CELEBRATING 125 YEARS OF EXPLORATION

FEBRUARY 2013

NATIONAL GEOGRAPHIC

UNSEEN Libya

RECLAIMING ITS FORGOTTEN PAST

THE TEMPLE OF ZEUS

This 2,500-year-old World Heritage site is part of a rich Greco-Roman history.

The Healing Power of Venom

Life on the Roof of the World

Africa's Passion for Soccer

THE RADICALLY NEW **AVALON**

A quantum leap in driving excellence, and the uncompromising new shape of things to come for Toyota.

Search: "avalon let's go places"

THE ART OF MAKING CARS
WILL NEVER BE THE SAME.

TOYOTA | Let's Go Places

Member FDIC

ALLY BANK — 'BEST ONE-YEAR CD.'

– Money® Magazine, Oct. 2012

Ally has great rates, no monthly maintenance fees, and a Ten Day Best Rate Guarantee.
That's the difference between a bank, and a bank that's your Ally.

ally BANK®

Your money needs an Ally.℠

allybank.com | 1-877-247-ALLY

VOL. 223 • NO. 2

NATIONAL GEOGRAPHIC

The khan dreams of a car. Never mind that there isn't a road.
page 92

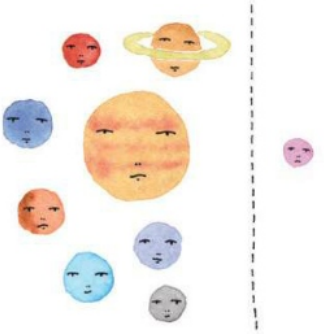
With fangs in the back of its mouth, the boomslang delivers a killer bite: Its venom stops blood from clotting.

MATTIAS KLUM

February 2013

OFFICIAL JOURNAL OF THE NATIONAL GEOGRAPHIC SOCIETY

February 2013



On the Cover The Temple of Zeus was part of the colony of Cyrene, founded by the Greeks in the seventh century B.C. in what is now Libya. The ruins of this vital city were rediscovered in the early 1700s and today are a UNESCO World Heritage site near Shahhat, Libya.
Photo by George Steinmetz

Subscriptions For subscriptions, gift memberships, or changes of address, contact Customer Service at *ngmservice.com* or call 1-800-NGS-LINE (647-5463). Outside the U.S. and Canada please call +1-813-979-6845.

DIGITAL EDITIONS

National Geographic is available on the iPad, the Kindle Fire, and the iPhone.

Wakhan Corridor
Video
Get a glimpse of life on the roof of the world.

River Otters
Video
See how they use their senses underwater.

Ocean Currents
Video Animation
Admire the swirling beauty of the oceans in motion.

PHOTOS: MATTHIEU PALEY (TOP); CHARLIE HAMILTON JAMES (MIDDLE)

PRINTED ON
100% PEFC-CERTIFIED PAPER
Please recycle.

ZzzQuil™ SLEEP-AID.

BECAUSE SLEEP IS A BEAUTIFUL THING.™

The non-habit forming sleep-aid from the makers of NyQuil.®
It's not for colds.
It's not for pain.
It's just for sleeping soundly, so you can wake refreshed.

Use as directed for occasional sleeplessness. Read each label.
Keep out of reach of children.

VICKS®

Fatal Attraction

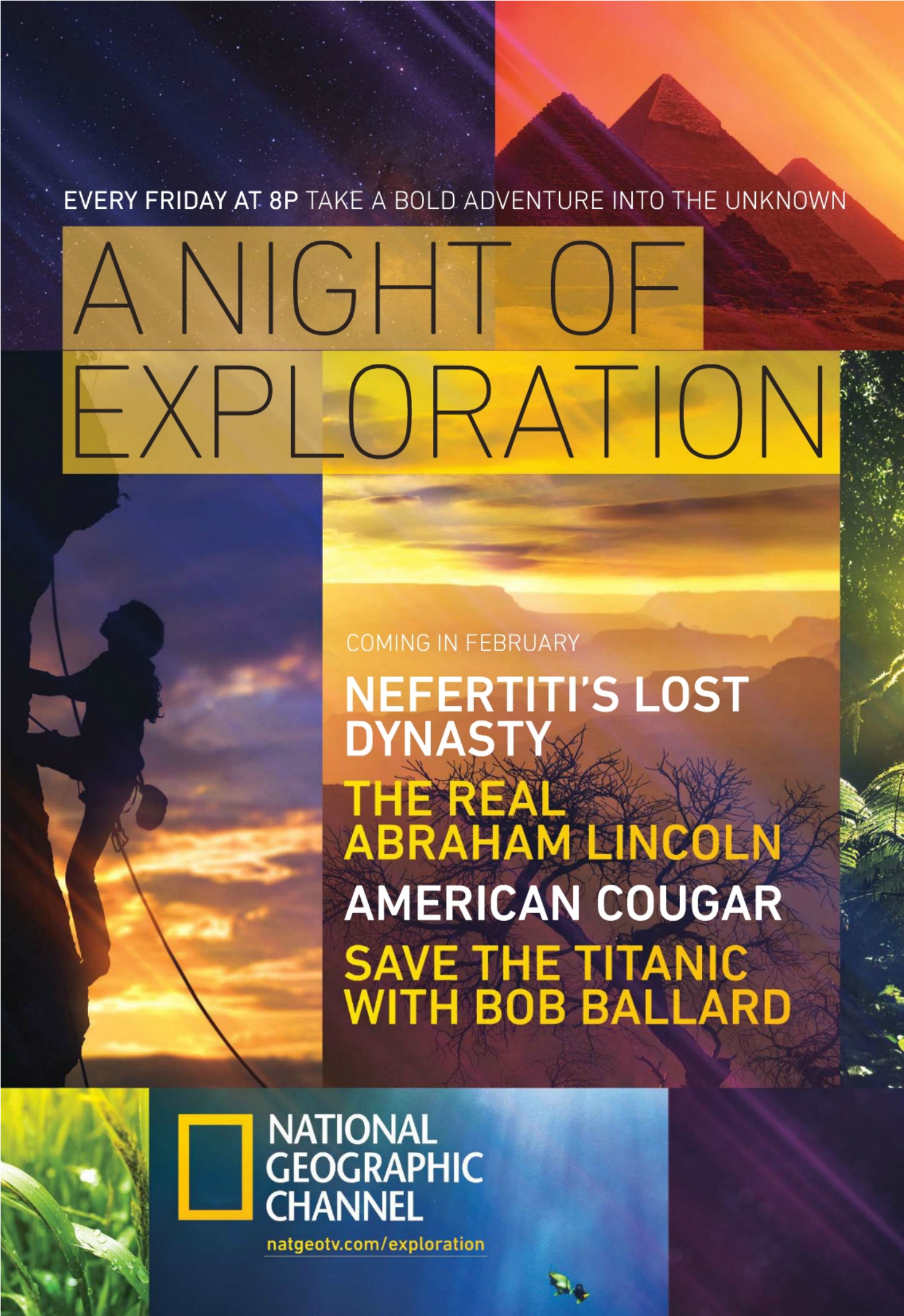
Among words you never want to hear, I'd suggest that "There's a black mamba under your bed" ranks fairly high on the list. About ten years ago my guide and friend Dave Hammon and I were staying in a tree house while on assignment near the Mozambique border. Night was falling; it was getting darker in the room with our uninvited reptilian guest, which had slithered into our midst. The mamba is one of the world's deadliest snakes. I grew up with rattlesnakes, but a mamba makes a rattlesnake seem like an earthworm by comparison. If we didn't deal with the problem, no one would be getting any sleep. Fortunately the mamba was lured out of hiding and dispatched. Crisis averted.

There's another side to this deadly beauty.

Herpetologist Zoltan Takacs was named a National Geographic Society emerging explorer in 2010.

In addition to being deadly, the mamba is beautiful. It has shiny scales and bright eyes, moves like lightning, and radiates energy. I think it's the coolest snake around. From vipers to scorpions, nature's venomous creatures inspire horror mixed with fascination. But there's another side to this deadly beauty, as this month's story on venom explains. Zoltan Takacs, an expert in toxins and a National Geographic Society emerging explorer, estimates that 20 million toxins in nature can be screened for drugs to treat everything from cancer to pain. "Venom has opened up whole new avenues of pharmacology," he says. In short, toxinology and pharmacology are two sides of the same coin. They are interwoven. The ancients knew this well. After all, the badge of Asclepius, the Greek god of medicine, is a serpent coiled around a staff.

ART: GRAFILU. BASED ON A PHOTO BY MARCO GROB


EVERY FRIDAY AT 8P TAKE A BOLD ADVENTURE INTO THE UNKNOWN
A NIGHT OF EXPLORATION
COMING IN FEBRUARY
NEFERTITI'S LOST DYNASTY
THE REAL ABRAHAM LINCOLN
AMERICAN COUGAR
SAVE THE TITANIC WITH BOB BALLARD
NATIONAL GEOGRAPHIC CHANNEL
natgeotv.com/exploration

NATIONAL GEOGRAPHIC

Inspiring people to care about the planet

The National Geographic Society is chartered in Washington, D.C., as a nonprofit scientific and educational organization "for the increase and diffusion of geographic knowledge."

NATIONAL GEOGRAPHIC MAGAZINE

EDITOR IN CHIEF **Chris Johns**

DEPUTY EDITOR Victoria Pope

CREATIVE DIRECTOR Bill Marr

EXECUTIVE EDITORS Dennis R. Dimick *(Environment)*, Jamie Shreeve *(Science)*

MANAGING EDITOR David Brindley

TEXT

DEPUTY DIRECTOR: Marc Silver. **STORY DEVELOPMENT EDITOR:** Barbara Paulsen
ARTICLES EDITOR: Oliver Payne
SENIOR EDITORS: Lynn Addison *(Features)*, Robert Kunzig *(Environment)*, Peter Miller *(Expeditions)*
EDITOR AT LARGE: Cathy Newman. FEATURES EDITORS: Glenn Oeland, Jane Vessels
EDITOR, MISSION PROJECTS: Hannah Bloch. ASSOCIATE EDITORS: Jeremy Berlin, Amanda B. Fiegl
SENIOR WRITERS: Peter Gwin, Tom O'Neill, Rachel Hartigan Shea, A. R. Williams
ADMINISTRATION: Nicholas Mott; Katia Andreassi, Lacey Gray

CONTRIBUTING WRITERS: Caroline Alexander, Don Belt, Joel K. Bourne, Jr., Chip Brown, Bryan Christy, Robert Draper, Cynthia Gorney, Peter Hessler, Jennifer S. Holland, Mark Jenkins, David Quammen

DEPARTMENTS DIRECTOR: Margaret G. Zackowitz
DEPUTY DIRECTOR: Luna Shyr. EDITOR: Johnna Rizzo. ADMINISTRATION: Catherine Zuckerman

PHOTOGRAPHY

DEPUTY DIRECTOR: Ken Geiger
SENIOR EDITORS: Bill Douthitt *(Special Editions)*, Kathy Moran *(Natural History)*, Kurt Mutchler *(Science)*, Susan Welchman *(Departments)*. EDITOR AT LARGE: Michael Nichols

SENIOR PHOTO EDITORS: Pamela Chen, Alice Gabriner, Kim Hubbard, Todd James, Elizabeth Krist, Sarah Leen, Sadie Quarrier. PHOTO EDITOR: Jeanne M. Modderman. RESEARCH EDITOR: Mary McPeak. STAFF PHOTOGRAPHER: Mark Thiessen. STUDIO: Rebecca Hale. DIGITAL IMAGING: Edward Samuel, Evan Wilder. PHOTO ENGINEERING: Walter Boggs, David Mathews, Kenji Yamaguchi
RIGHTS MANAGER: Elizabeth Grady. ADMINISTRATION: Jenny Trucano; Sherry L. Brukbacher, Zahira Khan, Elyse Lipman, Elena Sheveiko, Jenna Turner, Tess Vincent

DESIGN/ART

DEPUTY CREATIVE DIRECTOR: Kaitlin M. Yarnall
DESIGN DIRECTOR: David Whitmore. **ART DIRECTOR:** Juan Velasco

SENIOR DESIGN EDITORS: John Baxter, Elaine H. Bradley. DESIGN EDITOR: Hannah Tak. SENIOR GRAPHICS EDITORS: Fernando G. Baptista, Martin Gamache, Virginia W. Mason, John Tomanio, Jason Treat. SENIOR CARTOGRAPHY EDITOR: Gus Platis. GRAPHICS EDITORS: Jerome N. Cookson, Lawson Parker. SENIOR DESIGNER: Betty Clayman-DeAtley. DESIGNER, DIGITAL EDITION: Bethany Powell. GRAPHIC DESIGN SPECIALISTS: Stewart Bean, Kevin DiCesare, Sandi Owatverot-Nuzzo, Daniela Santamarina, Maggie Smith, Matthew Twombly. ADMINISTRATION: Cinde Reichard; Trish Dorsey, Michael Kritikos

COPY/RESEARCH

SENIOR COPY EDITOR: Mary Beth Oelkers-Keegan. COPY EDITORS: Kitty Krause, Cindy Leitner
DEPUTY RESEARCH DIRECTOR: Alice S. Jones. RESEARCH EDITORS: Heidi Schultz, Elizabeth Snodgrass, Christy Ullrich, Barbara L. Wyckoff. SENIOR RESEARCHERS: Karen C. Font, Nora Gallagher, David A. Lande, Nancie Majkowski, Taryn L. Salinas, Brad Scriber
PRODUCTION: Sandra Dane. ADMINISTRATION: Jacqueline Rowe

E-PUBLISHING

DIGITAL EDITIONS DIRECTOR: Lisa Lytton. **VIDEO DIRECTOR:** Hans Weise

SENIOR WEB PRODUCER: John Kondis. ASSOCIATE WEB PRODUCER: William Barr. VIDEO PRODUCER: Spencer Millsap. COORDINATING VIDEO PRODUCER: Sarah Joseph. INTERACTIVE DEVELOPER: Jaime Hritsik. PRODUCTION SPECIALIST: Susan Park Lee

ADMINISTRATION

Karen Dufort Sligh *(Asst. to the Editor in Chief)*, Carol L. Dumont *(Scheduling)*, Valarie Cribb-Chapman *(Finance)*, Nikisha Long; Laura Flanagan

COMMUNICATIONS VICE PRESIDENTS: Beth Foster, Mary Jeanne Jacobsen; Barbara S. Moffet
IMAGE COLLECTION, VIDEO ARCHIVE AND SALES SENIOR VICE PRESIDENT: Maura A. Mulvihill; William D. Perry. **LIBRARY** DIRECTOR: Barbara Penfold Ferry; Renee Braden, Anne Marie Houppert. **PUBLISHING SYSTEMS** VICE PRESIDENT: Dave E. Smith. DIGITAL PROJECTS DIRECTOR: Melissa Wiley. SENIOR PROJECT MANAGER: Gina L. Cicotello. SYSTEMS ADMINISTRATORS: Patrick Twomey; Robert Giroux, Casey Jensen

PRODUCTION SERVICES

SENIOR VICE PRESIDENT: Phillip L. Schlosser

IMAGING VICE PRESIDENT: Thomas J. Craig. GENERAL MANAGER: Bernard Quarrick; Neal Edwards, James P. Fay, Arthur N. Hondros, Gregory Luce, Ann Marie Pelish, Stephen L. Robinson
PRINTING: Joseph M. Anderson. **QUALITY** DIRECTOR: Ronald E. Williamson; Clayton R. Burneston, Michael G. Lappin, William D. Reicherts. **DISTRIBUTION** DIRECTOR: Michael Swarr

INTERNATIONAL EDITIONS

EDITORIAL DIRECTOR: Amy Kolczak

PHOTO AND DESIGN EDITOR: Darren Smith. PHOTOGRAPHIC LIAISON: Laura L. Ford
PRODUCTION: Angela Botzer. ADMINISTRATION: Sharon Jacobs

EDITORS

ARABIC Mohamed Al Hammadi
BRAZIL Matthew Shirts
BULGARIA Krassimir Drumev
CHINA Ye Nan
CROATIA Hrvoje Prćić
CZECHIA Tomáš Tureček
ESTONIA Erkki Peetsalu
FRANCE François Marot
GEORGIA Levan Butkhuzi
GERMANY Erwin Brunner
GREECE Maria Atmatzidou
HUNGARY Tamás Vitray
INDIA Niloufer Venkatraman
INDONESIA Didi Kaspi Kasim
ISRAEL Daphne Raz
ITALY Marco Cattaneo
JAPAN Shigeo Otsuka
KOREA Sun-ok Nam
LATIN AMERICA Omar López Vergara
LATVIA Rimants Ziedonis
LITHUANIA Frederikas Jansonas
MONGOLIA Delgerjargal Anbat
NETHERLANDS/BELGIUM Aart Aarsbergen
NORDIC COUNTRIES Karen Gunn
POLAND Martyna Wojciechowska
PORTUGAL Gonçalo Pereira
ROMANIA Cristian Lascu
RUSSIA Alexander Grek
SERBIA Igor Rill
SLOVENIA Marija Javornik
SPAIN Josep Cabello
THAILAND Kowit Phadungruangkij
TURKEY Nesibe Bat

ADVERTISING

161 Sixth Avenue, New York, NY, 10013; Phone: 212-610-5500; Fax: 212-610-5505

EXECUTIVE VICE PRESIDENT AND WORLDWIDE PUBLISHER: Claudia Malley. NATIONAL ADVERTISING DIRECTOR: Robert Amberg. VICE PRESIDENT MARKETING: Jenifer Berman. VICE PRESIDENT BUSINESS AND OPERATIONS: Margaret Schmidt. NATIONAL MANAGER: Tammy Abraham

INTERNATIONAL MANAGING DIRECTOR: Charlie Attenborough. DIRECTORS: Nadine Heggie *(International)*, Rebecca Hill *(Marketing)*, David Middis *(British Isles)*

EXECUTIVE VICE PRESIDENT WORLDWIDE CONSUMER MARKETING AND MANUFACTURING: Terrence Day
VICE PRESIDENTS: John MacKethan *(Financial Planning and Retail Sales)*, John A. Seeley *(International)*. DIRECTORS: Christina C. Alberghini *(Member Services)*, Anne Barker *(Renewals)*, Richard Brown *(New Business)*

NATIONAL GEOGRAPHIC SOCIETY

CHAIRMAN AND CEO **John Fahey**

EXECUTIVE MANAGEMENT

LEGAL AND INTERNATIONAL EDITIONS: Terrence B. Adamson
MISSION PROGRAMS: Terry D. Garcia
CHIEF TECHNOLOGY OFFICER: Stavros Hilaris
COMMUNICATIONS: Betty Hudson
CHIEF MARKETING OFFICER: Amy Maniatis
PUBLISHING AND DIGITAL MEDIA: Declan Moore
TELEVISION PRODUCTION: Brooke Runnette
CHIEF FINANCIAL OFFICER: Tracie A. Winbigler
DEVELOPMENT: Bill Lively

BOARD OF TRUSTEES

Wanda M. Austin, Michael R. Bonsignore, Jean N. Case, Alexandra Grosvenor Eller, Roger A. Enrico, John Fahey, Daniel S. Goldin, Gilbert M. Grosvenor, William R. Harvey, Maria E. Lagomasino, George Muñoz, Reg Murphy, Patrick F. Noonan, Peter H. Raven, Edward P. Roski, Jr., James R. Sasser, B. Francis Saul II, Gerd Schulte-Hillen, Ted Waitt, Tracy R. Wolstencroft

COUNCIL OF ADVISORS

CHAIRMAN: Edward P. Roski, Jr.

Darlene T. Anderson, Lucy C. Billingsley, Michael R. Bonsignore, Howard G. Buffett, Virginia Busch, D. Keith Campbell, Jean N. Case, David Court, Roger A. Enrico, Juliet C. Folger, David H. Koch, Iara Lee, Deborah M. Lehr, Sven-Olof Lindblad, Bruce L. Ludwig, Claudia Madrazo de Hernández, David P. Margulies, Michael L. Matkins, Mark C. Moore, Larry Mullen, Jr., Michael Pillsbury, Susan Pillsbury, Sally Engelhard Pingree, W. Russell Ramsey, Catherine B. Reynolds, Victoria P. Sant, B. Francis Saul II, Clara Wu Tsai, Ted Waitt, Sam R. Walton, Garry A. Weber, Tracy R. Wolstencroft, Pamela Mars Wright

EDUCATION FOUNDATION BOARD OF GOVERNORS

CHAIRMAN: John Fahey
VICE CHAIRMAN: Patrick F. Noonan

Brendan P. Bechtel, Jack Dangermond, Gilbert M. Grosvenor, Charles O. Holliday, Jr., Gary E. Knell, Gerry Lenfest, Lyle Logan, Julie A. McGee, Floretta Dukes McKenzie, William K. Reilly, Alex Trebek, Anthony A. Williams

RESEARCH AND EXPLORATION COMMITTEE

CHAIRMAN: Peter H. Raven
VICE CHAIRMAN: John M. Francis

Paul A. Baker, Kamaljit S. Bawa, Colin A. Chapman, Keith Clarke, J. Emmett Duffy, Philip Gingerich, Carol P. Harden, Jonathan B. Losos, John O'Loughlin, Naomi E. Pierce, Jeremy A. Sabloff, Monica L. Smith, Thomas B. Smith, Wirt H. Wills

MEDIA ADVISORY COUNCIL

Jean N. Case, Miles Gilburne, Kevin J. Maroni, Roger McNamee, Nigel Morris, Dennis R. Patrick, Vivian Schiller, Tracy R. Wolstencroft

EXPLORERS-IN-RESIDENCE

Robert Ballard, James Cameron, Wade Davis, Jared Diamond, Sylvia Earle, J. Michael Fay, Beverly Joubert, Dereck Joubert, Louise Leakey, Meave Leakey, Johan Reinhard, Enric Sala, Paul Sereno, Spencer Wells

MISSION PROGRAMS

SR. VICE PRESIDENT, CONTENT DEVELOPMENT: Mark Bauman
VICE PRESIDENT, EDUCATION: Daniel Edelson
VICE PRESIDENT, RCE GRANTS: John M. Francis
CHIEF OPERATING OFFICER: Sarah Laskin
VICE PRESIDENT, PUBLIC PROGRAMS: Gregory A. McGruder
VICE PRESIDENT, STRATEGIC INITIATIVES: Alexander Moen

HUMAN RESOURCES SR. VICE PRESIDENT: Thomas A. Sabló

TREASURER: Barbara J. Constantz

CHIEF SUSTAINABILITY OFFICER: Hans H. Wegner

NATIONAL GEOGRAPHIC CHANNEL

CEO: David Lyle

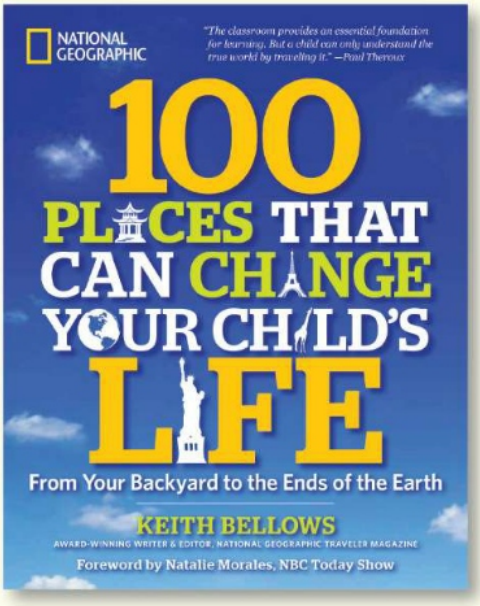
PRESIDENT: Howard T. Owens

CHIEF MARKETING OFFICER: Courteney Monroe

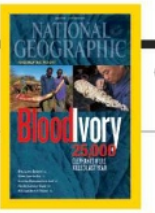
MACKENZIE BELLOWS IN THE GALÁPAGOS. PHOTO: KEITH BELLOWS

The best way to raise kids to be curious about the world is to **show it to them.** Journey with *National Geographic Traveler* Editor in Chief **KEITH BELLOWS** and his family to visit 100 of the world's greatest destinations, from America's national parks to the Galápagos Islands to your own backyard. This book provides some of **the world's top places for kids** (and the adults in their life)—including insightful insider tips and advice. You'll also find great ideas to supplement your travels—foods, music, films—and carefully curated lists of **kid-friendly activities**, all designed to give your kids the wonder of travel.

NATIONAL GEOGRAPHIC



FIND US ON FACEBOOK.COM/NATGEOBOOKS · AVAILABLE WHEREVER BOOKS ARE SOLD



Blood Ivory

Your article on the slaughter of elephants for ivory by turns upset me, angered me, and baffled me. Obviously the only course of action is to make the ivory unavailable or unworthy to the poachers. Is there something that can be fed to the animal that can change the color of the ivory from the inside—or can the tusks be deeply stained from the outside—to make it permanently unusable for the ivory trade without harming the animal?

STEVEN F. GRAVER
Columbus, Georgia

I hope that the ignoramus ivory collector in your story who said, "I don't see the elephant. I see the Lord," received a copy of the magazine. Maybe the photographs will improve his vision.

BRENDA PETRUZZELLA
Columbus, Ohio

I find Kenya's stockpiling of ivory yet burning of 5.5 tons of other countries' illegal ivory to be a hypocritical waste. The ivory could have been sold to China—the Chinese are going to acquire it by some other means anyway—and the money used to help protect the remaining population of elephants by hiring more park rangers, putting up fences, etc. Destroying it only makes Kenya's stockpile go up in value.

RYAN AYRES
Modesto, California

I cannot get over such a bloody and vicious photo on the cover. I am certain that there are ways to get the message across of the horrible crime perpetrated against animals for their ivory without dripping blood.

DAWN BROWN
Birmingham, Alabama

Your article was disturbing, from the politics and corruption to Buddhists and Catholics ignoring the precepts of their religions. The elaborate carvings the Chinese are buying are garish. Ivory looks much more beautiful on an elephant in the wild.

DIANE KRAUSE
Arlington, Massachusetts

As a Catholic, I couldn't help but wonder what St. Francis of Assisi would have to say about buying and selling such objects. He had much to say about the care of God's creatures and the dangers of wealth.

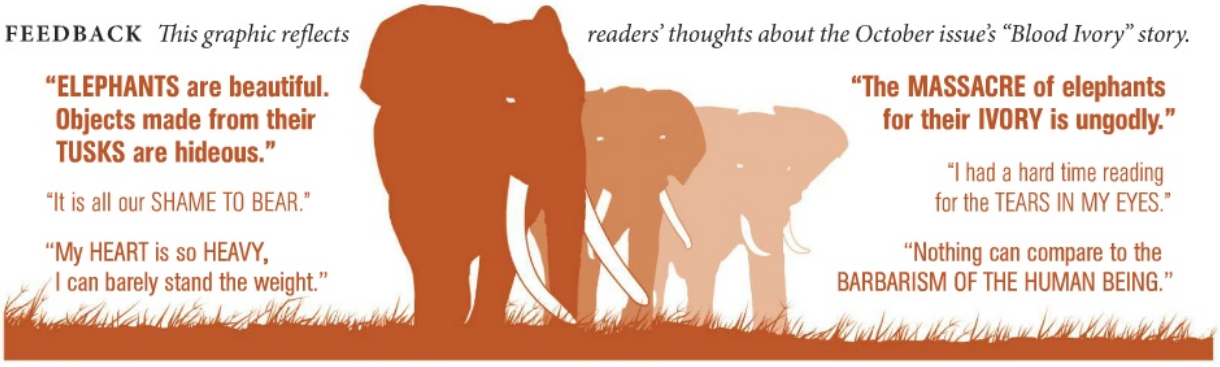
SARAH BUCHWALDER
Bristol, Maine

Corrections

OCTOBER 2012, THE GLORY OF LEAVES
The plant on page 67 was misidentified as grapevine. It is actually *Bryonia dioica*, commonly called bryony.

Watch *Battle for the Elephants* on PBS
See author Bryan Christy in National Geographic's *Battle for the Elephants* on February 27 at 9 p.m. Check local listings. Learn more at *nationalgeographic.com/elephantvoices.*

FEEDBACK *This graphic reflects readers' thoughts about the October issue's "Blood Ivory" story.*



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

GRAPHIC: MATTHEW TWOMBLY, NGM STAFF

Eaglecrest Estate

Highway 168 - Prather, California - USA

Please Enjoy Our Streaming Wildlife Video Cameras

For the public's education and enjoyment, Eaglecrest Estate in 2011 partnered with the world renowned Raptor Resource Project of Decorah, Iowa, and with Ustream, to install several live, 24/7 streaming video cameras at a Red-Tailed Hawk nest. The first event-filled season saw the nest nearly destroyed by a windstorm; only to be later taken over by a fascinating pair of Canadian Geese. The camera site became a popular sensation in its first season with over 1.3 million visitors from around the world. For 2012, the Eaglecrest Wildlife Site has been expanded to TWELVE cameras which now cover the original tree, two additional Red-Tailed Hawk nests, and the entire area . . . around the clock, everyday.

