

INSIDE: ARMY ANTS

NATIONALGEOGRAPHIC.COM/MAGAZINE AUGUST 2006

NATIONAL GEOGRAPHIC

No End in Sight

Killer Hurricanes

New Orleans: Home No More 42

Ghost World Guardian 78 Great Smoky Mountains 90

A Geographic Life 108 Where Currents Collide 120



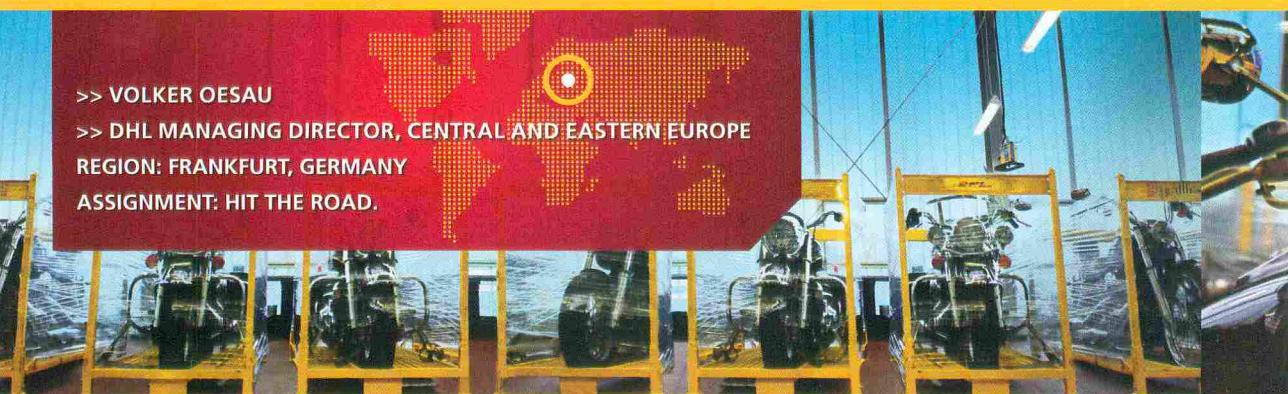
From delivering motorcycles worldwide to getting a unique collectible safely to Daytona Bike Week, Volker Oesau knows what counts in motorcycle logistics. Because he's passionate about bikes, too. We think the best way to help your business is to know it as well as ours. It's the spirit of can do and the experience of know how. It's the people who go all the way to get the job done. www.dhl.com/alltheway

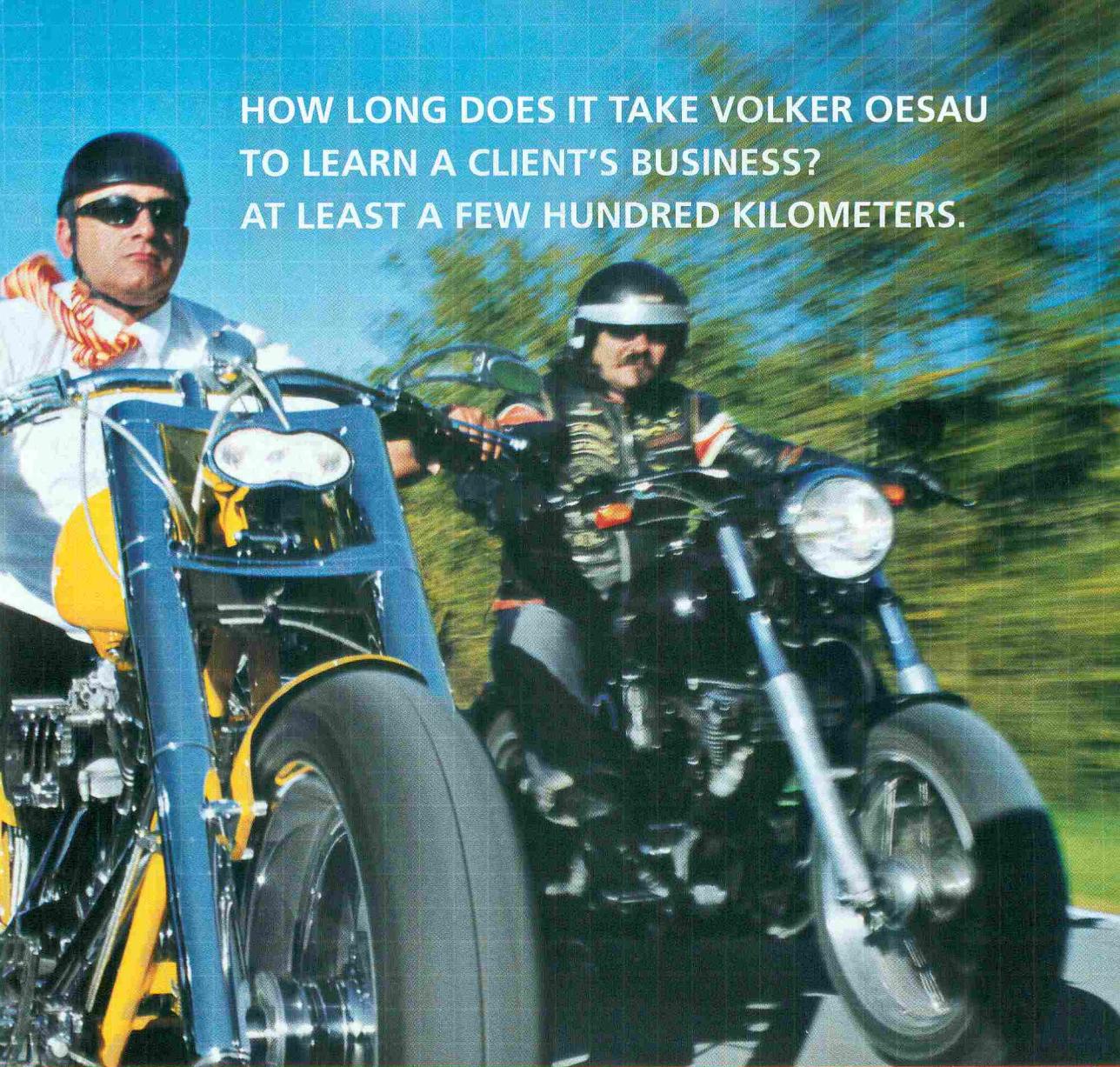
>> VOLKER OESAU

>> DHL MANAGING DIRECTOR, CENTRAL AND EASTERN EUROPE

REGION: FRANKFURT, GERMANY

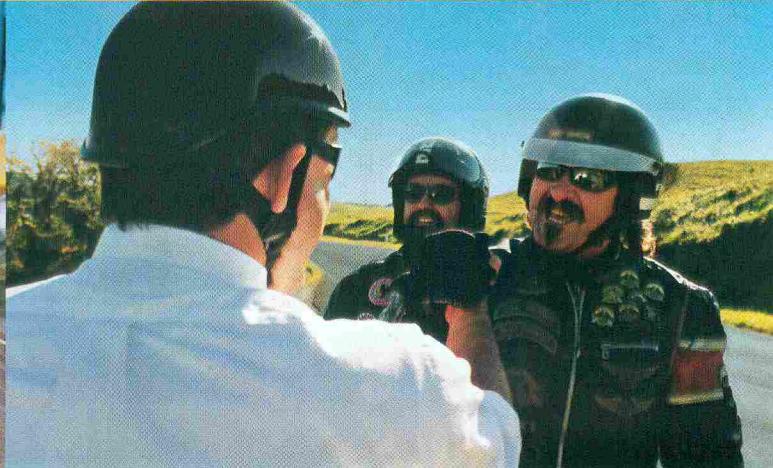
ASSIGNMENT: HIT THE ROAD.





HOW LONG DOES IT TAKE VOLKER OESAU
TO LEARN A CLIENT'S BUSINESS?
AT LEAST A FEW HUNDRED KILOMETERS.

ALL THE WAY **DHL**





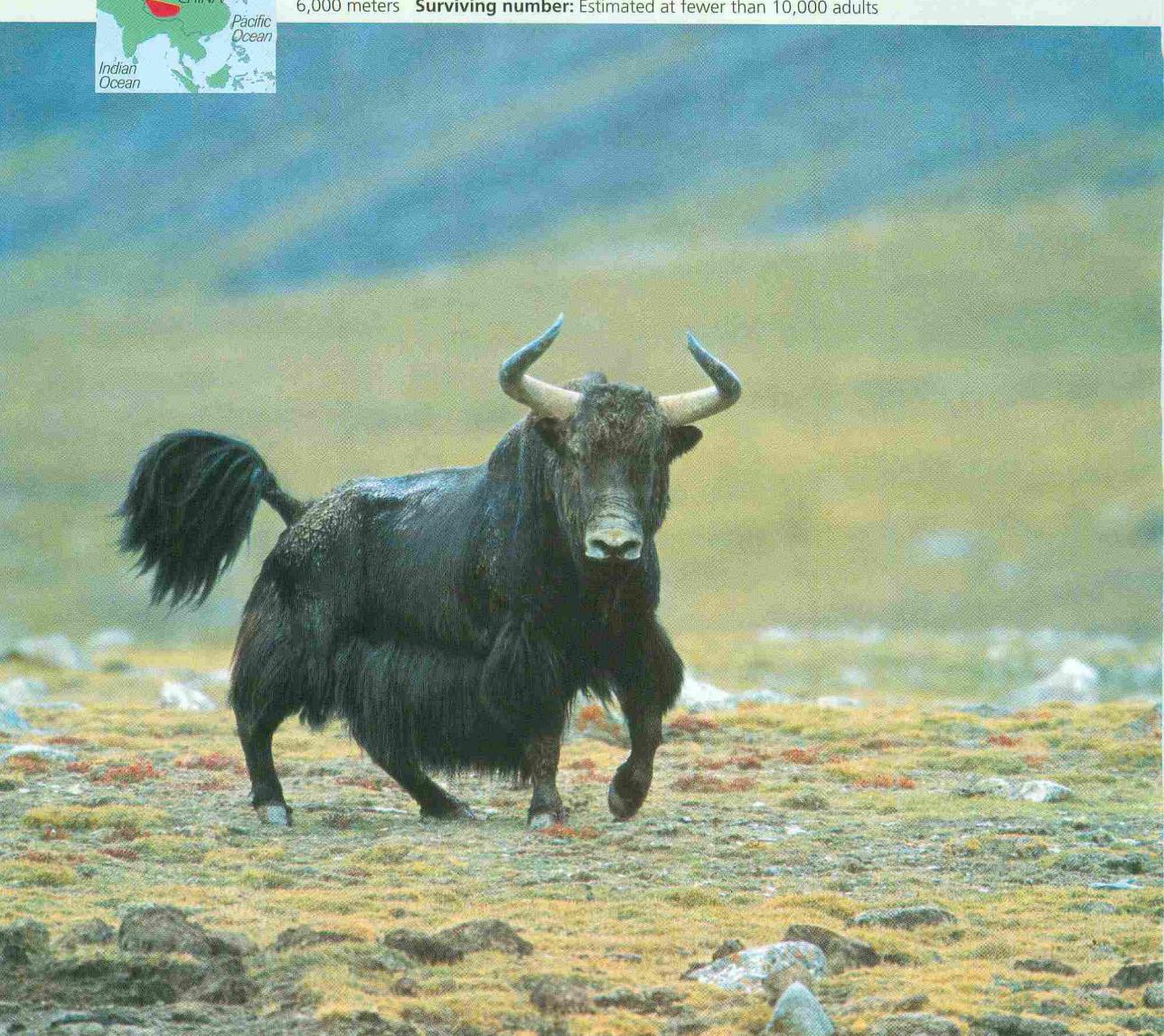
Wild Yak (*Bos grunniens*)

Size: Head and body length, up to 325 cm; shoulder height, up to 200 cm

Weight: 305-820 kg

Habitat: Alpine tundra and cold desert regions of the northern Tibetan plateau, at altitudes of 4,000-6,000 meters

Surviving number: Estimated at fewer than 10,000 adults



Photographed by Milo Burcham

WILDLIFE AS CANON SEES IT

Yak attack? More aggressive than its domesticated cousins, the wild yak is quick to charge when an intruder appears in its path. In most cases, though, it prefers the peaceful expedient of running away. Though it lives much of the year in the isolation of single-sex herds—protected from the elements by a marvelous skirt-like coat—the massive animal must travel great distances to forage for vegetation. These trips can be hazardous, bringing the yak into contact

with persistent poachers as well as livestock and the attendant risks of disease and interbreeding. As its habitat shrinks, more and greater dangers cross the wild yak's path every day.

As an active, committed global corporation, we join worldwide efforts to promote awareness of endangered species. Just one way we are working to make the world a better place—today and tomorrow. Visit ngm.com/canonwildlife to find out more.

Canon

NATIONAL GEOGRAPHIC

AUGUST 2006 • VOL. 210 • NO. 2

Swarm Raiders

An army ant straddles the remains of an insect victim's exoskeleton as she carries it home to her colony in the forests of Panama.



MARK W. MOFFETT

Features

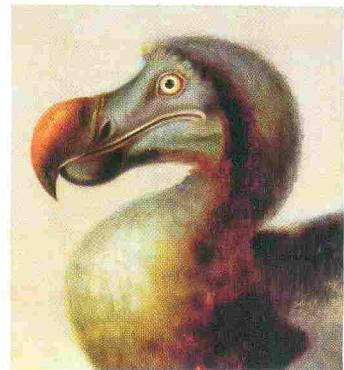
- New Orleans Portfolio** **42** Last year's Gulf Coast hurricanes upended landscapes and lives. Much will be rebuilt, but much is gone forever.
PHOTOGRAPHS BY DAVID BURNETT ESSAY BY ERNEST J. GAINES
- Super Storms** **66** Scientists are urgently trying to forecast the next killer hurricanes.
BY THOMAS HAYDEN
- Ghost World Guardian** **78** For 50 years rancher Waldo Wilcox guarded a Utah canyon full of artifacts from the ancient Fremont culture. Now the secret's out.
BY DAVID ROBERTS PHOTOGRAPHS BY IRA BLOCK
- Smoky Mountain Seasons** **90** The quiet splendor and patchwork history of the popular national park offer lessons in how humanity can coexist with nature.
BY ADAM GOODHEART PHOTOGRAPHS BY MICHAEL MELFORD
- A Geographic Life** **108** Some people dream of exotic adventures with NATIONAL GEOGRAPHIC. Thomas J. Abercrombie lived that dream.
BY DON BELT
- Where Currents Collide** **120** In wild tides surging through the straits of Vancouver Island off British Columbia, marine life grows up strong and beautiful.
TEXT AND PHOTOGRAPHS BY PAUL NICKLEN
- Army Ants on the March** **136** At the pinnacle of social cooperation, army ants overwhelm their prey through their sheer force of numbers.
ESSAY BY EDWARD O. WILSON
TEXT AND PHOTOGRAPHS BY MARK W. MOFFETT

COVER Hurricane Katrina approaches New Orleans on August 28, 2005.

IMAGE: RAY STERNER AND STEVE BABIN, JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY; NOAA

© Cover printed on recycled-content paper

OFFICIAL JOURNAL OF THE NATIONAL GEOGRAPHIC SOCIETY



VISIONS OF EARTH

FOSSILS
HEALTH
WILDLIFE
COLOR OF MONEY
CULTURE
WHERE IN THE WORLD?

VOICES

Departments

Namibia
South Africa
Nepal
Dodo Graveyard
Ways to Go
400-pound Jellyfish
Funny Money
Air-conditioning
Maelifell Volcano
Bill McKibben

Miscellany

EDITOR'S NOTE
LETTERS
YOUR SHOT
PHOTO JOURNAL
INSIDE GEOGRAPHIC
FLASHBACK

On the Web

ngm.com/0608

► In the Wake of Hurricanes

"I remember finding out that my grandpa was alive." New Orleans teenagers record Katrina's aftermath in words and photos. Photographer David Burnett finds the Gulf Coast still in turmoil.

► Ants: Up Close and Personal

Biologist-photographer Mark Moffett offers himself as live bait while narrating this video of army ant behavior.

► Live WildCam: Grizzlies

The world's largest gathering of brown bears stakes out a remote corner of the Alaska Peninsula each summer to gorge on salmon. You can experience this remarkable event live via webcam at ngm.com/wildcamgrizzlies.

Member Services

Subscriptions

To order a subscription to NATIONAL GEOGRAPHIC magazine, give a gift membership, or change address, contact Customer Service online at ngmservice.com, or call 1-800-NGS-LINE (647-5463). Hearing-impaired TDD users may call 1-800-548-9797. Outside the U.S. and Canada call +1-813-979-6845.

Customer Service

Write to:
National Geographic
PO Box 63001
Tampa, FL 33663-3001

Online Index

For an online index of all National Geographic publications go to: nationalgeographic.com/publications.

Shopping

For National Geographic products go to: shopng.com or call 1-888-225-5647.

Mailing List

We occasionally make a mailing list available to carefully screened companies whose services may be of interest to National Geographic Society members. To remove your

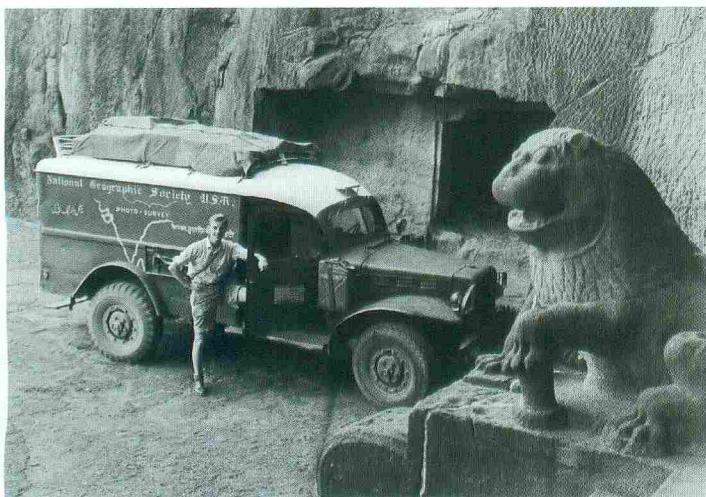
name from this list, email ngline@customersvc.com. U.S. and Canadian customers call 1-800-NGS-LINE (647-5463).

International customers call +1-813-979-6845. Or write: National Geographic Society, PO Box 63005, Tampa, FL 33663-3005. Please include address label from the magazine wrapper.

EDITOR'S NOTE

This magazine has lost two dear friends within the past few months—both photographers and larger-than-life legends. You'll read about one of them, Tom Abercrombie, in this month's issue. Volkmar Wentzel, whose career spanned 48 years, died as this issue was going to press. You'll learn about Kurt, as he was called, in Photo Journal in next month's issue; in the meantime, I'd like to tell you how his work influenced me.

As a child growing up in a small town in Oregon, I spent Saturdays with my grandparents. They had shelves of old magazines,



Kurt Wentzel visited India's Ellora caves for a May 1953 GEOGRAPHIC story.

and I passed many afternoons absorbed in back issues of NATIONAL GEOGRAPHIC. Even today, I can summon the images, particularly those by Kurt Wentzel. There was the picture of a princess borne on a palanquin to her wedding in Jodhpur, the turbaned Rajput with his luxuriant beard, and the ruins of a temple near Islamabad. But nothing fired my imagination more than the image of a surplus army ambulance Kurt had outfitted as a rolling dark-room. Kurt explored 40,000 miles of Indian subcontinent in that vehicle, and to understand its impact on me, you need to know that I never left the West Coast until I was 18; a visit to my aunt and uncle in San Diego was my idea of exotic travel. I don't know at what point during my afternoon voyages through the magazine that the thought occurred to me: I can do this, too. I do know the image of that ambulance helped put me on the path of my life's work and passion. Kurt Wentzel's photographs opened a door to the realm of possibility.



PHOTO: VOLKMAR WENTZEL

NATIONAL GEOGRAPHIC

CHRIS JOHNS, Editor in Chief

Victoria Pope, Managing Editor

Dennis R. Dimick, Executive Editor

Bill Marr, Executive Editor

Carolyn White, Executive Editor

Robert L. Booth, Associate Editor

SENIOR EDITORS

Tim Appenzeller, Science

Don Belt, Geography & World Affairs

Bill Douthitt, Story Development

John A. Echave, Research Grants

Ken Geiger, Technology

David Griffin, Photography

Valerie A. May, New Media

Peter Miller, Expeditions

Kathy Moran, Natural History

Oliver Payne, Manuscripts

Lesley B. Rogers, Research

Christopher P. Sloan, Graphics

David C. Whitemore, Design & Typography

Margaret G. Zackowitz, Departments

TEXT

Assistant Editors: Alan Mairson, Peter L. Porteous, Jane Vessels. **Text Editors:** Lynn Addison, Karen M. Kostyal, Glenn Oeland, Barbara Paulsen, Jennifer Reek. **Senior Writers:** Joel E. Bourne, Jr., John L. Elliott, Jennifer S. Holland, Karen E. Lange, Cathy Newman, Tom O'Neill, Cliff Tarpy, A. R. Williams. **Writers:** Chris Carroll, Peter Gwin, Carol Kaufmann, Michael Klesius, Cate Lineberry, Neil Shea, Lynne Warren. **Departments:** Whitney Dangerfield, Siobhan Roth. **New Media:** Cassandra Franklin-Barbajosa, Senior Writer

PHOTOGRAPHY

Susan A. Smith, Deputy Director. **Photo Editors:** Bert L. Fox, Todd James, Elizabeth Krist, Sarah Leen, Kurt F. Mutchler, Sadie Quarier, Susan Welchman. **Photographers:** William Albert Allard, Jodi Cobb, Michael Nichols, Mark Thiessen. **Photo Engineering:** Lawrence B. Maurer, Joseph S. Stancampiano

DESIGN AND GRAPHICS

Design Editors: Robert Gray, Deputy Director; Elaine H. Bradley, Beth L. Rakouskas. **Designers:** Betty Clayman-DeAtley, Joanna Foucheux, Oliver R. Uberl; Cinde Reichard, Production. **Maps:** William E. McNulty, Director. **Art:** Jeffrey L. Osborn, Deputy Director; Charles L. Floyd, Christopher A. Klein, Joshua Korenblat. **Infographics:** Brenna Maloney, Juan Velasco. **Art Research:** Patricia B. Kellogg, Director; Ellie Boettlinger, Ann R. Perry

RESEARCH

David Brindley, Deputy Director; Abigail A. Tipton, Asst. Director. **Research Editors:** Victoria C. Ducheneyau, Alice J. Dunn, Kathy B. Maher, Mary McPeak, Heidi Schultz, David W. Woodell, Barbara L. Wyckoff. **Senior Researchers:** Nore Gallagher, Mary Jennings Luger, Marisa J. Larson, Elizabeth Snodgrass, Christy Ulrich. **Researchers:** Karen C. Courtingay, Emily Krieger, Nanci Majkowski, David A. O'Connor, Terry Salinas, Brad Scriber, Shelley Sperry

EDITORIAL SERVICES

Administration: Marisa Doneymko, Staff; Mark Feldman, Finance; Carol Dumont Kerby, Scheduling; Brian E. Strauss, Electronic Publishing; Sandra Dunford Sligh, Asst. to the Editor in Chief; Sandra M. Dane, Ewart Ignacio, Caroline Wallinger. **Communications:** Mary Jeannine Jacobsen, Vice President; Barbara S. Moffet, Heather Riley. **Correspondence:** Joseph M. Blanton, Jr., Director; Carol Stroud, Lisa Walker. **Image Collection:** Maura A. Mulvihill, Vice President; William D. Perry, Sales; Carolyn J. Harrison, John A. Rutter. **Libraries and Information Services:** Susan Fifer Canby, Vice President; Renee Braden, Ellen D. Briscoe, Barbara P. Ferry, Anne Marie Houppert, Ann E. Hubbs, Karen Huffman. **New Media:** Lisa Hungness, General Manager. **Travel:** Cristine E. Ghilani, Director

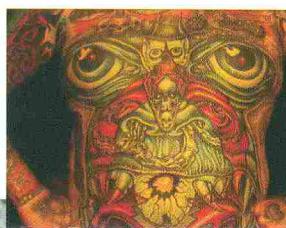
PRODUCTION SERVICES

Hans H. Wegner, Vice President. **Digital Imaging:** Thomas J. Craig, Director; Clayton R. Burneston, Phillip E. Plude, Bernard G. Quarrick. **Distribution:** Michael Swarr, Director. **Engraving:** George Bounelis, Director; William D. Reicherts. **Printing:** Joseph M. Anderson, Luz Garcia, Edward J. Holland. **Quality:** Ronald E. Williamson, Director

MAGAZINE PUBLISHING

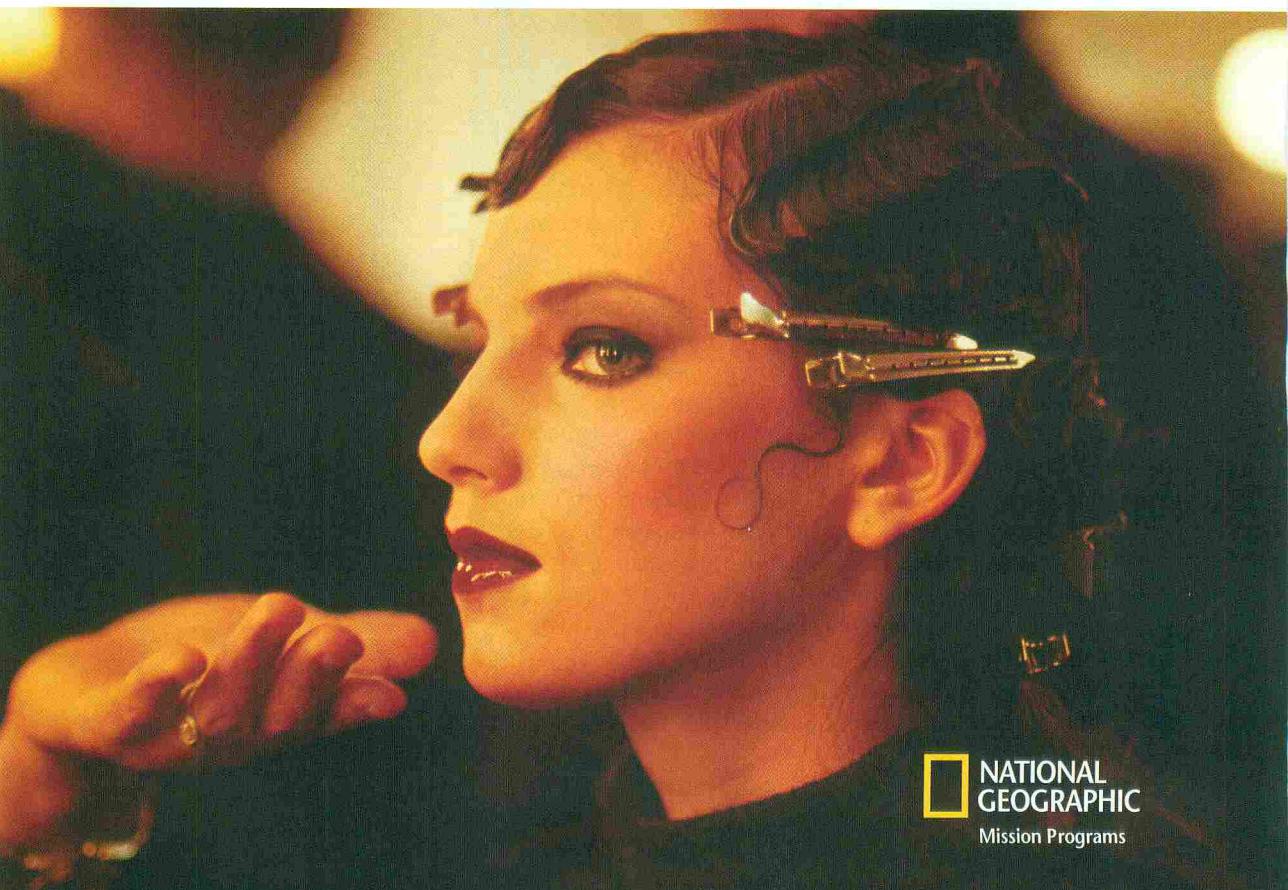
Advertising: Stephen P. Giannetti, Vice President and Group Publisher; Claudia Malley, Vice President and U.S. Publisher. **International:** Declan Moore. **National Advertising Directors:** Jerry Brennan, Western; John Patten, Eastern. **Directors:** Ron Bottorff, West Coast Sales; Suzanne McKeon, Marketing; Margaret Robertson, Business and Operations. **Managers:** Bob Amberg, Southeast; John Favone, Detroit. **Collaboration:** Terry Day, Vice President. **Directors:** Elizabeth M. Safford, North America; John A. Seeley, International. **Member Services:** Christina C. Alberghini, Director

VIEWPOINT: *beauty*



"I find photographing the way each culture exaggerates universal ideals of beauty fascinating. In Papua New Guinea, men are the most flamboyant, taking their cue from male birds' bright plumage. In early Polynesia, tattoos marked life events, making the body a visual journal. Scarring, plates in lips, and bound feet have all been beautiful to some, while unimaginable to others. As our world grows smaller, unique expressions of beauty are all the more rare, and wonderful."

—Jodi Cobb



NATIONAL
GEOGRAPHIC
Mission Programs

JODI COBB NATIONAL GEOGRAPHIC PHOTOJOURNALIST

Page 8 ::



trendy

traditional



traditional

trendy

An unpredictable bunch. People.

Everywhere you go you get a different opinion and a different point of view.

What's in, what's out? What is of the moment and what is so 'yesterday'?

And when you talk to a hundred million people all over the planet you'd be amazed at what you learn.

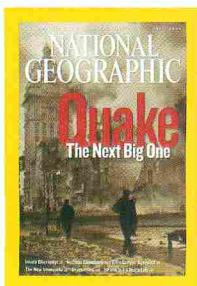
We have learned that the more you look at difference as potential, the less it looks like a problem.

yourpointofview.com

HSBC 
The world's local bank

Issued by HSBC Holdings plc

LETTERS



April 2006 Many readers wrote in about "Nuclear Power." Opinions on the subject were mixed, but our online poll was decisive: At press time, more than 70 percent of respondents felt the benefits of nuclear energy outweighed its costs. Other readers this month debated power of a different sort—that of Venezuela's President Hugo Chávez.

► Voice opinions about August stories at ngm.com.

Nuclear Power

Apparently we can build nuclear reactors that are perfectly safe and would involve no eventual expensive decommissioning. All we need now are perfect safeguards against human laziness, stupidity, or malevolence.

RALPH A. LEWIN
La Jolla, California

By almost any measure, the peaceful use of nuclear energy has been highly successful for more than 50 years, except for two events—Chernobyl and Three Mile Island. Based on sustained efforts primarily by utility companies, the Institute of Nuclear Power Operations, the Electric Power Research Institute, and individuals dedicated to this technology, the operation of existing facilities is and will be acceptably safe, effective, cost-efficient, and reliable.

Write, Email, Fax

Write
National Geographic Magazine
PO Box 98199
Washington, DC 20090-8199
Email
nsgforum@nationalgeographic.com
Fax
202-828-5460
Include name, address, and daytime telephone. Letters may be edited for clarity and length.

Yet due almost exclusively to uninformed and misguided decisions by policymakers and a public wary of any complex technology, the pursuit of new design, construction, and implementation of advanced nuclear facilities in the U.S. has been halted for more than 25 years.

GLENN HUDSON
Tuscumbia, Alabama

I think your article on nuclear energy is biased. Nuclear energy is attractive for the shortsighted future. You point out that it is a cash cow, and it produces a large amount of power with very little pollution. But are the shortsighted gains worth the long-term consequences? Like waste for thousands of years?

JOE LORENZO
Clearfield, Utah

In the picture on pages 54-5, a young boy is cutting the grass with a gasoline-powered lawn mower within sight of the Three Mile Island station cooling towers. The boy is wearing nothing but shorts; no safety glasses, no shoes, no trousers, no long-sleeved shirt, and no hat. It is more likely that the boy will be injured due to improper safety guidance than any potential injury

from the nuclear power plant in the background.

CARL FEDAKO
Bloomsburg, Pennsylvania

Inside Chernobyl

Your Chernobyl article was well done and quite accurate, as was the nuclear rebirth article. But to combine them in the same issue effectively paints a picture of doom and gloom, and, as usual, casts a negative light on the safety and performance record of electricity-producing commercial nuclear plants in the U.S.

MICHAEL W. SCRIMSHER
Burbank Heights, Washington

Chernobyl's "deadly footprint" is dwarfed by the catastrophic consequences for those living downwind from the Aral Sea, which Uzbekistan shares with Kazakhstan. This inland sea became filled with chemical and agricultural wastes prior to the breakup of the former Soviet Union. When its rivers were diverted, its shores receded, and prevailing winds dispersed residual salts contaminated with noxious pollutants. Millions in the region suffer chronic health problems, high infant mortality rates, and disproportionate birth defects.

DONALD E. PIBURN
Kaaawa, Hawaii

The Next Big One

I am a California-registered geologist. I live within ten miles of two major active faults, and I've mapped a few dozen others. I'm both amused and exasperated by continuing chatter about the Next Big One. How about all those "little" ones, all in southern California, namely Santa Barbara in 1925, Long Beach



At the heart of the image



Top-notch Performer



Armed with remarkable image processing technology, and brilliantly balanced with an easy-to-use interface. The D200, loaded with 10 megapixel power and superior shooting capabilities, will precisely execute your every command.

The D200's professional list of features include a 10 effective megapixel DX Format CCD for high quality images, a newly developed 11-area AF system for exceptional sharpness, our Creative Lighting System providing the ultimate in lighting control, Ultra-High speed 5fps continuous shooting to capture fleeting moments, and a magnesium alloy body for the perfect blend of durability, weight, and feel.

NIKON HONG KONG LTD.
Website: www.nikon.com.hk

Tel:(852) 2862-3936 Fax:(852) 2504-5689

NIKON SINGAPORE PTE LTD.

Website: www.nikon.com.sg

Tel:(65) 6559-3618 Fax:(65) 6559-3671

NIKON (MALAYSIA) SDN BHD (Co. No. 531447-K)

Website: www.nikomymalaysia.com.my

Tel:(603) 7809-3688 Fax:(603) 7809-3633

NIKON IMAGING (CHINA) SALES CO., LTD.

Website: www.nikon.com.cn

Tel:(86) 21 6340-5188 Fax:(86) 21 6340-5066

Nikon is the official supporter of the AFC.



DIGITAL SLR CAMERA

D200

<http://nikonimaging.com>

LETTERS

in 1933, San Fernando in 1971, and Northridge in 1994, where damage was estimated at 20 billion dollars. The preoccupation with the San Andreas Fault, with a few thoughts tossed at the Hayward and Calaveras Faults, is ridiculous.

ROBERT H. PASCHALL
Bishop, California

The New Madrid Fault Zone, an area that runs along Arkansas, Tennessee, and Missouri, was only mentioned on the insert map. According to the University of Arkansas at Little Rock Center for Earthquake Education and Technology Transfer, the New Madrid zone has historically been the site of some of the largest earthquakes in North America. In 1811 and 1812, four catastrophic earthquakes, with magnitude estimates of 8.0, occurred during a three-month period. At the time, the population density in these areas was minimal. Not so in 2006. A quake there now with a similar magnitude could result in devastating loss of life.

ELIZABETH COCKRELL LOEB
Forrest City, Arkansas

The New Venezuela

I was disappointed by your article on Hugo Chávez. While he may deserve criticism, let us try to keep some perspective. Yes, he makes long broadcasts on the state-run television network, but he doesn't interfere with the private networks, which overwhelmingly oppose him. Yes, he has a lot of power, but he was elected in a landslide. You paint Chávez as a dictator, criticizing his "squandering" of oil money to help feed and

educate his people. Would it be better for him to give away public resources to corporations for private profit, as is favored by our politicians?

STEVE SCHNAAR
Santa Cruz, California

Your article leaves the impression that Venezuela's current government is a champion for the poor. During its tenure, unemployment has reached unprecedented levels, and even though the government tries to put on appearances of generosity, the programs reach a small minority. Worse yet, as the government boasts about its handouts, it does nothing to create jobs to truly help the nation prosper.

MANUEL SCETTRI
Caracas, Venezuela

It's easy to judge President Hugo Chávez. He may be the wrong man for Venezuela. On the other hand, I can't recall any right-leaning president or dictator in modern Venezuelan history who made a difference or paid any attention to the poor of that country.

ERNESTO WEISSON
San Antonio, Texas

A Dry Red Season

You noted in the story how water from Lake Powell created green Little League fields and lush golf courses, but you did not note how many farms are irrigated nor how much power is generated. Granted there is always an environmental impact in damming rivers, but in comparison to the cost and hazards of nuclear power, also featured in the issue, hydroelectric power is a real plus.

BERNARD H. MEYER
Newtown Square, Pennsylvania



"FOR THE INCREASE AND DIFFUSION OF GEOGRAPHIC KNOWLEDGE"

The National Geographic Society is chartered in Washington, D.C., as a nonprofit scientific and educational organization. Since 1888 the Society has supported more than 8,000 explorations and research projects, adding to knowledge of earth, sea, and sky.

JOHN M. FAHEY, JR., President and CEO

EXECUTIVE VICE PRESIDENTS

Terrence B. Adamson
Linda Berkeley, *President, Enterprises*
Terry D. Garcia, *Mission Programs*
John O. Griffin, *President, Magazine Group*
Nina D. Hoffman, *President, Books and School Publishing Group*
Christopher A. Liedel, *CFO*

BOARD OF TRUSTEES

Gilbert M. Grosvenor, *Chairman*
Reg Murphy, *Vice Chairman*
Joan Abramson, Michael R. Bonsignore, Martha E. Church, Roger A. Enrico, John M. Fahey, Jr., Daniel S. Goldin, John Jay Iselin, James C. Kautz, J. Willard Marriott, Jr., Floretta Dukes McKenzie, George Muñoz, Patrick F. Noonan, Nathaniel P. Reed, Rozanne L. Ridgway, James R. Sasser, B. Francis Saul II, Gerd Schulte-Hillen

TRUSTEES EMERITUS

Joe L. Albritton, William L. Allen, Thomas E. Bolger, Frank Borman, Lewis M. Branscomb, Robert L. Breeden, Michael Collins, Lloyd H. Elliott, George M. Elsey, Mrs. Lyndon B. Johnson, William K. Reilly, Robert C. Seamans, Jr.

