bain, a biologist at Cornell University, published a study in January showing that the population of shortnose sturgeon in New York's Hudson River has risen from 13,000 in the late 1970s to roughly 60,000 today. Bain sees the discovery as proof that, over time, conservation efforts can help some imperiled species recover. The sturgeon, an ancient fish with tough skin, bony plates, and no scales, was a charter member of the 1973 U.S. Endangered Species Act. Back then, overfishing, pollution, and damming had jeopardized the fish in Atlantic coast rivers. The act tightened fishing and pollution controls, boosting its numbers. It's a net gain for the sturgeon—and for the act, at a time when some politicians are pushing to weaken it. *—Neil Shea*

Earth Watch

Holey Clouds UFO hunters be warned—there is probably a perfectly reasonable explanation for the massive holes that mysteriously form in cloud layers as if, well, a giant spaceship had blasted through. Scientists just haven't nailed it down yet.

Hole punch clouds, like one that formed over Mobile, Alabama, in 2003 (right), are thought to result when high-altitude ice crystals (possibly from jet exhaust) fall into lower clouds, explains J. Marshall Shepherd, a meteorologist at the University of Georgia. As the crystals descend they grow, and cloud water droplets around them evaporate, opening a window on the sky.

PHOTOS: PAUL VECSEI (TOP); PHIL M. LODER

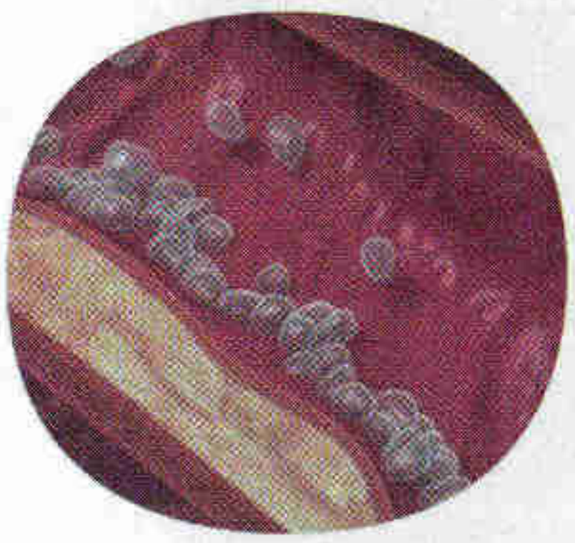


You can help protect against the formation of clots and reduce your risk of a future heart attack or stroke.

This is important information if you've been hospitalized with heart-related chest pain or a certain type of heart attack. That's because these conditions, known as Acute Coronary Syndrome—or ACS—are usually caused when blood platelets stick together and form clots that block blood flow to your heart. And if you've already had a clot, you're at an increased risk for a future heart attack or stroke.

PLAVIX, taken with other heart medicines, helps provide greater protection against heart attack or stroke than other heart medicines alone.

That's because prescription PLAVIX works differently than your cholesterol and blood pressure medications, focusing on your blood platelets to help keep them from sticking together and forming clots.



IMPORTANT INFORMATION: If you have a stomach ulcer or other condition that causes bleeding, you should not use PLAVIX. When taking PLAVIX alone or with some medicines including aspirin, the risk of bleeding may increase. To minimize this risk, always talk to your doctor before taking aspirin or other medicines with PLAVIX, especially if you've had a stroke. Additional rare but serious side effects could occur.

See important product information on the following pages.

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INDICATIONS AND USAGE

PLAVIX (clopidogrel bisulfate) is indicated for the reduction of atherothrombotic events as follows:

- **Recent MI, Recent Stroke or Established Peripheral Arterial Disease**

  For patients with a history of recent myocardial infarction (MI), recent stroke, or established peripheral arterial disease, PLAVIX has been shown to reduce the rate of a combined endpoint of new ischemic stroke (fatal or not), new MI (fatal or not), and other vascular death.

- **Acute Coronary Syndrome**

  -For patients with non-ST-segment elevation acute coronary syndrome (unstable angina/ non-Q-wave MI) including patients who are to be managed medically and those who are to be managed with percutaneous coronary intervention (with or without stent) or CABG, PLAVIX has been shown to decrease the rate of a combined endpoint of cardiovascular death, MI, or stroke as well as the rate of a combined endpoint of cardiovascular death, MI, stroke, or refractory ischemia

  -For patients with ST-segment elevation acute myocardial infarction, PLAVIX has been shown to reduce the rate of death from any cause and the rate of a combined endpoint of death, re-infarction or stroke. This benefit is not known to pertain to patients who receive primary angioplasty.

CONTRAINDICATIONS

The use of PLAVIX is contraindicated in the following conditions:

Hypersensitivity to the drug substance or any component of the product.

Active pathological bleeding such as peptic ulcer or intracranial hemorrhage.

WARNINGS

Thrombotic thrombocytopenic purpura (TTP):

TTP has been reported rarely following use of PLAVIX, sometimes after a short exposure (<2 weeks). TTP is a serious condition that can be fatal and requires urgent treatment including plasmapheresis (plasma exchange). It is characterized by thrombocytopenia, microangiopathic hemolytic anemia (schistocytes [fragmented RBCs] seen on peripheral smear), neurological findings, renal dysfunction, and fever. (See **ADVERSE REACTIONS**.)

PRECAUTIONS

General

PLAVIX prolongs the bleeding time and therefore should be used with caution in patients who may be at risk of increased bleeding from trauma, surgery, or other pathological conditions (particularly gastrointestinal and intraocular). If a patient is to undergo elective surgery and an antiplatelet effect is not desired, PLAVIX should be discontinued 5 days prior to surgery.

Due to the risk of bleeding and undesirable hematological effects, blood cell count determination and/or other appropriate testing should be promptly considered, whenever such suspected clinical symptoms arise during the course of treatment (see **ADVERSE REACTIONS**).

In patients with recent TIA or stroke who are at high risk for recurrent ischemic events, the combination of aspirin and PLAVIX has not been shown to be more effective than PLAVIX alone, but the combination has been shown to increase major bleeding.

GI Bleeding: In CAPRIE, PLAVIX was associated with a rate of gastrointestinal bleeding of 2.0%, vs. 2.7% on aspirin. In CURE, the incidence of major gastrointestinal bleeding was 1.3% vs 0.7% (PLAVIX + aspirin vs. placebo + aspirin, respectively). PLAVIX should be used with caution in patients who have lesions with a propensity to bleed (such as ulcers). Drugs that might induce such lesions should be used with caution in patients taking PLAVIX.

Use in Hepatically Impaired Patients: Experience is limited in patients with severe hepatic disease, who may have bleeding diatheses. PLAVIX should be used with caution in this population.

Use in Renally-impaired Patients: Experience is limited in patients with severe renal impairment. PLAVIX should be used with caution in this population.

Information for Patients

Patients should be told it may take them longer than usual to stop bleeding, that they may bruise and/or bleed more easily when they take PLAVIX or PLAVIX combined with aspirin, and that they should report any unusual bleeding to their physician. Patients should inform physicians and dentists that they are taking PLAVIX and/or any other product known to affect bleeding before any surgery is scheduled and before any new drug is taken.

Drug Interactions

Study of specific drug interactions yielded the following results:

Aspirin: Aspirin did not modify the clopidogrel-mediated inhibition of ADP-induced platelet aggregation. Concomitant administration of 500 mg of aspirin twice a day for 1 day did not significantly increase the prolongation of bleeding time induced by PLAVIX. PLAVIX potentiated the effect of aspirin on collagen-induced platelet aggregation. PLAVIX and aspirin have been administered together for up to one year.

Heparin: In a study in healthy volunteers, PLAVIX did not necessitate modification of the heparin dose or alter the effect of heparin on coagulation. Coadministration of heparin had no effect on inhibition of platelet aggregation induced by PLAVIX.

Nonsteroidal Anti-Inflammatory Drugs (NSAIDs): In healthy volunteers receiving naproxen, concomitant administration of PLAVIX was associated with increased occult gastrointestinal blood loss. NSAIDs and PLAVIX should be coadministered with caution.

Warfarin: Because of the increased risk of bleeding, the concomitant administration of warfarin with PLAVIX should be undertaken with caution. (See **PRECAUTIONS– General.**)

Other Concomitant Therapy: No clinically significant pharmacodynamic interactions were observed when PLAVIX was coadministered with **atenolol, nifedipine,** or both atenolol and nifedipine. The pharmacodynamic activity of PLAVIX was also not significantly influenced by the coadministration of **phenobarbital, cimetidine** or **estrogen.**

The pharmacokinetics of **digoxin** or **theophylline** were not modified by the coadministration of PLAVIX (clopidogrel bisulfate).

At high concentrations *in vitro*, clopidogrel inhibits P_{450} (2C9). Accordingly, PLAVIX may interfere with the metabolism of **phenytoin, tamoxifen, tolbutamide, warfarin, torsemide, fluvastatin,** and many **non-steroidal anti-inflammatory agents,** but there are no data with which to predict the magnitude of these interactions. Caution should be used when any of these drugs is coadministered with PLAVIX.

In addition to the above specific interaction studies, patients entered into clinical trials with PLAVIX received a variety of concomitant medications including **diuretics, beta-blocking agents, angiotensin converting enzyme inhibitors, calcium antagonists, cholesterol lowering agents, coronary vasodilators, antidiabetic agents** (including **insulin), thrombolytics, heparins** (unfractionated and LMWH) **GPIIb/IIIa antagonists, antiepileptic agents** and **hormone replacement therapy** without evidence of clinically significant adverse interactions.

There are no data on the concomitant use of oral anticoagulants, non-study oral anti-platelet drugs and chronic NSAIDs with clopidogrel.

Drug/Laboratory Test Interactions

None known.

Carcinogenesis, Mutagenesis, Impairment of Fertility

There was no evidence of tumorigenicity when clopidogrel was administered for 78 weeks to mice and 104 weeks to rats at dosages up to 77 mg/kg per day, which afforded plasma exposures >25 times that in humans at the recommended daily dose of 75 mg.

Clopidogrel was not genotoxic in four *in vitro* tests (Ames test, DNA-repair test in rat hepatocytes, gene mutation assay in Chinese hamster fibroblasts, and metaphase chromosome analysis of human lymphocytes) and in one *in vivo* test (micronucleus test by oral route in mice).

Clopidogrel was found to have no effect on fertility of male and female rats at oral doses up to 400 mg/kg per day (52 times the recommended human dose on a mg/m^2 basis).

Pregnancy

Pregnancy Category B. Reproduction studies performed in rats and rabbits at doses up to 500 and 300 mg/kg/day (respectively, 65 and 78 times the recommended daily human dose on a mg/m^2 basis), revealed no evidence of impaired fertility or fetotoxicity due to clopidogrel. There are, however, no adequate and well-controlled studies in pregnant women. Because animal reproduction studies are not always predictive of a human response, PLAVIX should be used during pregnancy only if clearly needed.

Nursing Mothers

Studies in rats have shown that clopidogrel and/or its metabolites are excreted in the milk. It is not known whether this drug is excreted in human milk. Because many drugs are excreted in human milk and because of the potential for serious adverse reactions in nursing infants, a decision should be made whether to discontinue nursing or to discontinue the drug, taking into account the importance of the drug to the nursing woman.

Pediatric Use

Safety and effectiveness in the pediatric population have not been established.

Geriatric Use

Of the total number of subjects in CAPRIE, CURE and CLARITY controlled clinical studies, approximately 50% of patients treated with PLAVIX were 65 years of age and older and 15% were 75 years and older. In COMMIT, approximately 58% of the patients treated with PLAVIX were 60 years and older, 26% of whom were 70 years and older.

The observed risk of thrombotic events with clopidogrel plus aspirin versus placebo plus aspirin by age category is provided in Figures 3 and 6 for the CURE and COMMIT trials, respectively (see **CLINICAL STUDIES**). The observed risk of bleeding events with clopidogrel plus aspirin versus placebo plus aspirin by age category is provided in Tables 5 and 6 for the CURE and COMMIT trials, respectively (see **ADVERSE REACTIONS**).

ADVERSE REACTIONS

PLAVIX has been evaluated for safety in more than 42,000 patients, including over 9,000 patients treated for 1 year or more. The clinically important adverse events observed in CAPRIE, CURE, CLARITY and COMMIT are discussed below.

The overall tolerability of PLAVIX in CAPRIE was similar to that of aspirin regardless of age, gender and race, with an approximately equal incidence (13%) of patients withdrawing from treatment because of adverse reactions.

Hemorrhagic: In CAPRIE patients receiving PLAVIX, gastrointestinal hemorrhage occurred at a rate of 2.0%, and required hospitalization in 0.7%. In patients receiving aspirin, the corresponding rates were 2.7% and 1.1%, respectively. The incidence of intracranial hemorrhage was 0.4% for PLAVIX compared to 0.5% for aspirin.

In CURE, PLAVIX use with aspirin was associated with an increase in bleeding compared to placebo with aspirin (see Table 5). There was an excess in major bleeding in patients receiving PLAVIX plus aspirin compared with placebo plus aspirin, primarily gastrointestinal and at puncture sites. The incidence of intracranial hemorrhage (0.1%), and fatal bleeding (0.2%), were the same in both groups.

The overall incidence of bleeding is described in Table 5 for patients receiving both PLAVIX and aspirin in CURE.

Table 5: CURE Incidence of bleeding complications (% patients)

Event	PLAVIX (+ aspirin)* (n=6259)	Placebo (+ aspirin)* (n=6303)	P-value
Major bleeding †	3.7 ‡	2.7 §	0.001
Life-threatening bleeding	2.2	1.8	0.13
Fatal	0.2	0.2	
5 g/dL hemoglobin drop	0.9	0.9	
Requiring surgical intervention	0.7	0.7	
Hemorrhagic strokes	0.1	0.1	
Requiring inotropes	0.5	0.5	
Requiring transfusion (≥4 units)	1.2	1.0	
Other major bleeding	1.6	1.0	0.005
Significantly disabling	0.4	0.3	
Intraocular bleeding with significant loss of vision	0.05	0.03	
Requiring 2-3 units of blood	1.3	0.9	
Minor bleeding ¶	5.1	2.4	<0.001

* Other standard therapies were used as appropriate.

† Life threatening and other major bleeding.

‡ Major bleeding event rate for PLAVIX + aspirin was dose-dependent on aspirin: <100 mg=2.6%; 100-200 mg= 3.5%; >200 mg=4.9%
Major bleeding event rates for PLAVIX + aspirin by age were: <65 years = 2.5%, ≥65 to <75 years = 4.1%, ≥75 years 5.9%

§ Major bleeding event rate for placebo + aspirin was dose-dependent on aspirin: <100 mg=2.0%; 100-200 mg= 2.3%; >200 mg=4.0%
Major bleeding event rates for placebo + aspirin by age were: <65 years = 2.1%, ≥65 to <75 years = 3.1%, ≥75 years 3.6%

¶ Led to interruption of study medication.

Ninety-two percent (92%) of the patients in the CURE study received heparin/LMWH, and the rate of bleeding in these patients was similar to the overall results.

There was no excess in major bleeds within seven days after coronary bypass graft surgery in patients who stopped therapy more than five days prior to surgery (event rate 4.4% PLAVIX + aspirin; 5.3% placebo + aspirin). In patients who remained on therapy within five days of bypass graft surgery, the event rate was 9.6% for PLAVIX + aspirin, and 6.3% for placebo + aspirin.

In CLARITY, the incidence of major bleeding (defined as intracranial bleeding or bleeding associated with a fall in hemoglobin > 5 g/dL) was similar between groups (1.3% versus 1.1% in the PLAVIX + aspirin and in the placebo + aspirin groups, respectively). This was consistent across subgroups of patients defined by baseline characteristics, and type of fibrinolytics or heparin therapy. The incidence of fatal bleeding (0.8% versus 0.6% in the PLAVIX + aspirin and in the placebo + aspirin groups, respectively) and intracranial hemorrhage (0.5% versus 0.7%, respectively) was low and similar in both groups.

The overall rate of noncerebral major bleeding or cerebral bleeding in COMMIT was low and similar in both groups as shown in Table 6 below.

Table 6: Number (%) of Patients with Bleeding Events in COMMIT

Type of bleeding	PLAVIX (+ aspirin) (N = 22961)	Placebo (+ aspirin) (N = 22891)	P-value
Major* noncerebral or cerebral bleeding**	134 (0.6%)	125 (0.5%)	0.59
Major noncerebral	82 (0.4%)	73 (0.3%)	0.48
Fatal	36 (0.2%)	37 (0.2%)	0.90
Hemorrhagic stroke	55 (0.2%)	56 (0.2%)	0.91
Fatal	39 (0.2%)	41 (0.2%)	0.81
Other noncerebral bleeding (non-major)	831 (3.6%)	721 (3.1%)	0.005
Any noncerebral bleeding	896 (3.9%)	777 (3.4%)	0.004

* Major bleeds are cerebral bleeds or non-cerebral bleeds thought to have caused death or that required transfusion.

** The relative rate of major noncerebral or cerebral bleeding was independent of age. Event rates for PLAVIX + aspirin by age were: <60 years = 0.3%, ≥60 to <70 years = 0.7%, ≥70 years 0.8%. Event rates for placebo + aspirin by age were: <60 years = 0.4%, ≥60 to <70 years = 0.6%, ≥70 years 0.7%.

Adverse events occurring in ≥2.5% of patients on PLAVIX in the CAPRIE controlled clinical trial are shown below regardless of relationship to PLAVIX. The median duration of therapy was 20 months, with a maximum of 3 years.

Table 7: Adverse Events Occurring in ≥2.5% of PLAVIX Patients in CAPRIE

	% Incidence (% Discontinuation)	
Body System **Event**	**PLAVIX [n=9599]**	**Aspirin [n=9586]**
Body as a Whole – general disorders		
Chest Pain	8.3 (0.2)	8.3 (0.3)
Accidental/Inflicted Injury	7.9 (0.1)	7.3 (0.1)
Influenza-like symptoms	7.5 (<0.1)	7.0 (<0.1)
Pain	6.4 (0.1)	6.3 (0.1)
Fatigue	3.3 (0.1)	3.4 (0.1)
Cardiovascular disorders, general		
Edema	4.1 (<0.1)	4.5 (<0.1)
Hypertension	4.3 (<0.1)	5.1 (<0.1)
Central & peripheral nervous system disorders		
Headache	7.6 (0.3)	7.2 (0.2)
Dizziness	6.2 (0.2)	6.7 (0.3)
Gastrointestinal system disorders		
Any event	27.1(3.2)	29.8 (4.0)
Abdominal pain	5.6 (0.7)	7.1 (1.0)
Dyspepsia	5.2 (0.6)	6.1 (0.7)
Diarrhea	4.5 (0.4)	3.4 (0.3)
Nausea	3.4 (0.5)	3.8 (0.4)
Metabolic & nutritional disorders		
Hypercholesterolemia	4.0 (0)	4.4 (<0.1)
Musculo-skeletal system disorders		
Arthralgia	6.3 (0.1)	6.2 (0.1)
Back Pain	5.8 (0.1)	5.3 (<0.1)
Platelet, bleeding, & clotting disorders		
Purpura/Bruise	5.3 (0.3)	3.7 (0.1)
Epistaxis	2.9 (0.2)	2.5 (0.1)
Psychiatric disorders		
Depression	3.6 (0.1)	3.9 (0.2)
Respiratory system disorders		
Upper resp tract infection	8.7 (<0.1)	8.3 (<0.1)
Dyspnea	4.5 (0.1)	4.7 (0.1)
Rhinitis	4.2 (0.1)	4.2 (<0.1)
Bronchitis	3.7 (0.1)	3.7 (0)
Coughing	3.1 (<0.1)	2.7(<0.1)
Skin & appendage disorders		
Any event	15.8 (1.5)	13.1 (0.8)
Rash	4.2 (0.5)	3.5 (0.2)
Pruritus	3.3 (0.3)	1.6 (0.1)
Urinary system disorders		
Urinary tract infection	3.1 (0)	3.5 (0.1)

No additional clinically relevant events to those observed in CAPRIE with a frequency ≥2.5%, have been reported during the CURE and CLARITY controlled studies. COMMIT collected only limited safety data.

Other adverse experiences of potential importance occurring in 1% to 2.5% of patients receiving PLAVIX (clopidogrel bisulfate) in the controlled clinical trials are listed below regardless of relationship to PLAVIX. In general, the incidence of these events was similar to that in patients receiving aspirin (in CAPRIE) or placebo + aspirin (in the other clinical trials).

Autonomic Nervous System Disorders: Syncope, Palpitation. *Body as a Whole-general disorders:* Asthenia, Fever, Hernia. *Cardiovascular disorders:* Cardiac failure. *Central and peripheral nervous system disorders:* Cramps legs, Hypoaesthesia, Neuralgia, Paraesthesia, Vertigo. *Gastrointestinal system disorders:* Constipation, Vomiting. *Heart rate and rhythm disorders:* Fibrillation atrial. *Liver and biliary system disorders:* Hepatic enzymes increased. *Metabolic and nutritional disorders:* Gout, hyperuricemia, non-protein nitrogen (NPN) increased. *Musculo-skeletal system disorders:* Arthritis, Arthrosis. *Platelet, bleeding & clotting disorders:* GI hemorrhage, hematoma, platelets decreased. *Psychiatric disorders:* Anxiety, Insomnia. *Red blood cell disorders:* Anemia. *Respiratory system disorders:* Pneumonia, Sinusitis. *Skin and appendage disorders:* Eczema, Skin ulceration. *Urinary system disorders:* Cystitis. *Vision disorders:* Cataract, Conjunctivitis.

Other potentially serious adverse events which may be of clinical interest but were rarely reported (<1%) in patients who received PLAVIX in the controlled clinical trials are listed below regardless of relationship to PLAVIX. In general, the incidence of these events was similar to that in patients receiving aspirin (in the other clinical trials) .

Body as a whole: Allergic reaction, necrosis ischemic. *Cardiovascular disorders:* Edema generalized. *Gastrointestinal system disorders:* Peptic, gastric or duodenal ulcer, gastritis, gastric ulcer perforated, gastritis hemorrhagic, upper GI ulcer hemorrhagic. *Liver and Biliary system disorders:* Bilirubinemia, hepatitis infectious, liver fatty. *Platelet, bleeding and clotting disorders:* hemarthrosis, hematuria, hemoptysis, hemorrhage intracranial, hemorrhage retroperitoneal, hemorrhage of operative wound, ocular hemorrhage, pulmonary hemorrhage, purpura allergic, thrombocytopenia. *Red blood cell disorders:* Anemia aplastic, anemia hypochromic. *Reproductive disorders, female:* Menorrhagia. *Respiratory system disorders:* Hemothorax. *Skin and appendage disorders:* Bullous eruption, rash erythematous, rash maculopapular, urticaria. *Urinary system disorders:* Abnormal renal function, acute renal failure. *White cell and reticuloendothelial system disorders:* Agranulocytosis, granulocytopenia, leukemia, leukopenia, neutropenia.

Postmarketing Experience

The following events have been reported spontaneously from worldwide postmarketing experience:

- *Body as a whole:*
  -hypersensitivity reactions, anaphylactoid reactions, serum sickness
- *Central and Peripheral Nervous System disorders:*
  -confusion, hallucinations, taste disorders
- *Hepato-biliary disorders:*
  -abnormal liver function test, hepatitis (non-infectious), acute liver failure
- *Platelet, Bleeding and Clotting disorders:*
  -cases of bleeding with fatal outcome (especially intracranial, gastrointestinal and retroperitoneal hemorrhage)
  -thrombotic thrombocytopenic purpura (TTP) – some cases with fatal outcome- (see **WARNINGS**).
  -agranulocytosis, aplastic anemia/pancytopenia
  -conjunctival, ocular and retinal bleeding
- *Respiratory, thoracic and mediastinal disorders:*
  -bronchospasm, interstitial pneumonitis
- *Skin and subcutaneous tissue disorders:*
  -angioedema, erythema multiforme, Stevens-Johnson syndrome, toxic epidermal necrolysis, lichen planus
- *Renal and urinary disorders:*
  - glomerulopathy, increased creatinine levels
- *Vascular disorders:*
  - vasculitis, hypotension
- *Gastrointestinal disorders:*
  - colitis (including ulcerative or lymphocytic colitis), pancreatitis, stomatitis
- *Musculoskeletal, connective tissue and bone disorders:*
  - myalgia

OVERDOSAGE

Overdose following clopidogrel administration may lead to prolonged bleeding time and subsequent bleeding complications. A single oral dose of clopidogrel at 1500 or 2000 mg/kg was lethal to mice and to rats and at 3000 mg/kg to baboons. Symptoms of acute toxicity were vomiting (in baboons), prostration, difficult breathing, and gastrointestinal hemorrhage in all species.

Recommendations About Specific Treatment:

Based on biological plausibility, platelet transfusion may be appropriate to reverse the pharmacological effects of PLAVIX if quick reversal is required.

DOSAGE AND ADMINISTRATION

Recent MI, Recent Stroke, or Established Peripheral Arterial Disease

The recommended daily dose of PLAVIX is 75 mg once daily.

Acute Coronary Syndrome

For patients with non-ST-segment elevation acute coronary syndrome (unstable angina/non-Q-wave MI), PLAVIX should be initiated with a single 300 mg loading dose and then continued at 75 mg once daily. Aspirin (75 mg-325 mg once daily) should be initiated and continued in combination with PLAVIX. In CURE, most patients with Acute Coronary Syndrome also received heparin acutely (see **CLINICAL STUDIES).**

For patients with ST-segment elevation acute myocardial infarction, the recommended dose of PLAVIX is 75 mg once daily, administered in combination with aspirin, with or without thrombolytics. PLAVIX may be initiated with or without a loading dose (300 mg was used in CLARITY; see **CLINICAL STUDIES**).

PLAVIX can be administered with or without food.

No dosage adjustment is necessary for elderly patients or patients with renal disease. (See **Clinical Pharmacology: Special Populations.)**

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Brief Summary of Prescribing Information Revised February 2007

PLA-FEB07-B-Ae

WHERE IN THE WORLD?

The San Juan River meanders through Utah toward the Colorado River and Lake Powell.

Goosenecks State Park The silty San Juan River takes its time wending through ten-acre Goosenecks State Park in Utah: Unfurled, the river's path would stretch five times as far. One of the world's most dramatic examples of the geologic formation known as "entrenched meander," the twisting thousand-foot-deep chasm was carved by the river over the course of some four million years. *—Margaret G. Zackowitz*

PHOTO: SPACE IMAGING

OYSTER PERPETUAL
GMT-MASTER II

Rolex patented a unique process to create the bezel of the GMT-Master II. It is made from an extremely hard ceramic material. The numerals are carved before the ceramic hardens. The entire bezel is then covered with gold, atom by atom. Finally, it is polished until only the gold in the numerals remains, permanently. Even a Rolex has to suffer to be beautiful.

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NEW YORK For an Official Rolex Jeweler call 1-800-367-6539. Rolex ♛ Oyster Perpetual and GMT-Master II are trademarks.

A gold-splashed cap and brick-hued body distinguish the male firecrown from the female, whose feathers are green, blue, and purple. About five inches long, the birds feed on nectar and insects.

Fading Firecrown Saving endangered species is a big job shadowed by big questions. Can we preserve them all? Should we even try? Researcher Erin Hagen doesn't have the answers. For now, she's doing what she can to help just one: the Juan Fernández firecrown, a showy, highly curious hummingbird that hovers on the edge of extinction. The firecrown lives only on Robinson Crusoe Island, more than 400 miles off the coast of Chile. Nineteenth-century records show the birds were so plentiful that collectors could shoot 100 males in a day. Now, perhaps 1,000 birds remain.

Hagen, a University of Washington doctoral student, is working with the Chilean government to learn more about the bird's dramatic decline and to devise conservation plans. Clues suggest problems arrived from across the sea: Imported goats and plants reduced the firecrown's native food. Cats and rats ate the birds and their eggs. Even immigrant hummingbirds appear to vie for resources and now outnumber the firecrown two to one. *—Neil Shea*

ART: JOHANNA ENRIQUEZ

wHr r Ur car kEz?

I nEd 2 mEt 4 wit my fRnds

Sometimes it seems like your teen speaks a different language. Which makes it pretty tough when you need to talk to them about certain issues, like smart driving. But we've created a Web site with the help of the National Safety Council to make "the talk" a little easier. At nationwidesmartride.com, we've included tips and tools to help you make your teen a smarter driver. You'll even find expert research from psychologists focused on teen brain development and ways to effectively communicate with them. Even understand them. So no lectures, eye rolling or whatevers. Just you and your teen talking face to face about smart driving. Now that's Life Comes at You Fast® or, as they'd say, LCAYF.

Nationwide®

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nationwidesmartride.com

wHr r Ur car kEz? I nEd 2 mEt 4 wit my fRnds.

TECHNOLOGY

A Colorado bison sports antenna panels.

Former sugar silos now hold phone gear.

The fruit of the palm: antenna panels.

A cross takes cell signals closer to heaven.

The flag's real. The pole's a cellular tower.

Cell Phonies To paraphrase Joyce Kilmer: "I think that I shall never see, a cell phone tower lovely as a tree." And that's not poetic license. Municipal officials and nature lovers are requiring camouflage because a naked tower with antenna panels and cables is deemed an eyesore, notes telecom lawyer Jonathan Kramer, and a "mono-pine" is a popular disguise. Cellular firms pay a price for fiberglass or foam fakery. A rooftop antenna enclosure starts at about $3,000; a steeple can cost from $15,000 to $80,000 or more. If the tower is on private property, monthly rent ranges from $500 to $4,000. Some 20,000 to 50,000 stealth structures have been built in the U.S., and more communities are calling for concealment. But the average citizen may be blissfully unaware. "If you didn't notice it," says Shea Burman of Wireless Concealment Systems, "we did a good job." *—Marc Silver*

A mock rock lets Californians talk.

A cellular cactus curtails prickly reception.

A fake water tank stands on a parking lot.

Antennas haunt a house in a cemetery.

The red light alerts low-flying copters.

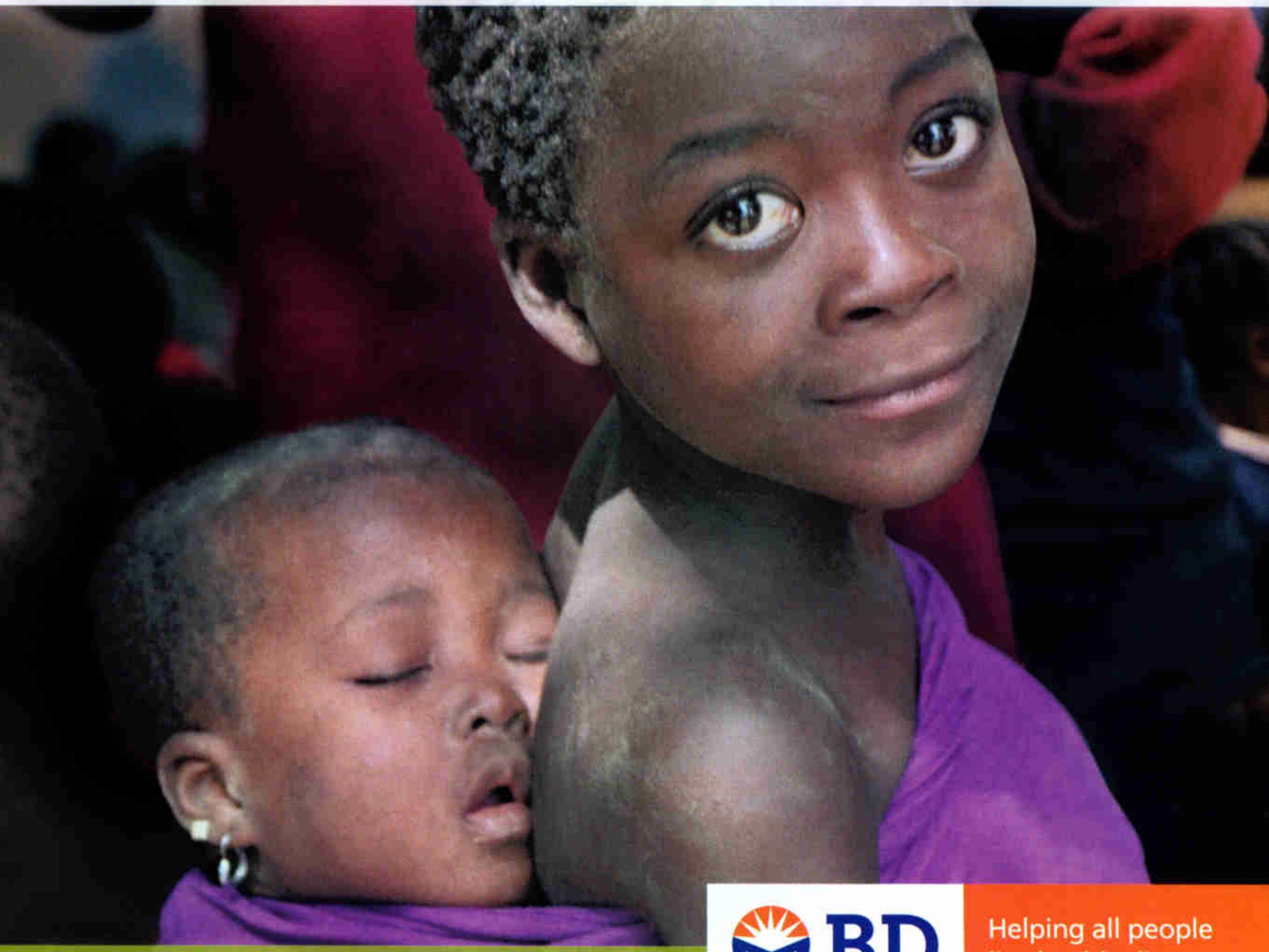
Cell Test Identify the camouflage sites in a Photo Gallery at **ngm.com/0709.**

PHOTOS: JONATHAN L. KRAMER, KRAMER FIRM, INC.

American Red Cross

Measles, a disease barely remembered by most Americans, kills more than 600,000 children a year, half of those in Africa.[1]

The Measles Initiative is a commitment to vaccinate 200 million African children over five years. Leading this effort are the American Red Cross, United Nations Foundation, Centers for Disease Control and Prevention, World Health Organization, and United Nations Children's Fund. To learn more, go to www.measlesinitiative.org.



BD

Helping all people live healthy lives

Together in caring

A life-saving vaccine against measles was developed 40 years ago, but in some developing countries it has not been available. Getting it to every at-risk child in sub-Saharan Africa is the objective of the Measles Initiative.

For 40 years, syringes from one company have delivered more measles vaccines than any other: BD. It is only natural that today BD would partner with the American Red Cross in supporting this life-giving program.

BD SoloShot™ Syringes are ideal to deliver the measles vaccine in Africa because they automatically disable upon use—preventing reuse of the syringe and the potential spread of infectious diseases. In addition, BD is supporting an intensive program to raise awareness locally and to teach healthcare providers to inject the vaccine correctly.

BD is a medical technology company serving some of the greatest needs of the global community. Healthcare institutions, life sciences researchers, clinical laboratories, industry, and the general public all rely on BD products every day.

BD—selected as one of America's Most Admired Companies by *FORTUNE* magazine[2]—is privileged to partner with the American Red Cross and organizations like it to protect life by addressing fundamental healthcare issues in every corner of the world.