Canadian Goose With Seven Hatchlings

Red-Tailed Hawks' Mating Ritual

IR Camera Catches Great Horned Owl

Google 'Eaglecrest Hawks' - click on USTREAM link
-or- go to http://www.ustream.tv/eaglecresthawks

For more information, contact us at: EaglecrestWildlife@gmail.com

Iain Couzin
National Geographic
Emerging Explorer

EXPERTISE
Swarm behaviorist

LOCATION
Mauritania

Dodging Locusts

Locust swarms eat all the vegetation in their path, seeking protein, salt, and water. When that runs out—sometimes even before—they turn cannibal. Locusts hate to be around each other. They change color and behavior when in groups, and start to form swarms. They're the Jekyll and Hyde of the insect world. Imagine hopping masses of millions of bugs, each trying to eat the ones in front of it.

Mauritania suffers countrywide outbreaks of these swarms. My team and I, studying the outbreaks there, wanted to know more. When I picked up one locust to examine it more closely, my hands swelled up. Toxic chemicals on the insect had reacted in sunlight when they touched my skin. To make matters worse, we were a two-day drive outside Mauritania's capital, in the middle of the desert, and had just run out of food. Across Mauritania there was a shortage, because the locusts were eating the crops. We couldn't eat the locusts, normally a great source of protein, because they were toxic. We got desperate after a day or two. We tried to buy food from the nomads who stopped to drink tea, and managed to get our hands on some camel entrails. My decade of vegetarianism prior to the trip went out the window.

We dried the entrails in a tree outside camp. After I ate them, cramps and vomiting set in and I started hallucinating. I was in a dream world, and not a good one. We were very short of water, had no medical equipment except some antibiotics, and had no way of getting out of the sun other than to bake in our airless tents. It was a waiting game. After I started feeling better a few days later and we got some supplies in, a massive sandstorm kept us in the tents for an extra day and a half. We just had to ride it out.

ART: ISTVAN BANYAI. PHOTO: GABRIEL MILLER

There's never been a better time for

ORGANIZATION

with the Neat Digital Filing System

Deduct stress from tax time.
Neat saves you time with taxes by transforming paper receipts into **digital documents that are accepted by the IRS**. You can easily categorize your receipts and other documents in Neat, then quickly generate PDF tax reports or export data to popular accounting software.

Keep the info, lose the paper.
Once it's in Neat, you don't need to keep the paper. **Reclaim your desk from paper and your home from clutter**. Share files with your accountant using NeatCloud®. Use NeatMobile® to scan with your phone, so you can leave receipts at the store.

Meet NeatCloud + NeatMobile.
Imagine all of your important files, always in your pocket. Whether you scanned it at the office, emailed it in from the road, or even snapped it with your smartphone, NeatCloud + NeatMobile keeps it **all together and always available**.

neat

ORDER NEATDESK OR NEATRECEIPTS AND RECEIVE A
FREE 30-DAY TRIAL OF NEATCLOUD + NEATMOBILE

VISIT **NEAT.COM/NGTAX** | OR CALL **855-877-7300**

VISIONS

China
Frigid festivities abound at the annual Harbin International Ice and Snow Festival in northeastern China. Here a swimmer pumps up enthusiasm before plunging into a pool carved out of the frozen Songhua River.

PHOTO: CANCAN CHU, GETTY IMAGES

England
Sporting feathery gills, a Mexican axolotl, about six inches long, paddles around a West Sussex fish tank. The unusual salamander species, whose numbers are dwindling in the wild, retains its larval features as an adult.

PHOTO: STEPHEN DALTON, NHPA/PHOTOSHOT

Italy
A plastic swordfish head—possibly a cast replica—makes a curious companion for fish enthusiast Maria Agnese Cornaro, of Canelli. She received the head as a gift years ago, after hosting a town exhibition of people's aquariums.

PHOTO: REED YOUNG

This page features two photographs: one chosen by our editors and one chosen by our readers via online voting. For more information, go to ngm.com/yourshot.

EDITORS' CHOICE **Natela Grigalashvili** Tbilisi, Georgia

While visiting a fishing village in southern Georgia, Grigalashvili couldn't speak with this Armenian boy. "But he made me understand that he wanted a photo with the fish," she says. As the shutter snapped, the boy kissed and fondled the fish.

READERS' CHOICE

Indranil Mukhopadhyay
Woodland Hills, California

Clouds added drama as the sun rose over Utah's Canyonlands National Park one morning last summer. Mukhopadhyay, a software engineer, saw how the rays would enrich the view. "Landscape art," he says, "is simply being in the right place with the right light."

For patients 12 years and older whose asthma is not well controlled on a long-term asthma medicine or whose disease severity warrants

IF YOU THINK ASTHMA 'COMES AND GOES'

THINK AGAIN.

IT'S MISUNDERSTOOD. ASTHMA DOESN'T COME AND GO. Inflammation, the root cause of asthma is always there, making your lungs more vulnerable to triggers. So, while it's important to avoid triggers, it's also important to treat this inflammation. SYMBICORT helps reduce the underlying inflammation. SYMBICORT helps keep airways open and improve lung function for better breathing all day and night.* SYMBICORT does not replace a rescue inhaler for sudden symptoms. Once your asthma is well controlled, your doctor will decide if you can stop taking SYMBICORT without loss of control and may prescribe a long-term asthma control medicine such as an inhaled corticosteroid.

* When taken twice daily.

Ask your doctor about SYMBICORT.

IMPORTANT INFORMATION ABOUT SYMBICORT

Important Safety Information About SYMBICORT for Asthma

SYMBICORT contains formoterol, a long-acting beta$_2$-adrenergic agonist (LABA). LABA medicines such as formoterol increase the risk of death from asthma problems. It is not known whether budesonide, the other medicine in SYMBICORT, reduces the risk of death from asthma problems seen with formoterol. SYMBICORT should be used only if your health care provider decides that your asthma is not well controlled with a long-term asthma control medicine, such as an inhaled corticosteroid, or that your asthma is severe enough to begin treatment with SYMBICORT.

If you are taking SYMBICORT, see your health care provider if your asthma does not improve or gets worse. It is important that your health care provider assess your asthma control on a regular basis. Your doctor will decide if it is possible for you to stop taking SYMBICORT and start taking a long-term asthma control medicine without loss of asthma control. Children and adolescents who take LABA medicines may have an increased risk of being hospitalized for asthma problems.

SYMBICORT does not replace rescue inhalers for sudden asthma symptoms.

Be sure to tell your health care provider about all your health conditions, including heart conditions or high blood pressure, and all medicines you may be taking. Some patients taking SYMBICORT may experience increased blood pressure, heart rate, or change in heart rhythm.

Do not use SYMBICORT more often than prescribed. While taking SYMBICORT, never use another medicine containing a LABA for any reason. Ask your health care provider or pharmacist if any of your other medicines are LABA medicines, as using too much LABA may cause chest pain, increase in blood pressure, fast and irregular heartbeat, headache, tremor, and nervousness.

Patients taking SYMBICORT should call their health care provider or get emergency medical care:

- if you experience serious allergic reactions including rash, hives, swelling of the face, mouth and tongue, and breathing problems.
- if you think you are exposed to infections such as chicken pox or measles, or if you have any signs of infection. You may have a higher chance of infection.
- if you experience an increase in wheezing right after taking SYMBICORT, eye problems including glaucoma and cataracts, decreases in bone mineral density, swelling of blood vessels (signs include a feeling of pins and needles or numbness of arms or legs, flu like symptoms, rash, pain and swelling of the sinuses), decrease in blood potassium and increase in blood sugar levels.

If you are switching to SYMBICORT from an oral corticosteroid, follow your health care provider's instructions to avoid serious health risks when you stop using oral corticosteroids. Common side effects include nose and throat irritation, headache, upper respiratory tract infection, sore throat, sinusitis, stomach discomfort, flu, back pain, nasal congestion, vomiting, and thrush in the mouth and throat.

Approved Uses for SYMBICORT for Asthma

SYMBICORT is a medicine for the treatment of asthma for people 12 years and older whose doctor has determined that their asthma is not well controlled with a long term asthma control medicine such as an inhaled corticosteroid or whose asthma is severe enough to begin treatment with SYMBICORT. SYMBICORT is not a treatment for sudden asthma symptoms.

Please see Important Product Information on adjacent page and discuss with your doctor.

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

FREE PRESCRIPTION OFFER† Call 1-800-687-3755 or visit MySymbicort.com

† Subject to eligibility rules. Restrictions apply.

For more information, call 1-866-SYMBICORT or go to MySymbicort.com

If you're without prescription coverage and can't afford your medication, AstraZeneca may be able to help. For more information, please visit www.astrazeneca-us.com

Symbicort®
(budesonide/formoterol fumarate dihydrate)
Inhalation Aerosol

AstraZeneca

IMPORTANT INFORMATION ABOUT SYMBICORT

Please read this summary carefully and then ask your doctor about SYMBICORT.

No advertisement can provide all the information needed to determine if a drug is right for you or take the place of careful discussions with your health care provider. Only your health care provider has the training to weigh the risks and benefits of a prescription drug.

WHAT IS THE MOST IMPORTANT INFORMATION I SHOULD KNOW ABOUT SYMBICORT?

People with asthma who take long-acting beta$_2$-agonist (LABA) medicines, such as formoterol (one of the medicines in SYMBICORT), have an increased risk of death from asthma problems. It is not known whether budesonide, the other medicine in SYMBICORT, reduces the risk of death from asthma problems seen with formoterol.

SYMBICORT should be used only if your health care provider decides that your asthma is not well controlled with a long-term asthma control medicine, such as an inhaled corticosteroid, or that your asthma is severe enough to begin treatment with SYMBICORT. Talk with your health care provider about this risk and the benefits of treating your asthma with SYMBICORT.

If you are taking SYMBICORT, see your health care provider if your asthma does not improve or gets worse. It is important that your health care provider assess your asthma control on a regular basis. Your doctor will decide if it is possible for you to stop taking SYMBICORT and start taking a long-term asthma control medicine without loss of asthma control.

Get emergency medical care if:

- breathing problems worsen quickly, and
- you use your rescue inhaler medicine, but it does not relieve your breathing problems.

Children and adolescents who take LABA medicines may be at increased risk of being hospitalized for asthma problems.

WHAT IS SYMBICORT?

SYMBICORT is an inhaled prescription medicine used for asthma and chronic obstructive pulmonary disease (COPD). It contains two medicines:

- Budesonide (the same medicine found in Pulmicort Flexhaler™, an inhaled corticosteroid). Inhaled corticosteroids help to decrease inflammation in the lungs. Inflammation in the lungs can lead to asthma symptoms
- Formoterol (the same medicine found in Foradil® Aerolizer®). LABA medicines are used in patients with COPD and asthma to help the muscles in the airways of your lungs stay relaxed to prevent asthma symptoms, such as wheezing and shortness of breath. These symptoms can happen when the muscles in the airways tighten. This makes it hard to breathe, which, in severe cases, can cause breathing to stop completely if not treated right away

SYMBICORT is used for asthma and chronic obstructive pulmonary disease as follows:

Asthma

SYMBICORT is used to control symptoms of asthma and prevent symptoms such as wheezing in adults and children ages 12 and older.

Chronic Obstructive Pulmonary Disease

COPD is a chronic lung disease that includes chronic bronchitis, emphysema, or both. SYMBICORT 160/4.5 mcg is used long term, two times each day, to help improve lung function for better breathing in adults with COPD.

WHO SHOULD NOT USE SYMBICORT?

Do not use SYMBICORT to treat sudden severe symptoms of asthma or COPD or if you are allergic to any of the ingredients in SYMBICORT.

WHAT SHOULD I TELL MY HEALTH CARE PROVIDER BEFORE USING SYMBICORT?

Tell your health care provider about all of your health conditions, including if you:

- **have heart problems**
- **have high blood pressure**
- **have seizures**
- **have thyroid problems**
- **have diabetes**
- **have liver problems**
- **have osteoporosis**
- **have an immune system problem**
- **have eye problems such as increased pressure in the eye, glaucoma, or cataracts**
- **are allergic to any medicines**
- **are exposed to chicken pox or measles**
- **are pregnant or planning to become pregnant.** It is not known if SYMBICORT may harm your unborn baby
- **are breast-feeding.** Budesonide, one of the active ingredients in SYMBICORT, passes into breast milk. You and your health care provider should decide if you will take SYMBICORT while breast-feeding

Tell your health care provider about all the medicines you take including prescription and nonprescription medicines, vitamins, and herbal supplements. SYMBICORT and certain other medicines may interact with each other and can cause serious side effects. Know all the medicines you take. Keep a list and show it to your health care provider and pharmacist each time you get a new medicine.

HOW DO I USE SYMBICORT?

Do not use SYMBICORT unless your health care provider has taught you and you understand everything. Ask your health care provider or pharmacist if you have any questions.

Use SYMBICORT exactly as prescribed. **Do not use SYMBICORT more often than prescribed.** SYMBICORT comes in two strengths for asthma: 80/4.5 mcg and 160/4.5 mcg. Your health care provider will prescribe the strength that is best for you. SYMBICORT 160/4.5 mcg is the approved dosage for COPD.

- SYMBICORT should be taken every day as 2 puffs in the morning and 2 puffs in the evening.
- Rinse your mouth with water and spit the water out after each dose (2 puffs) of SYMBICORT. This will help lessen the chance of getting a fungus infection (thrush) in the mouth and throat.
- Do not spray SYMBICORT in your eyes. If you accidentally get SYMBICORT in your eyes, rinse your eyes with water. If redness or irritation persists, call your health care provider.
- Do not change or stop any medicines used to control or treat your breathing problems. Your health care provider will change your medicines as needed
- **While you are using SYMBICORT 2 times each day, do not use other medicines that contain a long-acting beta$_2$-agonist (LABA) for any reason. Ask your health care provider or pharmacist if any of your other medicines are LABA medicines.**
- SYMBICORT does not relieve sudden symptoms. Always have a rescue inhaler medicine with you to treat sudden symptoms. If you do not have a rescue inhaler, call your health care provider to have one prescribed for you.

Call your health care provider or get medical care right away if:

- your breathing problems worsen with SYMBICORT
- you need to use your rescue inhaler medicine more often than usual
- your rescue inhaler does not work as well for you at relieving symptoms
- you need to use 4 or more inhalations of your rescue inhaler medicine for 2 or more days in a row
- you use one whole canister of your rescue inhaler medicine in 8 weeks' time
- your peak flow meter results decrease. Your health care provider will tell you the numbers that are right for you
- your symptoms do not improve after using SYMBICORT regularly for 1 week

WHAT MEDICATIONS SHOULD I NOT TAKE WHEN USING SYMBICORT?

While you are using SYMBICORT, do not use other medicines that contain a long-acting beta$_2$-agonist (LABA) for any reason, such as:

- Serevent® Diskus® (salmeterol xinafoate inhalation powder)
- Advair Diskus® or Advair® HFA (fluticasone propionate and salmeterol)
- Formoterol-containing products such as Foradil Aerolizer, Brovana®, or Perforomist®

WHAT ARE THE POSSIBLE SIDE EFFECTS WITH SYMBICORT?

SYMBICORT can cause serious side effects.

- Increased risk of pneumonia and other lower respiratory tract infections if you have COPD. Call your health care provider if you notice any of these symptoms: increase in mucus production, change in mucus color, fever, chills, increased cough, increased breathing problems
- Serious allergic reactions including rash; hives; swelling of the face, mouth and tongue; and breathing problems. Call your health care provider or get emergency care if you get any of these symptoms
- Immune system effects and a higher chance for infections
- Adrenal insufficiency--a condition in which the adrenal glands do not make enough steroid hormones
- Cardiovascular and central nervous system effects of LABAs, such as chest pain, increased blood pressure, fast or irregular heartbeat, tremor, or nervousness
- Increased wheezing right after taking SYMBICORT
- Eye problems, including glaucoma and cataracts. You should have regular eye exams while using SYMBICORT
- Osteoporosis. People at risk for increased bone loss may have a greater risk with SYMBICORT
- Slowed growth in children. As a result, growth should be carefully monitored
- Swelling of your blood vessels. This can happen in people with asthma
- Decreases in blood potassium levels and increases in blood sugar levels

WHAT ARE COMMON SIDE EFFECTS OF SYMBICORT?

Patients with Asthma

Sore throat, headache, upper respiratory tract infection, thrush in the mouth and throat

Patients with COPD

Thrush in the mouth and throat

These are not all the side effects with SYMBICORT. Ask your health care provider or pharmacist for more information.

NOTE: This summary provides important information about SYMBICORT. For more information, please ask your doctor or health care provider.

Manufactured for: AstraZeneca LP, Wilmington, DE 19850
By: AstraZeneca AB, Dunkerque, France Product of France
Rev 11/11 1504903

Visit **www.MySymbicort.com**
Or, call **1-866-SYMBICORT**

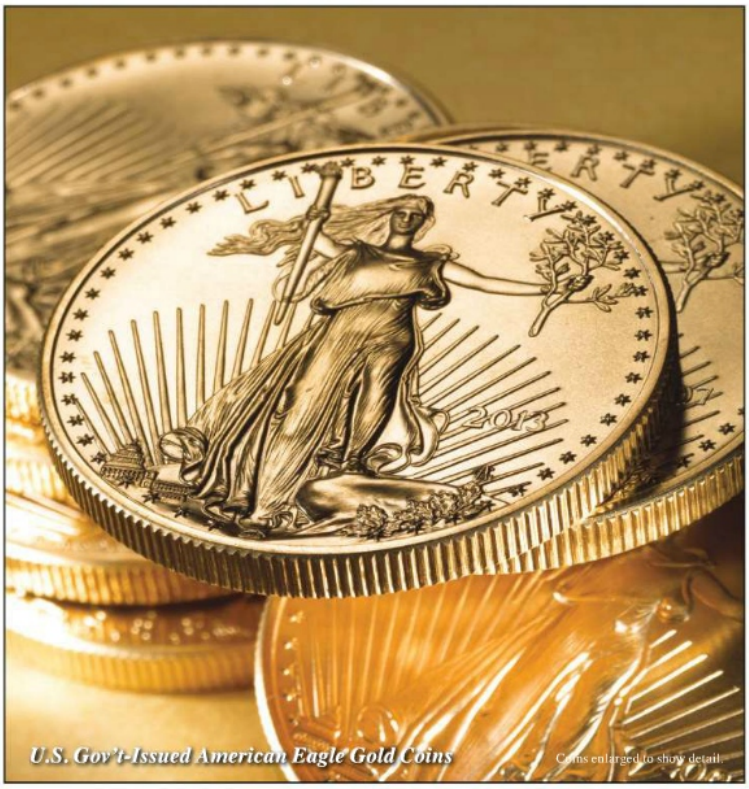
Symbicort®
(budesonide/formoterol fumarate dihydrate)
Inhalation Aerosol

AstraZeneca

U.S. GOV'T GOLD

U.S. GOLD COINS AUTHORIZED FOR IMMEDIATE RELEASE

The U.S. Money Reserve Vault Facility today announces what could be the final release of U.S. Gov't-Issued Gold Coins previously held in The West Point Depository/U.S. Mint. For a limited time, U.S. citizens will have the opportunity to purchase these $5 Gov't-Issued Gold Coins for the incredible "at-cost" price of only $180.00 per coin. An amazing price because these U.S. Gov't-Issued Gold Coins are completely free of dealer markup. That's correct — our cost. This may be your final opportunity to buy U.S. Gov't-Issued Gold Coins "at-cost." Gold, which recently skyrocketed past $1,700/oz., is predicted by experts to have the explosive upside potential of reaching up to $10,000/oz. in the future. Please be advised: Our U.S. Gov't Gold inventory will be priced at $180.00 per coin while supplies last or for up to 30 days. These coins may sell-out. Call today! U.S. Money Reserve will release these U.S. Gov't-Issued Gold Coins "at-cost" on a first-come, first-served basis. Orders that are not immediately received or reserved with the order center could be subject to cancellation and your checks returned uncashed. Good luck. We hope that everyone will have a chance to purchase this special U.S. Gov't-Issued Gold at this price because it could be going to $10,000/oz. Order immediately before our vault sells out completely! Special arrangements can be made for Gold purchases over $50,000.



U.S. Gov't-Issued American Eagle Gold Coins Coins enlarged to show detail.

AUTHORIZED BY CONGRESS: PUBLIC LAW 99-185

By Executive Order of Congress Public Law 99-185, Americans can now buy new Government-Issued Gold. Congressionally authorized United States Gold Coins provide American citizens with a way to add physical Gold to their portfolios. Gold American Eagles are made from solid Gold mined here in America, minted at the U.S. Mint at West Point, and produced with a U.S. Dollar denomination... making them Legal Tender United States Gold Coins. They are highly liquid, easily transportable, and, unlike paper assets, American Gold Eagles have a tangible value you can feel each time you hold your own Gold. Though no one, including U.S. Money Reserve, can guarantee a Gold Coin's future value will go up or down, numerous experts are predicting Gold to reach $10,000/oz. Now is the time to consider converting part of your paper assets into Gold. U.S. Money Reserve has a limited supply and urges you to make your vault reservations immediately. Call a Sr. Gold Specialist at 1-800-592-4423 to start your Gold collection and begin protecting your wealth today. If you've been waiting to move your money into Gold, the time is now.

DO NOT DELAY - LIMITED SUPPLIES AVAILABLE!

GOV'T-ISSUED GOLD COIN

THE MARKETS FOR COINS ARE UNREGULATED. PRICES CAN RISE OR FALL AND CARRY SOME RISKS. THE COMPANY IS NOT AFFILIATED WITH THE U.S. GOVERNMENT AND THE U.S. MINT. PAST PERFORMANCE OF THE COIN OR THE MARKET CANNOT PREDICT FUTURE PERFORMANCE. SPECIAL AT-COST OFFER IS STRICTLY LIMITED TO ONLY ONE LIFETIME PURCHASE OF 10 AT-COST COINS (REGARDLESS OF PRICE PAID) PER HOUSEHOLD, PLUS SHIPPING AND INSURANCE. PRICES MAY BE MORE OR LESS BASED ON CURRENT MARKET CONDITIONS. CALL NOW.

PURE COST - NO DEALER MARKUP!

ONLY $180.00 EACH

SHIPPING & INSURANCE $8-15

VAULT CODE: NG17-180

Call Toll-Free 7 Days a Week:

1-800-592-4423

MASTERCARD • VISA • AMEX • DISCOVER
CHECK • BANK WIRE

U.S. MONEY RESERVE


C-MAX says **Ha.**
C-MAX says **Wheeee.**
C-MAX gets 54 more net horsepower than the **Prius *v*,**
a hybrid that C-MAX also beats in **MPG.***
Say hi to the all-new 5-passenger 2013 47-combined-MPG
C-MAX HYBRID
ford.com
Ford
Go Further
*EPA-estimated 47 city/47 hwy/47 combined mpg. Actual mileage will vary.

NEXT

A new blue pigment, created as a powder (right), can help keep houses cool in warm weather.

Coat d'Azure

Oregon State University researchers were thrilled in 2009 to discover the formula for a new blue pigment, the first new inorganic blue created in more than two centuries. It was a bonus when they realized the compound was also unusually good at reflecting heat, making it an ideal color to paint energy-efficient roofs and cars of the future. Made at 2350°F, the pigment is extremely stable. Its recipe—a mix of yttrium, manganese, and indium oxides—isn't too complicated either. Unlike dyes, which are made easily using organic compounds, it won't fade over time.

Building companies and car manufacturers are clamoring for various shades of the new pigment, eyeing lower energy costs. White still reigns as the most efficient reflector of solar radiation but is hard to maintain. Plus, says Mas Subramanian, a materials chemist behind the discovery, "blue just looks so much nicer." *—Daniel Stone*

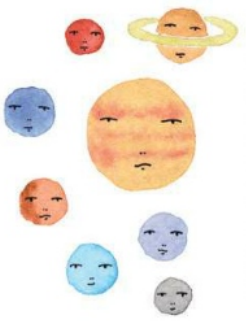
PHOTO: JEANNE M. MODDERMAN, NGM STAFF

With the Earth's rotation, a person standing at the Equator moves at more than a thousand miles an hour.

In Bangkok shark fins hang on hooks to promote the sale of shark fin soup.

Toxic Shark Fins?

University of Miami neurologist Deborah Mash found an unsavory ingredient in the fins of seven shark species: a neurotoxin with possible links to Parkinson's, Alzheimer's, and Lou Gehrig's disease. Called beta-methylamino-L-alanine (BMAA), the molecule is made by cyanobacteria, often called blue-green algae, and can accumulate as it travels up the food chain. Previous research in Guam found that BMAA in bats eaten by locals was the likely cause of a neurodegenerative illness; the bats fed on the seeds of cycad trees with bacteria-harboring roots. Because the bacteria are ubiquitous in the ocean, Mash turned to marine species. Some controversy remains about BMAA detection methods, but Mash believes that with cyanobacterial blooms on the rise, more BMAA will be on the menu for sharks—and possibly people too. *—Elizabeth Preston*



New Views of Pluto

Astronomer Alan Stern rejects the 2006 demotion of Pluto from planet to dwarf planet and thinks it will command more respect once people see the first close-up pictures from the spacecraft New Horizons, due in July 2015. "We've been blown away every time we've been to a new planet," says Stern, who's using a Hubble census of nearby objects to ensure the ship doesn't get hit by any en route. *—EP*

PHOTO: PAUL HILTON. GRAPHIC: ÁLVARO VALIÑO. SOURCE: NASA. ART: MARC JOHNS

PLAN FOR A BETTER WORLD

PHOTO: NEL CEPEDA

In 2007, Pat Minnick decided to establish a charitable gift annuity to support National Geographic. She now receives a guaranteed life income and is a direct part of the Society's efforts to inspire people to care about the planet. She says, "I feel good knowing that National Geographic is doing so much to protect endangered wildlife."

Establishing a charitable gift annuity is a great way to help ensure a beautiful and diverse planet for generations to come, while guaranteeing a steady income for yourself right now.

CONTACT US: Phone: (800) 226-4438 • Email: plannedgiftinfo@ngs.org • Web: www.nationalgeographic.org/donate

The National Geographic Society is a 501(c)(3), tax-exempt organization.

SAMPLE ANNUITY RATES FOR ONE BENEFICIARY: Age 60=4.4% Age 70=5.1% Age 80=6.8% Age 90+=9.0%

(Rates at other ages available upon request.) Rates are subject to change. Please contact us for the most current rates.

TO MAKE YOUR BEQUEST

to National Geographic, please use the following language: "To the National Geographic Society in Washington, D.C., I give _____% of my estate." You can also name a fixed dollar amount.

Include National Geographic in your financial plans.

☐ **Yes!** Please send me information about a National Geographic charitable gift annuity!

Birthdate #1_____Birthdate #2_____

Minimum age 50. Payments begin at age 60.

Amt.: ☐ $10,000 ☐ $50,000 ☐ $100,000

☐ _____ Other *(Minimum gift $10,000)*

☐ Send me information on including National Geographic in my will.

☐ I have already included National Geographic in my will.

Name _____

Address _____

_____

Phone _____

Email _____

Mail to: National Geographic Society
Office of Estate Planning
1145 17th Street N.W.
Washington, D.C. 20036-4688

Tracking common butterflies can show climate change.

BUTTERFLY PATTERNS | A climate's changes are tough to quantify. Butterflies can help. Entomologists prefer "junk species"—the kind of butterflies too common for most collections—to keep up with what's going on in the insect's world. They're easy to find and observe. When they do something unusual, something's changed in the area.

Art Shapiro's team at UC Davis monitors ten local study sites, some since the 1970s. The ubiquitous species are the study's go-tos, helping distinguish between lasting changes (climate warming, habitat loss) and ones that will right themselves (one cold winter, droughts like last year's). Consistency is key; they collect details year after year, no empty data sets between.

A few species have disappeared from parts of the study area altogether, probably a lasting change. On the other hand, seemingly big news in 2012 might be just a year's aberration. Two butterflies came back to the city of Davis last year, the umber skipper after 30 years, the woodland skipper after 20—both likely a result of a dry winter with near-perfect breeding conditions of sunny afternoons and cool nights. *—Johnna Rizzo*

ART AND MAP: JOSHUA MAXWELL. SOURCES: JOHN M. BURNS, SMITHSONIAN INSTITUTION; ART SHAPIRO, UC DAVIS. PHOTOS: REBECCA HALE, NGM STAFF

LEGAL NOTICE

If You Were Enrolled in the "Disco" Group Text Messaging Service Offered by Slide, Inc., You Could Get a Monetary Payment from a Class Action Settlement.

A Settlement has been reached in a class action lawsuit about whether Slide, Inc. ("Slide"), a Google Inc. subsidiary, sent text messages to consumers regarding the "Disco" messaging service without receiving prior express consent to do so. Slide and Google are referred to as the "Defendants."

Who's Included?

You are included if you live in the U.S. or its territories and you received a text message regarding the Disco messaging service that was sent through the Disco messaging service without your prior express consent. The text messages involved contained the following or similar language: **"Disco is a group texting service. Standard SMS rates may apply or chat for FREE w/ our app – http://disco.com/d More info? Text *help To quit? Text *leave." More information about who is included is available at www.discotextsettlement.com.**

What Can You Get?

Defendants have created a Settlement Fund for disbursement of funds to class claimants. If you qualify, you may be eligible for a payment, the amount of which will be a *pro rata* share of the Settlement Fund based on the number of valid claim forms received, after payment of notice and administration expenses, attorneys' fees and incentive awards, and such *pro rata* share is not to exceed $500.00.

How to Get Benefits?