COUNCIL OF ADVISORS

Roger A. Enrico, *Chairman*
Darlene T. Anderson, Michael R. Bonsignore, Howard G. Buffett, Craig D. Campbell, Jean N. Case, Juliet C. Folger, Robert B. Haas, Robert A. Hefner III, David H. Koch, Bruce L. Ludwig, Sally Engelhard Pingree, W. Russell Ramsey, Catherine B. Reynolds, Joseph E. Robert, Jr., Edward P. Roski, Jr., Victoria P. Sant, B. Francis Saul II, Michele Sojka, Ted Watt, Garry A. Weber, Tracy R. Wolstencroft

RESEARCH AND EXPLORATION COMMITTEE

Peter H. Raven, *Chairman*
John M. Francis, *Vice Chairman*
Martha E. Church, Steven M. Colman, Scott V. Edwards, Philip Gingerich, William L. Graf, Nancy Knowlton, Dan M. Martin, Scott E. Miller, Jan Nijman, Stuart L. Pimm, Elsa M. Redmond, Bruce D. Smith, Patricia C. Wright, Melinda A. Zeder

EXPLORERS-IN-RESIDENCE

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

MISSION PROGRAMS

Vice Presidents:
Barbara A. Chow, *Education Foundation*
John M. Francis, *Research, Conservation, and Exploration*
Jacqueline M. Hollister, *Development*
Sarah Laskin, *Public Programs*
Exhibits: Susan S. Norton
Expeditions Council: Rebecca Martin
Geography Bee: Mary Lee Eiden
Lectures: P. Andrew van Duym, Gregory A. McGruder
Communications: Betty Hudson, *Sr. Vice President*
Human Resources: Thomas A. Sabilo, *Sr. Vice President*
International: Robert W. Hernández, *Sr. Vice President*
Treasurer: H. Gregory Platts, *Sr. Vice President*

NATIONAL GEOGRAPHIC VENTURES

Dennis R. Patrick, *Chairman*
Timothy T. Kelly, *President and CEO*
Edward M. Prince, Jr., *COO*
National Geographic Channel: David Haslingden, *President, International*; Lauren Ong, *President, U.S.*
Digital Media: Chris McAndrews, *President*
National Geographic Maps: Frances A. Marshall, *President*; Allen Carroll, *Chief Cartographer*
Television: Michael Rosenfeld, *Executive Vice President*

Contributions to the National Geographic Society are tax deductible under Section 501(c)(3) of the U.S. tax code.

Copyright © 2006 National Geographic Society. All rights reserved. National Geographic and Yellow Border: Registered Trademarks ® Marcas Registradas. National Geographic assumes no responsibility for unsolicited materials. Printed in U.S.A.



**SPEND EVEN MORE TIME
TOGETHER WITH A \$100
COUPON FOR NEXT TIME.**

When you stay with us, romance is awakened whether you leave the room or not. Sleep late in our new beds with soothing, cotton linen and big downy soft pillows. Watch the sun settle into the horizon as you lounge around the pool. Or enjoy a romantic dinner after another amazing afternoon. Contact us to plan your next rendezvous so the only thing you have to think about is each other.

IT'S THE MARRIOTT WAY.SM

Stay For BreakfastSM

Breakfast is included, plus pay with your Visa card to receive a Bonus coupon valued at up to \$100 for your next stay.

Marriott[®]
HOTELS & RESORTS



JW MARRIOTT.
HOTELS & RESORTS



RENAISSANCE.
HOTELS & RESORTS

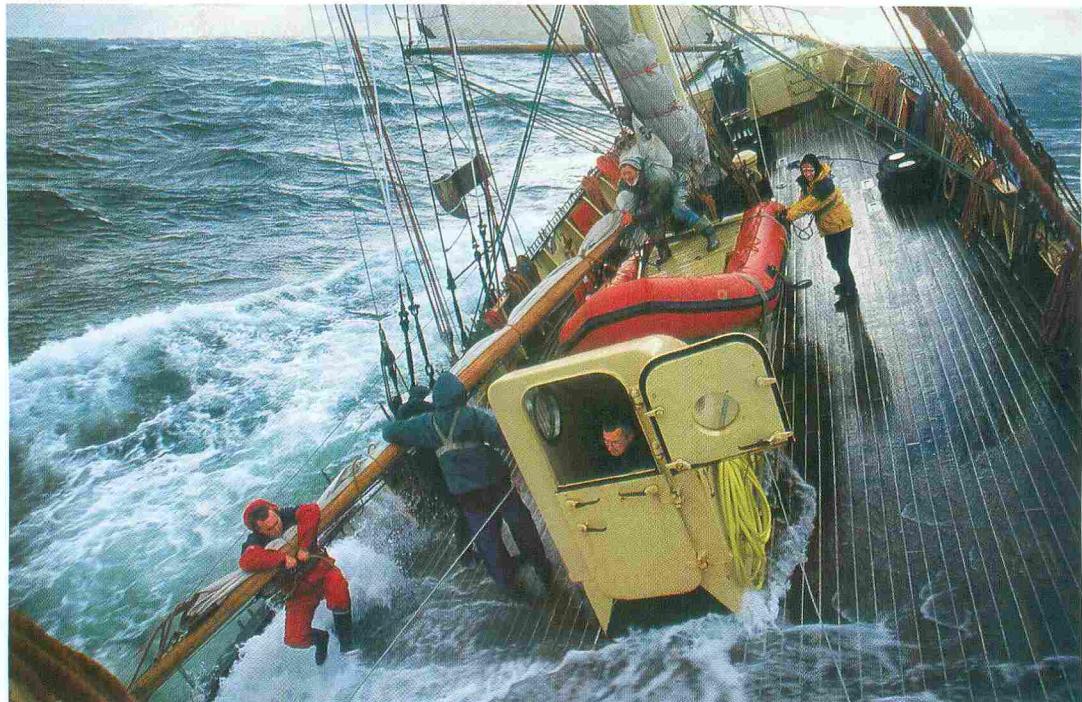


Call any Marriott Global Reservations Office or contact your travel professional. Alternatively, book online at Marriott.com or reach us by email at hkres@marriott.com. Please remember to quote ratecode OTP.

VISA
PROUD PARTNER

Offer valid on Stay For BreakfastSM only, for stays from 1 May through 3 September 2006 at participating Marriott, JW Marriott, Renaissance and Courtyard Hotels & Resorts outside the US and Canada. Must stay over a Friday or Saturday night to get the breakfast rate. Offer may be made available seven days a week at select locations. Rate includes breakfast in hotel restaurant for up to two adults and children age 12 and under. Offer not applicable to groups of 10 or more. A limited number of rooms are available and blackout dates may apply. Payment must be made with a valid Visa card in order to receive one Bonus Bucks / Extra Euros / Premium Pounds / Australian dollars coupon valid for six months on a future consecutive two-night paid stay. One coupon issued per room, per stay. A stay is defined as consecutive nights spent at the same hotel, regardless of check-in/check-out activity. All Visa programme terms and conditions apply. See complete terms and conditions on Marriott.com. ©2006 Marriott International, Inc.

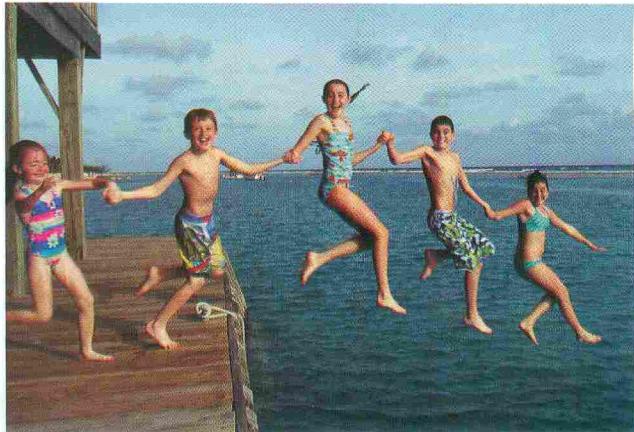
Your Vacation These pictures on the theme of "Where I Vacation" were selected from reader photos posted to the Your Shot website. Continue the conversation with our editors—and with NATIONAL GEOGRAPHIC readers—by submitting your own images on the new theme of "Around the Table." Photographs selected will be published in the November 2006 issue. For guidelines, a submission form, and more information, go to ngm.com/yourshot.



Wojciech Kocot Kraków, Poland

ABOVE "The sea went wild," says Wojciech Kocot of a Baltic crossing by the *Zawisza Czarny*—a ship owned by the Polish Boy and Girl Scouting Association. "I was in fear of losing the camera." Kocot, a Kraków engineer and college professor, volunteered as an officer on the ship's crew.

RIGHT Their father Frank caught "Team O'Brien" (Erin, from left, Kiernan, Kaitlyn, Egan, and Shealagh) in mid-leap during a trip to the Cayman Islands. "I could hear the kids running from the far side of the dock," he says. "When they started to jump, I clicked."



Frank O'Brien Easton, Connecticut

α

As far as the eye can see, and beyond...

smooth



Feel the change in the air as you dive into the world of **α**. The newest Sony Digital SLR that promises you outstanding image quality built on a heritage of advanced engineering. Set free your creative vision. It all begins with **α**.

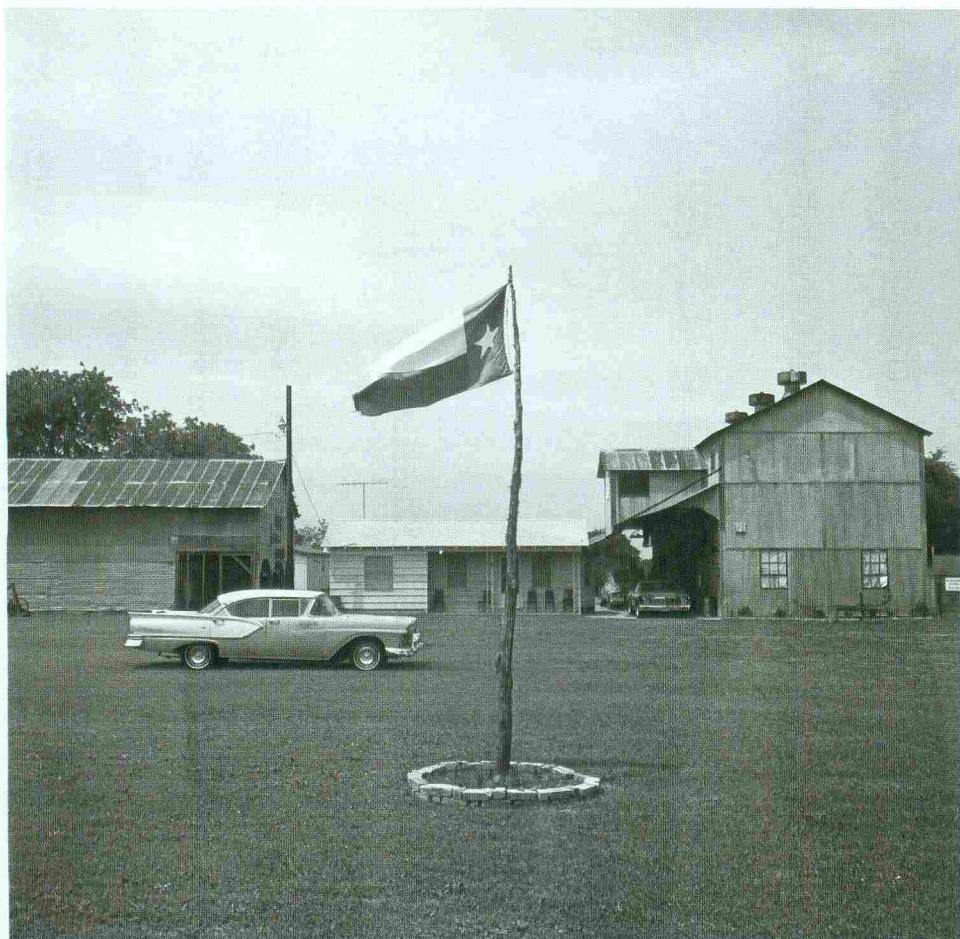
www.sony-asia.com/dslr

10 Mega Pixels CCD • BIONZ Image Processing Engine • Super SteadyShot Inside • High Performance Continuous Shooting • Anti Dust

SONY

Page 15:::www.up2u.in:::

like.no.other™



Brad Preston's place in Crawford is an old converted cotton gin.

The President's Neighbors

I first visited Crawford, Texas, while traveling with President George W. Bush on assignment as a photographer for *Time* magazine. Back in 1999, when he was simply "candidate Bush," the Texas governor purchased roughly 1,600 acres in Crawford and named it Prairie Chapel Ranch. Now people call it the western White House. There are more than 1,400 miles between it and the more famous one in Washington, D.C. Perhaps that's why the President is so fond of it.

Heavily armed Secret Service agents and assertive press officials direct and control where photographers can go at the western White House—and when, and how. I'm known in those circles as "the guy who stepped on the grass." That's not a metaphor. Once, I accidentally put my foot down on a strip of the native buffalo grass at the Bush ranch and was severely scolded for doing so.

A tiny piece of Crawford always seems to peek out from behind the shoulders of correspondents as they report on the President's activities. But the town itself is rarely a focal point for coverage. On my visits there, when given the chance, I've strayed from the ranch's makeshift press room and set out to meet the people I call the President's neighbors.

► Photo Gallery View more of Musi's images at ngm.com/0106/feature4.

What would you find if you drained the oceans?



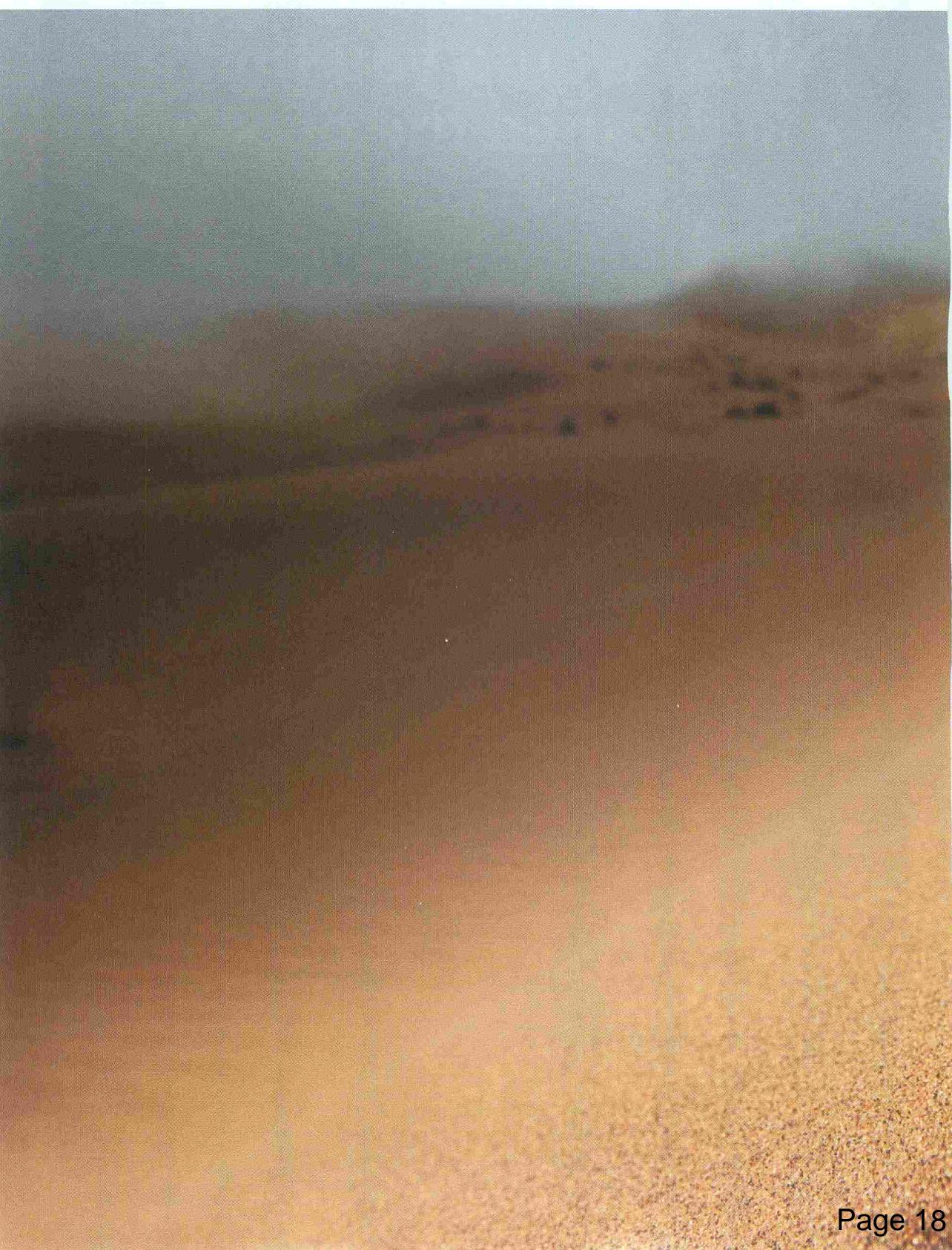
THE DEEP, part of Naked Science
CHECK LOCAL LISTINGS

More people have visited the moon than the deepest part of the ocean. Naked Science goes down into the depths of deep sea trenches to explore one of most extraordinary landscapes on the planet.

NATIONAL
GEOGRAPHIC
CHANNEL

Think again.

VISSIONS OF EARTH



Namib Desert, Namibia A tenebrionid beetle faces downhill to help fog droplets roll toward its mouth. The insect may have evolved the behavior because rain is rare but fog abundant in this coastal desert.

PHOTO: OLIVIER GRUNEWALD



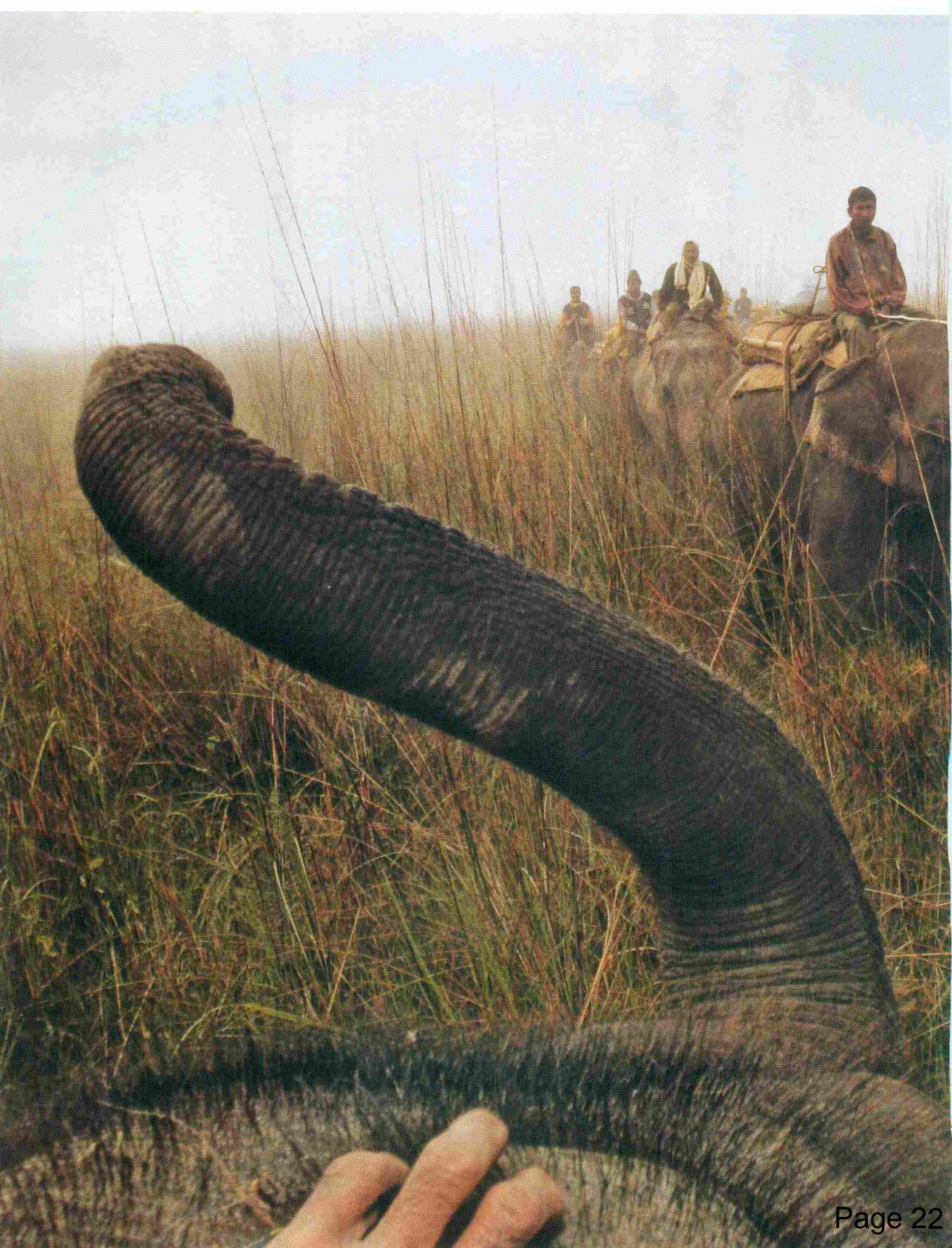
Mkuze Game Reserve, South Africa A speckled emperor moth diverts predators with an illusion. Patterns on its hind wings resemble a mammal's face, complete with glinting "pupils."



PHOTO: CARLO DELLI



Tarai Region, Nepal Mahouts, or elephant handlers, guide their animals on an early morning ride through tall grass in Royal Chitwan National Park.



► Decorate your desktop with Visions of Earth images in Fun Stuff at ngm.com/0608.

PHOTO: AMY TOENSING



F OSSILS



This dodo was painted in the 19th century, long after the birds became extinct.

Graveyard of the Dodos They waddled rather than flew, laid single eggs, and lived in a world free of predators. But little else is known about the famously extinct dodo. Even its name has a hazy history—perhaps stemming from a Dutch phrase describing its tail feathers. Hunted relentlessly, the species disappeared from the island of Mauritius in the 17th century, less than 100 years after colonists arrived. No complete dodo skeleton has ever been found.



Dodo leg bones found on Mauritius

layer of earth and date back as far as 3,000 years. Kenneth Rijsdijk of the Geological Survey of the Netherlands says that the find proves that tambalacoque and ebony trees, which now exist only in Mauritius's mountains, once flourished in the lowlands, and that dodos feasted on their fruits. Carbon dating currently under way should determine whether the animals died in one catastrophic event, such as flooding caused by a storm. —Siobhan Roth

The recent discovery on Mauritius of the remains of some 20 dodos, along with the fossils of a thousand tortoises and dozens of other bird and plant species, promises to reveal more about dodos and their environment. All the bones were found in the same

Fresh Dirt

The earliest known wildfire smoldered in England near the Welsh border some 418 million years ago. At the time, plants grew only an inch or so tall, and oxygen levels may have been higher than they are today. The combination resulted in a low-intensity burn that left plants preserved as charcoal fossils.

Omo 1 and Omo 2, partial skulls found by paleoanthropologist Richard Leakey in Ethiopia in 1967, were long thought to be a mere 130,000 years old. Recent tests reveal that they're the oldest *Homo sapiens* remains ever found. The Omos date back some 195,000 years, supporting the theory that modern humans arose in Africa.

Ways to Go

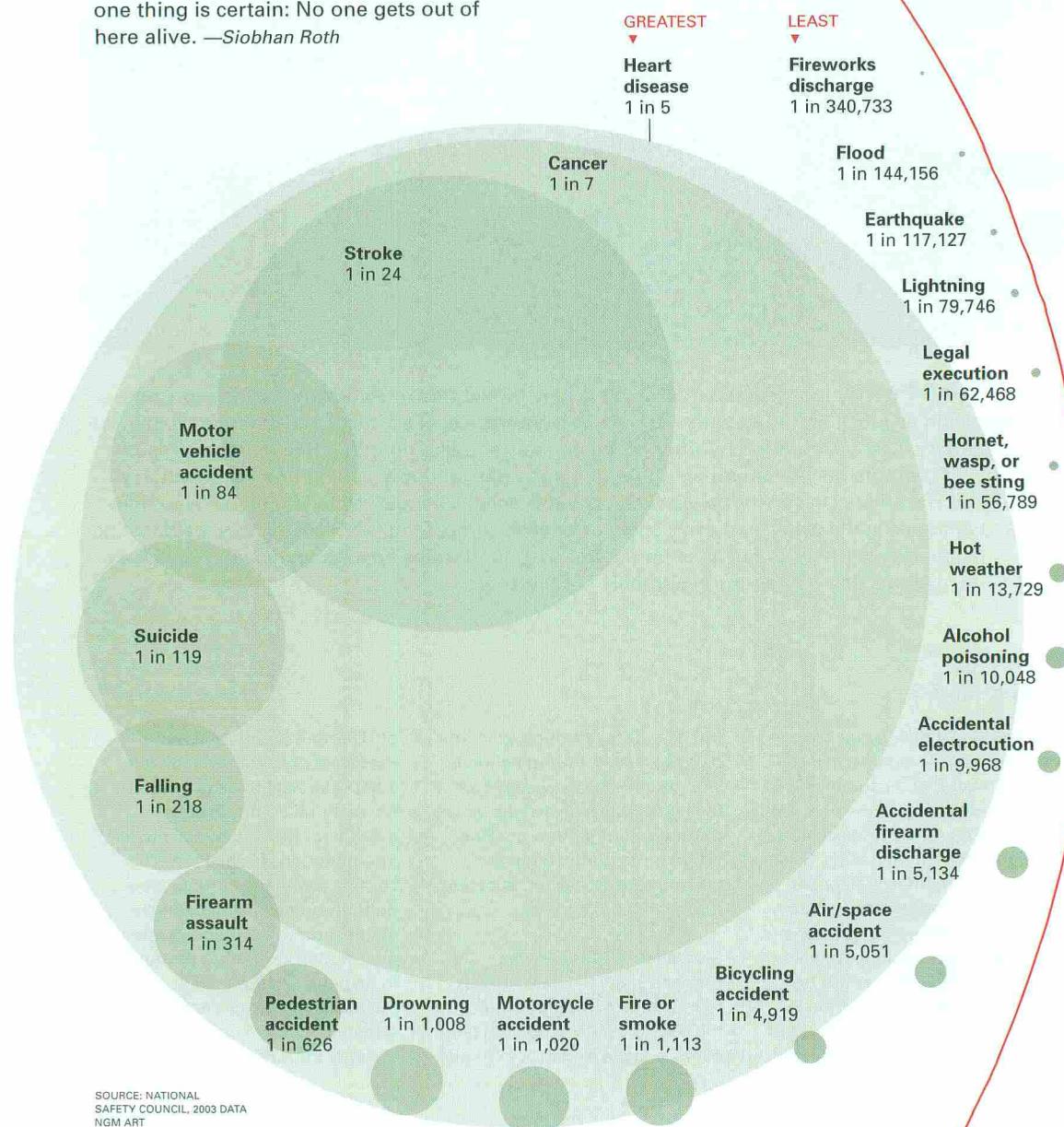
When and how death will arrive can rarely be predicted, but statistics reveal what holds the greatest chance of ending a life. Riding a motorcycle, for example, is far riskier than playing with fireworks, statistically speaking. This chart shows what the lifetime probabilities are of a U.S. resident dying in a relatively common event, such as a pedestrian accident, or a less common but larger scale catastrophe, such as an earthquake. No matter what the cause, one thing is certain: No one gets out of here alive. —Siobhan Roth

Total odds of dying, any cause

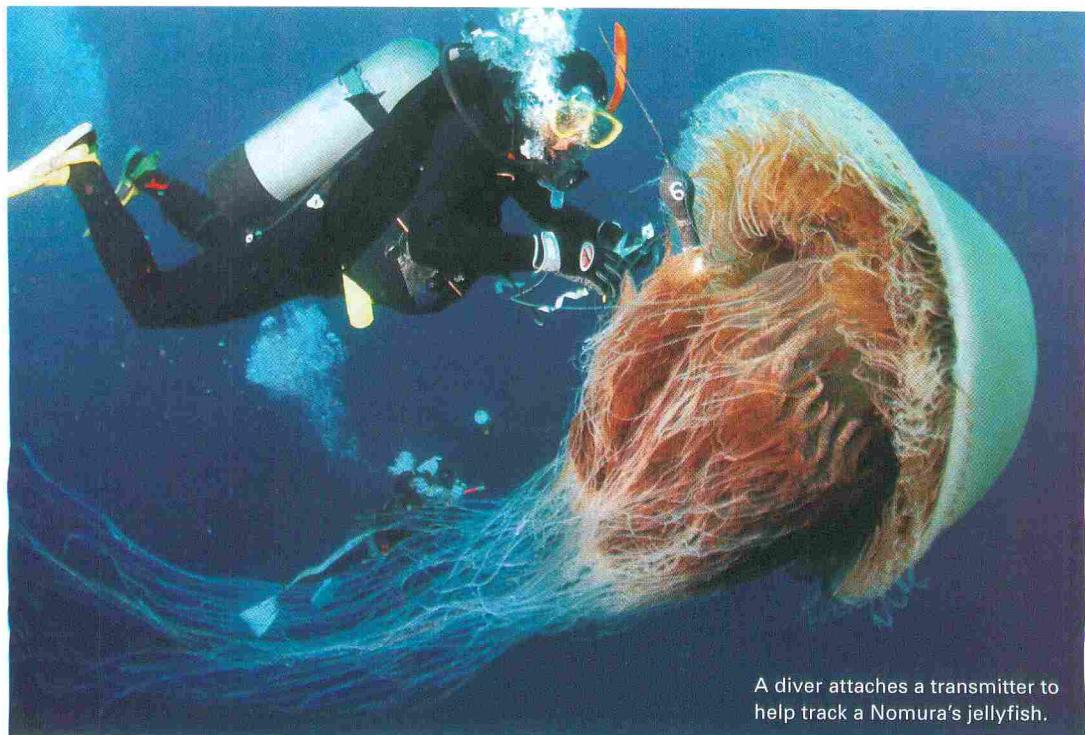
**1 in 1
(100%)**

GREATEST ▼

LEAST ▼



SOURCE: NATIONAL SAFETY COUNCIL, 2003 DATA
NGM ART



A diver attaches a transmitter to help track a Nomura's jellyfish.

Jelly Giant It may look lethal, but its sting is only moderate: The worst injury the monsters—they can weigh as much as 400 pounds—known as Nomura's jellyfish inflict may be to the Japanese fishing industry. Last year a huge number of the animals showed up in the Sea of Japan, resulting in 100,000 complaints by fishermen about damaged nets and lost fishing time. Shin-ichi Uye, a biologist at Hiroshima University, believes that environmental changes, including global warming, increased nutrients in the water, and overfishing of jellyfish competitors for plankton may be boosting the population. He estimates the peak of immature, six-pound jellies floating to Japan in 2005 was "300 to 500 million a day—an amazing number!" —John Eliot

What's New?

By hitching a ride, larvae of non-biting midges—aquatic insects resembling tiny mosquitoes—spread their range over great distances. The larvae travel inside the guts of migrating birds. Scientists studying insect dispersal by birds found the larvae when examining droppings of waterfowl that roosted in a Spanish marsh on their way south to Africa for the winter. Of the 95 intact larvae retrieved from the droppings, 12 were unharmed

by the journey through the birds' digestive tracts. According to the study, published in *Biology Letters*, the birds likely ingested the larvae during mid-migration gorging. When birds gorge, digestion becomes less efficient, allowing more larvae to survive.

Scratch just a little lower. Humans aren't the only animals to indicate where they want their backs scratched. Male chimpanzees in the Ngogo community

of Uganda's Kibale National Park were observed engaging in what scientists think is referential gestural communication, a behavior previously unknown in nonhumans in the wild. The chimps scratched certain spots on their bodies using exaggerated gestures to catch the attention of their grooming partners. In 64 percent of the observed instances, the groomer would scratch the other chimp in exactly the spot indicated.

Funny Money

J. S. G. Boggs never sells his art. He spends it. His project started in 1984 at a diner—a doodle of a dollar on a napkin to pay for a doughnut and coffee. He's since used the bills in transactions worth more than a million dollars. After creating, say, a ten Boggs bill, he finds a merchant who will accept it as the equivalent of ten dollars. Boggs then sells the receipt to an art collector, who must hunt down the bill. But Boggs's work exacts a price: He's been arrested in England and Australia for counterfeiting.



His drawings diverge from real banknotes in small details and a major difference: One side is always blank.

Boggs added his name to this bill, as well as the town and year in which he did the drawing.

Elaborate artwork mimics that on the Swiss franc's sixth banknote series, begun in 1976.

J. S. G. Boggs's visage replaces that of 17th-century architect Francesco Borromini on the Swiss bill.



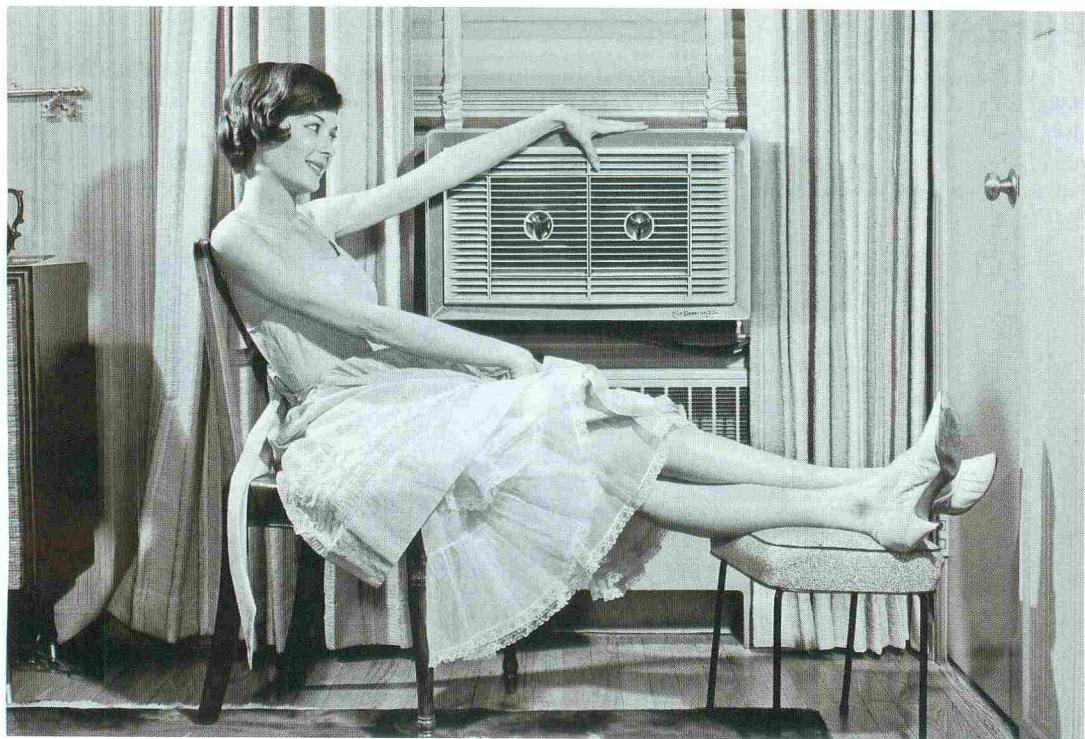
Boggs drew this bill for the Florida United Numismatists, a banknote- and coin-collecting organization.

The Supreme Court building appears on this Boggs bill. Real ten-spots feature a similar-looking building—the U.S. Treasury.



This "FUNback" hails from "The United States of Florida." Boggs created several hundred of these bills.

"In Us We Trust" the FUNback proclaims. Boggs also flipped the two round images. On the U.S. dollar, the eagle sits on the right.



By the early 1960s, when this picture was made, even some modestly priced homes came with air-conditioning.