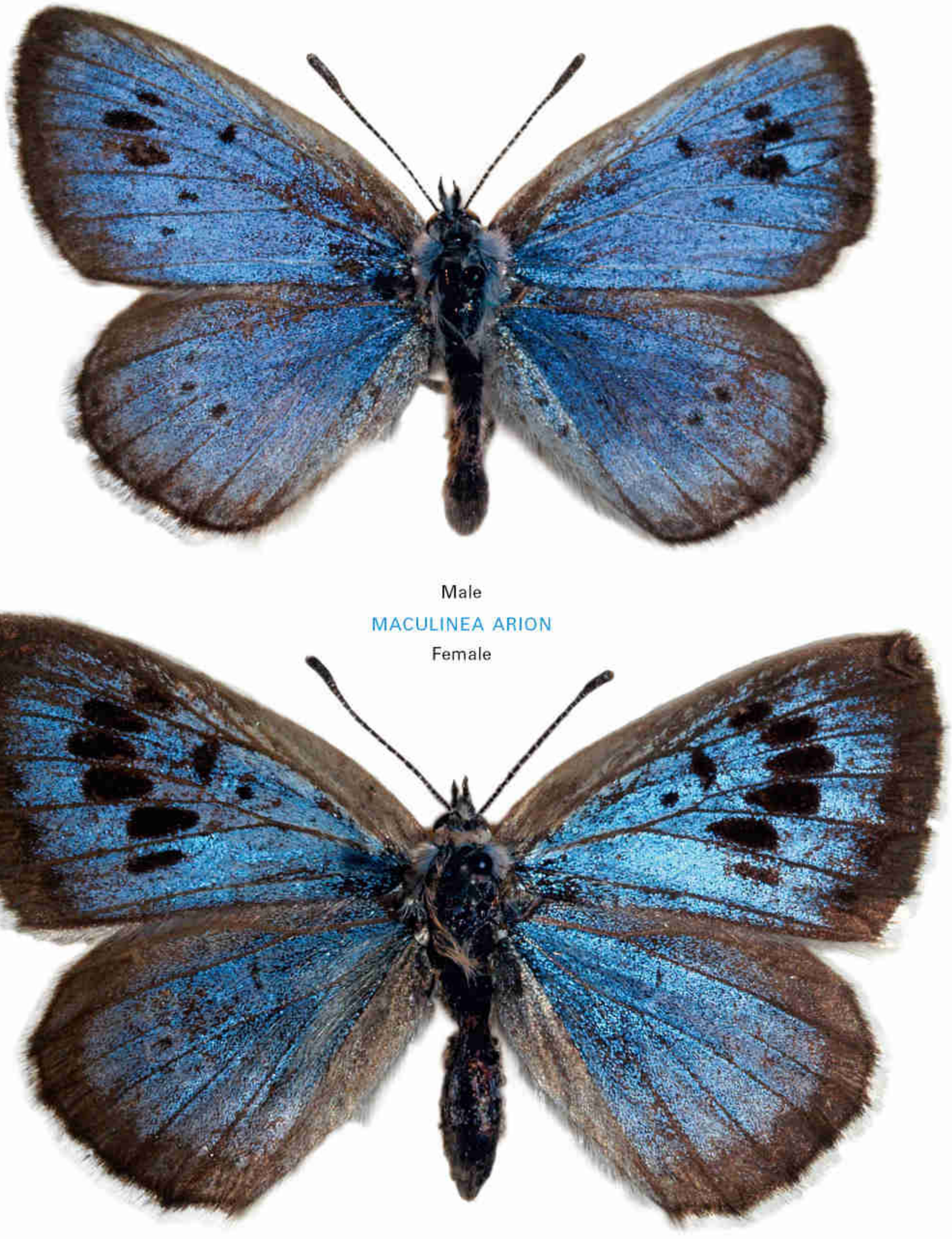
BD—Helping all people live healthy lives.

Please visit www.bd.com.

[1] Official World Health Organization figures: 614,000 total deaths; 312,000 in Africa.

[2] "America's Most Admired Companies" annual survey, 2007; *FORTUNE* magazine, March 19, 2007.

Photo ©Qualter-Bernal/US Fund for UNICEF



Male

MACULINEA ARION

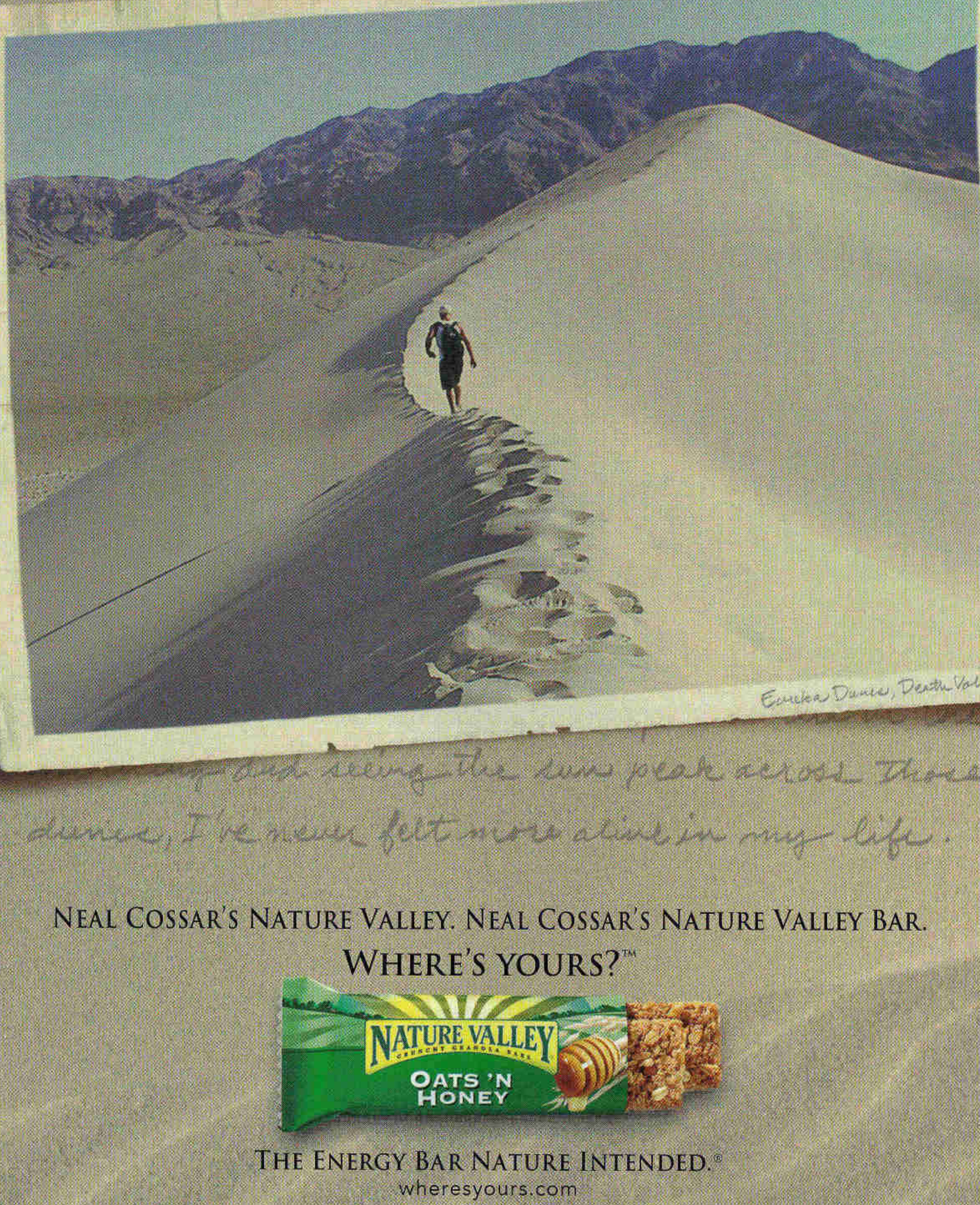
Female

Big Blue Is Back In 1979, England's last large blue butterfly —about two inches long—perished. Ecologist Jeremy Thomas watched it die . . . and knew why. Its caterpillars fed on the larvae of a species of red ant that thrived on closely grazed hillsides. But as land use changed, sheep and cattle lost out, ants diminished, and butterflies vanished. Thomas's colleague David Simcox at Dorset's Centre for Ecology and Hydrology rallied volunteers to the cause, bringing back grazing animals and importing caterpillars from Sweden. After a 20-year effort, some 10,000 big blues flitted over the English countryside last summer. —*Joel K. Bourne, Jr.*

PHOTO: DAVID SIMCOX, CENTRE FOR ECOLOGY AND HYDROLOGY, DORSET, U.K.

YOU LEAVE YOUR MARK ON THE SAND. AND VICE VERSA.

Part of me thinks I'll never get the sand out of my shoes. The other part hopes I never do. In



Eureka Dunes, Death Valley

...eryone but keeping the two peak xeroxed. These dunes, I've never felt more alive in my life.

NEAL COSSAR'S NATURE VALLEY. NEAL COSSAR'S NATURE VALLEY BAR.

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THE ENERGY BAR NATURE INTENDED.®

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FOSSILS

On a dig in northeastern China, paleontologist Nick Fraser discovered fossilized plants, including the fern *Cladophlebis* (above).

NG GRANTEE **Return of the Ferns** The last time these plants performed photosynthesis, the oxygen they produced was inhaled by early dinosaurs. Now the 220-million-year-old greenery is in the hands of scientists.

Paleontologist Nick Fraser, of the Virginia Museum of Natural History, came across the fossils while in China on a fellowship in 2005. He and two Chinese geologists went to Liaoning Province, famous for flamboyantly feathered dinosaur fossils from the final era of the dinosaurs. Those sites require permits, so the scientists instead visited an area of rocks from the Triassic period, when the first dinosaurs lived. "We spent an afternoon just hacking through some of the sediment in this village, using hammers," Fraser says.

They were rewarded with some of the most complete Triassic plant remains ever found: ferns, cycads, and horsetails, some showing cuticle, a thin leaf layer that will help further identify the plants. Many were preserved flat, still attached to the rhizomes, their underground rootlike structures. Fraser plans to use plants from the site—along with any insects that turn up—to learn how the world looked when dinosaurs took their first steps. *—Helen Fields*

PHOTO: NICK FRASER

Recycling isn't monkey business.

Stop monkeying around. Everyone can recycle their used rechargeable batteries once they've worn out. It's easy. Check the batteries in your laptop computers, camcorders, cordless power tools, cordless and cellular phones, digital cameras, and two-way radios. If they no longer hold a charge, recycle them by visiting one of many collection sites nationwide, including those retailers listed below. For a complete list of rechargeable battery drop-off locations, visit **www.call2recycle.org** or call toll free **877-2-RECYCLE**.

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Recycle at one of these national retailers: BEST BUY · Circuit City · Office DEPOT · RadioShack · Sears · STAPLES · TARGET

ANNOUNCING THE INAUGURAL NATIONAL GEOGRAPHIC PHOTOGRAPHY CONTEST

As a leader in capturing our world through brilliant imagery, *National Geographic* magazine sets the standard for photographic excellence. Now, we're inviting you to share your vision of the world through your own photography.

Submit your entry online in any of these four categories:

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Enter to win and you could find your photograph published in the pages of *National Geographic* magazine!

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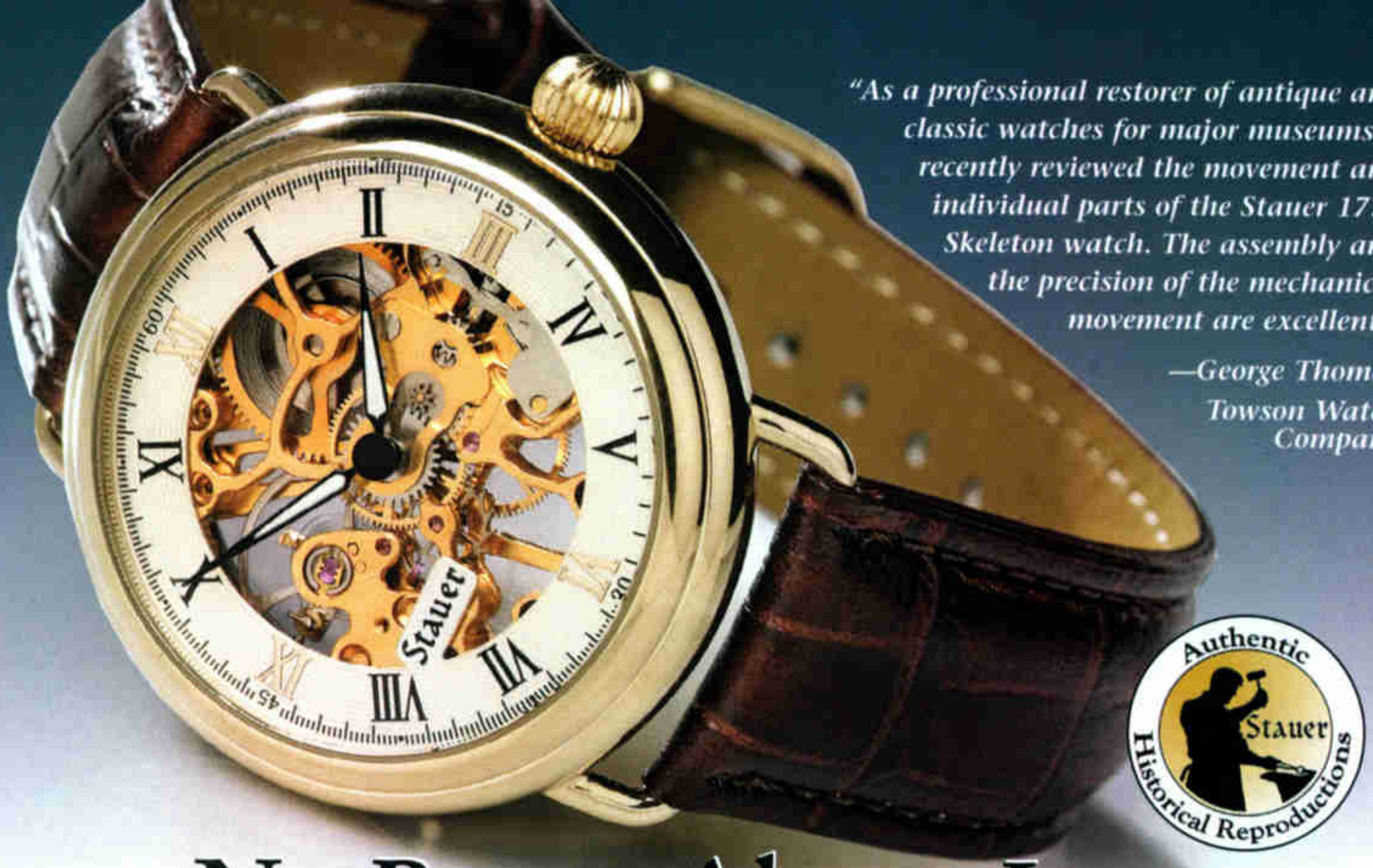
Hurry, contest ends October 31, 2007. For more details, complete rules and regulations, and information on how you can enter today, visit **www.ngphotocontest.com.**

PHOTOGRAPHS FROM LEFT: NICK NICHOLS (LEFT AND CENTER), JODI COBB



No Bones About It

The Vintage Design of the Stauer 1779 Skeleton Reveals the Precision Inner Workings of a Great Machine.

We found our most interesting watch in our oldest history book. A trip to an antique book store led us to find one of the earliest examples of the sought after skeleton timepiece. With a 227-year-old design, Stauer has brought back the past in the intriguing old world geometry of the Stauer 1779 Skeleton. See right through to the precision gears and hand assembled movement and into the heart of the unique timepiece. It's like seeing an X-Ray inside the handsome gold filled case.

The open exhibition back allows you to further explore the intricate movement and fine craftsmanship.

Beauty is Only Skin Deep But the Engineering Goes Right to the Bone. Intelligent collectors of vintage mechanical watches have grown bored with mass produced quartz movements. Like fine antique car collectors, they look for authenticity, but they also want practicality from their tiny machines. Inspired by a rare museum piece dating to 1779, we engineered this classic with $31,000,000 worth of precise Swiss built machinery to create the intricate gears and levers. So the historians are thrilled with the authenticity and the demanding engineers are quite impressed with the technical performance.

See All the Way Through. The crystal on the front and the see through exhibition back allow you to observe the gold-fused mainspring, escapement, balance wheel and many of the 17 rubies work in harmony. The balance wheel oscillates at 21,600 times per hour for superb accuracy. The crocodile embossed leather strap adjusts from 6 1/2" to 9" so it will fit practically any wrist. So give it a little wind and the gears roar to life.

The Time Machine. We took the timepiece to George Thomas, a noted historian and watch restorer for major museums, and he dissected the 110 parts of the vintage movement. He gave the "1779" top reviews. "It is possible to build it better than the original, and your new skeleton requires so little maintenance." When we shared the price with him, George was stunned. He said that no other luxury skeleton can be had for under $1000. But we pour our money into the watch construction, not into sponsoring yacht races and polo matches. We have been able to keep the price on this collector's limited edition to only three payments of $33. So you can wear a piece of watch making history and still keep most of your money in your pocket, not on your wrist. This incredible watch has an attractive price and comes with an exclusive 30-day in-home trial. If you're not completely satisfied with the performance and exquisite detail of this fine timepiece, simply return it for a full refund of your purchase price. The Stauer Skeleton Watch is a limited edition, so please act quickly. Historical value rarely repeats itself.

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Sourdough starter, a culture of bacteria and wild yeast, creates a crusty, tangy loaf.

Sourdough, Slow and Fast Before packaged yeast and factory-baked bread, most leavened loaves were sourdough, born of the interaction among flour, bacteria, and wild yeast floating in the air. That mighty breadmaking combo, called a starter, has quite a history. In ancient Egypt, sourdough fed the workers who built the pyramids at Giza. Today, home bakers can use the Internet to order vintage starters with distinctive tangs from sourdough hot spots like San Francisco, Russia, and Australia. But sourdough bread does take time: A loaf relying on a starter instead of commercial yeast needs to rise at least 12 hours. That's too long for many bakeries, which now stir in enzymes and chemicals, called bread improvers, to speed up the process. *—A. R. Williams*

PHOTO: MITCHELL FEINBERG

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Coffee, Tea, or WD-40? In the living room of the future, a man gestures from the couch. A robot rolls over and asks what he wants. Tea, he says. Another robot in the kitchen pours a cup and hands it to the wheeled humanoid, who, guided by sensors in the floor and furniture, delivers it without spilling a drop. This, say researchers, may be how many elderly are cared for in a decade or two: in their homes, by robots. The server and tea-pourer (below) showed off earlier this year at a Tokyo University demo. So far, they can perform their tasks only in a specially equipped room.

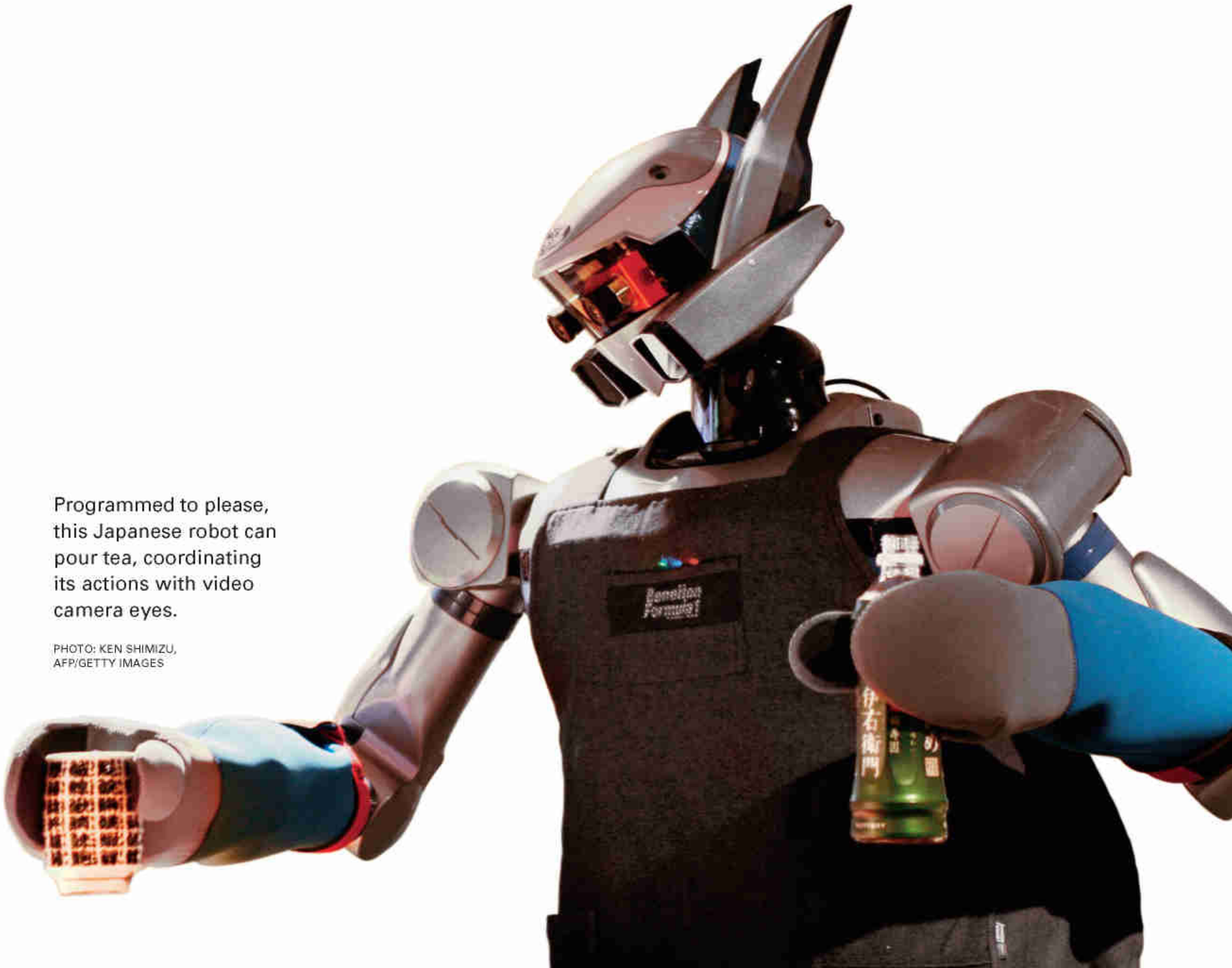
The robot Domo—Japanese slang for "thank you"—takes on trickier chores, like putting away groceries. Judging an item's size is hard for a humanoid, even one with googly blue eyes. But Domo is able to grasp and size up an object, then efficiently shelve it. To meet other needs, the robot is also capable of fixing a drink, shaking hands, and proffering a hug. Domo's designer, MIT postdoctoral fellow Aaron Edsinger, hopes a similar 'bot will someday sell for about $40,000.

Until then, consumers will have to settle for far simpler, specialized machines, such as robotic toilet cleaners. Skeptics, like Stanford University robotics expert Sebastian Thrun, say that's all people will ever need: "A dishwasher is a much better way of cleaning dishes than a humanoid robot." *—Karen E. Lange*

ROBOT ROUNDUP

■ **Synthetic Seal**
Paro looks like a baby harp seal and moves its flippers and head when its soft fake fur is stroked. In studies at hospitals and nursing homes, the robot improved the mental health of patients who spent time with it.

■ **Steel Chef** China's cooking robot is programmed to fix more than 100 dishes. Put a box of prepped ingredients inside the robot, which looks like a fridge but has a gas burner and wok. Within minutes it cooks a hot meal. Developed at Shanghai Jiao Tong and Yangzhou Universities and a tech firm, the robo-cooker is poised to toil in restaurants this year.



Programmed to please, this Japanese robot can pour tea, coordinating its actions with video camera eyes.

PHOTO: KEN SHIMIZU, AFP/GETTY IMAGES

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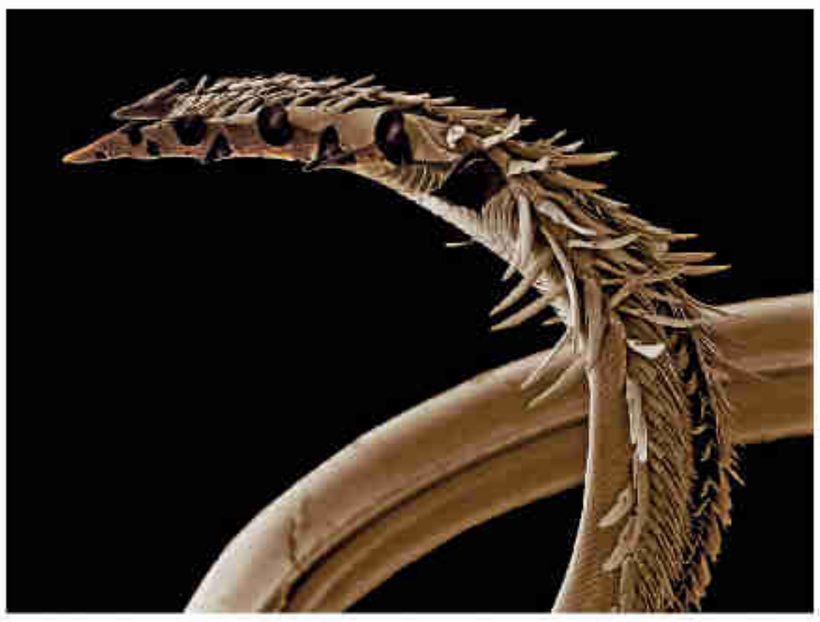
Look closely: The moth's thin brown proboscis is sipping tears from the bird's closed eye.

Bird's-Eye Beverage The moth alights on the neck of a sleeping bird and drinks its tears. The bird slumbers on, oblivious. That's the extraordinary sight that was revealed by the headlamp of German primatologist Roland Hilgartner in Madagascar's Kirindy Reserve. Light reflecting off its eyes, the insect drank for half an hour from the eye of a common Newtonia (above). *Hemiceratoides hieroglyphica* is not nature's sole tear sipper. Other moths and butterflies suck up tears to get salt and proteins. But they drink from much larger creatures, like antelope, that aren't bothered by the insects. *H. hieroglyphica* is the only one that goes for a bird's tears.

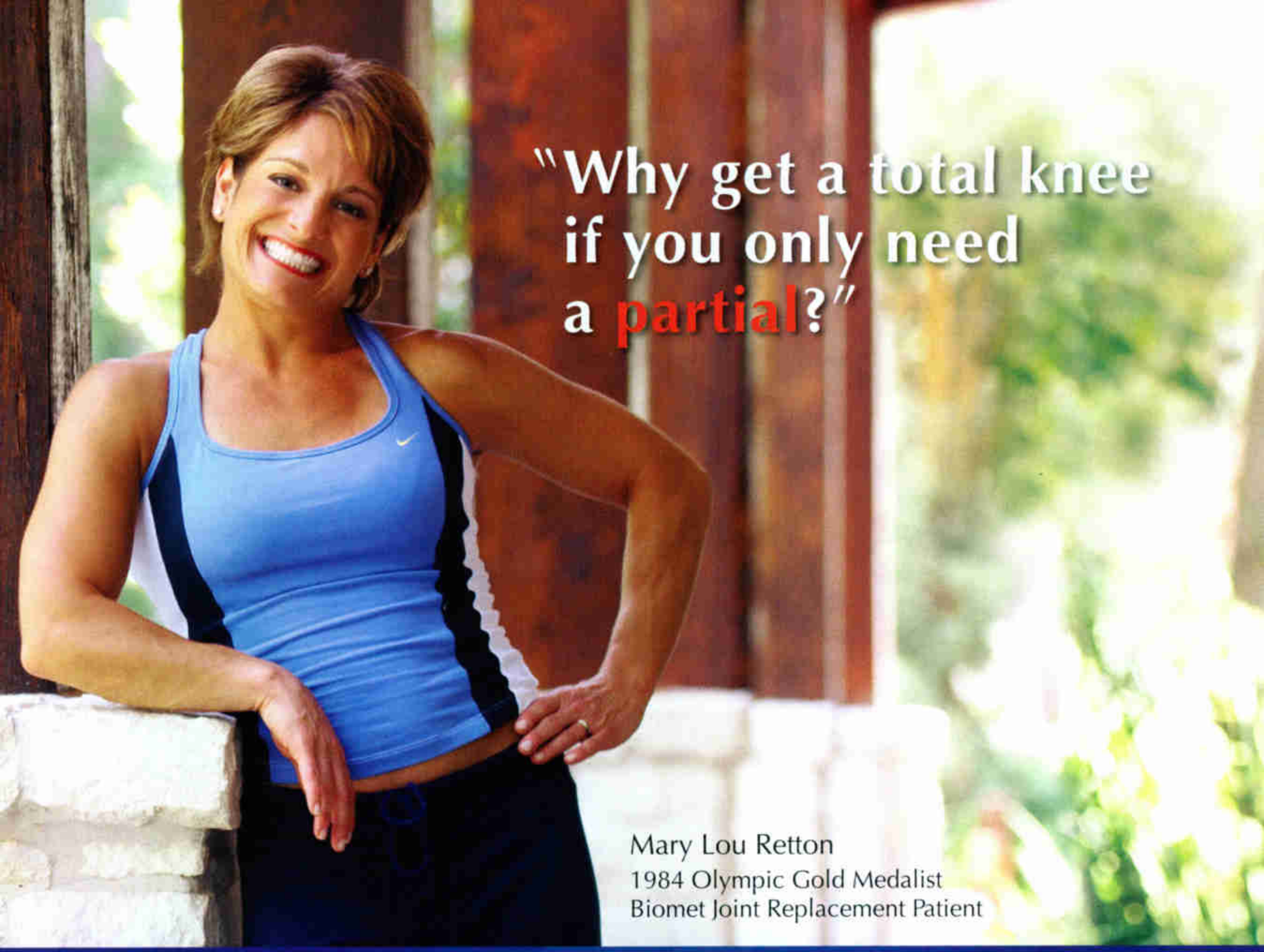


Its secret weapon is a straw-like proboscis (above). The spines, barbs, and hooks anchor the drinking tube once it's slipped under the bird's double eyelid. The moth may also inject an anesthetic to keep the bird from awakening. Why doesn't *H. hieroglyphica* simply sip from forest puddles containing salt and other minerals? Because they're dangerous places, full of frogs. *—Karen E. Lange*

OTHER SOURCES FOR TEARS

- **Turtles and caimans** provide liquid for passionflower butterflies in Brazil.
- **Water buffalo, cattle, and deer** give up their tears to a Southeast Asian moth, *Lobocraspis griseifusa*.
- **Pigs, elephants, and sometimes humans** are among the animals visited by another Southeast Asian moth, *Pionea damastesalis*.

PHOTO (TOP): ROLAND HILGARTNER. SEM PHOTO (LEFT), HARALD W. KRENN, UNIVERSITY OF VIENNA, COLORIZED BY MAMISOLO RAOILISON-HILGARTNER



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Chemotherapy is now an option that can help extend survival in metastatic prostate cancer.

The FDA approved Taxotere® in combination with prednisone as the first and only chemotherapy regimen that may help some prostate cancer patients live longer (up to 2.5 months over another chemotherapy tested) when their cancer has spread and no longer responds to hormone therapy.

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Cancer treatment has advanced so that aggressive treatments like Taxotere® can be used to treat certain types of prostate cancer. Taxotere® attacks the structure of cells, including prostate cancer cells, when cancer has spread beyond the prostate.

Is chemotherapy right for me?

If you are interested in learning more about the latest advancement in chemotherapy to treat metastatic prostate cancer that no longer responds to hormone therapy, make sure to include a medical oncologist as part of your healthcare team. Including the perspective of a medical oncologist, along with that of your urologist and radiation oncologist, will help ensure that you are aware of all your treatment options. Options that until now, you never thought you had. To learn if Taxotere® is right for you, ask your doctor. For more information visit www.taxotere.com or call 1-800-618-7148.

Important safety information.

WARNING: Taxotere® treatment can cause serious, physically limiting, and potentially life-threatening side effects, such as infection, low blood-cell counts, allergic reaction, and retention of excess fluid (edema).

Taxotere® should not be given to patients with low white–blood-cell counts, abnormal liver function, or a history of allergic reactions to Taxotere® or any of the ingredients in Taxotere®.

Before each Taxotere® treatment, all patients treated with Taxotere® must receive another medicine called dexamethasone. This drug can help reduce the risk of fluid retention (edema) and allergic reactions.

Taxotere® should be administered only under the supervision of a qualified physician experienced in the use of anticancer treatments. Appropriate management of complications is possible only when adequate diagnostic and treatment facilities are readily available.

The most common severe side effects are low white–blood-cell count, anemia, fatigue, diarrhea, and mouth and throat irritation. Low white–blood-cell count can lead to life-threatening infections. The earliest sign of infection may be fever, so **tell your doctor right away if you have a fever.**

Other common side effects from Taxotere® include nausea, vomiting, hair loss, rash, infusion-site reactions, odd sensations (such as numbness, tingling, or burning) or weakness in the hands and feet, nail changes, muscle and/or bone pain, or excessive tearing.

Before receiving Taxotere®, tell your doctor if

- You have any allergies
- You are taking any other medicines—including nonprescription (over-the-counter) drugs, vitamins, and dietary or herbal supplements

When taking Taxotere®, contact your doctor if

- You have symptoms of an allergic reaction (warm sensation, tightness in your chest, itching/hives, or shortness of breath)
- You experience any other side effects

Please see adjacent page for patient information leaflet for detailed information about these side effects, and talk to your doctor about any questions you may have.

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PATIENT INFORMATION LEAFLET
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Rev December 2006

PATIENT INFORMATION LEAFLET
Questions and Answers About Taxotere® Injection Concentrate
(generic name = docetaxel)
(pronounced as TAX-O-TEER)

What is Taxotere?
Taxotere is a medication to treat breast cancer, non-small cell lung cancer, prostate cancer, stomach cancer, and head and neck cancer. It has severe side effects in some patients. This leaflet is designed to help you understand how to use Taxotere and avoid its side effects to the fullest extent possible. The more you understand your treatment, the better you will be able to participate in your care. If you have questions or concerns, be sure to ask your doctor or nurse. They are always your best source of information about your condition and treatment.

What is the most important information about Taxotere?
• Since this drug, like many other cancer drugs, affects your blood cells, your doctor will ask for routine blood tests. These will include regular checks of your white blood cell counts. People with low blood counts can develop life-threatening infections. The earliest sign of infection may be fever, so if you experience a fever, tell your doctor right away.
• Occasionally, serious allergic reactions have occurred with this medicine. If you have any allergies, tell your doctor before receiving this medicine.
• A small number of people who take Taxotere have severe fluid retention, which can be life-threatening. To help avoid this problem, you must take another medication such as dexamethasone (DECKS-A-METH-A-SONE) prior to each Taxotere treatment. You must follow the schedule and take the exact dose of dexamethasone prescribed (see schedule at end of brochure). If you forget to take a dose or do not take it on schedule you must tell the doctor or nurse prior to your Taxotere treatment.
• If you are using any other medicines, tell your doctor before receiving your infusions of Taxotere.

How does Taxotere work?
Taxotere works by attacking cancer cells in your body. Different cancer medications attack cancer cells in different ways.
Here's how Taxotere works: Every cell in your body contains a supporting structure (like a skeleton). Damage to this "skeleton" can stop cell growth or reproduction. Taxotere makes the "skeleton" in some cancer cells very stiff, so that the cells can no longer grow.