You will need to submit a Claim Form to get benefits. You can submit a Claim Form online at www.discotextsettlement.com or by mail. The deadline to submit a Claim Form is **June 28, 2013**.

Your Other Rights.

If you do nothing, your rights will be affected. If you do not want to be legally bound by the Settlement, you must exclude yourself from the Settlement. The deadline to exclude yourself is **April 2, 2013**. If you do not exclude yourself, you will not be able to sue the Defendants for any claim relating to the lawsuit. If you stay in the Settlement, you may object to it by **April 2, 2013**. The Court appointed attorneys at Edelson McGuire LLC to represent you. A hearing will be held on **May 14, 2013 at 2:00 p.m.** to consider whether to approve the Settlement and a request for attorneys' fees up to $2,000,000, as well as incentive awards to the class representatives of $5,000. You can appear at the hearing, but you don't have to. You can hire your own attorney, at your own expense, to appear or speak for you at the hearing.

www.DiscoTextSettlement.com
1-877-341-4575

How to Make a Splash Without Getting Wet

Bring home 300 carats of aquamarine, the legendary "sailor's gem" — now available for under $130!

92% OFF the independently appraised value

This is not a necklace. It's the World's Most Beautiful Personal Flotation Device. Ever since ancient times, sailors have sworn by aquamarine for protection on the open water. For them, it was a sacred gem connected to Neptune. But today you don't have to leave shore to reap the benefits of this legendary blue gem, because your ship has come in. Today, you can wear this spectacular ***300-Carat Maré Aquamarine Necklace for only $129!***

Stauer Exclusive! Order today for only $129!

A legend among luxury jewelers. Named for the Latin words for "water of the sea," aquamarine shines with all the colors of the ocean. Each bead is like a droplet of the sea frozen in space and time. Walk into the most exclusive retail jewelers and you'll find the gem in a place of honor. Fifth Avenue thinks nothing of offering a strand of aquamarine "pebbles" for nearly $12,000. But you deserve more than a dollop. That's why we collected the bluest stones from three continents, polished them to perfection and arranged them in this 20" double-stranded, 300-carat masterpiece.

Other jewelry stores hate us because we don't play by their rules. Stauer wants to turn the luxury business on its head. We took the ***Maré Aquamarine Necklace*** to an independent appraiser who works with auction houses, luxury estate sales and insurance companies. He valued our ***Maré*** necklace at $1,590.* We thanked him for his professional opinion and then ignored it. Because even if a graduate gemologist tells us that this necklace is valued at nearly $1600, we want you to wear it for **ONLY $129**. Yes, we're serious.

Your satisfaction is 100% guaranteed. If you don't fall in love with the ***Maré***, send it back within 30 days for a complete refund of your purchase price. It's that simple. Call now to set sail on your own incredible aquamarine deal while they last!

JEWELRY SPECS: - 300 ctw of genuine polished aquamarine
- Luxurious gold-finished spacers and clasp

Maré Aquamarine Collection

Necklace (300 ctw)..... Appraised at ~~$1,590~~
Your price $129
Bracelet (60 ctw).....***Only $79***
Earrings (15 ctw).....***Only $59***
Bracelet & Earrings Set (300 ctw)— ~~$138.~~...
Now only $99

Call now to take advantage of this fantastic offer.

1-888-373-0654

Promotional Code MAN251-03
Please mention this code when you call.

Stauer®
14101 Southcross Drive W.,
Dept. MAN251-03
Burnsville, Minnesota 55337
www.stauer.com

BBB ACCREDITED BUSINESS
Rating of A+

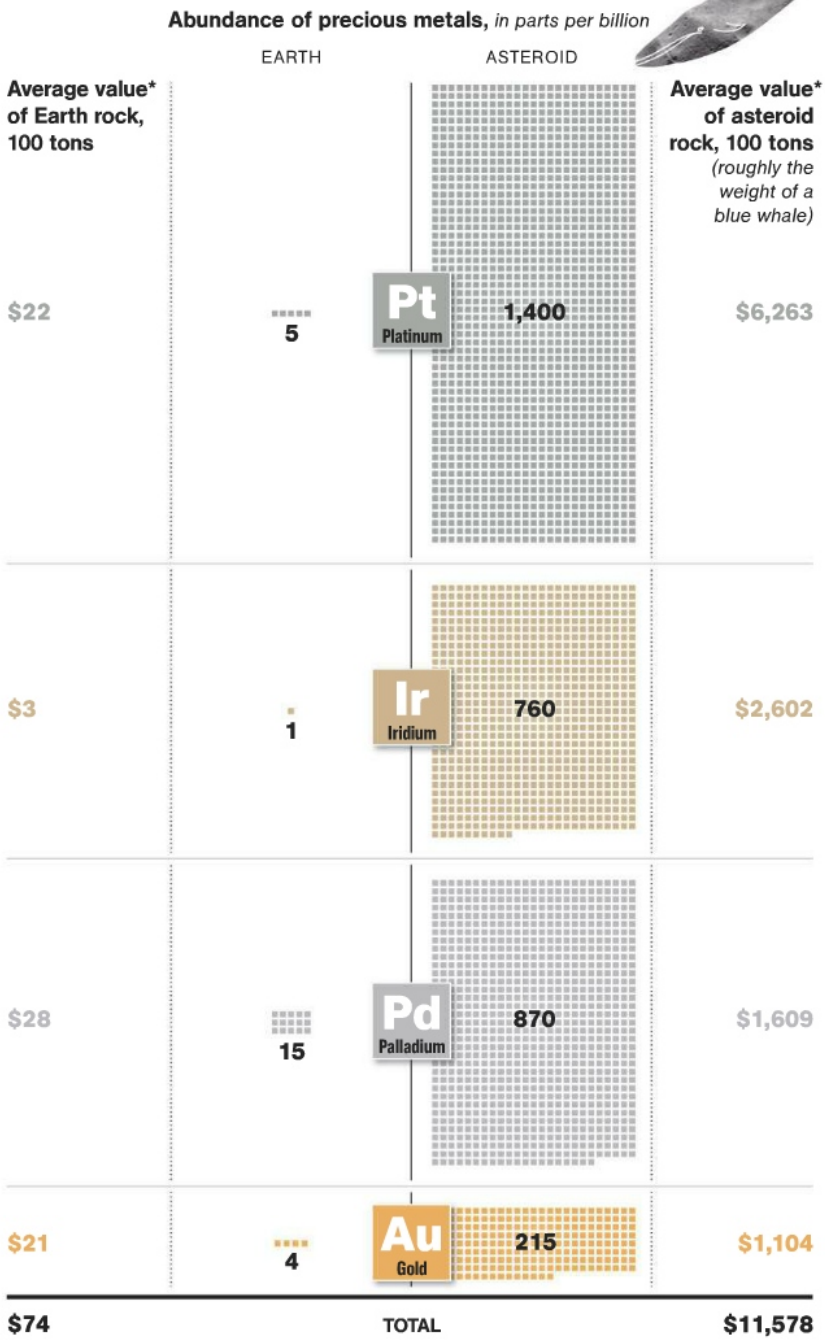
** For more information concerning the appraisal, visit **http://www.stauer.com/appraisedvalues.asp**.*

300 Carats for $129!

Necklace enlarged to show luxurious color.

Asteroid, Be Mine

In demand for everything from wedding rings to auto parts, platinum is pricey because it's so scarce—on Earth. Untapped treasure awaits in near-Earth asteroids, where platinum and related metals are roughly a thousand times more abundant. Scientists say mining the rubble of old planets via robotic spacecraft could be possible by 2025. Entrepreneurs are already gearing up for the prospect. *—Amanda Fiegl*



*August 2012 prices

Glowing Review

U.K. scientists are capturing lightning in a bottle. Harnessing a firefly's glow—actually, the catalyzing enzyme and its companion fluorescent molecule—can reveal food-borne bacteria such as salmonella, listeria, and *E. coli*. An extract of potentially compromised food is put in a test tube with the firefly molecules plus a bit of DNA that recognizes the suspected pathogen. Lights on signals that DNA from the food and test DNA match: contamination.

What else might the test tube do? Molecular scientist Laurence Tisi hopes it can help spot hospital-acquired infections like MRSA and one day monitor viral loads in HIV/AIDS patients who have little or no access to hospital laboratories. *—Johnna Rizzo*

GRAPHIC: JASON TREAT, NGM STAFF. SOURCE: ANDREW CHENG, JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY. PHOTO: JAMES JORDAN PHOTOGRAPHY, FLICKR/GETTY IMAGES

Imagine Life

full of *energy* and free of *pain*

(NO ENERGY DRINK REQUIRED)

Footwear EVOLVED

1. SHOES THAT ABSORB HARMFUL SHOCK

Reduces harmful impact, makes hard surfaces seem pillow-soft, improves comfort in your heels, knees, hips and even lower back.

"I just got back from a fifteen day trip to the Caribbean with long arduous tours on very rough surfaces almost every day. Without your shoes, I wouldn't have had a chance." – **Burton Katz**

"I actually noticed the biggest difference in my back... And then I noticed, Oh yeah... my knee feels fine too!" - **NADJA Hoyer-Booth, housewife**

"If you're healthy or not, if you are young or old, no matter what age you are, you have feet and you need to take care of them... Gravity Defyer is my miracle shoe." - **Nisso, heel cancer survivor**

2. SHOES THAT PROPEL YOU FORWARD

Never fight gravity again. The sole's dynamic energy return propels you forward, making every step seem effortless.

"They made me feel younger...more youthful... I literally felt like the shoes were propelling me forward when I walked." - **Susan Pinckney, sales pro**

"Gravity Defyer's gave me the spring in my step that makes me feel like I'm back in my mid-30's and 40's which for me –pushing 60– is a great 20 year gain!" - **Robert Fleet, ex-athlete**

"A shoe like this really is life changing. Especially for someone like me: an ex-athlete, or stuntwoman or anyone who has just been on their feet their whole lives." - **Gloria Obrien, stuntwoman**

A ***shockwave*** passes through your body with every jarring step, taking a toll on your feet, knees and joints. You are left feeling drained, exhausted and worn down. Don't slip lazily onto that couch or grab an energy drink for a much needed pick-me-up… We can help.

Increase Stamina
with dynamic energy return

We've engineered a revolutionary new line of footwear that will change your life. The SUPERNOVA's powerful shock absorbing system reduces harmful impact on your body before returning that absorbed energy to you, propelling you forward and sending you flying –filled with energy. You'll find yourself walking longer distances, running faster, dancing, and just staying on your feet longer. With the new SUPERNOVA, you won't just feel like you're walking on air, you'll be defying gravity!

Reduce Harmful Impact
from walking and running

- Relieve discomfort
- Absorb harmful impact
- Increase athletic performance
- Improve posture
- Feel Rejuvenated

For a limited time try this revolutionary new footwear with no obligation to you. We even pay the shipping (and will come and pick it up from you if you are not fully satisfied). So, you have nothing to lose but everything to gain. We are sure you are going to love the power and the energy of Gravity Defyer™ shoes like millions of other satisfied customers. So now is your chance.

Take a snapshot of the old you, just to remember... We guarantee you'll love the changes you see in the next 30 days!

Now with 3x more SHOCK ABSORBING POWER And 2x more ENERGY RETURN

MEN $129.95 Sizes 7.5 - 15 Medium widths

WOMEN $129.95 Sizes 5 - 11 Medium widths

Try the G-Defy™ SUPERNOVA FREE* for 30 days!

Call 1 (800) 429-0039 | Coupon Code: MH4BEK2
or go online **www.GravityDefyer.com/MH4BEK2**

*Deferred billing for 30 days from date shipped is an optional selection during checkout. Credit card authorization required. See website for details.

Guaranteed to Change the Way You Live

How to Outsmart a Millionaire

Only the "Robin Hood of Watchmakers" can steal the spotlight from a luxury legend for under $200!

Mr. Bigshot rolled up in a roaring high-performance Italian sports car, dropping attitude like his $22,000 watch made it okay for him to be rude. That's when I decided to roll up my sleeves and teach him a lesson.

"Nice watch," I said, pointing to his and holding up mine. He nodded like we belonged to the same club. We did, but he literally paid 100 times more for his membership. Bigshot bragged about his five-figure purchase, a luxury heavyweight from the titan of high-priced timepieces. I told him that mine was the ***Stauer Corso, a 27-jewel automatic classic now available for only $179.*** And just like that, the man was at a loss for words.

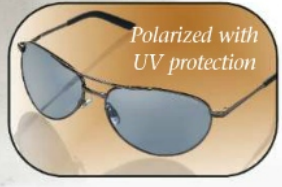
The Stauer *Corso* is proof that the worth of a watch doesn't depend on the size of its price tag. Our factory spent over $40 million on Swiss-made machinery to insure the highest quality parts. Each timepiece takes six months and over 200 individual precision parts to create the complex assembly. Peer through the exhibition back to see the 27-jeweled automatic movement in action and you'll understand why we can only offer the ***Corso*** in a limited edition of 14,999.

Our specialty is vintage automatic movements. The ***Corso*** is driven by a self-winding design, inspired by a 1923 patent. Your watch will never need batteries. Every second of power is generated by the movement of your body. The black dial features a trio of date complications including a graphic day/night display. The ***Corso*** secures with a two-toned stainless steel bracelet and is water-resistant to 3 ATMs.

Your satisfaction is 100% guaranteed. Test drive the Stauer ***Corso***. If you don't love it, send it back within 30 days and we'll refund every dollar of your purchase price. Spending more doesn't make you smarter. But saving thousands on a watch this stunning will leave you feeling (and looking) like a genius!

Exclusive OFFER!

Order the Stauer Corso and these Stauer Flyboy Optics™ Sunglasses (a $99 value) are yours ***FREE****!*



Another Stauer Exclusive Not In Stores

Stauer Corso Timepiece— *Only $179* *+S&P* ***PLUS*** **receive the Stauer Flyboy Optics™ Sunglasses FREE— a $99 value!**

Call now to take advantage of this limited offer with our 30-day money back guarantee.

1-800-859-1626

Promotional Code CSW290-02
Please mention this code when you call.

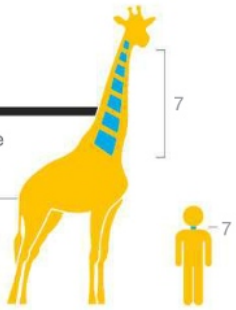
Limited Edition... Order Today!

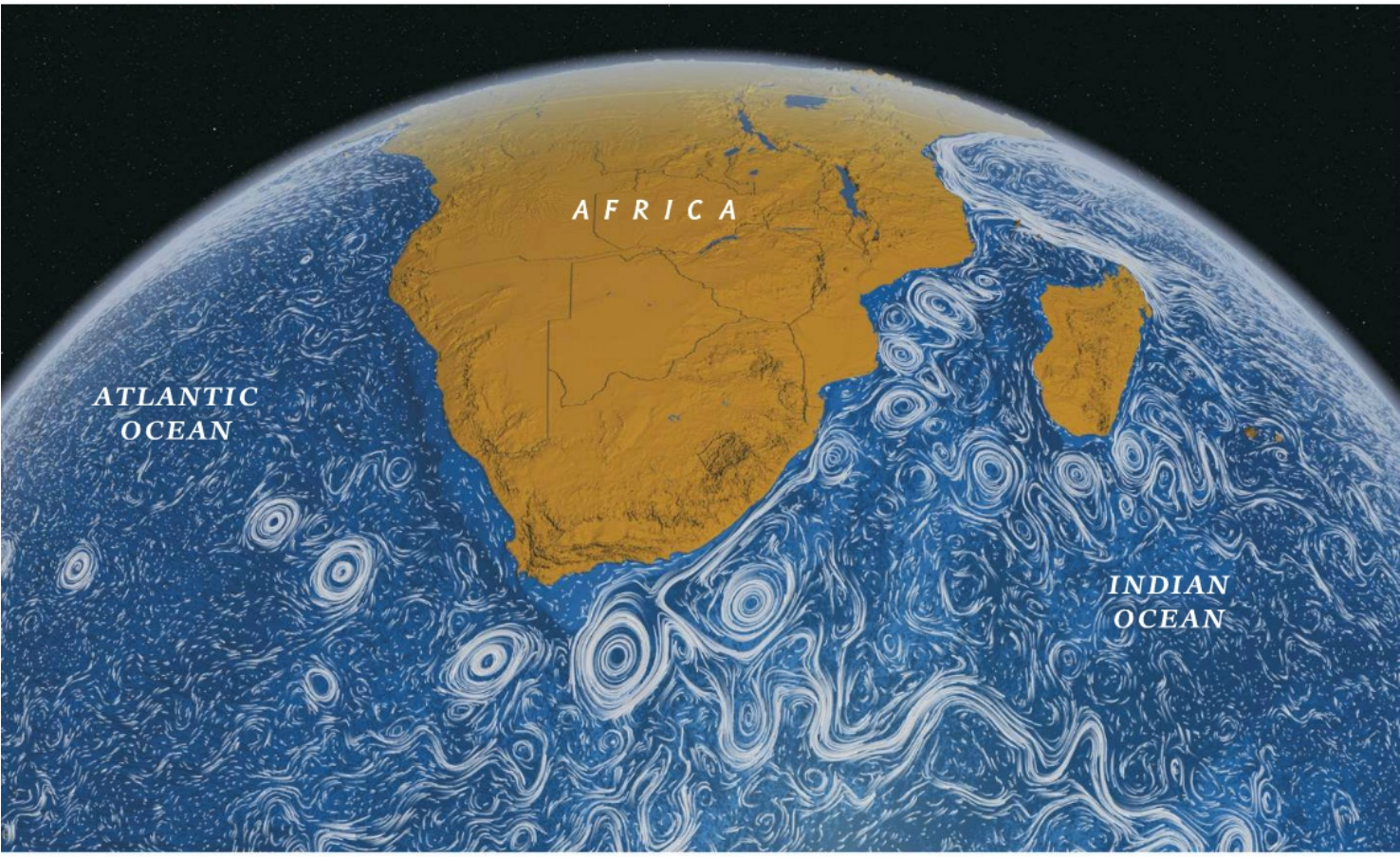
BBB ACCREDITED BUSINESS
Rating of A+

Stauer®
14101 Southcross Drive W.,
Dept. CSW290-02
Burnsville, Minnesota 55337
www.stauer.com

27-jeweled Vertex automatic movement - Interior dials - Transparent caseback - Dual-toned stainless steel case and bracelet band fits wrists 6 ½"–9"

Giraffes and humans have the same number of vertebrae in their necks.





White lines show the flow of ocean currents. Eddies form where they are disturbed by land or other currents.

Motion Picture

The oceans cover nearly three-quarters of Earth, so understanding how currents move around the planet requires stepping off the world. Oceanographers at NASA's Jet Propulsion Laboratory and MIT turned to satellites that can measure water temperatures and sea heights across the globe. They mixed in wind measurements and other data, then fed everything into a computer model. An animation made from the model revealed a dynamic portrait of surface currents. "Everyone is amazed at how chaotic the ocean is—that water doesn't flow smoothly from place to place," says Horace Mitchell, head of NASA's Scientific Visualization Studio. Other visions created this way: atmospheric winds and ice flows. *—Luna Shyr*

Watch the oceans in motion on our digital editions.

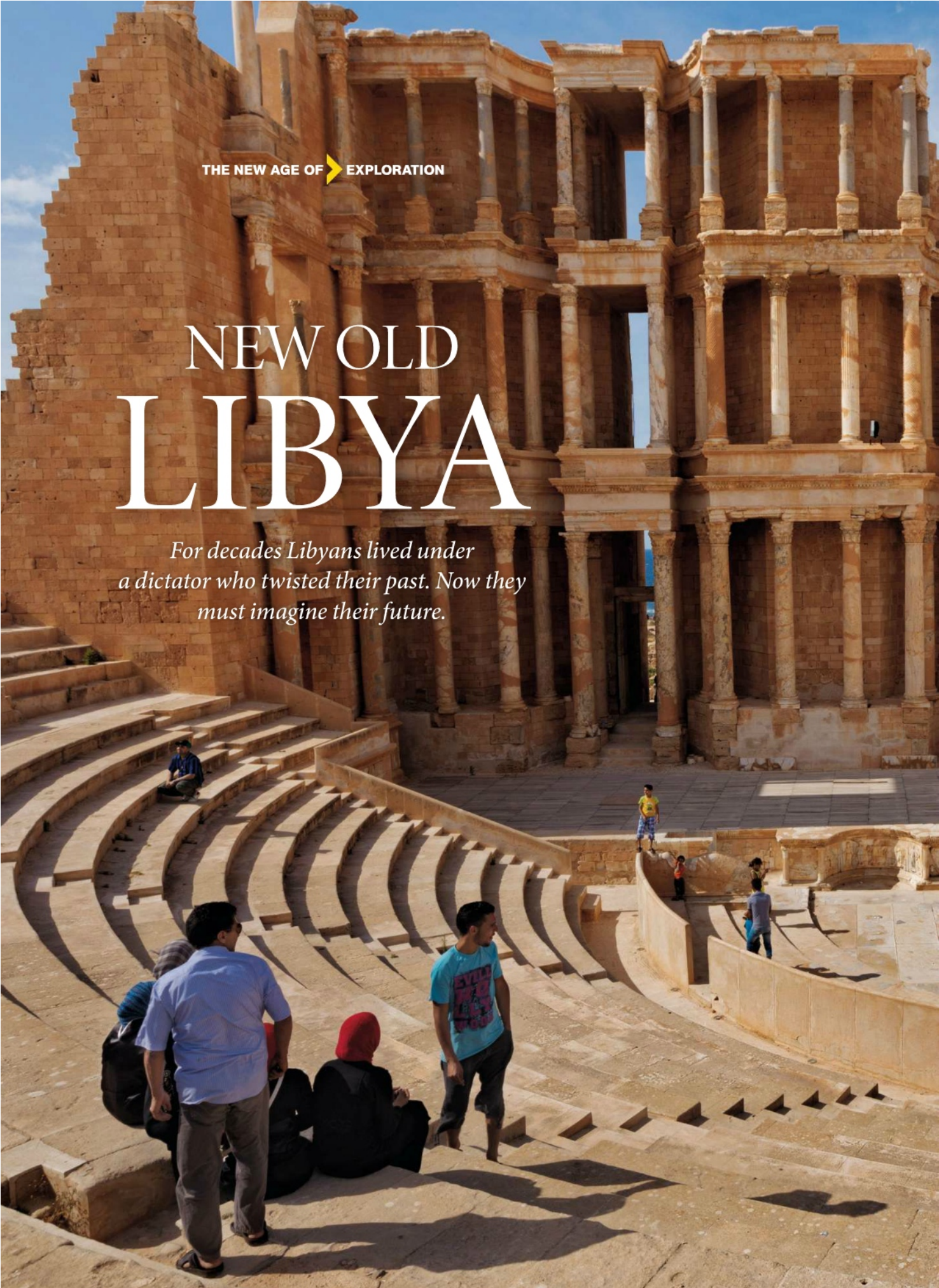
ET CETERA

On February 15 the **ASTEROID 2012 DA14** is expected to pass within 27,000 miles of Earth's surface, about one-tenth as far as the moon. • Scientists say that **CADMIUM SULFIDE NANOWIRES** may hold a key to future energy, fueling machines with light instead of electricity. • Biologists nicknamed a new ant species **MANHATTANT** after finding it in New York City. • Tanzanian **BONE FRAGMENTS** showing anemia suggest that early humans ate meat regularly to survive beginning about 1.5 million years ago.

IMAGE: NASA GODDARD SPACE FLIGHT CENTER SCIENTIFIC VISUALIZATION STUDIO; NGM MAPS. GRAPHIC (TOP): KELLY MCHUGH

NEW OLD LIBYA

For decades Libyans lived under a dictator who twisted their past. Now they must imagine their future.



Libyans enjoy a visit to Sabratah's ancient Roman theater, one of Africa's largest.

VESTIGES OF GLORY

Among the world's largest, best preserved ancient Roman cities, Leptis Magna flourished under Emperor Septimius Severus, who was born here. A vast theater, forum (at top right), and market became part of an urban center to rival Rome. Muammar Qaddafi saw sites like this as symbols of Western imperialism.

ROME

In the second century A.D.
faced off with leopards and
Magna amphitheater. Arm
no headgear or armor, th
staged hunts in

N AFRICA

animal fighters called venatores
other African wildlife in the Leptis
ed with only a spear and wearing
venator engaged in dangerous
eturn for pay or glory.

HUB OF HISTORY

For 10,000 years Libya's location on the Mediterranean attracted nomads, settlers, conquerors, and colonizers. As its population absorbed each wave of newcomers, it slowly forged a Libyan identity. Today evidence of other cultures and history—Greek theaters, Roman amphitheaters, Ottoman palaces, even Italian cafés—is indelibly stamped on this now predominantly Arab country.

2000–100 B.C.

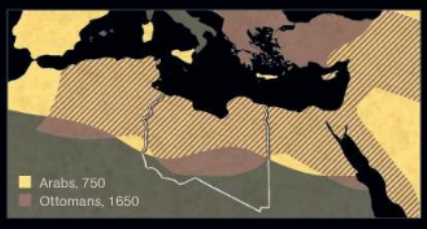
Indigenous Berbers were engaging in trade by 900 B.C. with the Phoenicians, who had forged Mediterranean trade routes by 1200 B.C. The Greeks, who called North Africa "Libya," had settled on the eastern coast by 700 B.C.

100 B.C.–A.D. 400

Phoenician and Greek influence gave way to the Roman Empire, which came to dominate North Africa for 450 years; Libyan-born Septimius Severus ruled the entire Roman Empire from A.D. 193 to 211.

A.D. 600–1900

Arabs began spreading Islam across North Africa in the seventh century. They dominated the region for 900 years; the Ottoman Empire, also united by Islam, held power for much of the next four centuries.



1900–2011

Italy invaded Libya in 1911 and was ousted by Allied forces in 1943. Libya won independence eight years later and was led by a monarch until Muammar Qaddafi's 1969 coup. The 2011 revolution ended the dictator's life.

LEFT: JASON TREAT, FERNANDO BAPTISTA, AND AMANDA HOBBS, NGM STAFF
ART: KEKAI KOTAKI. SOURCE: JON C. N. COULSTON, UNIVERSITY OF ST. ANDREWS, SCOTLAND

ABOVE: JEROME N. COOKSON AND AMANDA HOBBS, NGM STAFF
SOURCE: HAFED WALDA, KING'S COLLEGE LONDON

PICTURES OF THE PAST

An 1,800-year-old chariot race comes alive under the gentle care of Italian and Libyan conservators working at Villa Silin, a Roman residence buried under dunes on the coast near Leptis Magna until 1974. Layers of sand protected mosaics like this from damage.

HARBOR TO THE WORLD

Leptis Magna was built around a natural harbor, which welcomed Roman ships from across the Mediterranean empire. A more recent lifeline—a 323-mile gas pipeline to Sicily completed in 2004—is helping Libya reestablish links with its European neighbors.

PILLARS OF POSSIBILITY

Horses wander freely around the 2,500-year-old Temple of Zeus at Cyrene, the only ancient Greek site among Libya's five World Heritage sites. Archaeologists are now documenting and preserving these once neglected ruins.

The bronze likeness of Muammar Qaddafi's nemesis was lying on his back in a wooden crate shrouded in the darkness of a museum warehouse. His name was Septimius Severus. Like Qaddafi, he was from what is now Libya, and for 18 years bridging the second and third centuries A.D. he ruled the Roman Empire. His birthplace, Leptis Magna—a commercial city 80 miles east of what the Phoenicians once called Oea, or present-day Tripoli—became, in every meaningful way, a second Rome. More than 1,700 years after the emperor's death, Libya's Italian colonizers honored him by erecting a statue of the imposing, bearded leader with a torch aloft in his right hand. They installed the statue in Tripoli's main square (now Martyrs' Square) in 1933—where it remained for a half century, until another Libyan ruler took umbrage.

"The statue became the mouthpiece of the opposition, because he was the only thing Qaddafi couldn't punish," says Hafed Walda, a native Libyan and professor of archaeology at King's College London. "Every day people would ask, 'What did Septimius Severus say today?' He became a figure of annoyance to the regime. So Qaddafi banished him to a rubbish heap. The people of Leptis Magna rescued him and brought him back home." And that is where I found him, reposing in a wooden box amid gardening tools and discarded window frames, awaiting whatever destination the new Libya might have in store for him.

Qaddafi correctly viewed the statue as a threat. For Septimius Severus stood as a wistful reminder of what Libya had once been: a Mediterranean region of immense cultural and economic wealth, anything but isolated from the world beyond the sea. Spreading over 1,100 miles of coastline, bracketed by highlands that recede into semiarid wadis and finally into the copper vacuum of the desert, Libya had long been a corridor for commerce and art and irrepressible social aspiration. The tri-city region of Tripolitania—Leptis Magna, Sabratah, and Oea—had once provided wheat and olives to the Romans.

Yet Qaddafi squandered the country's advantages: its location just south of Italy and Greece, which made it one of Africa's gateways to Europe; its manageable population (fewer than seven million inhabiting a landmass six times the size of Italy); its vast oil reserves. He quashed innovation and free expression. To schoolchildren, who memorized Qaddafi's tangled philosophy as inscribed in his *Green Book,* the story of their country consisted of two chapters: the dark days under the West's imperialist bootheel, and then the glory days of the Brother Leader.