Birth of the Cool One hundred years ago, Willis Carrier received a patent for a system to cool the air inside a building and control its humidity at the same time. It was the first modern air conditioner. Today nearly four-fifths of all U.S. homes are air-conditioned—96 percent in the sweltering South. As home air-conditioning has become more common, heat-related deaths nationwide have declined. But comfort has a cost: AC soaks up one-sixth of the electricity consumers buy each year. Stringent federal energy-efficiency standards for central air conditioners went into effect in January, and experts project that more efficient appliances will save consumers about 25 billion dollars between this summer and 2030. —Lynne Warren

Culture Beat

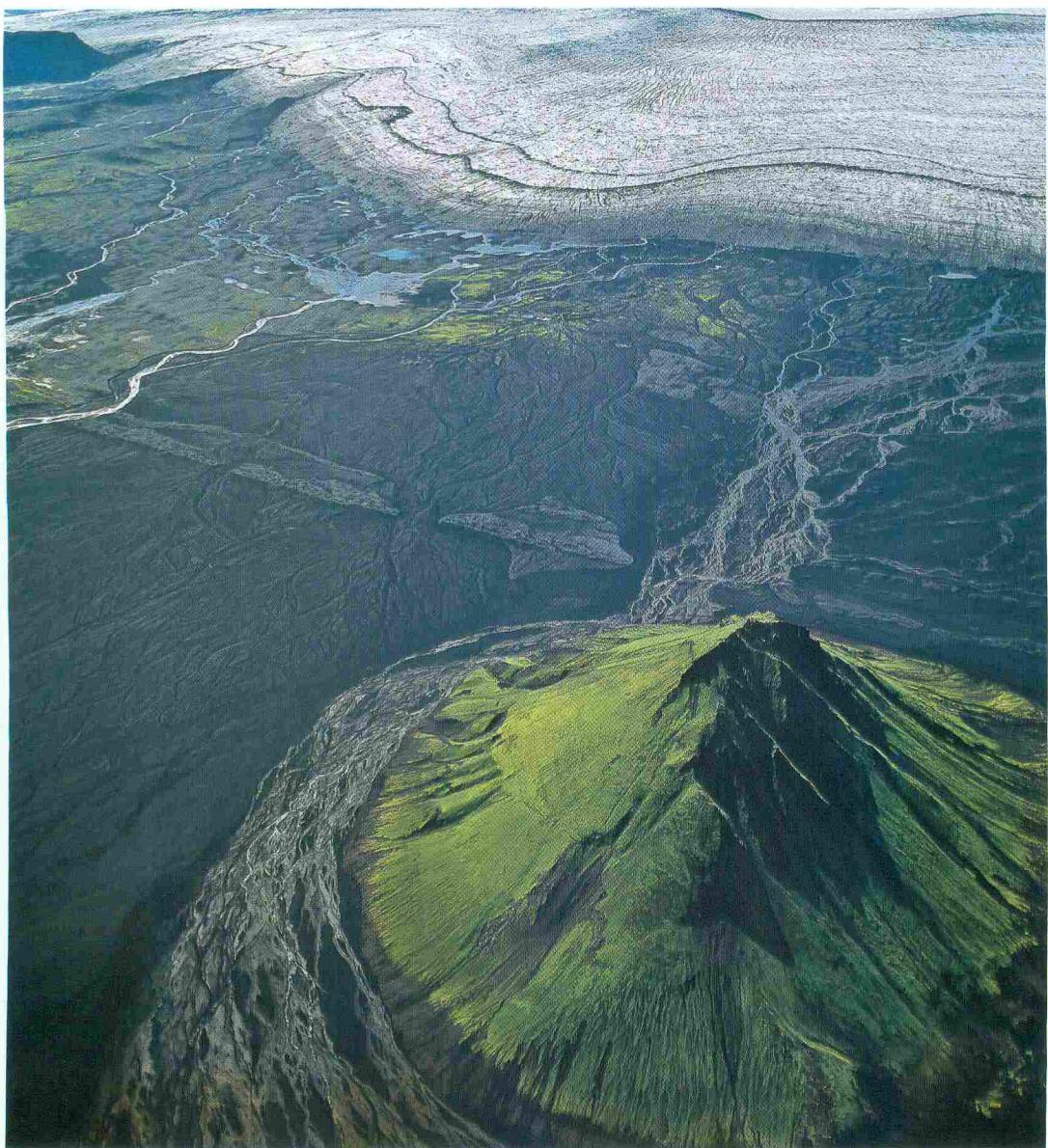
Michelangelo was here, a newly uncovered signature suggests. The citizens of Marcialla, Italy, have long insisted that the master from Florence painted the fresco above their church's altar, a claim backed by 17th- and 18th-century church documents. Recently a stone slab forming part of the altar was moved, revealing the

letters M, B, and F—possibly M for Michelangelo, B for Buonarroti (the artist's surname), and F for *fecit*, Latin for "made," or *fiorentino*, for "Florentine."

The number of meetings that American workers attend more than doubled in the last half of the 20th century.

A study published in the *Journal of Applied Psychology* found that poorly run meetings strain workers' health, especially that of those who dislike meetings. The study also found that while many people complain about meetings, a large number secretly enjoy the confabs and derive a sense of well-being from the interaction.

WHERE IN THE WORLD?

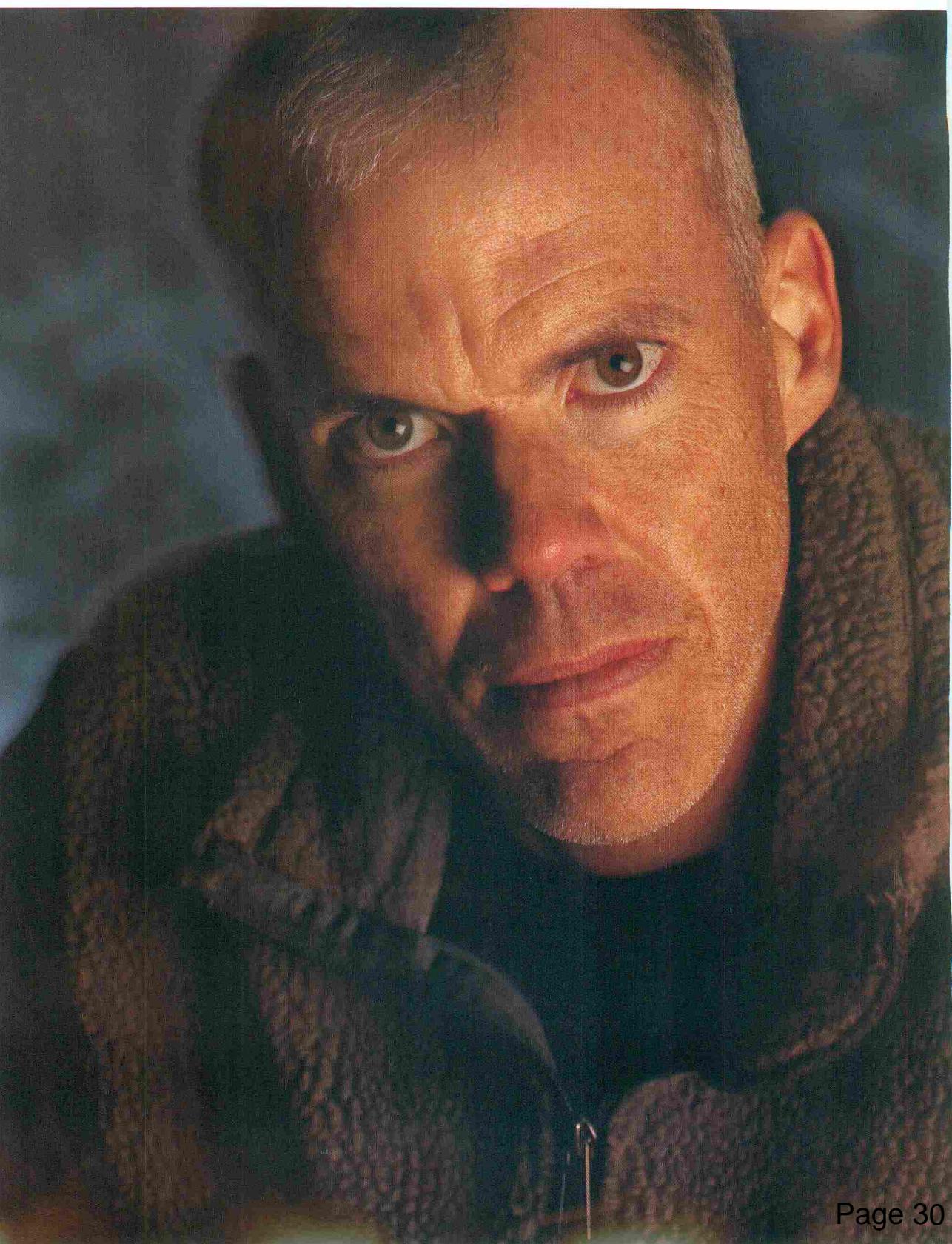


Maelifell sits at the edge of a 270-square-mile glacier in southern Iceland.

Volcanic View Vegetation carpets the jagged cone of Maelifell, a peak in southern Iceland. Surrounded by gray glacial outwash and braided streams of meltwater, the 2,600-foot-tall volcano has not erupted in more than 10,000 years. Says volcanologist Lee Siebert, "It's safe to call this particular one extinct." The same cannot be said for the one beneath a nearby glacier called Mýrdalsjökull, at top. Sitting over a fissure where magma periodically rises to the surface, Mýrdalsjökull hides Katla, one of the most active volcanoes in Iceland. Katla last erupted in 1918 and could erupt again in the next decade, triggering flash floods that would threaten nearby farms and villages. —Whitney Dangerfield

PHOTO: BERNHARD EDMAYER

VOICES





A Deeper Shade of Green

BY BILL MCKIBBEN

*At times he can seem like a biblical prophet, lamenting how our human failings are destroying the planet. Yet listen more carefully to Bill McKibben—environmental essayist, activist, and author of the best seller *The End of Nature*—and you'll hear a redeeming message that transforms the idea of what “green” can mean.*

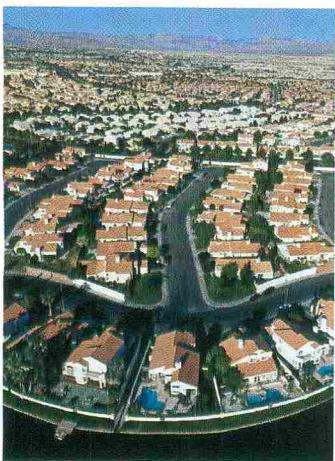
This is the year when we finally started to understand what we are in for. Exactly 12 months ago, an MIT professor named Kerry Emanuel published a paper in *Nature* showing that hurricanes had slowly but steadily been gaining in strength and duration for a generation. It didn't attract widespread attention for a few weeks—not until Katrina roared across the Gulf of Mexico and rendered half a million people refugees. The scenario kept repeating: Rita choking highways with fleeing Texans; Wilma setting an Atlantic Ocean record for barometric lows; Zeta spinning on New Year's Day. Meanwhile, other data kept pouring in from around the planet: Arctic sea ice melting past an irrevocable tipping point; thawing permafrost in northeastern Siberia creating so much methane that lakes didn't freeze even in the depths of boreal winter; the NASA calculation that 2005 had been the warmest year on record.

In January, a trinity of announcements sealed the mood. First, British scientist James Lovelock, who invented the instrument that allowed us to detect our eroding ozone layer, published an essay predicting that we'd already added too much CO₂ to the atmosphere and that runaway global warming was inevitable. He predicted that billions will die this century. A few days later came a less dramatic but equally alarming announcement. The steady and long-serving NASA climatologist James Hansen defied federal attempts to gag him and told reporters that new calculations about, among other things, the instability of Greenland's ice shelf showed “we can't let it go on another ten years like this.” If we did? Over time, the buildup of CO₂ emissions would “imply changes that constitute practically a different planet.” Less than ten years to reverse course. Not our kids' lifetimes, or our grandkids'. Ours.

Finally, at month's end, even President Bush, as faithful a friend as the fossil fuel industry has ever had, announced America was “addicted to oil.” Historians, I think, will look back on this as the time when denial finally began to crumble. When we finally began to understand that the planet as we've known it was at stake—and not from a possible scenario, like nuclear war, but from the consumption of the coal and oil and gas that power most of the actions of our lives. This is new. Humans have never faced a civilization-scale challenge before. Whether we deal with

Bill McKibben lives in a Vermont valley, where he puts his ideas for a new cultural environmentalism into practice.

MARK THIESSEN, NATIONAL GEOGRAPHIC PHOTOGRAPHER



Sprawling suburban developments, like this one in Las Vegas, Nevada, decentralize communities and create a car-dependent lifestyle.

it gracefully or not depends, I believe, on what happens to that creed we call environmentalism.

Environmentalism is mostly an American invention, one of the most powerful ideas we've offered to the rest of the planet. It arose here for a simple reason. We came to full consciousness while we were still in the process of subduing the nation's forests and prairies. In much of Asia and Europe, the woods were cut and the rivers tamed before the age of writers. Here, though, Henry David Thoreau could see the line between man and nature on his daily walks. George Perkins Marsh could watch what happened to the flow of streams when New England forests were cut down. Aldo Leopold could look on as the fierce green fire turned dull in the eyes of a gunned-down wolf.

None of these environmentalists, or the hundreds of thousands of other women and men who believed passionately in such ideas, were able to slow the economic juggernaut that rushed across this continent, however. Most didn't think of that as their role; it didn't even cross their minds. They set up small islands of park and wilderness for the tide to rush around. And they worked, especially after Rachel Carson, to cure modernity's most toxic side effects, making sure certain chemicals were banned and the Clean Air Act passed. This movement has been remarkably effective. Even as our economy has grown larger, smog has also abated. We can swim in most of our rivers again. And our model has spread to the rest of the world. Other countries have adopted their own clean air acts, built their own national parks. And environmentalists can still win great victories: The Sierra Club and the Wilderness Society and all the rest have managed so far, for instance, to preserve the Arctic National Wildlife Refuge from drilling.

But when it came time to deal with global warming, this kind of environmentalism flunked. Despite 20 years of increasingly dire warnings, American carbon emissions continue to grow; we won't even engage in the Kyoto Protocol, the one international effort to bring carbon emissions under some kind of control. A few western European nations are doing better, but even they are having trouble meeting their reduction targets. And the developing world is starting to flood the atmosphere with CO₂ on an almost American scale. From 1990 to 2004, China's carbon emissions increased by 67 percent, nearly all of it the result of coal.

We're now starting to realize this failure was almost inevitable. Environmentalism's method of handling global warming is flawed.

The old paradigm works like this: We judge just about every issue by asking the question, Will this make the economy larger? If the answer is yes, then we embrace whatever is in question—globalization, factory farming, suburban sprawl. In this paradigm, the job of environmentalism is to cure the worst effects, and endless economic growth makes that job easier. If you're rich, you can more easily afford the catalytic converter for the end of the tailpipe that magically scrubs the sky above your city.

The old paradigm works like this: We judge just about every issue by asking the question, Will this make the economy larger? But endless economic growth is built on the use of cheap fossil fuel.

But it turns out that, above all else, endless economic growth is built on the use of cheap fossil fuel. The industrial revolution began the day in 1712 that Thomas Newcomen figured out how to use a steam engine to pump water out of a coal mine, so that it could be mined more cheaply and easily, thus allowing more steam engines. Coal, oil, and natural gas were, and are, miraculous—compact, easily transportable, crammed with Btu, and cheap. Dig a hole in the ground, stick a pipe in the right place, and you get all the energy you could ever need.

Precisely the same fuels that gave us our growth now threaten our civilization. Burn a gallon of gas and you release five pounds of carbon into the atmosphere. And as China demonstrates every day, the cheapest way to spur growth is by burning more fossil fuel. Even Benjamin Friedman, the Harvard economist who wrote a brilliant book last year defending the morality of economic growth, conceded that carbon dioxide is the one major environmental contaminant for which no study has ever found any indication of improvement as living standards rise.

Which means we might need a new idea. We need to stop asking, Will this make the economy larger? Instead, we need to start asking, Will this pour more carbon into the atmosphere? Some of the shift would be technological. If carbon carried a real price, then we'd be building windmills far faster than we are now. All cars would be hybrid cars, and all lightbulbs would be compact fluorescent. Every new coal plant would be paying the steep price to separate carbon from its exhaust stream and store it underground. All that would help—but not enough to meet Hansen's ten-year prognostication, not enough to reduce worldwide carbon emissions by the 70 percent required to stabilize the climate at its current degree of disruption.

For that to happen, we'd need to change as dramatically as our lightbulbs. We'd need to see ourselves differently—identity and desire would have to shift. Not out of a sense of idealism or asceticism or nostalgia for the '60s. Out of a sense of pure pragmatism.

For instance, we've gotten used to eating across great distances. Because it's always summer somewhere, we've accustomed ourselves to a food system that delivers us fresh produce 365 days a year. The energy cost is incredible—growing and transporting a single calorie of iceberg lettuce from California to the eastern U.S. takes 36 calories of energy. What would it take to get us back to eating more locally, to accepting what the seasons and smaller scale local farmers provide?

Or think about the houses we now build. They're enormous—more than double the size they were in 1950, despite the fact that the number of people in the average home continues to fall. Even a technologically efficient furnace or air conditioner struggles to heat or cool such a giant space—and the houses can only be built on big suburban lots, guaranteeing that their occupants will be entirely car-dependent. What would it take to make us consider smaller homes, closer to the center of town, where we could use the bus or a bike for daily transportation?



Farmers markets across the U.S. are growing in popularity. Eating what's grown locally reduces the cost of transporting food and fosters a "convivial environmentalism."

It would require, I think, a movement that takes people's aspirations for good and secure and durable lives seriously. That takes those desires more seriously even than the consumer economy has taken them. We would need a kind of cultural environmentalism that asks deeper questions than we're used to asking.

How deep? Here's a data set just as interesting as the ongoing spike in planetary temperatures—and almost as depressing. Since researchers started trying to measure such things in the years after World War II, the percentage of Americans who consider themselves "very happy" with their lives has remained steady, even though the material standard of living has nearly tripled in the same period. More stuff is not making us happier—but we can't break out of the cycle that offers more stuff as our only real goal.

What we really seem to want, according to the economists and psychologists conducting such research, is more community. Standard economic theory has long assured us that we're insatiable bundles of desires. That may be true, but more and more it feels like our greatest wish is for more contact with other people. We've built the most hyper-individualized society the world has ever seen: According to some surveys, most Americans don't know their next-door neighbors, which is a truly novel idea for primates. That's contributed to the great success of our economy—each of us rises and falls based on our own efforts, which is a great motivator. But it's also contributed to that gathering sense of dissatisfaction, and to that cloud of carbon dioxide. If everyone has to drive their own car everywhere (and the biggest car possible, to maximize their own safety), then it's hard to reduce emissions. If our idea of paradise remains a 4,000-square-foot house on its own isolated lot, it's hard to imagine really rapid change.

But there are at least glimmers of another possible future. Consider food again. Last winter I conducted an experiment: Could I get through the cold months in my northern valley eating just the food grown in my county? As it turned out, I didn't simply survive; I thrived. There were plenty of potatoes and onions and beets and beef and cider and beer and wheat and eggs, and just enough tomatoes canned in the heat of summer, to see me through. I'm sure I saved lots of energy, though I can't calculate just how much. What I can list, though, are the new friends I made, and they numbered in the dozens. My food cost more in terms of time; it wasn't as convenient to go to the farmers market as to the Shop 'n Save. But that cost, thought of differently, was actually the biggest benefit of the whole experiment.

And I'm not alone. The number of farmers markets in the country has doubled in the past decade. Sales are growing at least 10 percent annually, making it among the fastest expanding parts of the food sector. A Saturday in Madison, Wisconsin, finds nearly 18,000 people shopping in the streets around the state capitol. In Burlington, Vermont's largest city, about 7 percent of the fresh food the populace eats is grown on just a hundred acres of

Standard economic theory has long assured us that we're insatiable bundles of desires. That may be true, but more and more it feels like our greatest wish is for more contact with other people.

community-supported farmland near the town's old dump. Some farmers markets cater to yuppies, and some are in housing projects; all bring people closer together.

And you can do the same kind of rethinking about many other parts of daily life, from transportation to housing to energy itself: Imagine a windmill at the end of your cul-de-sac, powering the ten homes along the street. You wouldn't be generating much carbon, and you would be generating lots of companionship.

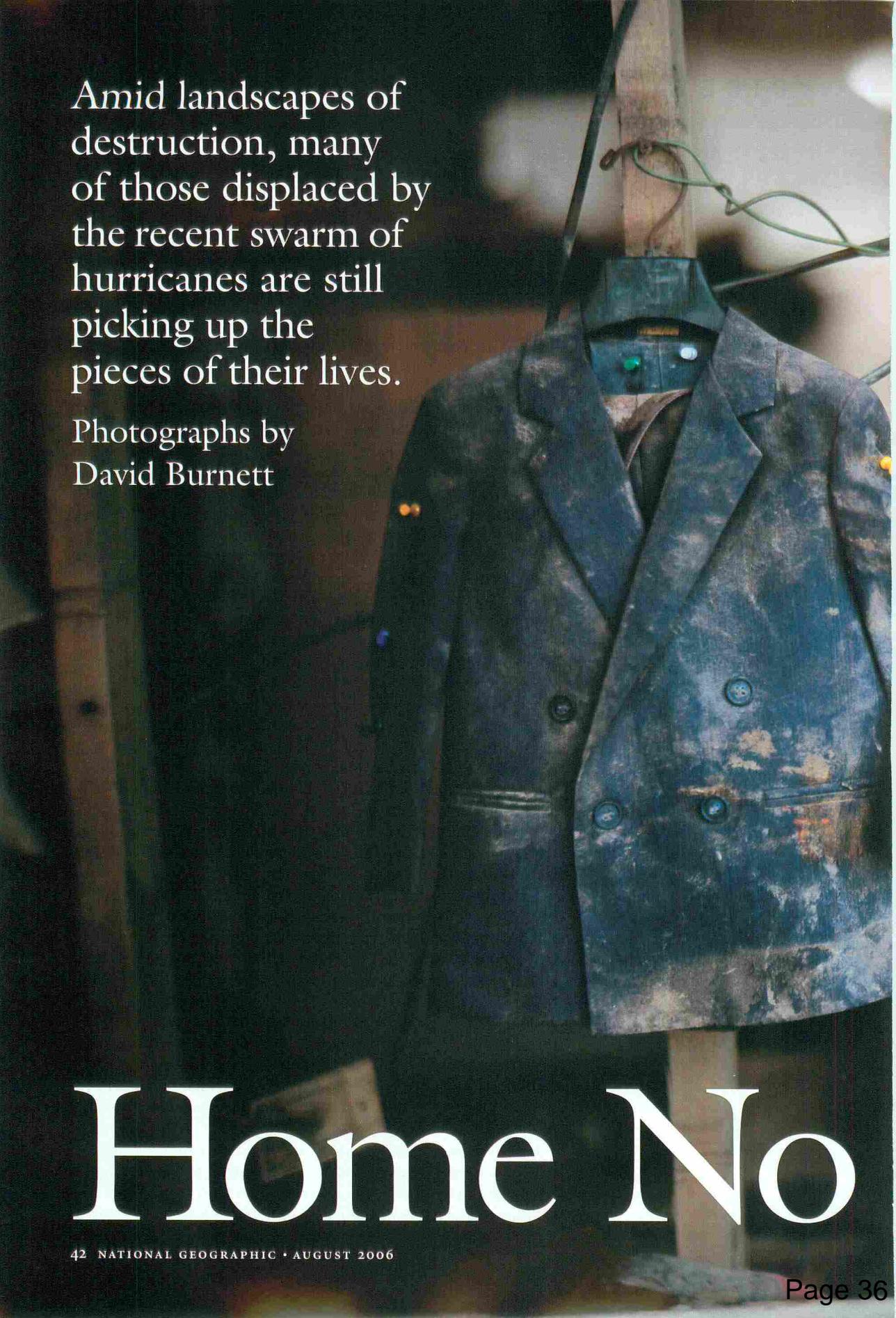
Environmentalism has often been a somewhat grim business. (There is, after all, plenty to be grim about.) But a convivial environmentalism, one that asks us to figure out what we really want out of life, offers profound possibilities.

Perhaps the most important of those possibilities is a new link with communities of faith in this country. Though they don't always live up to their ideals, churches and synagogues and mosques are among the few institutions that can posit some idea for human existence other than accumulation. They understand that it's not just, as Bill Clinton's campaign asserted, "the economy, stupid." Their political help is crucial for making necessary legislative change—maybe the best news of the year was that some 90 prominent evangelical leaders broke ranks with Pat Robertson and his ilk to announce that they wanted to fight global warming, and fight it with their particular set of tools. "This is God's world," they said, which is a shocking idea for a culture that's come to think of everything as ours. It's precisely this ability of religious leaders of all stripes to see individuals as part of something larger than themselves that's so important. And also their commitment to taking care of the needy, because of course there are lots of people in the world who aren't rich. If we can't help them figure out some path to dignity other than our hyper-individualism, the math of global warming will never work.

We don't need to erase individualism; it is one of the glories of the American character. But environmentalists desperately need to learn how to celebrate community, too.

Environmentalism isn't dying. In fact, the need for it has never been greater. But it has to transform itself into something so different that the old name really won't apply. It has to be about a new kind of culture, not a new kind of filter; it has to pay as much attention to preachers and sociologists as it does to scientists; it has to care as much about the carrot in the farmers market as it does about the caribou on the Arctic tundra. That's what the printouts on atmospheric concentrations of carbon dioxide tell us, and it's a message echoed by the researchers studying happiness and satisfaction. We don't need a slightly rejigged version of the world we now inhabit; we need to start working on changes on the scale of the problems we face.

Fear of what will happen unless we shift, desire for what might happen if we do—together they're creating new openings for a more thorough shake-up than any American thinker since Thoreau has envisioned. But ten years is not a lot of time; we'd best get started. □



Amid landscapes of destruction, many of those displaced by the recent swarm of hurricanes are still picking up the pieces of their lives.

Photographs by
David Burnett

Home No

New Orleans

Hadi Amini returned to his ruined house, torn apart when Katrina's storm surge breached the 17th Street Canal levee last August, and found his seven-year-old son's dress-up clothes. "I hung them there to show how quickly life can change."



More





New Orleans

Houses and cars were half buried when the London Avenue Canal's floodwall gave way, unleashing water and sand. "The car is sitting in the front yard of the house next to my aunt and uncle's house," says Maureen Lillich. "They both drowned in the rushing water. I don't think the rest of the nation realizes the sorrow and struggle we continue to endure. All these months have passed, and my aunt and uncle's neighborhood still looks devastated."



New Orleans

Herbert Getridge and his wife raised nine children in this house, which he built with his own hands in 1953. When Hurricane Betsy flooded the Lower Ninth Ward in 1965, water approached the top of the decorative archways that Getridge, a plasterer by trade, had shaped himself. A year ago Katrina filled the house to the ceiling, ruining Getridge's extensive wardrobe—scores of suits, dozens of hats, closets

of accessories. But the house, built solid, suffered no structural damage, just a broken window-pane, and Getridge, now 82, is steadily rehabilitating it. "I've been in the building trades all my life," he says. "I can still build anything I can think of."





Greetings from Holly Beach, Louisiana

MARK BURKE AND GERALD TOUCHET

Holly Beach, Louisiana

"It was the poor man's Riviera," says Lecaster Leger, who owned one of the hundreds of tiny vacation houses washed away by Hurricane Rita's 15-foot storm surge last September. Because of new building regulations—larger lots, higher elevations—many people can't afford to rebuild. "It won't be poor man's anything anymore," Leger says.













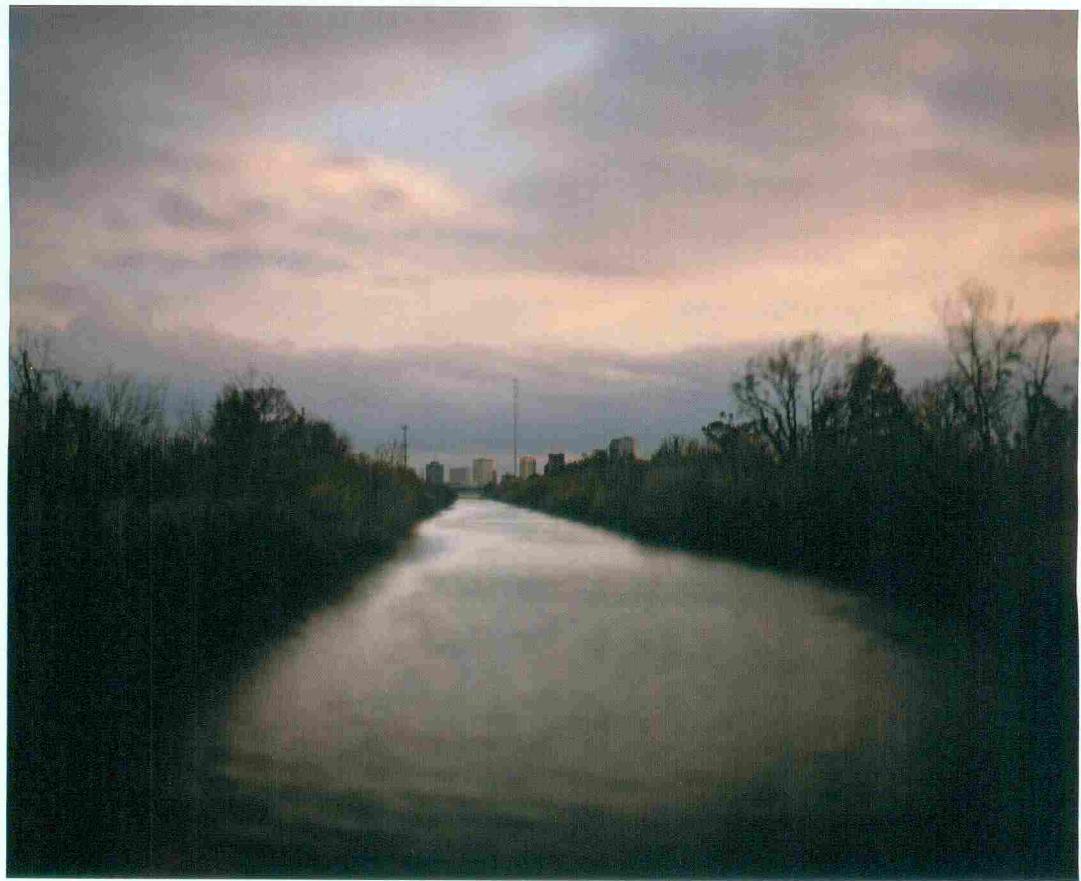
New Orleans

Six months after Katrina splintered the modest houses and wrecked the cars, the Lower Ninth Ward remained a scene of apocalypse and a reflection of lives thrown into chaos.

Born and raised in coastal Louisiana, Ernest J. Gaines is the author of eight books of fiction, including

Where have you gone New Orleans?

by Ernest J. Gaines



New Orleans Built for drainage, the London Avenue Canal carried floodwaters into the city.

Yes, New Orleans will bounce back. Taxis and buses and limousines will leave hotels and casinos, cutting in and out of traffic to deliver passengers to Louis Armstrong International Airport. They will pass by homes and apartments and offices and neighborhood grocery stores and neighborhood bars that had been, now gone but for the debris.

Yes, New Orleans will bounce back, because the taxis and buses and limousines will bring people back from Louis Armstrong airport to hotels and casinos, passing by the debris of Katrina. New Orleans will come back because the debris of homes and lives will eventually be cleared away from the streets, and the people in the taxis and buses, and especially those in limousines, will look out the window and forget what had been. Yes, after clearing all the debris of clothing and toys and furniture—refrigerators and TV sets and armoires and chifforobes (bought from Sears, Roebuck in the forties) and dressers and washstands and old pianos—and handbags and tricycles and broken dishes and dolls with one arm and no head and old laceless boxing gloves—after all this has been cleared away, New Orleans will come back.

New Orleans will come back after the old sidewalks and potholes in the streets have been repaired. Yes, New Orleans will come back after bulldozers have knocked down homes in the Ninth Ward and cleared away all remnants of the people who lived there. New Orleans will come back when streetcars run up and down St. Charles Street, and tourists won't be afraid of getting off anywhere. New Orleans will come back when infrastructure is back in place on streets like Gentilly, when trees and flowers like azaleas and camellias and magnolias are blooming again on Esplanade. New Orleans will come back when you can go to Dooky Chase and order your favorite Creole meal, and later visit Snug Harbor, where the bartender knows exactly how you like your martini. Yes, for some New Orleans will come back.

There will be times when you can cross Bourbon Street in front of traffic, knowing all the time they won't dare hit you because this is the Big Easy, and you can do anything you like. You can walk down Royal Street and look into antique shops, dreaming but never buying. Or you can go to Café du Monde for beignets and café au lait. There will be musicians out on the sidewalk—they may not be the same ones as before Katrina, but there will be music. And

Let us not worry, there will always be a New

there will be the old carriages, driven by old men, with tired old mules, and you can go for a ride in the French Quarter or along the French Market. . . .

Yes, New Orleans will come back after politicians have argued over what part of the city should be rebuilt, and what part of the city should not be rebuilt at all. There will be town meetings, and there will be private citizens screaming at politicians, but in the end New Orleans will be rebuilt. Let us not worry, there will always be a New Orleans.

But I imagine stories of loss, and I wonder.

The Joseph sisters—so we will call them, for this is only a story—used to walk two miles to church every Sunday in starched white dresses and white hats and white gloves. They walked Indian style on the narrow, broken sidewalk, the older sister in front, the younger one a pace or two behind. Every Sunday they would go to the nine o'clock service. They would come back a couple of hours later, take off their neat white dresses, hats, and gloves, and put on everyday wearing clothes and sit out on the porch. But Katrina changed all that. The older sister was drowned when six feet of water came into the house. The other sister was rescued and taken away. Some said she was taken to Houston, some said Detroit. Others said they believed she went to Atlanta, but they weren't sure.

Or imagine a man standing among the crowd on Canal Street watching the Mardi Gras floats go by. There were thousands of people, but the man remembered one voice, a little boy who called out to the floats: "Throw me something, mister, throw me something, throw me something, mister, throw me something." There were thousands and thousands of screaming voices, but the man remembered that one voice. Each time one of the revelers on the floats would throw something—a doubloon, a string of beads, a plastic horn, or a plastic whistle—someone else would get to the prize before the boy did. Then the man had the luck to catch a red plastic horn, but when he looked for the boy, the boy was not there. Who was that little boy? Where did he go? Why did he leave before he got his treasure? The man heard another voice behind him, a woman's, saying, "You gon' keep that little horn, mister? I got some beads for my little girl, but nothing for my little boy. He sure would like that little red horn."

Orleans. But will it be my New Orleans?

That was years before Katrina. Two months after the storm, imagine this same man driving down South Claiborne Avenue, where he noticed a little red plastic horn on a pile of debris. He wondered if it could possibly be the same one he had given to the woman. No, no, it could not be. The people on the floats must have thrown thousands of those things since then. But he still wondered. What had happened to the woman? What had happened to her children? Were they alive, scattered all over the country, or were they dead?

There are other stories—true stories—just like these.

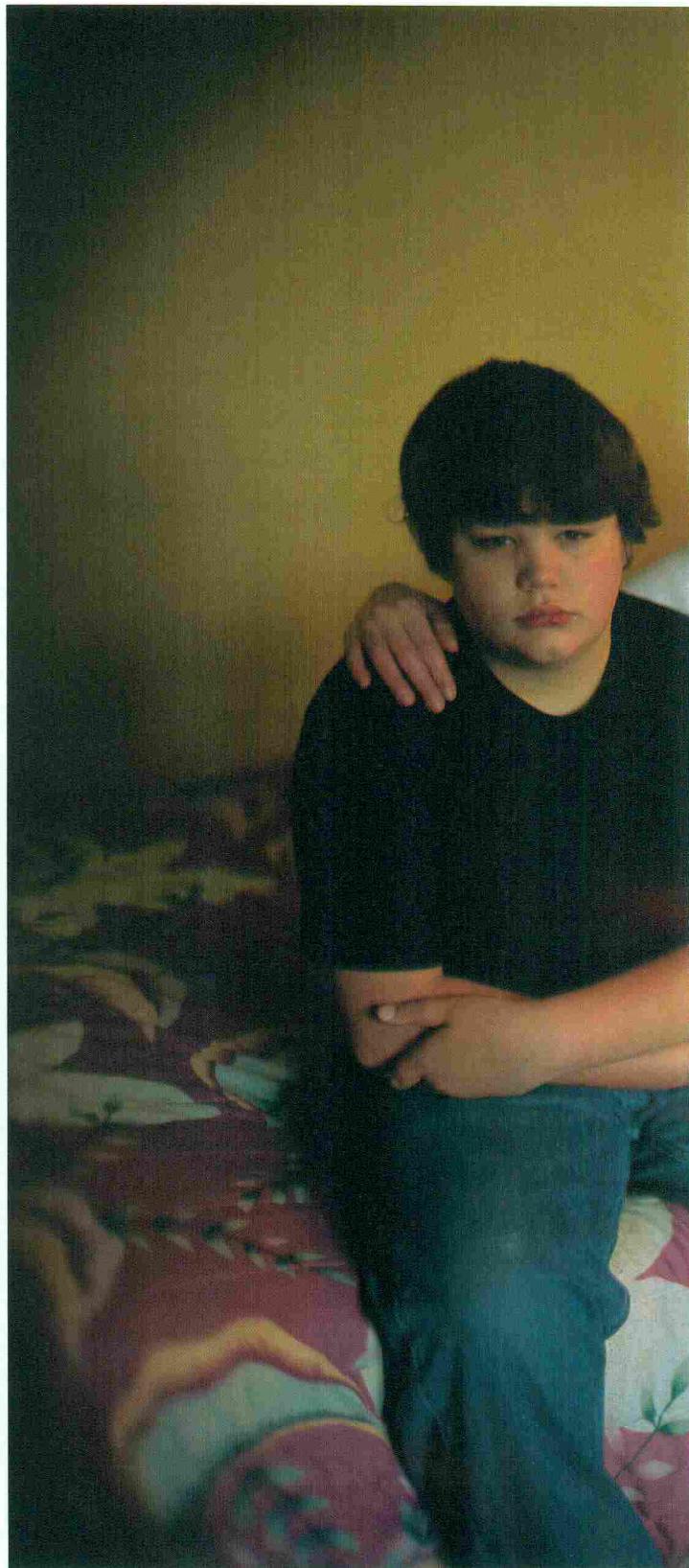
New Orleans, New Orleans, New Orleans, you will come back. But will you be my New Orleans, or the little boy's New Orleans, or the woman's New Orleans, or the Joseph sisters' New Orleans? I doubt it. Katrina and the politicians have made you a different New Orleans forever.



New Orleans Cracked mud upholsters the pews of the Greater St. Rose Baptist Church in the Lower Ninth Ward, where water rose more than 12 feet after the Industrial Canal levee failed.

Baton Rouge, Louisiana

Katrina felled a pine that cut the Jenkins family's trailer home in two. Since then, they've lived most of the time in a hotel room an hour away, cramped by salvaged possessions. Piles of hand-copied paperwork document their appeals to FEMA, the agency that pays for the room, for disaster aid to replace their uninsured trailer. "I don't know how we ever work our way out of this hole," says Delos Jenkins III, far right. He's disabled by a congenital heart defect, while his wife, Peggy, has frequent seizures. Son D. J., 12, separated from his friends and familiar school, now gets D's in subjects in which he once excelled.