How will I receive Taxotere?
Taxotere is given by an infusion directly into your vein. Your treatment will take about 1 hour. Generally, people receive Taxotere every 3 weeks. The amount of Taxotere and the frequency of your infusions will be determined by your doctor. As part of your treatment, to reduce side effects your doctor will prescribe another medicine called dexamethasone. Your doctor will tell you how and when to take this medicine. It is important that you take the dexamethasone on the schedule set by your doctor. If you forget to take your medication, or do not take it on schedule, make sure to tell your doctor or nurse **BEFORE** you receive your Taxotere treatment. **Included with this information leaflet is a chart to help you remember when to take your dexamethasone.**

What should be avoided while receiving Taxotere?
Taxotere can interact with other medicines. Use only medicines that are prescribed for you by your doctor and **be sure** to tell your doctor all the medicines that you use, including nonprescription drugs.

What are the possible side effects of Taxotere?
Low Blood Cell Count – Many cancer medications, including Taxotere, cause a temporary drop in the number of white blood cells. These cells help protect your body from infection. Your doctor will routinely check your blood count and tell you if it is too low. Although most people receiving Taxotere do not have an infection even if they have a low white blood cell count, the risk of infection is increased.
Fever is often one of the most common and earliest signs of infection. Your doctor will recommend that you take your temperature frequently, especially during the days after treatment with Taxotere. If you have a fever, tell your doctor or nurse immediately.
Allergic Reactions – This type of reaction, which occurs during the infusion of Taxotere, is infrequent. If you feel a warm sensation, a tightness in your chest, or itching during or shortly after your treatment, tell your doctor or nurse immediately.
Fluid Retention – This means that your body is holding extra water. If this fluid retention is in the chest or around the heart it can be life-threatening. If you notice swelling in the feet and legs or a slight weight gain, this may be the first warning sign. Fluid retention usually does not start immediately; but, if it occurs, it may start around your 5th treatment. Generally, fluid retention will go away within weeks or months after your treatments are completed.
Dexamethasone tablets may protect patients from significant fluid retention. It is important that you take this medicine on schedule. If you have not taken dexamethasone on schedule, you must tell your doctor or nurse before receiving your next Taxotere treatment.

Gastrointestinal – Diarrhea has been associated with TAXOTERE use and can be severe in some patients. Nausea and/or vomiting are common in patients receiving TAXOTERE. Severe inflammation of the bowel can also occur in some patients and may be life threatening.
Hair Loss – Loss of hair occurs in most patients taking Taxotere (including the hair on your head, underarm hair, pubic hair, eyebrows, and eyelashes). Hair loss will begin after the first few treatments and varies from patient to patient. Once you have completed all your treatments, hair generally grows back.
Your doctor or nurse can refer you to a store that carries wigs, hairpieces, and turbans for patients with cancer.
Fatigue – A number of patients (about 10%) receiving Taxotere feel very tired following their treatments. If you feel tired or weak, allow yourself extra rest before your next treatment. If it is bothersome or lasts for longer than 1 week, inform your doctor or nurse.
Muscle Pain – This happens about 20% of the time, but is rarely severe. You may feel pain in your muscles or joints. Tell your doctor or nurse if this happens. They may suggest ways to make you more comfortable.
Rash – This side effect occurs commonly but is severe in about 5%. You may develop a rash that looks like a blotchy, hive-like reaction. This usually occurs on the hands and feet but may also appear on the arms, face, or body. Generally, it will appear between treatments and will go away before the next treatment. Inform your doctor or nurse if you experience a rash. They can help you avoid discomfort.
Odd Sensations – About half of patients getting Taxotere will feel numbness, tingling, or burning sensations in their hands and feet. If you do experience this, tell your doctor or nurse. Generally, these go away within a few weeks or months after your treatments are completed. About 14% of patients may also develop weakness in their hands and feet.
Nail Changes – Color changes to your fingernails or toenails may occur while taking Taxotere. In extreme, but rare, cases nails may fall off. After you have finished Taxotere treatments, your nails will generally grow back.
Eye Changes – Excessive tearing, which can be related to conjunctivitis or blockage of the tear ducts, may occur.
If you are interested in learning more about this drug, ask your doctor for a copy of the package insert.

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Every three-week injection of TAXOTERE for breast, non-small cell lung, stomach, and head and neck cancers
Take dexamethasone tablets, 8 mg twice daily.

Dexamethasone dosing:

Day 1 Date:_____ Time:_____AM _____PM

Day 2 Date:_____ Time:_____AM _____PM
(Taxotere Treatment Day)

Day 3 Date:_____ Time:_____AM _____PM

Every three-week injection of TAXOTERE for prostate cancer
Take dexamethasone 8 mg, at 12 hours, 3 hours and 1 hour before TAXOTERE infusion.

Dexamethasone dosing:

Date:_____ Time:_____

Date:_____ Time:_____
(Taxotere Treatment Day)

Time:_____

WHERE IN THE WORLD?

Brownish areas of the reefs are living coral colonies flush with nutrients; white portions are coral sand deposits.

Coral History The Maldives are built on coral. Cast across the Indian Ocean, the Asian nation consists of 16 major atolls, each a ring of reefs around a lagoon. Within Ari Atoll, small "patch" reefs (above) gleam like gems. Twenty thousand years ago, during the last glacial age, the sea's retreat stranded some coral mounds 400 feet above water, says marine biologist Bruce Hatcher of Nova Scotia's Cape Breton University. Today, the reef islands peak a few feet over the waves, making the Maldives the nation with the most to lose if global warming brings rising seas. Hatcher thinks corals might not suffer. But the 370,000 Maldivians? They have "real reason to worry." *—Neil Shea*

PHOTO: BERNHARD EDMAIER

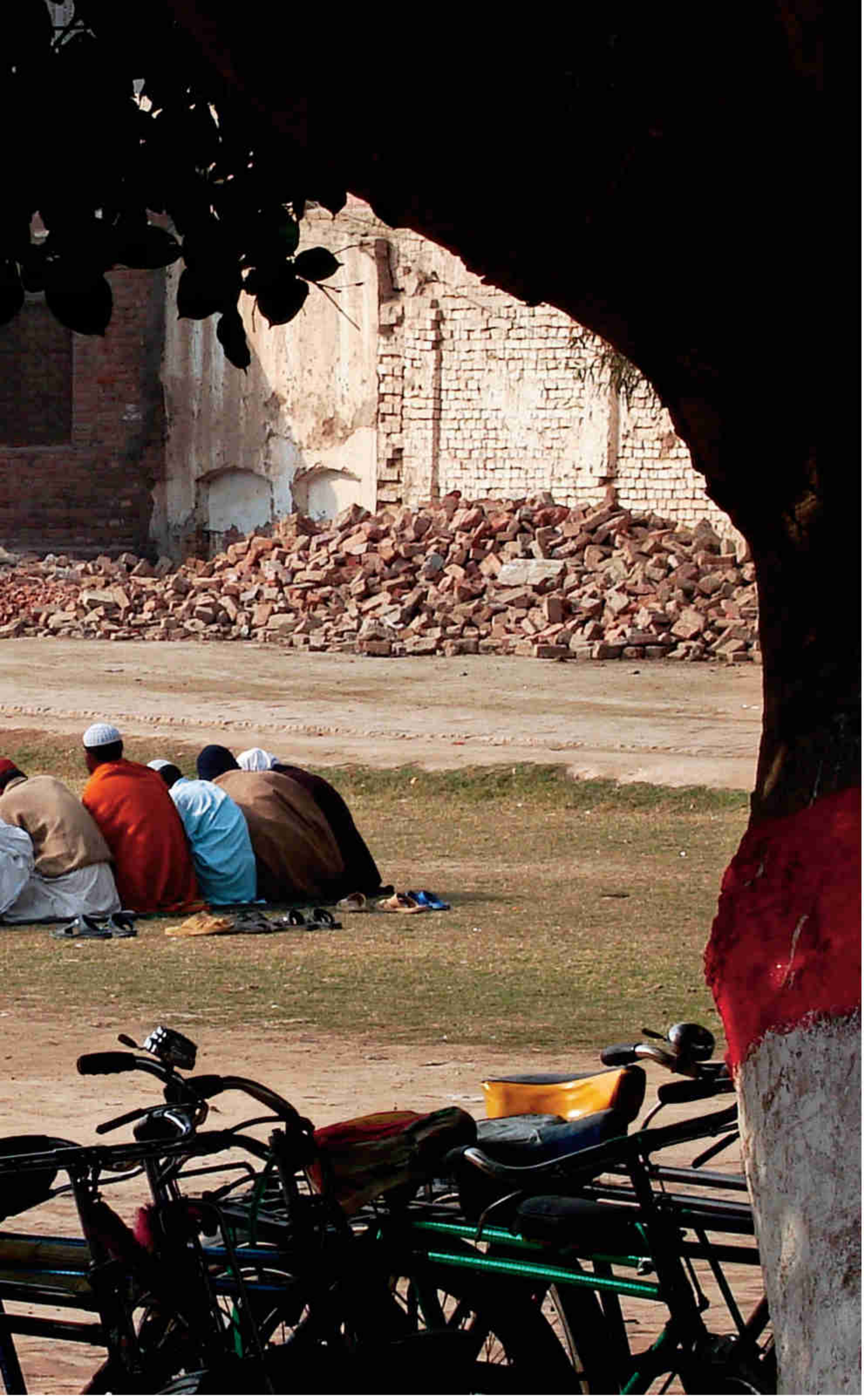
Struggle for the Soul of Pakistan

Sixty years after its founding as a homeland for India's Muslims, Pakistan straddles the fault line between moderate and militant Islam. Its dilemma is a cautionary tale for the post-9/11 world.

BY DON BELT NATIONAL GEOGRAPHIC STAFF
PHOTOGRAPHS BY REZA

Her life both enriched and circumscribed by tradition, a 20-year-old woman in Balochistan bends over embroidery that will earn extra income for her family.

Guns cocked, a military patrol scans a roadside near Peshawar, a fundamentalist stronghold near the Afghan border. Amassed to counter archrival India, the army now runs Pakistan, reaping billions from industry and landholdings and wielding a quick trigger finger on politics: None of the past four civilian governments has been allowed to finish its term in office.



Students learn a volatile mix of Islam and politics at Khair-ul-Madaris, a Deobandi madrassa, or religious school, in Multan. Filling in for dysfunctional public schools, madrassas have thrived since General Zia-ul-Haq's government began funding them in the 1980s. Many, including this one, promote a pro-Taliban agenda aimed at turning Pakistan into an Islamic state.


علی اللہ

Whirling dervishes glorify the shrine of Lal Shahbaz Qalandar, a 13th-century Sufi saint who preached peace between Muslims and Hindus. A faith embraced by most Pakistanis, Barelvi Islam combines Sunni with Shiite and Sufi mystical traditions. Believers flock by the millions to such "zones of peace," where the oppressed and the powerful worship side by side.

If there is an address, an exact location for the rift tearing Pakistan apart, and possibly the world, it is a spot 17 miles west of Islamabad called the Margalla Pass. Here, at a limestone cliff in the middle of Pakistan, the mountainous west meets the Indus River Valley, and two ancient, and very different, civilizations collide. To the southeast, unfurled to the horizon, lie the fertile lowlands of the Indian subcontinent, realm of peasant farmers on steamy plots of land, bright with colors and the splash of serendipitous gods. To the west and north stretch the harsh, windswept mountains of Central Asia, land of herders and raiders on horseback, where man fears one God and takes no prisoners.

This is also where two conflicting forms of Islam meet: the relatively relaxed and tolerant Islam of India, versus the rigid fundamentalism of the Afghan frontier. Beneath the surface of Pakistan, these opposing forces grind against each other like two vast geologic plates, rattling teacups from Lahore to London, Karachi to New York. The clash between moderates and extremists in Pakistan today reflects this rift, and can be seen as a microcosm for a larger struggle among Muslims everywhere. So when the earth trembles in Pakistan, the world pays attention.

Travel 8,000 miles across this troubled country, as I did recently, and it becomes obvious that, 60 years after its founding, Pakistan still occupies unsettled ground. Traumatized by multiple wars with India, a parade of military strongmen (including the current president, Gen. Pervez Musharraf), and infighting among ethnic groups —Punjabi, Sindhi, Baluchi, Pashtun—Pakistan's 165 million people have never fully united as one nation, despite being 97 percent Muslim. To hold the country together, successive governments have spent billions on the military, creating a pampered and self-serving monolith of mostly Punjabi generals while neglecting the basic needs of the people, for justice, health, education, security, and hope. Lately, these grievances have spilled onto the streets, as lawyers and other opponents challenge Pakistan's military government and demand a return to civilian, democratic rule. Meanwhile, six years after 9/11, the forces of Islamic radicalism are gaining strength and challenging Pakistan's moderate majority for the soul of the country.

It's not just the surging homegrown Taliban, which in one two-week period this year scorched and bloodied the streets of half a dozen cities with suicide bombs. Or the al Qaeda fighters who prowl the western mountains of Waziristan, butchering anyone suspected of being an American spy. Just as chilling are the "night letters" posted on public buildings, warning that all girls, upon threat of death, must wear head-to-toe burkas and stop attending school. Or, in a rising tide of intimidation, the murders of teachers and doctors and human rights workers accused of "crimes against Islam." But perhaps the most telling evidence of all was my encounter with a 22-year-old woman named Umme Ayman, who seemed all too eager to die.

Taking aim at military rule, lawyers in Lahore protest the firing of Iftikhar Muhammad Chaudhry, Pakistan's independent-minded chief justice, by President Pervez Musharraf last March. Musharraf's U.S.-supported military government, says Asma Jehangir, a leading attorney, "makes a mockery of democratic institutions."

I CANNOT SEE HER FACE, or even her eyes, but I can tell you that Ayman is an impressive young woman. She wears glasses under a black veil and speaks in short, eruptive bursts of English that sound like well-rehearsed lines in a school play. She and a group of 200 female religious students have taken over a public children's library in Islamabad. They are protesting the destruction of mosques run by radical clerics that the government says were built without permits. Riot police, bristling with sidearms and batons, have encircled the library and ordered the students to leave. But Ayman is in no mood to listen.

"We are not terrorists," she says. "We are students. We wish to spread Islam over all the world. If America wants to end Islam, then we are prepared to die defending our faith. We have said our goodbyes." Ayman and the other women sit around the library's circular tables in tiny chairs meant for children. Amid shelves lined with children's storybooks, they have posted signs reading "Allah is for Muslims, not infidels." Across the street, their parents have been holding an anxious vigil for weeks.

"Our fate is with Allah," Ayman says, as other protesters gather around, "but if the government grants our demands, there will be no problem." And what are those demands? "To rebuild the mosques and to make Pakistan an Islamic state." Half a dozen veiled heads bob in agreement.

From the start, the founders of Pakistan intended their nation to be a refuge for Muslims, not an Islamic state. Pakistan was created when India, a British colony for nearly a hundred years, gained its independence and was partitioned into two countries along a hastily drawn border. Pakistan's first leader, Mohammed Ali Jinnah, and his brain trust of secular intellectuals created a fledgling democracy that gave Islam a cultural, rather than political, role in national

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Reza, a frequent contributor to National Geographic, *is a Paris-based photographer who has documented the people and politics of Central Asia for 25 years.*

K. M. CHAUDHRY, AP IMAGES

life. Their Pakistan was to be a model of how Islam, merged with democratic ideals, could embrace the modern world. "Muslims would cease to be Muslims, not in the religious sense," Jinnah said in his inaugural address, but "as citizens of the state."

Sixty years later, having been educated in schools that teach mainly the Koran, the young women in the library are stunned when I mention Jinnah's secular vision for Pakistan. "That is a lie," Ayman says, her voice shaking with fury. "Everyone knows Pakistan was created as an Islamic state, according to the will of Allah. Where did you read this thing?" Such is the certainty of Pakistan's Islamists, whose loud assertions give them political influence far beyond their numbers.

The women may be on the front lines of this protest, but it's clear the clerics in the mosque next door are calling the shots. The children's library is a few yards from one of the most radical mosques in Pakistan, Lal Masjid, or Red Mosque, which has posted dozens of lean young jihadists in black turbans around the library, brandishing swords, staffs, axes, and AK-47s. The men from the mosque, who are overseeing the protest, include pro-Taliban clerics and Javed Ibrahim Paracha, a bearded, heavyset former member of parliament who has been dubbed "al Qaeda's lawyer" for successfully representing several hundred jihadists captured in Pakistan after 9/11. He explains what emboldens these young women to risk their lives for Islam: "This government has lost all credibility," he says. "People look at Musharraf and they see a U.S. puppet who's willing to declare war on fellow Muslims to satisfy America. They also see his generals getting rich, while they're getting poorer every day. There are no jobs, no ways forward. People are losing hope. Pakistan and its government are becoming two different things. This will have to change, and soon."

A week later, the standoff comes to an apparent end after the government backs down and agrees to start rebuilding the mosques. The children's library is stripped of all books deemed un-Islamic, and the students take over. In the capital, a mere ten minutes' drive from the presidential palace, the Islamists have won.

If Gen. Muhammad Zia-ul-Haq were alive today, he might stop by to congratulate Ayman and her friends. More than anyone, it was Zia who created Pakistan's current generation of Islamic militants, and the climate in which they thrive. A Punjabi general with a pencil-thin mustache and raccoon circles under his eyes, Zia seized power in a coup in 1977, had the democratically elected prime minister tried and hanged, and promptly pressed for the Islamization of Pakistan, calling for more religion in the classroom and the use of punishments such as flogging and amputations for crimes against Islam. To Zia, Pakistan's secular founders, with their emphasis on Muslim culture, had it exactly backward. "We were *created* on the basis of Islam," Zia said, and he set out to remake democratic Pakistan as a strict Islamic state—despite the fact that a large majority of Pakistanis were, and remain, moderates.

Whether by temperament or tradition, most Pakistani Muslims are more comfortable with the mystical and

Taking cover behind a plume of fire, Pakistan's army special forces conduct antiterrorist training in North Waziristan—a semi-autonomous tribal area dominated by local Taliban.

Pakistan's Great Divide

The rise and ruin of empires—Indus, Aryan, Persian, Mogul, British—are written in the soil of Pakistan, which was founded as a Muslim homeland in 1947 with the partition of India. Pakistan's borders encompass five major ethnic groups and two distinct geographies. A "fault line" down the middle of the country mirrors a religious divide as well: Where the mountains meet the lowlands, the fierce fundamentalism of the Afghan frontier confronts the moderate Islam of the Indian subcontinent.

UZBEKISTAN
TAJIKISTAN
CHINA
Boundary claimed by Pakistan
NORTHERN AREAS
Gilgit
KASHMIR
AFGHANISTAN
NORTH-WEST FRONTIER PROVINCE
Line of control
2005 Earthquake epicenter
Mohmand
Khyber Pass 3,500 ft 1,067 m
Peshawar
Margalla Pass
AZAD KASHMIR
Islamabad
Rawalpindi
FEDERALLY ADMINISTERED TRIBAL AREAS
Miram Shah
North Waziristan
Durand Line (present-day boundary)
South Waziristan
Sialkot
Khushab
Gujranwala
Lahore
Faisalabad
PUNJAB
Nizampur
Khanewal
Multan
Quetta
PAKISTAN
Bahawalpur
INDIA
Indus
Ras Koh Range
Site of Pakistan's nuclear tests
Sukkur
Larkana
BALOCHISTAN
SINDH
Sehwan
IRAN
Panjgur
Hyderabad
Turbat
Karachi
Gwadar
Arabian Sea

Nuclear reactor

0 mi 100
0 km 100

RELIEF BY TIBOR G. TÓTH
NGM MAPS

60 Years of Turmoil

1947 India, a longtime British colony, gains its independence and is partitioned into India and Pakistan, a nation for Muslims. In the chaotic aftermath, up to a million people die.

1971 Pakistan loses more than half its population when East Pakistan (renamed Bangladesh) declares its independence, triggering a war between its ally, India, and Pakistan.

1979 After the U.S.S.R. invades Afghanistan, the U.S. and Pakistan join to support an insurgency of Afghan and Pakistani jihadists. Pakistan's leader, General Zia-ul-Haq, pushes an Islamic fundamentalist agenda.

1998 Directed by scientist A. Q. Khan, Pakistan conducts several nuclear tests to counter India's arsenal. Secretly, Khan is selling nuclear hardware and know-how to Iran, Libya, and North Korea.

2001 After 9/11 attacks, President Pervez Musharraf, who seized power in 1999, drops support of the Taliban in Afghanistan and allies with the U.S. in a "war on terror."

2007 Protests, sparked when Musharraf fires Pakistan's chief justice, escalate into violent clashes between Musharraf supporters and opposition groups calling for a return to democratic rule.

"People look at Musharraf and they see a U.S. puppet who's willing to declare war on fellow Muslims to satisfy America."

—Javed Ibrahim Paracha, former member of parliament

Ruling the sky but not the ground, army troops pass over Miram Shah (right), capital of North Waziristan, near Afghanistan. Since 2003 Pakistan has lost hundreds of soldiers battling Pashtun tribes allied with Taliban and al Qaeda fighters along this border.

ecstatic rituals of Barelvi Islam, a colorful blend of Indian Islamic practice and Sufism. For a Punjabi farmer whose crop has just come in, it has always been more satisfying to hang out at a Sufi shrine listening to *qawwali* music and watching dervishes whirl than reciting the Koran in a fundamentalist mosque. Most Pakistanis, though powerless to resist, were lukewarm to Zia's Islamization program, as was much of the outside world.

That all changed in December 1979, when the Soviet Union invaded neighboring Afghanistan, driving hundreds of thousands of Afghan refugees—mainly conservative Pashtun tribesmen—across the border into Pakistan. Within months Zia's Islamist dream got a huge boost: The United States and Saudi Arabia joined Pakistan in a covert alliance to supply arms, training, and billions of dollars to an anti-Soviet insurgency in Afghanistan. The motto of Zia's army—Jihad in the Service of Allah—became a rallying cry for thousands of mujahideen training in camps funded by the CIA in Pakistan's North-West Frontier Province. Over time, Zia's agenda, and that of the United States, became indistinguishable: If Zia wanted to Islamize Pakistan while mobilizing support for the anti-Soviet jihad, all the more power to him. Besides, the fundamentalist madrassas of northwestern Pakistan made excellent recruiting centers for mujahideen—young fighters who saw the struggle against the Soviets as a holy war.

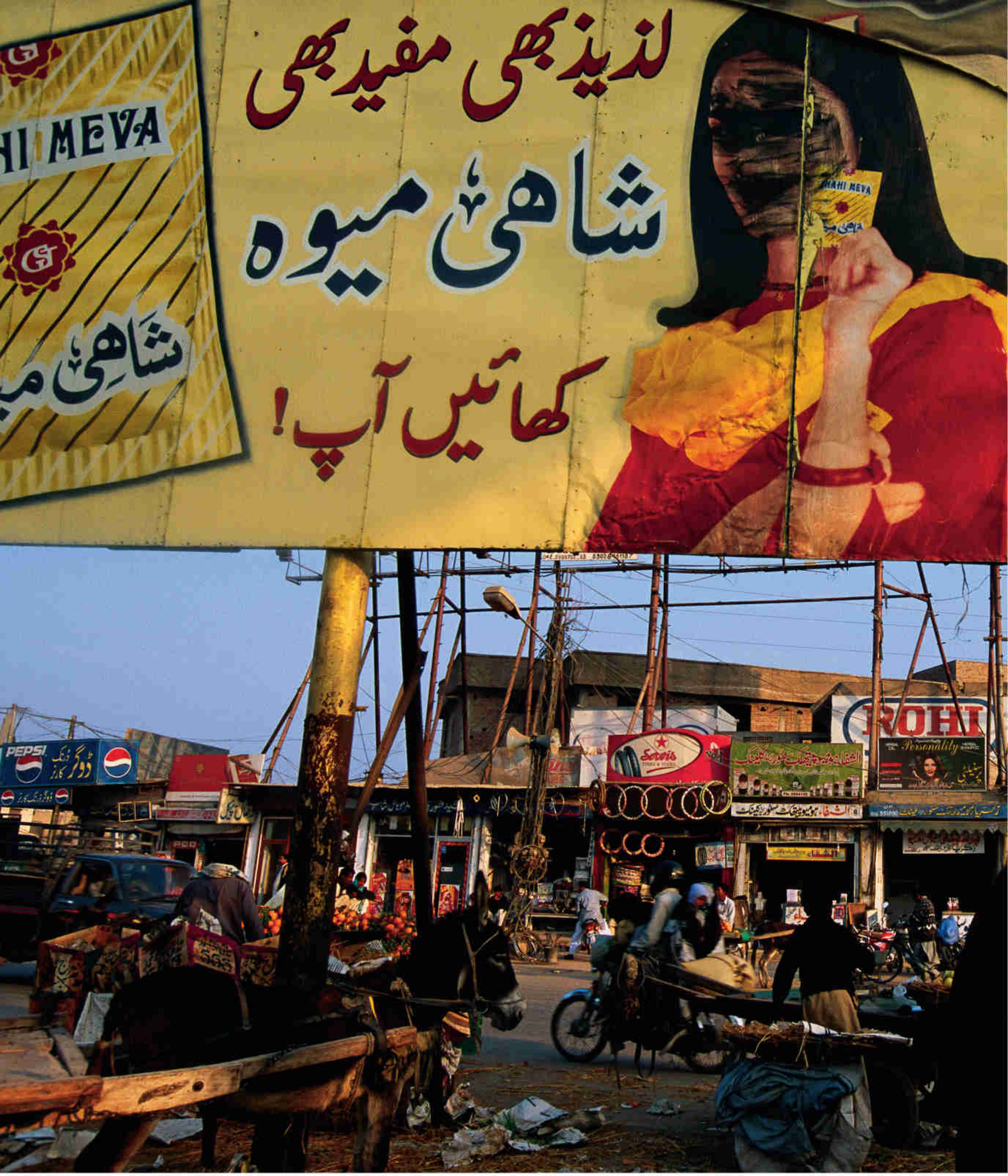
During the 1980s, as the mujahideen prevailed against the Soviets in Afghanistan, the winds of extremism blowing from the northwest began to chill all of Pakistan. Millions of dollars from Saudi Arabia flowed into the hardline Sunni madrassas clustered along Pakistan's border with Afghanistan, which eventually spread across Pakistan. Not all Pakistani madrassas today are fundamentalist or radical. Some are shoestring operations run by moderate clerics to meet the educational needs of the poor. But the majority —more than 60 percent—are affiliated with the fundamentalist Deobandi sect, an austere interpretation of Islam that calls for a rejection of modernity and a return to the "pure," seventh-century Islam of the Prophet Muhammad. Politically savvy and extremely well funded, more than 10,000 of these schools operate across Pakistan today, compared with fewer than 1,000 before General Zia took power. Thousands more operate unofficially.

By the time Zia died in a mysterious 1988 plane crash, the Islamization of Pakistan was well under way. The following year, the Soviet Union, preoccupied with its own implosion, pulled its demoralized troops from Afghanistan. The U.S. promptly declared victory and returned home, leaving the Afghan people to the chaotic rule of the mujahideen warlords. One crucial chapter in the story of radical Islam's ascendancy had come to a close. The one we are still living had just begun. Osama bin Laden and other leaders of the Afghan jihad now moved freely in and out of northwestern Pakistan and its Federally Administered Tribal Areas. The madrassas swelled with the children of the Zia Generation. In the rugged mountainous land shared by Afghanistan and Pakistan, the seeds of the Taliban, and al Qaeda, had been sown.

"YES, THERE ARE EXTREMISTS here," says Pakistani novelist Mohsin Hamid. "But they are a small minority in a nation of 165 million people. Most of us want nothing to do with violence." This is true. But like moderates everywhere, those in Pakistan have a hard time being heard over the racket rising up from their streets and television sets, a raucous soundtrack of religious sermonizing, Indo-Pakistani saber rattling, and a general gnashing of teeth that passes for public discourse. Ordinary people are also stifled by a government and police force that are among the most corrupt in the world, led by an army that answers to no one. But it is a measure of the country's underlying goodness, and a sign of hope, that 60 years after independence the most revered figure in Pakistan is not a mullah or a sports hero, but a 79-year-old man who routinely washes dried blood off dead bodies and fishes his clothes from a donation barrel.

Abdul Sattar Edhi began serving his fellow citizens a few years after the founding of Pakistan, when he opened a free clinic in Karachi. Later he bought a dented Hillman station wagon, its blue paint peeling, and turned it into Pakistan's first private ambulance. He shuttled poor people to medical care and collected the bodies of the city's homeless from the gutters, washed them, and gave them a proper burial. "I felt it was my duty as a human being," he says, recalling the revulsion he learned to overcome. "It was obvious the government wasn't going to do it."

Decades later, that hasn't changed. While the military accounts for a quarter of the national budget, less than 3 percent is spent on education, health, and public welfare. And so Edhi still tends to Pakistan's dirty work, body by body. His one-man charity is now an acclaimed international foundation. His single, beat-up old station wagon has grown into a fleet of 1,380 little


HI MEVA
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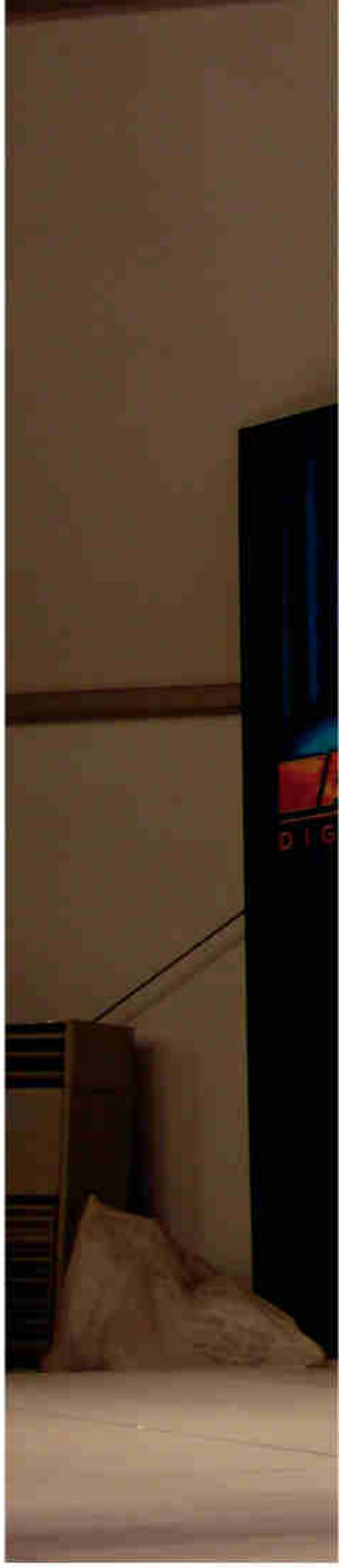
Personality

Profane in the eyes of radical mullahs, a woman's face on a billboard has been "veiled" in black paint in Multan, the ancient city in Punjab that is now a center for fundamentalist mosques and madrassas. Once confined to the fiercely conservative northwest, "talibanization" is spreading across Pakistan, pushed by a small but vocal minority.

Pakistan's founders wanted to show how Islam, merged with democratic ideals, could embrace the modern world.

Pakistani chic takes the stage at a fashion show in Karachi (right), the port city that fuels the country's economic growth. "We have to prepare for tomorrow," says Prime Minister Shaukat Aziz. "You can't drive a car looking in the rearview mirror."



white ambulances positioned across Pakistan, tended by thousands of volunteers. They are usually first to arrive on the scene of any tragedy. In May 2002, when police found the remains of Daniel Pearl, the *Wall Street Journal* reporter murdered in Karachi, it was Edhi who gently collected the body parts, all ten, and took Daniel Pearl to the morgue.

Edhi was born in the Indian town of Bantva, 250 miles from Mumbai. As a teenager, he'd gone with his father to hear Jinnah, the tall, gaunt, visionary founder of Pakistan, deliver a speech urging local Muslims to join him in the new country. At first his father hesitated. But during partition, when Hindu mobs began marauding nearby, the family joined the more than 14 million people from both countries—Muslims, Hindus, and Sikhs—who fled their homes and crossed to the other side of the line. As many as a million people died in sectarian riots, massacres, and killings along the way.

Edhi's family came by ship, landing on September 6, 1947, three weeks after Pakistan came into being, amid throngs of people shouting "*Pakistan zindabad*—long live Pakistan!" Within an hour, as he walked the streets of his new home, he saw a Hindu man murdered by a mob of young Muslim boys. "They stabbed him over and over with a knife, and I'll never forget watching him writhe in pain on the ground. All over Karachi, Hindus were packing up and running away, exactly as we'd done in India. Just like that, our joy turned to horror and shame. That's what I remember about partition."

Edhi's adopted city of Karachi has grown from a population of 450,000 in 1947 to a surging metropolis of more than 15 million people. It may be the most cosmopolitan of Pakistan's cities, but it is among the most dangerous as well—a place where Pakistan's widening gap between rich and poor is on full display. Karachi is a sprawling universe of ramshackle neighborhoods that radiate north, west, and east from the glitzy seaside hotels, office towers, and diplomatic fortresses downtown, where car bombs are an occupational hazard and personal security a billion-dollar-a-year business. Al Qaeda and other terrorist groups are known to operate in the squalid "no go" neighborhoods of Karachi, beyond the reach of police and perhaps even Inter-Services Intelligence, Pakistan's powerful military intelligence agency.

In the middle of all this sits Edhi, a dignified man wearing a gray *shalwar kameez* (Pakistan's national dress) and a furry black cap in the style Jinnah wore—a fitting touch in a man who describes himself as a "super patriot." In a neighborhood of litter-strewn streets, Edhi's headquarters is a cluttered office that adjoins the two small rooms where he lives with his wife, Bilquis, his partner in the foundation. Edhi's operation relies on donations; he refuses to accept government money or even a ride in someone else's car. He travels by ambulance, in case someone needs help along the way. Outside Edhi's office, a metal crib is stationed on the stairway beneath a sign reading, "Don't Kill Your Baby." Every Edhi Foundation office in the country has such a crib, where a mother can leave an unwanted baby, no questions asked. Edhi's Karachi office alone receives 90 babies a month, half of them alive.

Today a young nurse in a head scarf brings in a newborn left in the crib overnight, a girl wrapped in a soft floral blanket, perhaps four days old, her arms and legs shrunken and disfigured. The nurse places her on Edhi's desk, like a gift. He picks up the infant and gently strokes her malformed hands with his finger, whispering to her in Gujarati, his native language, his long gray beard tickling her nose. As this little girl grows, she'll be given medical care in one of the foundation's clinics, sheltered in its orphanage, educated in one of its schools, and sent forth into a carefully arranged marriage with job skills and a dowry. Edhi has given away hundreds of brides at the foundation's wedding facility, a cross between a Bollywood set and the Elvis Suite at a Las Vegas hotel, with a bed in the shape of a heart. A bulletin board in the lobby is filled with dozens of wedding pictures, each happy bride a miracle child plucked from Edhi's rescue cradle.