Today the dictator and his warped vision for Libya are dead, and the nation is undergoing the spasmlike throes of reinvention. As Walda says, "The journey of discovery has just begun. In many ways this moment is more dangerous than wartime." Temporary prisons are overstuffed with thousands of Qaddafi loyalists awaiting their fate as laws and court procedures are reformed. Militias control whole swaths of the country. Guns are less visible than they were during the war, but that only means the hundreds of thousands who possess them have learned to keep them out of sight. Highways in rural areas remain thoroughly unpoliced (not counting the checkpoints manned by former rebels, or *thuwwar*). Immigrants pour into Libya from its western and southern borders. Key Qaddafi associates, as well as his wife and some of his children, remain at large. Several new ministers are already on the take.

Last September's terrorist attack on the U.S. Consulate in Benghazi left the unmistakable

THE NEW AGE OF EXPLORATION is a yearlong series of articles celebrating *National Geographic* at 125.

BY ROBERT DRAPER
PHOTOGRAPHS BY GEORGE STEINMETZ

YOUNG SURVIVORS *Five-year-old Fatima Shetwan, wrapped in the tricolor flag of independent Libya, takes part in a Misratah school assembly. Many children lost parents in the city's three-month siege.*

impression of a country teetering on a knife-edge. Yet despite its struggles, Libya is hardly on the brink of anarchy. The democratically elected General National Congress is commissioning a new constitution. Tripoli is for the most part calm. In its nerve center of Martyrs' Square—a jungle land of gunfire during the revolution—a couple of motorcyclists zigzag loudly around newly installed children's rides. The city center is alive with purpose. On the south end of the square, vendors sell many of the new publications that have sprung up since the uprising began. To the east, dozens of Libyans congregate on the patio of a jazzy café beneath an Ottoman-era clock tower, chattering over lattes and croissants. Banners and graffiti depicting the red-black-and-green Libyan flag, banned by Qaddafi for 42 years because of its association with the deposed King Idris, now adorn every building in sight. Billboards and posters bear the images of Libya's many fallen rebels, with inscriptions like: "We died for a free Libya—please keep it free!" "Collect all the weapons!" On the street passersby exclaim in English, "Welcome to new Libya!"

Beneath the roiling uncertainties is a nation

Robert Draper is a contributing writer for the magazine who reports often from Africa. George Steinmetz is an expedition photographer who has documented remote corners of the world for 25 years.

POSTERS PROCLAIM:
"WE DIED FOR A FREE LIBYA—
PLEASE KEEP IT FREE!"
"COLLECT ALL THE WEAPONS!"
ON THE STREET PASSERSBY
EXCLAIM IN ENGLISH,
"WELCOME TO NEW LIBYA!"

possessed by an almost adolescent eagerness to rejoin the free world. Salaheddin Sury, a professor at the Centre for National Archives and Historical Studies in his 80s, told me, "When we got our independence in 1951, it was something we got almost for free. This time the young people paid for it in blood. I didn't bother with the national anthem back then. Now for the first time," he declared with a proud grin, "I've memorized it by heart."

Yet on the desert slog to rediscovery, flag-waving offers only the mirage of a shortcut. As Sury acknowledged, Libya's rebuilding "starts at zero." The terrorist attack last September casts a dark shadow over Libya's attempts to increase stability and rebuild its government. Whether the 30,000 Libyans who protested against militias ten days later constitute a better predictor of Libya's future, it is too early to say. In ways both obvious and insidious, Libya remains half-blinded by its former dictator's heavy hand. Now, like the statue in the wooden box, it awaits its future in an unforgiving light.

When the revolution came to the commercial hub of Misratah in February of 2011, Omar Albera went to his family and declared, "I'm going to take off my uniform and fight Qaddafi."

"You are one of Qaddafi's policemen," his wife exclaimed. "The others will be suspicious of you. And what if the revolution fails? What then?"

His younger son also voiced fears. Only the police colonel's eldest son praised his decision—subsequently fighting by his father's side and dying in battle at the age of 23. The young rebels the police colonel helped command were newcomers to warfare. Having no weapons at their disposal early on, they threw stones and Molotov cocktails. Once the rebels had begun to amass the firearms of dead soldiers, the police colonel taught some how to shoot. A few were criminals he'd once locked up. They were tougher than the others; he was glad to have them in his ranks, and they in turn came to view him as a fellow rebel.

After Misratah at last beat back a ferocious three-month siege by Qaddafi's troops—a small-scale Battle of Leningrad that would prove decisive in the revolution, though at a terrible cost to Libya's third largest city—Albera again put on the police uniform he had worn through 34 years of the Qaddafi regime. He is now Misratah's chief of police. His goal is to introduce the people of his city to a different concept of police work—namely, that a man who wears his uniform is not a thief or a thug but a protector, that boys should one day aspire to wear such a uniform, to regard it as an emblem of dignity rather than of criminality. The new chief is no sunny idealist. He is 58, with the pensive equanimity of a much older man. He suffers no illusion that credibility can be won overnight when historically as many as three-quarters of Libya's policemen have been corrupt.

Further compounding the chief's challenge is that he is not, in the final analysis, the head law enforcement authority in Misratah. "The *thuwwar* are the real power in the city," he admits. The police department's equipment was destroyed during the war; the young men he helped train to fight in the revolution are now the ones with the weapons. "Even though they were brave, they were not trained to be leaders," he says. "Many are honest. Some are impressionable. This makes for a very delicate situation."

The delicate situation has vast implications. The Davids who felled Goliath with slingshots now run the kingdom and are not about to give it back to some new giant. Nor do they intend to hand over all of the giant's weaponry. Nor, for that matter, are they eager to forgive and

UNSPOILED TREASURES

As Libya shakes off Qaddafi's legacy of isolation to reconnect with the world, renewed attention to neglected ancient sites could help point the way forward.

Libya's rich archaeology is all over the map. There's the extensive Greek site of Cyrene on the eastern coast, the elaborate Roman ruins of Leptis Magna and the Phoenician port of Sabratah on the western coast, the rock-art sites of the Akakus Mountains, and the oasis town of Ghadames in the Sahara. Long neglected, these five World Heritage sites—and many other treasures—were nevertheless protected by the lack of development under Qaddafi. And despite fears of destruction during Libya's revolution, most sites were undamaged by the turmoil, largely thanks to the efforts of local guards and to the Blue Shield's "no-strike list," which provided geographic coordinates to help NATO bombers avoid the sites.

Now, as Libya rebuilds, its treasures are under a new threat: development, particularly along the coast. Qaddafi's rejection of Libya's non-Arab heritage means that few Libyans have been properly trained as archaeologists, though that could change if heritage preservation, and the tourism it could attract, become a priority. Could Libya's ancient assets someday compete with oil as a resource? With security uncertain, hopes for a tourist boom are distant but not far-fetched.

JEROME N. COOKSON AND AMANDA HOBBS, NGM STAFF. SOURCE: HAFED WALDA, KING'S COLLEGE LONDON

UP FOR GRABS *At an abandoned military facility near Ajdabiya, heavy munitions—including tank rounds and boxes of mortar shells stacked to the ceiling—are ripe for looting. The taking of unsecured arms "poses a direct threat to civilians," warns Human Rights Watch.*

forget. Qaddafi's supporters remain in their midst. Some are neighbors. In Misratah's case that neighbor is Tawurgha, a working-class town 25 miles away, from which government forces launched a ferocious assault on Misratah.

Central to Qaddafi's vision for Libya was a bellicose populism designed to undermine the urban centers that threatened his power base. Toward that end, he lavished the Tawurghans—almost exclusively dark-skinned Africans of sub-Saharan descent—with jobs and housing in return for their unswerving loyalty. This divide-and-conquer strategy pitted towns and ethnic and tribal groups against each other all over Libya. The revolution turned those divisions into battle lines. Overnight, towns like Riqdalin and Al Jumayl became bases for loyalist attacks on their bigger neighbor Zuwarah. The city of Az Zintan was suddenly besieged by the neighboring tribal Mashashiya town of Al Awaniya. A Qaddafi-backed Tuareg militia suppressed a rebel uprising in Ghadames. And Tawurgha volunteers joined Qaddafi's soldiers, marched on Misratah, killed their neighbors, and in some cases raped their neighbors' women.

The reports of assaults on women have left the Misratans blind with rage. Wild exaggerations (was it 50 rapes? 400? 1,080? 8,600?) are countered in turn by Tawurgha sympathizers (no rapes at all occurred, hostility toward Tawurghans is racially motivated). One fact is inarguable: Tawurgha

is now a ghost town. The Misratans evacuated the town by force and razed most of its buildings. Nearly all 30,000 Tawurghans now live in displacement camps, mainly in Benghazi and Tripoli. When I visited the bullet-riddled carcass that was once Tawurgha, its streets were empty except for artillery shells, a few ragged garments, and a half-starved cat. The roads to the town were heavily guarded by Misratan militia. No one may return to Tawurgha.

The Misratans stubbornly refuse to make peace. As one prominent local merchant, Mabrouk Misurati, told me in a loud and trembling voice, "You cannot accept those who have raped and killed our sisters living among us again! This is not easy! Reconciliation is what we are asking the new government to do—to take those who committed those crimes to justice. Then we'll talk about letting them come back."

This appetite for vengeance worries Misratah's new police chief. "We can't put all of the people of Tawurgha on the same playing field," Albera says. "We can't do mass punishments the way Qaddafi did. We must act according to the law. This is what we're trying to achieve in a new Libya."

For now, achievements come in increments. The chief has succeeded in forming a security council of the more levelheaded militia members and persuading them to inventory their weapons. "We need to get everything back under control," he says. Too many shootings are taking place—some by accident, like two horsemen killed by celebratory gunfire at a wedding, and some the result of macho vendettas. Too many cars on the streets lack license plates. Too many criminals freed in the chaos of the revolution remain on the streets. Then again, the chief says, they fought valiantly beside him. So what should he do with them?

And too many young people are taking drugs. This, at least, he can understand. "Keeping in mind what they've recently been through, many of them need psychological treatment," the chief says. "Maybe we all do, to be honest. My 17-year-old son—he watched his older brother fall to the ground right next to him."

But how does a nation go about cleansing its soul? Today in Misratah schoolchildren who once were made to recite *The Green Book* are expected to completely forget its author, the man who killed their fathers and sisters. "All of the Qaddafi period has been erased from the textbooks," a local teacher told me. "We do not mention his name. He has been buried."

THE GHOSTS of Libya's greatness past remain plainly visible by the grace of a dry climate, a paucity of urban sprawl, tribal beliefs against tampering with the ruins of the dead, and an abundance of sand as an optimal preservative. On the western coast stands Leptis Magna, among the world's most spectacular Roman archaeological sites, its triumphal arch and sprawling forum and colonnaded streets evoking a pinnacle of urban dynamism. Its splendor becomes even more evident when imagining the marble later stripped by the French for use at Versailles and when viewing the monumental imperial sculptures—of Claudius, Germanicus, Hadrian, Marcus Aurelius—that once graced the city and now reside in Tripoli's museum.

Farther west lies the former seaside mercantile center of Sabratah, dominated by a majestic sandstone theater erected at the close of the second century A.D. Directly behind the Corinthian pillars looming over the theater's elevated stage shimmers the curtain of the sea. Seeing Sabratah as an exquisite representation of Roman might, Mussolini ordered that the theater, which had lain in ruins since the earthquake of A.D. 365, be restored. Il Duce attended its reopening in 1937, when *Oedipus Rex* was performed and, it is said, the locals were ordered by Italian soldiers to applaud with such vigor that their hands bled.

To the east resides Libya's most enduring archaeological rival to the Roman sites: the ancient Greek stronghold of Cyrene, a crucial breadbasket where the ruins of an amphitheater and a brawny 2,500-year-old Temple of Zeus suggest an era of fecundity and wealth. Following centuries of foreign rule, Bedouin tribes invaded Libya in the seventh century. With them came Islam, a spiritual culture that persisted through each and *(Continued on page 56)*

OUT OF THE WRECKAGE *Wires dangle from what remains of Az Zawiyah's Bank of Commerce & Development, destroyed by rocket fire during battles between Qaddafi loyalists and militias in March 2011. The city, population about 200,000, was devastated, but its oil refinery, which supplies Tripoli and other parts of western Libya, was spared.*

AGE-OLD ARCHITECTURE *Tight clusters of traditional mud-brick-and-palm houses have stood for centuries in Ghadames, a pre-Roman oasis town in the Sahara. Rooftop walkways allowed women to move freely, concealed from men's view.*

A FRESH START *A bride adorned with lace and henna designs on her arms is ushered into a Benghazi hotel. Marriage ceremonies are segregated by gender. It's unclear whether a post-Qaddafi Libya will allow women more freedom, but hopes run high.*

INVITING THE WORLD IN *Kasim Abdu Salaam Habib, 39, opens his lovingly decorated 600-year-old home to foreign tourists in Ghadames. The house needs repairs, and visitors are scarce these days. But Habib is optimistic. "I want to see Libya as a democracy," he says.*

WHILE RUINS WENT UNTENDED, TRIPOLI'S MUSEUM FEATURED WHOLE EXHIBITS DEVOTED TO THE BROTHER LEADER, INCLUDING HIS JEEP AND VOLKSWAGEN BEETLE.

(Continued from page 47) every subsequent external force: the Ottomans, the Italian occupiers, the British and American military, the foreign oil companies, and a monarchy supported by the West. After the military overthrow of King Idris in 1969, Qaddafi immediately set to work rewriting Libya's history. He spurned North Africa's indigenous Berber, or Amazigh, people and held up Arabs as the true Libyans. In doing so he thrust himself, the son of an Arab Bedouin nomad, into the center of Libyan identity.

The ancient Greek and Roman sites of Libya meant nothing to him. He equated the ruins with the Italian occupiers. Although the archaeology at Leptis Magna and Sabratah and Cyrene went largely untended, Tripoli's museum featured whole exhibits devoted to the Brother Leader, including his Jeep and Volkswagen Beetle.

Famous for sleeping in a tent even on state visits to Paris and other European capitals, Qaddafi espoused an outmoded version of the Bedouin ethic, says Mohammed Jerary, the director of Libya's national archives. "Being a Bedouin, his goal was to emphasize Bedouin values over settled values, the tent conquering the palace. He wanted us to forget about organized cities and highly sophisticated things—even culture and the economy. But the Bedouin themselves didn't remain primitive. They learned that it wasn't proper to invade someplace every time their camels ran out of food. They learned to believe in systems and government. Qaddafi insisted on accentuating only the bad values of Bedouin life."

His rule was one of orchestrated chaos. "There was no routine—things could change in a minute, destabilizing everything," Walda told me. "Suddenly you cannot own a second house. You cannot travel overseas. You cannot play for a sports team. You cannot study a foreign language." Many of the country's most prominent thinkers were carted off to the dreaded Abu Salim prison, where some 1,200 were massacred by their jailers in 1996. Muslim clerics found themselves imprisoned for the offense of seeming more loyal to Islam than to their leader. Qaddafi loyalists belonging to the revolutionary committees kept watch in classrooms and workplaces. Government payrolls swelled with hundreds of thousands of workers who were paid subsistence wages to do nothing. Flunkies reaped lavish lifestyles, while the regime's mildest critics were, as some Libyans would lyrically put it, "taken behind the sun."

Even Libya's geography was not spared. "He pushed back the sea from Tripoli, filling the floor with sand and planting palm trees there—to show that Libya had turned her face away from the Mediterranean," says Mustafa Turjman, an archaeological specialist at the Department of Antiquities since 1979. "He was the god of ugliness!"

In a single practical gesture to the outside world, Qaddafi in 2004 completed a new lifeline: an undersea pipeline to deliver natural gas to Sicily. All other connections the god of ugliness severed.

SHORTLY AFTER THE FIRST gunshot-wound cases were carted into the emergency room of Benghazi's Al Jala Hospital on the afternoon of February 17, 2011, the surgeon began shouting out directions. Then she stopped herself. Her ex-husband had always told her, "Maryam, the woman shouldn't be the decision-maker. Let the man speak his opinion first." Was he right?

But civilians were being gunned down in the streets of Benghazi by the government's soldiers. Qaddafi's men had ordered the hospital director not to treat the rebels. When the director defied their edict, government thugs began

roaming the hospital, taking down the names of doctors who were continuing their work. But 31-year-old Maryam Eshtiwy did not take off her white coat and go home—not until the third day, and then only to breast-feed her six-month-old daughter, who was staying with her grandparents. After that the surgeon returned to the hundreds of wounded young men stretched across every available inch of the hospital.

In a single day the social order dictating that Libyan women should defer to men had undergone a jolting tectonic shift. Or had it? Libya has long been a moderate Islamic nation. Qaddafi had encouraged women's participation in education and the workplace. It remains to be seen, however, whether a country seeking to reconnect with its European neighbors across the Mediterranean will further embrace women's rights—or lose out on the talents of half its population.

It may well be that years of battling ingrained Arab traditions helped steel Eshtiwy for those gory first days of the Libyan revolution. "Let's be honest. I'm working in a man's medium," she says. Her parents wished for her the stress-free life of a pharmacist or ophthalmologist. The head of surgery—a man, of course—was hard on her. She could not help but notice that during the rounds the males were never criticized, but whenever she presented a case to him, he argued every single point, as if pushing her to leave. Eshtiwy made it clear that she had no intention of doing so.

She had made it equally clear to her ex-husband, a chemist, before their wedding: "I'm a surgeon, and I'm working in the hospital, and I'm driving my own car." He professed to be fine with that. Theirs was a semi-arranged marriage: an introduction by his sister, followed by two months of courtship, engagement, and then a traditional three-day wedding attended by 700, culminating in vows in front of an all-female audience while every man except the groom killed time somewhere outside the wedding hall.

Overnight his attitude toward her profession seemed to change. "Forgive me for saying this, but men don't like their wives to be better than them," Eshtiwy says. He telephoned her one morning to say he was divorcing her. Under Libya's Islamic law, the woman has no recourse—not even a woman three months pregnant, as she was at the time. When war broke out nearly a year later, some of her family and friends urged her, "Go back to him—maybe he's learned his lesson. If you are killed in the hospital, your daughter will have no mother."

The injured rebels, for their part, did not recoil at the surgeon's gender. Some seemed to prefer her bedside manner, her emotional accessibility. And today at Al Jala Hospital many husbands express relief that she, rather than a man, will be examining their wives. Eshtiwy feels relatively secure in her place. She points to other Benghazi women—professors, lawyers, judges, engineers, politicians—and says, "The Libyan women are very strong, very clever. We're managing by ourselves without any external help."

If only she could say the same about the country as a whole. "I'm worried about everything," she confesses. She prefers to see Libya as one fully unified country, but others in her city, mindful of the east's disproportionately minor political influence under Qaddafi despite providing most of the nation's oil revenues, have demanded that the new Libya yield far more autonomy to the regions south and east of Tripoli. The airwaves and streets are alight with edgy rhetoric—"a war now, a war of words," Eshtiwy says, and she does not know whom or what to believe. Her dismay over the death of U.S. Ambassador Christopher Stevens in her city was matched only by her outrage at accusations that the Ansar al-Sharia brigade guarding her hospital was responsible. "They are peaceful and respectful people," she maintains. "They are just rumors from outsiders who are trying to destroy the relationship that we've just restored with the U.S."

Eshtiwy remains a devout Muslim who embraces arranged marriages and who has never traveled outside Benghazi. Yet her straitjacketed but steady world has been thrown into tumult. "The picture," she says, "is distorted to me."

She believes there is cause for hope. The

experience in the hospital during the revolution—everyone working as a team, round the clock, treating rebels and Qaddafi loyalists alike without discrimination, while fellow citizens brought the staff food and blankets—has told her something about Libyans. "During the time of Qaddafi we thought that we were bad people, that no one could love us," she says. "We see now the beauty of our country."

But Eshtiwy also senses a gnawing post-traumatic stress pervading the city. It grips her as well. There are videos of her hospital heroics. She cannot watch them. "No way." She can't even watch the news. "It's depressing, you see," she says. "Sometimes I feel like, why did all these people die? Did we have to be paid with their precious blood for all this chaos?"

The worst is this: There is still more blood. Too much of it. Before the revolution Al Jala Hospital saw maybe three or four gunshot-wound cases every year. With firearms widespread throughout the new Libya, she treats three or four such cases every day.

"Now we are so expert at dealing with these," the surgeon says, sighing.

When I consider the future of Libya, a flailing man-child of a nation, my mind returns to a 61-year-old man I met in one of Benghazi's old souks. His name was Mustafa Gargoum, and he made a small living by selling vintage photographs of the city. Since 1996 he had occupied a street corner just a few hundred yards from the Mediterranean

TAKING THE PLUNGE
On a lazy Friday boys cool off at a Tripoli beach. As normal life resumes, Libyans hope hotels like the Marriott (green, at left) will reopen as part of a fledgling tourist economy.

coast, where he used to fish as a child. The photo collector's makeshift exhibit was the first of its kind in Benghazi and possibly in all of Libya. Small crowds would gather to ponder the images from a banished yesteryear: mules clattering down alleys bearing jugs of olive oil; the luminous Ottoman-era Hadada Square, currently overtaken by jewelry vendors; the Italianate parliament building, destroyed at Qaddafi's orders and now a parking lot. Old men crouched in front of Gargoum's photographs and stared for a very long time. Their eyes said what their mouths could not. Some of the photos included forbidden visuals, such as the old Libyan flag, which is the new Libyan flag.

Gargoum's streetside gallery also included posters on which he would write deliberately provocative passages such as: "Those who sacrifice liberty for security deserve neither." "Free minds of America and Europe, you have always disappointed us." "The Libyan people are more important." Unsurprisingly, these dissident musings earned Gargoum ongoing harassment. Every September, coinciding with the anniversary of the Brother Leader's ascension to power, Ministry of Interior officials would escort Gargoum to a police station and make him stay overnight. "We know what you're trying to do," they would tell him, though they always let him go. He continued to display his images and his messages. But the photographs he had collected of Qaddafi's sworn enemies he kept hidden in his home office, where he wrote on the walls sentiments that he did not dare display on the streets of Benghazi—bitter laments like, "The ceiling of the regime is too low for me to stand!"

When the first peaceful protests began in mid-February, Gargoum closed his gallery and joined the demonstrations, but soon retreated to his house. Eight months later, on the day that Qaddafi was killed, he returned to the souk with his photographs—not just the usual images, but also those of artists and intellectuals and soldiers who had once defied the dictator and been executed as a result. Included in this more expansive exhibit was a painting he had made in 1996, the first year that he had offered up his photographs and sly slogans to the jittery public of Benghazi. The painting consisted of a single monumental figure engulfed by darkness—his back turned, his hand holding a torch aloft. Though Gargoum had intended it to be a self-portrait, he had unconsciously reproduced the exiled statue of Septimius Severus.

On this new day of freedom Gargoum placed the painting on an easel and took out his paintbrush. With careful strokes he added a crowd of wispy figures to the background. He then nodded with satisfaction at the finished product, a portrait of an unfinished nation, its people standing together the evening after the revolution—momentarily blinded by torchlight, waiting for a new vision to pierce the darkness. □

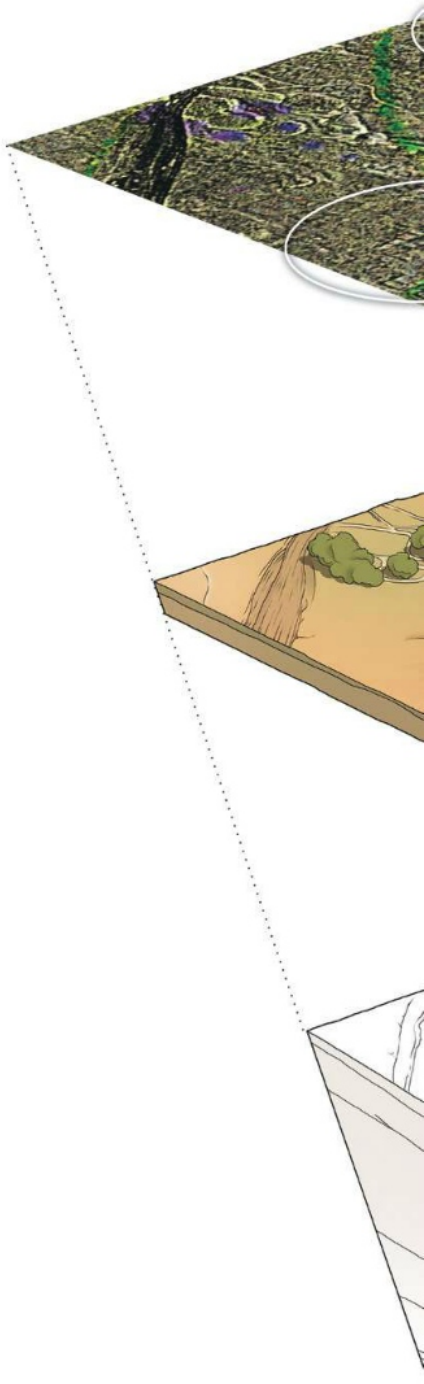
Satellite Archaeology

ARCHAEOLOGY IS A MESSY BUSINESS. Digging holes—in the dirt, in the sand, and in the rain forest—is essential. Now there's a new way to search, with no shovels needed. Some 400 miles up in space, satellites collect images that are used to identify buried landscapes with astonishing precision. Like medical scans that let doctors examine parts of the body they couldn't otherwise see, satellite images help scientists find and map long-lost rivers, roads, and cities, and discern archaeological features in conflict zones too dangerous to visit. "There is much we miss on the ground," emphasizes University of Alabama at Birmingham archaeologist Sarah Parcak, a pioneer in using satellite imagery in Egypt. "We've only discovered a fraction of one percent of archaeological sites all over the world."

Parcak is nudging that fraction up. Through "thousands of hours" of trial and error she has perceived what the human eye can't. Hard-won successes have taught her what works: combining and processing images so she can peer into the infrared part of the light spectrum, which is invisible to the naked eye. The images allow her to detect subtle surface changes caused by objects like mud bricks a foot or less underground. In 2011, relying on infrared satellite pictures, Parcak and her team identified 17 potential buried pyramids, some 3,000 settlements, and 1,000 tombs across Egypt. At the 3,000-year-old city of Tanis, once a capital in the Nile Delta, she found evidence of hundreds of dwellings. "Above ground, you can't see anything," she says. "It's a silty mound with brown, muddy earth covering everything." After a few days of processing and peering at the images, "this amazing map popped out," she recalls.

Using laborious, low-tech excavation, it might have taken a century to assemble a similar city plan. But old-fashioned digging is exactly what's needed to confirm these high-tech finds. A French team has made a start, excavating a single Tanis house. When it comes to archaeology, distance provides crucial perspective, but there's no substitute for being up close.