New Orleans

The force of rushing water blew out doors and windows of a house in the upscale Lakeview neighborhood, leaving only a handful of belongings (above) for homeowners to pick through. More than three million people were displaced by hurricanes Katrina, Rita, and Wilma. A year later, many of them are still scattered throughout the country.





Biloxi, Mississippi

Harrah's Biloxi Grand Casino barge was condemned after Katrina swept it ashore. Even though Gulf Coast gambling palaces sustained severe damage (Katrina knocked out all 13 casinos on the Mississippi coast), they are one part of the local economy that is roaring back, to the relief of state and local officials, who collect hundreds of millions of dollars in gambling taxes. Three casinos were back in business by late 2005, and Harrah's said it would reopen the Grand this year.





Punta Gorda, Florida

The FEMA trailer park is wedged between a cow pasture and a jail. More than a hundred white trailers filled with hurricane refugees are lined up on a field of blinding white sand and gravel. Fights and drug deals are common. "I wish we could go somewhere with houses and plants and colors," says Cory Arsenault, 14, who moved to the facility after Hurricane Charley tore up southwest Florida in 2004. The trailer park is overdue to be closed, and Cory's mother, who works in a day-care center, is seeking housing assistance so the family can move into an apartment nearby. □

▲ **Dramatic Effects** Photographer David Burnett demonstrates his unusual technique, and teenagers from New Orleans record Katrina's aftermath in words and pictures, at ngm.com/0608.

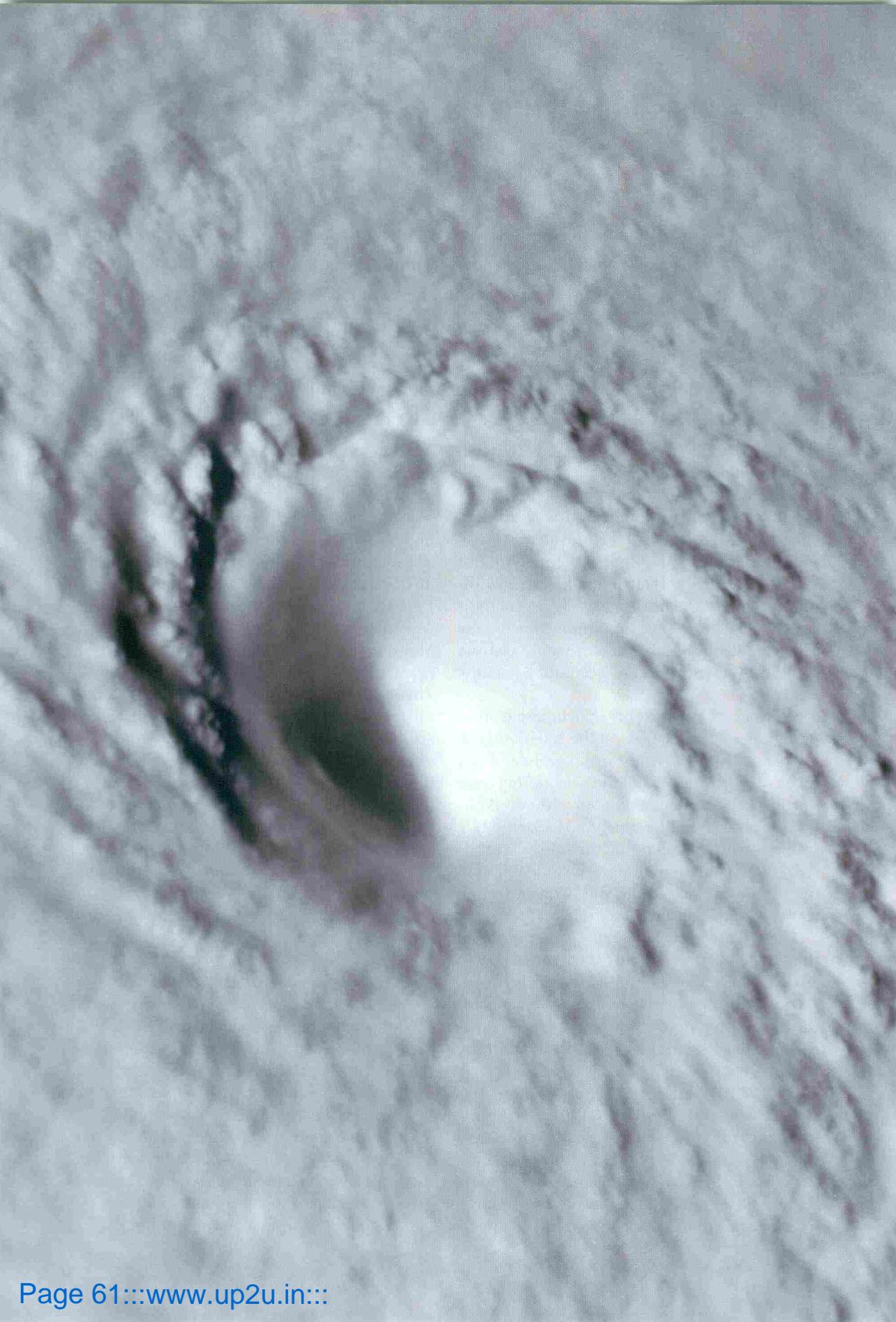
Think recent hurricanes were bad? Monster storms could become routine. Knowing when and where they will strike is a matter of life and death.

Super Storms

No end in sight

New Low

As Hurricane Wilma spun toward the Yucatán Peninsula on October 19, 2005 (the day this image was shot from the International Space Station), a hurricane hunter plane recorded an atmospheric pressure of 882 millibars in the eye of the storm. This record low drove winds of 185 mph and cemented Wilma's status as the most powerful Atlantic hurricane on record.



by Thomas Hayden

When the fiercest hurricane ever recorded in the Atlantic is bearing down on you, a salvaged armchair under a wood-and-tin awning might seem a poor choice of shelter. But that's where Don E. ("I'd rather keep my last name out of it") was parked when Wilma hit South Florida at 6:30 a.m. last October 24. For Don and a buddy, it was the start of the workday at Jimbo's Place, a ramshackle beer and bait shop down by the water on Miami's Virginia Key. "Once we got out here, it was kind of too late to do anything but ride it out," Don says with a small laugh.

Jimbo's looks like nothing so much as an abandoned shack. But whether through good luck or unexpectedly sound construction, it survived Wilma's fury. Mercifully, the winds had ebbed from 185 miles per hour at sea to 120 miles per hour by the time the storm hit, but Wilma still left almost all of South Florida without power. For the next two weeks a generator and donated bags of ice kept Jimbo's open—the only establishment on the key where visitors could be assured of a cold beer and a friendly welcome.

Wilma was a record breaker in a season of unsettling records. Katrina, at the end of August, killed more than a thousand people and left much of New Orleans and the neighboring coast in ruins. The damage exceeded a hundred billion dollars—the costliest natural disaster in U.S. history—and the toll in fractured lives is incalculable. Rita, in September, rivaled Wilma in intensity and ravaged the Gulf Coast through western Louisiana and East Texas.

These three monster storms were part of an unmatched run of Atlantic hurricanes—15 in all. With a total of 27 named tropical storms, 2005 was the first year meteorologists exhausted their preseason list of 21 Atlantic cyclone names and had to dip into the Greek alphabet for the latecomers.

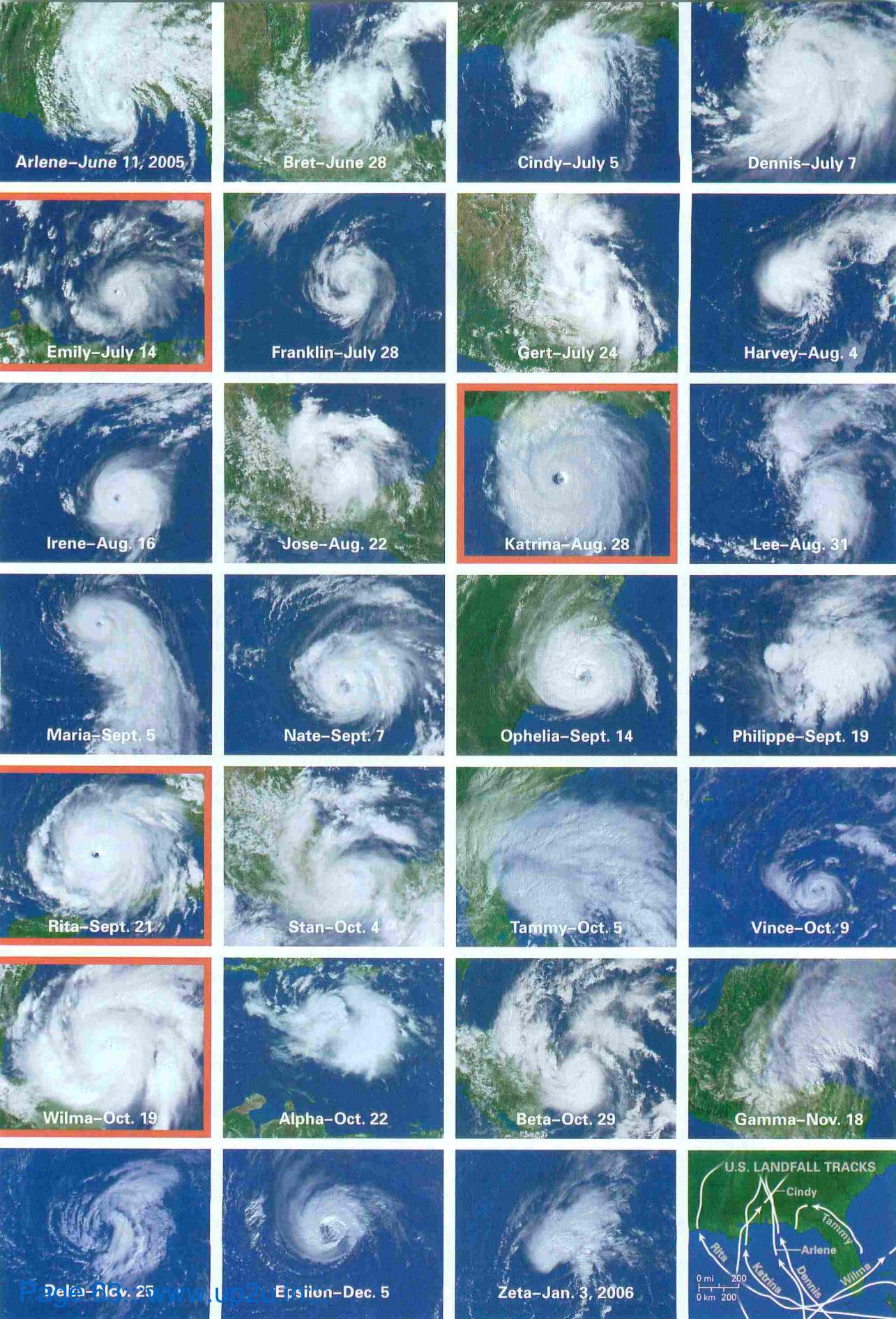
Days after Wilma, one visitor to Jimbo's was already worrying about what future hurricane seasons might bring. Sharan Majumdar, 34, is a hurricane researcher at the University of Miami's Rosenstiel School of Marine and Atmospheric Science, just across the highway from Jimbo's. He is one of a cadre of scientists trying to understand nature's most powerful storms and more reliably predict their surges, ebbs, and lurching paths from birth to landfall.

Swatting at sand flies on a warm November night, Majumdar says he can't really blame his fellow patrons at Jimbo's for deciding to stay put during Wilma. Forecasts today can get hurricane tracks wrong by hundreds of miles and wind speeds by tens of miles per hour. As a result, Majumdar says, "people often return after an evacuation to find nothing really happened." The solution, he says, is to improve forecasting through better science. "That's the only way to get people to trust the warnings."

The stakes have never been higher. Population is burgeoning along vulnerable coasts in the U.S., Asia, and the Caribbean. In the southeastern U.S., for example, coastal populations grew more than 50 percent from 1980 to 2003. The North Atlantic hurricane nursery, responding to a natural climate cycle, is experiencing a baby boom that isn't expected to end for a

2005: Year of the Hurricane

It was a season for superlatives. Never before had a hurricane caused as much economic damage as Katrina. Never before had the Atlantic seen 27 named tropical storms—so many that the list of storm names had to be extended with Greek letters. Seven made landfall in the U.S. (lower right). Never had 15 hurricanes been spotted in one season, including four Category 5 storms (colored borders).





“Mississippi and Alabama are pretty close to

decade or more. And behind it all lurks the grim possibility that global warming is making these storms stronger.

Like all weather, hurricanes are fueled by heat—the heat of sun-drenched tropical seas, which powers the storms by sending warm, moist air rushing toward the frigid upper atmosphere like smoke up a chimney. As surrounding air is sucked in at the base of the storm, Earth’s rotation gives it a twist, creating a whorl of rain bands. These whiplocks of thunderstorm activity are strongest where they converge in a ring of rising, spinning air, the eyewall, which encloses the cloud-free eye.

Hurricanes (called typhoons in the western Pacific and tropical cyclones in the Indian Ocean) can propel themselves to an altitude of 50,000 feet or more, where the rising air finally vents itself in spiraling exhaust jets of cirrus clouds. The largest ever, the 1979 Pacific typhoon Tip, sent gale-force winds across more than 650 miles. Even an average hurricane packs some 1.5 trillion watts of power in its winds—equivalent to about half the world’s entire electrical generating capacity.

Starting this great weather engine requires surface waters of 80 degrees or more, moist air, and little wind shear—a difference in wind speed at the surface and aloft that can tear apart a developing hurricane. But those ingredients often produce nothing more than a tropical disturbance—an unremarkable cluster of thunderstorms. “Disturbances look very similar day to day,” says David Nolan of the Rosenstiel School, “and then all of a sudden you get a big burst of convection, then within six hours it becomes a

depression, then it becomes a hurricane, then it’s flooding my apartment.” Katrina soaked Nolan’s 14th-floor Miami Beach home as the storm crossed Florida on its fateful course to New Orleans and the Gulf Coast. “It would be really nice to say what you need to make a hurricane,” he adds. “And we really can’t do that yet.”

One thing was clear in 2005: Conditions were ideal for making hurricanes. From June through November—the official Atlantic hurricane season—bulletins and warnings streamed from the National Hurricane Center in Miami. But the most telling moment of the season came on November 29, one day before its official end, when NHC director Max Mayfield and other officials gave a summary report. Even as the officials recited a sobering roll call of power and destruction, the NHC duty forecaster was charting tropical storm Epsilon, just then getting ready to spin itself into yet another hurricane.

Yet 2005 was just a continuation of the upward trend that began in 1995. Because of a tropical climate shift that brought warmer waters and reduced wind shear, the Atlantic has spawned unusual numbers of hurricanes for nine of the past eleven seasons. “We’re 11 years into the cycle of high activity and landfall,” NOAA meteorologist Gerry Bell says, “but I can’t tell you if it will last another ten years, or thirty.”

Weather satellites make it easy for meteorologists to keep tabs on hurricanes. But ordinary satellite images show only the cloud tops. Space-borne infrared sensors can reveal more detail, charting the size and shape of the warm eye, and satellite radar and microwave sensors can map the rain. Hurricane hunter aircraft actually fly



ideal for maximum storm surge.”

—RICK LUETTICH, UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL

right into Atlantic hurricanes. But they only probe conditions at altitudes of several thousand feet, above the worst turbulence, Jack Beven of the NHC says—“not at the surface, where they really matter to people.”

Last year, though, scientists flew a robotic aircraft straight into the maelstrom when tropical storm Ophelia was parked off the mid-Atlantic coast. The craft, called Aerosonde, swooped and circled for ten hours, as low as 1,200 feet, monitoring winds and the flow of heat and moisture from the ocean into the storm.

That foray was a test, but forecasters routinely probe the heart of storms with shorter lived devices called dropsondes. Released from high-flying aircraft into hurricanes and the surrounding winds, these instrument-packed tubes descend by parachute. “They take about 15 minutes from 40,000 feet to splash,” Majumdar says. Along the way, they measure temperature, pressure, humidity, and wind every half second, transmitting it all to the airplane before they hit the water.

By cranking dropsonde data into computer models that can simulate a storm and how it is likely to evolve, researchers have sharpened their forecasts of storm tracks. Three-day forecasts of Atlantic storm positions were off by an average of 440 miles in the 1970s; by 2005 the average error had dropped to 173 miles. But one-day forecasts were still wide of the mark by an average of 70 miles—more than enough to keep coastal dwellers second-guessing the experts. The data and models still can’t capture storms in enough detail to forecast all of their feints and swerves.

Storm intensity is proving even harder to forecast. Three-day wind-speed forecasts, off by an

A Devastated Shore

Twenty-five feet of water smashed into coastal Mississippi the morning Katrina hit, splintering buildings and killing hundreds of people. In Harrison County (western portion shown above) the water dumped ten-foot piles of debris hundreds of yards inland (red line)—enough, USGS coastal experts estimate, to fill 375,000 city garbage trucks. Scientists warn of the dangers of rebuilding within the debris zone, ground zero for surge in future hurricanes.

average of 23 miles per hour in the early 1990s, had improved only marginally by 2005. Hurricanes regularly surprise observers with their mood shifts. In a matter of hours, a Category 5 storm (winds over 155 mph) can fade to a Category 3 (111-130 mph), or a mere tropical storm can explode into a killer. “Intensity changes are the things that really hurt people,” says NOAA’s Bell.

The state of the ocean below a storm explains some intensity shifts. In 1995, tropical storm Opal was inching toward Category 1 status—an entry-level hurricane—as it made its way through the western Gulf of Mexico. Then, in just 14 hours, it surged to Category 4. Satellite readings of the warm sea surface showed nothing unusual. But Nick Shay of the Rosenstiel School and his colleagues discovered that the warm layer wasn’t limited to the top few yards of the ocean, as it usually is in the Gulf. Cold water at greater depths acts as a brake on hurricane

Looking Inside a Hurricane

To understand how hurricanes work, and improve forecasts, researchers need detailed information from the heart of the storms. During the 2005 hurricane season, the most active on record, scientists investigated hurricanes from top to bottom (this one shown in cross section) with satellites, airplanes, and new kinds of instrumented probes.

DATA
GATHERERS
FROM TOP
TO BOTTOM

Satellites
500 to
22,000 mi

A In space

Satellites track a storm's shape and position and use heat-sensing infrared instruments to map its eye and most powerful updrafts.

B In the storm

The Hurricane Rainband and Intensity Change Experiment (RAINEX) was the first to send NOAA and National Science Foundation aircraft on simultaneous flights through hurricanes, deploying three P-3 aircraft with Doppler radar through hurricane rain bands. The data showed how these rings of thunderstorms interact with the eyewall, where a hurricane's winds are strongest, to intensify or weaken a storm.

Dropsondes
Dropped from planes, these probes relay measurements of pressure, wind speed and direction, humidity, and temperature as they fall to the sea.

G-IV jet
aircraft
42,000 ft

P-3 propeller
aircraft
8,000, 12,000,
and 14,000 ft

Aerosonde
1,200 ft

C Close to the water

In September 2005, an unmanned aircraft called Aerosonde flew into the core of tropical storm Ophelia just 1,200 feet above the waves, monitoring how heat from the ocean was transferred to the storm.

Rain band

Rain band

Eyewall

Storm surge

Ocean
probes

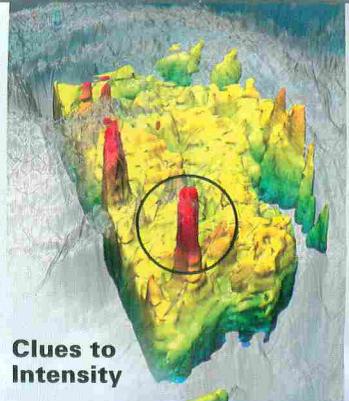
Dropped from planes, these probes then sink, measuring conditions to a depth of over 3,000 feet.

D In the ocean

Hurricanes Katrina and Rita strengthened dramatically when they crossed the Loop Current in the Gulf of Mexico. Ocean probes showed that the Loop Current's warmth extended to a depth of 300 feet, increasing the supply of heat to the storms. As a hurricane nears land, its winds pile up a destructive hill of water called storm surge.

Deeper
layers
of warm
water

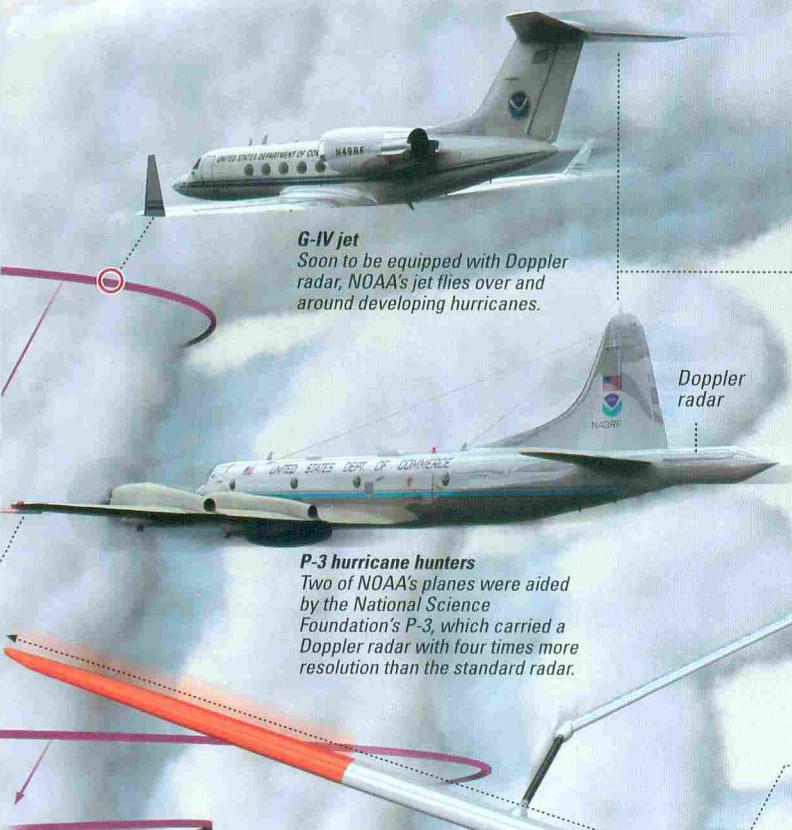
Cool water



Clues to Intensity

An image of Hurricane Rita based on infrared data from NASA's Tropical Rainfall Measuring Mission (TRMM) satellite reveals a pair of chimney clouds, called hot towers, reaching more than 11 miles high. First observed in 1998, hot towers may indicate that the storm is about to intensify.

A



G-IV jet

Soon to be equipped with Doppler radar, NOAA's jet flies over and around developing hurricanes.

Doppler radar

P-3 hurricane hunters

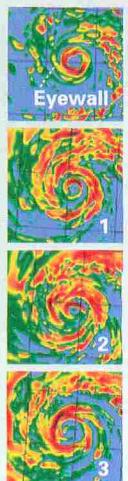
Two of NOAA's planes were aided by the National Science Foundation's P-3, which carried a Doppler radar with four times more resolution than the standard radar.

Aerosonde

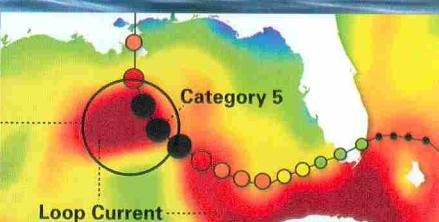
Small enough to be launched from the back of a pickup truck, the 28-pound plane flew in winds that topped 78 mph, relaying data every half second.

B

In Hurricane Rita the RAINEX experiment documented a phenomenon called eyewall replacement, in which a second eyewall (1) forms around the eye. The inner eyewall collapses (2) and temporarily weakens the storm. The outer eyewall then contracts and takes its place (3), strengthening the storm again.



C



An image of the Loop Current three days before Katrina's landfall shows how the storm intensified as it traveled over warmer waters (red).

SOURCES: PETER BLACK AND JOSEPH CIONE, NOAA ATLANTIC OCEANOGRAPHIC AND METEOROLOGICAL LABORATORY; SHUYI CHEN AND NICK SHAY, ROSENSTIEL SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE

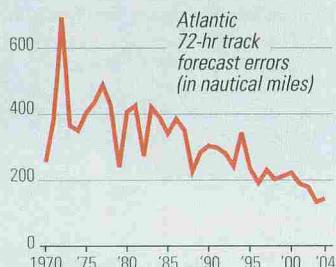
IMAGES: NASA GODDARD SPACE FLIGHT CENTER SCIENTIFIC VISUALIZATION STUDIO (TOP); ROSENSTIEL SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE (MIDDLE AND BOTTOM)

REPORTING BY BRENNAN MALONEY; DESIGNED BY JUAN VELASCO; ILLUSTRATIONS BY ROBERT KINKAID AND RAYMOND WONG

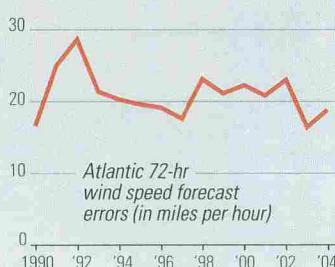
Improving Forecasts

Better forecasts of hurricane tracks and intensity could reduce deaths and property damage by enabling officials to issue more timely and accurate warnings and evacuation orders. Total damages in the U.S. for the 2005 Atlantic season alone came to more than one hundred billion dollars, with the loss of at least 1,000 lives.

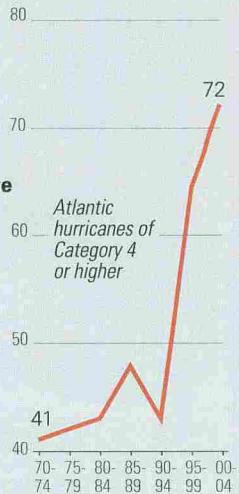
While track forecasts have improved substantially...



intensity forecasts have not...



in a time when severe hurricanes are more frequent in the Atlantic.

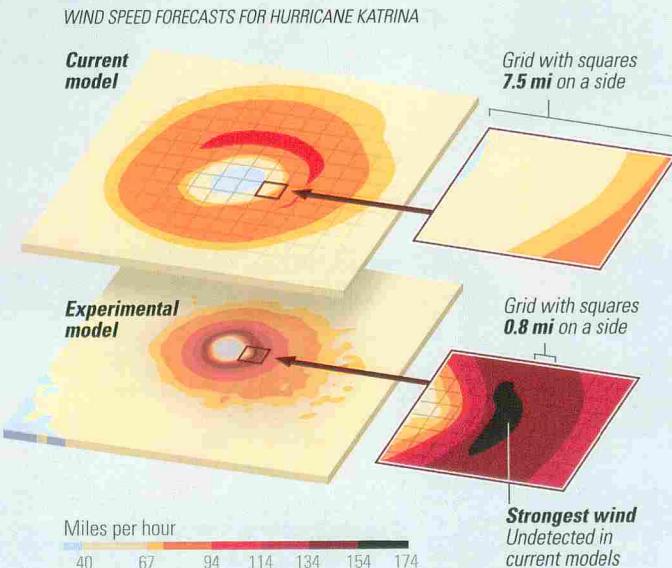


Building Better Models

Computer forecasting models break storms into a grid and use sophisticated methods to calculate the changes in wind speed, humidity, temperature, and clouds. Current NOAA models are too coarse to zero in on the features that determine where the greatest damage might occur. In 2007, the new high-resolution NOAA Hurricane Weather Research and Forecasting (HWRF) model will become operational.

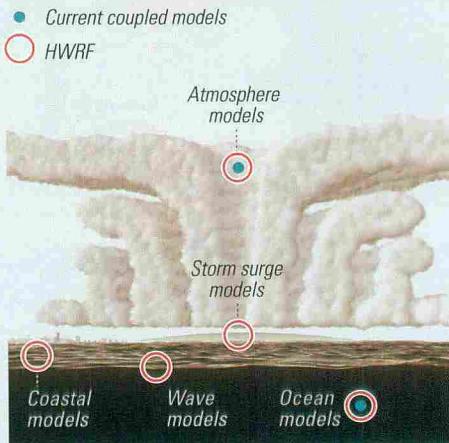
A clearer picture

Below are forecasts of wind speed for Hurricane Katrina for the morning of August 28, 2005, when it intensified to Category 5. The current model runs at a 7.5-mile resolution; HWRF will run at a 5.6-mile resolution. Researchers are experimenting with even higher resolution models (bottom). The finer grid captures critical features that the older models overlook.



A fuller picture

Accurate forecasts of a storm's track and intensity require the best possible picture of the ocean and atmosphere. Unlike current models, HWRF will rely on real-time wave, ocean, and coastal data to improve forecasts.



SOURCES: GREG HOLLAND, NATIONAL CENTER FOR ATMOSPHERIC RESEARCH; NAOMI SURGI, NOAA ENVIRONMENTAL MODELING CENTER; JAMES FRANKLIN, NOAA TROPICAL PREDICTION CENTER; PETER WEBSTER, GEORGIA INSTITUTE OF TECHNOLOGY; SHUYI CHEN, ROSENSTIEL SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE

Better science is the only way to get people to trust the warnings.

—SHARAN MAJUMDAR, ROSENSTIEL SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE

intensity when the winds churn it to the surface. But Opal had strayed across a pool of warm water extending hundreds of feet down. No matter how hard the wind blew, it stirred up more hurricane fuel, causing the storm to intensify.

The tropical ocean is littered with these deep warm pockets, and their importance was underscored last year by both Katrina and Rita, which shot up to Category 5 when they passed over a deep band of warm Gulf water called the Loop Current. Satellites can detect subsurface warmth by looking for subtle bulges in the sea surface, Shay says. “It’s not really rocket science, but here’s something that works and improves intensity forecasts by 5 to 15 percent.”

Waves, on the other hand, can blunt a storm. Whipped up by a hurricane, they can reach heights of more than a hundred feet, exerting a drag on the winds that created them. “Heat adds fuel, but waves slow the winds down—they’re fighting each other,” says Shuyi Chen of the Rosenstiel School, who is collaborating on a powerful new computer model, called the Hurricane Weather and Research Forecasting model, that will simulate the fine details of the interplay between atmosphere, waves, and ocean. “You can get a forecast one to two categories wrong if you don’t get the waves right.”

Forecasters also need to understand a hurricane’s internal workings. Katrina, for example, had grown into a certifiable monster by the morning of Sunday, August 28. Sucking energy from the Loop Current, the storm had screamed from the low end of Category 3 to a peak of 175 miles per hour, well into Category 5, in just 12 hours. As Katrina barreled toward land, the NHC issued an apocalyptic warning: “POTENTIALLY CATASTROPHIC HURRICANE KATRINA MENACING THE NORTHERN GULF COAST.”

And then, swiftly and remarkably, the storm took a breather. In satellite images late Sunday, hours before landfall, a huge bite appeared in the southern side of the eyewall. Scientists probing the storm with aircraft and radar in a project called RAINEX worked out what had happened. Katrina’s ferocious rain bands had converged

toward the heart of the storm, cutting off the eyewall’s moisture supply. The old eyewall broke up and a new one formed farther out—an inertial brake that slowed the storm just as a skater’s arms slow her spin when she thrusts them outward.

If Katrina had been moving just a little faster, it could have hit land as a Category 5 horror. Instead, thanks to the timing of its eyewall replacement, it sideswiped New Orleans as a milder—but still devastating—Category 3.

For a hurricane, landfall is a death sentence. Once its watery fuel supply has been cut off, the storm inevitably weakens. But that is scant solace to those caught up in its death throes.

From a washed-out stretch of Highway 90 along the Mississippi coast, almost four months after Katrina, the view inland took your breath away. The once lush coastline was still a litter of debris and splintered wood, houses swept from their concrete slabs, ancient spreading oaks stripped of Spanish moss and festooned with rags and tattered plastic.

Water was the primary agent of destruction here. Most hurricane casualties come not from wind but from rain, waves, and, as the scene here made harshly evident, surge—the vast mound of seawater that is pushed in front of the storm, rising 28 feet or more in the case of Katrina.

“If you really want to wallop something,” says Rick Luettich, a coastal oceanographer at the University of North Carolina at Chapel Hill, “Mississippi and Alabama are pretty close to ideal for maximum storm surge.” The coastal waters are shallow, easily plowed up by inrushing winds. Local features matter too, says Luettich, who has worked on a computer program that forecasts surge height. Bays and estuaries can funnel and intensify surge, for example, while barrier islands and wetlands can buffer it.

Coastal development weakens those defenses, as a flight over an adjacent stretch of coast in Louisiana makes clear. Channels crisscross the marshlands, dredged for boat traffic. They let salt water into the back marshes, killing vegetation

“We’re 11 years into the cycle. I can’t tell you

that holds them together. Add all the dikes and levees that hem in the Mississippi, cutting off the sediment that once replenished the marshes, and the result is staggering: More than 20 percent of Louisiana’s coastal wetlands reverted to open water from the 1950s through 2000, 27 square miles every year. The pilot holds up his chart of the tattered coast. “This here is the newest edition,” he says. “But it’s already out of date.”

The full impact of a giant hurricane can’t be measured in categories and wind speeds, in damage to homes and ecosystems, or even in lives lost. Those who live through one are never quite the same afterward. Tammy VanderZyl was a manager at Remoulade restaurant in New Orleans. She weathered Katrina in her apartment, then lived on the edge for three weeks with a group of near strangers. “You see things you never thought you would see,” she recalls. “I saw whitecaps in my parking lot.”

In his recent book, *Divine Wind*, Kerry Emanuel, a meteorologist at the Massachusetts Institute of Technology, intersperses the science and lore of hurricanes with paintings, poems, and literary excerpts inspired by the great storms of history. None is more poignant than the haiku VanderZyl composed after confronting Katrina:

*Strong wind blows away
Everything that I am
Where do I go now*

For VanderZyl and many of her fellow New Orleanians, the answer to the final line is obvious: right back home. The city will be different now. But leave? “No way,” she says. “Things would have to get way worse than this.”

Just over the horizon of scientific certainty lies the disturbing possibility that they might. Kerry Emanuel is by all accounts a cautious scientist. For years he believed there was no good evidence that global warming was making hurricanes any stronger. But last year new calculations stopped him in his tracks. When he looked at the total power of tropical cyclones worldwide, he was faced with the conclusion that during the past three decades, the

Paradise Lost

The remains of an oceanfront house now stand in the ocean off Dauphin Island, Alabama. More frequent and ferocious storms have made low-lying barrier islands ever more vulnerable. “There are places I wouldn’t pitch a pup tent,” Abby Sallenger of the USGS says.

storms have grown almost twice as destructive.

Emanuel’s results, published weeks before Katrina, were soon joined by another study, led by Peter Webster of the Georgia Institute of Technology. Webster concluded that the strongest storms—Categories 4 and 5—have become nearly twice as common over 35 years. The likely culprit, both scientists say, is global warming, which is adding hurricane-nurturing heat to the oceans.

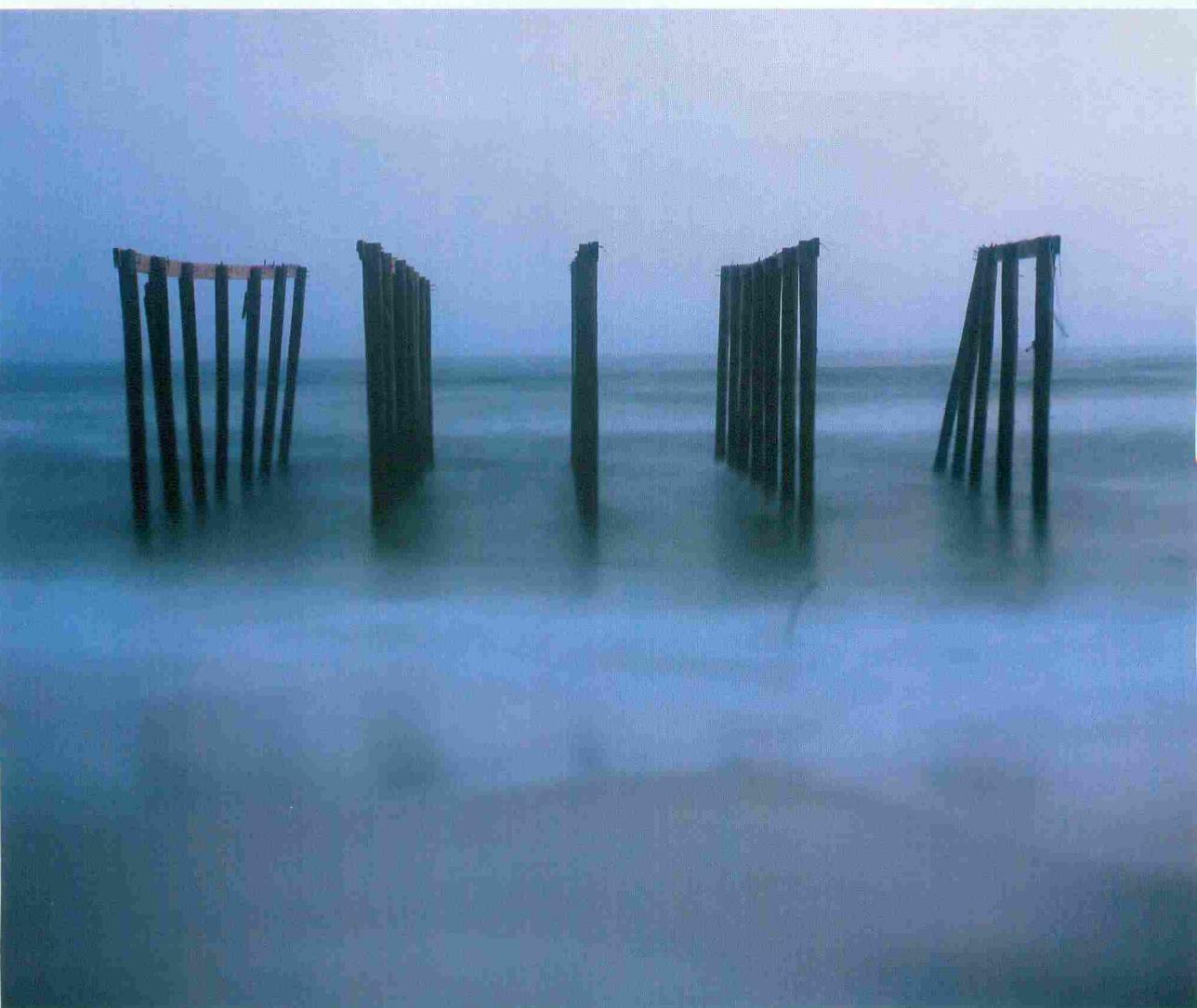
It would be easier to find a building undamaged by Katrina in New Orleans’ Ninth Ward than to locate a reputable climate scientist who doubts that human activity is warming the Earth. But the claim that hurricanes are growing stronger as a result has set off a tempest of its own. William Gray of Colorado State University, a pioneer hurricane forecaster, has called it “plain wrong.” He and the NHC’s Christopher Landsea say Emanuel and Webster’s statistics are fuzzy and that data on past storms can’t be trusted. Until weather satellites became common in the 1970s, many tropical storms at sea went unrecorded, and since then changes in sensing technology have made it difficult to compare hurricane strengths.