Despite his selfless deeds, Edhi is often attacked as "un-Islamic" by Pakistan's hard-line mullahs, who cite his policy on infidels. He has none. Edhi never asks whether an abandoned child, a psychiatric patient, a dead person, or a battered woman is Sunni or Shiite, Hindu or Christian—or, for that matter, Punjabi or Sindhi, Baluchi or Pashtun, Mohajir or Kashmiri. "I'm a Muslim," says Edhi, "but my true religion is human rights."

In modern Pakistan, that's an increasingly lonely position. There are many thousands of dedicated doctors, lawyers, teachers, social workers, and humanitarians—including some in government—who, like Edhi, are working to move their country forward, but the space in which they operate is shrinking. Recently, at Musharraf's bidding, parliament passed a bill to restrict the activities of NGOs and human rights groups. Even as he promotes "enlightened moderation,"

Musharraf accuses such groups of humiliating Pakistan by publicizing abuses, and declares them a threat to the national interest.

Such rhetoric only emboldens the Islamists, whose influence is growing across Pakistan. Edhi gets half a dozen death threats a week, ranging from crank calls to serious warnings that made him temporarily flee the country. Religious militants harass his offices—a campaign orchestrated, Edhi believes, by Pakistan's Islamist political parties, which compete with him for financial support. A few years ago, a new Edhi Foundation hospital, which cost three million dollars to build, was taken over by students from a radical madrassa north of Karachi. Intimidated by the mullahs, the police refused to act on Edhi's complaint, and his hospital is now a dormitory, with student laundry—black turbans favored by the Taliban—flapping from the windows, like flags over conquered territory.

HIGHWAYS IN PAKISTAN are a kind of national theater, in which throngs of people, nearly all men, hunker down on the roadside like spectators at a cockfight, keenly observing all that passes with an air of amused expectation. Stop along the roadway for a cup of tea, and you hear things. You hear people talk about chronic injustice. They tell stories of people losing their land, their lives, their honor, with no recourse. It is easy to think they exaggerate. And then you meet someone else who changes your mind.

A girl called Najma, who is 16, speaks in a cautious monotone, and it is difficult to know, after what happened, whether she will ever speak naturally again. She still wears the delicate ring in her nose that signifies her virginity. On this day she also wears a pink head scarf wrapped around her face, pretty and round with high cheekbones and wide-set eyes, though now they are dull and without expression, like a captive. She sits next

"Yes, there are extremists here. But they are a small minority. Most of us want nothing to do with violence."

–Mohsin Hamid, Pakistani novelist

Colored by faith and tradition, poor neighborhoods bask in their proximity to the shrine of Lal Shahbaz Qalandar in Sehwan (left), where each year hundreds of thousands of visitors find solace in the measured rhythms of Barelvi Islam.

to her mother on the bed where the incident occurred and tries to talk without crying.

Two weeks ago, at one in the morning, five men, maybe six, burst through the door of the family's mud-brick home, which sits on a tiny plot of land in the village of Nizampur in southern Punjab. They identified themselves as police and said they were searching for weapons. One held a pistol to her mother's chest while another pinned her nine-year-old brother, Rizwan, to the floor. And then two men held Najma down on the bed while a third raped her.

The leader masked his face with a scarf, her mother says, but she recognized the raspy voice of their neighbor, a police constable, who lives 200 yards away and wants the plot of wheat that Najma's family moved here to farm as tenants 40 years ago. According to the complaint Najma's father filed with the police, the attack resulted from his refusal to vacate the land. After the rape, the men spent a few minutes ransacking the house. As they left, they delivered a warning: Leave this place, or we'll be back for your other daughter.

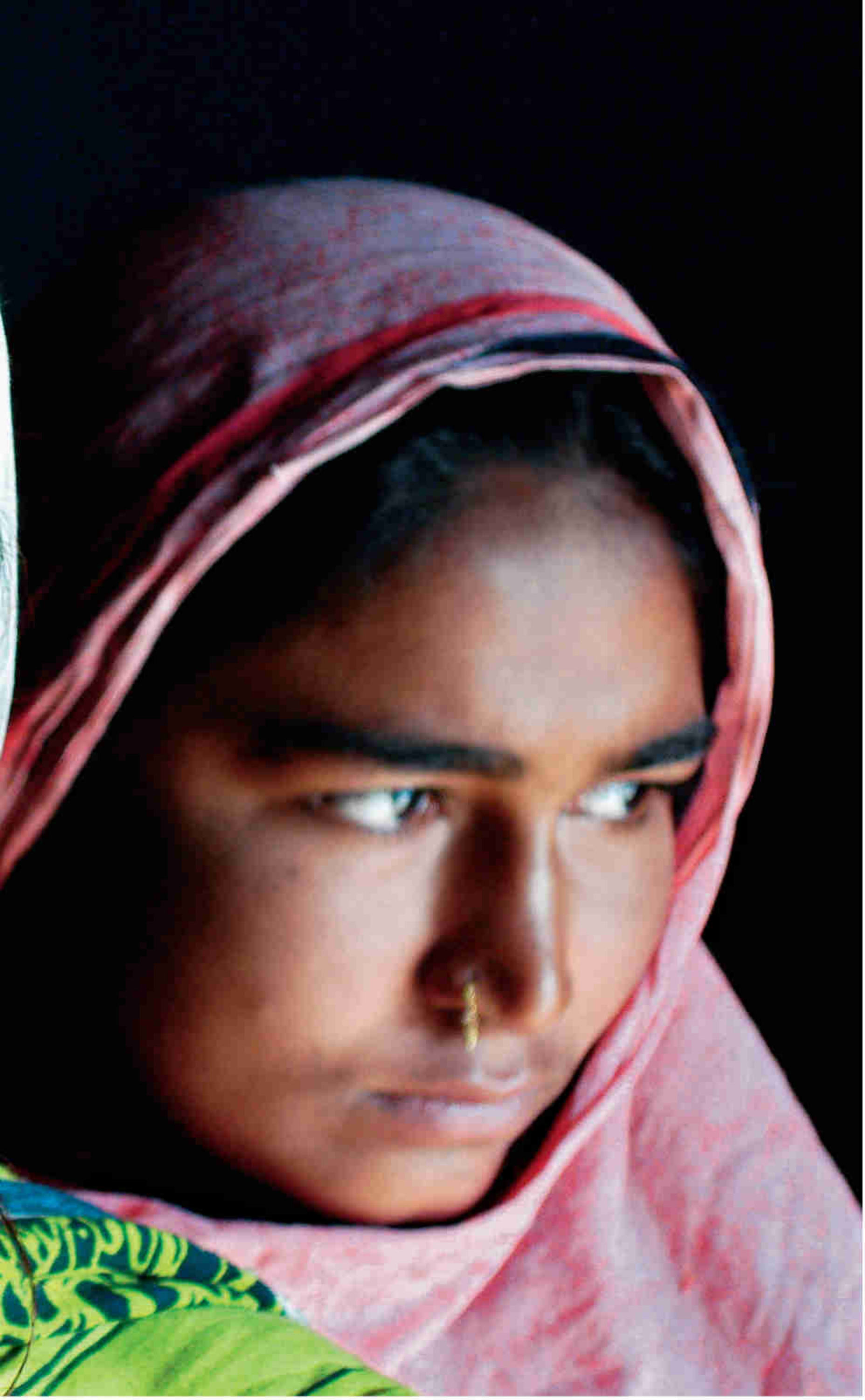
Rashid Rehman is a veteran human rights lawyer who volunteered to represent Najma for the Human Rights Commission of Pakistan. Rape is epidemic in parts of the country, Rehman says, where it is used as a barbaric instrument of tribal justice; a village might punish a husband's adultery, for example, by gang-raping his wife. Najma's case is typical in southern Punjab, he says, where the British rewarded their local allies with grants of land and autonomy; after partition, these feudal landlords became a law unto themselves. In their world, rape is a tool of intimidation wielded by powerful, politically connected landowners to terrorize peasants, to scare them off their land. If a family doesn't comply, Rehman says, they are often killed. "Who's going to stop them?" he asks.

In this case, he says, the family did everything right. They went to the police the next morning and sought medical help for Najma. She was examined by a doctor, who submitted a medical report confirming the rape. But the local police, who are of the same clan as the constable, refused to file charges. Incensed, Rehman appealed to officials in the nearby town of Khanewal.

Najma shows great dignity for a brutalized teenager. Today, as Rehman heads off to hear the outcome of the appeal, she asks for one last word. "I don't know what my life will be in the future," she tells him quietly, "but I'm ready to face my attackers in public and demand justice for what they did." Of the rapist, she says, "He must be hanged. He must."

At the police station in Khanewal, Rehman meets first with the acting superintendent, a stocky man in aviator glasses with a black baton in his hand and a portrait of Jinnah hanging behind his desk. As Rehman briefs him, the superintendent glances nervously at the six large men in plainclothes, intelligence types, who sit against the far wall, sipping tea. The superintendent takes a few notes, makes a phone call, hangs up. He turns his baton over and over. Finally, the phone rings. Long conversation. He hangs up and says that the forensic evidence in Najma's case has been, unfortunately, misplaced. Rehman asks to see the supervisor.

The afternoon light fades from gold to gray



Numb with rage and humiliation, a 16-year-old Punjabi girl, Najma, sits with her mother on the bed where she was recently raped—an act of intimidation committed by agents of a feudal land baron seeking to drive the family off their tiny plot of land. As in many rapes involving either tribal custom or wealthy landowners, local police dismissed the case.

as Rehman waits in another empty office. The electricity is out—yet another rolling blackout. Finally, the police inspector, a Mr. Khan, arrives and pulls up a battered chair. Wearing a shalwar kameez the color of old mustard, Khan is a rangy, loose-limbed speed-talker with a cigarette-scorched voice. He has studied Najma's case in detail, he says, and he's sure what he's about to say will please Rehman, since it will resolve the legal issues once and for all. He pauses, as if waiting for a drumroll.

Najma is lying, he announces, to protect her father from a previous charge of having assaulted the police constable. (Her father is a small, defeated man pushing 70, who can barely walk.) The medical evidence, Khan continues, reveals Najma to be a "habitual fornicator," based on certain measurements he is not at liberty to divulge. To conduct his investigation, he says, he personally traveled to the village and interviewed "60 or 90 people in the village mosque." All declared the police constable incapable of committing such a crime. The case, he says, is closed.

It is dark by the time Rehman pulls away from the police station, musing on what will happen to Najma's family. "If they don't leave immediately, they will be in danger," he says. "The constable could send men to rape the other sister, or to rape Najma again. Or he might kill them all, to make an example of them or to punish them for going to the police."

It was a similar lawlessness that drove the people of Afghanistan into the arms of the Taliban in the mid-1990s. The country was then in the midst of a civil war and run by warlords, who grew rich on the opium trade, terrorized the countryside, and seized the lands and daughters of any poor farmer they chose. One day near Kandahar, a mullah and former mujahideen commander named Mohammad Omar said enough was

Edhi is attacked by hard-line mullahs for helping infidels. "I'm a Muslim, but my true religion is human rights," he says.

Humanitarian to a nation, Abdul Sattar Edhi (left) opened his first clinic in Karachi shortly after partition. Today his foundation fills needs unmet by the government—schools, orphanages, hospitals, and the largest private ambulance service in the world.

enough. With the Koran in one hand and a Kalashnikov in the other, he rallied his students, or taliban, and launched a new jihad: to cleanse Afghanistan of lawlessness and corruption. Backed by Pakistan, the Taliban triumphed in 1996, took Kabul, and imposed their own extreme vision of Islamic law. Ordinary Afghans, at first, regarded the Taliban's dictates as a small price to pay for an end to civil war.

Rashid Rehman hears stories such as Najma's and fears what lies ahead for Pakistan. In the car on his way back to his office in the Punjabi city of Multan, he sits in the dark, looking out the window at the feeble lights of passing villages. When he speaks, he is calm and clear. "When government fails them, people get angry," he says. "They lose faith in the system and look for alternatives. Think how easy it would be for the Islamists—or Taliban or al Qaeda—to go to the brothers of this girl now and say, 'What happened to your family is not justice. This man dishonored your sister, he dishonored your father and your family name. Join us and we will help you get justice. We will make him pay.' When citizens are denied their basic human rights, they become radicalized. When people are powerless, they are easily manipulated. This is what worries me the most."

MY NEW FRIENDS want to know why Americans think they are terrorists. It's a good question, and an innocent one, judging by the young and open faces of the dozen or so students sharing their evening meal with me. They don't look like terrorists as they sit in a semicircle on green mats in the courtyard of Jamia Uloom-ul-Quran, a small Deobandi madrassa located in a historic downtown mosque in Peshawar. This provincial capital served as headquarters for the Afghan resistance against the Soviets, and jihad is still a going concern here. A block away from the madrassa, at shops selling shoes and used clothes, I'd bought a 50-cent al Qaeda DVD of a suicide bomber preparing for a mission. At the end of the disc, over religious music, the bomber is shown in his car at a distant crossroads, blowing up a convoy. "We know that shop," the students say. "But we're not terrorists."

A few of the students appear to be ten or younger, but most are in their late teens or early 20s. They say their dream for Pakistan is "a peaceful nation, in which justice prevails, in keeping with Islamic law." But they believe, as many here do, that Islam is under attack. By America, by the West, by India, by their own government. Under these circumstances, they say, jihad is justified. What about suicide bombing? Is it sanctioned by Islam? "You must think we have classes here in making bombs or AK-47s!" exclaims one boy, and they all laugh.

"In any Muslim land that's occupied, suicide bombing is allowed," says a personable older boy named Rafiullah, who has bright brown eyes and the beginnings of a beard. A few mention Iraq and Palestine as places where such bombings are justified. Another boy mentions Afghanistan. "But it's not allowed in Pakistan," Rafiullah says, "since we're not an occupied country." ("Not yet!" somebody else interjects, to laughter.) "Nobody has a right to blow you up, even if you're a non-Muslim, or an infidel. If you are here as a guest, you are welcome." He

A religious shrine rises from the hardscrabble landscape of Balochistan, Pakistan's poorest and least developed region. There is vast economic potential here, springing from rich reserves of natural gas and a new Chinese-built port at Gwadar. But conflict over these resources has led the downtrodden Baluchi tribes to take up arms against the government.

reaches to shake my hand, as if to reassure me.

The call for jihad is rising across Pakistan, but it is here, in the northwest, that the Islamists are taking control. Ever since 9/11, thousands of Taliban fighters have found refuge among their fellow Pashtun tribesmen in Peshawar, Quetta, and the mountainous tribal areas along the Afghan border, especially North and South Waziristan. A year ago this month, the government agreed to a cease-fire with the tribes and abandoned most of North Waziristan to the militants. It's a sign of the local Taliban's strength that the agreement was signed not by tribal elders but by Taliban commanders.

Pakistan's turnabout on the Taliban, which it had strongly supported since 1994, came shortly after 9/11. When Afghanistan's Taliban government, which had sheltered Osama bin Laden, disintegrated under the firestorm meted out by the United States and its coalition partners, President Musharraf confronted a stark choice: Cooperate or suffer the consequences. He immediately sided with the U.S. against the Taliban. It was not a popular decision. Today, Pakistan is under pressure to contain the Taliban and al Qaeda to the tribal areas along the Afghan border, although it's clear that they're gaining in other parts of Pakistan. Many Deobandi madrassas are believed to have an al Qaeda recruiter on the premises. But Muhammad Hanif Jalandhry, who runs a madrassa in Multan, says the reputation of Pakistan's madrassas as factories for terrorists is "propaganda. I tell you, it's the oppressive system we live under that's bringing people to these seminaries. People are seeking refuge and security—and dignity. They are seeking a future."

About a third of the students at the Deobandi madrassa in Peshawar, for instance, are poor kids from far-flung regions of the North-West

"When people are powerless, they are easily manipulated. This is what worries me the most."

—Rashid Rehman, human rights lawyer

Real-life dramas fill Storytellers Market in Peshawar, a city of two million that was a staging ground for jihadists fighting the Soviets in 1980s Afghanistan. Echoes of that war are felt even now, as hard-liners and moderates battle over the future of Pakistan.

Frontier Province or the tribal areas. They are like Mir Rahman, 16, a sweet-faced boy from a family of poor herders in the Mohmand Tribal Area. The family lives miles from the nearest public school, which is so badly run that few kids attend. It's not unusual in Pakistan to hear of public schools that receive no books, no supplies, and no subsidies from the government. Thousands more are "ghost schools" that exist only on paper, to line the pockets of phantom teachers and administrators. Faced with choosing between bad public schools and expensive private ones, many poor parents send their children to the madrassas, where they get a roof over their heads, three meals a day, and a Koran-based education—for free.

Pervez Hoodbhoy lives every day with the consequences of the lack of public education in Pakistan. An MIT-trained professor of nuclear physics at Quaid-i-Azam University in Islamabad, he was speaking to a graduate-level class in physics a few days after the huge disaster that devastated Kashmir in 2005, describing the geophysical forces that produced the disaster. "When I finished, hands shot up all over the room," he recalls. "'Professor, you are wrong,' my students said. 'That earthquake was the wrath of God.'"

This, he says, is the legacy of General Zia-ul-Haq, whose education ministry issued guidelines on bringing an Islamic perspective to science and other subjects in the public schools. "The Zia Generation has come of age," he says. "It isn't Islamic to teach that earthquakes are caused by the movement of tectonic plates. Instead, you are supposed to say, by the will of Allah, an earthquake happens." Today a government commission is working to modernize education, but "it goes deeper than updating textbooks," he says. "It's a matter of changing society."

A few miles from Hoodbhoy's classroom, I come upon a crowd of children in a vacant lot. It turns out to be another school—this one a free school for hundreds of street children run by a fireman named Muhammad Ayub, who founded the school 25 years ago because he felt sorry for the kids running wild in the neighborhoods nearby, dropouts who seemed destined for a jail cell, or a slab at Edhi's morgue. Ayub hands me his business card. It bears the name of the school: Second Time Civil Defense Educational Institution on Self Help Basis. "All my teachers are former students," he says proudly, gesturing to two men and a young woman with freckles, standing before the kids, who are laughing and carrying on. "See the looks on their faces?" he says. "This is the future I want for our country."

On a small hill nearby, a group of three or four students from a nearby madrassa, stern young men in their early 20s, are watching Ayub's class. Perhaps they are drawn to the laughing girl with the freckles, who isn't wearing a veil, or perhaps it is something more sinister. They are looking across the divide that runs down the middle of Pakistan, and it's not clear what they are thinking. □

Portrait of Pakistan Explore the intricacies of this conflicted country with a tour of our Photo Gallery at **ngm.com/0709**.

Crown of the Continent

Two national parks—
Glacier and Waterton Lakes—
join in a soaring wonderland.

Winter sunrise shares its pale luster with the rough-cut facets of 9,638-foot-high Vulture Peak in Montana's Glacier National Park.

Fir and spruce tower 80 feet or more over the forest floor—humbled in their turn by upthrust layers of billion-year-old rock. Blackfeet Indians call these mountains “the backbone of the world.”

At the gates of Canada's Waterton Lakes National Park, southern Alberta's rolling, wildflower-freckled grasslands heave abruptly, thunderously skyward to meet the front range of the Rockies.

By Douglas H. Chadwick
Photographs by Michael Melford

Glacier National Park is where everything bright and strong and never tamed comes together on high:

wolves, white-tailed ptarmigan, storms that hit the Great Divide like tsunamis with golden eagles surfing the wind waves, twisted trees 200 years old but scarcely tall enough to hide a bighorn sheep, impatient wildflowers shoving through snow to unfurl their colors, alpenglow on ancient ice, and great silver-tipped bears. To roam among these summitscapes is to open a conversation between your soul and a living planet on the move.

Leave bushwhacking to the elk and cliff-climbing to the mountain goats. The best way to get up these mountainsides is by bear elevator: avalanche chutes where winter slides have cleared paths down through brush fields and forests, which grow back at first as open meadows. No matter how hot or long the summer, it will still be springtime at some elevation in the chutes as plants sprout from meltwater-soaked soil in the wake of retreating snows. Flush with nutrients, the succulent new growth draws grazing grizzlies upward through the warm months, from valley floors all the way to the peaks.

A stretch of the Rocky Mountains runs virtually unbroken for 250 miles from central Montana into southern Canada with a skyline that exalts all the land within eyeshot. Many call this the Crown of the Continent. Glacier National Park, connected to wildernesses on the south and in both Alberta and British Columbia on the north, is the centerpiece. Up to two miles high, Glacier's peaks embrace a million Montana acres and 762 lakes to reflect them in hues from milky turquoise strewn with ice floes to so diamond clear you can see bottom stones 50 feet deep. One of the largest lakes has its head in Glacier and its azure body in a 125,000-acre sister reserve, Waterton Lakes National Park, just across the border in Alberta. The adjoining protected areas were proclaimed the world's first international peace park in 1932. Both were designated international biosphere reserves during the 1970s, and in 1995 Waterton-Glacier International Peace Park was further distinguished as a World Heritage site.

Although 95 percent of Glacier is managed as wilderness, more than 700 miles of interconnecting trails invite foot traffic into the farthest contours. Coming off a three-day trek through the northern reaches, I stuck out a thumb to get back to my car on Going-to-the-Sun Road. The sole highway across the park's interior, it feels like another winding trail, hewn across cliff walls here and there, with rockwork shoring up the outer edges. A nice family in a van picked me up. Barely a minute later, the mother was calling out: "Look, three waterfalls! Who has the camera?"

Uh-oh. Flatlanders.

"I see a taller one!" That was the daughter a hundred yards later. We pulled out for pictures again. Then we motored on for half a minute before little brother said, "Waterfall up on the right!"

Crews with plows had only recently opened the pass. Drifts still lay a hundred feet deep in the lee of some crests. Yet it was June. The air was warm and green. As usual with the onset of summer, the high country was in vertical flood. There were waterfalls pouring off every headwall, ledge, and hanging valley—staircases of falls; concatenated mare's tails of them; sheets, fans, flues, and dazzling braids; plumes bursting from shadowed cliffs like jets of pure light; drum ensembles and cannonades of them shaking the ground underfoot. "Dad. Dad! Pull over!"

It was the slowest trip I ever took. But I felt as though I was seeing Glacier's runoff for the

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Doug Chadwick, of Whitefish, Montana, and Michael Melford, of Mystic, Connecticut, have covered many of the world's scenic wonders for NATIONAL GEOGRAPHIC.

Up is as easy as down for nimble bighorn sheep (top), sprinting over steep slopes in a blur of early snowfall and their own speed. The slower grind of glaciers over ground yields rock flour—limestone and shale particles that tint meltwater pools like Grinnell Lake (above) in milky blue-green swirls.

Waterton-Glacier International Peace Park

The U.S.-Canada border runs right through Upper Waterton Lake, but for 75 years Waterton Lakes' and Glacier's combined 1.14 million acres have been designated, and jointly managed, as a transboundary conservation area—the world's first international peace park.

SOURCES: GLACIER NATIONAL PARK; USGS NORTHERN ROCKY MOUNTAIN SCIENCE CENTER. LANDSAT IMAGE: GLOBAL LAND COVER FACILITY, UNIVERSITY OF MARYLAND

JEROME N. COOKSON AND LISA R. RITTER, NGM MAPS

■ Visitor center

Scale varies in this perspective. Apgar to Waterton Park is 35 miles (56 kilometers).

Continental Divide
BRITISH COLUMBIA
ROCKY MOUNTAINS
N
Mt. Blakiston 9,581 ft 2,920 m
WATERTON LAKES NATIONAL PARK
Waterton Park
Upper Waterton Lake
ALBERTA
CANADA
UNITED STATES
Mt. Cleveland 10,466 ft 3,190 m
Vulture Peak 9,638 ft 2,938 m
North Fork Flathead River
MONTANA
89
Grinnell Lake
Grinnell Point
Lake Sherburne
Grinnell Glacier
Allen Mountain 9,376 ft 2,858 m
Lake Josephine
GLACIER NATIONAL PARK
St. Mary
Logan Pass
St. Mary Lake
Lake McDonald
GOING-TO-THE-SUN ROAD
Apgar
West Glacier
Hudson Bay–Gulf of Mexico Divide
Mt. Stimson 10,142 ft 3,091 m
Middle Fork Flathead River
GREAT BEAR WILDERNESS
2

first time, too, watching through their eyes as the park, my Montana backyard, softened into the long-light days, liquefying more than half a year's hoard of crystals to swell rivers bound across North America for the Pacific, the Gulf of Mexico, and Hudson Bay.

This is where, around 75 million years ago, tectonic forces buckling Earth's crust sent a slab of rock miles thick sliding eastward on top of the strata next door. The overthrust block is a layer cake of cream-colored limestone and red and green mudstones formed between 1.5 billion and 800 million years ago in a shallow inland sea. Many rocks reveal patterns of ripples, mud cracks, and even raindrops, as if raised from the shores only yesterday. A few preserve mats and mounds of cyanobacteria mixed with silt, all turned to stone. As fossils go, these microbe colonies, termed stromatolites, aren't especially striking—they look like smooshed cabbage heads—but they represent some of the oldest organisms on record. More important, they may have been the first to practice photosynthesis, manufacturing sugar for food with the help of energy captured from the sun.

The waste product given off by this invention was oxygen. As it got pumped into early skies rank with carbon dioxide and methane, photosynthesis began to change the atmosphere. That in turn transformed the course of life. Ultimately, the humble clumps of cyanobacteria and their successors made inhaling sweet air possible—made you and me possible, and the mountain-goat nannies with young single-filing along a blade-thin ridge, and the hoary marmots eyeing my trail snacks from nearby boulders. It's the sort of thing you think about at 9,000 feet with your rump on an overhang built from primeval ocean bottom and nothing around the rest of your body but blue, blue breathable sky.

Eon after eon, weather scuffed the uptilted stone layers and poked at their weak spots. Then came the ice ages, and erosion bent to its work. Over the past two million years, glaciers as much as a mile thick flowed over all but the highest points, reaching tentacles of frost into the smallest crevices of rock formations and pulling hefty chunks away as the white juggernauts growled and oozed relentlessly on. The Rockies meanwhile kept rising; not much, maybe the thickness of a snow bunting's wing each year, but ceaselessly. And when the tide of ice finally withdrew, the Crown of the Continent emerged spectacularly cut and polished, its peaks taller than ever and their sides far steeper, soaring above valleys rasped into broad U shapes with open vistas where narrow canyons had been.

Small alpine glaciers persisted on summit shoulders. Others lay cupped in cirque basins or stretched beneath headwalls too high and sheer for the sun to climb over even in midsummer. About 150 glaciers existed when the park was established in 1910. Today, with human activities spewing carbon dioxide and methane as if we were intent on re-creating Earth's ancient atmosphere, a warming climate has reduced the number of moving glaciers to fewer than 30. Dan Fagre, a U.S. Geological Survey ecologist working in the reserve, says, "The last one will probably disappear by the year 2030, tops." How does Glacierless National Park sound?

Fagre has more pressing questions as he documents decreasing snowpacks, earlier spring runoffs, longer growing seasons, and tree lines marching uphill into former subalpine and alpine habitats. For example: What's in store for the wildlife communities this reserve is supposed to protect? What happens downstream to farmers and ranchers dependent on irrigation, to communities needing drinking water, to fishermen—not to mention the fish—even to distant barge operators, once the glaciers and permanent snowfields that reliably provided water through late summer are gone?

"Let's hope the taxpaying public and policymakers understand that national parks are for more than scenery and recreation," Fagre says. "They perform valuable ecosystem services. They are also important listening posts for us—among the very few places where we can tease out

As if the lifeblood of the Earth were welling up in its stones, a Waterton creek bed gleams crimson. Iron-rich rocks are glazed by brushstrokes of tumbling water—some of the cleanest on the continent.

signals of environmental change in settings otherwise undisturbed by modern development."

I'm part of a band of volunteers with a wolverine research project in Glacier. We help pack bait into box traps built of logs, tag captured animals with transmitters, and roam the backcountry to track their movements with radio receivers. We do this because wolverines, the largest land-dwelling members of the weasel family, have become alarmingly scarce in the lower 48 states. Glacier, an all-too-rare stronghold, offers the opportunity to gather sorely needed information about reproduction and survival. We also do this because we think the wolverine is cool—the toughest 25-to-30-pound blur of constant motion to ever drive a grizzly off a carcass. Above all, we do this to be in the park.

The frozen surface of Lake Josephine, encircled by looming peaks, makes for a beautiful glide on skis. But at night, which is when a wolverine is most likely to enter the trap at the lake's head, it's not the same journey. Not with temperatures sinking toward 0°F. Not after avalanches off Grinnell Point have spilled across the ice. And especially not when the winds that howl from the divide across Glacier's eastern half for days on end have whipped up a stinging ground blizzard. I'm solo, so I'll take the longer route across the base of Allen Mountain.

After about two miles, the trail descends into a stand of big, old-growth spruce. Intercepted by curtains of boughs, the gusts fade to a breeze at ground level. High overhead, the treetops continue to rock. Branches thrash. Leaning snags rub against the limbs that blocked their fall. They fill the grove with moans, mews, wheezes, and whispers. Each sound has my full attention, if only because I usually cross fresh moose tracks here and, once in a while, those of a mountain lion. Skiing alone through a talking forest in tatters of moonlight on my way to meet a feisty carnivore no longer feels like a suspension of ordinary reality. It's just a night out.

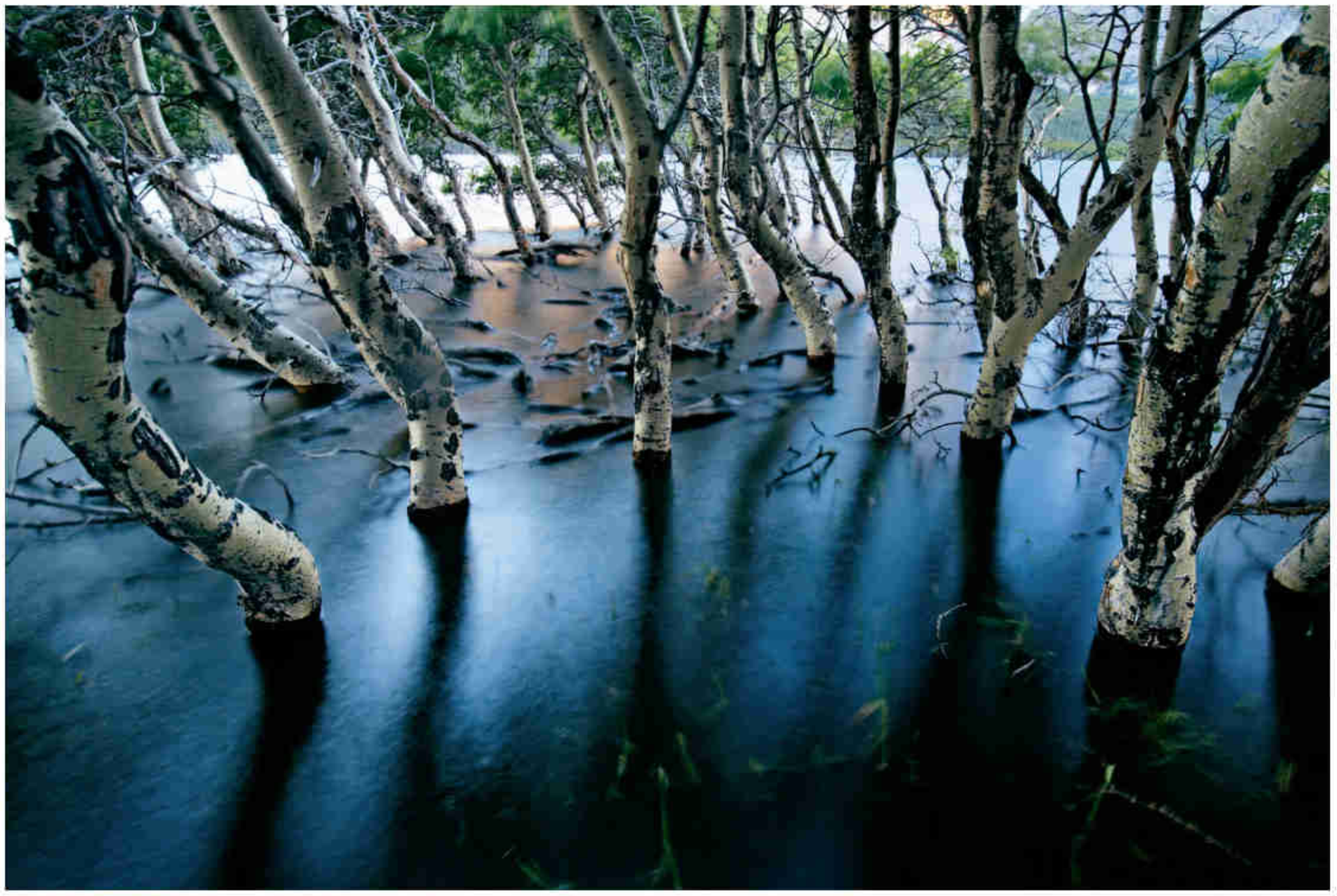
A lot of backcountry mixes the sense of a world freshly shaped by natural forces together with a timeless quality. Floods move the courses of rivers. Raw talus slopes turn into forests, and lightning-sparked blazes recycle the forests into pink swaths of fireweed. Yet in Glacier, the alterations go on alongside cliff faces that were standing in the dinosaurs' day. Backcountry also has a knack for interspersing moments of perfect tranquility with clenches of fear. Glacier's wildlands can generate more of both moods in a day than tame lands could muster in a month.

Lean out through a notch in the rimrock, and a huge view only keeps expanding; lean a fingertip farther, and you could join the rubble below. Lean back to nap against a sun-warmed boulder; awaken to a family of black bears digging for glacier lily bulbs on the other side. Maybe you were determined to walk around one more bend because every one before was lovelier than the last. But from that new vantage point, you can see thick-bellied clouds starting to pile in from the west, and the slant of light on the mountains so alluring a moment ago becomes a reminder of how soon the sun is going to sink behind them. You'll be lucky to get back before darkness, rain, and cramping muscles start to seriously break you down.

Then again, I recall times when all Glacier demanded of me was to jump in a lake on a hot summer afternoon. One day last fall, preparing to hike the park's east side to where I could perhaps spot a grizzly, I counted seven eating kinnikinnick berries up on a grassy slope before I'd left the parking lot and two more ambling across high ledges within the first half hour of strolling an easy trail through gold-leafed aspens.

Glacier's founders left it for each visitor to discover the best way to experience the park. I couldn't say which is best; there are so many still to be tried. But here's my advice for now: Light packs make for light spirits. Don't feed the bears. Save the wolverines. Let it snow.

Jewels in the Crown See more photos online and explore Waterton–Glacier International Peace Park with our interactive map at **ngm.com/0709**.



Brimming with summer snowmelt, Glacier's Lake Sherburne (top) overflows into a tangle of aspens on its shore. Two valleys south, the glass-clear waters of St. Mary Lake slosh in a glacier-carved basin ten miles long, shuffling cobbles that line the bottom (above) like decks of playing cards.

Chiseled promontories edging St. Mary Lake bear witness: Ice moved here. Glaciers ruled supreme 15,000 years ago, piled so deep that only the tops of the tallest peaks caught the warmth of sunrise.

When naturalist George Bird Grinnell began campaigning for the creation of a national park here over a century ago, his namesake glacier covered more than 500 acres. Today its remnants (above) are just over a third that size. All of Glacier's glaciers are expected to vanish within decades.