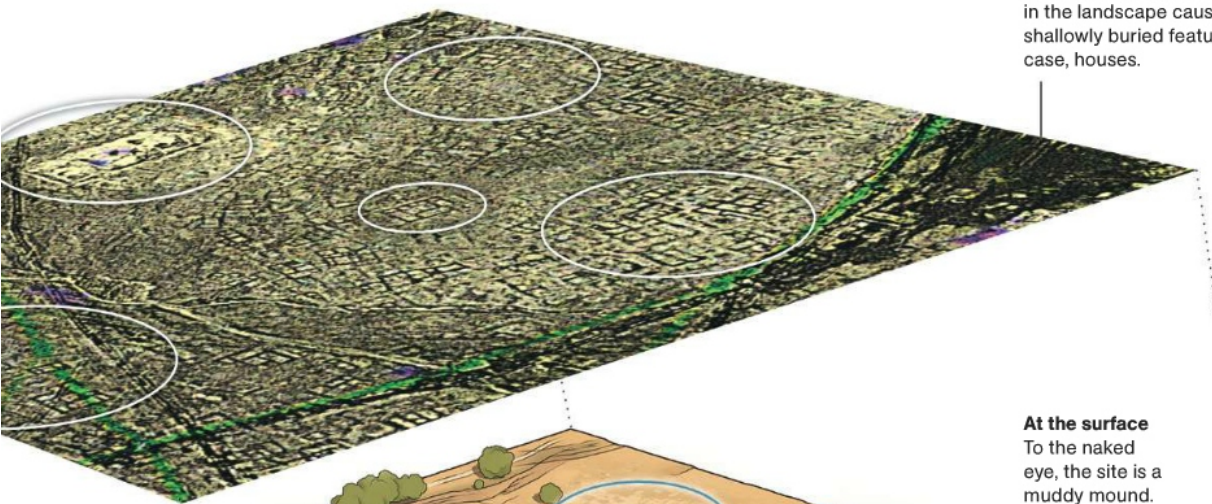
—Hannah Bloch



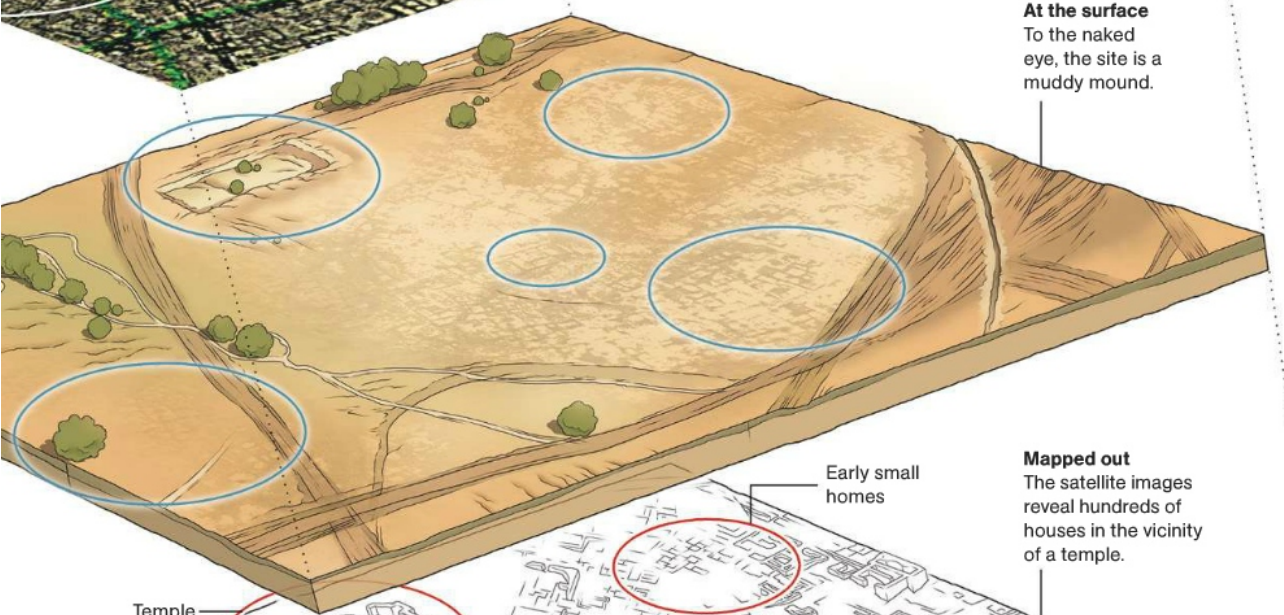
GRAPHICS: 5W INFOGRAPHICS. SOURCES: SARAH PARCAK AND GREGORY MUMFORD, UNIVERSITY OF ALABAMA AT BIRMINGHAM; DIGITALGLOBE

PEERING INTO EGYPT

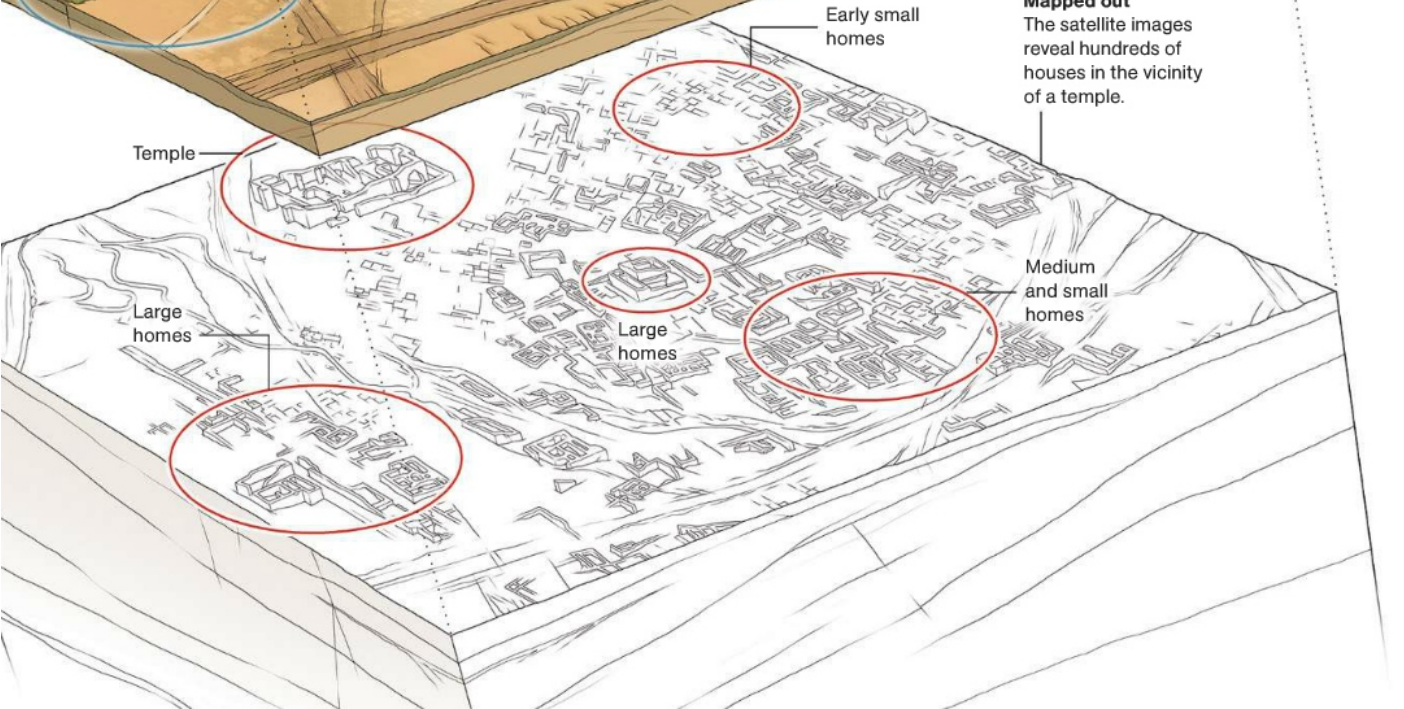
The town Tanis, seen from space
A computer program combines two satellite images into a high-res picture that reveals subtle changes in the landscape caused by shallowly buried features—in this case, houses.



At the surface
To the naked eye, the site is a muddy mound.



Mapped out
The satellite images reveal hundreds of houses in the vicinity of a temple.



By Pat Walters Photograph by Marco Grob

Crisis Mapper

PATRICK MEIER was sitting in his Medford, Massachusetts, apartment when the January 2010 earthquake struck Haiti. The 35-year-old Tufts Ph.D. candidate was soon assisting quake victims—without even leaving home. Opening his laptop, he mobilized hundreds of volunteers to scrape data points from tweets, text messages, UN reports, and more to build a constantly updated online map. His efforts guided citizens, aid workers, and the U.S. Coast Guard; experts say the map likely saved hundreds of lives. Meier, a Swiss citizen who grew up in Africa, now maps crises all over the world.

You caught flak from the UN after the situation in Haiti. Why?
Some UN agencies struggled with their response and were slow to mobilize. Meanwhile, a large team of volunteers in snowy Boston mapped the impact of the earthquake in near real time, providing professionals with the most up-to-date information available.

How did you get into mapping?
When I was 12, the first Gulf War broke out. I had a big map of the Middle East and started physically mapping the updates with crayons and pens and markers.

What have you and your team tackled so far?
Haiti started it all. A month later there was an earthquake in Chile. Then the floods in Pakistan that summer. Russian fires in July. Floods in Brisbane in January. A major earthquake in Christchurch, New Zealand, that February. Election crisis maps in Egypt, in Tunisia. And the UN asked us to launch a crisis map for Libya.

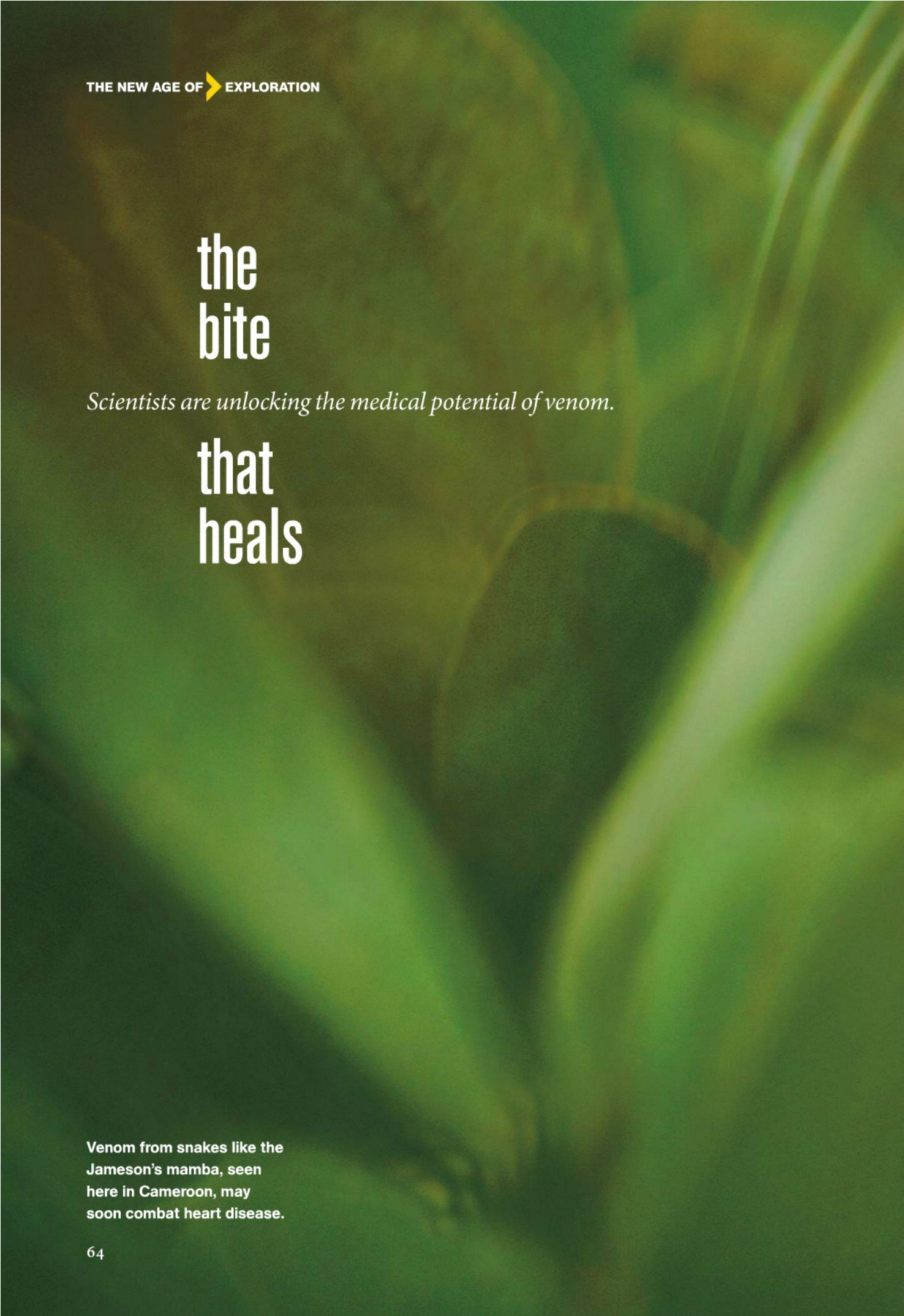
When you map a war zone, do you worry data will fall into the wrong hands?
Definitely. These maps can be used for good or bad. In Libya, you could be the UN using the map to coordinate relief operations, or Qaddafi loyalists using it to find humanitarian convoys to target. So we password-protected that map. You take very real risks when you make a map like this and have to ensure you're not putting people in harm's way.

Is it ever too risky to make such a map?
There's a reason we didn't get involved in Syria. In Syria you have a very sophisticated regime in terms of cyber surveillance, whereas in Libya you didn't. We did the cost-benefit analysis and said no.

Marco Grob's video interview with Patrick Meier can be viewed on our digital editions.

the bite that heals

Scientists are unlocking the medical potential of venom.



Venom from snakes like the Jameson's mamba, seen here in Cameroon, may soon combat heart disease.

Venom expert Zoltan Takacs grabs a yellow-lipped sea krait in Fijian waters. This snake's toxic bite causes paralysis, which keeps its strong and speedy eel prey from escaping.

By Jennifer S. Holland

Photographs by Mattias Klum

Michael decided to go for a swim. He was on vacation with his family in Guerrero, Mexico, and it was hotter than blazes. He grabbed his swimming trunks from where they'd been drying on a chair, slid them on, and jumped into the pool. Instead of cool relief, a burning pain ripped through the back of his thigh. Tearing off his trunks, he leaped naked from the pool, his leg on fire.

Behind him a small, ugly, yellow creature was treading water. He scooped it into a Tupperware container, and the caretaker of the house rushed him to the local Red Cross facility, where doctors immediately identified his attacker: a bark scorpion, *Centruroides sculpturatus,* one of the most venomous species in North America. The fierce pain from a sting is typically followed by what feels like electric shocks racking the body. Occasionally victims die.

Luckily for Michael (who asked me not to give his full name), the bark scorpion is common in the area, and antivenom was readily available. He had an injection and was released a few hours later. In about 30 hours the pain was gone.

What happened next could not have been predicted. For eight years Michael had endured a condition called ankylosing spondylitis, a chronic autoimmune disease of the skeleton, a sort of spinal arthritis. No one knows what triggers it. In the worst cases the spine may fuse, leaving the patient forever stooped and in anguish. "My back hurt every morning, and during bad flare-ups it was so horrible I couldn't even walk," he says.

But days after the scorpion sting, the pain went away, and now, two years later, he remains essentially pain free and off most of his medications. As a doctor himself, Michael is cautious about overstating the role of the scorpion's venom in his remission. Still, he says, "if my pain came back, I'd let that scorpion sting me again."

VENOM—THE STUFF that drips from the fangs and stingers of creatures lurking on the hiking trail or hiding in the cellar or under the woodpile—is nature's most efficient killer. Venom is exquisitely honed to stop a body in its tracks. The complex soup swirls with toxic proteins and

Contributing writer Jennifer S. Holland reported on the Great Barrier Reef in May 2011. NGS Fellow Mattias Klum has shot stories for the magazine on topics from Buddhist monasteries to king cobras.

Bitten by a venomous krait as he slept in his home in rural Vietnam, Can Van Thanh, 20, lies paralyzed in Hanoi's Bach Mai hospital. Takacs's team had antivenom flown in from Thailand, and he recovered.

peptides—short strings of amino acids similar to proteins. The molecules may have different targets and effects, but they work synergistically for the mightiest punch. Some go for the nervous system, paralyzing by blocking messages between nerves and muscle. Some eat away at molecules so that cells and tissues collapse. Venom can kill by clotting blood and stopping the heart or by preventing clotting and triggering a killer bleed.

All venom is multifaceted and multitasking. (The difference between venom and poison is that venom is injected, or dibbled, into victims by way of specialized body parts, and poison is ingested.) Dozens, even hundreds, of toxins can be delivered in a single bite, some with redundant jobs and others with unique ones. In the evolutionary arms race between predator and prey, weapons and defenses are constantly tweaked. Drastically potent concoctions can result: Imagine administering poison to an adversary, then jabbing him with a knife, then finishing him off with a bullet to the head. That's venom at work.

"There could be 20 million venom toxins out there waiting to be screened."

—Zoltan Takacs

The hollow fangs of the Jameson's mamba deliver toxins that can lead to respiratory paralysis—and a person's death within hours.

IRONICALLY, THE PROPERTIES that make venom deadly are also what make it so valuable for medicine. Many venom toxins target the same molecules that need to be controlled to treat diseases. Venom works fast and is highly specific. Its active components—those peptides and proteins, working as toxins and enzymes—target particular molecules, fitting into them like keys into locks. Most medicines work the same way, fitting into and controlling molecular locks to thwart ill effects. It's a challenge to find the toxin that hits only a certain target, but already top medicines for heart disease and diabetes have been derived from venom. New treatments for autoimmune diseases, cancer, and pain could be available within a decade.

"We aren't talking just a few novel drugs but entire classes of drugs," says National Geographic Society Emerging Explorer Zoltan Takacs, a toxinologist and herpetologist. So far, fewer than a thousand toxins have been scrutinized for medicinal value, and a dozen or so major drugs have made it to market. "There could be upwards of 20 million venom toxins out there waiting to be screened," Takacs says. "It's huge. Venom has opened up whole new avenues of pharmacology."

Toxins from venom and poison sources are also giving us a clearer picture of how proteins that control many of the body's crucial cellular functions work. Studies of the deadly poison tetrodotoxin (TTX) from puffer fish, for instance, have revealed intricate details about the way nerve cells communicate.

"We're motivated to look for new compounds to lessen human suffering," Angel Yanagihara of the University of Hawaii told me. "But while doing that, you may uncover things you don't expect." Driven in part out of revenge for a box jellyfish sting she endured 15 years ago, Yanagihara discovered a potential wound-healing agent within the tubules that contain jellyfish venom. "It had nothing to do with the venom itself," she said. "By getting intimate with a noxious animal, I've been informed way beyond my expectations."

More than 100,000 animals have evolved to produce venom, along with the glands to house it and the apparatuses to expel it: snakes, scorpions, spiders, a few lizards, bees, sea creatures such as octopuses, numerous species of fish,

and cone snails. The male duck-billed platypus, which carries venom inside ankle spurs, is one of the few venomous mammals. Venom and its components emerged independently, again and again, in different animal groups. The composition of the venom of a single snake species varies from place to place and between adults and their young. An individual snake's venom may even change with its diet.

Although evolution has been fine-tuning these compounds for more than a hundred million years, venom's molecular architecture has been in place much longer. Nature repurposes key molecules from around the body—the blood, brain, digestive tract, and elsewhere—to serve animals for predation or protection. "It makes sense for nature to steal the scaffolds already in place," Takacs says. "To make a toxin to wreck the nervous system, it's most efficient to take a template from the brain that already works in that system, make some tiny changes, and there you have it: Now it's a toxin."

Not all venom kills, of course—bees have it as a nonlethal defense, and the male platypus uses it to show rival males who's boss during mating season. But mostly it's for killing, or at least immobilizing, an animal's next meal. Humans are often accidental victims. The World Health Organization estimates that every year some five million bites kill 100,000 people, although the actual number is presumed to be much higher. In rural areas of developing countries, where most bites occur, victims may not be able to get treatment or may instead choose traditional therapies and are therefore not counted.

THE 44-YEAR-OLD TAKACS, Hungarian born and with a voice like tires crunching gravel, recently left the University of Chicago to become a toxin entrepreneur. When not at the lab bench, he can be found wrangling puff adders in South Sudan, sampling kraits in Vietnam, and milking Gaboon vipers in Congo. His goal is to collect blueprints for "toxin libraries" that could eventually hold the venom toxins of every animal on Earth.

His quest also takes him out to sea. From afar, the tiny tree-lined coral island of Mabualau, about eight miles east of Fiji's main island, Viti Levu, seems a tropical paradise. Up close, thousands of squawking red-footed boobies, frigates, and gulls clog the trees and sky. Their waste turns the shallow water into a fetid white soup whose stench somehow infiltrates the back of my throat. Before we've even anchored our tiny boat, Takacs hops over the side and wades ashore.

Yellow-lipped sea kraits, smooth-scaled silver-blue snakes with zebra stripes, thrive here, essing along the sandy bottom. The land-and-sea-going snakes, which need air to breathe, ascend the island's rough coral and limestone banks. They coil up under shells and foliage to digest their food and, every few months, shed their skins.

The kraits feed almost exclusively on eels, and their neurotoxic venom has evolved accordingly. The eels are big and strong and have sharp teeth, and it's hard to pry them out of their burrows. "The snake needs a potent and fast venom aimed at vital body parts," Takacs says, "so it can get the meal with low risk of injury to itself." Snake venom and the eel's defenses have been in an evolutionary one-upmanship for ages, he says.

The reefs also harbor venomous anemones,

By a campfire in Cameroon, Takacs takes tissue samples from a rhinoceros viper he wrangled from the forest floor. "This very moment is why I'm roughing it in the rain forest for weeks," Takacs says.

blue-ring octopuses, and a host of toxin-spewing fish about which little is known. And cone snails. Lovely as jewels, each of the more than 600 *Conus* species concocts a unique and wicked brew, some strong enough to kill a person with a single shot. (No matter how pretty it looks, never put a cone snail in your pocket.)

After a shallow dive, Takacs strolls along the water's edge holding treasure: a sea krait wriggling in one glove and a fist-size cone snail in the other. "The best the sea has to offer," he grins. "I have hundreds of toxins in my hands." The cone snail's shell is a gorgeous mosaic of brown paint-daubs on white. After I admire his finds, Takacs drops the snail into a seawater-filled container for later examination. Snakes are his first priority.

Always equipped with a sampling kit, Takacs sets up a basic field lab on the boat: lidded containers, tubes filled with preservatives, syringes and needles, a pair of snippers for tissue sampling, a camera for documenting each animal's patterns, and a big black glove. Sea kraits are quite passive, so the chances of getting bitten are almost nil. But Takacs wears the glove anyway. He's allergic to venom, which would cause him anaphylactic shock in addition to its usual paralyzing effects. He's also allergic to antivenom, made with serum from horses, so it's extraordinary that he's survived a total of six snakebites.

I help by holding the snake's tail, belly scales up. Takacs grips the biting end, stretches the snake to its length, and runs a finger down the body, feeling for the heart. When he locates it, pulsing against the skin about a third of the way down, he carefully inserts a needle and draws blood. He also clips off a fragment of tail tissue and shoots a few photos before setting the snake back in the water and watching it swim away.

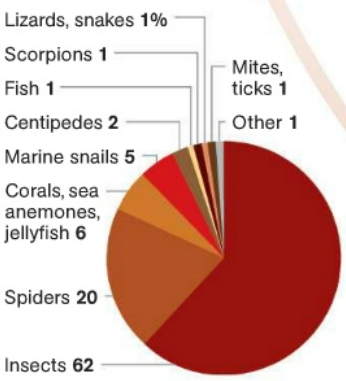
Takacs processes numerous snakes this way during our days on the water. And anytime we encounter local fishermen, he motors up to ask about their sea snake sightings, hoping to hear of other species in the area. "If you see the one with the yellow and black bands," he says, "would you let me know?" Indeed, one day he was summoned to the dock, where a slender-necked sea snake awaited in a bucket. Takacs is known to have engaged entire villages to look for snakes.

In Fiji, and wherever else he collects venomous animals, Takacs is adding to his venom library. Meanwhile, in the lab he teases out variations in the makeup of toxins between species, within species, and even within populations. He also investigates what makes animals resistant to their own venom—information that could help yield better venom-derived therapeutic drugs.

I was surprised that Takacs wasn't milking the venom of the sea kraits, but he explained

Untapped bounty

A single animal's venom can contain hundreds of different toxins that immobilize, harm, or kill. Because the toxins target body functions selectively, they're ideal for developing drugs. Only a fraction have been studied.



100,000
VENOMOUS ANIMALS*

20,000,000
ESTIMATED TOXINS

> **10,000**
KNOWN TO SCIENCE

> **1,000**
STUDIED IN DEPTH

*Conservative estimates for major groups of venomous animals.
**Numbers are approximate because classifications vary.

that DNA underpins his work. Venom itself can offer important information, but when you have tissue, Takacs says, "you can take it home and extract the blueprint for the entire animal—including most of its toxins." Each toxin is expressed by a gene, and genes can be copied and manipulated. "We can make bucketloads at a time, and then we have the luxury of being able to modify the toxins any way we want, and screen quickly to see which version has the most promising effects."

At the University of Chicago, Takacs co-invented Designer Toxins, a system that allows researchers to make variations of nature's originals by recombining toxins and comparing therapeutic values. Designer Toxins encompasses the millions of years of evolutionary wisdom preserved in venoms. This makes it possible to create vast numbers of variants (more than a million so far), potentially streamlining efforts to develop drugs. "We're mining the molecular biodiversity in nature," Takacs says.

VENOM-BASED CURES aren't a new idea. They show up, for example, in Sanskrit texts from the second century A.D., and around 67 B.C. Mithradates VI of Pontus, an enemy of Rome who dabbled in toxicology, was supposedly saved twice on the battlefield by shamans who administered steppe viper venom to his wounds. (Crystallized venom from the snakes is now a medical export from Azerbaijan.) Cobra venom, applied for centuries in traditional Chinese and Indian medicine, was introduced to the West in the 1830s as a homeopathic pain remedy. John Henry Clarke's *Materia Medica,* published around 1900, describes the venom as alleviating many ills, even those caused by venom. "We should always endeavour to use the same drug to cure as produced the symptoms," the author wrote. Clinical applications of carefully diluted cobra venom included "Angina pectoris. Asthma. Dysmenia. Hay-fever. Headache. Heart, affections of. Œsophagus, spasmodic stricture of. Ovaries, affections of. Plague…Throat, sore." But be careful, it was noted: "The curative dose [is] just within the limit of the pathogenetic dose." Walking such a fine line, physicians of old likely hastened patients' deaths as often as—or more often than—they prolonged their lives.

The science of transforming venoms into cures took off in the 1960s, when an English clinician named Hugh Alistair Reid suggested that the venom of the Malayan pit viper might be used against deep-vein thrombosis. He'd discovered that one of the snake's toxins, a protein called ancrod, saps a fibrous protein from the blood, preventing clotting. Arvin, a clot-busting

THE PRODUCTS OF VENOM**

10-15 diagnostics

Snake venom toxins act on the molecules that control blood clotting and muscle contraction.

RUSSELL'S VIPER
dRVVT

TEST: Measures blood-clotting time, which is longer in people with the lupus anticoagulant.

VENOM: Disrupts clotting and attacks kidneys, muscles, and nerves. Often fatal in humans.

10-20 medicines

These treat pain, diabetes, and major cardiovascular diseases. Most come from snakes.

GILA MONSTER
Exenatide

DRUG: Treats type 2 diabetes by stimulating the pancreas to secrete insulin.

VENOM: Causes severe pain, swelling, nausea, hypotension, and shock in humans.

1 cosmetic

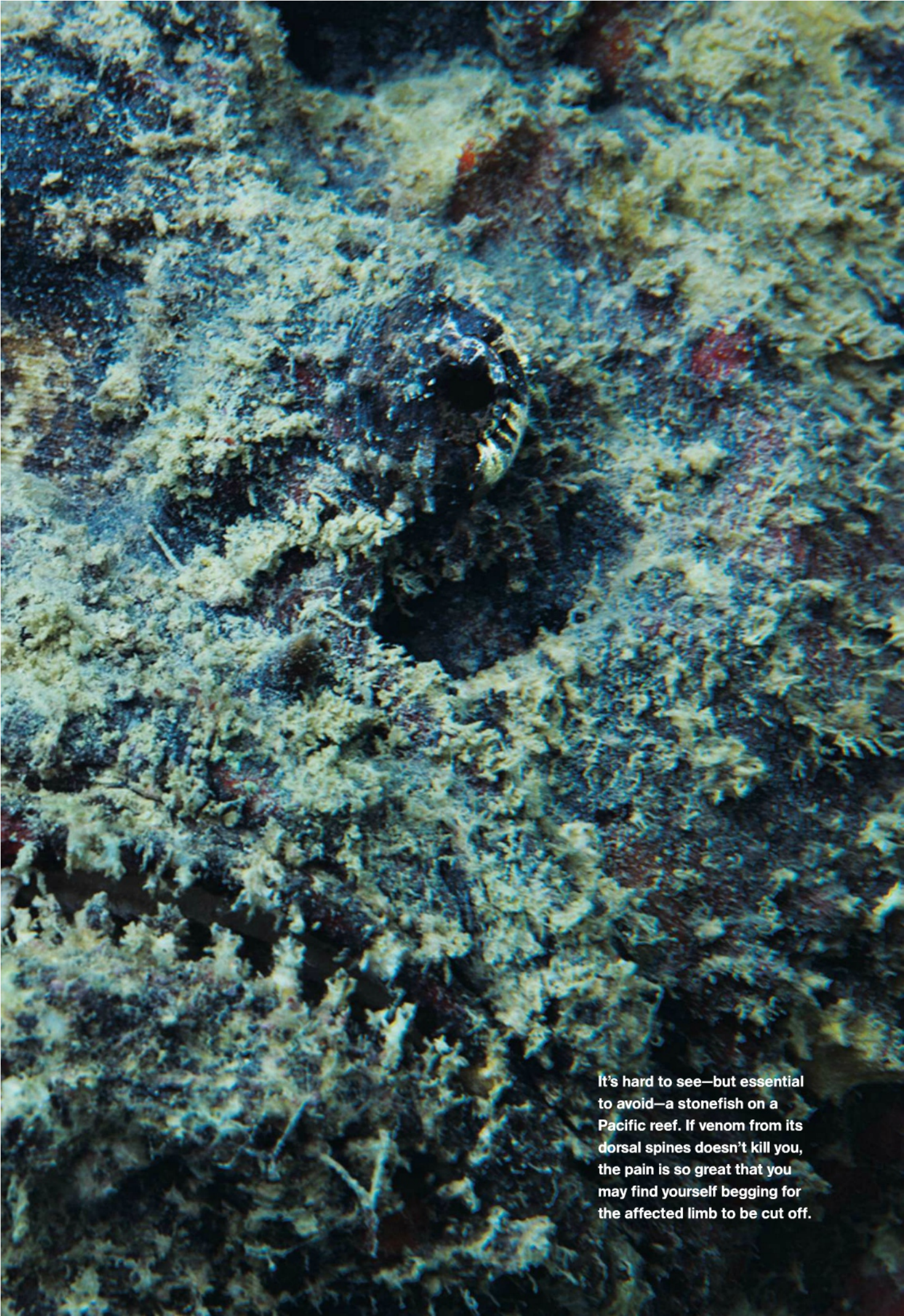
A wrinkle treatment—a snake's answer to Botox—is the only one of its kind.

TEMPLE PIT VIPER
Syn-Ake

CREAM: Sold to smooth wrinkles by blocking nerve signals that cause muscles to contract.