Emanuel agrees that the data aren’t perfect. “But this is an important issue,” he says, “and the only way to get a better answer would be to have a longer record of reliable data,” which would make any trends stand out.

To improve the record, Landsea has been analyzing hurricanes back to the mid-1800s, trying to gauge their intensity from accounts of storm surge and wind damage. Other researchers are looking for signs of past hurricanes at the bottom of coastal lakes, where the strongest

if it will last another ten years, or thirty.”

—GERRY BELL, NOAA METEOROLOGIST

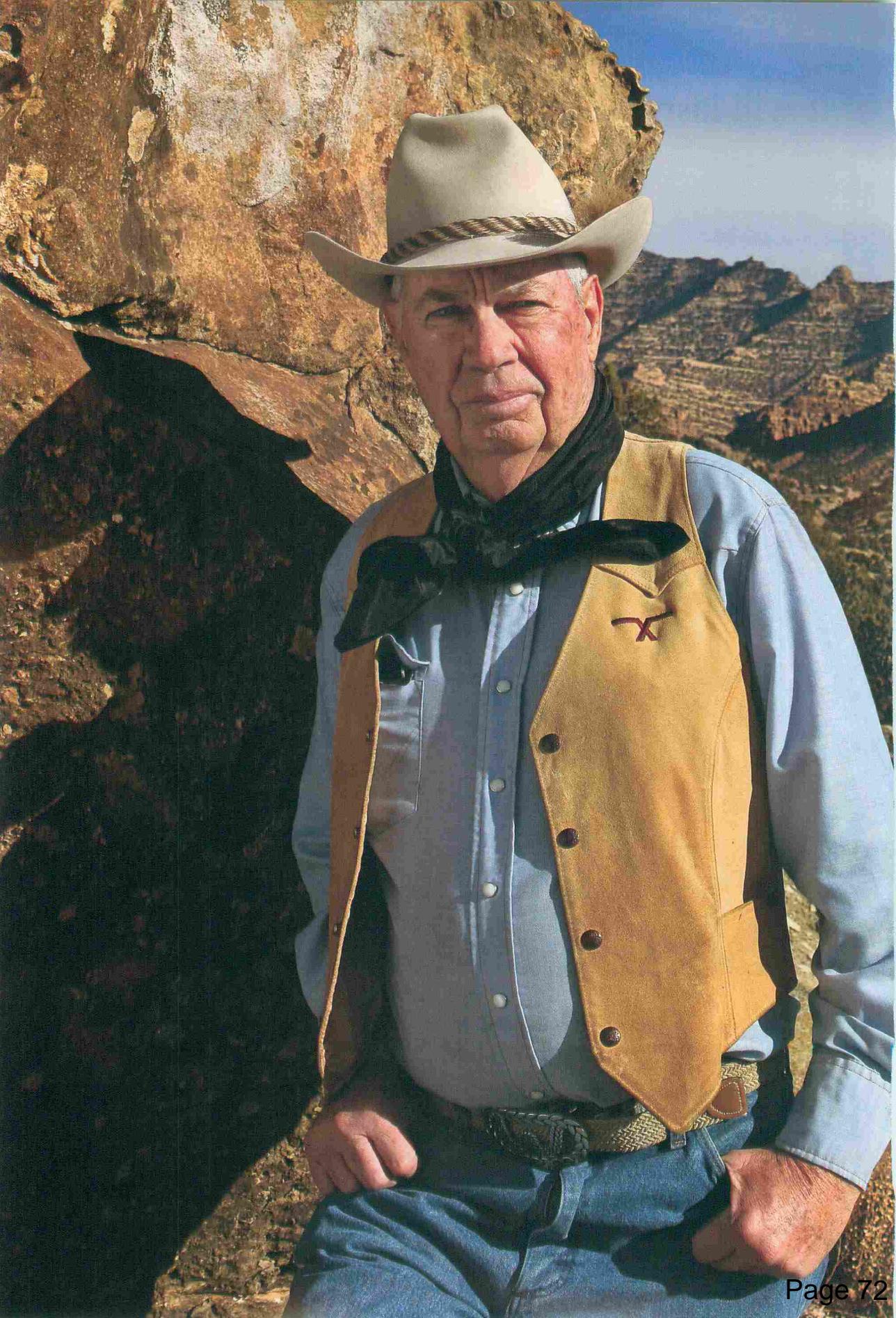


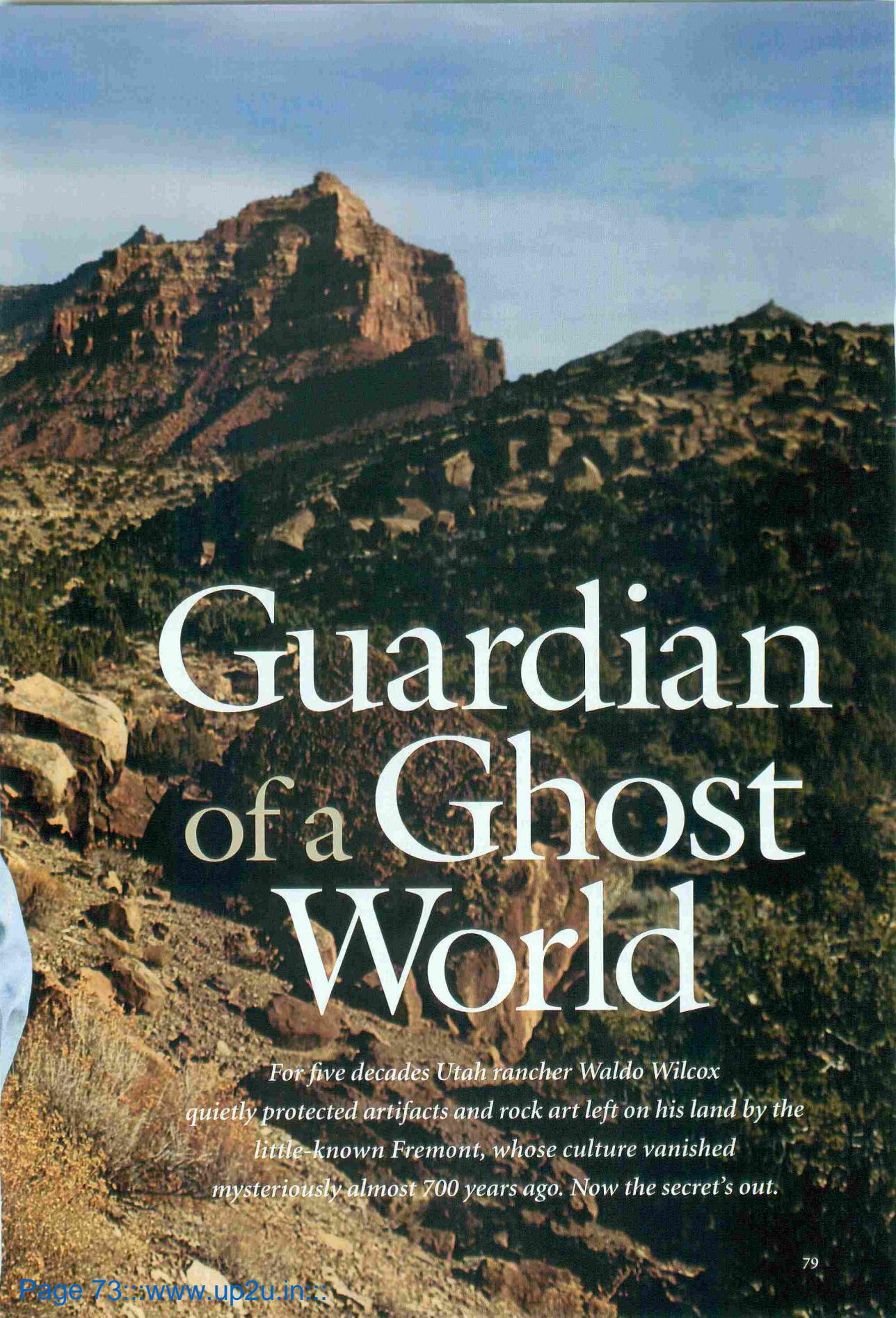
storms deposited layers of windblown beach sand, and in the wood of old trees from coastal forests. Rainwater from hurricanes is minutely lighter than regular rain, so a tree drenched by passing hurricanes preserves a subtle record of each storm in its growth rings.

While the debates go on, hurricanes will continue to strike increasingly populous coasts. That, says Landsea, is reason enough to worry. “The changes in society are as important, if not more

important than global warming, or even natural cycles,” he says. “When you double some vulnerable populations every 20 to 30 years, that’s what’s going to cause disasters. We’ve got a huge problem even if hurricanes don’t change at all.” □

► **Hurricane Fury** Have you ever lived through a hurricane? How did it affect you? Share your stories in our online forum and post your thoughts on hurricane assistance at ngm.com/0608.





Guardian of a Ghost World

*For five decades Utah rancher Waldo Wilcox
quietly protected artifacts and rock art left on his land by the
little-known Fremont, whose culture vanished
mysteriously almost 700 years ago. Now the secret's out.*

BY DAVID ROBERTS
PHOTOGRAPHS BY IRA BLOCK

W

ALDO WILCOX stayed on his father's Utah homestead in Range Creek for 50 years, even as he married and had four kids, and during that half century, the man performed a truly extraordinary feat.

As soon as the Wilcoxes had moved to Range Creek in 1951, they built sturdy fences with locked gates at either end of their prime cattle-raising spread, which stretched 12 miles along a remote canyon floor. As a grown man, Waldo regularly patrolled his valley—with shotgun in hand, rumor has it—to keep out trespassers.

In 2001, at the age of 71, he sold his ranch to the Trust for Public Lands. Waldo's wife had never much liked her remote home, and he had seen no way to divide the ranch fairly among his grown children. With heavy heart, Waldo moved into a boxy little house in nearby Green River.

The next summer, archaeologists got their first look at Range Creek. They were overwhelmed by what they found: arrowheads, potsherds, beads, grinding stones, rock art, granaries on high ledges, and rings of stones, the remnants of buried pit houses—all this, the work of the Fremont, farmers and hunter-gatherers who had lived there a thousand years ago and more.

Unlike many ranchers in the American West, for whom collecting prehistoric treasure was a customary hobby, Waldo had left virtually every artifact undisturbed. "I won't lie to you," Waldo says. "I picked up arrowheads, 'cause if I didn't, somebody else would. But I never dug anything up. Maybe I'm superstitious, but I figured them Indians wanted the stuff left there." About human remains, the rancher was particularly circumspect: "I don't want some damned hippie digging up my body after I die."

Last year at a meeting in Salt Lake City, Kevin Jones, the official Utah state archaeologist, said Range Creek was the best protected area he'd ever seen. "And the great irony," he said, "is that it was protected by a single private owner, not by all the laws that we've passed to preserve our cultural heritage."

Because of the canyon's riches Range Creek was kept secret for three years after Waldo sold it. But when a local newspaper leaked the story in 2004, a nasty controversy erupted. Powerful lobbyists for sportsmen's groups that had helped raise the money to buy the ranch insisted the canyon, now owned by the state of Utah, remain open to big-game hunting and trout fishing. Some even recommended clearing piñon and juniper trees to improve the reserve for wildlife. Native Americans were furious that the archaeologists had been invited into Range Creek before they knew of it. In the end, a number of tribes claimed ancestral affiliation, sight unseen, with the canyon, and Native American spokesmen demanded they be consulted about its future.

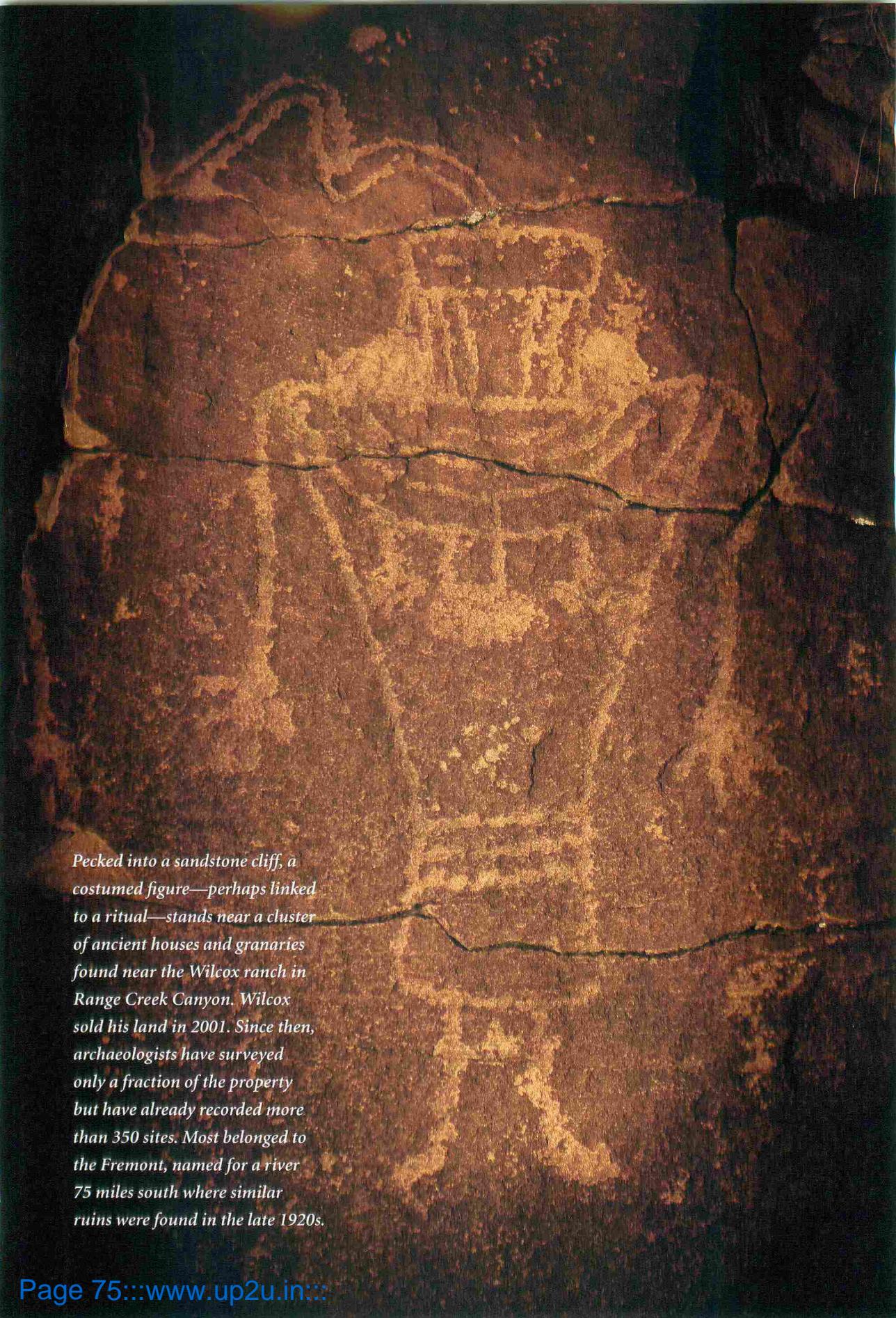
As of 2006, the future of Range Creek is still up in the air.

FROM THE START, the archaeologists enlisted Waldo as their guide to the often well-hidden Fremont sites. One spring day last year, as she walked the valley-bottom dirt road in Range Creek, team co-leader Renee Barlow, of the Utah Museum of Natural History, was bursting with pride: "So far we've found 280 sites, ranging from ruins and rock art panels to scatters of potsherds and toolmaking debris. Every one Waldo either told us about, or we found it on the way to a site he told us about. And we've only seen 15 percent of the canyon!"

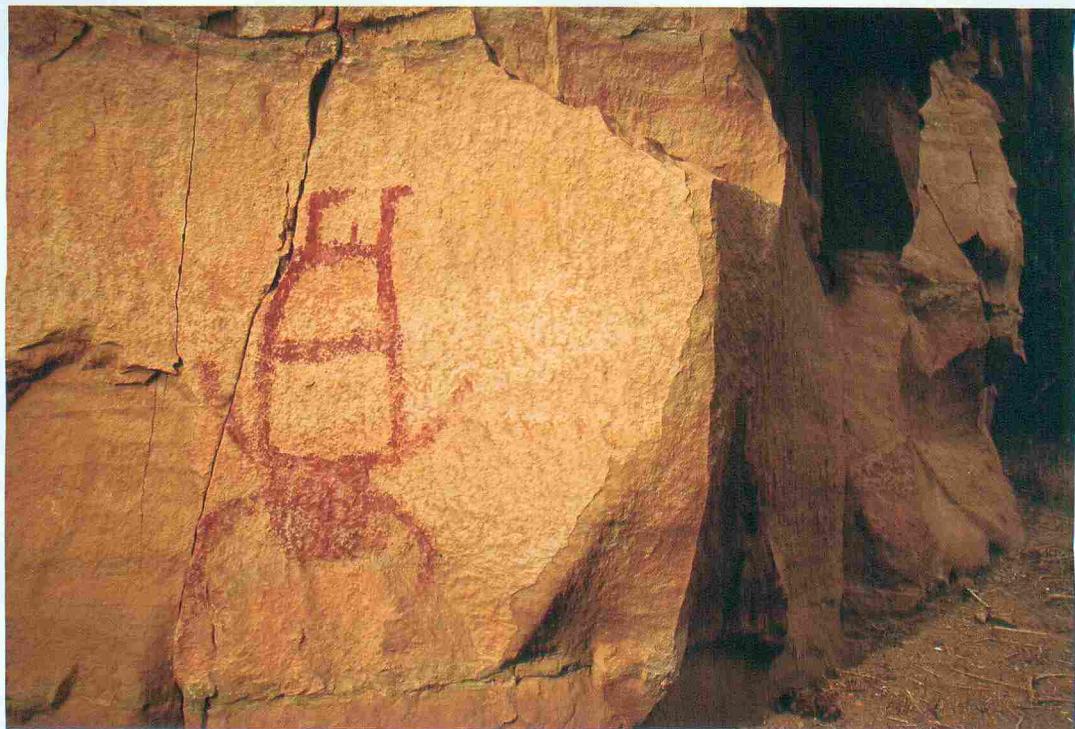
"You ain't seen 5 percent, kiddo," Waldo rejoined.

Waldo's partnership with the researchers has a certain edge, for he takes a dim view of professional archaeology—and not without reason. Years ago, at a ruin a good thousand feet above the valley floor, Waldo had found an eroding Fremont skeleton sticking skull-first out of the earth. To protect it, he picked up a nearby metate—or "corn grinder," as he calls the stone basin the ancients used to pulverize their maize—and laid it over the skull.

Four years ago, Waldo directed a pair of archaeology students to the site. They came back



Pecked into a sandstone cliff, a costumed figure—perhaps linked to a ritual—stands near a cluster of ancient houses and granaries found near the Wilcox ranch in Range Creek Canyon. Wilcox sold his land in 2001. Since then, archaeologists have surveyed only a fraction of the property but have already recorded more than 350 sites. Most belonged to the Fremont, named for a river 75 miles south where similar ruins were found in the late 1920s.



from the all-day hike exhausted but exhilarated. "They told me, 'We've discovered that the Fremont buried their dead with corn grinders covering their heads,'" Waldo recounted. "I said, 'Yep, and I bet I can tell you right where that was, too.'"

Waldo gradually developed his own theories about the ancients who once thronged Range Creek. One evening, in the cinder-block house he had built for his family that now serves as the cluttered headquarters for the archaeologists, the rancher unfurled his ideas, based on the rock art and artifacts he had found.

"The first people in here wasn't but four foot tall," he said. "I call 'em the Little People. I think the Fremont come in and killed off the Little People. Then later the Utes come in and killed off the Fremont. Every place you find an arrowhead, there was a dead Indian."

Project leader Duncan Metcalfe, of the University of Utah, absorbed this narrative from an adjoining chair. He kept a straight face, but professional dismissal oozed from his pores. Metcalfe and the other archae-

ologists had found little evidence of any prehistoric inhabitants other than the Fremont. And no professional would give credence to Waldo's Little People.

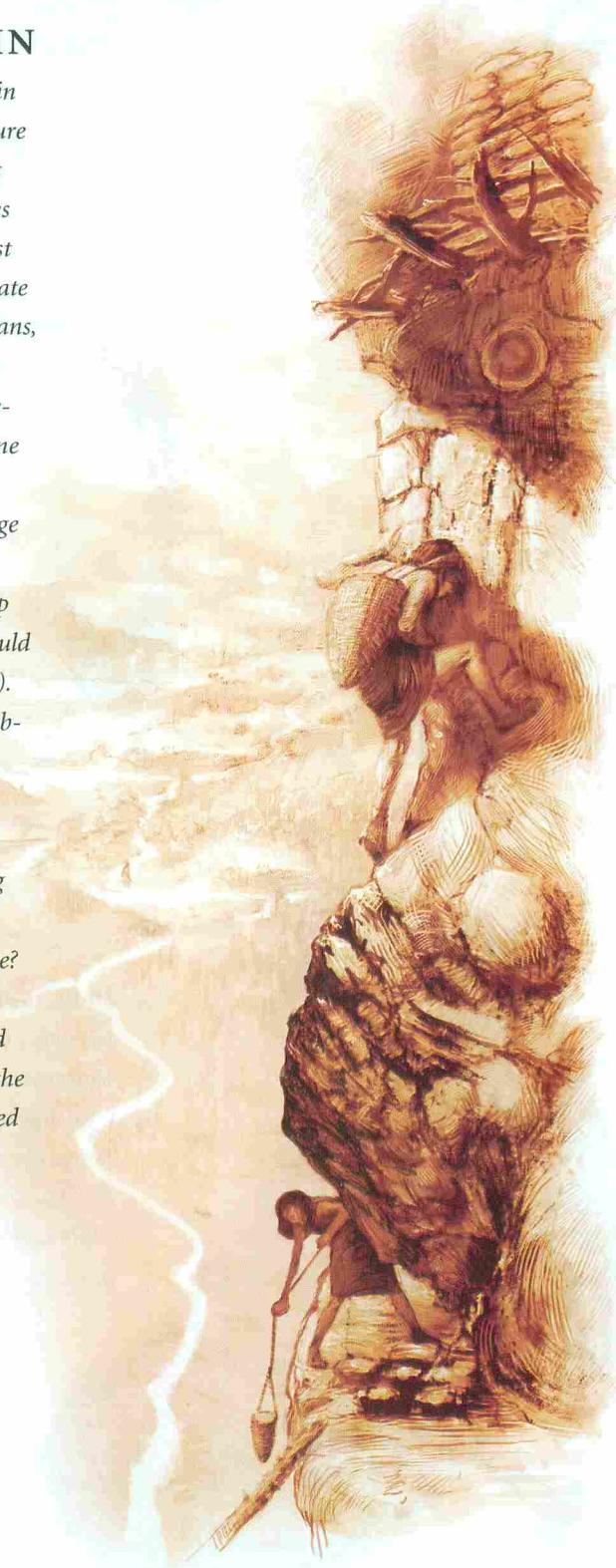
Waldo perceived the dismissal. "I may not know what I'm talkin' about," he said later, "but hell, them archaeologists don't know either. They're just guessin'?"

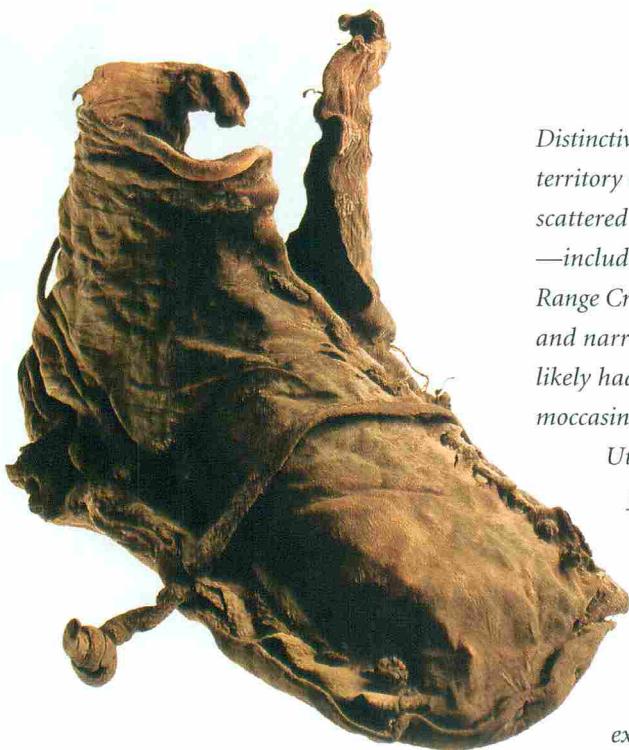
One of the first to guess was Noel Morss, an amateur archaeologist who named the Fremont in 1931, after digging sites in central Utah on the Fremont River. More than 70 years later, experts still struggle to come up with a list of distinctive cultural traits to differentiate the Fremont from their contemporaries to the south, the Anasazi. They know, for instance, that the Fremont created sophisticated rock art, leather moccasins rather than yucca sandals, and a particular kind of thin-walled gray pottery. These scholars believe that the Fremont homeland reached from Utah into Nevada, Idaho, Wyoming, and Colorado. Dwelling on the edge of the reliable (Continued on page 89)



EXTREME TERRAIN

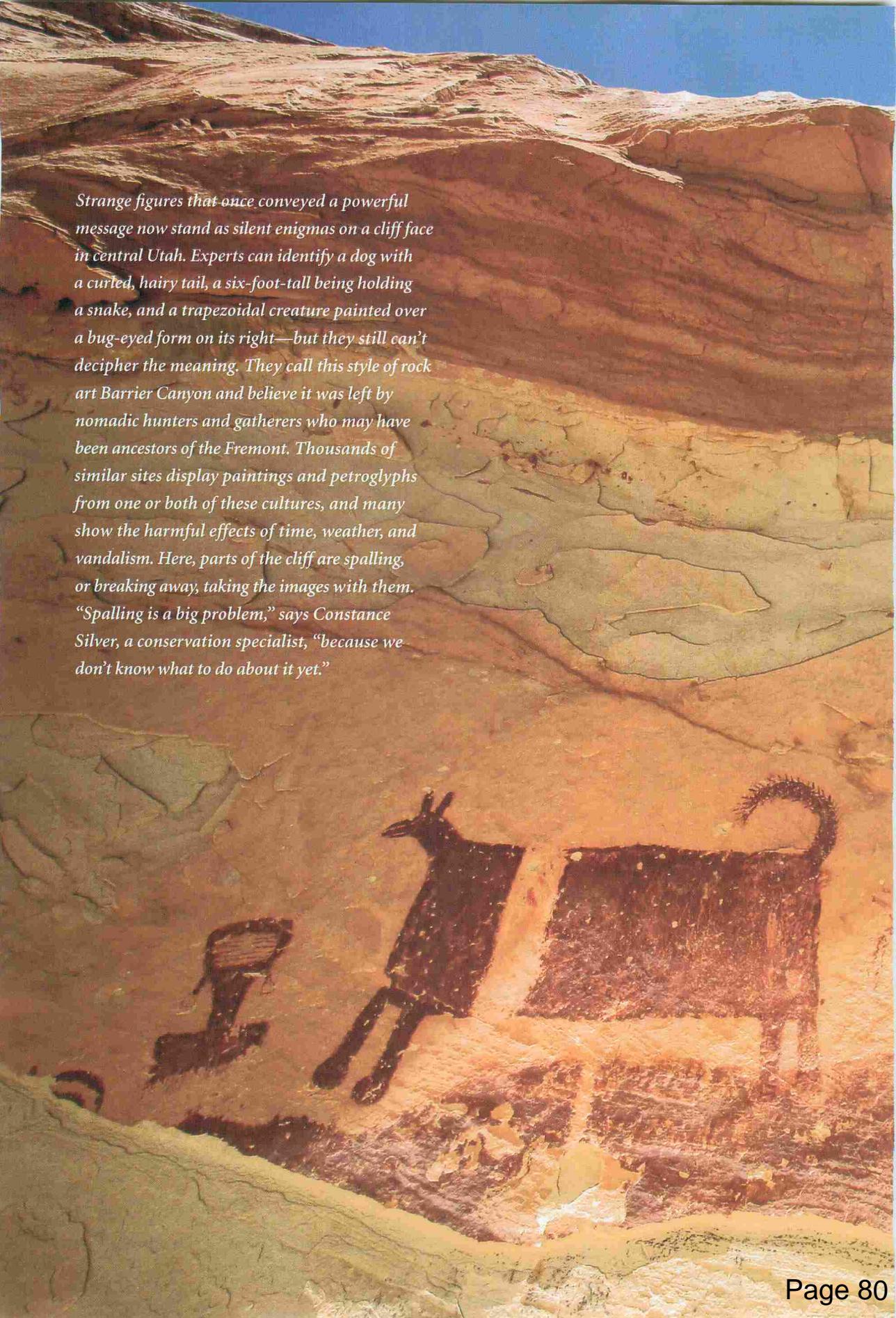
Living off the land was never easy in the region where the Fremont culture arose before A.D. 400—now most of Utah and parts of nearby states (map, below left). Even in the best of times, when the harsh, dry climate allowed the cultivation of corn, beans, and squash along waterways like Range Creek, the Fremont supplemented their diet by hunting game and gathering plants in the wild. During hard times they took refuge in villages on defensible spits of land and hauled their harvests up canyon walls to granaries that would be almost impossible to raid (right). Some must have fallen while climbing, a tragedy perhaps shown in a painting at Range Creek (left). The Fremont's aeries may attest to violent conflict. Did neighboring communities fight over scarce resources? Did a foreign group invade? Archaeologists hope the ruins at Range Creek—virtually untouched and unspoiled—will help reveal the Fremont's fate. Whatever happened to them, their culture had all but disappeared by 1350.





Distinctive artifacts found throughout Fremont territory characterize the culture that united these scattered farmers and foragers. Clay figurines—including this finely worked example from Range Creek (right)—display the broad shoulders and narrow waist often seen in rock art and likely had spiritual significance. Deerskin moccasins—like one discovered at Hogup Cave, Utah (left)—were probably everyday footwear. Fishing tackle (above) crafted from bone, wood, plant fiber, and pine resin was found in a basket in Mantle's Cave, Colorado, along with hunting snares and a net bag—the tools of people accustomed to exploiting every available food source.

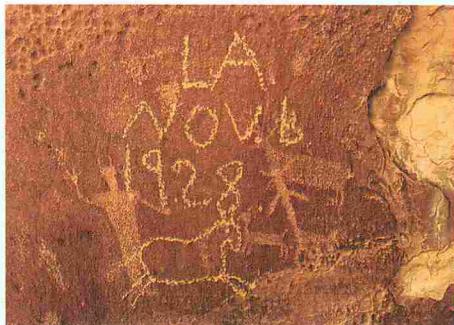
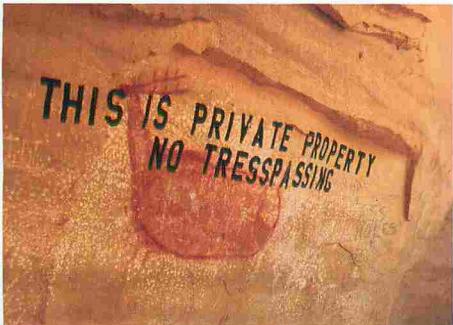
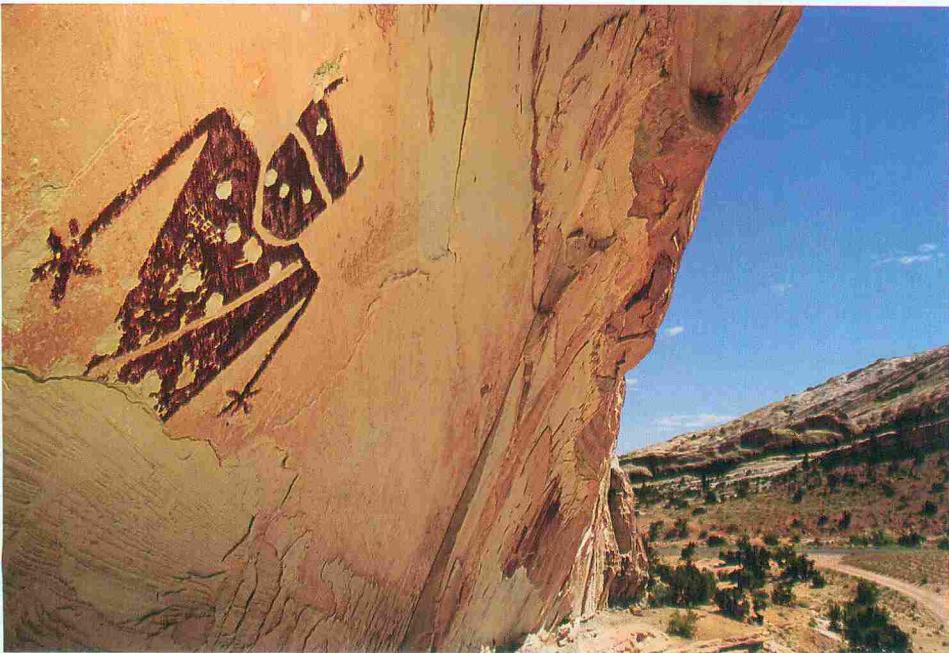




Strange figures that once conveyed a powerful message now stand as silent enigmas on a cliff face in central Utah. Experts can identify a dog with a curled, hairy tail, a six-foot-tall being holding a snake, and a trapezoidal creature painted over a bug-eyed form on its right—but they still can't decipher the meaning. They call this style of rock art Barrier Canyon and believe it was left by nomadic hunters and gatherers who may have been ancestors of the Fremont. Thousands of similar sites display paintings and petroglyphs from one or both of these cultures, and many show the harmful effects of time, weather, and vandalism. Here, parts of the cliff are spalling, or breaking away, taking the images with them.

"Spalling is a big problem," says Constance Silver, a conservation specialist, "because we don't know what to do about it yet."





THOUGHTLESS DESTRUCTION

Whether malicious or simply misguided, modern humans have left their mark on Utah's ancient art. A figure near Temple Mountain (top) bears bullet holes as well as carved initials and a date, both common kinds of damage. Like many travelers in the late 1800s and early 1900s, someone recorded a trip to petroglyphs near Rochester Creek (above right); today such vandalism on public and Indian lands can result in a prison sentence, a fine, or an order to perform public service—if the perpetrator is caught. Decades ago a rancher stenciled a misspelled warning over a painted elk in Nine Mile Canyon (above left). “There was nothing illegal about it,” says archaeologist Jerry Spangler, “but it reflects the growing conflict between private landowners and tourists who traipse over their property without permission.” So far, the sites at the Wilcox ranch are unscarred. The question now is how to keep them that way.

(Continued from page 82) growing season, where late-spring or early-fall frosts all too often ruined a whole year's crops, the Fremont never fully committed to a farming way of life. Many kept hunting and gathering as a fallback option, always ready to pack up and move on.

By A.D. 1350, the Fremont had largely disappeared from their homeland. No one knows what became of them. Perhaps some migrated east to the Great Plains and assimilated with nomads who hunted bison. Others may have been wiped out by the Ute, Shoshone, and Paiute, who might have surged into the Fremont heartland from the west as early as the 13th century. Perhaps many Fremont simply starved to death.

THE MOST SIGNIFICANT ruins in Range Creek are all high, inaccessible sites, many of them granaries. Greg Child, an expert mountaineer, Renee Barlow, and I worked our way into ones that even Waldo hadn't reached, becoming almost certainly the first visitors in at least 700 years.

That the Fremont stored their grain on such severe cliffside ledges made perfect sense to Waldo. "It's like why you put your money in a bank," he said. "If you only got a little bit of corn, and everybody's hungry, you hide it away where other folks can't steal it."

The most extraordinary of all the sites we explored—nicknamed Waldo's Catwalk by Renee—was 60 feet up an overhanging 150-foot cliff. When we arrived at the base of the cliff, Greg said softly, "My mind is blown." We could see the route some Fremont daredevil had used to reach a ledge with two granaries. The Fremont climber had leaned a 25-foot-tall Douglas fir trunk against the cliff to shinny up. From the tip of this makeshift ladder, he had "gone for it" (in climbing parlance), using hand- and footholds to launch his body over two outjuts of rock that blocked his way like roof cornices on a building. Midway through that desperate passage, he had hung on with one hand while with the other he had slammed a hefty stick into a crack, then trusted it with all his weight as he pulled himself up on it before continuing his climb.