Dustings of yellow glacier lilies bloom along the Continental Divide (top). These plants take years to mature, if grizzlies don't eat the bulbs first. Fossil stromatolites (above) mark the edges of a sea where colonies of marine bacteria flourished a billion years before the arrival of flowers—or bears.

The calendar said last day of summer, but the sky declared a January mood, with road-closing snowdrifts. In a landscape painted for millennia in the blue-white hues of cold, winter is never far away. □

TALES FROM THE BOG

Hanged with a leather cord and cast into a Danish bog 2,300 years ago, Tollund Man was probably a sacrifice. Like other bodies found preserved in Europe's peat bogs, he poses haunting questions. How was he chosen? Who closed his eyes after death? And what god demanded his life?

Conservators sawed off Tollund Man's foot shortly after he was discovered in 1950, then soaked it in a preservative that turned his skin black. He emerged from his grave shoeless and nearly naked, but other bog bodies have been found with leather capes, wool leggings, and intricately cut shoes (opposite).

BY KAREN E. LANGE

NATIONAL GEOGRAPHIC STAFF

PHOTOGRAPHS BY ROBERT CLARK

The man—or what was left of him—emerged from the Irish sod one winter day in 2003, his hair still styled the way he wore it during his last moments alive. The back was cropped short; the top, eight inches long, rose in a pompadour, stiffened with pine resin. And that was only the beginning of the mystery.

Spotted in the industrial-size sieve of a peat processing plant, he was naked, his head wrenched sharply to the left, his legs and lower arms missing, ripped away by the machine that had dug him from a bog in the townland of Clonycavan. His head and trunk carried marks of deliberate violence, inflicted before he was cast into the mire: His nose had been broken, his skull shattered, his abdomen sliced open. While he lay in the bog, the weight of sodden sphagnum moss had flattened his crushed head, and the dark waters had tanned his skin to leather and dyed his hair orange red.

A call went out to archaeologists, for this was no ordinary murder victim: Clonycavan Man was a bog body, a naturally embalmed testament to mysterious rituals during northern Europe's Iron Age, the centuries just before and after Christ. Hundreds of these unusual mummies have been found in the wetlands of Ireland, the U.K., Germany, the Netherlands, and especially Denmark, preserved by lack of oxygen and antimicrobial compounds from the sphagnum.

People have been spinning tales about bog bodies ever since they were widely recognized as ancient in the late 1800s. Their sculpted repose contrasting with their cruel deaths, the bodies inspire fascination and a longing to connect with a remote ancestral past, when miry wetlands—now drained and dug out for profit—were portals to another world. Gods inhabited bogs; so did restless outcast spirits. Here Iron Age peoples might have buried the most feared or loathed among them, or sacrificed loved ones and even the powerful to win the gods' favor.

These days investigators have new tools—CT scans, three-dimensional imaging, and radiocarbon dating—to make sense of the bodies and the few artifacts found with them. There is little else to go on. Iron Age Europeans left no written records of their beliefs and customs. Many of the bodies themselves vanished when they were reburied or left to decompose. Some, in museums, suffered the restoration efforts of overeager conservators and curators. Others are phantoms: Last year two scholars published an

Hair piled high above folds of leathery skin, Clonycavan Man is one of hundreds of bodies from the bogs of northern Europe. The finds date from 400 B.C. to A.D. 400 in the Iron Age, a time when the region's Celtic and Germanic peoples looked upon bogs as portals to the supernatural world.

NATIONAL MUSEUM OF IRELAND, DUBLIN

NATIONAL MUSEUM OF DENMARK

Floating lacy green in an Irish bog (below), sphagnum moss releases compounds that preserve human tissue. As the moss decays, it compacts into peat, which can be burned for fuel. In 1898, diggers slicing peat at Nederfrederiksmose in Denmark uncovered the first bog body to be photographed as it was found (above).

article called "Imaginary People" in a German archaeology journal. They reluctantly concluded that the late Alfred Dieck, a German archaeologist who made cataloging bog bodies his life's work, fabricated many of the more than 1,800 cases he recorded.

Not surprisingly, bog body research has taken wildly wrong turns. Desperate for historical accounts of preliterate Germanic societies, researchers turned decades ago to the writings of Tacitus, a first-century A.D. Roman historian. But his description of customs beyond the Rhine was based on second- and thirdhand accounts and written to shame Romans for what he considered decadent behavior. Tacitus declared approvingly that the Germans killed homosexuals and cowards and staked their bodies down in bogs.

Accordingly, many bog bodies were interpreted as people in disgrace, supposedly punished with torture, execution, and burial in the bog instead of cremation, the customary Iron Age practice. Windeby Girl, discovered in northern Germany in 1952, was said to be an adulteress whose head had been shaved in a manner described by Tacitus. Then, researchers speculated, she was blindfolded and drowned in the bog. A body found nearby was identified as her lover.

But the theory unraveled after Heather Gill-Robinson of North Dakota State University took a close look at the body and tested its DNA: Windeby Girl was likely a young man. Radiocarbon dating by other scientists revealed that the supposed lover lived three centuries earlier. The Windeby "girl" may have lost his hair when archaeologists digging out the body were careless with their trowels. And growth interruptions in the bones indicated that the young man was malnourished and sickly and might have simply died of natural causes. University of Hamburg archaeologist Michael Gebühr speculates that the body was blindfolded before burial to protect the living from the gaze of the dead.

In Denmark, a team of forensic investigators including Niels Lynnerup of the University of Copenhagen has reexamined that country's bog bodies and found that some of the damage once interpreted as torture or mutilation was actually inflicted centuries after death. Grauballe Man, discovered in a bog northwest of Copenhagen in 1952, is one of the best preserved bog bodies and now the most thoroughly examined. Previous x-rays of his body were hard to read—the bones, demineralized by acidic bog waters, looked like glass. Now CT scans have shown that Grauballe Man's skull was fractured by the pressure of the bog, abetted when a boy wearing clogs accidentally stepped on the body as it was being excavated. Grauballe Man's broken leg could also be the work of the bog and not, as some scholars had thought, proof of a vicious blow to force him to kneel for execution.

Lynnerup, archaeologist Pauline Asingh, and other members of the team now interpret Grauballe Man's death some 2,300 years ago as a sacrifice to one of the fertility goddesses that

> When they reached a flooded pit, one pulled Grauballe Man's head back and slit his throat from ear to ear.

Celtic and Germanic peoples believed held the power of life and death. It could have happened one winter after a bad harvest, the researchers say. People were hungry, reduced to eating chaff and weeds. They believed that one of their number had to die so the rest could survive.

Grauballe Man, a strapping 34-year-old, apparently learned his fate a few days in advance: Stubble on his jaw indicates that he stopped shaving. Then came the terrible hour when the villagers—perhaps his friends and family—led him into a nearby bog. They picked their way among holes dug for peat and bog iron, the ore from which Iron Age people forged tools and weapons. At the edge of a flooded pit, one of them pulled back Grauballe Man's *(Continued on page 92)*

Robert Clark has photographed four National Geographic *feature stories so far this year, including a second one in this issue, on Vesuvius (page 114).*

Mutilated by the iron rods of workers dredging peat from a Dutch bog, Yde Girl's body offers clues to her death. The band of fabric around the 16-year-old's throat suggests she was strangled. She may have been chosen for sacrifice because of a deformity revealed by a CT scan: a curvature in her spine.

A cavernous wound gapes on Grauballe Man's throat, cut with such force that the blade nicked a vertebra in his neck. Researchers once thought other damage done to the body meant he was tortured before execution. But recent study has shown that his bones broke during long burial in a Danish bog.

"As if he had been poured
in tar, he lies
on a pillow of turf
and seems to weep
the black river of himself."

—From "The Grauballe Man," by Seamus Heaney

head and, with a short knife, slit his throat from ear to ear. The executioner pushed the dying man into the pit. The body twisted as it fell and was swallowed by the bog.

Eamonn Kelly, keeper of Irish antiquities at the National Museum of Ireland, thinks similar scenes of sacrifice may have played out in his country's ancient kingdoms. Three months after Clonycavan Man came to light, another ancient body fell from the bucket of a backhoe digging in a bog 25 miles away. This man had once stood almost six feet four inches tall, but only his trunk and arms remained. Arm wounds suggested he had tried to fend off a knife before he was fatally stabbed in the heart.

Then his body had been oddly mutilated—his nipples apparently cut, his upper arms pierced and small wreaths (withies) of twisted hazel threaded through the holes. Encircling one biceps was an armband of braided leather with a bronze amulet incised with Celtic designs. Like Clonycavan Man's hair pomade, made with resin that archaeologists concluded must have been imported from the south of France, these were costly marks of status.

The bodies may have represented the most splendid of offerings: pretenders to the throne or failed kings.

Another clue linked this new body, called Oldcroghan Man, to some 40 other Irish bog bodies including Clonycavan Man: All were buried on borders between ancient Irish kingdoms. Together with the costly ornaments, Kelly says, the locations suggest tales of royal sacrifice. In ancient times, he explains, Irish kings symbolically married the fertility goddess; famine meant the goddess had turned against the king and had to be mollified. Kelly believes the bog bodies represented the most splendid of offerings: high-ranking hostages taken to force rebellious lords into obedience, pretenders to the throne, or even the failed kings themselves. Each injury they suffered honored a different aspect of the goddess—fertility, sovereignty, and war. "It's controlled violence," Kelly says. "They are giving the goddess her due."

Oldcroghan Man normally ate meat, laboratory analysis of his hair and nails showed. But residues in his gut indicated that his last meal consisted of cereals and buttermilk, emblems of fertility befitting a sacrifice to the goddess. After his death, his nipples may have been cut to mark him as a rejected ruler, says Kelly—in ancient Ireland a king's subjects ritually demonstrated their submission by sucking on the ruler's nipples. Then his body was hacked to pieces and sown along the border of the kingdom, his arms threaded with withies to confer protective magic that would guard the territory.

Science can't prove Kelly's scenario. Other researchers say, for example, that the bog rather than the killers might be responsible for the damage to Oldcroghan Man's nipples; his waterlogged body was as fragile as wet cardboard. And even if Kelly is right about the royal status of Irish bog bodies, people on the Continent had a different culture—Germanic rather than Celtic—chiefs instead of kings, and, almost certainly, other rites of sacrifice.

Bodies still lying undiscovered in the bogs of northern Europe will yield more clues about how and why the bog people met their ends. But new finds are likely to be rare and often damaged when they are ripped from the earth by peat cutters and backhoes.

Lynnerup, who has applied the most powerful science available to the secrets of Grauballe Man and who can call up three-dimensional images of the body's bones and muscles and tendons on his computer, doesn't mind the lingering mysteries. "Strange things happen in the bog. There will always be some ambiguity." Lynnerup smiles. "I sort of like the idea that there's just some stuff we'll really never know." □

Haunting Remains Learn more about bog-body mysteries and hear photographer Robert Clark talk about his images at **ngm.com/0709**.

Arches and whorls on Oldcroghan Man's fingertips are clear enough for police to take his prints. But researchers can only speculate about the Irish body's identity. Their best guess: He was of noble birth, perhaps a disgraced king or contender for the throne, sacrificed when a new monarch was crowned.

NATIONAL MUSEUM OF IRELAND

ultra marine

In far eastern Indonesia,
the Raja Ampat Islands embrace
a phenomenal coral wilderness.

A school of golden sweepers shelters
beneath a canopy of table coral.

PARAPRIACANTHUS RANSONNETI (GOLDEN SWEEPER)

Layers of life: A nearly transparent triplefin (left), less than two inches long, lingers on stony coral studded with blue polyps. A porcelain crab (right) could rest on a thumbnail. It blends with a soft coral's striations, bits of calcium carbonate that brace the coral's water-inflated body.

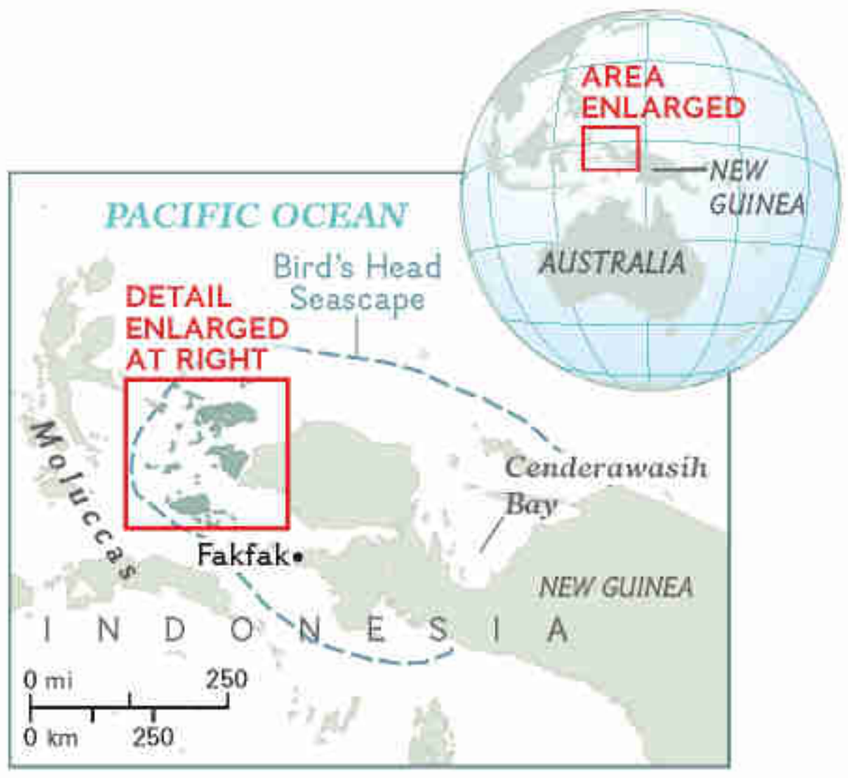
UCLA XENOGRAMMUS (FISH); *PORCELLANELLA* SP. (CRAB)

JENNIFER HAYES (LEFT)

Text and photographs by David Doubilet

What scientists found when they surveyed the waters of the Raja Ampat Islands six years ago set off an international alert for their preservation. The archipelago's reefs were not just rich—the region would prove to have the greatest coral reef biodiversity for its size in the world. Even a short initial voyage confirmed more than 450 species of reef-building coral, nine newly discovered. The entire Caribbean, by contrast, holds fewer than 70 species. With so many of the world's reefs destroyed or suffering catastrophic decline, efforts to safeguard this treasure went into high gear.

One of the first divers to get an inkling of the abundance that lay below wasn't a scientist but an adventurer named Max Ammer, who came to the sparsely populated Raja Ampat Islands from the Netherlands in 1990 looking for abandoned jeeps and sunken aircraft from World War II. He stayed for the coral and carved out two eco-resorts on the small island of Kri. In 1998 he guided renowned Australian ichthyologist Gerry Allen on a few dives. "Each dive was a mini-exploration," says Gerry. "A light snapped on in my brain, and I thought: This is it."



Jungled karst islands form the magical maze of Wayag (top) at the northern reach of the Raja Ampat Islands. Its baroque geography is a microcosm of the archipelago. Protection efforts include the newly created Bird's Head Seascape (inset).

Gerry lobbied Conservation International (CI) to conduct a marine survey. Both the region's remoteness and the political turmoil in Indonesia had made it difficult to study these waters systematically, but in 2001 Gerry was among the scientists gathered by CI to make a rapid assessment of Raja Ampat. His intuition had been spot-on. The survey brought Raja's fish species count to an astounding 970; Gerry set a record for personally counting 283 species on one dive. Follow-up surveys coordinated by CI and the Nature Conservancy added to Raja's species count in fish, corals, and other marine life, and confirmed that this biological frontier was an El Dorado of coral reefs.

But these are not all vacation-poster reefs bathed in bright, gentle waters. This is an unruly frontier. Fortified with plankton, key to the reefs' fecundity, the waters are often murky and veiled, churned by currents so powerful you feel as if you're diving in a washing machine and so dizzying with life that the scene could have been painted by Jackson Pollock.

As diving partner Jennifer Hayes and I swam over the lip of a reef off a rocky islet near Kri, the sea changed from lighthearted blue to brooding green. Purple fields of leather coral rippled as the current came at us like threatening gusts of wind. Reaching a protected undercut, we entered a grove of orange, red, and yellow sea fans surrounded by a pink and purple hedge of soft corals. Swarms of orange anthias fish hovered at the edge of the current, while a squadron of plate-size batfish patrolled the perimeter of the soft coral garden.

Running low on air, I pushed off to return to the boat and spun into the propelling current, one hand on my cameras, one hand stretching for the boat's ladder, which I caught like a trapeze artist. The islet itself was trailing a wake from the current whipping around it. It's easy to believe the local tale that during World War II the Americans bombed this islet at dusk, thinking it was a Japanese patrol boat steaming across the bay.

What makes these waters a cauldron of life? "Habitat, habitat, habitat," says biologist Mark Erdmann, senior adviser to CI's Indonesian Marine Program. "Extensive fringing reefs, wave-pounded drop-offs, calm deep bays funneling upwellings of nutrients, sand flats, mangroves, sea grass meadows—all in an area that's isolated and still for the most part intact."

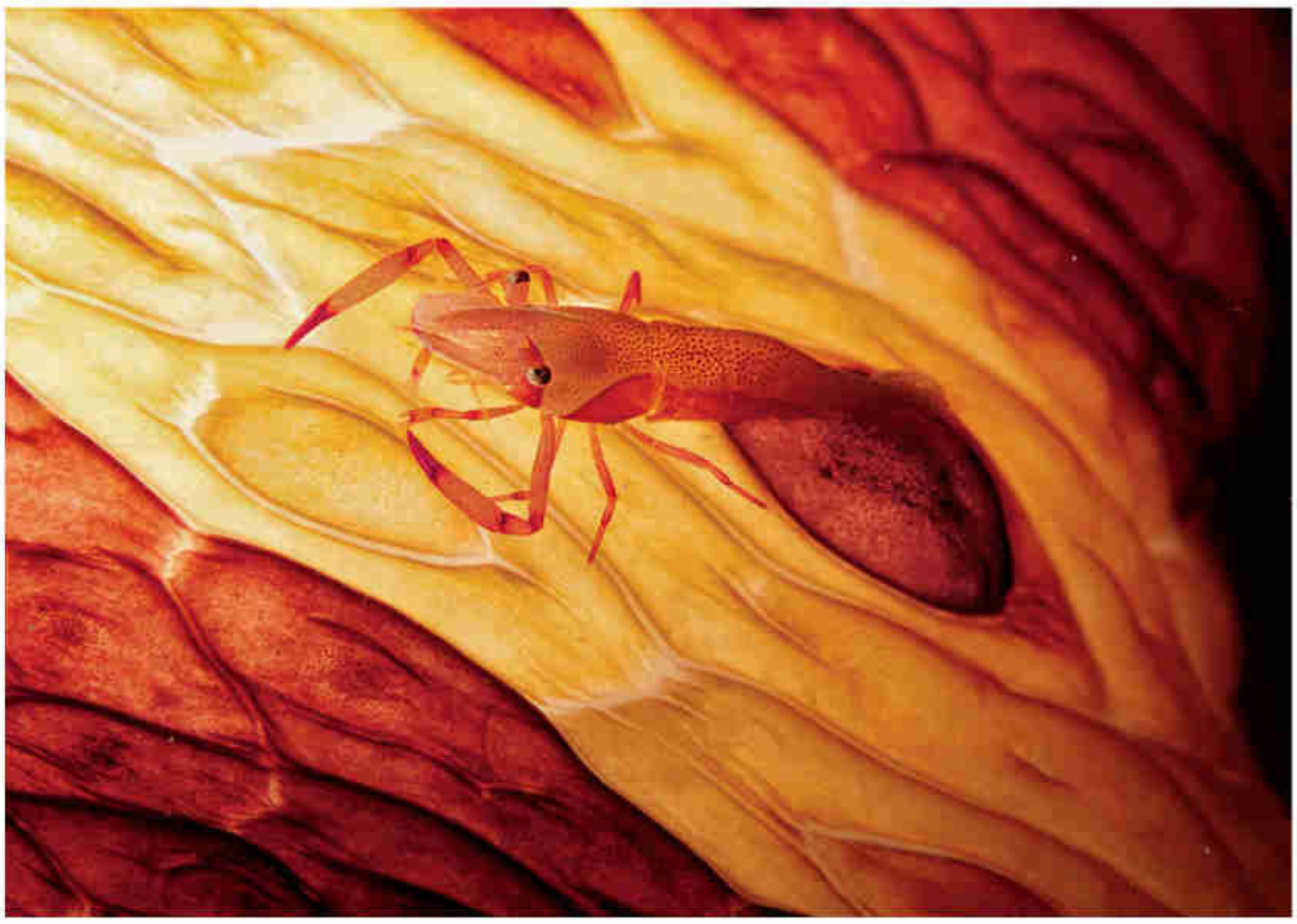
How these reefs became, in Mark's words, "a species factory," goes back geologic lifetimes to when a series of ice ages lowered ocean levels, leaving small, isolated seas in which species could evolve and diversify. Now the region is a crossroads for Pacific and Indian Ocean species, whose numbers are still being counted. Surveys in 2006 revealed marine life rivaling Raja Ampat's richness—and at least 56 new species—just to the east along the island of New Guinea around Fakfak and Cenderawasih Bay. To encourage protection of these sites as well as Raja Ampat, CI, the

Nature Conservancy, and the World Wide Fund for Nature–Indonesia, with the backing of the Indonesian government, created the 70,600-square-mile Bird's Head Seascape. Most of it is not yet legally protected, but the government this year named seven new marine protected areas covering nearly 3,500 square miles in Raja Ampat.

What the Bird's Head Seascape holds: 2,500 islands and reefs, nearly 1,300 fish species, 600 coral species, 700 mollusks (including seven species of giant clam), sea turtle rookeries, and more. What it's been robbed of: sharks. They've been slaughtered by outside commercial fishermen supplying the shark-fin soup market. Commercial fishing remains a threat, as does logging and nickel mining. Blast fishing by local subsistence fishermen has damaged some reefs, though the practice is fading as villagers become economic partners in conservation programs.

Raja Ampat is the seascape's crown jewel. Fittingly, the name means "four kings." Centuries ago those kings were men, four rajas granted rule here by a sultan of the Spice Islands, today's Moluccas, just to the west across the Halmahera Sea. Now Raja Ampat's four largest islands are considered the kings. Their waters make them truly royal.

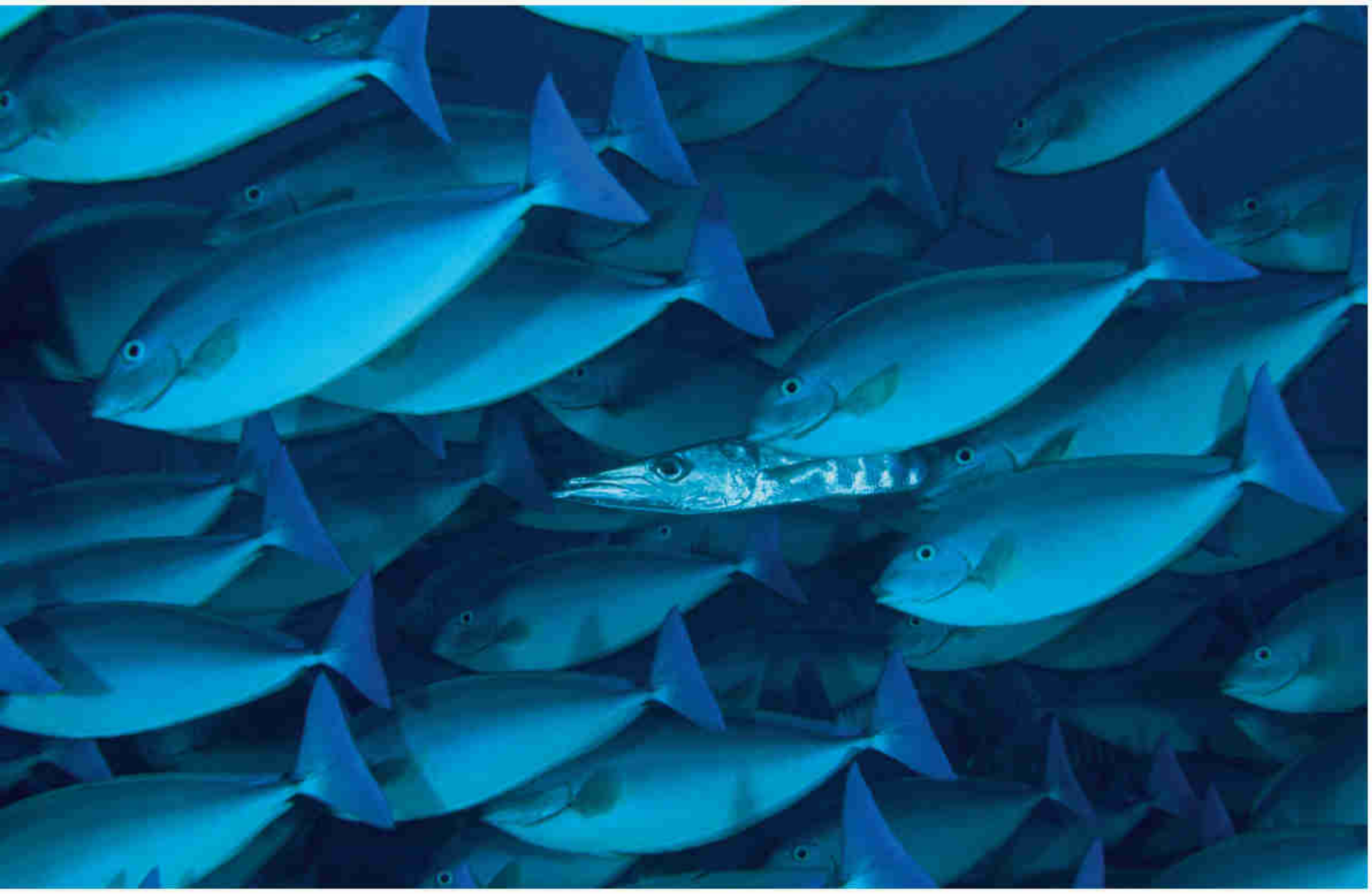
Underwater photographer David Doubilet has spent his life covering the world's oceans and coral kingdoms, contributing more than 60 pieces to the magazine since 1972. He received the Lennart Nilsson Award for scientific photography in 2001.



PERICLIMENES IMPERATOR (SHRIMP)

The parquet-patterned skin of a sea slug sets a choice table for an emperor shrimp. The inch-long crustacean cleans the slug, about as broad as a pancake, by eating plankton and detritus that collect on it.

A coral jungle, a heart of
darkness—not bright and sunny
but veiled and fertile



NASO CAERULEACAUDA (UNICORNFISH); *PLECTORHINCHUS POLYTAENIA* (SWEETLIPS)

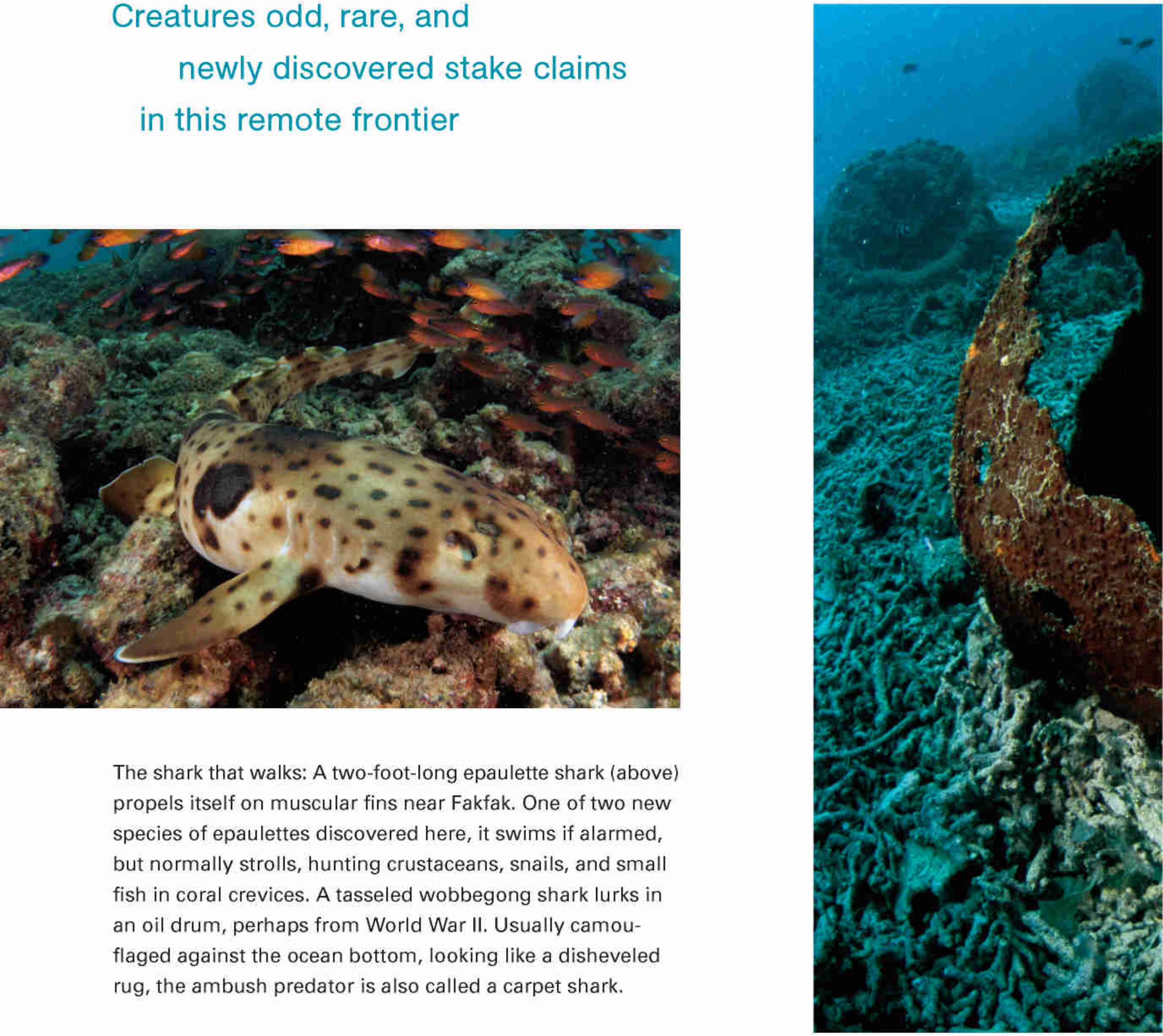
A lone barracuda insinuates itself into a school of bluetail unicornfish (above). These fish congregate by the hundreds, following currents at the edge of reef drop-offs. At the base of a reef 65 feet down, ribboned sweetlips peer from a towering coral tree (right). The small school often shuffled its formation, but never left the sanctuary of the branches.

JENNIFER HAYES (RIGHT)

MANTA BIROSTRIS

They were like condors soaring on thermals, mantas with wingspans of ten feet and more, caught by sunlight as they glided and looped in currents ripping through Dampier Strait. While mantas filter-feed in this murky broth of plankton, yellow-striped jacks find protection among the giants.

Creatures odd, rare, and
newly discovered stake claims
in this remote frontier



The shark that walks: A two-foot-long epaulette shark (above) propels itself on muscular fins near Fakfak. One of two new species of epaulettes discovered here, it swims if alarmed, but normally strolls, hunting crustaceans, snails, and small fish in coral crevices. A tasseled wobbegong shark lurks in an oil drum, perhaps from World War II. Usually camouflaged against the ocean bottom, looking like a disheveled rug, the ambush predator is also called a carpet shark.