VENOM: Contains unique toxins that target receptors responsible for muscle contraction.

GRAPHIC: LAWSON PARKER, NGM STAFF. SOURCE: ZOLTAN TAKACS



It's hard to see—but essential to avoid—a stonefish on a Pacific reef. If venom from its dorsal spines doesn't kill you, the pain is so great that you may find yourself begging for the affected limb to be cut off.

drug derived from pit viper venom, reached clinics in Europe in 1968. Today Arvin has been replaced by other viper venom anticoagulants.

The Brazilian pit viper's venom led to the development in the 1970s of a class of drugs called ACE inhibitors, now widely used against hypertension. Researchers began by asking why Brazilian banana plantation workers bitten by these snakes collapsed with crashing blood pressure. The researchers then teased out the key pressure-lowering component in the venom. But drug-company managers needed convincing that what comes from snake fangs would save human lives. And you can't just put venom in a pill and hand it to patients, so the useful component of the venom had to be modified at the molecular level—resized and tinkered with to survive the harsh effects of the human digestive system. Eventually a synthetic version made it to human trials, and in 1975 the first oral drug for hypertension, captopril, was approved for use. The ACE inhibitor class of drugs pioneered by captopril now treats tens of millions worldwide, with multibillion-dollar sales.

THE MOLECULAR GIFTS of toxic animals offer hope in the fight against a host of debilitating diseases. Heart patients owe gratitude to the Eastern green mamba, a deadly African tree snake whose venom impairs its victim's nerves and blood circulation. Researchers at the Mayo Clinic fused a key peptide from the venom with a peptide from cells in the lining of human blood vessels to make cenderitide, the subject of clinical trials. It is intended not only to lower blood pressure and reduce fibrosis (the growth of excess connective tissue) in a failing heart but also to shield the kidneys from an overload of salt and water. "That's the beauty of this drug," says Mayo cardiovascular researcher John Burnett.

Venom-based cures aren't new. They show up in Sanskrit texts from the second century.

This cobra, known to spit its venom, is one of numerous snakes farmed in concrete bunkers in Le Mat Village, Hanoi. Cobras in Vietnam and many other snakes are traded within Southeast Asia for consumption.

"It's designed to cover both things." The closely related black mamba, a snake whose open mouth resembles a coffin and whose venom can quickly put you in one, holds a toxin with huge potential to be a powerful new painkiller.

Gila monsters, pebbly-skinned lizards found in the deserts of the U.S. Southwest, eat as few as three big meals a year (storing fat in their tails for the long wait), but their blood sugar remains stable. In 1992 an endocrinologist named John Eng at the Bronx/James J. Peters VA Medical Center in New York identified a component in Gila venom that controls blood sugar and even reduces appetite. Exenatide, a drug derived from the venom in their saliva, works like a natural hormone, stimulating cells to deal with sugar overload but remaining inactive when sugar levels are normal. It even helps diabetics produce their own insulin and lose weight. With almost 25 million people suffering from type 2 diabetes in the U.S. alone, the Gila monster is nothing short of a medical superhero.

Venomous mammals, though rare, are in the game. The current drug for ischemic stroke victims works only if administered within three hours. A drug based on an anticoagulant toxin in the saliva of the vampire bat is now in clinical trials and would extend the time to nine hours. Even some arthropods are skittering down the venom-to-medicine track. Recall Michael's run-in with the scorpion in Mexico. Takacs, in what may be his first Designer Toxins breakthrough, is investigating a novel toxin fused from the venoms of three different scorpion species that selectively blocks immune T cells, implicated in numerous autoimmune diseases. Several drug companies are also pursuing this lead.

Meanwhile, a neurotoxin from the venom of the giant deathstalker scorpion has been found to attach to the surface of brain cancer cells. The overwhelming reason tumors come back is that surgeons can't reliably distinguish good cells from bad at the growths' edges. Magnetic resonance imaging—the best available diagnostic tool—doesn't detect masses smaller than about a billion cells. This means surgeons have to find the boundaries between tumors and healthy tissue "purely by visual and textural cues," says James Olson of the Fred Hutchinson Cancer Research Center in Seattle, Washington. "It's a very imperfect science. Glioma cells weave into normal tissue, and pieces sometimes get left behind."

Doctors who treat glioma, the most common form of brain cancer, created a "molecular flashlight" by marking chlorotoxin with a near-infrared dye. On the very first trial, Olson says, the "tumor paint," as he calls the scorpion-derived marker, "lit up the cancer beautifully. We were literally jumping up and down because we knew what incredible potential this had." The paint reveals masses with as few as 200 tumor cells. "You can truly see the tumor almost cell by cell," Olson says. "This will let surgeons get more cancer out, maybe even 100 percent." Human trials on the dyed toxin will start later this year, and if tests go well, the paint could be used for prostate, colorectal, lung, breast, pancreatic,

Snakes, snake eggs, and lizards infuse rice wine in bottles at a restaurant in Le Mat Village. Locals say that drinking these concoctions eases pain, keeps organs healthy, and boosts virility.

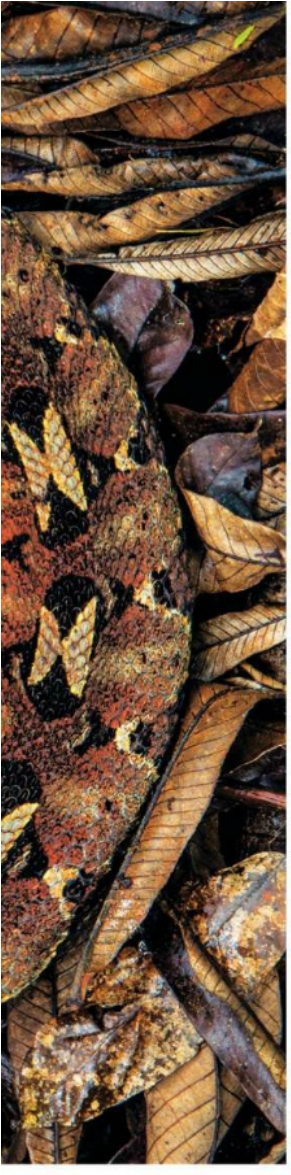
and skin cancers, as well as glioma, potentially saving or prolonging millions of lives every year.

No drugs based on scorpion toxins have yet been approved, but these toxins represent a versatile chemical arsenal. One may be a cancer foe, others the basis of cardiac, painkilling, antiseizure, and antimalarial drugs. There's even a possible pesticide among them.

THE CONE SNAIL lacks the menacing air of a scorpion, but as I'd learned with Takacs in Fiji, there's a beast in this beauty. Cone snails have no jaws and no claws. "They have only a very precarious tether for grabbing their prey," says Baldomero Olivera, a *Conus* expert at the University of Utah. "So they compensate by having 50 or more venom components working on different levels." The fish-eating species *Conus purpurascens,* one of Olivera's favorites, uses its extendable, venom-loaded proboscis to essentially Taser a fish, immobilizing it in an instant. That gives time for multiple toxins in the venom to disperse and destroy muscle activity.

Being stung by a cone snail, Olivera says, "is like being bitten by a cobra and eating fugu at the same time." (The fugu's TTX is more than a thousand times deadlier to humans than cyanide.) Cone snails, Olivera says, "are like little drug companies that have engineered their own compounds to suit their needs." Conotoxins in snail venom shut down nerve cell processes—which, it turns out, is an effective way to mask pain in people with late-stage cancer. Snail venom peptides called conantokins, which have exceptionally precise molecular targets, are being tested with some success against epileptic seizures. Both conotoxins and conantokins may be protective

Society Grant Zoltan Takacs's toxinology research was funded in part by your Society membership.



You can't just put venom in a pill. The useful component must be modified at the molecular level.

The element of surprise gives this rhino viper in Cameroon an edge over prey. Quick-kill venom finishes the job. Vipers provide valuable toxins, including those used in drugs for hypertension and heart disease and to control bleeding during surgery.

against Alzheimer's and Parkinson's diseases, depression, and even nicotine addiction. So far, five compounds from the snails have made it to human trials, and one morphine-like pain drug, ziconotide, has resulted. Ziconotide is chemically identical to the component the snail makes.

Another sea creature, the sun anemone, has toxic tentacles that stun its prey before wrapping the victim—often a small fish or a shrimp—into its maw for dinner. But the anemone's stinging cells, called nematocysts, fire off venom that contains peptides useful in treating human autoimmune diseases. In the 1990s a team led by physiologist George Chandy of the University of California, Irvine revealed that one of the peptides blocks the activity of a protein that promotes inflammation. The researchers reconfigured the peptide into one they called ShK-186. Now Kineta, a biotechnology company based in Seattle, is developing this against autoimmune diseases. What makes it so promising, says Shawn Iadonato, Kineta's chief scientific officer, is how specifically it binds to diseased cells. "Our drug is very specialized to target the cells at work in these diseases. Other meds are problematic because they have many side effects and leave patients vulnerable to infection and cancer."

The sun anemone holds promise for treating diseases such as multiple sclerosis, rheumatoid arthritis, psoriasis, and lupus. "It will let patients experience a more normal life," Iadonato says. "It just takes a long time, even when you have a breakthrough discovery. There are so many side avenues to take to make sure there are no unintended effects. There's a lot of unraveling and putting back together to get it just right."

ADVANCES IN FIELDS such as molecular biology continue to give scientists better ways to understand venoms and their targets. While drug companies once relied on luck, screening thousands of compounds for a particular effect, today's higher tech options, such as Designer Toxins, give sharper detail, making it easier to shape medicinal keys to fit specific molecular locks. This means that a spray to stop bleeding derived from the venom of the brown snake will likely soon be saving lives at accident scenes, and a peptide from mambas will someday be treating heart failure.

The medical potential of venom, Zoltan Takacs never tires of saying, is "mind-blowing." But we're at risk of losing the sources of that potential faster than we can identify their toxin gifts. Snakes, in adapting to fill varied niches all over the globe, have evolved a stunning range of venomous compounds. But snakes are in decline, as are so many other animals. The oceans too are under pressure; their changing chemistry could wipe out promising sources of venom, from cone snails to octopuses.

"In conserving biodiversity worldwide," Takacs says, "we should better appreciate molecular biodiversity." That would put the molecules in nature's deadliest potions high on the agenda when conservation decisions are made. And that would be a lifesaver. □

Nomads by necessity, the Kyrgyz move their herds across the Wakhan—a panhandle of alpine valleys and high mountains in northeastern Afghanistan. A young shepherd wears a makeshift face mask to weather the extreme cold of winter.

STRANDED ON THE ROOF OF THE WORLD

Afghanistan's Kyrgyz nomads survive in one of the most remote, high-altitude, bewitching landscapes on Earth. It's a heavenly life—and a living hell.

BY MICHAEL FINKEL
PHOTOGRAPHS BY MATTHIEU PALEY

In this high, barren valley called Little Pamir, survival depends on livestock. Red-robed Kyrgyz girls corral sheep for milking, while dung dries atop the walls for use as fuel. The sheep, along with goats, yaks, and camels, provide milk, meat, and wool and even serve as currency: One lamb buys 110 pounds of flour.

Teenager Bibi Zohra will soon exchange her childhood crimson veil for a wife's white headdress. She's marrying a man twice her age and faces a risky future: The mortality rate among Kyrgyz women during childbirth is unmercifully high, some 500 times greater than in the developed world.

The khan dreams of a car.

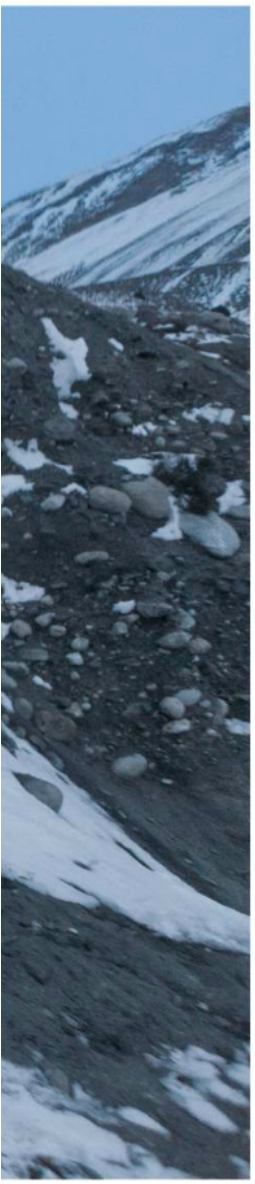
Never mind that there isn't a road. His father, the previous khan, spent his life lobbying for a road. The new khan does the same. A road, he argues, would permit doctors, and their medicines, to easily reach them. Then maybe all the dying would stop. Teachers too could get to them. Also traders. There could be vegetables. And then his people—the Kyrgyz nomads of remote Afghanistan—might have a legitimate chance to thrive. A road is the khan's work. A car is his dream.

"What kind of car?" I ask.

"Whatever car you want to give me," he says. The ends of his mustache curl around a smile.

But for now, with no car and no road, the reality is a yak. The khan is holding one by a rope strung through its nose. Other yaks are standing by. It's moving day; everything the khan owns needs to be tied to the back of a yak. This includes a dozen teapots, a cast-iron stove, a car battery, two solar panels, a yurt, and 43 blankets. His younger brother and a few others are helping. The yaks buck and kick and snort; loading them is as much wrestling as packing.

Moving is what nomads do. For the Kyrgyz of Afghanistan, it's from two to four times a year, depending on the weather and the availability of grass for the animals. They call their homeland Bam-e Dunya, which means "roof of the world." This might sound poetic and beautiful—it is



Kyrgyz men seek shelter in a shepherd's cave during their annual journey from their mountainous homeland to the nearest trading village in Pakistan, an icy, five-day trek. They will barter livestock, wool, and dairy products for everything from tea to television sets.

undeniably beautiful—but it's also an environment at the very cusp of human survivability. Their land consists of two long, glacier-carved valleys, called pamirs, stashed deep within the great mountains of Central Asia. Much of it is above 14,000 feet. The wind is furious; crops are impossible to grow. The temperature can drop below freezing 340 days a year. Many Kyrgyz have never seen a tree.

The valleys are located in a strange, pincer-shaped appendage of land jutting from the northeast corner of Afghanistan. This strip, often referred to as the Wakhan corridor, was a result of the 19th century's so-called Great Game, when the British and Russian Empires fought for influence in Central Asia. The two powers created it, through a series of treaties between 1873 and 1895, as a buffer zone—a sort of geographical shock absorber—preventing tsarist Russia from touching British India. In previous centuries the area was part of the Silk Road connecting China and points west, the route of armies and explorers and missionaries. Marco Polo passed through in the late 1200s.

But communist revolutions—Russia in 1917, China in 1949—eventually sealed the borders. What was once a conduit became a cul-de-sac. Now, in the postcolonial age, the corridor is bordered by Tajikistan to the north, Pakistan to the south, and China to the east. Mainland Afghanistan, to the west, can seem so far away—the corridor is about 200 miles long—that some Kyrgyz refer to it as a foreign country. They feel locked in a distant outpost, encaged by a spiked fence of snowy peaks, lost in the swirl of history and politics and conflict.

To reach the nearest existing road—the road the khan wants extended into Kyrgyz territory—requires at least a three-day journey through the mountains, on a trail where a fall could be deadly. The closest significant town, one with shops and a basic hospital, is an additional day's travel. This intense isolation is the reason the Kyrgyz suffer from a catastrophic death rate. There's no doctor, no health clinic, few medicines. In the harsh environment, even a minor ailment—a sniffle, a headache—can swiftly turn virulent. The death rate for children among Afghan Kyrgyz may be the highest in the world. Less than half live to their fifth birthday. It is not unusual for parents to lose five children, or six, or seven. Women die at an alarming rate while giving birth.

I met one couple, Halcha Khan and Abdul Metalib, who had 11 children. "Every year," said Abdul, "one would die." They died as infants, as toddlers, as little kids. Many likely died from easily treatable diseases. Each was wrapped in

---

Michael Finkel last reported on Nepal's Sky Caves for the magazine. French photographer Matthieu Paley has documented Wakhan's Kyrgyz nomads over eight expeditions—three in winter. His book Pamir *is just out in France and Germany.*

a white shroud and buried in a shallow grave. "That cut me into pieces," said Abdul. To numb the pain, Halcha and Abdul turned to opium. The drug's easy availability has created an epidemic of addiction among the Kyrgyz. Only one of their children, a son, survived to age five. Then he too passed away.

The khan knows about the outside world. He has twice traveled beyond the Wakhan region, and he exchanges news with merchants who venture into Kyrgyz land, trading his animals for goods like cloth, jewelry, opium, sunglasses, saddles, carpets, and lately, cell phones—not for calls (there's no reception) but for playing music and taking pictures.

The khan realizes that the rest of the planet, day by day, is leaving his people behind. The Kyrgyz nomads, with a total population of about 1,100, have only just begun a rudimentary educational system. The khan himself has never learned to read or write. He knows that almost everyone else has access to medical help, that the world is connected by cars and computers. He knows that children aren't supposed to die like this.

It is a lot for a young leader to bear. The khan is only 32 and looks it—even his mustache, with its expressive little Fu Manchu tips, can't mask his boyish appearance. He's diminutive too, no more than five feet seven, and moves with a nervous, jackrabbity energy. He has light brown eyes and ruddy, wind-chapped skin and is partial to

Khairuddin's father hopes that shaving his son's head—and putting the hair in a "clean place," such as a frozen river—will cure the boy's persistent headaches. Although the Kyrgyz are Sunni Muslims, their rituals also reflect other ancient traditions. They believe that evil spirits cause many medical problems.

The Kyrgyz are not gregarious people. They don't laugh much. They own no books, no playing cards, no games.

wearing a fur-lined cap with the earflaps tied overhead. He dresses, like most Kyrgyz men, in an all-black outfit, jacket to pants to shoes. He's not above telling the occasional dirty joke.

His name is Hajji Roshan Khan. He and his wife, Toiluk, have four daughters. The "Hajji" part of his name is an honorific, meaning he's been to Mecca. The Kyrgyz are Sunni Muslims, and in 2008 his father, Abdul Rashid Khan, took him—him alone out of 14 children—to Saudi Arabia. That was the first time he'd left the Wakhan. The other time was last spring, when he traveled to Kabul and met with ministers in the Afghan government, as well as President Hamid Karzai, pleading for funding to build a medical clinic and a couple of schools and, of course, the road.

Though his father was the khan, the position of tribal leader is not hereditary. It must be agreed upon by the elders of the community. When Abdul Rashid Khan died in 2009, it was clear whom he wished to succeed him. That summer, Er Ali Bai, one of the more respected Kyrgyz, invited the leading elders to his camp. A camp is the chief division of Kyrgyz life—three to ten families who migrate together and share the herding of yaks and fat-tailed sheep and long-haired goats.

The Kyrgyz are not poor. Though paper money is almost nonexistent, many camps' herds contain hundreds of valuable animals, including the horses and donkeys used for transportation. The basic unit of Kyrgyz currency is a sheep. A cell phone costs one sheep. A yak costs about 10 sheep. A high-quality horse is 50. The going rate for a bride is 100. The wealthiest families own the ultimate Kyrgyz status symbol—a camel, the two-humped kind, called a Bactrian, that appears perpetually foul tempered.

Er Ali Bai has six camels. He's 57 years old and walks with a pronounced limp, leaning on a metal hiking pole that was given to him by a visitor. When the mood strikes, he's prone to whack somebody playfully—yet painfully—with his pole. He loves to chat on his walkie-talkie. These two-way radios, recently introduced by itinerant traders, have allowed news to be passed from camp to camp, though the resulting information is often as accurate as in the party game telephone. Er Ali Bai is the owner of the only chicken in Kyrgyz country. The chicken, a hen, has one leg. The other was lost to frostbite.

About 40 men arrived at Er Ali Bai's camp to anoint the new khan. They sat outside on blankets, in a large circle. Sheep and goats were slaughtered, the traditional way to begin any Kyrgyz occasion. The hunk of fat around a sheep's tail, boiled until gelatinous and pale yellow, is a great delicacy. They met for more than eight hours. In the end everybody agreed that Hajji Roshan Khan would be the new leader.

They agreed, but this doesn't mean the khan is well liked. In fact, many people have deep misgivings about him. This is not surprising. The Kyrgyz are notoriously fractious and independent

minded. They don't often rally around a leader, says Ted Callahan, an anthropological researcher who lived with the Kyrgyz for more than a year. A Kyrgyz joke goes that if you put three people in a yurt and come back an hour later, you'll find five khans.

Some say the new khan is too young. Or too inexperienced. They say he's an opium smoker. (He insists he's quit.) They say he is not *sangeen,* which means "like a rock," representing the strength and toughness the Kyrgyz look for in a leader. One faction argues that a rival who lives on the other end of the valley should have become khan. Others insist there is no need for a khan anymore; the time of the khans is finished.

The new khan's biggest supporter, though, is Er Ali Bai. Some critics complain that an *aksakal*—a "white beard"—should have been picked. "Yes," Er Ali Bai replies. "There are people with long beards. Goats also have long beards. Should we have selected a goat?" There's no need for concern, he adds. "He will become a great khan."

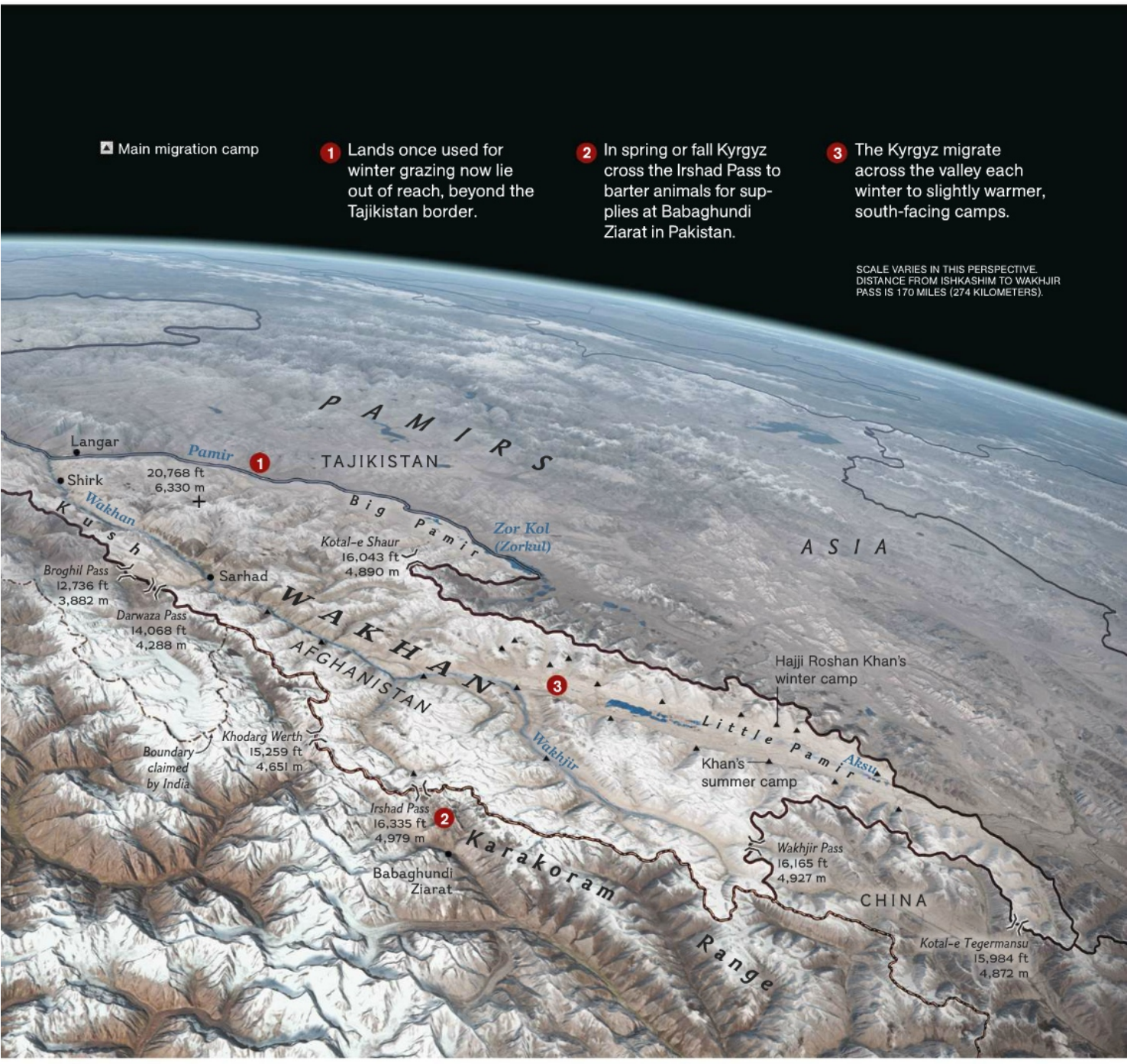
Still, the young khan worries. He's striving to convince his people that he is the right person for this job. And he is working to resolve the tremendous problems the Kyrgyz face as they fight to survive in one of Earth's most unforgiving environments.

On moving day the khan must focus on making sure the loaded yaks arrive at his summer camp. Though it's late June, snow falls, swirling beneath cottage cheese clouds. But the khan can't wait. The grass at his winter camp requires every day of the brief growing season to renew.

The khan and his family live in a gloomy, thick-walled mud hut in winter, and in a yurt the rest of the time. Each Kyrgyz camp follows a relatively simple migration pattern, living on the warmer, south-facing side of the valley in winter, then trekking the five or so miles to the other side in summer. I catch a ride on one of the khan's tamer yaks and join the procession.

The horizon, everywhere you look, is halted by towering chiseled peaks. Here, on the roof of the world, several of Asia's highest ranges meet—the

The Kyrgyz feel locked in a distant outpost, encaged by a spiked fence of snowy peaks, lost in the swirl of history and politics and conflict.



Corridor to Nowhere

A narrow, high-altitude strip of Afghanistan wedged between Tajikistan and Pakistan, the Wakhan corridor was a political creation of the Great Game in the 19th century: Britain paid Afghanistan to annex the land to prevent British India and tsarist Russia from sharing a border. Once part of the Silk Road, the region today is cut off from the world, with most of its borders strictly regulated.

VIRGINIA W. MASON AND BRAD SCRIBER, NGM STAFF. ART: STEPHEN TYSON
SOURCES: U.S. DEPARTMENT OF STATE; MATTHIEU AND MAREILE PALEY

High above the tree line, a winter caravan of traders relies on sure-footed yaks to traverse a treacherous path down to a lower valley. At altitudes above 14,000 feet, winters in the Little Pamir last eight months or more, and snow can fall even in summer.

Whip in mouth, a Kyrgyz man steers his horse in a game of buzkashi, *a competition akin to polo—except a headless goat carcass takes the place of the ball. Buzkashi is the Afghan national sport. The Kyrgyz call it* ulak tartysh, *or "kid grabbing."*

The Kyrgyz are not poor. Their basic currency is sheep. A cell phone costs one sheep. A bride is 100.

Hindu Kush, the Karakoram, the Kunlun—a spot so tangled with mountains it's known as the Pamir Knot. The Wakhan corridor is also the birthplace of rivers flowing both east and west, including the Amu Darya, or "mother river," one of the main waterways of Central Asia.

We reach the banks of the Aksu River. This time of year, with snowmelt accelerating, it's deep and rapid. The khan's loaded yaks plunge in. Two of them lose their footing and begin drifting downstream, carried by the current, noses held above water, eyes wild, the stacks of supplies on their backs getting soaked.

The khan's brother-in-law, Darya Bai, charges into the water on his horse. Gripping the reins in one hand, leaning sideways in his saddle, he grabs a yak's neck and tries to haul it across. For a moment it seems that the yaks, the supplies, and the brother-in-law might all be swept downriver. But they're carried into an oxbow where the water flattens, and the yaks, followed by Darya Bai, soon emerge on the far bank, dripping and shaking.

Then the khan crosses on his horse with his five-year-old daughter, Rabia, her hands clamped around his waist, feet raised to avoid getting wet. His two-year-old, Arizo, rides behind his wife, while his other children, six-year-old Kumush Ai (Silver Moon) and three-year-old Jolshek, share a horse with their uncle.

They reach a grassy area at the mouth of a narrow, glacier-packed side canyon. Goats stare from atop a pointy boulder. The wind—the brutal, unrelenting *bad-e Wakhan*—picks up. Snowflakes hurtle sideways, stinging faces. Loads are dumped from the yaks into a large pile.

The khan's wife and children huddle while the men begin building the yurt, listening to Kyrgyz music on a cell phone—a chanty tune featuring a three-stringed lute called a *komuz*. Constructing a yurt is a jigsaw puzzle feat requiring several hours. When finished, a yurt from the outside seems unimpressive, a sort of lumpy boiled potato, the whole thing covered in dirty white felt that the Kyrgyz make themselves.

The Kyrgyz are not the most gregarious people. They don't laugh much. They own no books, no playing cards, no board games. Their one dance is little more than a gentle waving of a handkerchief. With a single exception—a young boy who filled a notebook with marvelous penciled portraits—I met no one who seemed interested in fine art or drawing. A wedding I attended was shockingly joyless, with the exception of a game of *buzkashi,* a fast and violent sport played on horseback with the headless carcass of a goat as the ball.