Greg estimated the route would rate 5.11 for modern climbers, on soft, crumbly sandstone—near the limit even for today's best rock jocks using nylon ropes, sticky-soled shoes, and cams and nuts for protection. We were not about to tackle it. Instead, Greg got us into the site from

the rim above by slotting spring-loaded cams into a crack, stitching a rappel tight to the overhang, then swinging sideways till he reached the ledge.

Some 50 years ago, Waldo had *climbed to the* base of this cliff, then stared up in wonder. But when I expressed astonishment at the Fremont acrobat, Waldo was less impressed. "Look at it this way," he said. "Them Indians did nothin' but climb every day. Maybe some of 'em fell off and died, but the ones that didn't got pretty darn good at it."

IN THE SUMMER of 2005, the tension between Waldo and the scientists who had taken over his erstwhile paradise began to mount. During their four seasons in Range Creek, the teams had plotted the GPS coordinates of every site they'd found and recorded the location of every potsherd, arrowhead, and metate. But they were also gathering up artifacts to take to the Utah Museum of Natural History. Waldo was dismayed. "I think they should leave the stuff where it is," he said. "The canyon's the biggest and best museum the Indian stuff could ever be in."

Waldo has nursed a sense of doom about the canyon he loved. The cattle he ran kept the valley grazed, but today the grass stands thigh-high, creating a tinderbox. It infuriates Waldo that the archaeology team—more than half of whom smoke—won't institute a site-wide smoking ban.

"The whole place is gonna burn down," Waldo said. "Ten years from now, when the canyon's ruined. . . ."

One May evening, Waldo and I sat on the lawn in front of the cinder-block house. Far above us to the north, a butte where Waldo had discovered a ruin caught the orange glow of sunset. The old man seemed in a pensive mood. "What does it feel like to come back?" I asked.

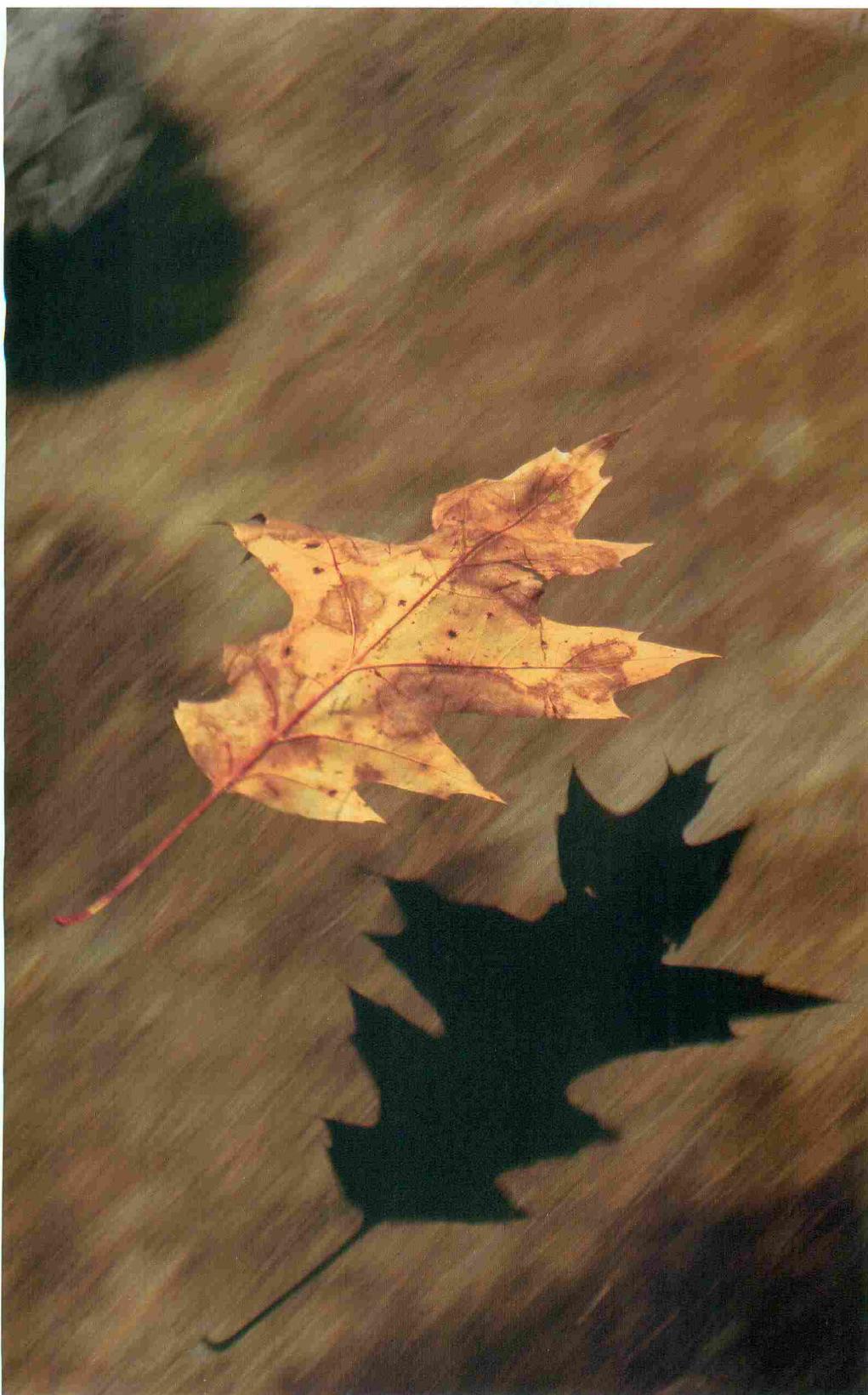
Waldo paused. "It hurts," he finally said. "I should've had my ass kicked for sellin' it. There's only one Range Creek in the world, and I let it slip through my fingers."

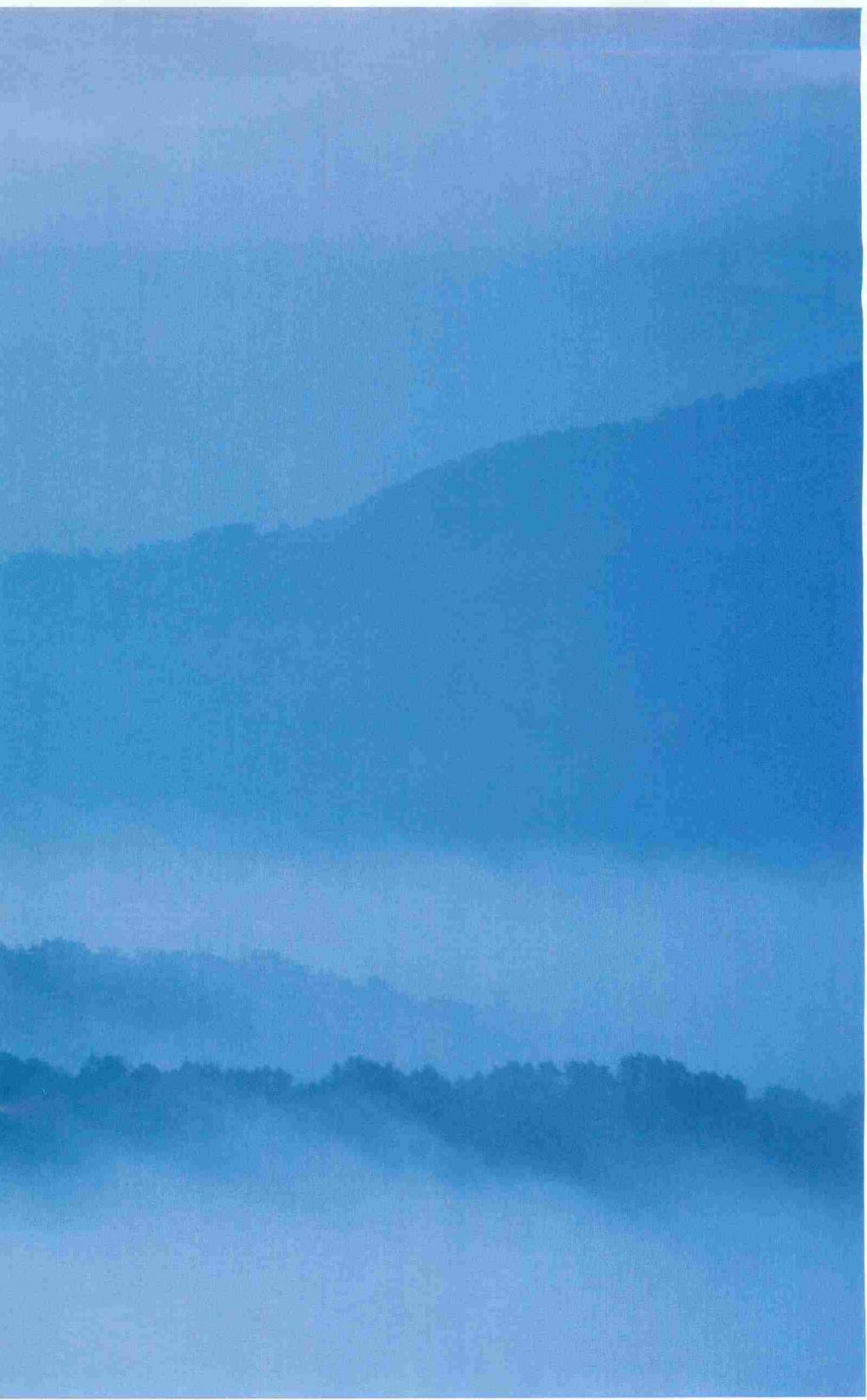
But then a certain gleam lit his gaze. "There's one other place I know of with as much Indian stuff in it as you got here," he said. "And if they ruin Range Creek, that secret's goin' with me to the grave." □

► **Outdoor Museum** Should artifacts be kept in situ or moved to museums? Share your thoughts in our forum at ngm.com/0608.

Seasons of smoke

To the Cherokee these hills were *shaconage*—blue, the color of smoke. To more than nine million visitors a year, Great Smoky Mountains National Park offers sanctuary for the soul.





Tennessee and North Carolina, this is a park for all seasons, robed in a wealth of living things.



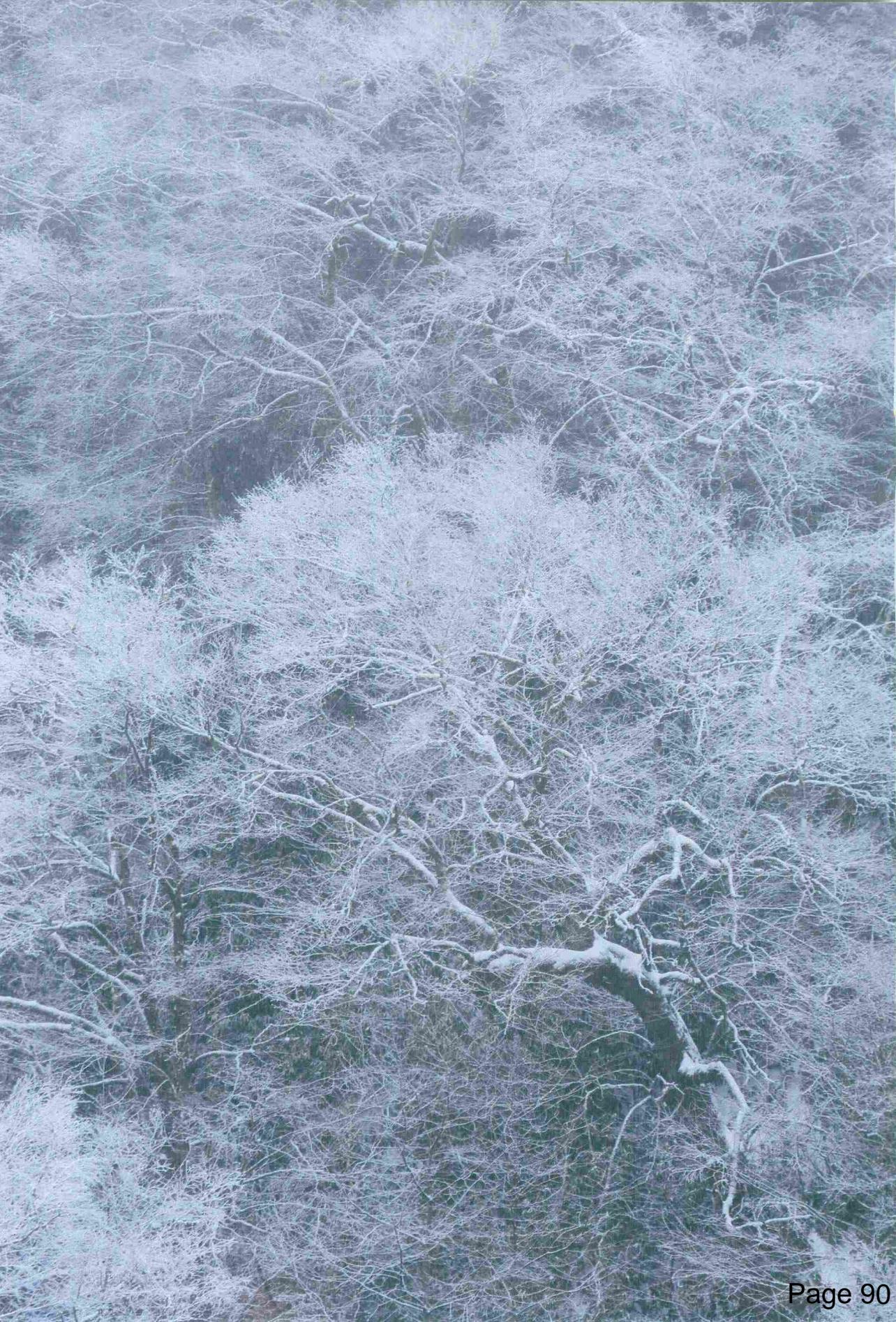
Misty ridges unfurl near 6,000-foot peaks. Straddling the border between



Pennsylvania sedge flows over Black Camp Gap in
Page 88



June (above). Adrift in autumn, an oak leaf (left) floats down Big Creek at the park's northeastern edge.



BY ADAM GOODHEART

PHOTOGRAPHS BY MICHAEL MELFORD

Surely these are, if nothing else, the most perfectly named mountains in the world. “Great Smoky Mountains”: The words conjure fog drifting off a breathing canopy of trees, mist rising above a waterfall, the soft warmth of southern air. Perhaps, as well, the tang of barbecue chased down with moonshine whiskey. But whoever may have coined that poetic phrase, his identity, or hers, is lost to history. Some say it harks back to the Cherokee word for blue—*shaconage*—for these ancient summits seem cloaked in the wood-smoke of a thousand vanished council fires.

When its boosters brag about the qualities of Great Smoky Mountains National Park, they mention both its wildness (“the last great virgin forest in the East”) and its proximity to civilization (“within a day’s drive of more than a third of the U.S. population”). It seems an impossible paradox, especially as you inch your way through Gatlinburg on Highway 441 toward the park’s busiest entrance, past an unbroken wall of motels, waffle houses, and T-shirt shops on either side. How could an area like this possibly contain some of the most verdant habitats and sublime mountain vistas in eastern North America?

Yet once inside the park itself—through which Highway 441 continues, but now as a kind of tunnel through lush foliage—it is clear that you have entered a different world. The park’s 814 square miles, stretching in an oblong mass across the Tennessee–North Carolina border, put it nearly on a scale with great western parks like Yosemite. But visitors who come in search of Ansel Adams landscapes may be disappointed. They will find no glaciers here, no geysers, no heart-stopping canyons. There are, wrote one early traveler, Horace Kephart, “no ribs and vertebrae of the earth exposed. Seldom does one see even a naked ledge of rock.”

Instead, these ancient, eroded mountains are covered by a living carpet of green. The vast wealth of the Smokies is in the

A January storm paints a winter canvas near Newfound Gap, buried by nearly 70 inches of snow each year.



A coyote flees with an apple pilfered from a visitor in 6,800-acre Cades Cove (map, right).

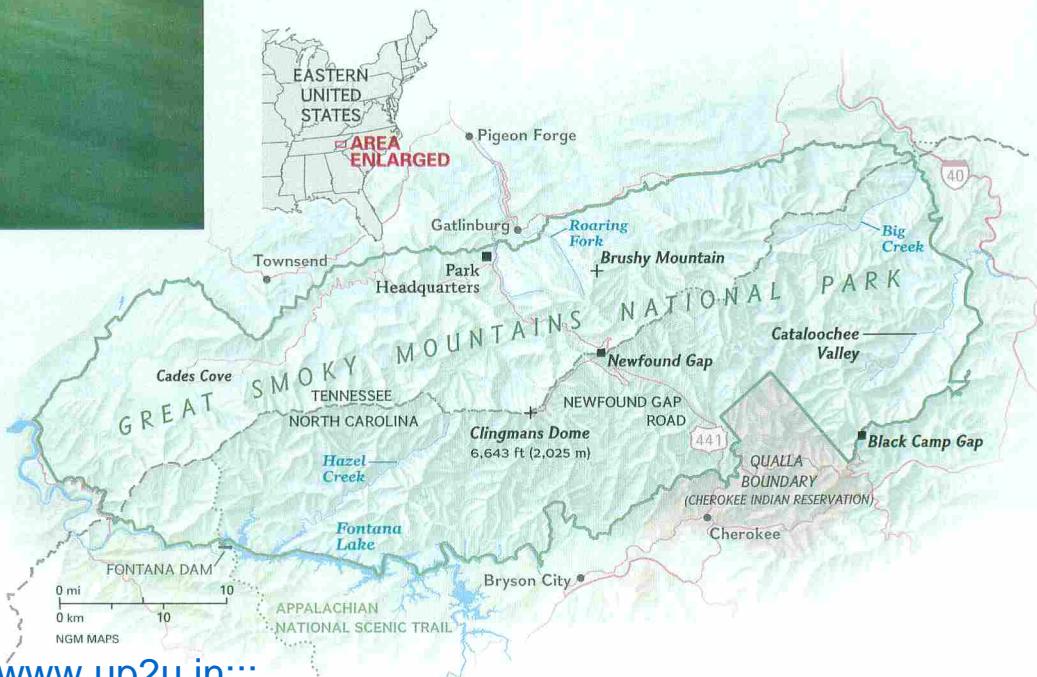


region's profusion of animal and plant life—riches that have only recently begun to be fully appreciated. Since 1997, a coalition of scientists, naturalists, and citizen volunteers has undertaken a treasure hunt to identify and catalog every single species found in the park. The survey is the most ambitious and sustained effort of its kind ever conducted in North America.

So far the tally stands at 14,000 and counting—among them some 600 living organisms previously unknown to science, many of which probably exist nowhere else. Most of these are not what one would call “charismatic” species: They include snails, beetles, moths, and new types of algae. Still, scientists say the findings indicate a level of biodiversity rivaled by few other places on the planet outside the great tropical rain forests. And they believe that the Smokies’ ultimate species total may reach ten times the current count.

A conspiracy of factors made these mountains a near-perfect hothouse of biodiversity, according to Keith Langdon, one of the project’s coordinators. The north-south orientation of the Appalachian chain helped: During the last ice age, many species took refuge from the glaciers here, fleeing southward along protected valleys. The Smokies also have a diverse underlying geology, and a heavy annual rainfall fueled by tropical air from the Gulf of Mexico. Most important, dramatic changes in elevation mean that this relatively small region encompasses a stunning variety of ecosystems. “When you hike from the lowlands to the upcountry here, it’s like hiking from Georgia to Maine,” Langdon said.

In fact, for anyone who grew up somewhere in that long stretch of the United States, walking in these woods is like experiencing familiar landscapes that have been somehow enriched, enlivened,







A sycamore spreads bare arms in late October, though fall colors usually peak in early November.

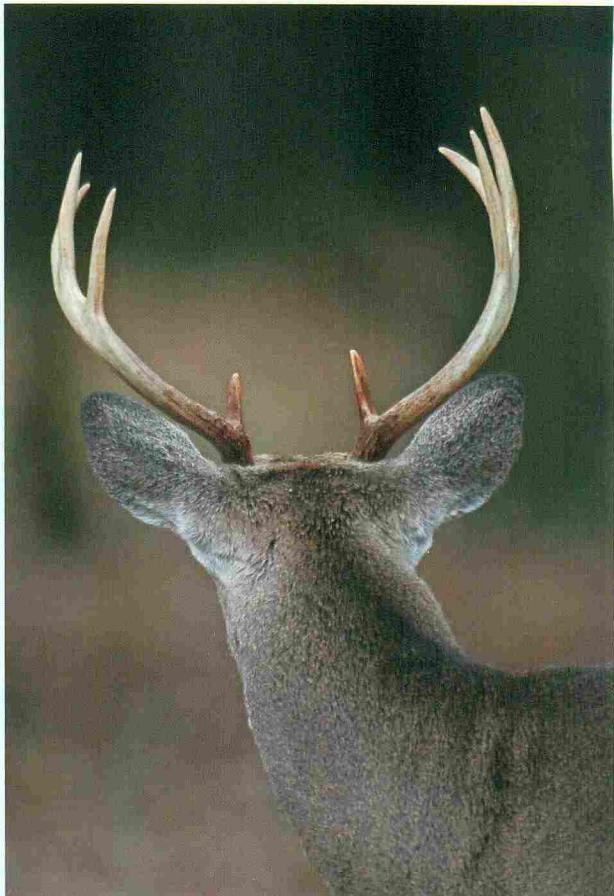
concentrated. Meadows hum with bees, groves of hemlocks echo with the knock of woodpeckers, barred rays of sunlight shift and dance above the surface of a trout stream: It is as if a thousand well-loved meadows, a thousand groves, a thousand streams, had all been distilled into this mythic forest, this eastern Eden.

THANKS TO THEIR sheltered isolation, the Smokies are—or once were—a kind of cultural biosphere reserve, as well as an ecological one. One local person who is well aware of that is Mike Maples, whose European-American forebears began settling here in the late 1700s. “There’s not a place in the park where I’m not rich in cousins,” he boasted. Maples, an avid amateur historian, spoke in the present tense, but the truth is that all those kinfolk have been gone for decades, dispersed when the national park was created in the 1930s. Unlike most of the western parks, which were carved out of vast holdings of federal land, Great Smoky Mountains National Park was stitched together from thousands of small tracts, including farms and villages that had existed for a century or more.

This part of Appalachia was the ancestral home of the Cherokee and one of the first frontiers of the fledgling United States, where the restless energies of the young nation spilled over into a green new land. Tough Scotch-Irish veterans of the Revolution made their way, rifles in hand, along the chain of mountains. They and their descendants built communities in which old ways died hard, family feuds died even harder, and moonshining was a way of life. (Without decent roads, turning your corn crop into liquor was the only way to get it handily to market.)

Although the Park Service has preserved scores of scattered buildings, not much is left of many settlements but some gnarled fence posts in the woods, a few tumbled chimney stacks, and perhaps a small cemetery on a muddy hillside. There also remains a lingering resentment of the park among some local families who were forced to give up hard-won lands and livelihoods.

I met one of the last of the dispossessed, 96-year-old Gudger Palmer, at a reunion of families that once lived in the park’s



White-tailed deer like this eight-point buck thrive in the park. In Cades Cove, 19th-century settlers planted the first gladiolus, which still bloom today (right). Since 1997, one of the most comprehensive biodiversity inventories ever conducted has logged 14,000 species of plants and animals in the park, and the count goes on.



dows to photograph deer—but they never glimpse the backcountry trails, just a few miles away, where even on a summer weekend you can hike all day and encounter scarcely another living soul.

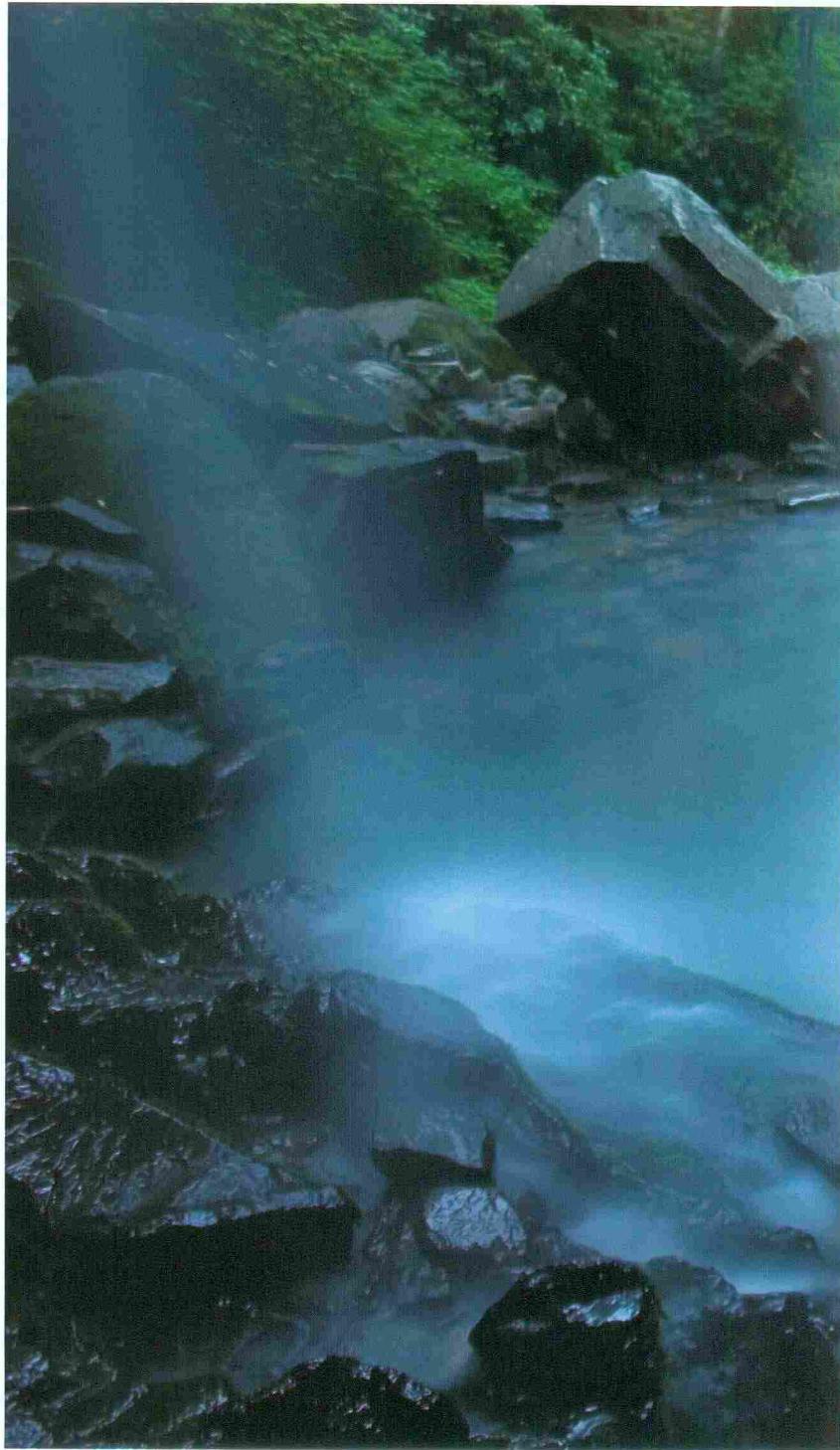
Great Smoky also suffers from some of the worst air pollution of any national park in the country, thanks not just to those cars but also to coal-burning power plants and factories throughout the eastern United States. When you hike a ridgeline on an overcast day, you may be inhaling rain clouds that have the approximate acidity of vinegar and ozone pollution that rivals nearby cities. Not surprisingly, many trees along those ridges are dead or dying, although the dirty air serves only to weaken them. The actual killers are exotic insects and other plagues. An invasive blight in the 1930s all but erased the mighty American chestnut. More recent invaders threaten the park's hemlocks, dogwoods, butternuts, beeches, spruces, and firs. "What will the forests look like 20 years from now? Probably very different," said backcountry manager George Minnigh.

Crisis and change are not new to these woods. One weekend

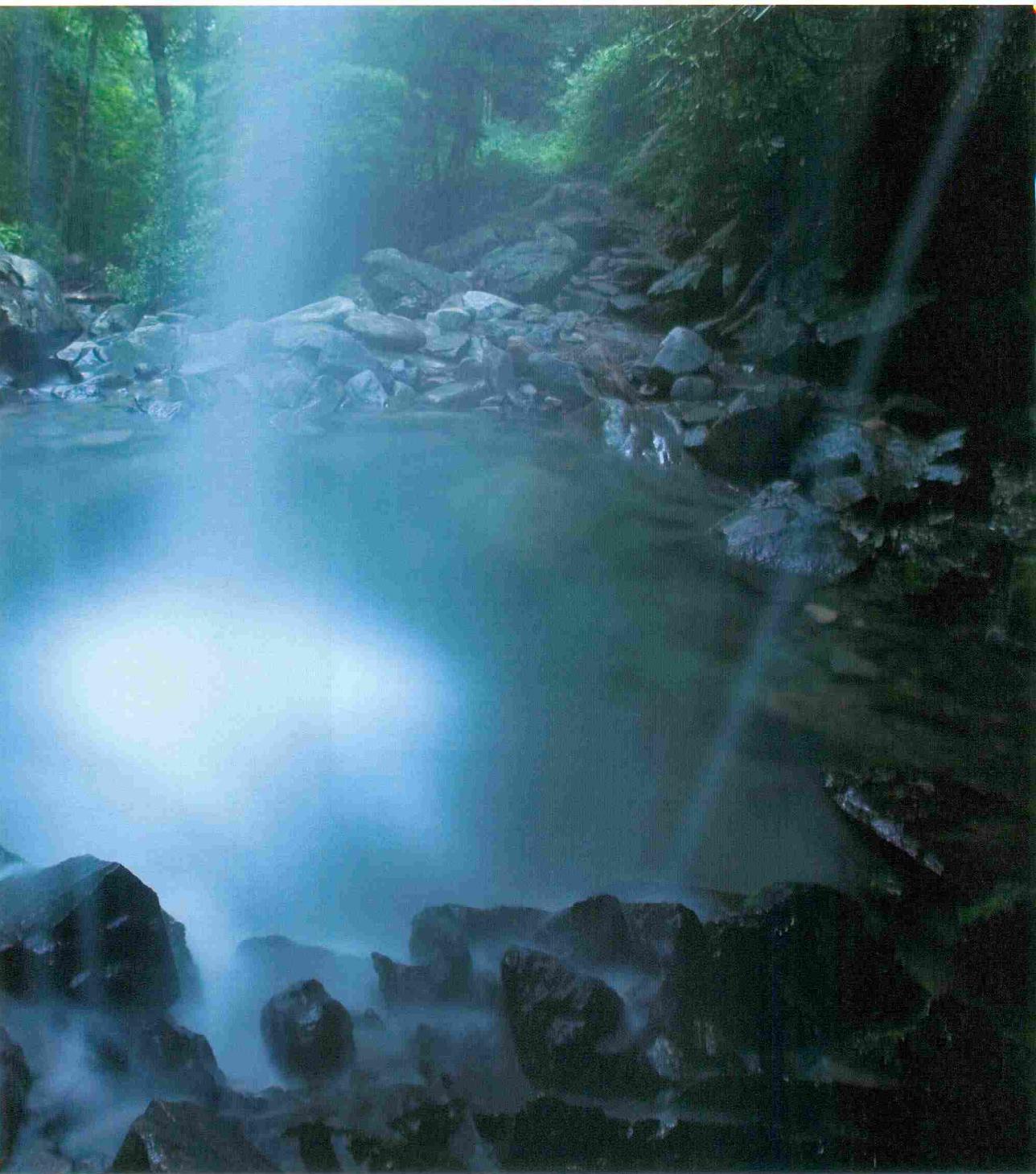
Cataloochee Valley. Palmer's great-grandfather, in the 1830s, cleared with his own hands fields that have now been made wilderness again. "I used to mow hay right here, with a horse-drawn mowing machine," Palmer said, pointing to a meadow where elk, reintroduced to the park several years ago, now roam. "There were about a thousand people in this valley, including children. It feels like home still. People didn't want to go, but we knew we had to."

Maples shares the sentiment but has also come to terms with the past. "My grandmother hated the park till her last day on Earth. But if it weren't for the park, what would all this be now? Nothing but condos and hotels, probably."

THE SMOKIES ARE, by some measures, the most visited national park in the country, yet the great majority of visitors never set foot on an unpaved surface. They may stop by the park visitors center or drive the scenic loop at Cades Cove—a grassy valley where cars crawl bumper to bumper as people lean out of windows to photograph deer—but they never glimpse the backcountry trails, just a few miles away, where even on a summer weekend you can hike all day and encounter scarcely another living soul.



A trail leads behind the veil of a waterfall along a swift stream called Roaring Fork.



I hiked up Hazel Creek, the still-remote area where Horace Kephart camped a century ago. A writer and ethnographer, Kephart came to these mountains in 1904, drawn by his love of wilderness and of communities where he found the 18th century still living undisturbed in the 20th. "All about us was the forest primeval," he wrote in his most famous book, *Our Southern Highlanders*, a vivid anecdotal account of life among moonshiners and mountain folk. "Our settlement was a mere slash in the vast woodland that encompassed it."

Years later Kephart returned to the area to find it altered beyond recognition. "Industrial logging had come to Hazel Creek. They'd just raped it," said my hiking companion Kenneth Wise, a librarian and Kephart aficionado. After the big lumber companies ramped up logging in the Smokies in the early 1900s, about 80 percent of the forest was clear-cut and turned into clapboard houses, newsprint, and World War I biplane struts.

Fighting to save what was left, Kephart became one of the earliest and most eloquent advocates for a national park in the Smokies. Today, robust second-growth forest covers the hillsides along Hazel Creek. Even that "mere slash" in the wilderness has vanished almost without a trace.

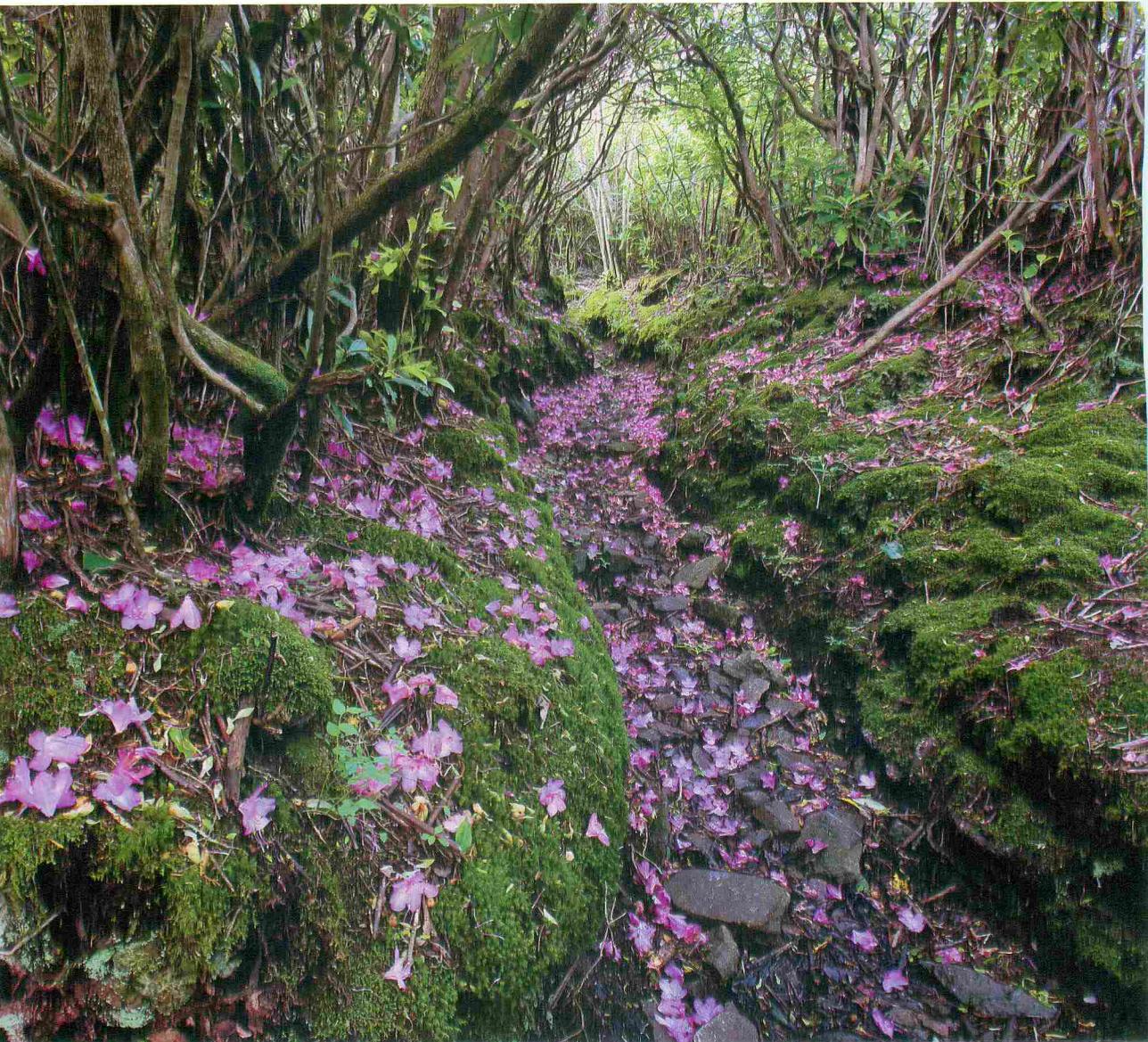
EVERYONE, INCLUDING THE MOST CASUAL VISITORS to the park—the ones just passing through on Highway 441 on their way to someplace else—stops to take a picture at Newfound Gap. It is the notch where the road crosses the ridgeline between North Carolina and Tennessee, and from the highest point there is a panoramic view of green peaks stretching row on row into the farthest distance. In the parking lot one summer afternoon, road-tripping parents and kids mingled with Chinese-speaking tourists and grizzled Appalachian Trail through-hikers.