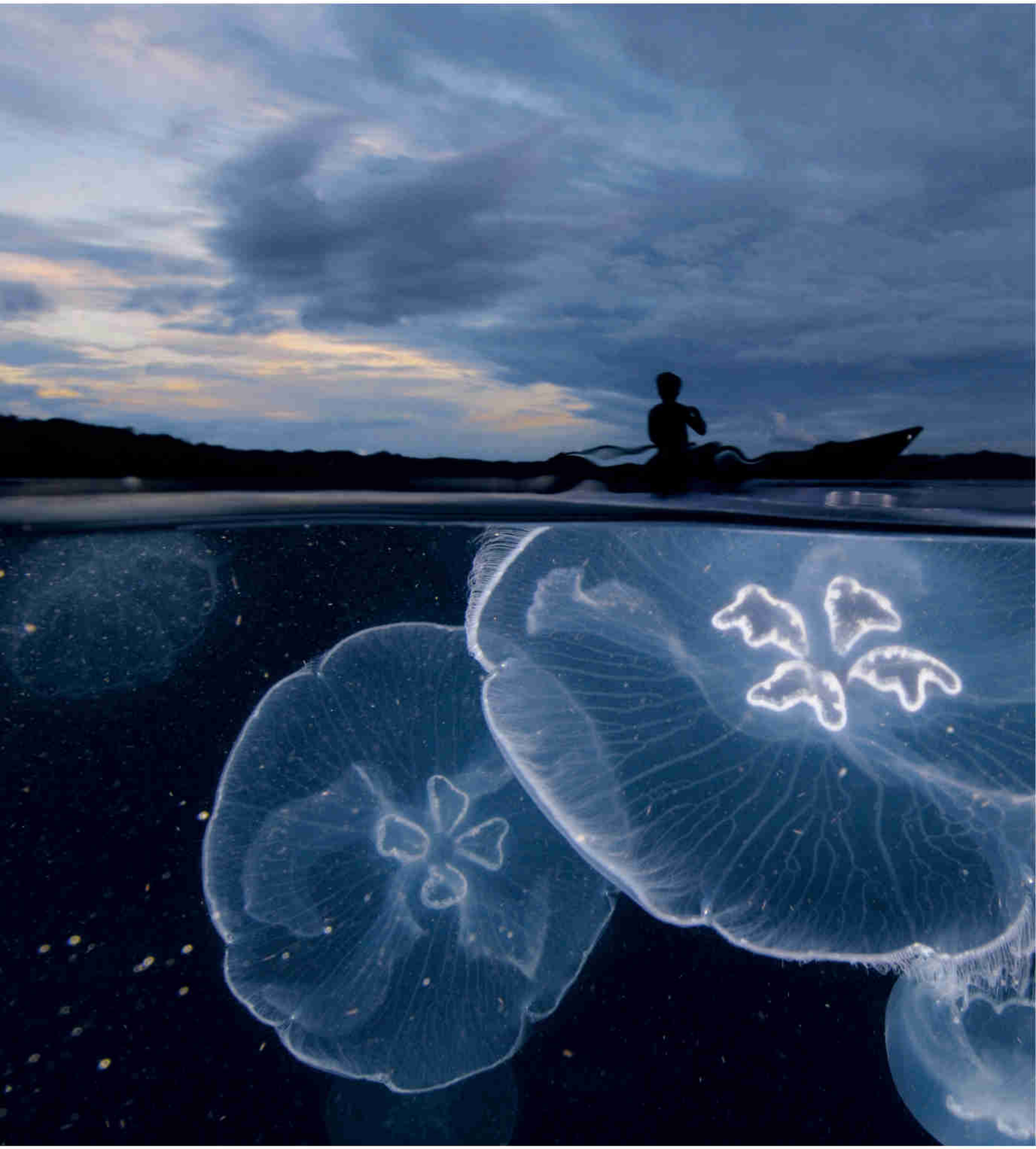
HEMISCYLLIUM SP. (EPAULETTE SHARK); *EUCROSSORHINUS DASYPOGON* (WOBBEGONG)

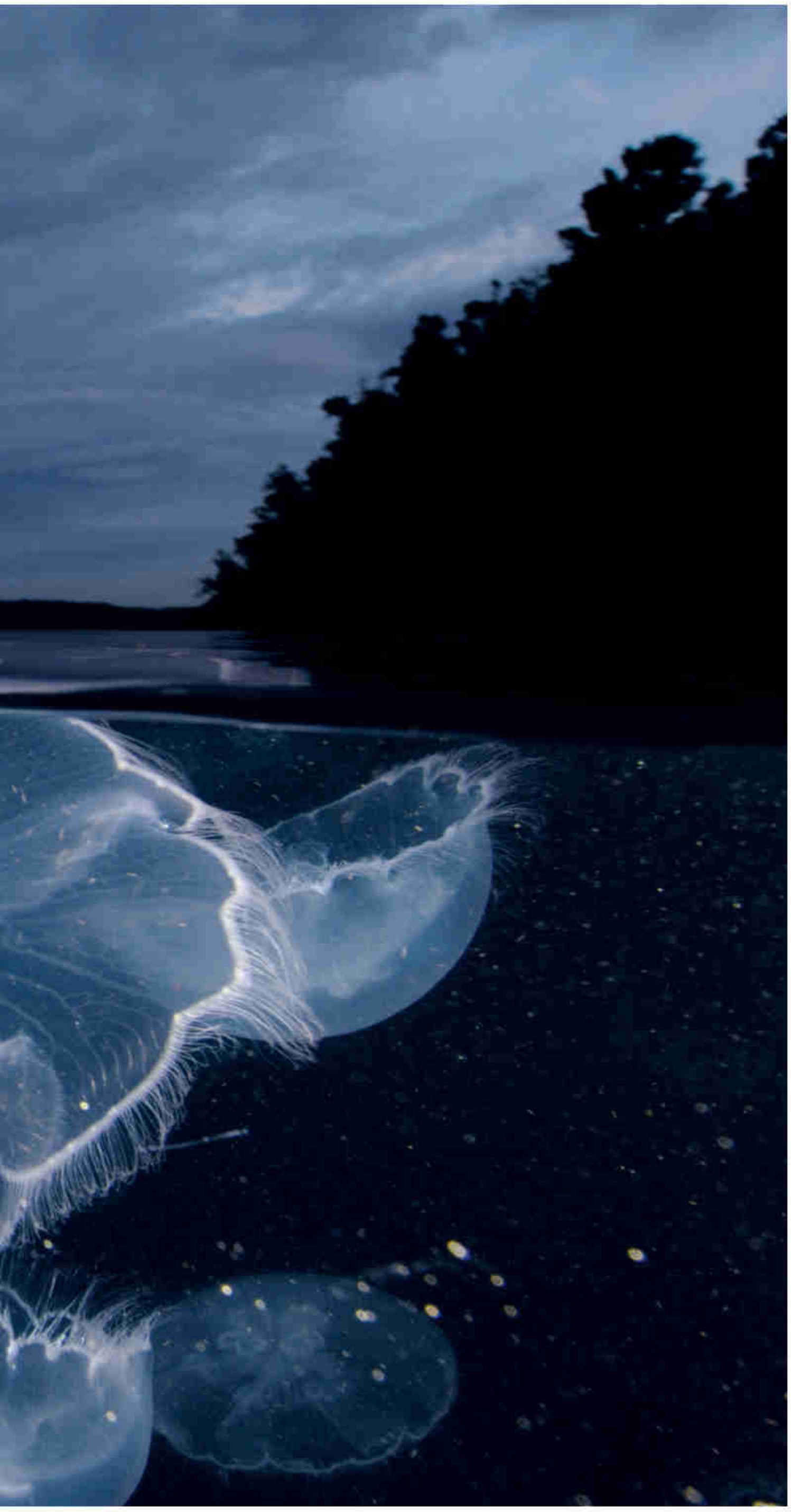
Reef meets rain forest in the
serpentine passage between
the islands of Waigeo and Gam.
Ten feet below the surface,
a glade of sea fans bathes in
light scattered by jungle above.

In terms of biodiversity,
this is the Amazon
of coral reefs

HIPPOCAMPUS DENISE (SEAHORSE); *PRIONOVOLVA* SP. (COWRY)

Imitation is the sincerest form of survival for Denise's pygmy seahorse, no bigger than a pinkie nail (above). White bumps mimic the polyps of its coral corral. Flamboyant in close-up, a cowry (right) is well disguised at a distance in the fluffy arms of pink-and-white soft coral. The mollusk's body covers its shell, polishing it to the famous cowry sheen.





AURELIA AURITA

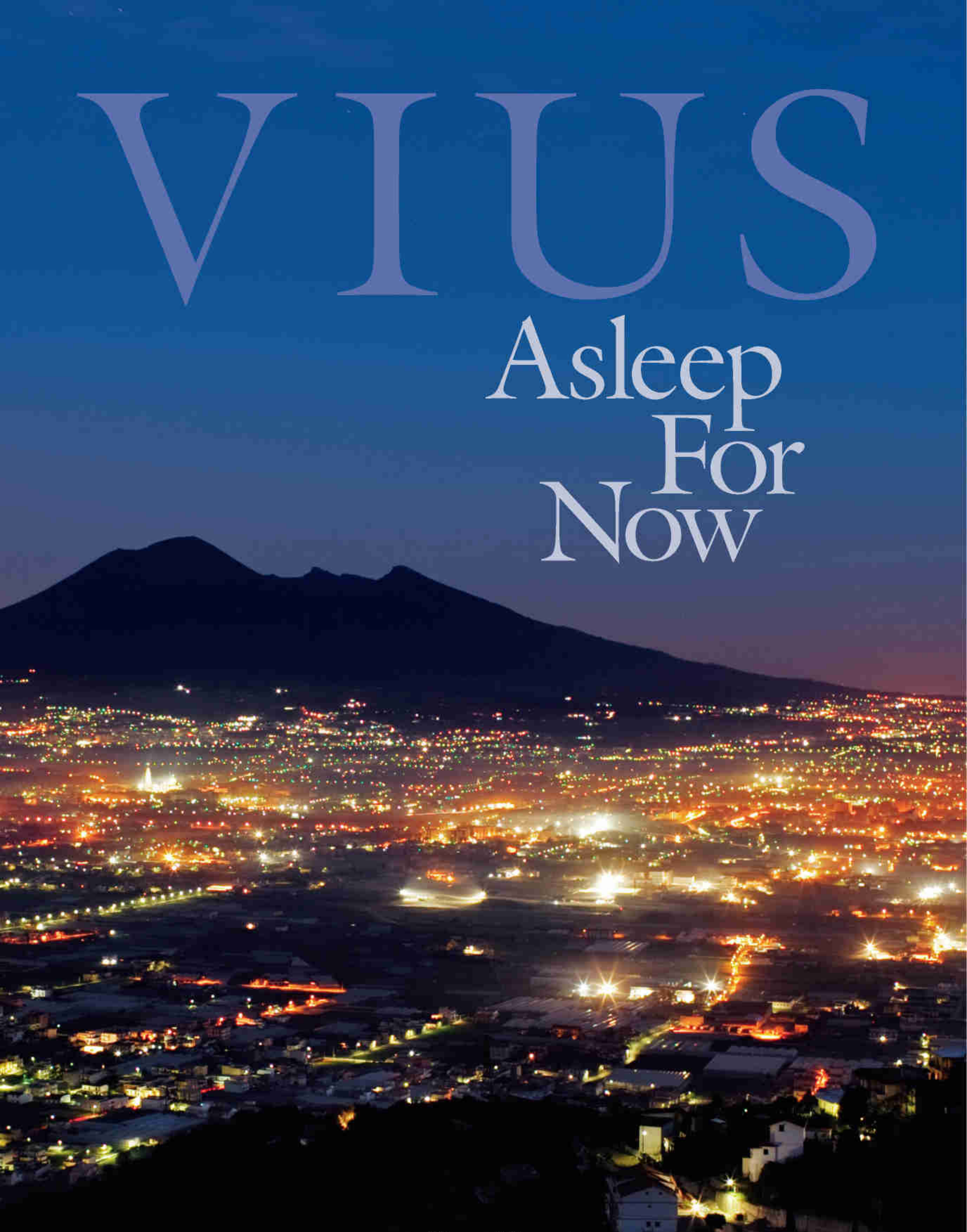
Moon jellies rise at nightfall off the island of Gam. Brightened by a strobe, their translucent bodies glowed. Thousands of them, about ten inches wide, pulsed in this sheltered bay, luminous heartbeats of a living sea. □

Dive on the Wild Side Take a narrated journey with David Doubilet, and find links to organizations working to preserve coral reefs at **ngm.com/0709.**

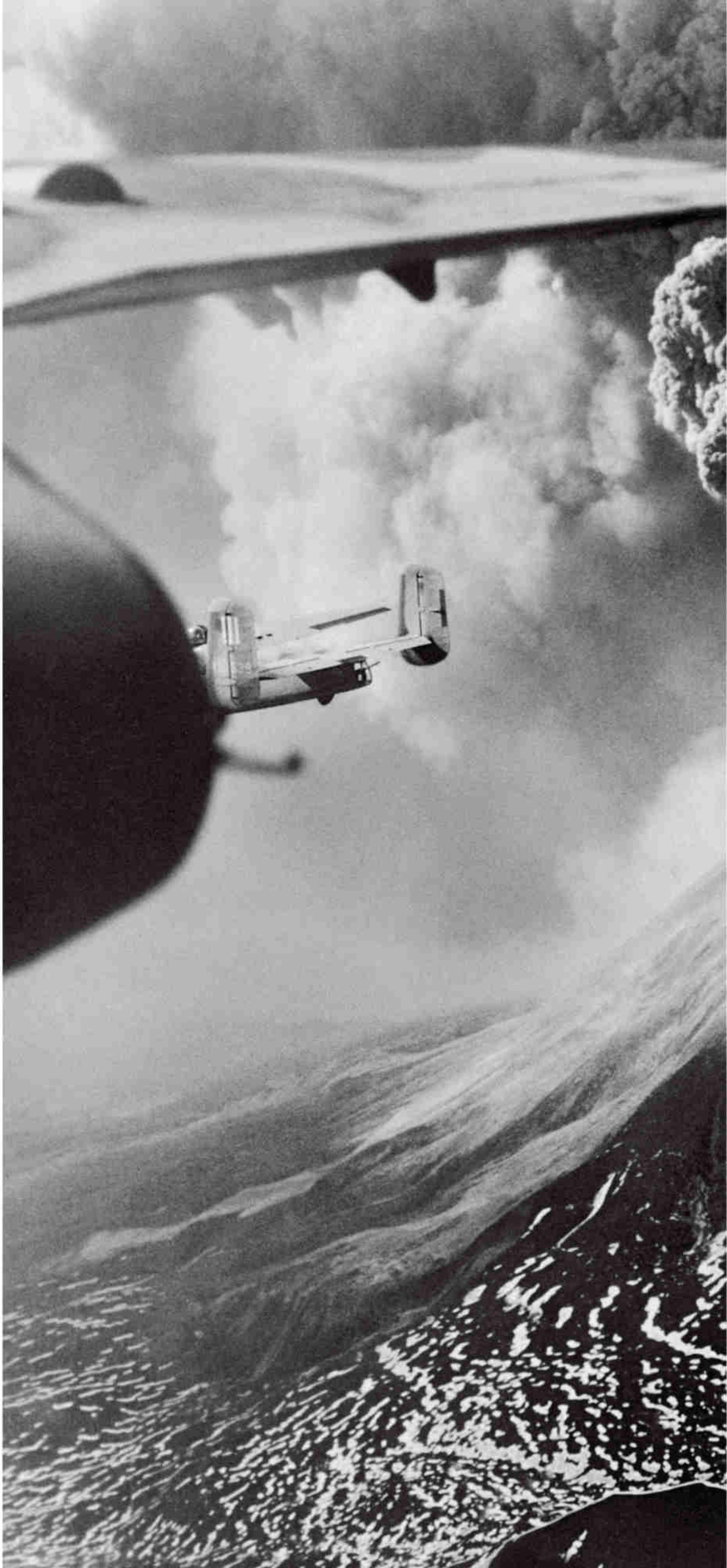
VESU

VIUS

Asleep For Now



The world's most dangerous volcano looms over the lives of three million people in southern Italy. An eruption in A.D. 79 buried the town of Pompeii (near the white spire, at center), but new research indicates the next blast could be much bigger.



During World War II, Vesuvius's last eruption, in 1944, shot a roiling cloud of ash skyward as U.S. bombers headed toward German troops. Even this minor eruption overran several villages, killed around 45 people, and damaged 88 Allied aircraft based nearby.

U.S. ARMY AIR FORCES

The city of Naples bustles above a deep layer of ash thrown down in a massive eruption about 1780 B.C. In the face of a similar catastrophe, residents have to hope they get enough warning to evacuate.

By Stephen S. Hall
Photographs by Robert Clark

When the first thunderous boom echoed across the plain of Campania, quickly followed by a blistering hail of volcanic rock, the man and the woman hastily abandoned their village and made a run for it to the east, up a gently sloping hill toward what must have seemed like possible sanctuary in a nearby forest. She was about 20 years old; he was in his mid-40s. A violent downpour of rubbly pumice mixed with incandescent rocks capable of crushing skulls and scalding skin obscured their escape. To their uncomprehending minds, the calamity descending upon them must have seemed like the end of the world.

Thousands of other people were at that same moment running for their lives, marking the soft ash and wet volcanic mud with footprints of human desperation that would remain undiscovered for millennia. The people whose footprints led to the north or northwest chose a path that probably saved their lives; those who set out to the east, like the young woman and the older man, toward the present-day Italian town of Avellino, unwittingly chose a path that led to certain death. They headed, by ill luck, smack into the middle of a fallout zone that would be swiftly buried under three feet of pumice.

Battered by the fallout as if stoned by the gods, weary with the effort and terrorized by the darkness that descended around them, each breath more labored than the one before, the couple—surely united in their desperation if not by any ancient form of matrimony—began to slow down. After struggling part way up the hill, a hill that rises toward a promontory now called Castel Cicala, they finally collapsed and fell to the ground, in the final throes of asphyxiation.

"They couldn't have seen more than a few feet in front of themselves," Giuseppe Mastrolorenzo was saying. A volcanologist at the Osservatorio Vesuviano in Naples, Mastrolorenzo stood in a small, well-lit room in the Museum of Anthropology at the University of Naples, leaning over a display case containing the beautifully preserved skeleton of the young woman extended on a bed of pumice, just as it had been found.

"In the eruption that buried Pompeii and Herculaneum, the deaths were instantaneous. People didn't know what was happening to them," added Pier Paolo Petrone, the anthropologist who had excavated and analyzed the woman's skeleton. "But her death was more tragic because it wasn't sudden." In one final, futile gesture of self-protection, the woman and the man raised

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Science writer Steve Hall's most recent book is entitled Size Matters. *Hall and photographer Robert Clark both live in New York City.*

A replica in a Naples museum shows how terrified victims fell when the A.D. 79 eruption hit Herculaneum. The scorching ash vaporized their flesh as it enveloped them.

their arms to shield their faces—and wore that fretful salute into eternity.

The bones lay where the couple fell until December 1995, when Italian archaeologists, digging a test hole for a future gas pipeline outside the small town of San Paolo Bel Sito, about ten miles northeast of Vesuvius, discovered a human skeleton nested in the roots of a hazelnut tree. It was the woman. Soon after, they uncovered a second skeleton, the man, beside the first.

Organized crime has made a lamentable comeback in the squat, dusty towns surrounding Naples, and when workers stumble upon human remains, it's sometimes a tough decision whether to call in an archaeologist or a homicide detective. Not in this case. The skeletons' final resting place, a bumpy bed of volcanic rock covered by pumice, provided a precise geologic time stamp for the moment of death. All that was required was a volcanologist to read the layers of rock. That process was set in motion when Petrone and Mastrolorenzo got news of the discovery. Petrone rushed to the site; authorities granted him exactly two afternoons to extract the bones. "It was a miracle that we were able to save this," Petrone said.

The skeletons of San Paolo Bel Sito—frozen in terrified flight, their choice of a mistaken escape route immortalized in their weary, ossified repose—offered Italian scientists clues in a project that has combined volcanology, archaeology, and physical anthropology into

The Avellino eruption occurred approximately 3,780 years ago, and researchers now argue that it represents the nightmare blueprint for a future calamity.

something like a *CSI: Vesuvius*. Over the past decade the project has rewritten the story of the nearby volcano, adding ominous fuel to scientific debates about the danger of future eruptions.

The man and woman were not doomed refugees of the famous A.D. 79 eruption that buried Pompeii and Herculaneum. Rather they were Bronze Age inhabitants of one of the dozens of prehistoric villages that dotted this beautiful, fertile plain during an earlier—and, it turns out, more violent—eruption of Vesuvius. The Avellino eruption occurred approximately 3,780 years ago, and researchers now argue that it represents the nightmare blueprint for a future calamity that could envelop Naples itself.

Since 1995, Petrone and Mastrolorenzo have roved the countryside of Campania, the region that surrounds Naples, a bit like the archaeological version of storm chasers, hustling to newly discovered excavation sites before the evidence can be removed or covered up. They have pieced together an anthropological and volcanological picture of the Avellino eruption—from thousands of fleeing footsteps of its victims, preserved in volcanic ash, to a spectacularly preserved prehistoric village (since dismantled) that was practically abandoned with dinner on the table—that has redefined the volcanic might and environmental toll of Vesuvius. They have not only given eloquent voice to the skeletons of San Paolo Bel Sito, but their enterprising research has turned that voice into a stark warning: Beware, modern Naples and surroundings, with your three million inhabitants, because an eruption of this magnitude is likely to happen again, and perhaps (in geologic time) very soon.

Ancient peoples gravitated to the plain of Campania for the same reasons we do today: clement weather, access to the sea (and seafood) at the present-day Gulf of Naples, fertile volcanic soil, and perhaps even the beauty that has captivated writers from Virgil to Stendhal. Long before Aeneas returned from his travels, more than a thousand years before Greeks settled in Cumae and ruled the Campanian plain, prehistoric settlers came down out of the nearby Apennines and began to tame the land, growing cereal crops and tending flocks.

Later the Greeks moved east from Cumae to Neapolis, the New City, a little farther along the coast where modern Naples now stands. We have a very good idea what life in this sun-splashed land was like during the Roman era because of the recovered splendor of Pompeii and Herculaneum. But as the well-trod earth of Campania continues to yield ancient secrets, Mastrolorenzo and Petrone, with their colleague Lucia Pappalardo, have put together a rich view of an earlier time and what may have been humankind's first encounter with the primal force of Vesuvius.

Almost all has come to light by chance. In May 2001, for example, construction workers began digging the foundation for a supermarket next to a desolate, weed-strewn intersection just outside the town of Nola. An archaeologist working for the province of Naples noticed several traces of burned wood a few feet below the surface, an indication of earlier human habitation. At 19 feet below, relicts of a perfectly preserved Early Bronze Age village began to emerge.

Over the next several months, the excavation unearthed three large prehistoric dwellings: horseshoe-shaped huts with clearly demarked entrances, living areas, and the equivalent of kitchens. Researchers found dozens of pots, pottery plates, and crude hourglass-shaped canisters that still contained fossilized traces of almonds, flour, grain, acorns, olive pits, even mushrooms. Simple partitions separated the rooms; one hut had what appeared to be a loft. The tracks of goats, sheep, cattle, and pigs, as well as their human masters, crisscrossed the yard outside. The skeletons of nine pregnant goats lay in an enclosed area that included an animal pen. If a skeleton can be said to cower,

the bones of an apparently terrified dog huddled under the eaves of one roof. What preserved this prehistoric village, what formed a perfect impression of its quotidian contents right down to leaves in the thatch roofs and cereal grains in the kitchen containers, was the fallout and surge and mud from the Avellino eruption of Vesuvius. Claude Albore Livadie, a French archaeologist who published the initial report on the Nola discovery, dubbed it "a first Pompeii."

During May and June 2001, provincial archaeological authorities oversaw excavation of the site. Mastrolorenzo hurried out to Nola, about 18 miles east of Naples. He and Pappalardo took samples of the ash and volcanic deposits, which contained chemical clues to the magnitude of the eruption. But then the scientific story veered off into the familiar opera buffa of Italian archaeology. The owner of the site agitated for construction of the supermarket to resume or to be compensated for the delay—not an unusual dilemma in a country where the backhoes and bulldozers of a modern economy clang against the ubiquitous remains of ancient civilizations.

Government archaeologists hastily excavated the site and removed the objects. As it turns out, the supermarket was never built, and all that remains of a site that miraculously captured one of civilization's earliest encounters with volcanic destruction is a hole in the ground on a vacant, weed-choked lot, the foundation walls of the huts barely visible. A small, weathered sign proclaiming the "Pompeii of Prehistory" hangs limply from a padlocked gate.

The sad archaeological scenario of Nola has repeated itself several times. In 2002, an Italian construction company under contract to the U.S. government to build a support facility for the large U.S. Navy base in the southern Mediterranean uncovered another ash-covered village near the modern town of Gricignano di Aversa; it was, according to Mastrolorenzo, even more extensive than the Nola site, with

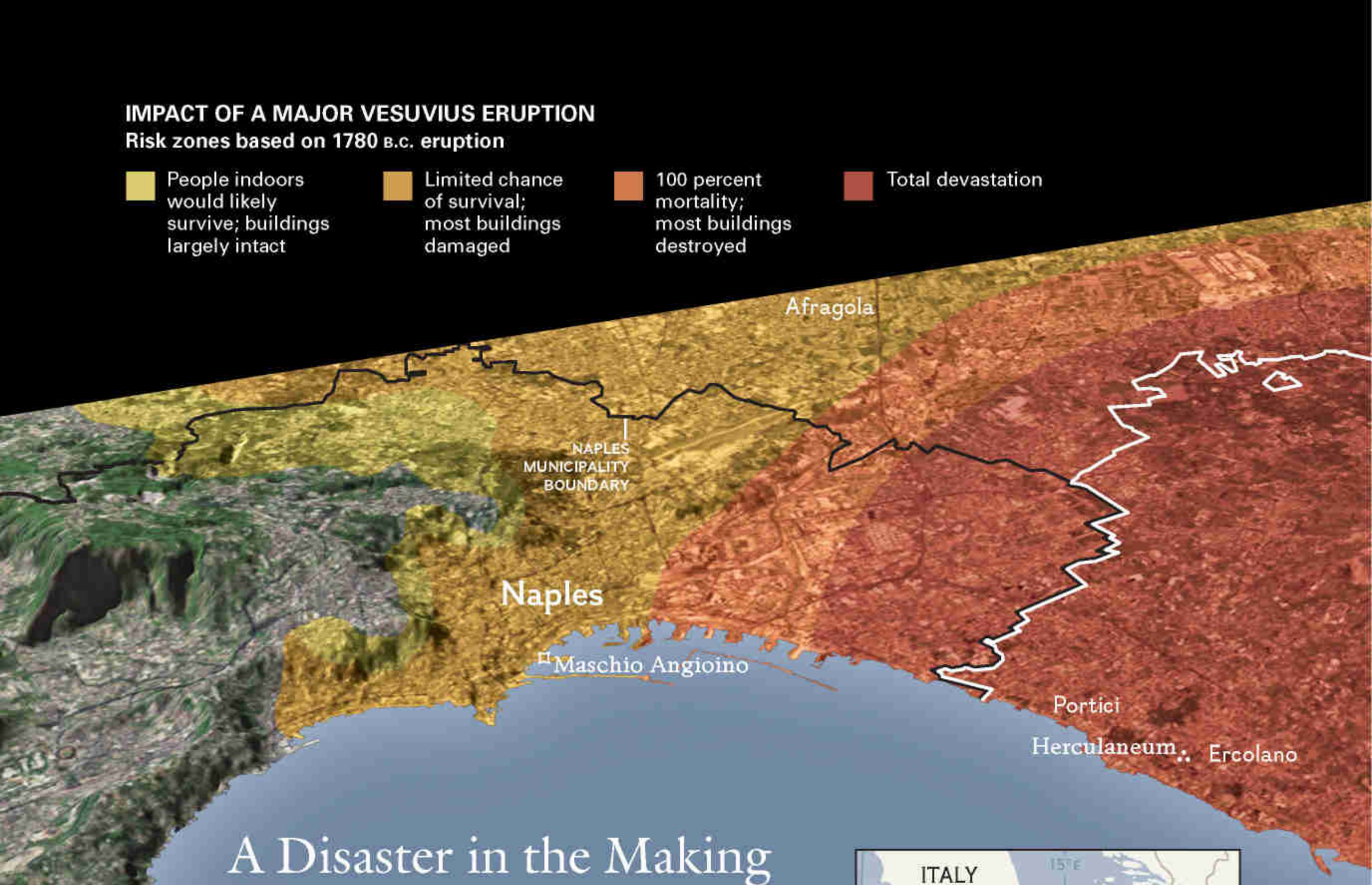
Just four miles from Naples, ash from the 1780 B.C. eruption preserved the footprints of two people fleeing the volcano. Thousands of other prints nearby testify to a mass exodus.

traces of numerous Copper and Bronze Age huts. "They spend a short time 'documenting' the site," Petrone said sarcastically of archaeologists who examine construction sites, "and then it is destroyed."

In the summer of 2004, during construction of the new high-speed railroad line between Naples and Rome, thousands of human footprints were uncovered near the town of Afragola. Geologic analysis established that they were the footprints of Bronze Age inhabitants fleeing the Avellino event. The threesome rushed to photograph the vivid residue of that ancient terror.

Despite the loss of these sites, Mastrolorenzo, Petrone, Pappalardo, and American volcanologist Michael Sheridan triggered worldwide fascination when they summarized these findings in the spring of 2006 in the *Proceedings of*

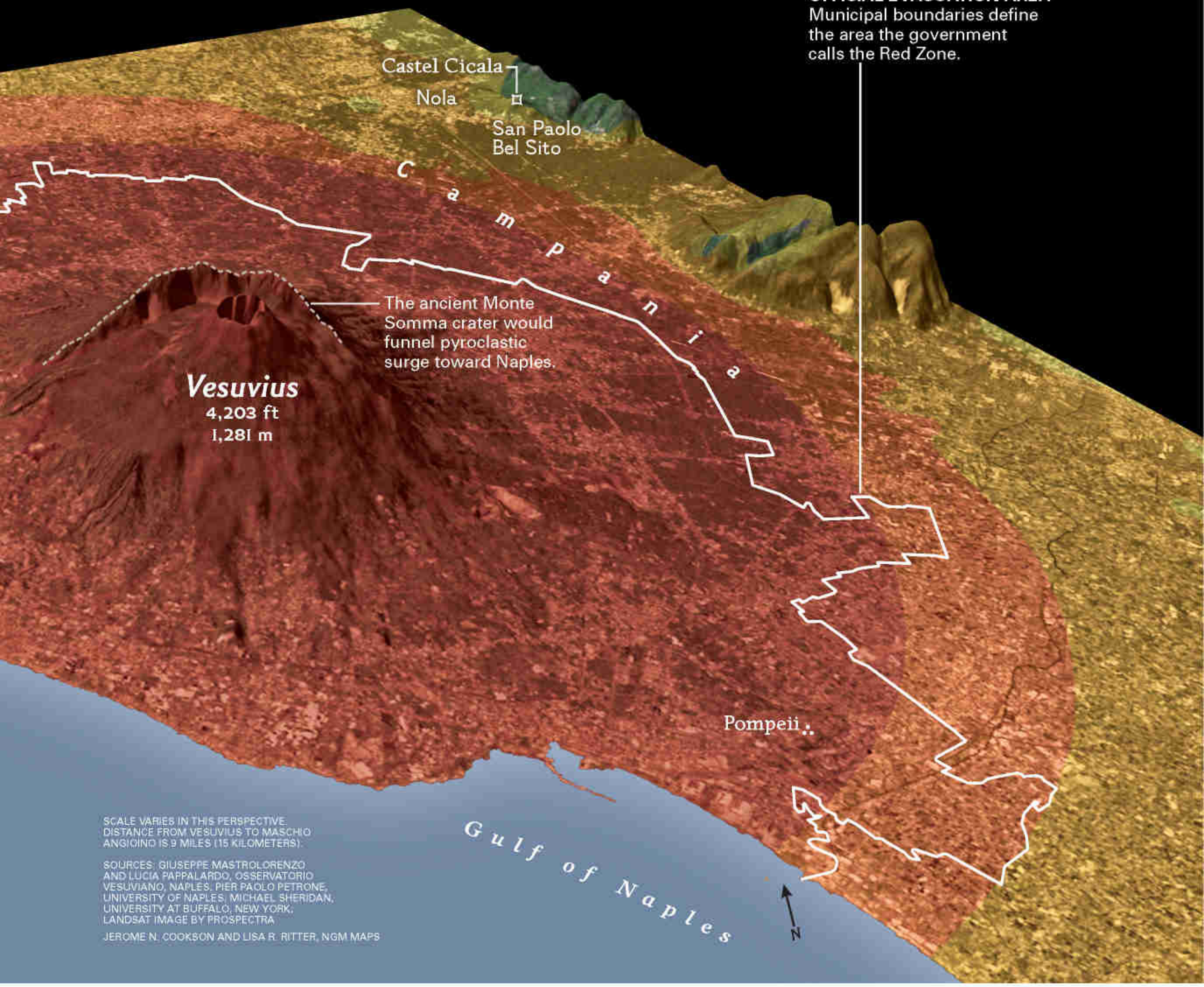
PIER PAOLO PETRONE, UNIVERSITY OF NAPLES



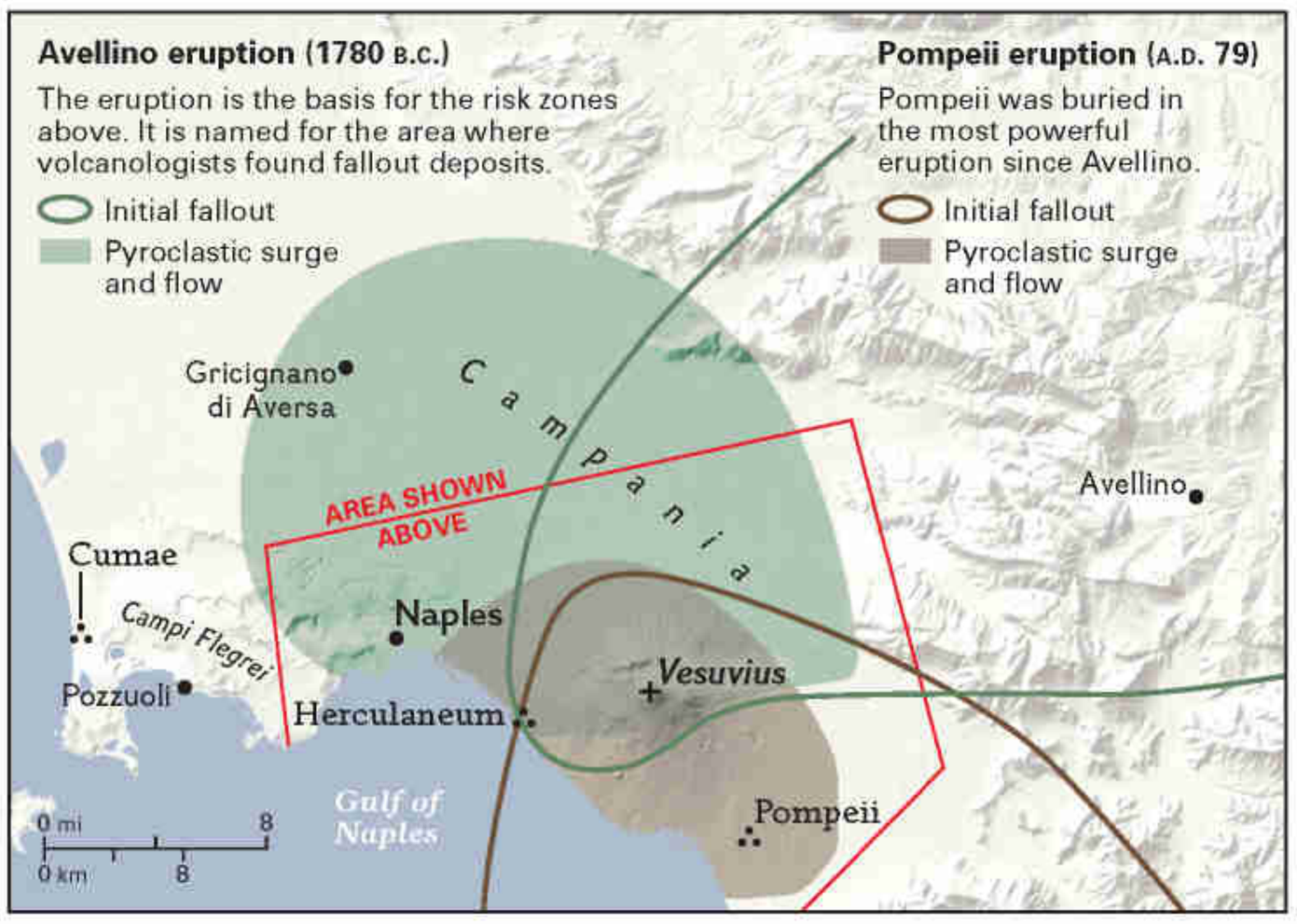
A Disaster in the Making

Towering over the Gulf of Naples, Vesuvius is a ticking time bomb. On that point, everyone agrees. How large the next eruption will be, and how many lives are at risk, are the subjects of serious debate. The current evacuation plan, based on a modest eruption, covers the 600,000 people who live in the Red Zone (white line above). Scientists now say a big blowout could threaten Naples, not yet included in the calculations.

HISTORY'S LESSONS
A sobering reminder of the volcano's lethal power, the plaster cast of a victim of the A.D. 79 eruption lies on display at Pompeii. Many died pressing pillows to their faces in a vain attempt to keep from inhaling ash. Vesuvius typically lets loose with a giant column of hot ash and stones that is dispersed by wind, but as the column collapses, searing



clouds of debris in the pyroclastic surge wreak havoc. The current evacuation plan is based on the 1631 blast, which barely reached the Naples area, but scientists have learned recently that a larger eruption in 1780 B.C. devastated most of where the city now sits. Such cataclysmic eruptions occur about every 2,000 years, so the next is coming due.



Vesuvius unleashed at least six cycles of pyroclastic surge and flow in 1780 B.C., destroying everything within about nine miles.