Kyrgyz manners could be considered gruff. It's acceptable to walk away in the middle of a conversation. More than once, without asking, a man would thrust his hand into my pocket to see what I kept in there. Or snatch my glasses off my nose to inspect them. The Kyrgyz eat meat by slicing off hunks and stashing the

Kyrgyz herders adore their cell phones, which they acquire by trading and keep charged with solar-powered car batteries. Though useless for communication—cellular service doesn't reach the isolated plateau—the gadgets are used to play music and take photos.

leftovers in a pocket. There's not much singing.

Perhaps this is understandable. This is a place, as the khan says, where "you get old fast." Maybe, when you are always cold, when you watch a half dozen of your children die, some emotion is sandpapered away. Maybe this land is too windy, too remote, too hard. If it doesn't kill you, it damages you; it robs you of a certain channel of joy.

Until you step into a Kyrgyz yurt. Move aside the heavy felt door. And suddenly everything changes. The outside world disappears, and you've walked into a Kyrgyz wonderland. The blankets and carpets and wall hangings and ceiling coverings are all decorated with ornate designs—paisley, flowered, spangled, psychedelic, kaleidoscopic. This is where the family eats and sleeps and escapes, in this ecstatic explosion of color.

In the center of the yurt is either an open fire or an iron stove. There's no wood in Kyrgyz country. Instead they burn yak dung, which actually emits a sweet odor. Always, there is a teapot on the boil. Usually several. Tea is the staple of the Kyrgyz; they drink it with yak milk and salt, and they drink it constantly. "I drink 120 cups a day," Er Ali Bai told me. He probably wasn't exaggerating much.

The Kyrgyz also eat yak-milk yogurt, fizzy and thick, and a hard cheese called *kurut,* which you soften in your mouth for several minutes before chewing. Also unleavened rounds of bread the

The khan knows about the outside world. He realizes that the rest of the planet, day by day, is leaving his people behind.

size of pizzas. Meat is reserved for special gatherings. The closest to a vegetable is a tiny wild onion, no bigger than a pea.

There is one thing more expressive than a Kyrgyz yurt. And that is a Kyrgyz woman. Men dress like they're perpetually on their way to a funeral. Women are Kyrgyz works of art. Atop their heads are tall, cylindrical caps draped with giant head scarves—red for unmarried women, white for married—that flow behind them like superheroes' capes.

They wear long, bright-red dresses, usually with red vests over them. Attached to this vest is an amazing mosaic of bling. Plastic shirt buttons are sewn around the collar by the dozens. There are sun-shaped brass brooches and leather pouches containing verses from the Koran. I spotted coins, keys, seashells, perfume bottles, and eagle claws. One woman had seven nail clippers pinned to her chest. Every movement by a Kyrgyz woman produces a jangling, wind-chimey tone.

Their hair is styled in two or more long braids affixed with silver ornaments. They wear multiple necklaces and at least one ring on every finger except the middle ones, even the thumbs. Bracelets galore. Dangly earrings. One watch is rarely enough—two or three are better. I counted as many as six.

The women perform endless chores—milking the yaks twice a day along with sewing and cooking and cleaning and babysitting. They rarely speak when men are around. I tried, as politely as possible, for half an hour to get one woman to explain why she was wearing three watches. Finally, she answered. "It's nice," she said. I did not exchange a word with the khan's wife, though I lived in their camp for a week.

The majority of women I met had never been more than a few miles from where they were born—their biggest journey was traveling to their husbands' camps after marriage. "We are not that sort of stupid people who let women go anywhere they want," explained the khan. All Kyrgyz marriages are arranged, usually when a woman is in her teens. Both the khan and his wife were 15 when they wed.

One of the few women who chatted with me was a free-spirited widow named Bas Bibi. She guessed she was 70 years old. She'd had five sons and two daughters. They all died. "Men never milk animals," she said. "Or wash clothes. Or cook meals. If women were not here, nobody could live a single day!"

Abdul Metalib and his wife, Halcha Khan, started smoking opium after losing a son; each of their 11 children died before age six. Many Kyrgyz say they use the drug as an escape from pain, since they have no doctors or medicine. As many as 50 percent of the nomads may be addicts.

Throughout their history, the Kyrgyz have always rejected the idea of being controlled by a government or serving as vassals to a king. "We are untamed humans," one Kyrgyz man proudly informed me. Their origins are murky. The Kyrgyz are first mentioned in a Chinese document from the second century A.D. and are thought to have come from the Altay Mountains of what is now Siberia and Mongolia.

The name Kyrgyz, according to anthropologist Nazif Shahrani, is possibly a compound of *kyrk,* meaning "40," and *kyz,* meaning "girl"—an etymology the Kyrgyz take to signify "descendants of 40 maidens."

Never a large tribe, the Afghan Kyrgyz roamed Central Asia for centuries—they were infamous for raiding Silk Road caravans—and by the 1700s had begun using the valleys where they now live as summertime grazing grounds. They'd leave to warmer areas when winter descended, avoiding the long, cruel season they must now endure. But then came the great empires, and their Great Game, followed by the spread of communism. By 1950 all the borders were shut and, says Ted Callahan, the Kyrgyz "by default became Afghan citizens," trapped year-round in the Wakhan corridor. In 1978 a military coup upended Kabul, and there was the looming threat of a Soviet invasion. The Kyrgyz feared that Afghanistan too would become communist. Nearly all the Kyrgyz, some 1,300 people, elected to follow the khan at the time—Rahman Kul—and escape across the Hindu Kush into Pakistan.

Disease killed a hundred during their first summer as refugees. Though Rahman Kul urged his people to remain in Pakistan—the Soviet soldiers in Afghanistan, he warned, would ban their religion and crush their freedoms—many Kyrgyz were disillusioned with his leadership. They missed their life on the roof of the world.

Soon there was a split. Abdul Rashid Khan,

Blanket-draped yaks hunker down outside a young couple's yurt on the eve of a summer trading journey. Made of interlaced poles covered with felt, these portable homes are packed up and reassembled for seasonal migration. Wooden doors are imported to the treeless plateau from lower altitudes.

Kyrgyz girls slide plastic jugs back to their family's camp after chopping a hole in a frozen spring to fetch water. Men handle herding and trading; much of the hard labor of daily life falls to the females.

The khan admits he's imagined moving, living a more normal life. Perhaps there comes a time to give up on your homeland.

the current khan's father, led about 300 Kyrgyz back into Afghanistan, including Er Ali Bai. This is when Abdul Rashid was designated as khan. The Soviet troops, when they arrived, treated the Kyrgyz kindly, and over the past three decades, the population has grown to the current level of more than a thousand, even with the high death rate.

Those who remained in Pakistan with Rahman Kul eventually resettled in eastern Turkey, where they now live in a village of cookie-cutter row houses, with electricity and cable TV and paved roads and cars. They were assigned Turkish last names. They like their video games, their flush toilets. They have been tamed.

During his recent trip to Kabul, the khan's appendix swelled. He went to a hospital and had it surgically removed. Not a big deal. But it rattled him deeply. "If that had happened here," he says, "I would have died. Lots of people die here because of that."

Sometimes, among the Kyrgyz of Afghanistan—often at night, sipping tea in the warmth of a yurt—the question is asked: Would they be better off someplace else? Though the Kyrgyz valleys are free from the fighting that afflicts the rest of Afghanistan, living here can feel like a constant roll of the dice. The idea of leaving again, this time for good, seems always in the back of their minds. Some mention relocating to the former Soviet republic of Kyrgyzstan, where the same language is spoken and they have ethnic ties. But it is unclear whether this idea is really an option.

Even the young khan is not immune to such thoughts. He admits, in moments of candor, that he's imagined moving with his family, settling in a town somewhere in mainland Afghanistan. Living a more normal life. Perhaps, the khan thinks, there comes a time to give up on your homeland.

On the khan's second day at his summer camp, important news arrives. Two government-employed engineers from Kabul have arrived at the end of the present road to survey routes that would extend the road through the mountains into Kyrgyz territory. The khan must greet them, a trip that will require three days of dawn-to-dark horse riding.

A girl carries a pair of lambs to be reunited with their mothers for the night. On especially cold days the vulnerable young animals are kept warm in cloth bags hung in the herders' huts. The Kyrgyz complain that their winters are brutal. But would they want to call any other place home?

From a metal trunk in his yurt, the khan's wife pulls out his finest clothes—a wool pin-striped suit, tall leather riding boots, a black-and-white scarf. His excitement is palpable. Maybe his people's fortunes are about to change. "Everybody will be happy," he says. His wife hands him a dark-blue bottle of cologne and a small brass container of *naswar,* the potent Afghan chewing tobacco. He climbs on his horse. There's "a 100 percent chance," he says, that the road will be built. He snaps his crop on the horse's flank.

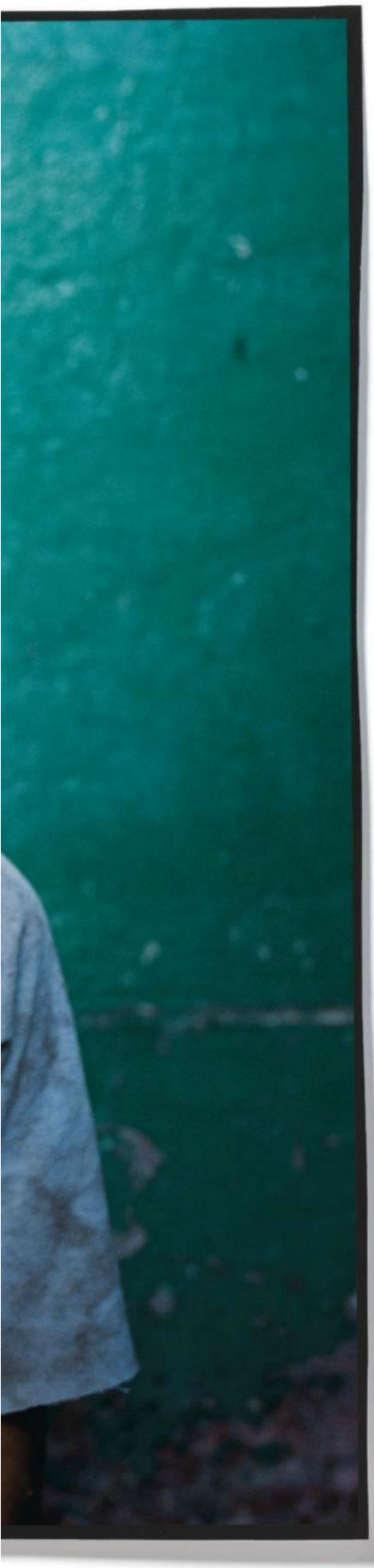
I watch him gallop down the valley. His confidence seems at odds with reality. In a

poverty-stricken country with widespread disorder, constructing a road that would cost millions of dollars—possibly hundreds of millions—to help a thousand or so people makes little sense. "Nobody is building a road," agrees Er Ali Bai. In the time of the khan's father, Er Ali Bai recalls, engineers also came by, also said they were surveying for a road. Nothing ever happened.

A road, Er Ali Bai points out, would bring its own problems. Yes, it would provide easy access for doctors and teachers. But also for tourists. And armies. The outside world would stream in—and that, Er Ali Bai says, might cause the younger generation to crave a less challenging life. To want to leave even more. "There are people who think riding in cars will make them happy," says Er Ali Bai. "But this place is very beautiful. We live with love and family. This is the most peaceful place in the world."

The views here are sweeping, and for a long time I see the khan riding away, his horse kicking up reddish brown dust. It's a gorgeous day, warm and as close to windless as it gets. I envision the khan at the wheel of a car, windows down, hair tousled, driving past the mountain spires gleaming white in the sun. But I also understand that if the khan is able to do this, if his work is rewarded, the road built, his dream fulfilled, then the time of the traditional Kyrgyz nomad—the tribe of rugged and proud people who have survived for almost 2,000 years—will have come to an end. □

In Chicome, Mozambique, Orlando's soccer ball is made from plastic bags twined with tree bark.



Joy is Round

On fields throughout Africa, plastic bags, old clothes, and shredded tires transform into magic orbs—soccer balls.

Photographs by

Jessica Hilltout

Miles from the main roads, in rural Africa, soccer balls bounce unevenly.

Playing fields are arid, lush, weedy, sandy—any flattish space will do. Goalposts might be made of gathered mahogany or driftwood. Some feet are bare, others shod in fraying sneakers, boots, rubber sandals. Yet children kick and chase handmade, lopsided balls with skill and abandon, competing for pride and joy—for the sheer pleasure of playing.

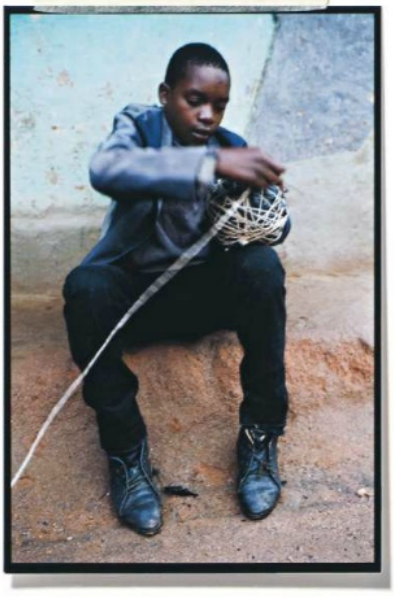
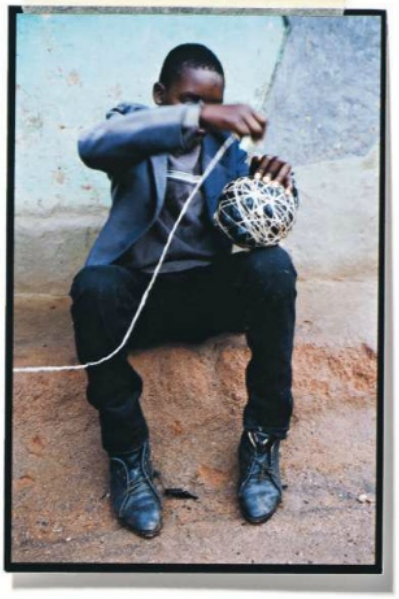
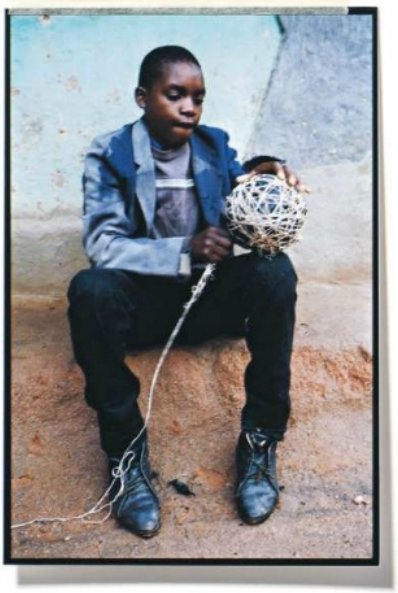
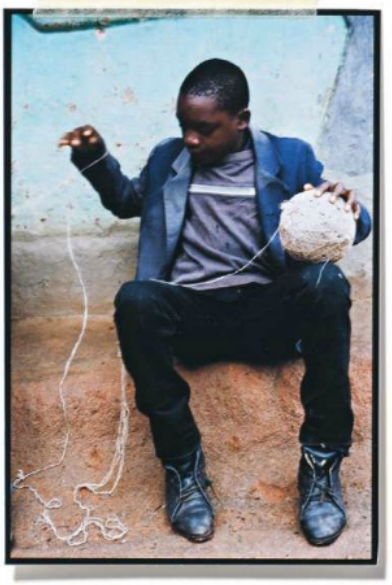
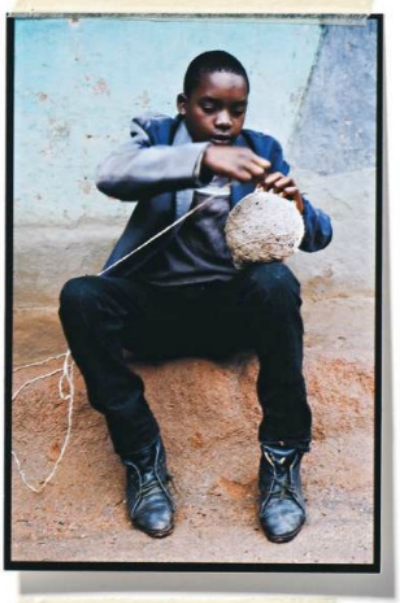
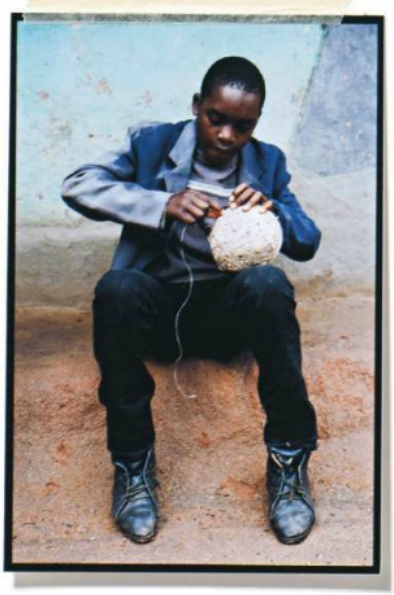
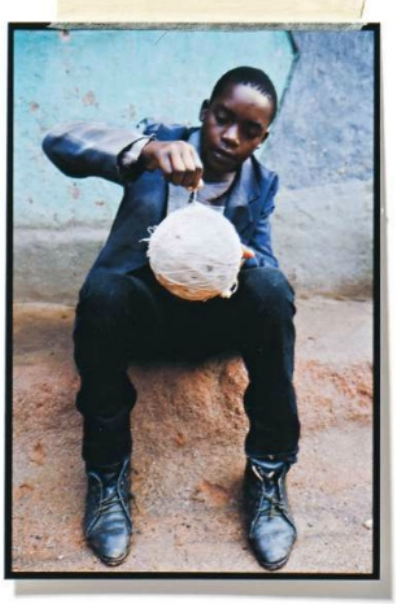
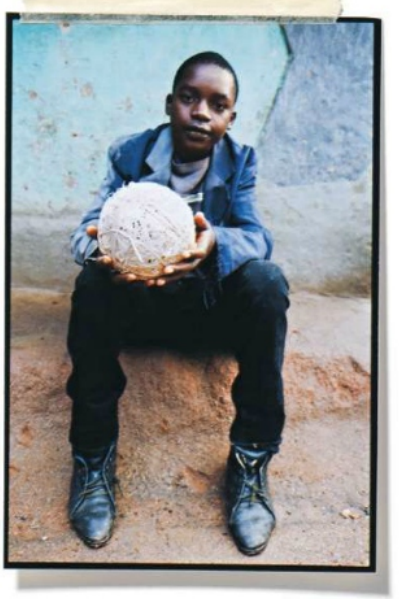
Has the "beautiful game" ever been lovelier?

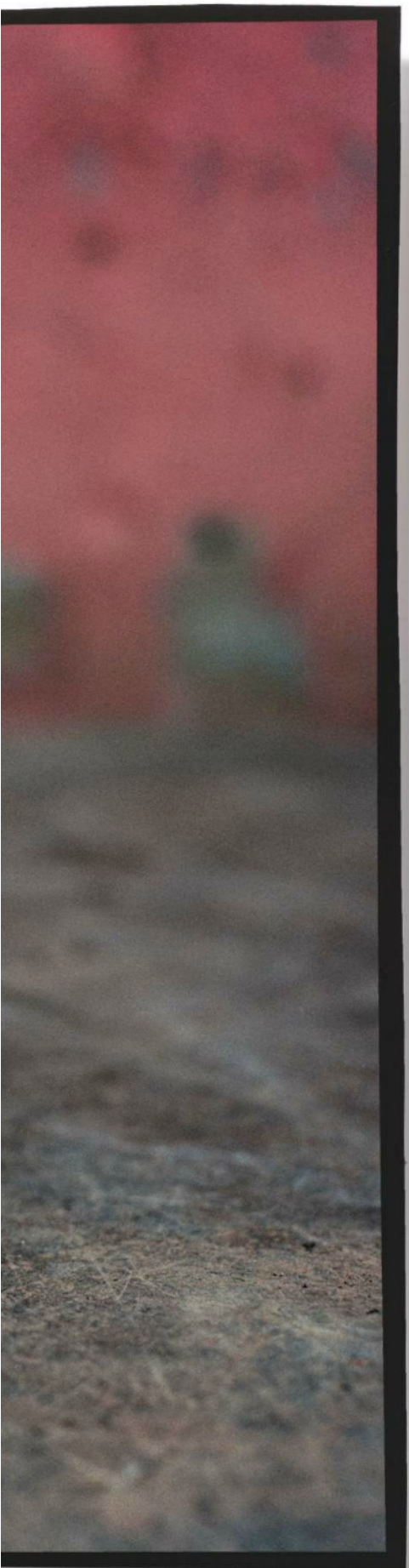
Jessica Hilltout doesn't think so. In 2010, when the World Cup came to Africa for the first time, the Belgium-based photographer set out to see what soccer looked like far from the bright lights and big stadiums. What she found—over seven months, ten countries, and 12,500 miles—was a grassroots game where passion trumped poverty, a do-it-yourself ethic prospered, and one ball could "bring happiness to an entire village."

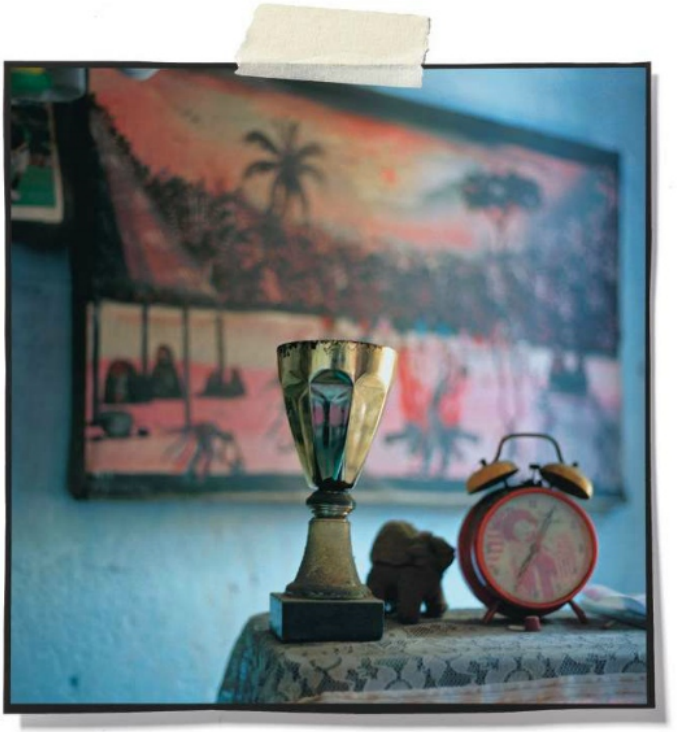
In the 30-odd soccer-loving localities she visited, in countries from South Africa to Ivory Coast, balls are spun into being with whatever's at hand: rag or sock, tire or bark, plastic bag or inflated condom. Each might last days or months on a field of gravel or hard earth. Wherever Hilltout went, she swapped the store-bought balls she kept in her car for these "ingenious little jewels," most of which were made by children.

The story of soccer in Africa is a long one, says Peter Alegi, author and history professor at Michigan State University. In 1862, a year before the game's international rules were codified in London, matches were played in Cape Town and Port Elizabeth. The game vined its way across the continent via European colonialism, *(Continued on page 122)*

Before his school day starts in Gondola, Mozambique, 13-year-old Isaac demonstrates his ballmaking technique. Using yarn, worn fabric, and an inflated condom, he can make a soccer ball in about 30 minutes.





Bound with rope, plastic bags equal a ball (left) in Bibiani, Ghana. A golden plastic trophy (above) is proudly displayed in a home in Lomé, Togo. In urban Kumasi, Ghana, factory-made balls abound. Michael Sarkodie holds one on the Anokye Stars field. Sani Pollux started the club in 1956. "Soccer keeps them out of trouble," he says of the 150 boys he coaches.

Handwritten journals helped Jessica Hilltout explain and document her project. At the top of this entry is a

FOR 600 PLAYERS...

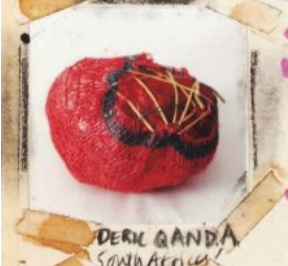
BALLS, BOOTS, SHIN PADS, SOCKS...

SINOTHANDO SOUTH AFRICA

SOUTH AFRICA

SOUTH AFRICA

AIHELELE SOUTH AFRICA



DERIK GANDA SOUTH AFRICA

SIPHELELE SOUTH AFRICA.

WE HAVE SOMETHING TO SAY,
WE HAVE A STRONG MESSAGE ABOUT FOOTBALL AND AFRICA.
WE KNOW OUR MESSAGE WILL BE HEARD IN TIME
WHEN IT IS WE WILL GO BACK TO HELP THOSE THAT MADE AMEN POSSIBLE
TO ENABLE THEM TO KEEP PLAYING THE GAME THEY LOVE

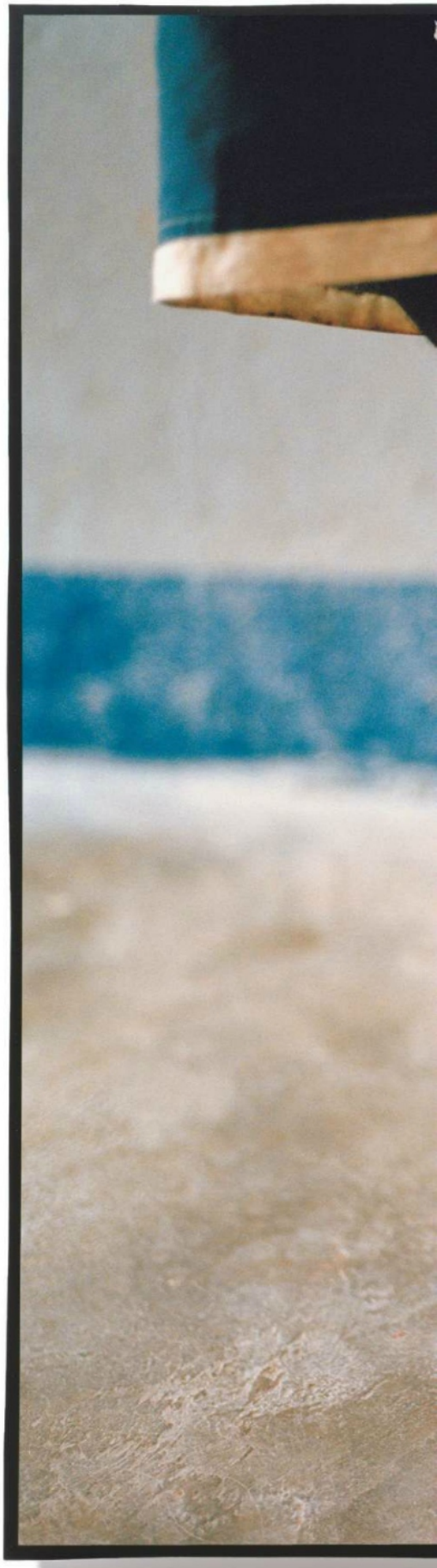
20 TEAMS or CLUBS = 600 PLAYERS

ANOKYE STARS FC - GHANA	± 150 players
GREAT EAGLES FC - GHANA	± 80 players
ETOILE BRILLANTE D'EBURNIE - IVORY COAST	20 players
PACASSE TEAMS (2) - MOZAMBIQUE	40 players
CHICOME TEAMS (2) - MOZAMBIQUE	40 players
GREENGRASS VILLAGE TEAMS (3) - GHANA	80 players
HAPPY SOKO CLUB - MALAWI	30 players
LET'S GO TEAM - TOGO	40 players
SIN-YIRRI TEAM - BURKINA FASO	20 players
CATTLE HERDERS - BURKINA FASO	20 players
PORT BOUET TEAM - IVORY COAST	30 players
EPC HELENE ESCOLA - MOZAMBIQUE	—
GONDOLA / NHAMBONDA TEAM - MOZAMBIQUE	30 players
JOAO GABRIEL RUBBER ROBBER - MALAWI	1 Player
DOCTEUR DES BALLONS - TOGO	1( )
AYI PHOTOGRAPHER - TOGO	1( )
ASIBI SHOE FACTORY - GHANA	1( )
BIBIANI (HASSAN + HARDY) - GHANA	2 Players
BUNTI DICKO'S VILLAGE - BURKINA FASO	20 players

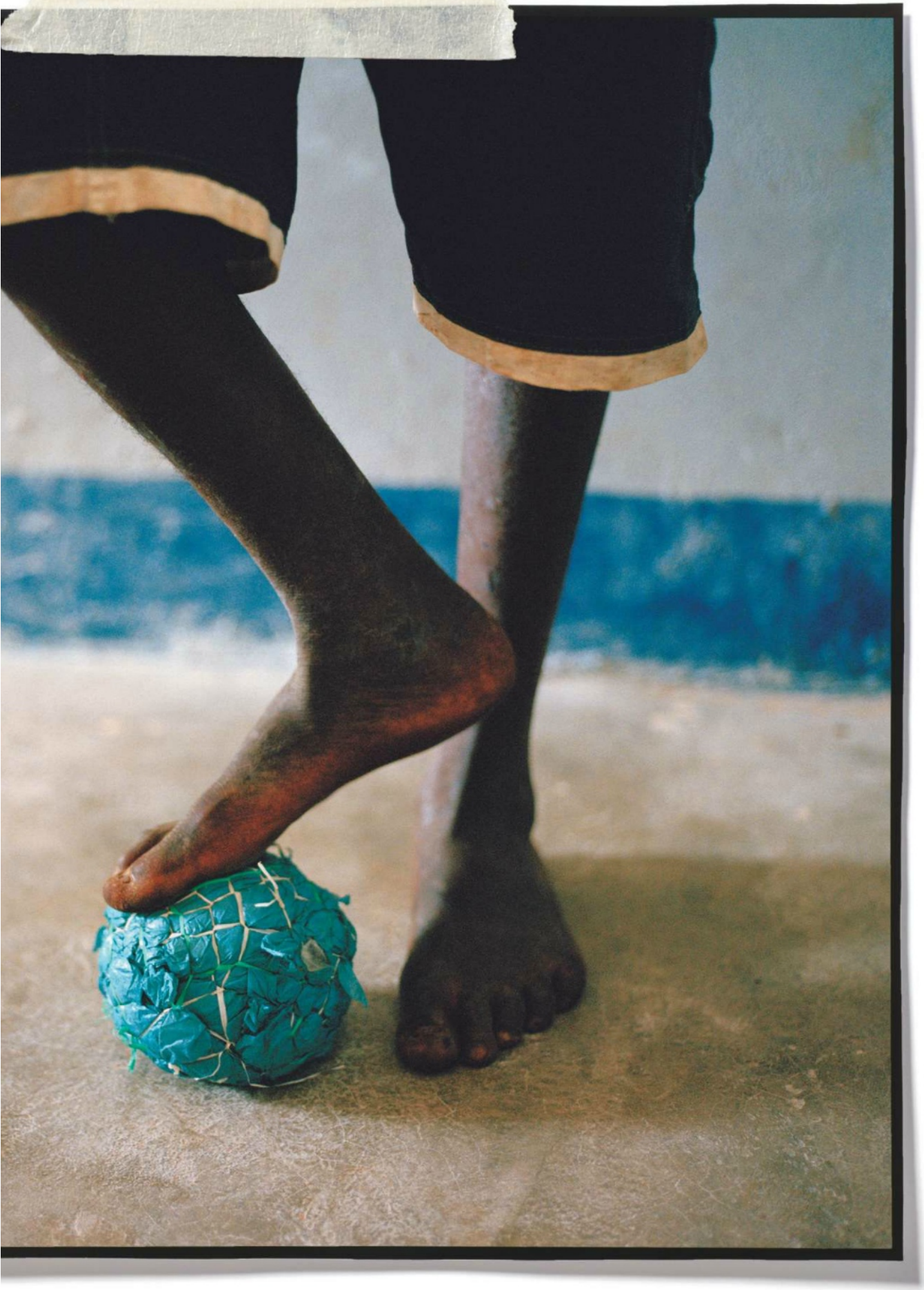
All the ones with pink dots are places that are seriously involved in football. The money would be wisely spent.