Newfound Gap is also the spot where, on September 2, 1940, President Franklin D. Roosevelt gave a speech dedicating Great Smoky Mountains National Park. "FOR THE PERMANENT ENJOYMENT OF THE PEOPLE," reads a plaque on the stone observation tower beneath which the President spoke. Those people included thousands of schoolchildren who donated pennies to help purchase the family farms of Gudger Palmer and others.

As I stood looking at the plaque and the green expanse beyond, it occurred to me that even more than other national parks, Great Smoky is not just a natural phenomenon but also a human, political one. The wilderness below me was, in a very real sense, man-made. And perhaps, in a crowded world, a place like this can offer hopeful clues to how we can continue coexisting with nature—or early warning signs of what we stand to lose. □



► **A Park for All Seasons** Bring the beauty of the Smokies to your desktop, explore a photo gallery, and get travel tips at ngm.com/0608.

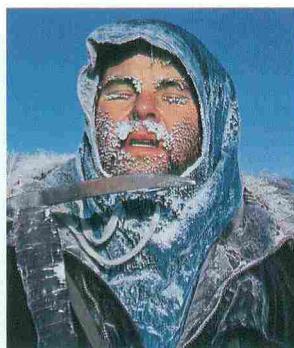


Catawba rhododendron petals carpet a trail up Brushy Mountain in June.



TOM ABERCROMBIE

1930-2006



A GEOGRAPHIC LIFE

By Don Belt

SENIOR EDITOR

Sixty years ago, a 15-year-old boy in Stillwater, Minnesota, accompanied his older brother to the town's Lumberjack Days parade. A pilot just back from World War II, the older brother, whose name was Bruce, brought along the Leica camera he'd purchased in Italy, and began taking pictures of the floats. His younger brother watched for a while, got bored, and wandered off in search of something more interesting. He noticed a boy on the curb, making faces at the girls on the floats. "Hey, Bruce," called the younger brother, "that's what you should be taking pictures of!" Later he borrowed his brother's Leica, made a drawing of it, and built a camera out of mirrors, a discarded lens, and scraps of plastic. His first photograph was of his girlfriend, Lynn.

Thus began the journalistic passion of Thomas J. Abercrombie, who died recently at age 75, after retiring in 1994 from a monumental NATIONAL GEOGRAPHIC career that took him to every continent, taught him four languages, brought him near death more times than he cared to count, and yielded 43 articles for this magazine, including some of the most ambitious ever published. During his 38 years on the staff, Abercrombie reported as a writer and photographer from

Tom on assignment in Saudi Arabia, 1965 (opposite); at the South Pole, 1957

LYNN ABERCROMBIE (OPPOSITE); ROBERT BENSON

109

He liked being married. In the Empty Quarter of Arabia, Tom and Lynn were traveling together when a local sheikh decided to claim Lynn, a tall, striking brunette he assumed to be Tom's daughter, as wife number four. He offered 30 camels for her. Tom countered with 50.



Lynn and Tom's wedding, 1952



Tom gearing up for Saudi Arabia, 1965

Japan and Cambodia, Tibet and Venezuela, Spain and Australia, Alaska and Brazil, and as the first photojournalist ever from the South Pole. But his most significant and enduring contribution surely lies in the 16 articles he produced on the Muslim world between 1956 and 1994, which guided *GEOGRAPHIC*'s readers through the glorious and tangled geography of what may be, now as then, the closest thing the Western world has to *terra incognita*.

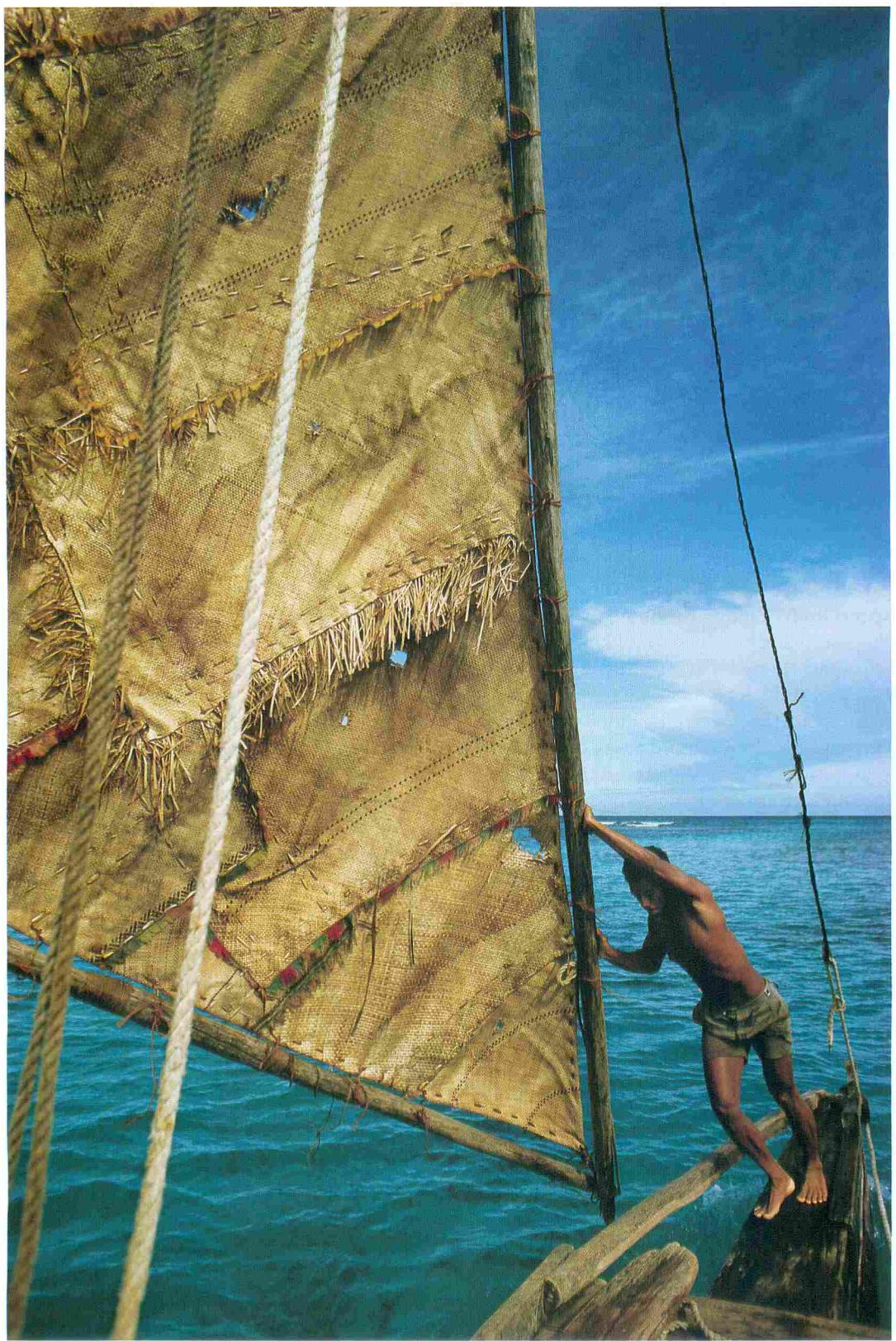
Abercrombie came to the Society in 1956, after a brief stint in the Army (scuttled by a foot fungus, which he'd picked up lifeguarding) and work as a photographer for two mid-western newspapers, the *Fargo Forum* and the *Milwaukee Journal*. Hard news coverage earned him Newspaper Photographer of the Year honors at the *Journal*, but it was a picture of a backyard bird—a robin tugging at a worm—that won the heart of *GEOGRAPHIC*'s Melville Bell Grosvenor, who said the picture could only have been taken by another robin. Abercrombie flunked his *GEOGRAPHIC* physical—those feet again—but Editorial overruled Medical, and Tom was hired.

He had never traveled outside the United States, but on his first overseas assignment, to Lebanon, he found that a short, gruff, good-natured man from Minnesota could strike up a conversation with just about anybody. He

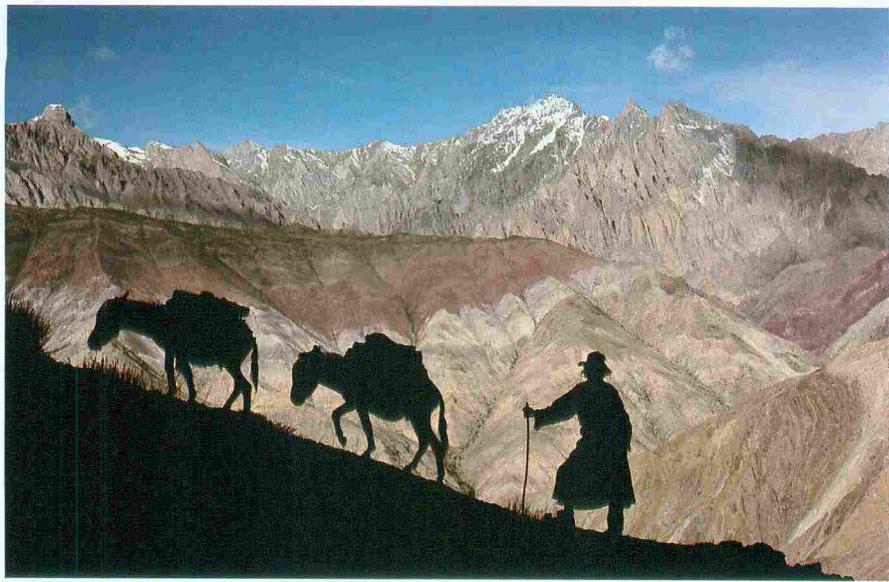
interviewed Lebanon's president, Camille Chamoun, and made the notoriously stiff Chamoun so comfortable that he invited Tom to photograph him and his wife sprawled under a tree. And in a Lebanese town, Qabb Ilyas, he made his first visit to a mosque, an epiphany of sorts that he later described in the article: "After the service I mingled with the people, drifting with the human current out the door past a long line of beggars and down the narrow street. Walking and talking with them, I had a warm feeling of belonging; they seemed to accept me as one of their own."

That moment, or something like it, played out thousands of times during Tom Abercrombie's career, which brought him into close and welcome contact with the people of more than 80 nations. He often likened himself to a one-man army when he set off into the field—in a customized Land Rover with metal gas cans lashed to the roof, a dozen or more hard cases, water jugs, sleeping bags, books, duct tape, baling wire, topographic maps, shrink-wrapped rations, mounds of pipe tobacco, and, depending on local circumstances, a firearm or two—but humanity was his secret weapon.

"Abercrombie was tough as nails, but he was incredibly gentle with people," says retired *GEOGRAPHIC* photographer Jim Stanfield, who traveled the Sahara with Tom in a 400-camel



Tom's photograph from Fiji, 1973



Tom's photograph from Ladakh, 1977

caravan. "He was a world-class listener. He'd spend hours talking to some guy in a coffee shop, smoking his pipe and yakking about this and that. He had a great mind, and infinite curiosity. He took his time with people, and they trusted him. Even when he didn't speak their language, he always found a way to connect."

In eastern Afghanistan, for example, he fell in with a group of men playing *buzkashi*, the traditional Afghan sport of galloping horses, calf carcasses, and bloody, horse-to-horse combat. "The way I got chummy with the players, who are not a real chummy bunch, was that I was photographing and a horse chewed one of these guy's ears right off," Abercrombie, who cursed like a sailor, told a reporter in 1998. "I had this hell of a first aid kit I carried around. I had damn near a hospital, this huge fishing tackle box full of morphine and sharpened scalpels. So I fixed this guy's ear up and made him feel a little better."

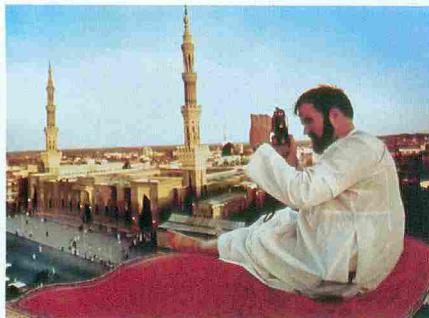
Abercrombie's medical exploits were legendary. There was the amputation, with a pocketknife, of a pilgrim's gangrenous toes in Tibet, his emergency care of survivors after an earthquake in Iran, his one-man triage and field surgery after a speeding truck piled high with passengers flipped over on a highway in Nigeria.

His expense accounts, too, elicited gasps from

his colleagues, especially those in Accounting. Yet the man who listed two AK-47s as "auto insurance" on his expense report from Yemen, presented the occasional gift of a sheep or goat to a Bedouin host, or bought a Cessna 185 to fly himself around Alaska was merely being practical. An early audit of his accounts by headquarters revealed a miserly average daily expenditure on meals and hotels of \$17.52. Tom, of Scottish blood, thought that a bit high. This was, after all, a man who wrote his stories on the backs of earlier manuscripts, and wore his pencils down to the nub. His home woodworking shop is a monument to thrift, littered with hoarded wood scraps and illuminated by handmade shop lights with shades of recycled aluminum pie plates.

Favored by genetics—he hailed from a line of civil engineers—Abercrombie also made his mark as a field mechanic. Once, at the *Milwaukee Journal*, he designed and built a waterproof housing for his camera out of Plexiglas and used it to photograph a Lake Michigan shipwreck for the newspaper. His boss in Milwaukee, Bob Gilka (who later became *NATIONAL GEOGRAPHIC*'s director of photography), recalls that Tom and his wife, Lynn, drove their car as close to the water's edge as possible. "Then Tom tied one end of a long rope to the bumper, the other end around his waist, and waded out

Tom was intensely private about his conversion to Islam and making the hajj to Mecca. But there's no doubt that his faith was genuine, and that it inspired him to build bridges of understanding between the Islamic world and the West.



Self-portrait in Mecca, 1965



Tom in Afghanistan, 1967

into the lake with his homemade underwater camera to test it. He and Lynn had worked out a plan: If there was trouble, he would signal by pulling on the rope—Lynn’s cue to start the car and pull Tom out of the lake.”

He liked being married. In the Empty Quarter of Arabia, Tom and Lynn were traveling together when a local sheikh decided to claim Lynn, a tall, striking brunette he assumed to be Tom’s daughter, as wife number four. He offered 30 camels for her. Tom countered with 50, and the pair, who were married in 1952, stayed together. “I really needed Lynn,” Tom later explained. “And what would I do with 50 camels?”

Such trips together were rare in the early years. Though a *GEOGRAPHIC* photographer herself, Lynn was busy raising their daughter, Mari, and son, Bruce, at the couple’s waterfront home in Maryland. So Tom often traveled alone, thousands of miles from home for months at a time. Yet whatever spare time he had went to writing long, tender letters to his “Rabbits” back home, or filling his suitcases with exotic knickknacks from the local suq to spring on them when he came through the front door.

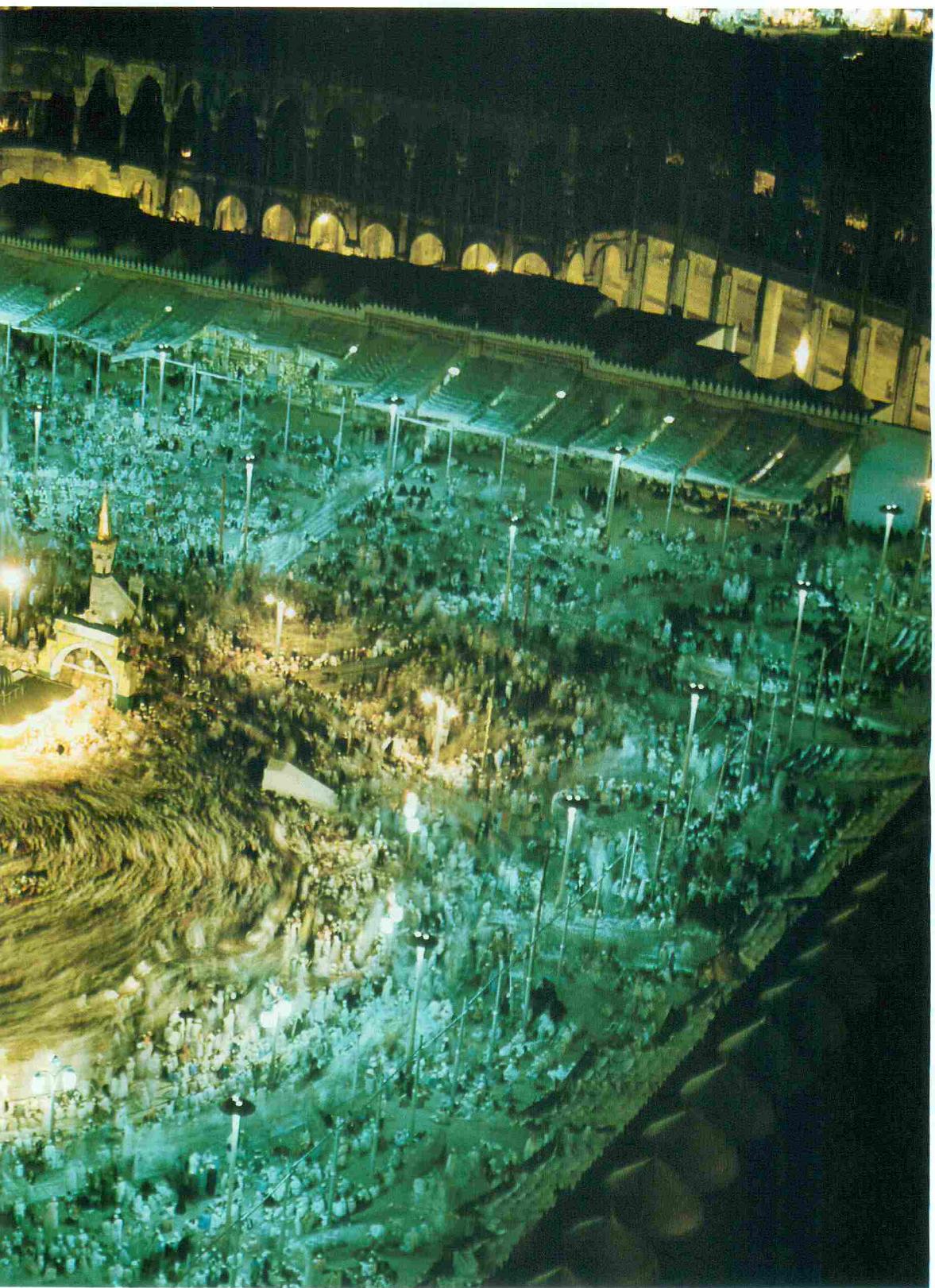
By the mid-1960s, Tom was spending so much time in the Middle East that it was clear he’d found his niche. He mastered Arabic

(along with German, French, and Spanish), read the Koran, and adopted an Arabic name, Omar, on his travels. But he was not, to anyone’s knowledge, religious, and few anticipated the news that arrived in a letter to Editor in Chief Melville Grosvenor, dated April 17, 1965. It was Tom, writing from Mecca: “Greetings and best wishes from Islam’s holiest city. I’ve just had the singular honor to witness, to cover photographically, and to participate in one of the most moving experiences known to man, the annual pilgrimage to Mecca and Arafat. It has been an unforgettable personal experience and, without a doubt, the climax of our coverage of Saudi Arabia.”

Tom was intensely private about his conversion to Islam and making the hajj to Mecca. But there’s no doubt that his faith was genuine, and that it connected him personally to the world’s Muslims. It also inspired him, through his work, to build bridges of understanding between the Islamic world and the West. Tom once said that his proudest professional accomplishment was writing and photographing “The Sword and the Sermon,” his epic journey through the history and culture of the Muslim world that appeared in the July 1972 issue. The article took him to Kazakhstan, where he visited a mosque in Alma Ata and attended Friday prayers. In a letter



Tom's photograph of the Grand Mosque, Mecca, 1965



His expense accounts elicited gasps. Yet the man who listed two AK-47s as “auto insurance” on his expense report from Yemen, presented the occasional gift of a sheep or goat to a Bedouin host, or bought a Cessna 185 to fly himself around Alaska was merely being practical.



Tom, Bruce, and Lynn—Long Island, 1972



Tom in Extremadura, Spain, 1989

home he described it, with typical understatement, as one of the most emotional experiences of his life.

“I introduced myself to the sheikh, and as we talked in Arabic the growing congregation of old Kazakhs, magnificent in their costumes and manners, began to gather around. When I showed them pictures of Mecca and the pilgrimage they were damn near crying. Many rubbed their hands on my clothes and then on their face for what blessing a hajji might bring. I was pretty choked up.”

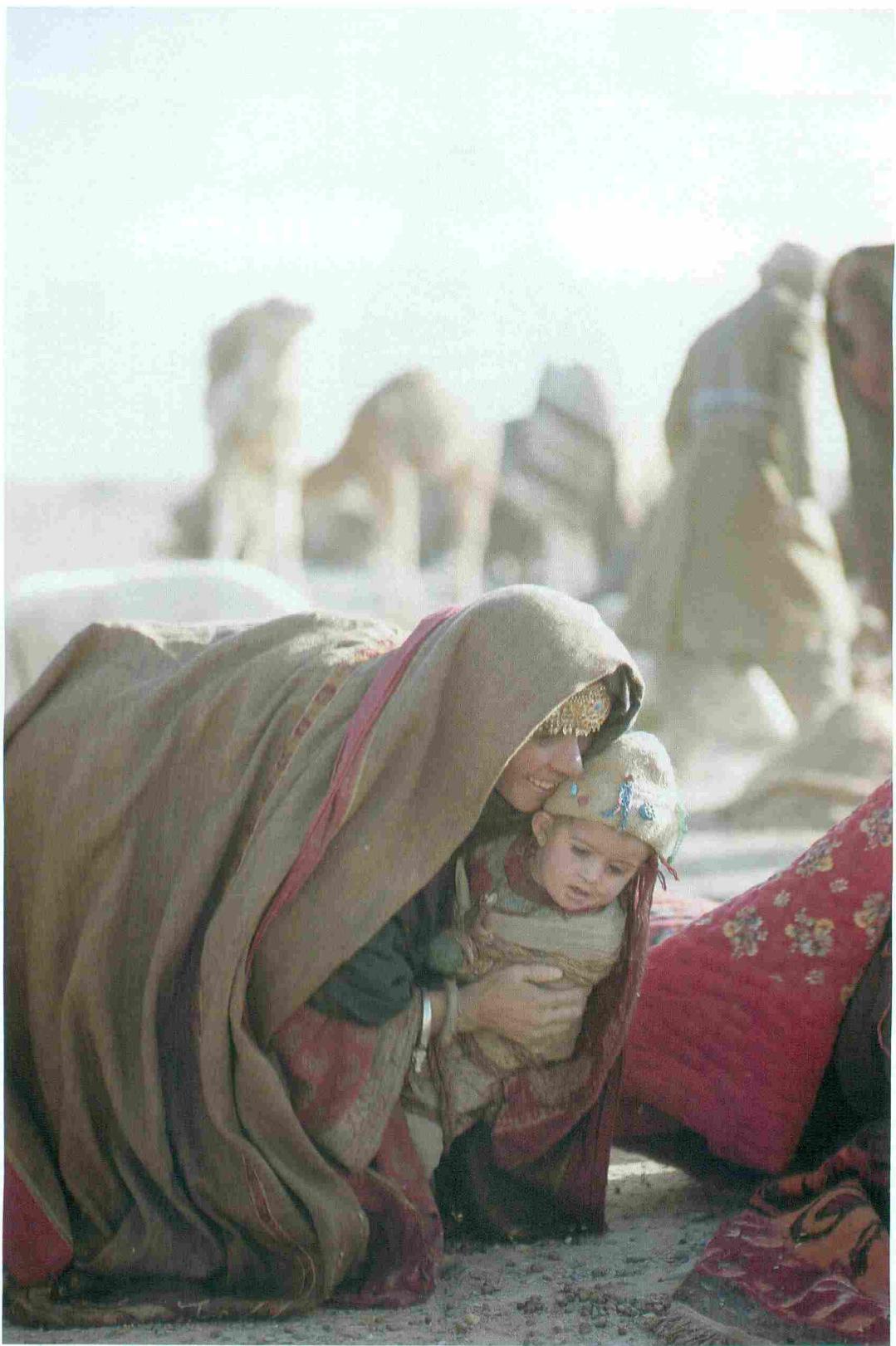
Crowned with such experiences, Tom’s GEOGRAPHIC career came to a close in 1994, and his family prepared, with some anxiety, for his homecoming. “Tom was never happier than when he was getting ready for an assignment—packing, studying maps, making plans,” Lynn said, “so I didn’t know what to expect when he retired. But he never looked back. He loved being home, building his boats, having lunch with his buddies. He was still a wanderer, of course. He’d go off on a walk and be gone for two or three hours, because he’d gotten caught up talking to a neighbor, or some perfect stranger he’d met on the road. But in general, he just went native.”

Tom toiled over his memoirs, a PG-rated version of the long, hilarious, self-deprecating tales he’d been telling over the lunch table

for decades—although writing them down, a lonely business, wasn’t nearly as much fun as telling them. His sagas did find a new audience at George Washington University, where he taught “geography with its boots on,” and at the NATIONAL GEOGRAPHIC office, where the next generation of writers and photographers always greeted his arrival as cause for celebration. Tom was a generous mentor, and on my own trips to the Middle East I followed his trail into deserts and back alleys from Jalalabad to Damascus. There I often found people who knew him and were his friends, and who welcomed me, Tom’s tribesman, as if I were his son.

The last few months of his life he spent pursuing his latest passion—stargazing—with the enthusiasm of a kid watching a parade. Even in the dead of winter, Tom, in his beret, was out in the backyard practically every night, studying the heavens through a telescope Lynn bought him for Christmas. The engineer in him, typically, spotted ways to improve the machinery, and he’d soon jury-rigged a new mount for it using parts from another telescope. Just before his own machinery gave out, he was scanning the sky charts and reading every book about the cosmos he could find.

Knowing Tom Abercrombie, I’d say he was just plotting his next expedition.



Tom's photograph from Afghanistan, 1967



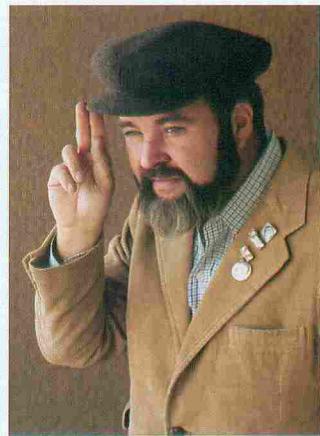
Tom's photograph from Afghanistan, 1967

“ Shortly after the National Geographic Society began publishing its journal more than a century ago, founder Alexander Graham Bell was asked what subject matter his new periodical would include. His reply: ‘The world and all that is in it’—a tantalizingly broad mandate. Down through the years Lynn and I tried hard to follow it. We worked on every one of the continents and left wakes across the seven seas. The *GEOGRAPHIC* was witness to a century—arguably the most telling in human history—and we were fortunate to have spent nearly half of it there.

A page from Tom's memoirs reflects on the changes he and Lynn saw over the course of his 38-year *GEOGRAPHIC* career. Few knew the world better, or loved its people more, than Tom Abercrombie.

Ours is a story—a picture story—of two people before whom was spread out the greatest of treasures: our planet Earth. For four decades we traveled aboard that magic carpet with the yellow border.

“Much of that world has changed since our days in the field—not always for the better. Many of the smiles we captured are no more—bleached by tourism, stricken with war, and battered by revolution. Multi-faith Lebanon is torn by sectarian anger; Saudi Arabia is constrained more than ever, as a government of wealthy princes faces off against its more fanatic citizens; Cambodia struggles to rid itself of a decades-long nightmare; Afghanistan bleeds from foreign invasions and its own medieval fundamentalists; Iran remains at loggerheads with the West; and Iraq lies in ashes. So, in a sense, my work records history as much as geography. As has often been said: The past is another country.” □

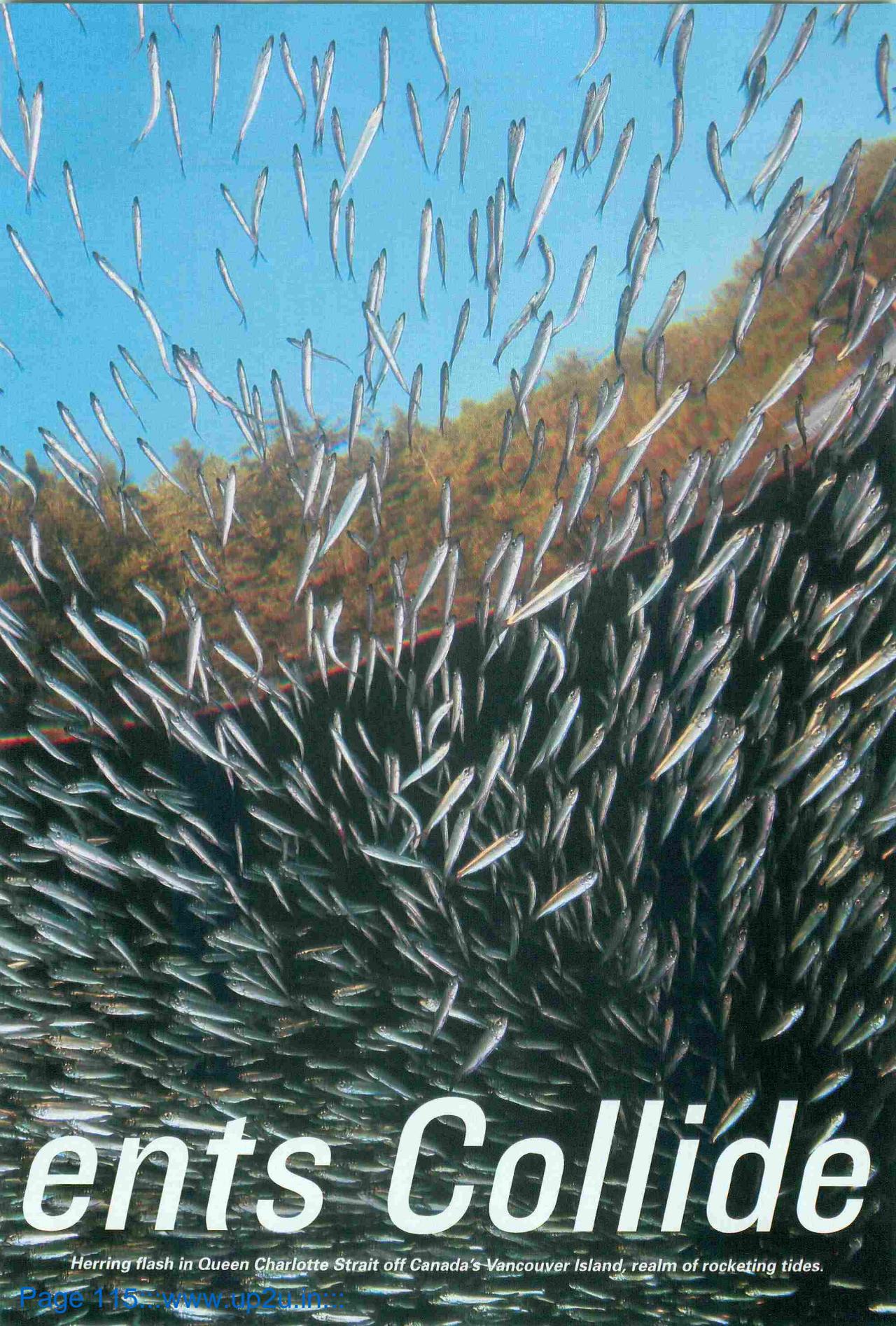


Tom in U.S.S.R., 1972

—TOM ABERCROMBIE
May 2005



Where Curr

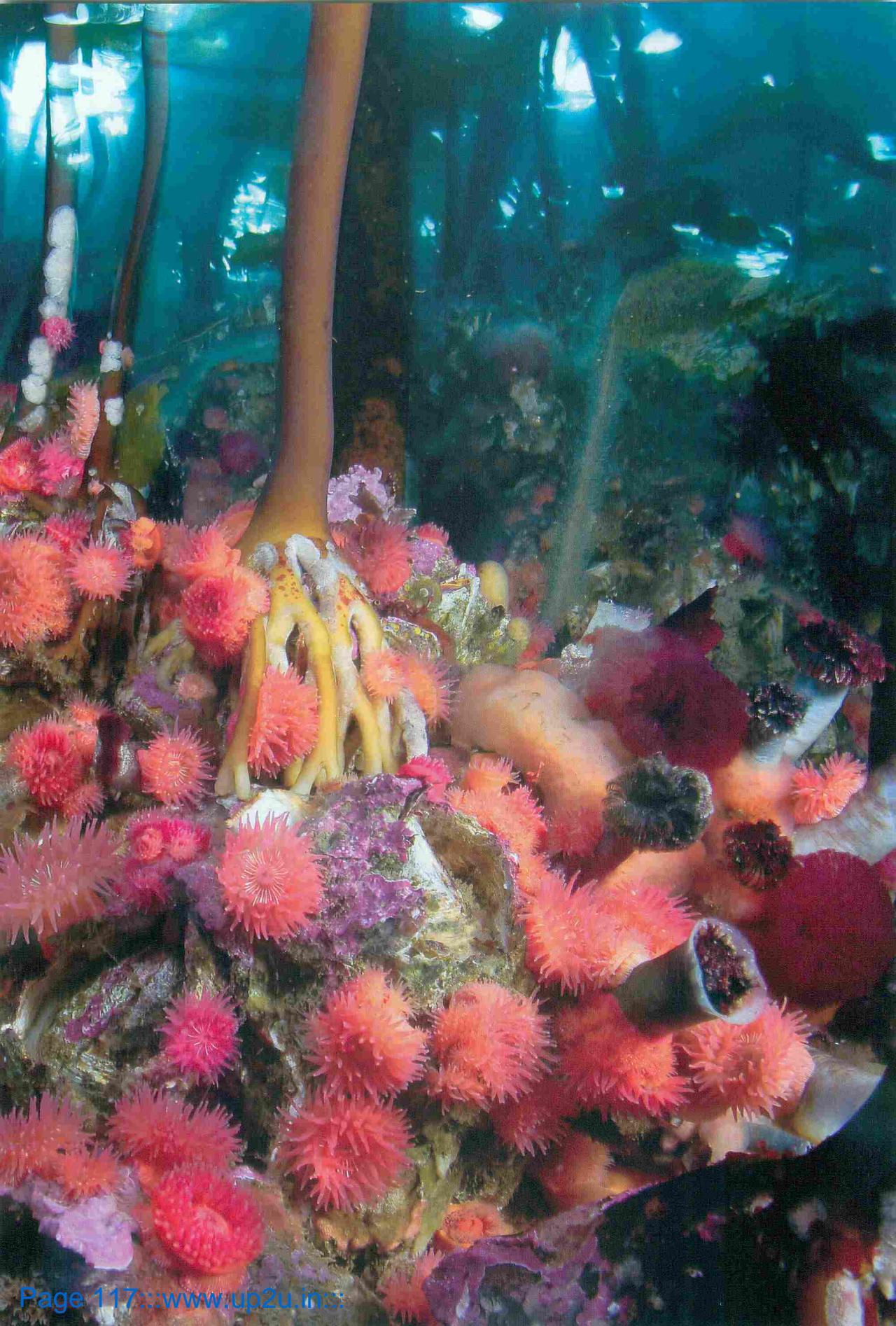


ents Collide

Herring flash in Queen Charlotte Strait off Canada's Vancouver Island, realm of rocketing tides.

In a swaying kelp forest, anemones bloom among lavender bryozoans, challenged yet fed by the waters of Queen Charlotte Strait. Life explodes in every crevice along the straits between Vancouver Island and mainland British Columbia, nurtured by the dynamics of fast, nutrient-rich water.







The rush of ebb tide at Nakwakto Rapids whips around Turret Rock at 14.5 knots (16.7 miles an hour). Locals call it Tremble Island, though seismographs don't support the belief that the rock shudders from the water's force. Slack tide here lasts about 15 minutes, then the frenzy of flood tide hits.



Text and photographs by Paul Nicklen

It seems insane to dive here. But it's the only way to witness the energy packed by some of the world's fastest water.

So, equipped for scuba, my diving partner and I leave the shelter of a bay called God's Pocket at the north end of Vancouver Island and turn our small boat toward Nakwakto Rapids. What greets us makes our knees go weak. As glacier-carved fjords drain with the ebb tide into Queen Charlotte Strait, the fury of released water gushes past Tremble Island at 14.5 knots. Whirlpools spit wide swaths of foam, and seven-foot standing waves explode into the sky.