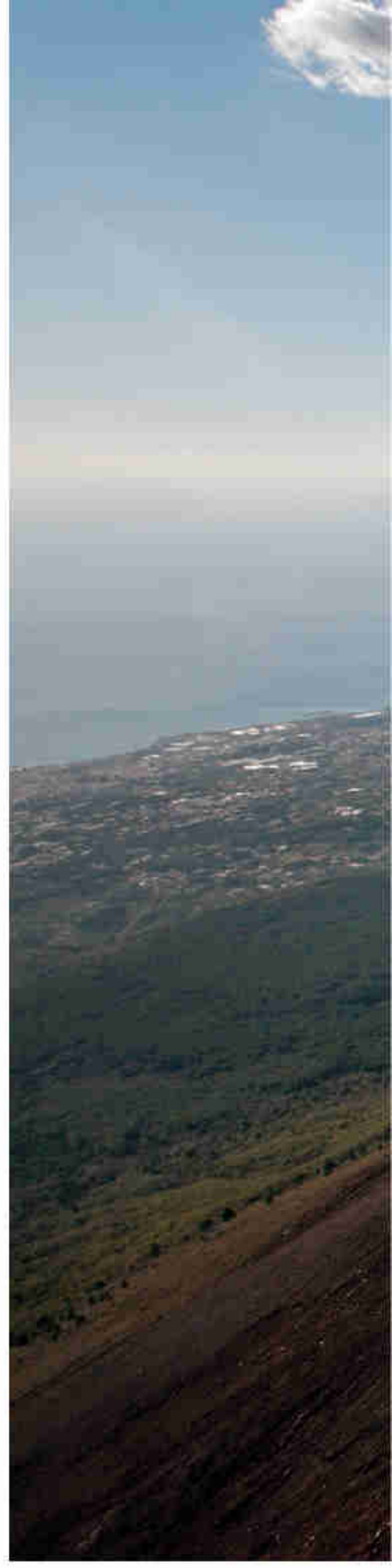
the National Academy of Sciences (PNAS). But their research went beyond mere archaeological documentation. The Avellino event, they wrote, "caused a social-demographic collapse and the abandonment of the entire area for centuries." The new findings, along with computer models, show that an Avellino-size eruption would unleash a concentric wave of destruction that could devastate Naples and much of its surroundings. In the world before Hurricane Katrina and the Indian Ocean tsunami, these warnings might have sounded as remote and transitory as those prehistoric footsteps. Not anymore.

There are many ways for a human being to die after a volcano erupts, and a blast like the one Vesuvius unleashed in 1780 B.C. provides a grim inventory of almost all of them.

"In the first hours of the Avellino eruption, material like this fell," Mastrolorenzo explained, dropping two transparent bags of volcanic material on the desk in his office at the Osservatorio Vesuviano. One of the bags contained a fine white powder, the ash that blanketed the fallout zone; the other was full of small rocks, no more than an inch or two in diameter. Some of the rocks were pumice, pebbles honeycombed with bubbles and nearly as light as Ping-Pong balls; others were dense and hard. "These are lighter than water; they float," he said, picking up a piece of pumice. "But these," he continued, picking up one of the harder rocks, called lapilli, "these were falling at about 90 miles per hour."

The first hint of the Avellino eruption of Vesuvius emerged in the early 1970s when volcanologists identified pumice deposits underneath the A.D. 79 residues. But in recent years Mastrolorenzo, Pappalardo, and their colleagues, analyzing everything from meters-thick ash deposits visible in road cuts to micron-thin slices of volcanic crystals viewed in a scanning electron microscope, have reconstructed the Avellino event in harrowing detail.

Some eruptions ooze lava in picturesque, slow-moving streams. But in an event like Avellino, the conduit of the volcano is so tightly corked by solid rock that it takes an enormous amount of pressure building up from below, in the magma chamber, to blow a hole to the surface. When it does, the violence of the explosion—the *boato,* Italian for the enormous roar—propels liquid rock into the air so fast that it breaks the sound barrier, unleashing a sonic boom. During the Avellino eruption, the boato accompanied a blast that hurled nearly 100,000 tons a second of superheated rock, cinders, and ash into the stratosphere. It reached an altitude of about 22 miles —roughly three times the cruising altitude of commercial airliners. As this incredible cloud of material rose, it spread at the top, assuming the classic shape—classic ever since Pliny the Younger first described it in a letter to the Roman historian Tacitus about the later eruption that buried Pompeii—of an umbrella pine tree, the iconic feature of a plinian eruption.



Prevailing winds out of the west carried the bulk of the initial fallout in a northeasterly direction, toward Nola and Avellino, where pumice and lapilli deposits piled up as high as nine feet near the volcano in several hours. The column of ash may have hovered in the air for up to 12 hours. Then it collapsed, producing an apocalyptic sequence of events that makes a plinian eruption one of the most lethal natural disasters on Earth.

When a plinian column falls upon itself, it creates a pyroclastic surge—a boiling, turbulent avalanche of debris that shoots out sideways

Scarred by minor eruptions, Vesuvius hovers menacingly above Naples, a mere nine miles away. A major explosion could shatter the crater, destroy the city, and ravage the entire region.

from the slopes of a volcano. This searing cloud can travel for many miles, initially at great speed. Not too many humans have seen (much less survived) a pyroclastic surge at close quarters, but many of us have an image of its horrifying power burned into our memories: It shares many physical properties with the huge clouds of powder and ash produced by the collapse of the World Trade Center towers in 2001.

Unlike the collapsed towers, the material in a pyroclastic surge is baked in a subterranean magma chamber to temperatures of up to 1650°F. The initial surge of the Avellino eruption, especially in the zones closest to Vesuvius, was instantly lethal. Hot, choking wind, advancing at about 240 miles an hour, reached temperatures of at least 900°F, and retained enough heat to bring water to a boil ten miles from the vent. "Below 200 degrees Fahrenheit, you can survive for several seconds, perhaps, if the wave passes quickly," Mastrolorenzo pointed out. "But even if you survive the temperature, you will suffocate on the fine powder in the air. The entire countryside surrounding Vesuvius was covered by foot upon foot of this powder, 65 feet deep at a distance of three miles from the crater to about ten inches thick at a distance of 15 miles. Eight inches of ash is enough to cause modern roofs to collapse."

The sizzling temperature of a Vesuvian surge has emerged as a key factor in explaining what happened at Pompeii and Herculaneum in the next great eruption, 1,900 years later. Petrone

The ruins of an abandoned restaurant offer a view of the future for the towns closest to the volcano. To get residents out of harm's way, the government now pays those who volunteer to move elsewhere.

On the Tangenziale, four lanes of cars jockeyed to squeeze into two. Traffic like this makes any emergency evacuation plan seem hopelessly optimistic.

and Mastrolorenzo, with colleagues in Italy and England, published a paper in the journal *Nature* in 2001 demonstrating that hundreds of fugitives who gathered in 12 seafront *fornici,* or boathouses, facing the beach of Herculaneum died instantly from a pyroclastic surge that reached temperatures of 932°F, vaporizing clothing and flesh within seconds.

In a grim bit of forensic paleoanthropology, Petrone and Mastrolorenzo reconstructed a parting picture of the victims huddled inside fornici 5, 10, and 12. The heat would have boiled their brain tissue, which would then have burst out in small, scalding explosions that left blue-black burn marks on the bone. Moisture from vaporized flesh and blood combined with volcanic ash in the surge to create a protective, plasterlike material that preserved the bones, and from the posture of the skeletons they could determine that victims in the fornici died instantly. (Petrone keeps samples of the bones, along with the San Paolo Bel Sito skeletons, in several large shopping bags in his office.)

The pyroclastic surge is just the first part of the one-two punch delivered by the collapse of a plinian column. When the vast amount of solid ash and debris mixes with steam fed by underground aquifers, a violent microclimate of pitched thunderstorms and torrential rains occurs, producing great mudflows. Ash falling into rivers creates more mudflows, known as lahars, that fill river valleys long after the eruption is over. "There are more victims from the mudflows than from the eruption itself," Mastrolorenzo says. "These mudflows travel with a force that moves houses hundreds of meters."

Blast, fallout, column collapse, surge, flow: In this classic sequence of plinian fury, the Avellino eruption disfigured the plain of Campania as rudely as if the gods had scraped, gouged, and reshaped the landscape with a giant trowel. The pattern of its deposits, the swirl of its volcanic signature in layers thick and thin, has allowed volcanologists to conclude that Vesuvius unleashed at least six cycles of pyroclastic surge and flow in that single eruption—six bursts of searing winds followed by six rampaging rivers of mud—that destroyed everything within about nine miles of the volcano. The immediate cataclysm probably lasted less than 24 hours, but it turned an idyllic landscape into a monochromatic desert, uninhabitable for 300 years.

The road that snakes up from the Gulf of Naples to the summit of Vesuvius reveals one more way a human being can perish on the slopes of this volcano: getting hit by one of the countless tour buses careening around the tight turns along the route from Ercolano to the 4,203-foot summit. Long gone are the days when brawny Neapolitan youths hoisted chairs bearing celebrities like Goethe and lugged them up the steep path to what the German writer memorably called "this peak of hell which towers up in the middle of paradise." Paradise nowadays is finding a free spot in the crowded car park.

After buying your ticket (the top of the volcano is now part of a national park), you hike along a path zigzagging over the rusty, iron-rich cinders of the cone. You pass several souvenir shops as well as the abandoned concrete piers of the funicular cableway that replaced the broad-shouldered youths (the original 19th-century version of this conveyance inspired the famous Neapolitan song "Funiculì, Funiculà"). And finally, you arrive at the rim of the crater, where the view on a clear day takes in everything from Capri and the Sorrentine Peninsula to the south, to modern-day Naples to the northwest, to Pompeii and Herculaneum, victims of the geophysical power momentarily contained beneath your feet.

After an enormous sub-plinian eruption in 1631, Vesuvius has adopted a more benign personality. It produced copious streams of lava during frequent eruptions in the 18th, 19th, and

early 20th centuries (when Mastrolorenzo was a child, his grandmother used to describe the time his grandfather swept ash and cinders off roofs in Naples following an event in 1906). But since its last eruption in 1944, the conduit has been plugged, and no one younger than 63 years of age has experienced an eruption. The occasional reminders that the volcano is still active produce a complex state of philosophical denial among people who live on or near Vesuvius. They tend to pooh-pooh the danger and, perhaps more than in many other parts of Italy, live for the moment in a gracefully fatalistic way.

Few people spend more waking hours, day in and day out, in close proximity to Vesuvius than Gennaro Cardoncello, a stolid and friendly young man who tends the last outpost of commerce on the crater rim. As he stood behind a truly astonishing array of curios carved from volcanic rock (Buddha, the Pietà, frogs, owls, the Three Graces), he was asked if he ever feels the small earthquakes or tremors that are believed to signal the run-up to an eruption.

"Maybe a few times, but it's not a big deal," he said.

With that sloe-eyed look of indifference that has been elevated to performance art in Naples and environs, Cardoncello shrugged his shoulders and changed the subject, producing a bottle of Lacryma Cristi, the local white wine whose grapes draw on Vesuvius's rich soil to produce their intense taste.

Streams of tourists clamber up the steep path to the crater, oohing at the postcard-perfect vistas in every direction, aahing as they peer down from the rim of the crater 800 feet to the floor, where several fumaroles barely manage to etch the air with their noxious breath. Few of these volca-tourists pause to think about the vast reservoir of molten rock about six miles below or contemplate the curving remnant of the larger, more ancient Monte Somma crater that funnels the view—and more important, would funnel any future pyroclastic surges—in a northwesterly direction toward metropolitan Naples. When Vesuvius had its last plinian eruption, the plain below was inhabited by thousands of sybaritic Romans; now it is inhabited by upwards of one million people in Naples alone, and hundreds of thousands more in the towns between the city and the crater.

On a clear day, with even modest binoculars, it is possible to stand on the crater rim and make out the massive 13th-century Angevin fortress in downtown Naples known as Maschio Angioino. Also known as Castel Nuovo, it is where the French Angevin monarchy first settled, and it marks the geographic and, in some ways, the emotional heart of the city. Several days after I visited the summit, Mastrolorenzo led me deep into the fortress's foundation, two floors beneath the elegant chamber where until recently the Naples City Council held its weekly meetings. He pointed to a deposit of volcanic pumice and ash roughly two and a half feet thick. It came, he said, from the Avellino eruption.

Michael Sheridan, a volcanologist at New York's University at Buffalo who collaborates with Mastrolorenzo, is an expert on catastrophic eruptions near densely populated urban centers. Sheridan has studied the 1902 eruption of Mount Pelée on the island of Martinique, which devastated the town of St. Pierre, and has been closely watching Cotopaxi, an active volcano that threatens more than a million people in the Andes highlands of Ecuador. He was unaware of the Castel Nuovo deposit until I mentioned it to him. "That's really damning," he said. "St. Pierre was destroyed by eight inches of that stuff, and everyone died. There would be no survivors in that part of Naples."

Scientists know from geologic records that Vesuvius has unleashed catastrophic plinian eruptions with a ragged but disquieting rhythm over recent geologic time. Since an eruption 25,000 years ago, major eruptions have occurred 22,500 years ago, 17,000 years ago, 15,000 years ago, 11,400 years ago, 8,000 years ago, then Avellino

Scientists know that Vesuvius has unleashed eruptions with a ragged but disquieting rhythm over recent geologic time.

3,780 years ago, and then the A.D. 79 Pompeii eruption nearly 2,000 years ago. Based on an interval of about 2,000 years between these larger eruptions, Sheridan and Mastrolorenzo have calculated that there is a greater than 50 percent chance of a major eruption each year now, the odds rising incrementally as the time since the last big plinian event grows longer year by year.

When Mastrolorenzo, Petrone, Pappalardo, and Sheridan published their research report on the Avellino eruption in March 2006, it sparked controversy with its blunt prediction that Vesuvius was due for a major eruption that could be powerful enough to threaten metropolitan Naples. Naples isn't even part of the current planning. The Italian emergency plan, introduced in 1995 and last revised in 2001, is based on a smaller, sub-plinian eruption and calls for the priority evacuation of the residents living in the immediate vicinity of Vesuvius—the 600,000 people who live in the so-called Zona Rossa, or Red Zone, defined by the boundaries of 18 municipalities on the slopes of the volcano.

The Vesuvius emergency plan has not been significantly updated in more than five years. When the *PNAS* paper came out last year, laying out a much more dire scenario for Naples, the president of Italy's National Institute of Geophysics and Volcanology, Enzo Boschi, denounced Sheridan's risk analysis as "alarmist and irresponsible," and flatly declared "the evacuation plans will not be changed." Some volcanologists at the University of Naples referred to the report's warnings as "scientific terrorism."

Predicting an impending eruption is an imprecise science at best. Although Mount St. Helens gave signs of increasing restlessness preceding the 1980 eruption, according to a U.S. Geological Survey account, it "showed no change from the pattern of the preceding month," and monitors on the morning of May 18, 1980, "revealed no unusual changes that could be taken as warning signs for the catastrophe that would strike about an hour and a half later."

If Vesuvius showed signs of rousing itself again, volcanologists believe they could predict that it was about to erupt in *breve tempo,* soon. When I asked Mastrolorenzo what exactly "soon" means, he replied: "This is the problem. We don't know —not in the way you can predict when a hurricane is likely to arrive." That imprecision could wreak havoc in a major metropolitan evacuation.

It's not nice to needlessly scare people, but it's much less nice to contemplate what happens when lots of scared people try to do the same thing in a big hurry at the same time. This thought occurred to me one afternoon as I sat, motionless, in a huge traffic jam on the Tangenziale, the expressway that threads around downtown Naples and leads to the main autostrada that heads north toward Rome.

What would happen if Vesuvius suddenly gave signs of becoming seriously restless? There would be, as there always is with probabilistic predictions, confusion and uncertainty. "It's hard to imagine what it would be like in the days leading up to an eruption," Mastrolorenzo said. "It would be worse than the eruption itself." Some Neapolitans might flee at the first hints of seismic indigestion, others might resolve to stay, still others might leave, grow disenchanted with weeks or months of seismic uncertainty, and then return. There simply is no modern precedent for an urban evacuation of this magnitude.

On the Tangenziale, cars inched along at a crawl; four lanes of cars jockeyed to squeeze into two northbound lanes. It took me about an hour to traverse a mile, and the most urgent thing

The Madonna statues sold at a gardening center in the Red Zone are popular symbols of people's unshakable faith and the serenity with which they contemplate their hulking neighbor.

on anyone's agenda that day was getting to the beach. Traffic like this makes any emergency evacuation plan seem hopelessly optimistic. Indeed, during a Red Zone evacuation drill in October 2006, traffic on the nearby Napoli-Pompeii autostrada ground to a halt; an overnight thunderstorm seriously complicated the exodus; and one of the 18 towns, Portici, participated under protest. Government officials pronounced themselves pleased with the results; news accounts described "delays and chaos." And this was just a minimalist exercise, involving only a hundred citizens from each of the 18 Red Zone towns.

In any event, a massive evacuation would have to be well under way prior to an Avellino-size eruption. Once the event began, once the volcano disgorged possibly billions of cubic feet of ash, rock, and debris into the air and sent it raining to the ground, all forms of transportation would become useless. Airplanes could not fly. Trains could not run. Neither cars nor buses nor scooters could function in even four or five inches of gritty ash. In fact, the only likely means of escape would be . . . by foot.

Four thousand years after Avellino, the inhabitants of Campania would be reduced to leaving their footprints in the ash. □

Braced for a Blowout Explore the impact a major eruption of Vesuvius might have with our online interactive map at **ngm.com/0709.**

DISCOVERIES

IN THE DARK

MEET THE ELUSIVE TROGLOBITES, CAVE-DWELLING CREATURES THAT NAVIGATE WITHOUT EYES, GO WEEKS OR MONTHS WITHOUT FOOD, AND CAN LIVE FOR MORE THAN A CENTURY.

A species of millipede discovered in California's Sierra Nevada skitters through life underground, at home in eternal darkness. This and fellow troglobites were photographed against a white backdrop in or near their native caves.

STRIARIID, UNIDENTIFIED SP., 1.25 INCHES (BODY LENGTH), HIDDEN CAVE

Armed with long-reaching legs and sensory hairs that pick up vibrations and temperature shifts, this cave spider has no need for eyes—or body pigment. Less visible adaptations to a life of scarcity may include lower metabolism and fewer young.

YORIMA NEW SPECIES, 0.2 IN, CLOUGH CAVE

All curves, this eyeless flatworm inhabits a series of cave pools where its kind has likely made a home for thousands of years. Vulnerable in its tiny world, "it shows that no matter how tenuous cave living can be," says geologist and cave specialist Joel Despain, "life is persistent."

TRICLADID, UNIDENTIFIED SP., 0.2 IN, CRYSTAL CAVE

BY KEVIN KRAJICK

PHOTOGRAPHS BY DAVID LIITTSCHWAGER

CAVE CREATURES LIVE BURIED ALIVE. Troglobites—the technical name for these millipedes, spiders, worms, blind salamanders, and eyeless fish—are made to navigate, mate, and kill amid perpetual darkness, desperate starvation, poison gases, and endless labyrinths of stone. Evolved in isolation and unable to disperse, species often consist of just a handful of individuals in one cave, or one room of one cave. Their existence raises many questions. How did they get there, and when? How do they survive—and how much longer can they hang on? Increasingly, many are threatened by pollution, quarrying, and vandalism. Ultimately, they are connected to a surface ever more populated, and penetrated, by us. They are the wildest canaries in the coal mine.

Worldwide, perhaps 90 percent of caves lack visible entrances and remain undiscovered. Even in well-explored caves, troglobites are expert at hiding. The roughly 7,700 species known are probably only a small taste of what lives below.

To survive stagnant, low-oxygen air in dead-end recesses and months without food, many troglobites have super-slow metabolisms. And because they live slow, they live long. The *Orconectes australis* crayfish of Shelta Cave in Alabama may reproduce at 100 years, and live to 175. Many troglobites possess extraordinarily long legs (and lots of them) with spiky feet adapted for getting over rocky terrain and sticking to moist surfaces. Pigments (which protect surface organisms from ultraviolet rays) and eyes disappear; for some creatures, eyeless sockets serve as fat reservoirs. Instead of vision, many have elaborate appendages and beefed-up nerve centers to interpret slight air-pressure or temperature changes, sounds, and smells. This sensory equipment lets them travel, sense objects moving or still, ambush prey, and, according to a recent study of troglobitic fish, judge the size and suitability of prospective mates, sight unseen.

Cave biology might be dated from 1797, when foot-long *Proteus* salamanders were first seen in Adriatic caves. They were the first, and still among the largest, known troglobites; locals at first thought they were baby dragons. Since then, scores of blind salamander and fish species have turned up in places like Texas' vast Edwards aquifer, where they sometimes shoot up in artesian wells tapping unseen watery caverns below.

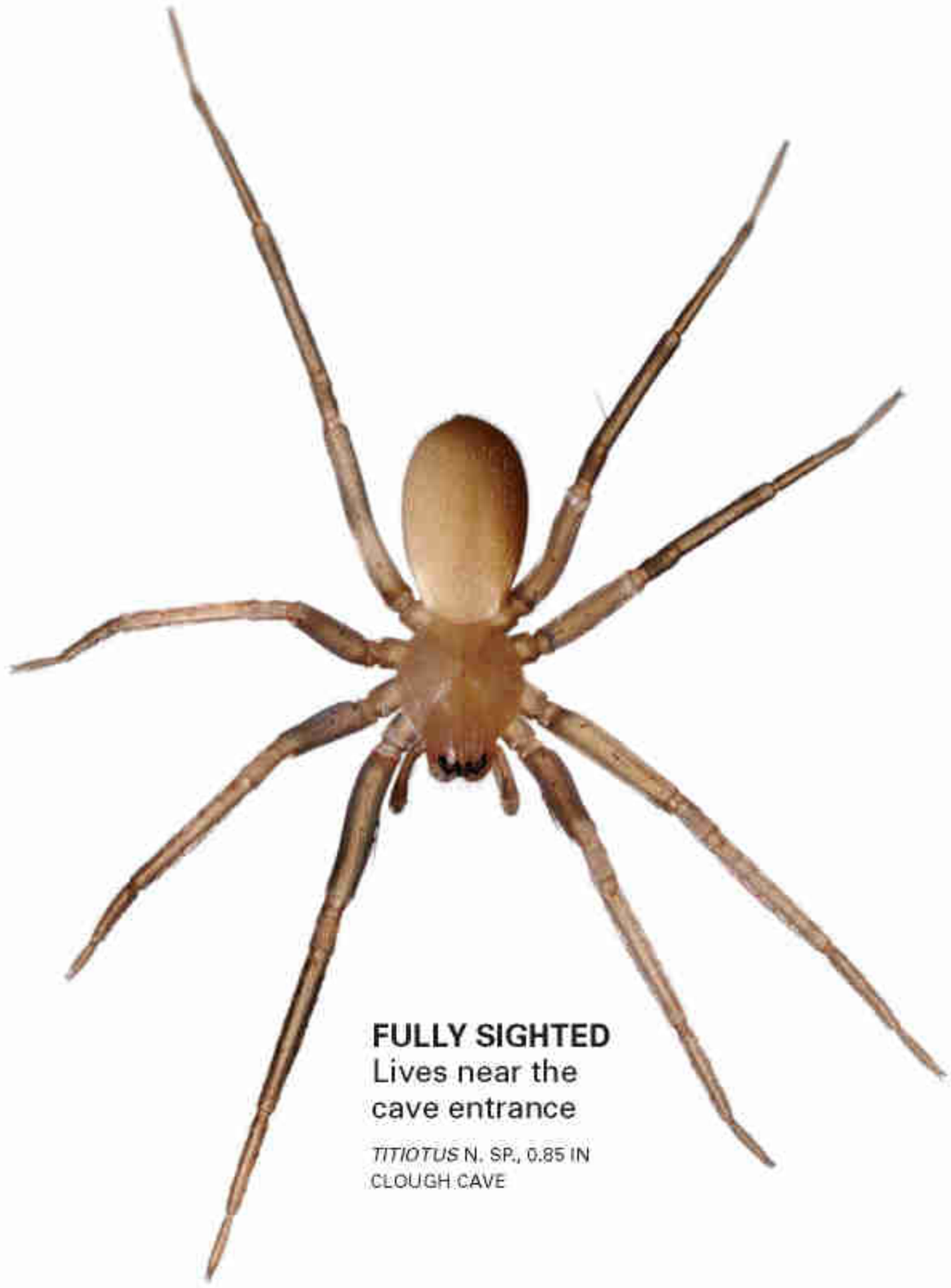
Startling new discoveries are now coming out of Sequoia and Kings Canyon National Parks, in the Sierra Nevada mountains of California. Here, scientists recently announced the discovery of some 30 new invertebrate species—an extraordinary number for such a small area—all still undescribed and unnamed. Scientists are also finding new caves—255 at last count, a number that increases every few months.

California's aboriginal Yokut people, who used some of these caverns for ceremonies, may have been the first to glimpse the Sierra troglobites;

Kevin Krajick writes often about extreme environments. Photographer David Liittschwager chronicles rare and endangered plants and animals.

LOSING SIGHT

Plying cave soil for invertebrates in Sequoia National Park's Ursa Minor Cave, Benjamin Tobin (above) shed his muddy boots and stayed on red-marked trails to protect the cave's fragile formations and troglobites. Scientists discovered some 30 new species during recent cave surveys in California's Sierra Nevada mountains. One clear message: Vision is overrated where the sun never shines. Take spiders. At cave entrances they see just fine, but species farther in often have fewer than the typical eight eyes, and those restricted to pitch black (far right), no eyes at all. How has this gradation occurred? Many biologists believe that natural selection has diminished eyes in favor of more touchy-feely senses—such as vibration sensitivity—which are heightened in blind spiders.



FULLY SIGHTED
Lives near the cave entrance

TITIOTUS N. SP., 0.85 IN
CLOUGH CAVE

PARTIALLY SIGHTED
Lives throughout
the cave

USOFILA N. SP., 0.09 IN
KAWEAH CAVE

BLIND
Lives in pitch-black
depths of the cave

USOFILA N. SP., 0.09 IN
CLOUGH CAVE

In the granite canyons of Sequoia National Park, pockets of marble and other easily eroded rock conceal some 255 caves—and innumerable troglobites. Species evolve in isolation in these caves, which date back nearly five million years.

they left pictographs of scorpions and spiders at entrances. Starting in the 1970s, scientists spotted a few, including a blind harvestman (daddy longlegs) with gigantic jaws for seeking out prey in the dark. In 2002, after years of growing awareness of species diversity in the region, the parks commissioned a survey led by Jean Krejca, an Austin biologist, and the parks' cave specialist, geologist Joel Despain.

One summer day last year, Krejca and Despain threaded their way down a remote, brush-choked canyon through poison oak and heaps of giant boulders toward Sequoia's Hurricane Crawl Cave. Tucked into a cliff was a black, funnel-shaped hole, fringed with thimbleberry shrub. On an otherwise still morning, the shrub's broad leaves were dancing: A breeze from the hole signaled it as an entry to another world, one with its own weather system. Krejca and Despain drew a deep breath, thrust their arms forward, and wriggled through 60 feet of twisting tube that pressed like a tight suit. They emerged in a tall, chill, shoulder-wide corridor floored with rubble.

Cut off from the fruits of photosynthesis, most caves are places of hunger. Yet, most depend indirectly on the sun. In some caves, like Hurricane Crawl, rootlets from trees far above dangle through cracks in ceilings, providing bug food. Leaves and twigs wash in on spring floods from nearby connected creeks. Rodents penetrate surprisingly far, bringing seeds and nesting material. Bats also come and go, leaving behind guano, and their dead. Occasional "accidentals"—big animals like raccoons or snakes—wander in but don't wander out, providing banquets that may stoke the food chain for centuries (in one Sequoia cave, debris and bones are piled a hundred feet deep in a pit trap). Hurricane Crawl is named for 30-mile-an-hour gusts that roar in through blowholes, driven by temperature fluctuations outside; these gusts may bear organic dust.

At least a dozen known caves from Romania to Wyoming have no ecological connection to the surface; they run on purely geologic substances such as sulfur compounds, methane, iron, and hydrogen eaten by specialized microbes, which in turn feed higher organisms. Israel's Ayalon Cave, uncovered accidentally in May 2006 by excavation in a rock quarry near Tel Aviv, was probably sealed for millions of years. Warm groundwater laced with sulfur appears to be feeding microbes and, ultimately, at least ten previously unknown crustaceans and other creatures. The fact that Ayalon was found in an area inhabited by people since ancient times suggests that the world holds many more such caves.

In Hurricane Crawl, the scientists turned over rocks until something crawled out of a pore on the underside of one. It was a dipluran—a translucent, eyeless insect with eerily long appendages that waved slowly in a headlamp's beam. It was almost certainly a new species, never seen by humans until that moment. For the next few hours, Krejca and Despain wove their conveniently slender bodies into tiny side passages like millipedes themselves, overturning rocks and scanning walls. Little more of note emerged. The problem is, there are two miles of known human-size passages in Hurricane Crawl, but vastly more unobservable "mesocaverns": endless small crevices and tubes with multiple layers of floor rubble. That is probably where the real action is. Krejca's advice: If you don't have time to leave bait—rotting shrimp and blue cheese are her favorites—just stay put and wait.

Troglobites tend to be lean, ready for action.

One day in nearby Crystal Cave, members of the team crawled through a low, lifeless passage floored with sand. They came upon a single acorn, probably brought in by a pack rat, and a squirt of rodent poop. These objects had sprouted whole ecosystems: cotton candy gardens of multicolored fungus, near-microscopic springtails, detritus-eating beetles, and quarter-inch *Taiyutyla* and Striariidae millipedes. The innards of a see-through Striariidae told the short story of its life: The yellowish blotch in its midsection was part of its gut; the brownish stuff farther back, its latest meal. Nearby lurked tiny predators: *Nesticus* spiders spun slender webs, and pale, venomous centipedes peculiar to Crystal darted with startling speed. Often caves contain a weird overabundance of predators; this suggests that prey often runs out, leaving the hunters to go after anything alive or dead, including each other. Up another sandy passage in Crystal Cave, one very lost acorn had used its stored energy to sprout a six-inch, pure white tendril with minuscule leaves—its last gasp before being devoured in this alien world.

Another morning the team hopped a rushing creek and climbed up to Kaweah Cave, whose airy cliff entrance was camouflaged with buckeye trees. Krejca disappeared through a tiny hole in back, and an hour later emerged with a prize: a new species of pseudoscorpion she had just discovered under a rock 200 feet back. Eyeless and gray, it looked like a scorpion minus the stinging tail; these creatures inject their venom instead with their sharp claws. These were wildly outsize compared with the body, and covered with fine sensory cilia that waved independently. Krejca breathed gently on it. It ran backward, then raised its poisoned hands as if to strike. Luckily, it was no bigger than a letter on this page.

Being small is an advantage if you live in small spaces, and many cave critters are. However, some go the other way. Recently researchers in Venezuela reported seeing *Scolopendra* centipedes nearly a foot long devouring whole roosting bats. *Titiotus* spiders of Kaweah Cave, blackish and bigger than silver dollars, are more than twice the size of their surface relatives. They do not spin webs but simply run down prey and grab them with their spiny legs. These spiders are found mainly near entrances and still have eyes and pigments, so they are classified as troglophiles—troglobites in training, retaining enough surface characteristics that they might also live under rocks or in soil burrows.

Scientists believe that virtually all terrestrial troglobites evolved from such animals, preadapted as they are to cool, moist, confined conditions. It is thought that at some point they moved farther down and stayed, either because they liked it or because they were confined there by climate swings on the surface.

But how long ago particular creatures went underground is rarely clear, for the immediate surface ancestors of most seem to have gone extinct. Scientists think aquatic organisms in the Edwards aquifer are descended from marine creatures stranded there some 60 million years ago when shallow seas receded. Remipedes, Earth's most primitive living crustaceans, dwell in saltwater coastal caves across the globe. They may have started out over 100 million years ago, when the supercontinent of Pangaea was breaking up. Today related remipedes are scattered from the Caribbean to Australia, possibly brought there by eons of continental drift.

Palmer Cave, the oldest dated cavern in Sequoia-Kings, goes back some 4.7 million years,

MATTERS OF SIZE

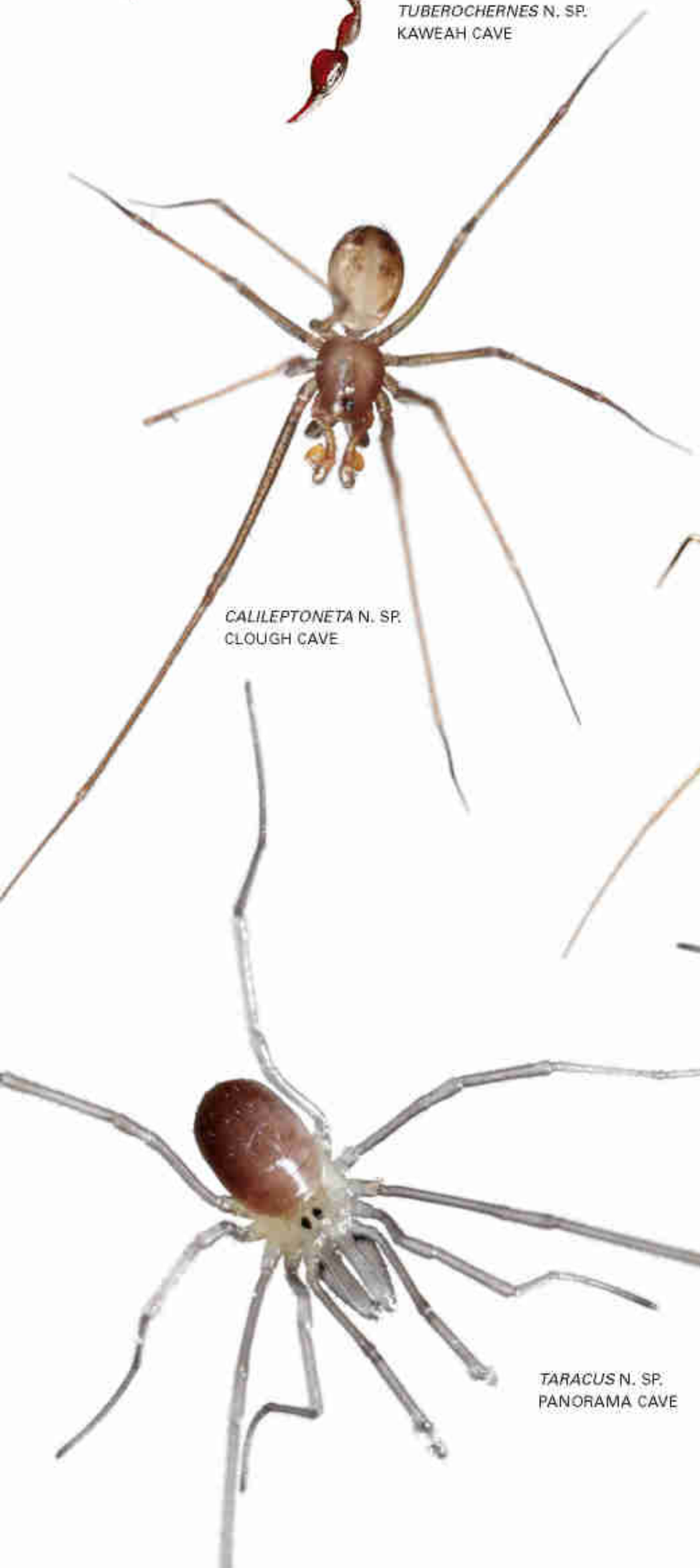
Though cave animals have evolved a range of sizes, little creatures dominate. "If you're small, you can survive on less," says biologist Jean Krejca, "which is important in a place where food is erratic." Meals may also be tucked into tight spaces—detritus in a rock vein, roots in a ceiling crack, a bug hunkered down in a hole—giving tiny hunters an edge. These recently found arthropods from Sierra Nevada caves, all shown at six times life-size, run the gamut from small to downright minute. Some are eyeless (true troglobites); others retain some sight (troglophiles).