TOTAL = 600 Players

promise she made to herself to return to Africa with new balls and equipment. A year later she did just that.



Carlos Ribeiro stands on a ball he made from rubbish (right) in Inharrime, Mozambique, where boys learn to make balls at age five. Young Thandile keeps his head in the game (top) for South Africa's Cape Town Stars. Mensah Dosseh bought his soccer shoes (above) at a market in Abidjan, Ivory Coast, then adorned them with the name of his favorite team—Barcelona.



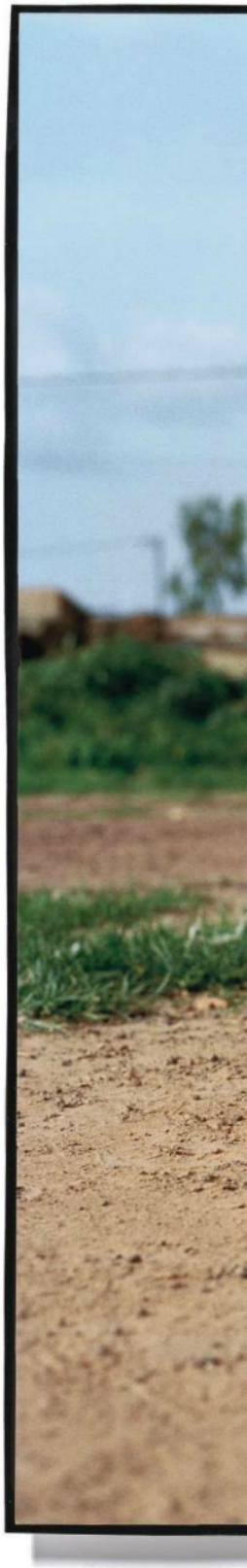
(Continued from page 114) spread by soldiers and traders, railway lines and missionary schools. Locals quickly adopted it, then imprinted it with their own regional playing styles. It has flourished here ever since. "If anything can be salvaged from the harsh and unequal encounter between Western and African cultures," writes soccer historian David Goldblatt, "then the list must include the arrival of football."

In the past century African players have changed the face of the global game. As countries have urbanized and declared independence, they've joined the International Federation of Association Football (FIFA) and competed well at the World Cup level. Today thousands of African soccer "academies"—some licensed, some not—recruit boys from cities, towns, and remote places, where playing conditions breed toughness, daring, ball control, and improvisation. A select few go on to play in Europe or join national squads; the vast majority don't make it to the pro level.

But that's not the point of the "raw game" played in the hinterlands, says Abubakari Abdul-Ganiyu, a teacher who oversees youth clubs in Tamale, Ghana. "It is the passion of everyone here," he says. "It pleases us and unifies us. The moment there is a match, we throw away all our quarrels." He adds: "Most clubs don't allow boys to play if they don't go to school. We're trying our best to mold young people and make them responsible in society. So for us, soccer is also a tool for hope."

Hilltout agrees. "Soccer is the most democratic sport in the world," she says. "It's accessible to everyone. The people I met do so much with so little. It's easy to look at a tattered ball and feel sadness. My aim was to make you look at the ball and feel uplifted." *—Jeremy Berlin*

More of photographer Jessica Hilltout's work can be seen at jessicahilltout.com *and in her book,* Amen: Grassroots Football.

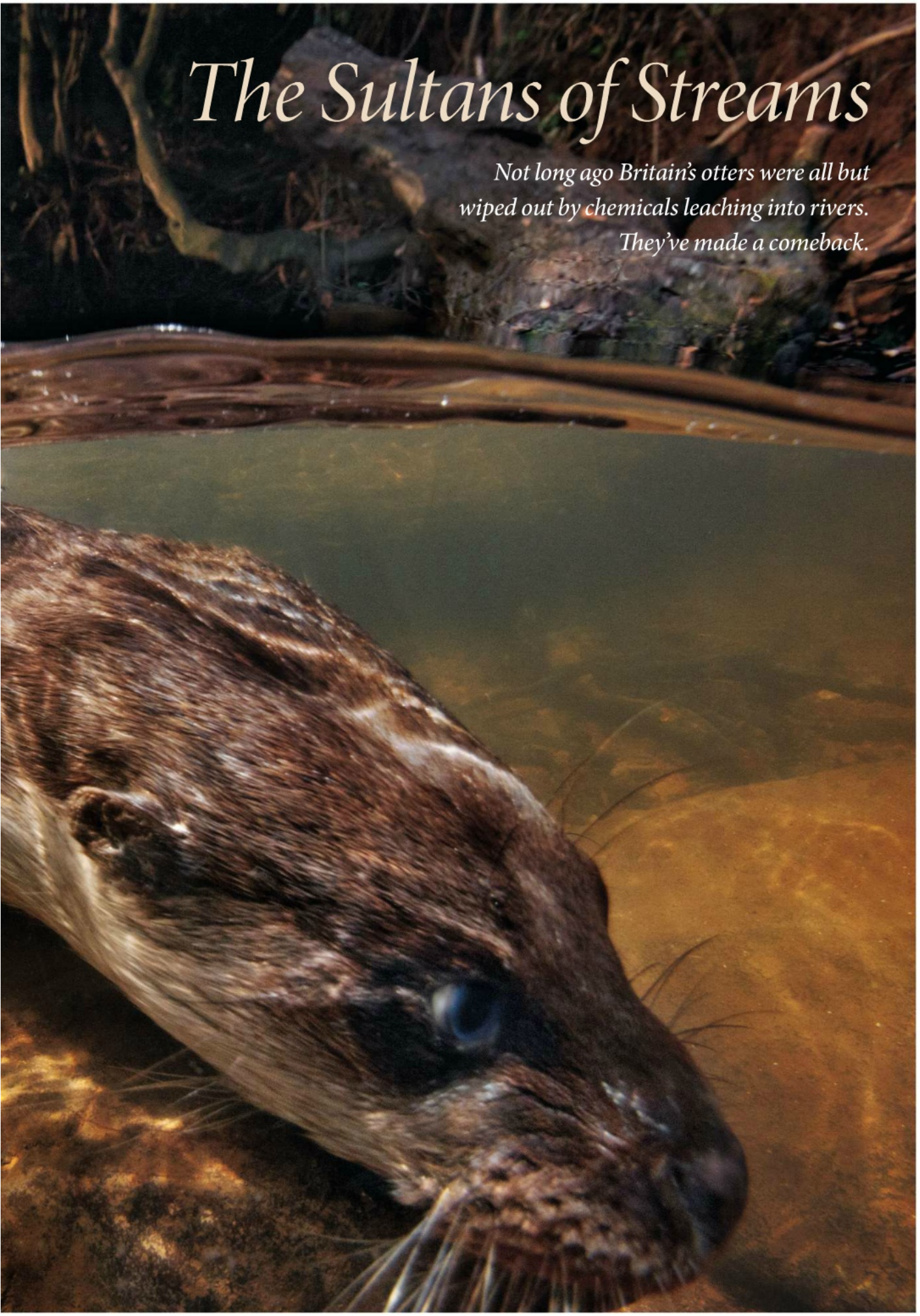


Players in Ouagadougou, Burkina Faso, aim the ball at this *petit poto,* or mini-goal—two and a half feet high and wide. "You don't need to be rich or have a manicured pitch to play soccer," says historian Peter Alegi. "You just need a flat space and a makeshift ball."

A female searches for prey in a river in western England. An otter's eyes become more convex underwater, the better to see fish.

The Sultans of Streams

Not long ago Britain's otters were all but wiped out by chemicals leaching into rivers. They've made a comeback.



By Adam Nicolson

Photographs by
Charlie Hamilton James

I am hunting otters with Charlie, the two of us in wet suits, our bodies submerged, level with the sea. The tankers are sliding in toward the piers and gas flares of the oil terminal at Sullom Voe. This is Shetland, at the far northern tip of the British Isles. Helicopters from the North Sea rigs clatter into the airport behind us, but they seem a world away.

Charlie Hamilton James has been photographing British otters ever since he fell in love with them during their decline some decades ago, and has followed them obsessively as they have made their way back to health. He knows how to stalk an otter and has told me the technique: Your face as low in the water as it can go, neoprene helmet well down, and quiet—no whispering (gestures better), your breath quiet, your fins quiet, and if you're lucky, you might get near one.

Tiny flatfish move away from our feet in the shallows. Two seals come to inspect us, goggle-eyes, fat submarine bodies. But the otter we thought was here, which an hour ago was a distant three-part silhouette in the binoculars, a disc of a head, the arched back, a long strong tail, or as it is beautifully called, the rudder, is nowhere to be seen. Male otters display like this, with the rudder prominent, in a kind of swaggering signal to other otters that this is their territory. We look and wait while the cold seeps into the bones.

Then Charlie taps me and points at some weedy rocks just inshore. A mass of damp bladder wrack and serrated wrack, a tangle of ochre and khaki. An anonymous coastline. Nothing there. Then I see him. A mound of soft flesh just above the tide. The drying chocolate-colored pelt, which for so many centuries was hunted for its warmth and thickness, has been combed into peaks by the otter's own movement through the water. He is asleep, more than a yard long, perhaps 15 or 20 pounds in weight, the luscious and glossily furred animal lying back in his nook away from the wind. His belly and pale chin are upward, his rucked pelt thick up around him in folds, the toes of his front paws open, the webs visible between them, his four legs in the air. Is he snoring? I can't quite tell. His long whiskers, which are there to detect movement in the water, pressure sensors responding to the pulse from a quivering fish tail ahead, extend out from his muzzle, as wide on each side as the width of his head. His head is an antennae cluster, his whole body a seek-search-and-destroy organism. Not

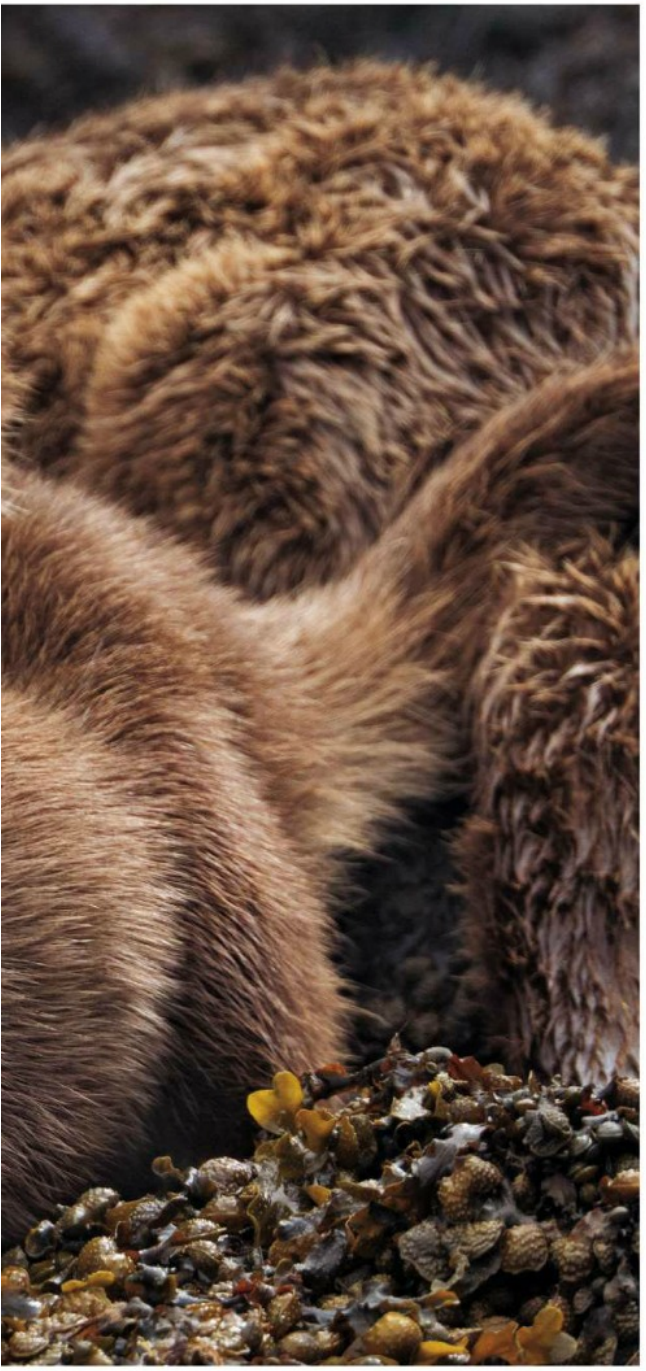
Adam Nicolson lives at Sissinghurst, Kent, where he expects otters will be seen again. Charlie Hamilton James, who lives in western England, has been fascinated by otters since he was a child.

NGM MAPS

Nostrils flaring, a young male surfaces after a dive for bullheads in the reedy shallows of a Dorset river. No mammal melts so easily into its water world.

In the Shetland Islands a mother and two male cubs listen intently to the clicking of the photographer's camera. The nose of the cub at right had a recent encounter with a crab. Adults don't live as pairs, and males play no part in raising the young.

Cubs play-fight as their mother dries off in a weedy nook in the Shetlands. With no blubber, otters must clean and dry their fur between dives to keep its insulating properties. In their second year, otters go their separate ways.



now though. Here is a sultan on his divan. The laid-back body oozes dominance, the perfect at-homeness of a top predator, the rollover luxuriance of animal ease.

THERE IS ONLY ONE SPECIES of otter in the British Isles, *Lutra lutra,* the Eurasian otter, which is just as much at home in the sea as in fresh water. The only difference is that sea-living otters must wash in freshwater pools frequently to keep their coats free of salt and insulatingly warm. It is a creature that has been familiar to human beings for many millennia. It was probably one of the most widespread mammals in the Old World. The word "otter" was part of the language spoken by early Europeans thousands of years ago. Otters were a constant presence in the river valleys where people settled, and were often trapped, pursued by hounds, and disliked by fishermen. The otter's face, or "mask," was favored for the most elegant of sporrans, those furry purses kilted Scotsmen like to wear around their waists. "All men that keep Otter dogs ought to have a Pension from the Commonwealth," the great Izaak Walton wrote in *The Compleat Angler* in 1653. But the otter hunters never destroyed the otters, and the otters did not eat all the fish. A form of man-otter-fish balance persisted through the centuries.

Estimates of historical numbers are difficult if not impossible. The otters' ability to disappear, to melt into the water, to slip into the background as if they had never been there meant that they became the all-present but hidden secret of the landscape. Elusiveness was their calling card.

The first signs of disaster, in the 1950s, were scarcely understood for what they were. At the same moment, the peregrine falcons began a precipitous decline. Problems developed in the 1940s with use of insecticides, fungicides, organochlorides, and the all-purpose wildlife killer DDT. These chemicals were used in industry to treat wool and cloth, get rid of insects and fungi, preserve seeds, and to dip scabby sheep. From the 1950s to 1970s organochlorines and PCBs, used as coolants in

electrical transformers and stabilizers in paint and many other products, led to widespread pollution of waterways. Such persistent substances do not break down and disappear when they are out in the environment. They accumulate as they move up the food chain: a tiny amount absorbed by a microbe, more by a microscopic shrimp, still more in a small fish or eel, yet more in the grand predatory fish, and most of all in the top-predator body of the otter. What should have been a system for delivering goodness had turned into an escalator for poison.

More than a decade of ignorance and inaction went by. Only in the mid-1960s were organochlorides banned in England as a sheep dip, largely because they had been identified as the reason that the populations of peregrine falcons and many other birds and mammals were declining. They remained legal as a seed dressing until 1975 (and for some specialist uses until 1992). And even when banned, they were replaced by organophosphates and synthetic pyrethroids that were also highly damaging to ecosystems. Only in 2006 was a final ban placed on the substances, which had been diminishing the life of English rivers for more than half a century.

The otter population collapsed, perhaps through lack of fish, perhaps through individual otters being poisoned. A national survey in the late 1970s found that only 6 percent of 2,940 English riverside sites had any evidence of them. Across large swaths of England, there were no otters at all. The rivers had died, and the otters had died with them. Only in the far west and on the Welsh borders had the animals survived. Otters went extinct in the Netherlands, Belgium, and Luxembourg. Most of France, Germany, and Italy were otterless. They were rare in the bulk of Norway and Sweden. Numbers stayed high in Scotland and eastern Europe, but elsewhere it seemed possible that the otter would disappear entirely.

Agonizingly slowly, as the chemical bans took effect, the population started to climb back toward health. By 1984-86, the proportion of English riverbanks occupied by otters had risen to 10 percent, and to 59 percent by 2009-10. Gradually otters pushed back eastward across the country, so that now only the London area and some northern industrial cities remain otter-free.

But the revival remains fragile. A small population in Kent has disappeared, perhaps because of road traffic killings. Deaths from cars are thought in some counties to be keeping pace with annual cub production. Low-level diffuse pollution characterizes nearly every stream, and far too much water is extracted for them to be in good shape. The pelts of otters killed by cars have been found to contain traces of the anti-inflammatories ibuprofen and diclofenac. In some areas where otters have returned in numbers, there is a steep increase in the wounds inflicted otter on otter, probably as a result of competition for territory.

FRAGILE, BUT NOT ALL BLEAK. Charlie and I went to a river in Dorset in the south of England. In the middle of a small market town, in the middle of the day, with the people crossing the footbridges over the river between the supermarket and the town park, taking their dogs for a walk or the children for a romp, we watched for four hours a family of otters, a mother and two nearly full-grown cubs, fishing and playing on the river. People stopped and chatted about "their" otters, amazed that we were amazed to see them there. They have been a regular sight in the town for the past couple of years.

But look closely and you can't help but be amazed at the high-performance intensity of those sleek liquid bodies nuzzling and shoving at the bankside vegetation and coming up spattered with the green speckles of duckweed, all three members of the family often sliding close up against each other, intensely sociable, fishing and hunting in the riverbed for bullheads and even minnows. It is a fierce and busy, high-turnover life: The repeated dive down often coming up with prey in their teeth, and then tossing it to the molars at the back, when one after another the otters chomp away with the upturned head and delighted air of a man in a restaurant who has just won the lottery and is now chewing in triumph on the juiciest of steaks. □

Fish in mouth, a young otter rises from kelp beds in the Shetlands. Using his forefeet to move stones, he's been snacking on sea scorpions, butterfish, rockling, and eelpouts.

Otters have powerful webbed feet and a body shaped for agility underwater, but none of it would be any use without their exceptionally warm, dense fur. Once threatened with extinction, they are now back as the glamour kings of England's rivers.

NATIONAL GEOGRAPHIC ON TV

Killing Lincoln

John Wilkes Booth carried out one of American history's most notorious crimes. His 1865 assassination of Abraham Lincoln is now the subject of a film from executive producer Ridley Scott. Travel back in time this month with the National Geographic Channel to meet the murderer—as well as his many accomplices—and relive the events surrounding that infamous day at Ford's Theatre.

LECTURE

SAVAGE MOUNTAIN Gerlinde Kaltenbrunner was the first woman to summit all 14 of the world's highest peaks without using supplemental oxygen. Join her in Los Angeles and Seattle for tales of her many high-altitude feats, including climbing K2. See nglive.org.

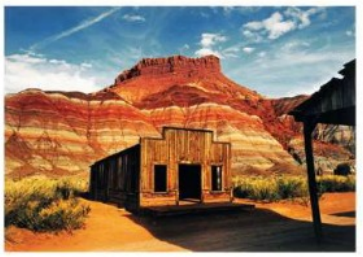
TRIP

TRAVEL TOGETHER National Geographic's family trips are designed for travelers of all ages and feature activities like scavenger hunts, rafting trips, and local-cuisine tastings. A seasoned expert is always on hand to explain the culture and wildlife of each location. For information on destinations, including the Galápagos, Alaska, Italy, and Costa Rica (right), visit ngexpeditions.com/family.

MAP

CHANGING WORLDS *Geographic* subscribers received their first world map in 1922. Now this replica—complete with areas marked "unexplored"—shows you the lay of the land that year. Flip it over for a map of the world today. Go to natgeomaps.com/125map.

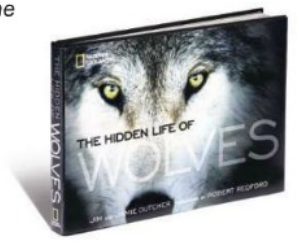
EXHIBIT



GO WEST Since 1889 *National Geographic* has been photographing the landscapes, wildlife, and people of the American West. A collection of these images, from historic to modern, is now on display at venues across the country. Locations are listed at photographsofthewest.org. Don't miss the companion book, *Greatest Photographs of the American West* ($30).

BOOK

WOLVES Husband-and-wife team Jim and Jamie Dutcher spent years gaining the trust of a small pack of wolves. Their photos and stories create an intimate portrait of these wild creatures. Available February 5 ($25).



PHOTOS (FROM TOP): NATIONAL GEOGRAPHIC CHANNEL; RANDY FARIS, CORBIS; DIANE COOK AND LEN JENSHEL

Little Bits of Libya

A photographer doesn't always rely on pictures to bring back memories. On his first trip to Libya, in 2008, George Steinmetz bought a watch bearing the face of Muammar Qaddafi. He's also filled a jar with desert sand and kept dinar notes—souvenirs of the now bygone Qaddafi era. The globe-trotting photographer isn't shy about acquiring artifacts, from butterflies and beetles (displayed in his glass-topped living-room table) to a sombrero purchased right off a Mexican rodeo cowboy's head. Once he tasted a giant clam in the Pacific islands, then had a crate built to ship the shell home. *—Luna Shyr*

BEHIND THE LENS

What's your favorite item here?

GS: The watch. A jewelry store in Tripoli had this Qaddafi watch that was a real rarity. The number is for the 39th anniversary of Qaddafi's rule. I didn't realize that in a few years they wouldn't be making them anymore.

What drew you to the other objects?

The knife [at right] is a classic Tuareg knife; you find these in the central Sahara. The locals use it to open a tuna can or slit a goat's throat. I thought it'd be a great letter opener. The sand from the Libyan border is very old. I put it in an empty coffee jar. The bills will soon be a rarity too. When I was in Libya last year, the people were tired of waiting for new money to be issued.

Is your house messy?

I have a big house, and there's a lot of travel debris in it. My wife sometimes calls it the "museum of natural history."

PHOTO: REBECCA HALE, NGM STAFF

Once Bitten "The viper is dead; the boy will live," read the caption for this photo, published in the October 1943 issue of *National Geographic.* "At Kasauli, in the Himalayas, is the Central Research Institute which produces serums against snake-bites and rabies. Since the identity of the Russell's viper was known [the father holds the dead snake at left], the frightened lad has a nine-to-one chance for recovery."

The Indian clinic specialized in producing antivenoms and rabies serums. During World War II it was tasked with producing large enough quantities of all manner of antidotes for both military and civilian use. The Russell's viper—profuse in many parts of Asia—has one of the deadliest bites. *—Johnna Rizzo*

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

PHOTO: NATIONAL GEOGRAPHIC STOCK

NATIONAL GEOGRAPHIC (ISSN 0027-9358) PUBLISHED MONTHLY BY THE NATIONAL GEOGRAPHIC SOCIETY, 1145 17TH ST. NW, WASHINGTON, DC 20036. ONE YEAR MEMBERSHIP: $39.00 U.S. DELIVERY, $45.00 TO CANADA, $51.00 TO INTERNATIONAL ADDRESSES. SINGLE ISSUE: $7.00 U.S. DELIVERY, $10.00 CANADA, $15.00 INTERNATIONAL. (ALL PRICES IN U.S. FUNDS; INCLUDES SHIPPING AND HANDLING.) PERIODICALS POSTAGE PAID AT WASHINGTON, DC, AND ADDITIONAL MAILING OFFICES. POSTMASTER: SEND ADDRESS CHANGES TO NATIONAL GEOGRAPHIC, PO BOX 62130, TAMPA, FL 33662. IN CANADA, AGREEMENT NUMBER 40063649, RETURN UNDELIVERABLE ADDRESSES TO NATIONAL GEOGRAPHIC, PO BOX 4412 STN. A, TORONTO, ONTARIO M5W 3W2. UNITED KINGDOM NEWSSTAND PRICE £4.99. REPR. EN FRANCE: EMD FRANCE SA, BP 1029, 59011 LILLE CEDEX; TEL. 320.300.302; CPPAP 0715U89037; DIRECTEUR PUBLICATION: D. TASSINARI DIR. RESP. ITALY; RAPP IMD SRL, VIA G. DA VELATE 11, 20162 MILANO; AUT. TRIB. MI 258 26/5/84 POSTE ITALIANE SPA; SPED. ABB. POST. DL 353/2003 (CONV L.27/02/2004 N.46) ART 1 C. 1 DCB MILANO STAMPA QUAD/GRAPHICS, MARTINSBURG, WV 25401. MEMBERS: IF THE POSTAL SERVICE ALERTS US THAT YOUR MAGAZINE IS UNDELIVERABLE, WE HAVE NO FURTHER OBLIGATION UNLESS WE RECEIVE A CORRECTED ADDRESS WITHIN TWO YEARS.

"MY MOM HASN'T ACCEPTED MY FRIEND REQUEST YET. WHAT COULD SHE POSSIBLY BE DOING?"

Options shown.

AVAILABLE WITH ALL-WHEEL DRIVE.

VENZA. *KEEP ON ROLLING.*

toyota.com/venza

TOYOTA

Let's Go Places

White-headed Langur *(Trachypithecus leucocephalus)*
Size: Head and body length, 47 - 62 cm (18.5 - 24.4 inches); tail, 77 - 89 cm (30.3 - 35 inches)
Weight: 6.7 - 9.5 kg (14.8 - 20.9 lbs) **Habitat:** Limestone forests and shrubby vegetation in South China's Guangxi Province **Surviving number:** Estimated at 580 - 620 in 2002

Photographed by Jed Weingarten

WILDLIFE AS CANON SEES IT

A rocky life. China's white-headed langurs spend the majority of their time on rocky surfaces, sleeping in caves and crevices in limestone cliffs and, in winter, devoting hours to sunbathing on bare rock to soak up warmth. In summer the rocks bake in the sun, sending the langurs back to shelter during resting time. When foraging, they focus on leaves, which constitute as much as 92% of their diet in some months. But venturing out in search of young leaves is a hazardous undertaking; poaching is rampant, and the 16 isolated habitat fragments they have left are threatened by uncontrolled fires. It's a rocky road to survival.

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

Canon