CALICINA N. SP.
KAWEAH CAVE

TUBEROCHERNES N. SP.
KAWEAH CAVE

FISSILLIERCREAGRIS N. SP.
HIDDEN CAVE

OAPHANTES N. SP.
CARMOE CREVICE



CALILEPTONETA N. SP.
CLOUGH CAVE

NEOCHTHONIUS N. SP.
CLOUGH CAVE

ORTHONOPS N. SP.
WALK SOFTLY CAVE

OAPHANTES N. SP.
PARADISE CAVE

TARACUS N. SP.
PANORAMA CAVE

TARACUS N. SP.
PET CEMETERY CAVE

BRACKENRIDGIA SP.
CLOUGH CAVE

CATOPOCERUS SP.
LOST SOLDIERS CAVE

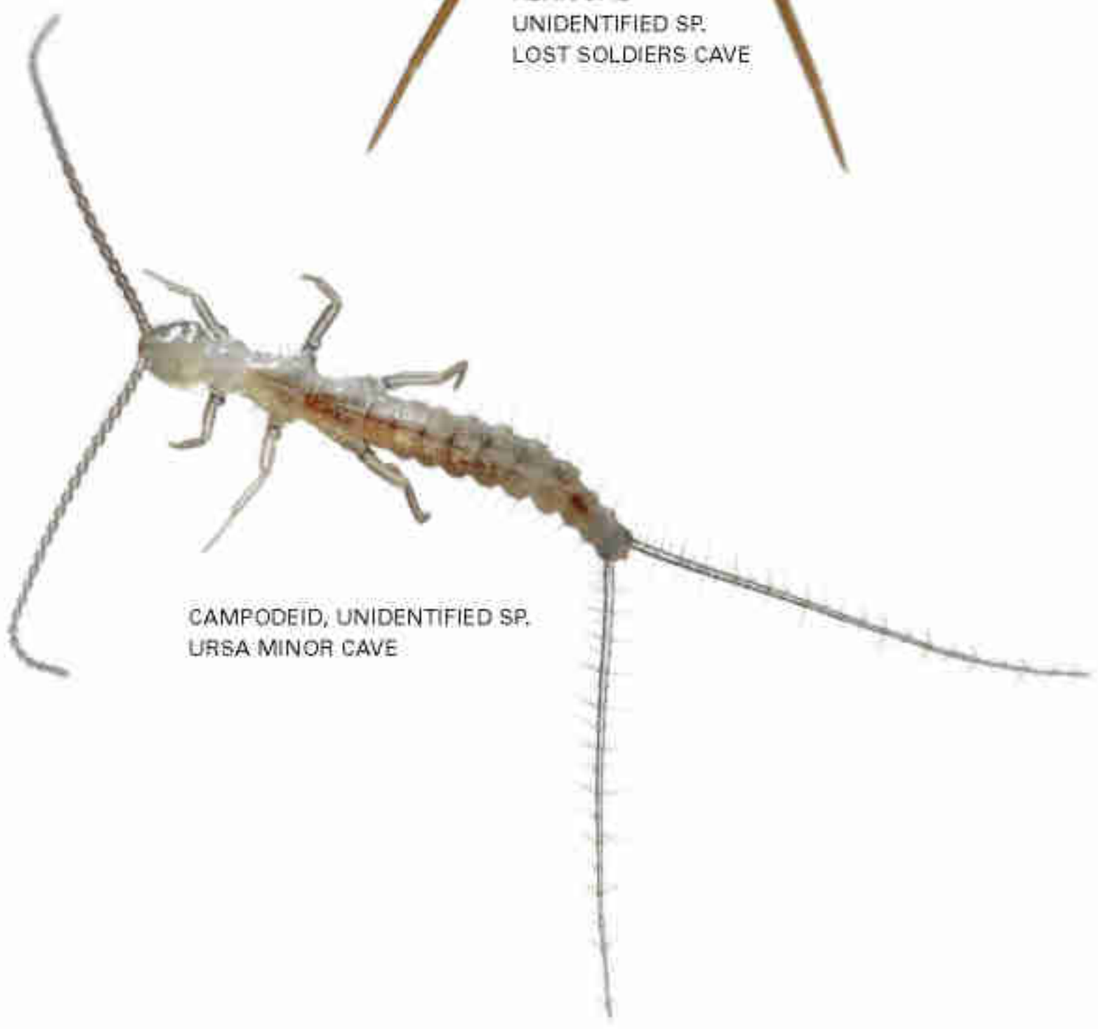
LITHOBIID
UNIDENTIFIED SP.
KAWEAH CAVE

HENICOPID
UNIDENTIFIED SP.
LOST SOLDIERS CAVE

NEARCTODESMID,
UNIDENTIFIED SP.
KAWEAH CAVE

TAIYUTYLA N. SP.
HURRICANE CRAWL CAVE

BIDENTOGON N. SP.
CLOUGH CAVE



CAMPODEID, UNIDENTIFIED SP.
URSA MINOR CAVE

Massive, venom-spitting pincers make this pseudo-scorpion a formidable predator that can grapple with feisty prey from a safe distance. A single cave yielded three species. "They're a cave's great white sharks," Joel Despain says.

CHTHONIID, UNIDENTIFIED SP., 0.14 IN, KAWEAH CAVE

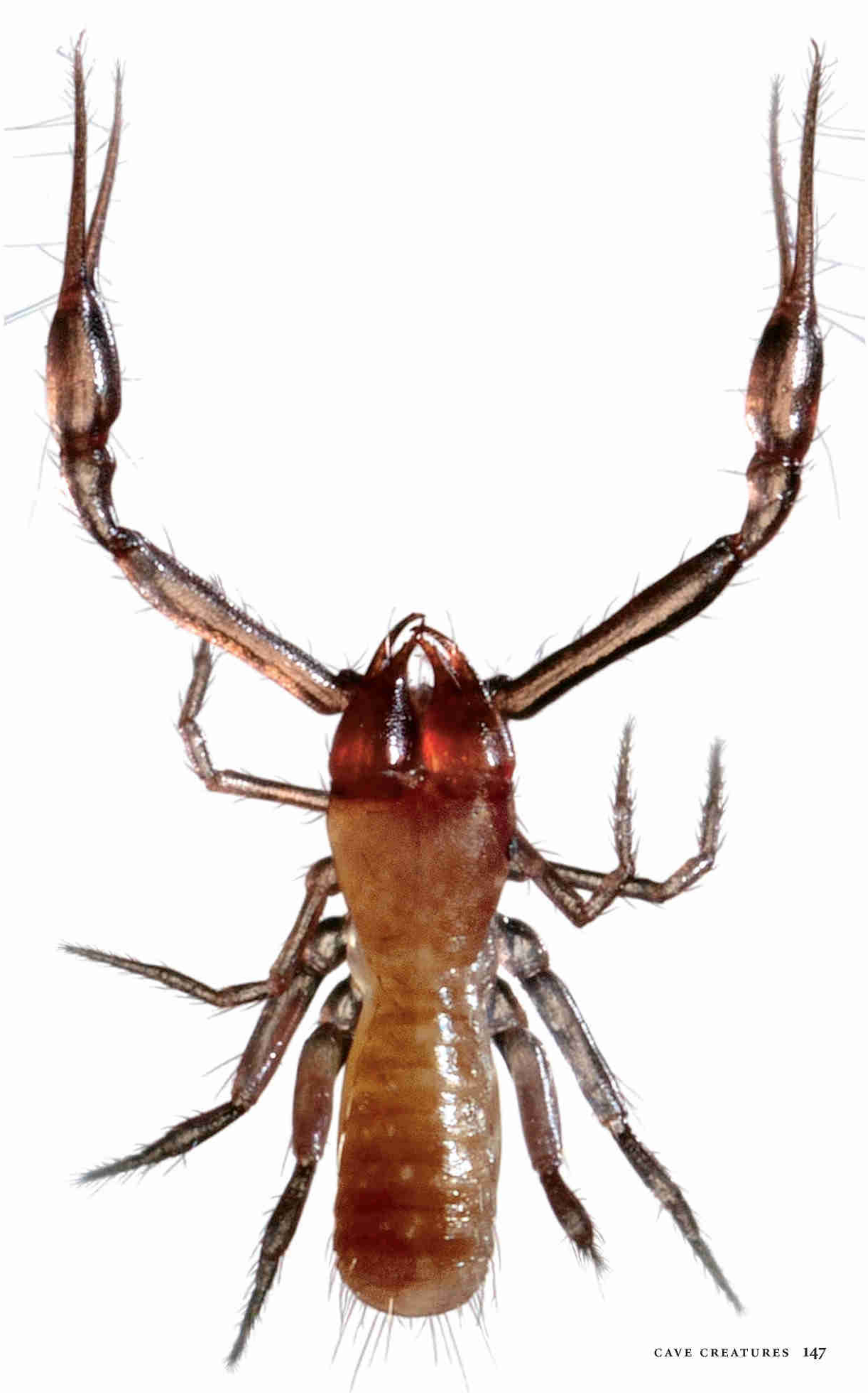
but the local troglobites could be far older. The Sierra have been uplifting and eroding for tens of millions of years, and mountains long gone may once have held caves; when they wore out, the occupants could just have moved downstairs. On the other end of the evolutionary timescale are endemic diplura and harvestmen in near-freezing Panorama Cave, in the alpine zone at 10,600 feet. This area was glaciated only 10,000 years ago, and it is hard to believe anything survived under a mile of ice and meltwater. Like Darwin's finches, these creatures must have arrived and evolved not over eons, but in human time.

Unfortunately, the futures of many troglobites may be shorter than their pasts. Just 41 species are on federal endangered or threatened lists, but the Nature Conservancy says 95 percent of the thousand species known in the United States are actually imperiled. Caves provide ready conduits for seeping pesticides and sewage from cities and farmlands; troglobites are exquisitely sensitive to such poisons. Entire aquifers such as the Edwards are fast being drained, and as the water disappears, so does aquatic habitat. Some caves are simply excavated out of existence for roads and buildings. The Kauai wolf spider, which inhabits lava tubes in Hawaii, is facing competition from a new invader: the brown recluse spider. In Sequoia-Kings, officials worry about airborne fertilizers and pesticides from the heavily farmed adjoining San Joaquin Valley—not to mention scores of marijuana growers who have invaded the parks' backcountry and apply the same stuff.

Even scientific expeditions, it must be admitted, can be a hazard. More than once, team members lightly brushed a tiny bug while turning over a rock, or crawling along: end of troglobite. In Crystal Cave, they peered respectfully at—but did not touch—a sink-size series of rimstone pools supplied with water dripping from the ceiling. A few grayish, jellylike things the size of string snippets cruised the surface's underside—newly discovered aquatic flatworms known from this spot, and this spot only, on Earth. One must be careful: Hairs, dandruff, and lint shed by humans may provide food sources that nourish competing alien surface mites, fungi, and bacteria, which also hitchhike in on humans. Finally, climate change—the force that may have helped create many troglobites—could help destroy them. Most caves have cool, constant temperatures that reflect the yearly mean outside. The critters are finely tuned to this constancy. If temperatures keep ascending at their current rate, some troglobites may not adjust rapidly enough.

For now, the frontier is still there. In late August last year, four amateur cavers were poking around a cliff face in the Sierra. They found a softball-size blowhole, enlarged it, climbed in, and discovered one of the most spectacular caves in the western U.S. Its cathedral-like spaces are up to a hundred feet wide and richly decorated with sparkling crystals and formations in every color of the rainbow. It has been named Ursa Minor, for the massive skeleton of a bear found lying at the foot of a curtain of stone. The first people to rappel in saw unidentified reddish worms clinging to the wall next to them. Farther back, one man thought he saw a flicker of movement in a pile of rocks. □

A Tight Squeeze Writer Kevin Krajick and photographer David Liittschwager found their story in the dark, in passages too small to turn around in. Read more in On Assignment at **ngm.com/0709**.



Beach Baby

© Mingo Zdravkevic/Audubon

Coastal Conservation Champions

Appearing as if alone on the beach, this day-old snowy plover chick surveys its surroundings. At less than three inches tall, and scarcely visible against the sand and shells of its beach habitat, snowy plovers are an increasingly rare, but integral part of the coastal environment. Thanks to protection measures established by the National Audubon Society's Coastal Bird Conservation Program—and funding from Southern Company, one of the nation's largest electricity producers—this chick has an excellent chance of growing to adulthood.

Wherever water meets land, you'll find great numbers of both birds and people. Coastal habitats are critical for resident and migratory birds. These beaches, estuaries, and rivers provide an impressive array of food and other resources. For people, as we know, these areas are popular as recreational destinations and homes.

As population increases, particularly on the coastline, balancing the needs of wildlife and people becomes increasingly complex, yet necessary, if treasured wildlife and habitat are to be preserved.

Combining science with citizen involvement, Audubon is working coast-to-coast to provide a sustainable balance between humans and birds. Through several programs, scientists from universities are using radar to identify critical stopover areas for migratory birds. Others are conducting research to understand what is needed to protect important species. Luckily, with today's technology and some old-fashioned outreach, it is possible for birds and people to enjoy the coast.

Southern Company's Power of Flight program, in partnership with the National Fish and Wildlife Foundation (NFWF), is working to protect birds and their habitats in the Southeast. Through Southern Company, NFWF, and their partners' efforts, nearly 2.4 million dollars has been invested in coastal bird conservation and education since 2003.

To complement this program, Southern Company partners with NFWF on two other programs—the Longleaf Legacy Program, helping restore the imperiled longleaf pine ecosystem, and the EPA-sponsored national Five Star Restoration Program, supporting community-based wetland, coastal, and stream restoration projects.

Southern Company has contributed 10.5 million dollars to fund these programs over a 10-year period, emphasizing just how powerful a company can be.

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HOW TO HELP

"The sound of children laughing," says Abdul Sattar Edhi (at left)—greeting students at a girls' school—"is my favorite sound on Earth."

PAKISTAN, PAGE 32 **Reaching Out** Abdul Sattar Edhi established his first medical clinic in Karachi 56 years ago—and he has never stopped helping the people of Pakistan. His nonprofit Edhi Foundation (see *edhifoundation.com*) now runs 320 centers across that country to provide health care, schools, and more for needy Pakistanis of any religion or caste. Voluntary donations from individuals make up all the foundation's funding; in order to maintain its independence, the organization accepts no support from any governments, religious groups, or relief agencies. Those helped by the Edhi Foundation include:

■ **Children** The foundation offers care for orphans and abandoned babies and also arranges adoptions in Pakistan and abroad. Other services include education, housing, counseling, and vocational training.

■ **Women** Edhi's shelters provide sanctuary to victims of domestic abuse. Family planning information and maternity care are also made available.

■ **Accident victims** Medical centers and a fleet of 1,380 ambulances in use throughout Pakistan serve people in need. Transportation and treatment are generally offered at nominal cost, but care after accidents and disasters is given free of charge. Even those who don't survive are cared for: Edhi provides collection, cleansing, and burial for the unclaimed bodies of the poor.

PHOTO: REZA

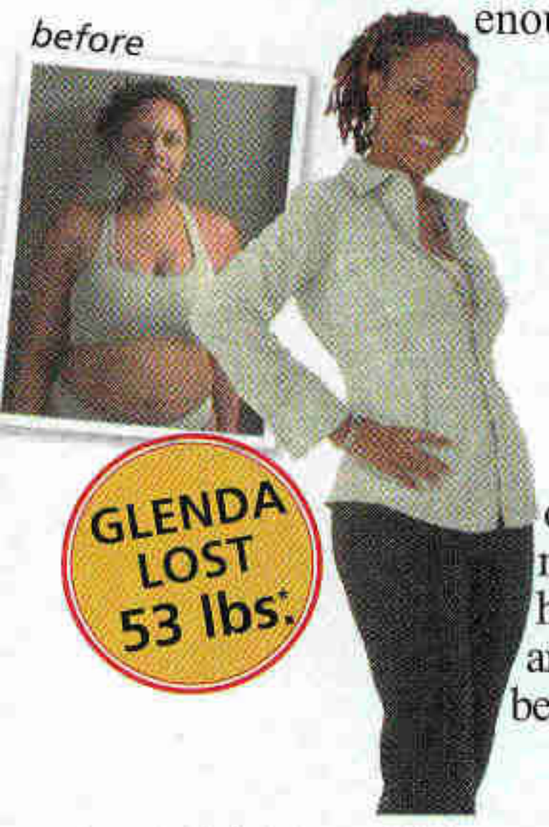
Glenda survived a serious car accident that nearly killed her and left her partially paralyzed. Despite that, after finishing college at West Point, she went on to medical school, got married and gave birth to her son, Avi. But the pressures of being a new mom and an overwhelmed psychiatry resident eventually took their toll. Her weight climbed to an all-new high.

"I was desperate.

My life was coming apart at the seams until...

I found NutriSystem."

Between my pregnancy and my injuries, it was impossible to keep my weight down. Dealing with a physical handicap and scars was hard enough; it was especially difficult to be overweight on top of that.



Then I discovered that my husband was having an affair, and my marriage began falling apart.

Part of me kept thinking: if I were slim, would things have ended this way? I desperately needed control of my life but just didn't know where to start.

Then I tried NutriSystem. Since then, I've lost 53 pounds and three jeans sizes on the NutriSystem program,* and I've gained so much self-confidence.

NutriSystem changed my life!

I had decided if I had more control over my life—my weight, my health, my appearance—maybe things would be a little bit easier. One night I was on the internet looking up options for weight loss surgery when I saw an ad for NutriSystem. That's when I made the decision that I was going to do this. Instead of arranging for surgery, I joined NutriSystem and placed an order for food. For the first time in a long time, I felt hopeful.

Now, a year after reaching my goal, I still have people telling me how amazed they are at my transformation.

It's like having my own personal chef!

The NutriSystem program is so convenient and a real time-saver, especially for busy moms like me. Now, I have more time to play with my son and relax because I'm not cooking all the time. Having your meals delivered to your door is priceless. It's so simple: I just open a box, lay out the food, add some fruit and veggies and go to town.

I hate dieting. It's always felt like I was punishing myself and depriving myself of something I love—food! But NutriSystem food really tastes great! I got to eat my favorites—and I still lost weight.

The secret is the NutriSystem Glycemic Advantage™

The power of the Glycemic Advantage™ allowed me to eat carbs and lose weight. You see, the people at NutriSystem have found a way to separate good carbs from bad. So I ate pizza, pasta and chocolate and still lost weight.

Plus, it was totally affordable. For about $10 a day, NutriSystem gives you three meals and desserts—and membership is absolutely free.

I started seeing great results, and everyone noticed.

When I started the program, the most challenging part of losing weight was being the only one who believed I could do it. No one really expected me to lose as much weight as I did.

Now, when I look in the mirror, I'm proud of the job I did, and I still get people telling me how great I look.

I cleared out my closet and got rid of eight bags of clothes that were too big. I would have never had the guts to do that before. That really represents a change in my self-esteem and my self-confidence. Losing weight has brought out a confidence in me that was always there but just hidden.

If I can do it, you can, too!

Here I am: 53 pounds lighter and three jeans sizes smaller.* I feel great, have more energy, and best of all, I've gained the self-confidence I deserve. Believe me, if NutriSystem can work for me—with everything I've been through—it can work for you, too. Call today.

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Check Out The NutriSystem Low Glycemic Foods For Two Weeks FREE!†

Now NutriSystem has a program that's based on a revolutionary nutritional breakthrough called the Glycemic Index. NutriSystem separates good carbs from bad. Carbs are no longer off-limits! So you can eat pasta, chocolate and other comfort foods and still lose weight.

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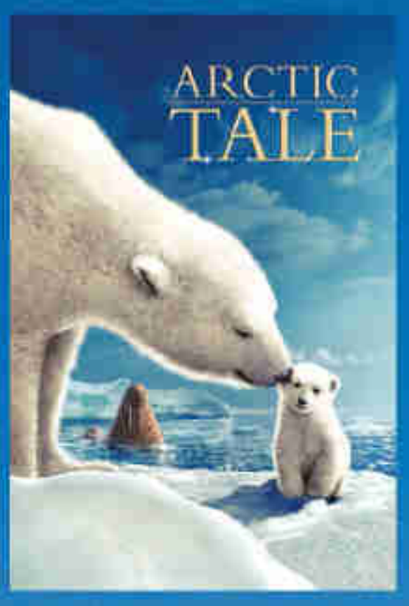
†Offer good on new Auto-Delivery order only. Limit one per customer. With Auto-Delivery, you automatically receive your 28-Day program once every 4 weeks unless you cancel. You can cancel Auto-Delivery at any time, however for this offer you must stay on Auto-Delivery for at least two consecutive 28-Day program deliveries to receive the second free week. One additional free week of food will be included with your first and second deliveries. Cannot be combined with any prior or current discount or offer.

*Results not typical. Individuals are remunerated. All other weight loss claims are based on an independent survey of NutriSystem clients who followed the program for an average of 12 weeks. On NutriSystem, you add-in fresh fruit, vegetables, salads and dairy items.

NG FILMS Arctic Tale Many filmmakers do coming-of-age movies. Sarah Robertson and Adam Ravetch's stars a walrus and a polar bear. *Arctic Tale* is the story of the two young creatures' struggles to survive in an icy, but warming, world.

Arctic filming was sometimes a struggle for Robertson and Ravetch, too. "You can be up there for weeks and just have two good days to shoot," says Robertson. Inuit hunters were the couple's guides—and sometimes their skeptics. At first locals discouraged Ravetch from diving with walruses. "They said one would knock my head off," he says. "Nobody had ever spent much time underwater with walruses." He kept his head. And footage he got of a mother cuddling her newborn pup was a first. *Arctic Tale,* from National Geographic Films and Paramount Vantage, is now in theaters everywhere.



A walrus—like this one—faces diminishing polar ice in the film *Arctic Tale.*

PHOTO: NORBERT ROSING, NATIONAL GEOGRAPHIC IMAGE COLLECTION

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❑ I will give $28 a month ($336 a year). Enclosed is my gift for a full year ❑, the first month ❑.

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For Women: 4b Bell Bladder Control Tea for Women

Helps quickly without side effects. Hamilton University says 65% of all women past child-bearing age suffer with incontinence. Many can avoid surgery. **True Testimonials: ● 15 years of bladder & kidney infections gone** in 1 week. Symptoms lessened 1st day. Strongest antibiotics didn't do anything. *Arlene Baswell, Palmetto, FL* ● **I was so thrilled** to be able to avoid being embarrassed day and night. I'm able now to exercise and work feeling care free. *Edith Netsky, 75, Melrose Park, PA.* ● **A friend recommended the tea** after she had surgery to shore up the bladder and was still having urgency and leakage. It also worked for me! *Anne Watham, 72, Whitby ON.* ● **Stop needless suffering and embarrassments.** Large box 120g $19.95.

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INSIDE GEOGRAPHIC

Writer Don Belt (at left) makes a phone call in Gilgit, a town in northern Pakistan, while photographer Reza stands by.

ON ASSIGNMENT

Under Cover

Among the first journalists in years to enter Pakistan's Waziristan region—a Taliban and al Qaeda stronghold—Don Belt and Reza kept a low profile. "In the tribal areas, bodies are often found with notes on them," says Belt, a GEOGRAPHIC senior editor. "The notes say 'Here's an American spy.'" Iran-born Reza had an easier time fitting in than South Carolinian Belt. "I've covered the area since the 1980s, and I know the culture," Reza says. Belt has also worked in Central Asia, but has a harder time concealing his nationality. While reporting under similar circumstances from Afghanistan, he says, "in public, my guide and I only spoke to each other in Spanish."

ON ASSIGNMENT **Wolverine Man** Writer Douglas Chadwick (below) volunteers in Glacier National Park in all seasons, but during winter it's a serious undertaking, what with 50-mile-an-hour winds and subzero temperatures. For the wolverines he helps study for the Forest Service's Rocky Mountain Research Station, though, winter is a walk in the park. Wolverines look like small bears, but they're related to weasels. Only about 45 adults live in Glacier. When not writing—as he did for this issue's story on Glacier–Waterton—Chadwick helps trap wolverines, put GPS collars on them, then retrieve the collars to track the animals' travels. Collars record location every five minutes, leading to data like this (right): After a ramble up a valley, one male jogged almost to the top of Mount Cleveland, Glacier's tallest peak. Another wolverine makes 2,000-foot climbs routinely. "I love the park, and I'm in awe of an animal that can master it," says Chadwick.

One wolverine strolled up this 10,466-foot peak before lunch.

PHOTOS: REZA (TOP); MICHAEL MELFORD (LEFT). NGM MAPS (ABOVE), DATA FROM U.S. FOREST SERVICE

INSIDE GEOGRAPHIC

See how technology affects the human body on National Geographic Channel's *Incredible Human Machine.*

NATIONAL GEOGRAPHIC CHANNEL

The Body Eclectic Two shows handle one subject—how the human form functions—in very different ways this fall on National Geographic Channel.

Inside the Living Body, airing in September, is a serious look at one female body's journey from birth through old age. A lifetime of physical experiences—childhood chicken pox to puberty to hangovers—is demonstrated down to the cellular level.

Incredible Human Machine offers a quirkier take on the extraordinary capabilities of the ordinary human body. Special footage is used to plunge viewers bone-deep into everyday activities: Thermal imaging shows heat thrown off during exercise, a "camera pill" treks down the digestive tract, high-speed cameras record the impact of a runner's footfalls. *Incredible Human Machine* debuts in October.

Film Festival

all roads film project
NATIONAL GEOGRAPHIC

National Geographic's All Roads Film Project was started in 2004 to bring together and fund film and photography from rarely heard voices around the world. The project's traveling film festival—coming to three cities this month—focuses on filmmakers from indigenous cultures such as Native Americans, the Maori of New Zealand, the Sami of northern Finland, and more. Festival attendees can also enjoy performances of music from around the world and an exhibit of still photography.

FESTIVAL DATES

Los Angeles Sept. 28–Oct. 1
Washington, D.C. Oct. 5–8
Santa Fe Dec. 6–10

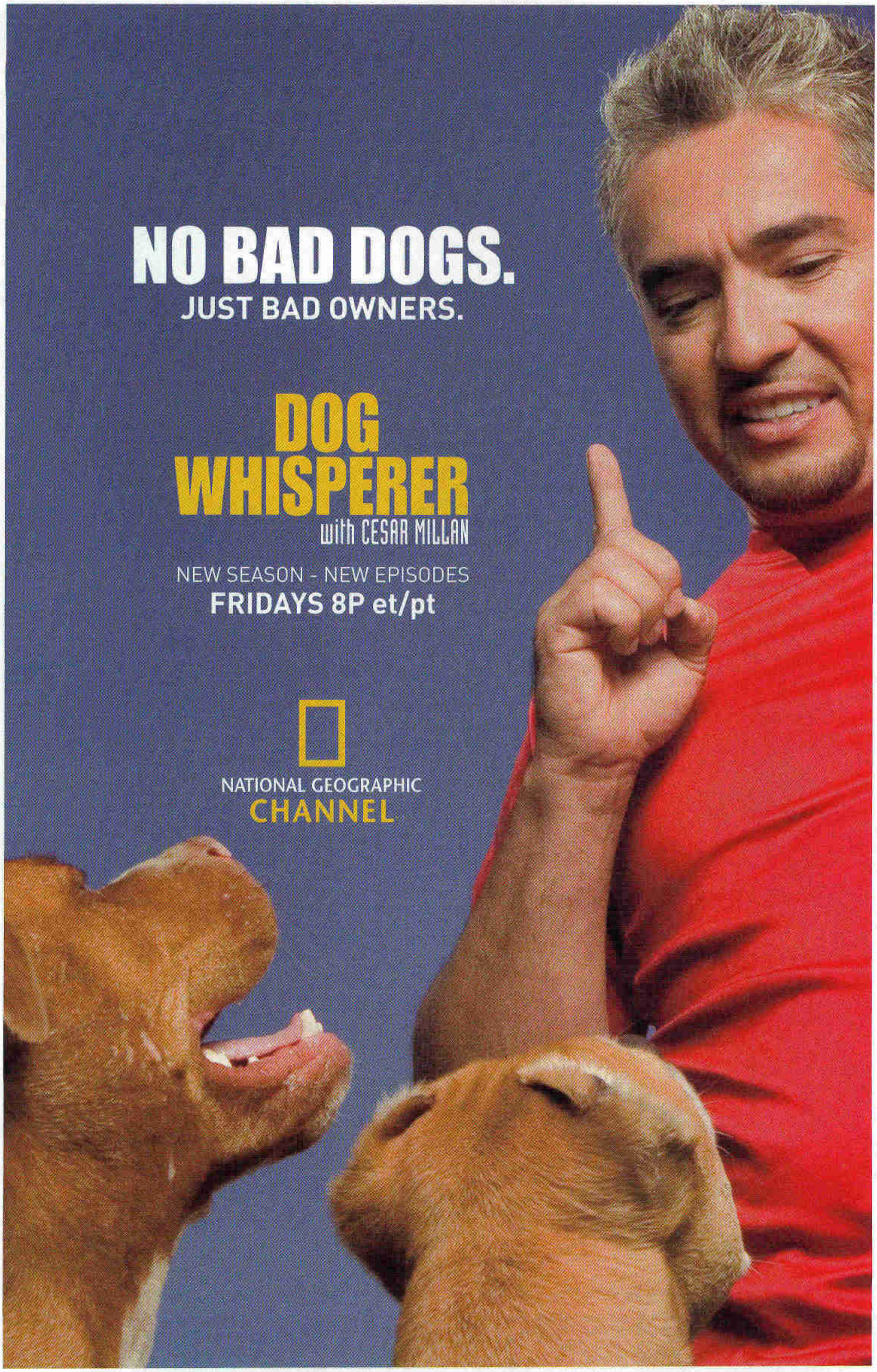
FEATURED FILMS

Waban-Aki: People From Where the Sun Rises
Native Canadian director Alanis Obomsawin turns her documentary eye on the village where she was raised.

Four Sheets to the Wind
A young Native American must deal with his father's suicide and its impact on the family. The film's director is a member of the Seminole and Creek Nations.

Crocodile Dreaming
Estranged half brothers struggle with their distrust of each other and their sense of identity in this short Australian film.

PHOTO ILLUSTRATION: PIXELDUST STUDIOS AND OLIVER UBERTI, NGS STAFF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FLASHBACK

Khan Games Children of Baluchistan's Khan of Kalat play on the palace grounds around 1950. Their father, Mir Ahmad Yar Khan, told journalist Sylvia A. Matheson—who took this photo—he'd designed his palace to resemble the *Queen Mary*, "with several 'decks' and his own personal quarters in the 'Captain's Cabin' on the top 'deck,'" she wrote. In 1948, Kalat became part of Pakistan. That nation's government later removed Mir Ahmad Yar Khan from power, though he was part of a brief, unsuccessful rebellion in 1958. As he barricaded himself within, "One shell from the encamped Pakistanis took off the top storey of the minaret attached to his private mosque by the side of the palace," noted Matheson. "A second shattered a corner of his living-room." *—Margaret G. Zackowitz*

Flashback Archive See all the photos plus e-greetings at **ngm.com/0709.**

PHOTO: SYLVIA A. MATHESON, NATIONAL GEOGRAPHIC IMAGE COLLECTION

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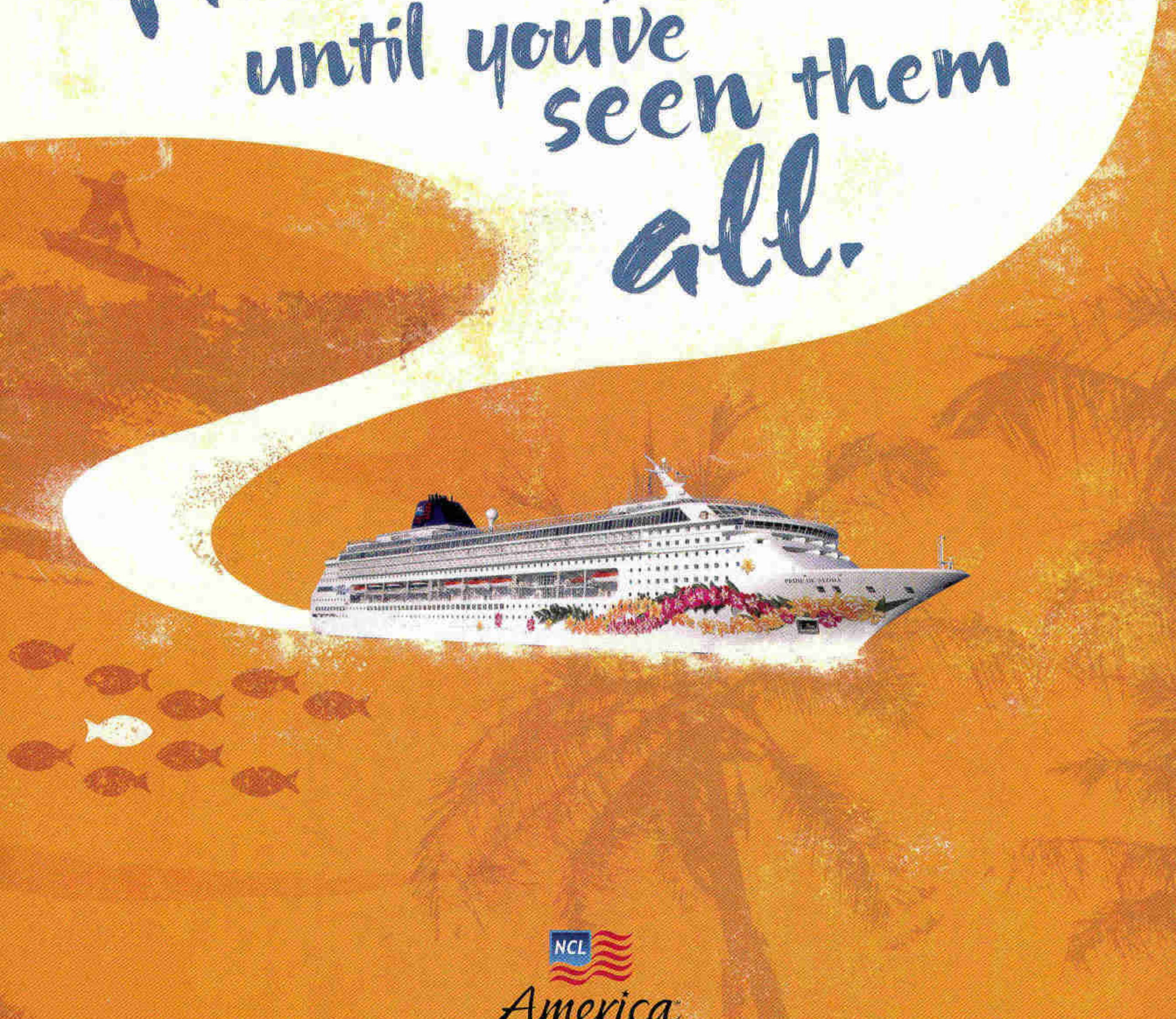

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*National Highway Traffic Safety Administration. Competitor standard ESC equipment by model based on AutoPlanner data available 11/15/06. Safety belts should always be worn. SE model shown, $22,095. **MSRP for base model with manual transmission. MSRPs include freight; exclude taxes, title, license, and options. Dealer price may vary. Hyundai and Hyundai model names are registered trademarks of Hyundai Motor America.

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