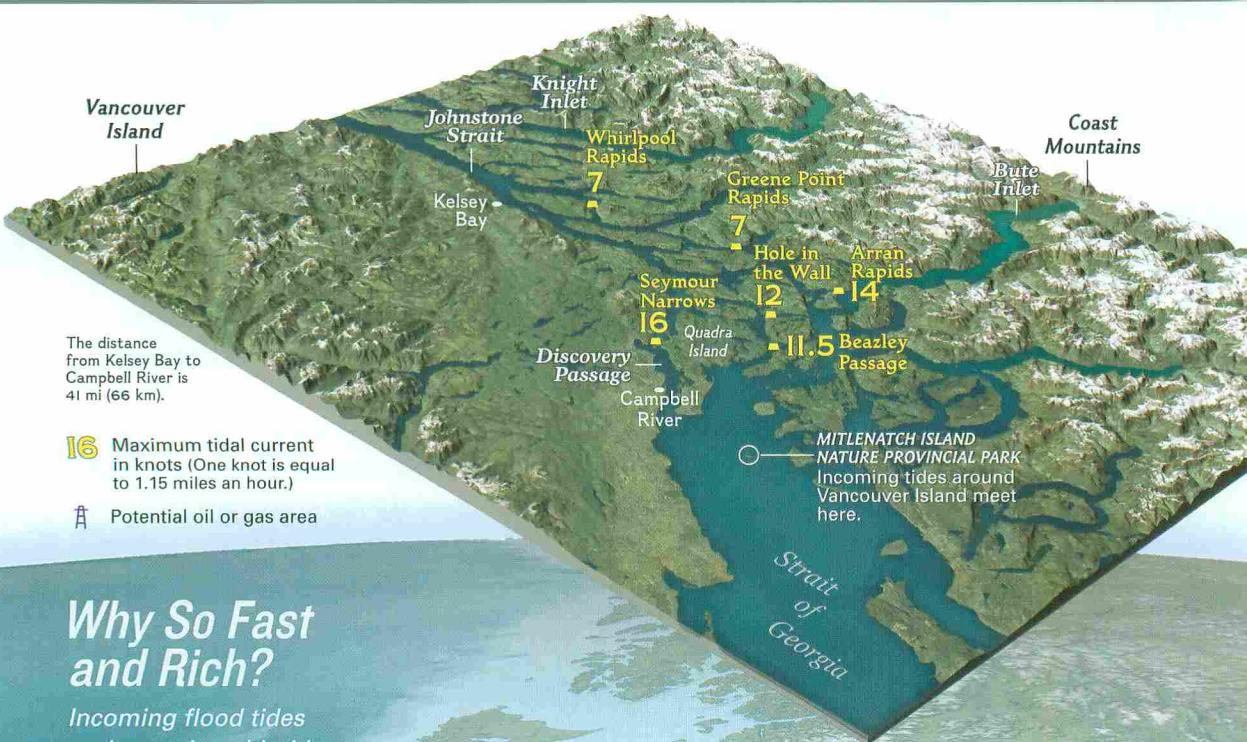
At slack tide, the water quiets enough for us to take the plunge. Descending 40 feet, we struggle against still powerful surges from all sides. Yet the base of Tremble is a palette of delicate beauty: rocks swollen with pearly gooseneck barnacles, nudibranchs, sponges, and hungry bouquets of feather duster worms. These dense colonies of animals thrive in the straits of Vancouver Island because the water is a vast protein shake, blended by upwellings, back eddies, and surges directed by the ebb and flood of tides. Phytoplankton and zooplankton rip through the water, practically force-feeding creatures adapted to cling to rocky ledges or the muddy ocean floor. These nutrients foster life stacked upon life stacked upon life.

The productive mayhem charges a food chain that reaches up through herring, salmon, orcas, and humpback whales. Fishermen (below, in the Strait of Georgia) harvest the rich herring population primarily for the roe. This major British Columbia fishery crashed in the 1960s as a result of overfishing. Government quotas, set at 60 million pounds last year, have helped herring numbers rebound. The most troubling threat now facing this region: Canada's ban against offshore oil exploration is under review. If the federal ban is lifted, British Columbia's provincial ban would likely also fall. Previous exploration has identified four off-

shore beds with potential for oil and natural gas (map, right). On top of the environmental disruption caused by drilling and increased ship traffic, the prospect of an oil spill spreading through these swift and vibrantly productive waters is a nightmare I hope will never come to pass.

► **Fast Zone** Download wallpaper and watch video of kayakers daring Skookumchuck Rapids at ngm.com/0608.





Why So Fast and Rich?

Incoming flood tides and outgoing ebb tides accelerate through the narrow straits and pick up more speed as they funnel through channels created by islands (inset).

The tides carry and mix nutrients from immense deepwater upwellings at both the northern and southern entrances. What makes these straits an exceptional cauldron of life is the way in which ocean tides interact with fresh water from the Fraser River and from snowmelt flowing out of fjords. As the lighter outbound fresh water rides over ocean water, it pulls some of the salt water into it. This creates a vacuum of sorts that draws even more deep ocean water—and more nutrients—into the straits.

Scale varies in these perspectives. The distance from Port Hardy to Victoria is 244 miles (393 kilometers).

IMAGES: GLOBAL LAND COVER FACILITY; NASA CONSULTANTS: DEPARTMENT OF FISHERIES AND OCEANS, CANADA; WOODS HOLE OCEANOGRAPHIC INSTITUTE
SHELL T. KIMBLE AND DAVID E. CHANDLER, NGM MAPS



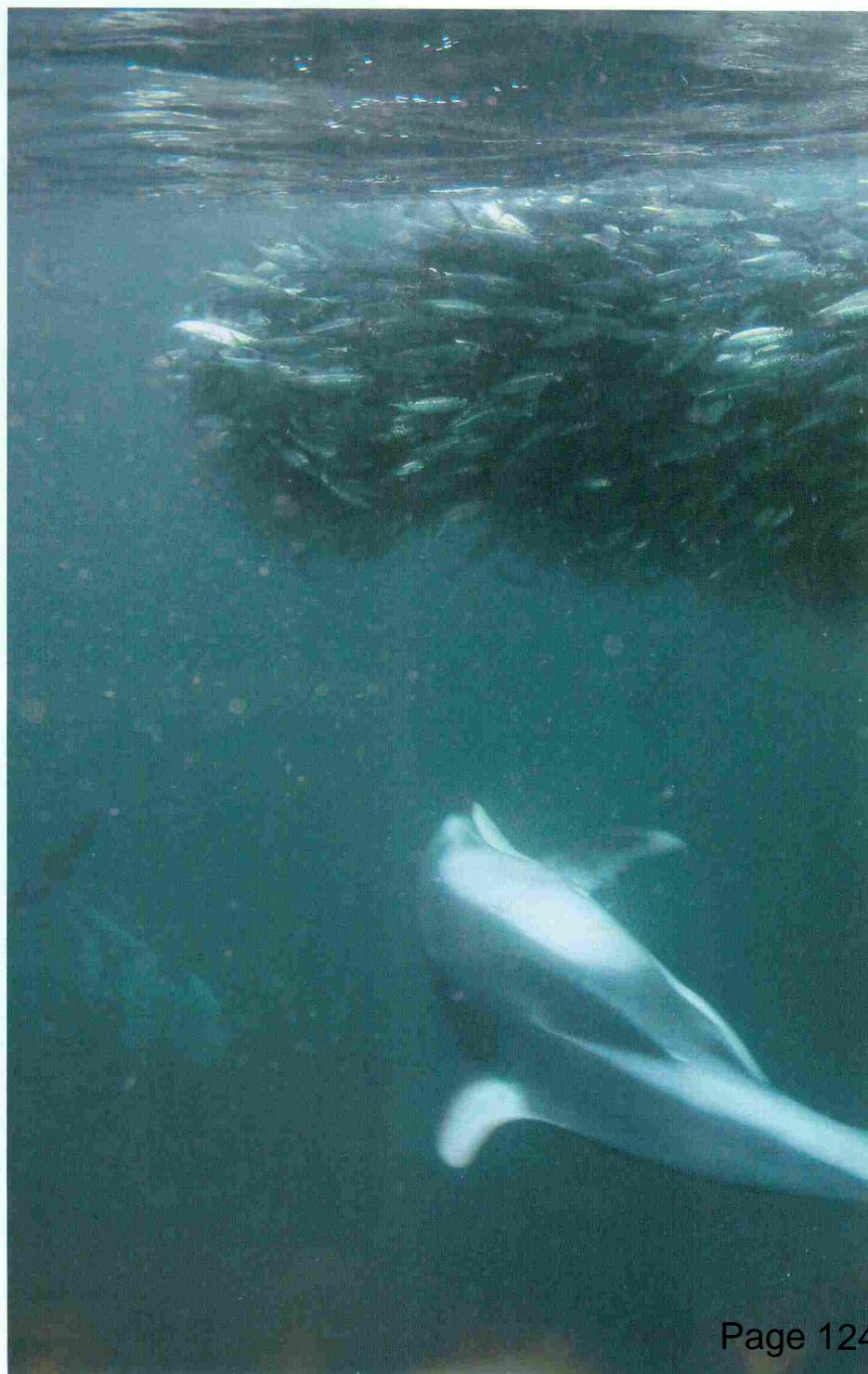
Gem Tones

The Emerald Sea, as these chill waters are called, turns deepest green in summer when plankton and algae flourish. Predators grow large in the churning pea soup—like this seven-foot wolf eel fish with a volleyball-size head (below). A giant Pacific octopus (life-size eye, middle right) might reach 20 feet. I expected to find octopuses hiding in caves when tides were flying, but that's when they feast, flattening their bodies to undulate with the current as they snake along life-laden walls. A sculpin known as a red Irish lord (life-size, bottom) wears its eyes high and moves each independently, giving the ambush predator a detailed view. To see how nutrient-saturated currents feed creatures like sea urchins, I poured a nontoxic dye and watched it flow not around the urchin colony but right through it (top).





Whirlwind Banquet



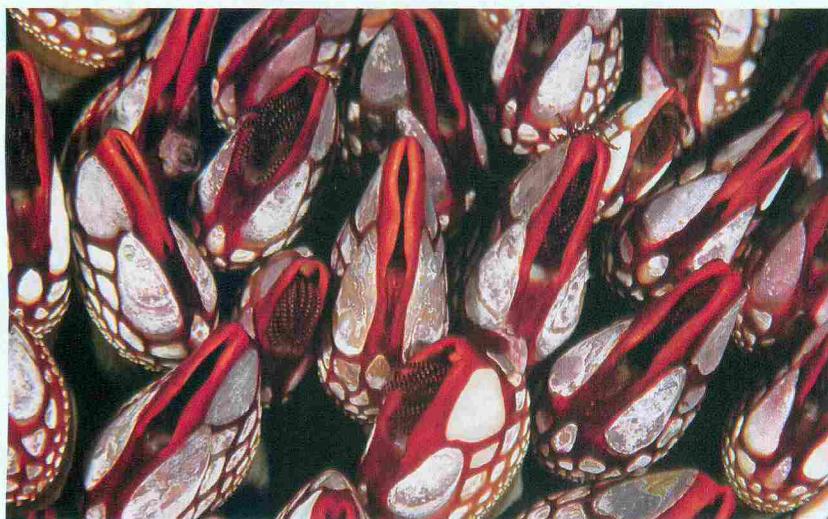
Pacific white-sided dolphins circle a school of herring like a cyclone, pressing them into a ball near the surface and plucking from the edges. If the ball expands, the dolphins dart in or release rushes of bubbles to push the fish back into formation. Gulls and auklets dip into the fray, helping keep the ball intact. At one point the entire school engulfed me. I pulled back, mindful that vastly bigger herring fans—humpback whales—were nearby.



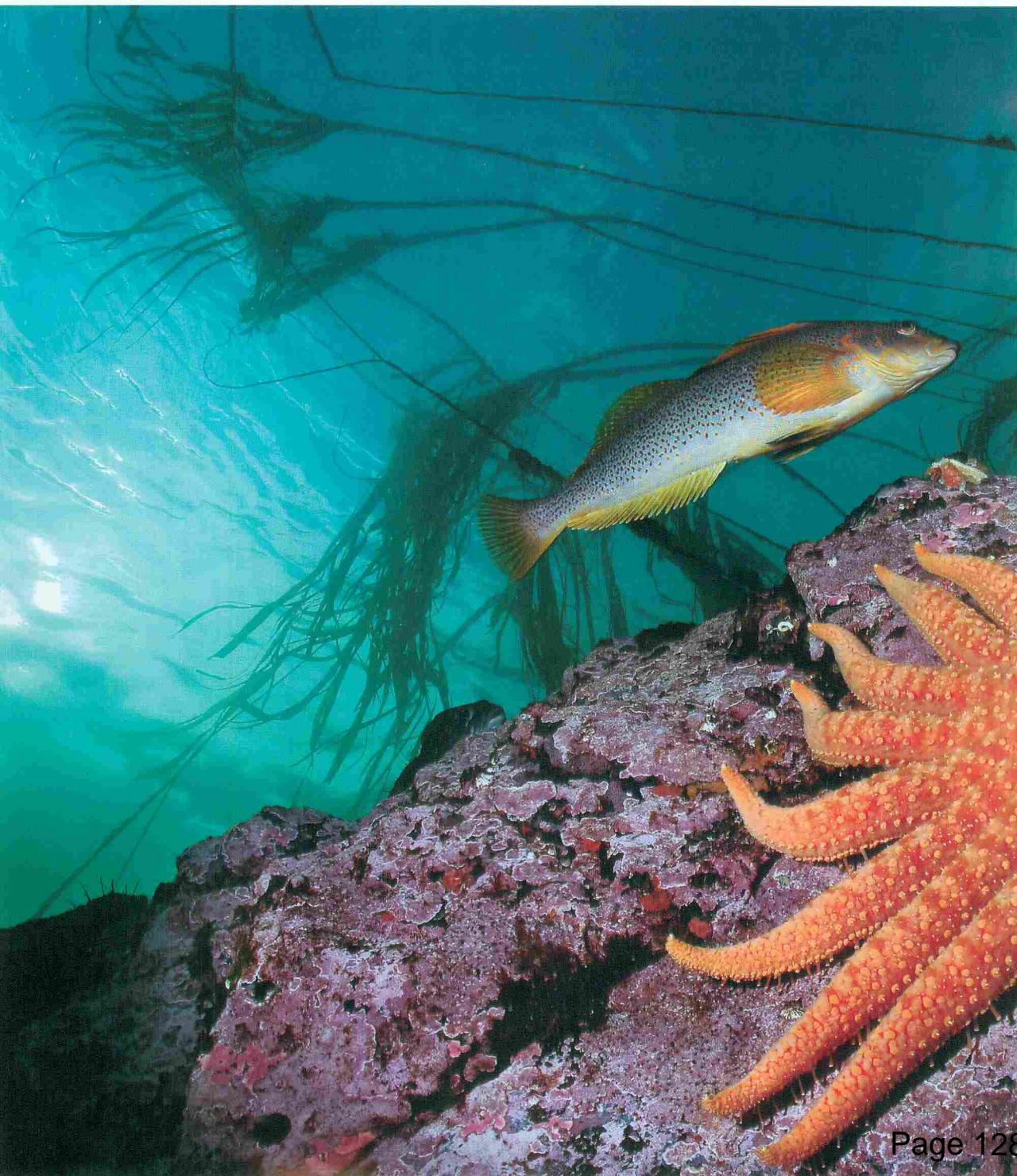


Clinging for Life

No strangers to ebb and flow, gooseneck barnacles (below) clamp to rocks with a cement so strong that scientists want to re-create it for commercial use. The bright-lipped filter feeders prefer strong currents and ocean surges, like the rapids around Tremble Island, where they cluster in 40-foot-long beds. A similar natural adhesive lets plumose anemones dangle at a site called Browning Wall (bottom). The anemones survive out of water for hours during low tide by retaining water in their body cavities. Submerged, they open to resemble fluffy heads of cauliflower and feed on zooplankton, fish, and jellyfish. The feathers of a two-foot-tall sea pen (opposite) house polyps that snare zooplankton. If threatened, the animal expels the water inflating its body and hides in the seafloor mud. Such are the sights that make Vancouver Island's straits a premier cold-water destination for experienced divers.

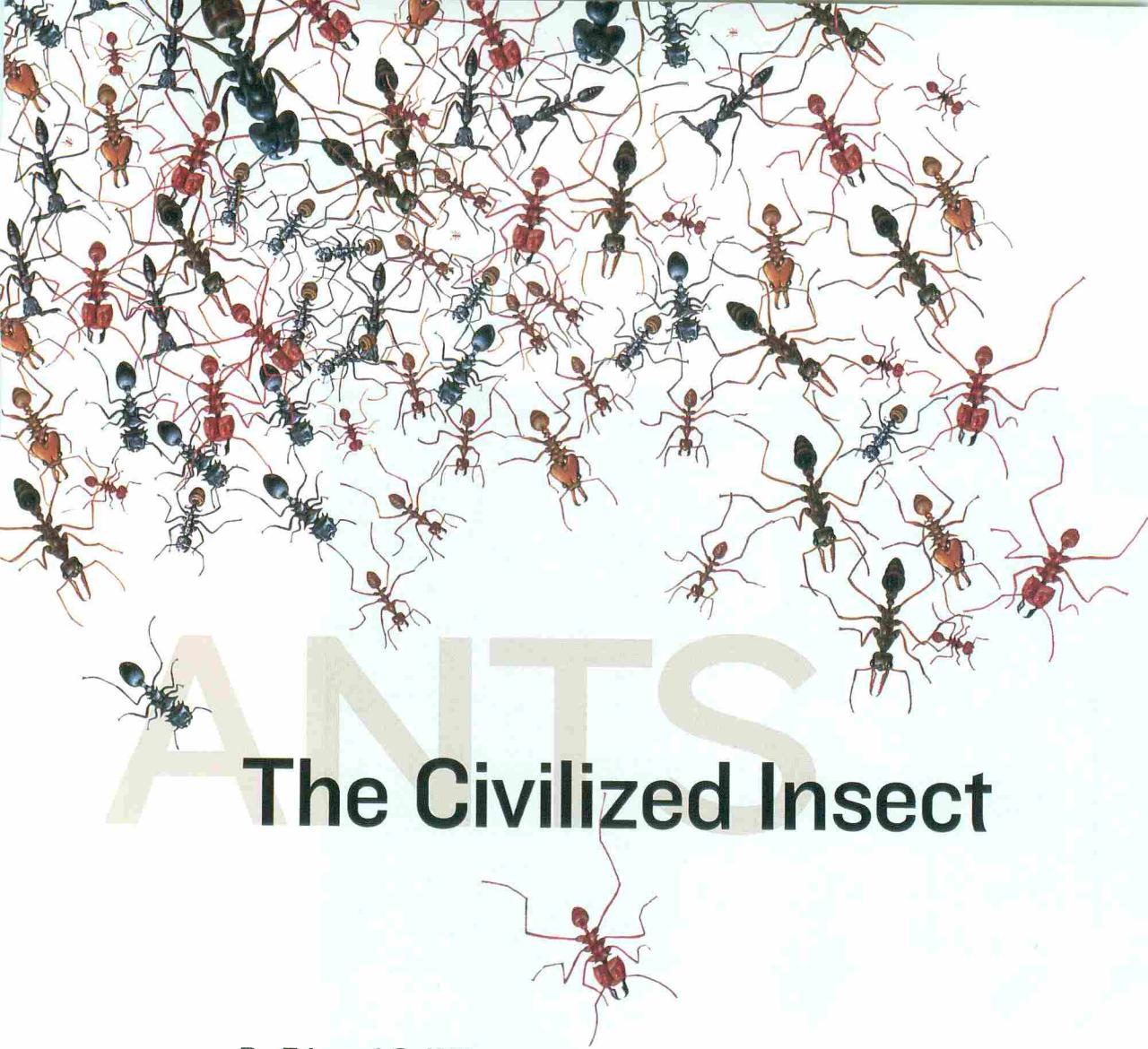


Rock Steady



Nineteen arms of suction power anchor a two-foot-wide sunflower star beneath Quadra Island. Overhead a greenling swims against current that tangles whips of bull kelp. One of the world's largest and fastest stars, with speed approaching a lively five feet a minute, the voracious sunflower easily overpowers urchins, clams, and other invertebrates. In this turbulent domain, life goes bold and vigorous—despite the wild waters, and because of them. □





ANTS

The Civilized Insect

By Edward O. Wilson

In Japanese the word "ant" is intricately written by linking two characters: one meaning "insect," the other meaning "loyalty." Altruistic and cooperative toward one another, nestmates readily go to war to preserve their colony. Renowned biologist and lifelong ant observer Edward O. Wilson introduces our new occasional series on these highly social creatures.

ANTS ARE OUR CO-RULERS OF THE LAND. An estimated ten thousand trillion strong worldwide, they weigh very roughly the same as all of humanity. They abound everywhere except on icy mountain peaks and around the Poles. From underground to tree-tops, they serve as the chief predators of insects and other invertebrates and the principal scavengers of small dead bodies. Although their 12,000 known species compose only about 1.4 percent of the world's insect species, their share of the collective body weight is easily ten times greater.

I was first drawn to these remarkable creatures almost 70 years ago as a boy in Washington, D.C. Inspired by the tales of Frank Buck and other wildlife adventurers, I launched my own expeditions from our family apartment into the "jungles" of Rock Creek Park. Ants especially intrigued me because of an article by William M. Mann in the August 1934 NATIONAL GEOGRAPHIC: "Stalking Ants, Savage and Civilized." Mann

was also director of the National Zoo, hence doubly my hero. The myrmecological lineage continued decades later with Mark Moffett, who earned a Ph.D. under my direction at Harvard and whose groundbreaking photography of ants focuses in this issue on army ants.

Ants are important for more than their ubiquity and environmental impact. They also exhibit social behavior as exotic as any we may ever hope to find on another planet. For most of each year colonies consist only of females: queens that reproduce for the colony and infertile workers that conduct all the labor. Males are bred and kept for short periods, exclusively for the insemination of virgin queens. The communication

Wilson at 13, looking for bugs in Mobile, Alabama, during the summer of 1942.

ELLIS MACLEOD

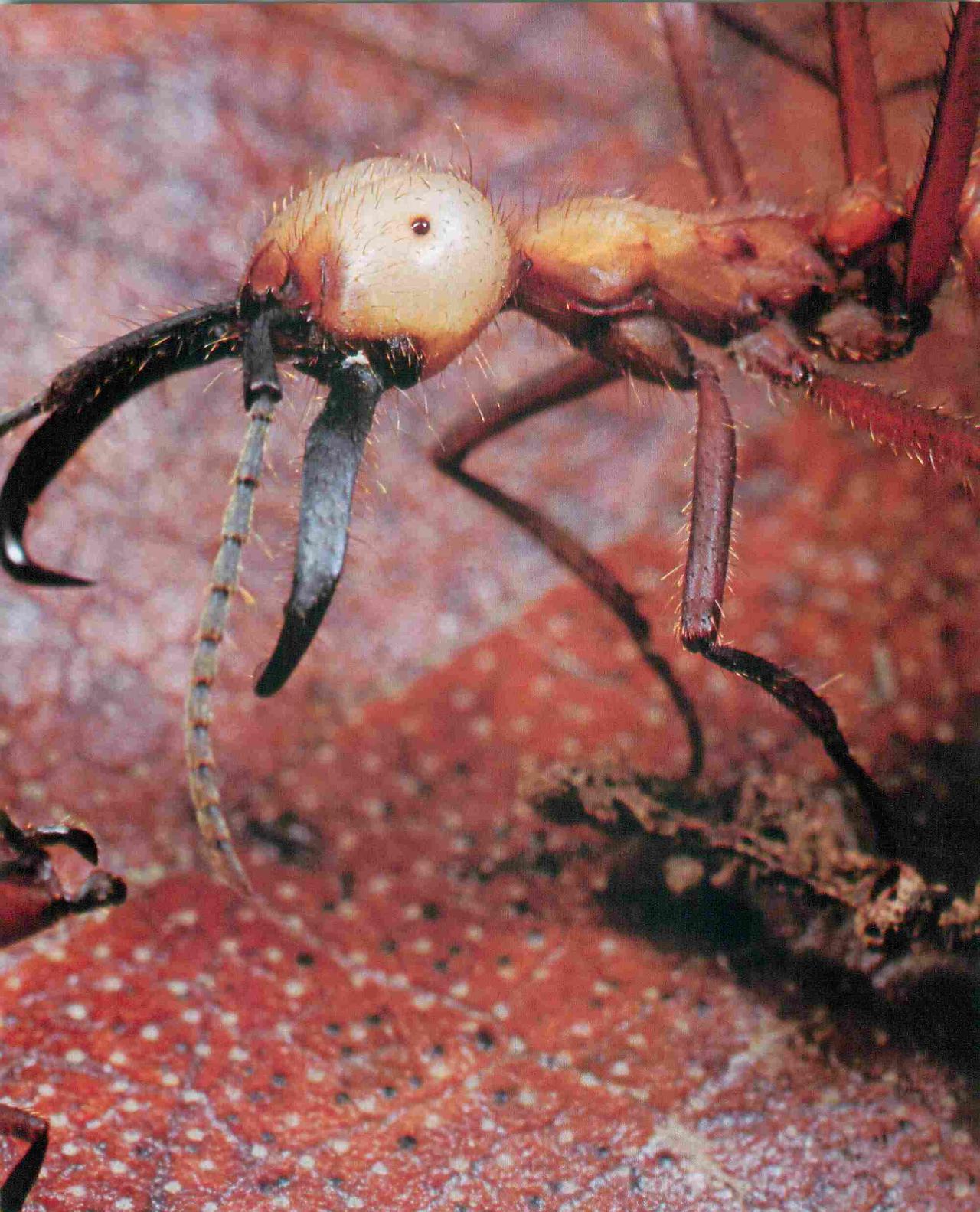
systems of ants are radically nonhuman. Where we use sound and sight, they depend primarily on pheromones, chemicals secreted by individuals and smelled or tasted by nestmates. Since the brain of an ant weighs less than one-millionth as much as a human brain, it is not surprising that a given species produces just ten to twenty signals. Unlike human language, these messages are entirely instinctual.

These marvelous little creatures have been on Earth for more than 140 million years. The most complex social organizations among them, such as those of the army ants and leafcutter ants, rank with Earth's greatest wildlife spectacles. Ants easily outlasted the dinosaurs, and they will easily outlast humanity should we stumble. □

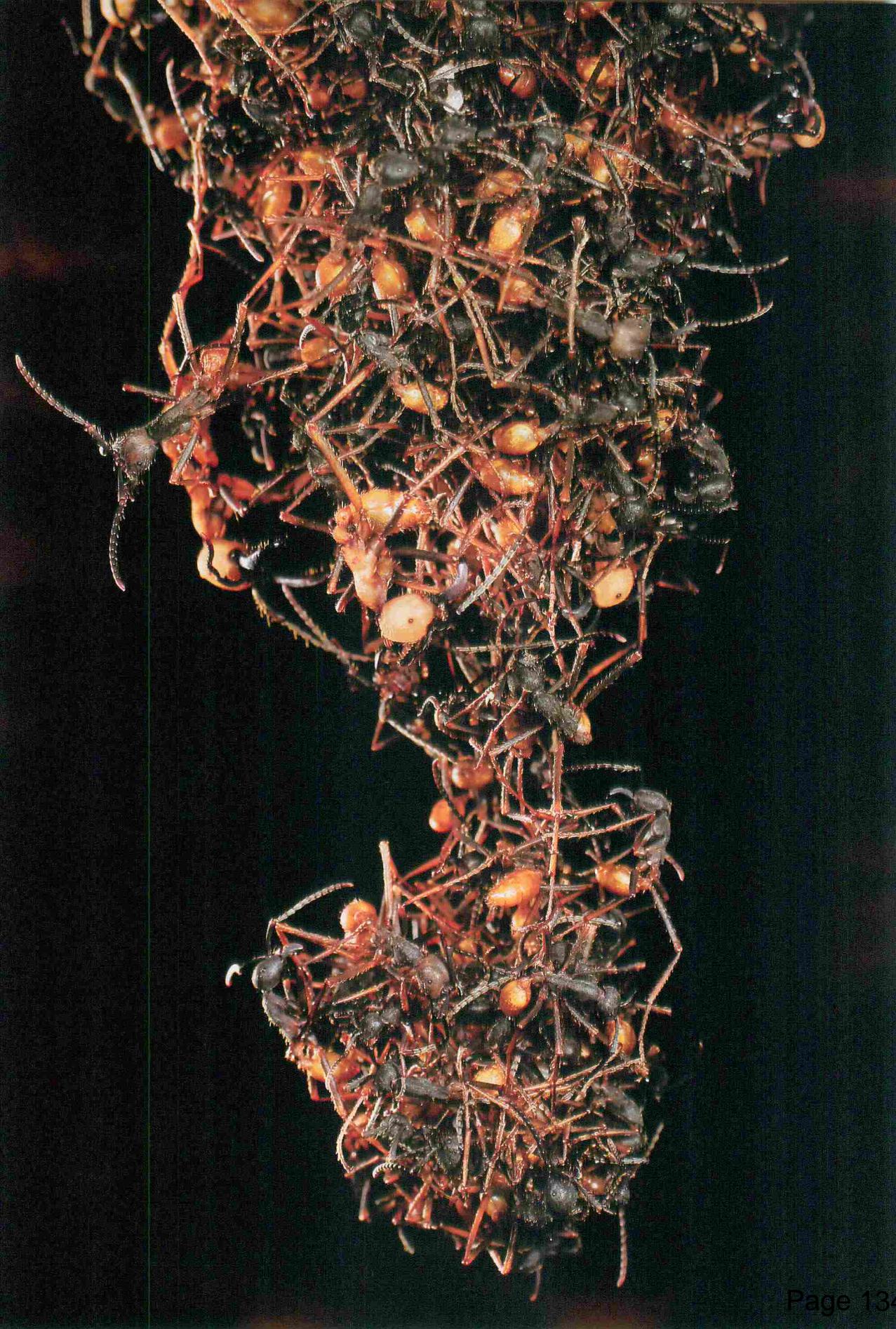


ARMY ANTS

Inside the Ranks



Larger but outnumbered, an army ant soldier of the species *Eciton burchellii* is corralled by workers of a rival army ant species, *Eciton hamatum*. Their two colonies sparred for an hour in a chance meeting, then retreated without fatalities. These army ants never kill each other, but they handily devour creatures many times their size.



Text and photographs by Mark W. Moffett



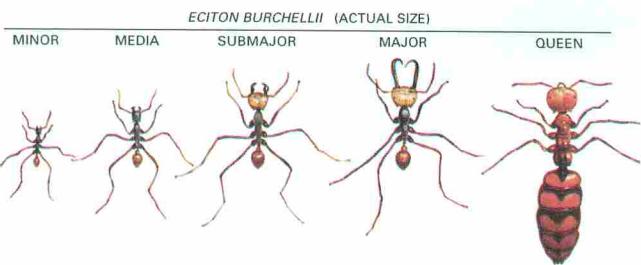
Linking toe to toe, *Ecton burchellii* army ants (left) use their own bodies to form massive nests called bivouacs. The nomadic raiders keep no permanent nests but suspend their bivouac beneath a log or woody overhang (right). *E. burchellii* is one of 150 army ant species in the New World; more than 170 other army ant species thrive in the tropics of Asia, Africa, and Australia.

FORGET LIONS, TIGERS, AND BEARS. Forget even our own famously aggressive species. When it comes to the art of war, it's army ants that will make you break into a cold sweat. Armored tough, with machete jaws, these masterful fighters hack and dice prey vastly larger than themselves by acting in numbers beyond easy comprehension. Imagine hordes of spear-wielding humans at a wooly mammoth's feet. That's the scale of army ant operations when they're attacking a tarantula or scorpion. Army ant colonies succeed at making tens of thousands such kills each day. Folklore to the contrary, their prowess does have limits. Their dragnets don't take down livestock or people (though some African species occasionally live up to that image).

I went to one of the best places to observe army ants in action, Barro Colorado, a six-square-mile island in a lake created by the Panama Canal and home to perhaps 50 colonies of *Ecton burchellii*, the most studied army ant in the world.

The ways of *E. burchellii* helped give rise to the name army ant. Their colonies are huge, ranging from 300,000 to 700,000. They are mobile, moving from nest site to nest site. Though not all army ant species share these characteristics, there's one hallmark they have in common: a shock-and-awe hunting strategy. Other ants search for food individually, sometimes using scouts. Army ants set out en masse. Being blind, they can't see what's ahead of them, but moving in such numbers they easily overwhelm their prey. For *E. burchellii* that's usually non-army ants and large arthropods. They can also kill, but don't eat, lizards, snakes, and frogs that fail to get out of the way. Their attack formation is called a swarm raid. As many as 200,000 ants leave the nest in a swarm that broadens into a fan as wide as 15 yards. Specialized birds follow the raiders, picking off prey as it scatters in vain attempt to survive.





In Her Majesty's Service

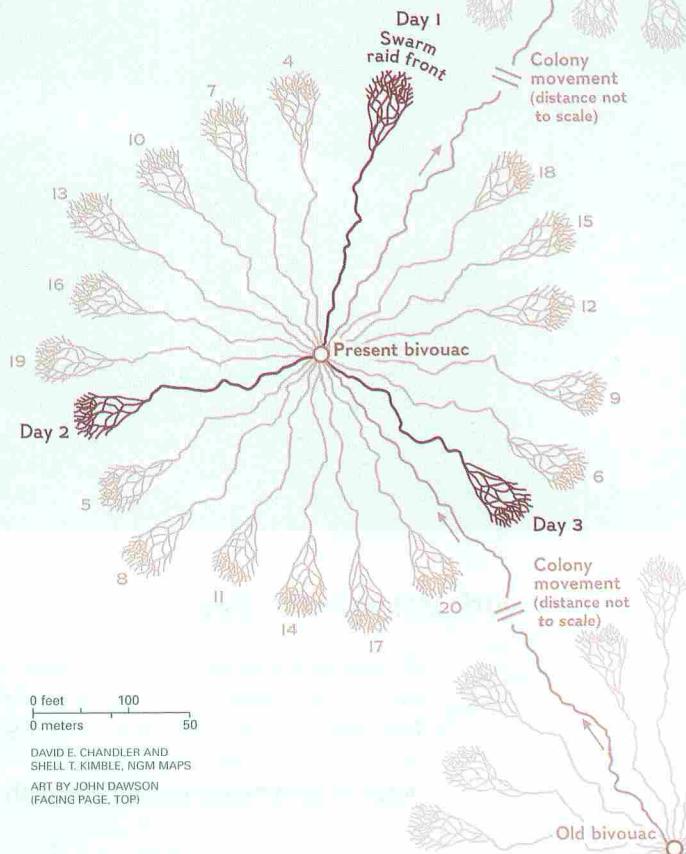
Carrying the pupae of the next generation (below), a colony on the move marches the length of a football field every day. *E. burchellii* alternate between nomadic and stationary phases, linked to the colony's reproductive cycle. Four sizes of workers (above) live to nourish and protect the queen (close-up, facing page). The three smallest workers kill and carry the colony's prey and also feed the queen and the larvae. Majors, or soldiers, defend the colony. Workers live only a few months, but the queen survives for several years. Her demise before the birth of a new queen would send the colony into chaos—and doom it.





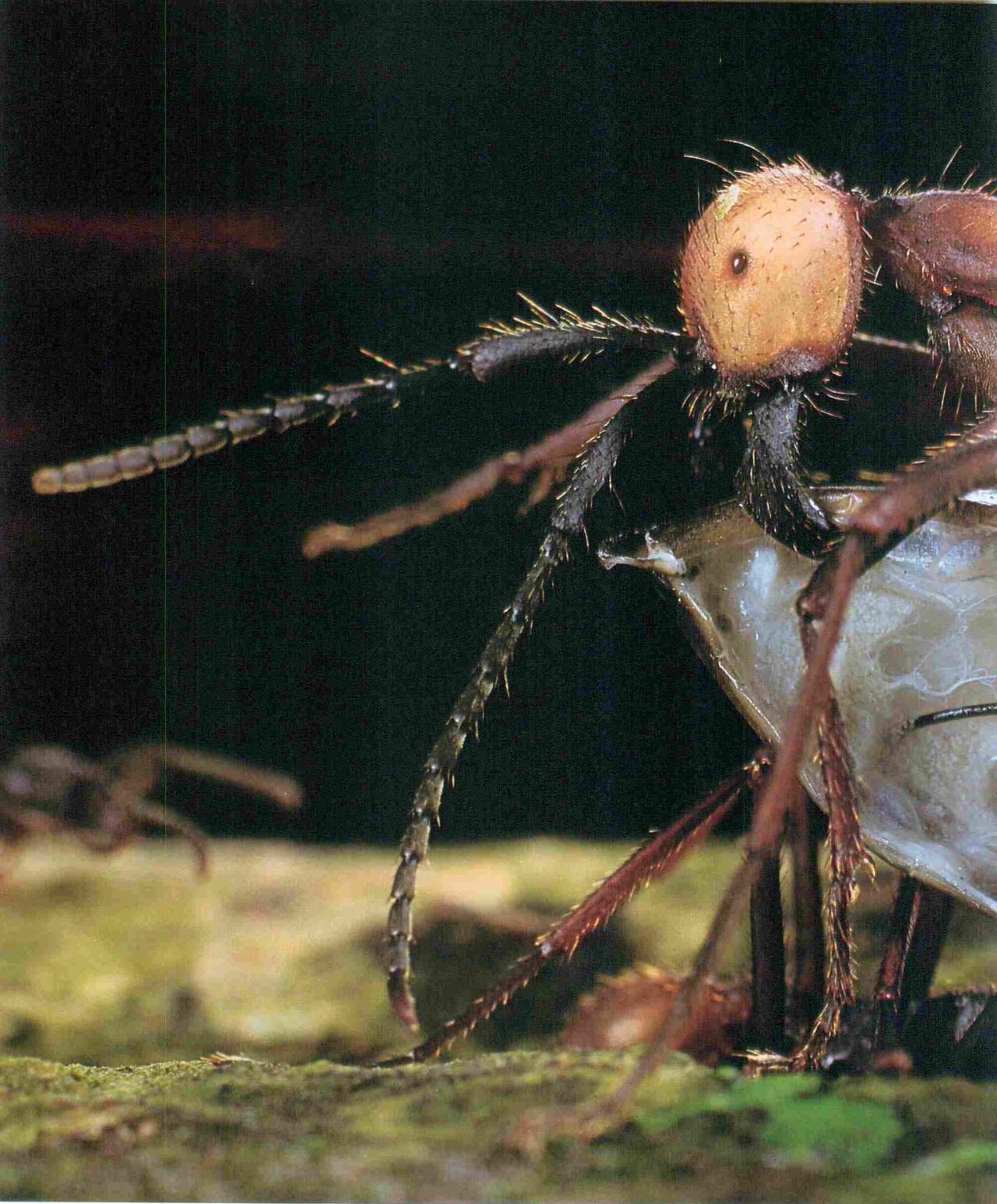
Camp Cycles

A colony bivouacs at one site for about 20 days as the larvae enter the pupal stage. There the queen lays as many as 300,000 eggs. Raids fan out in a pinwheel pattern that assures the ants cover fresh hunting ground. When new workers emerge from the pupae, and the new eggs hatch into larvae, the colony marches again, with larvae in tow. For the next two to three weeks the ants cover roughly a hundred yards a day, raiding as they go, and bivouacking nightly along the way.



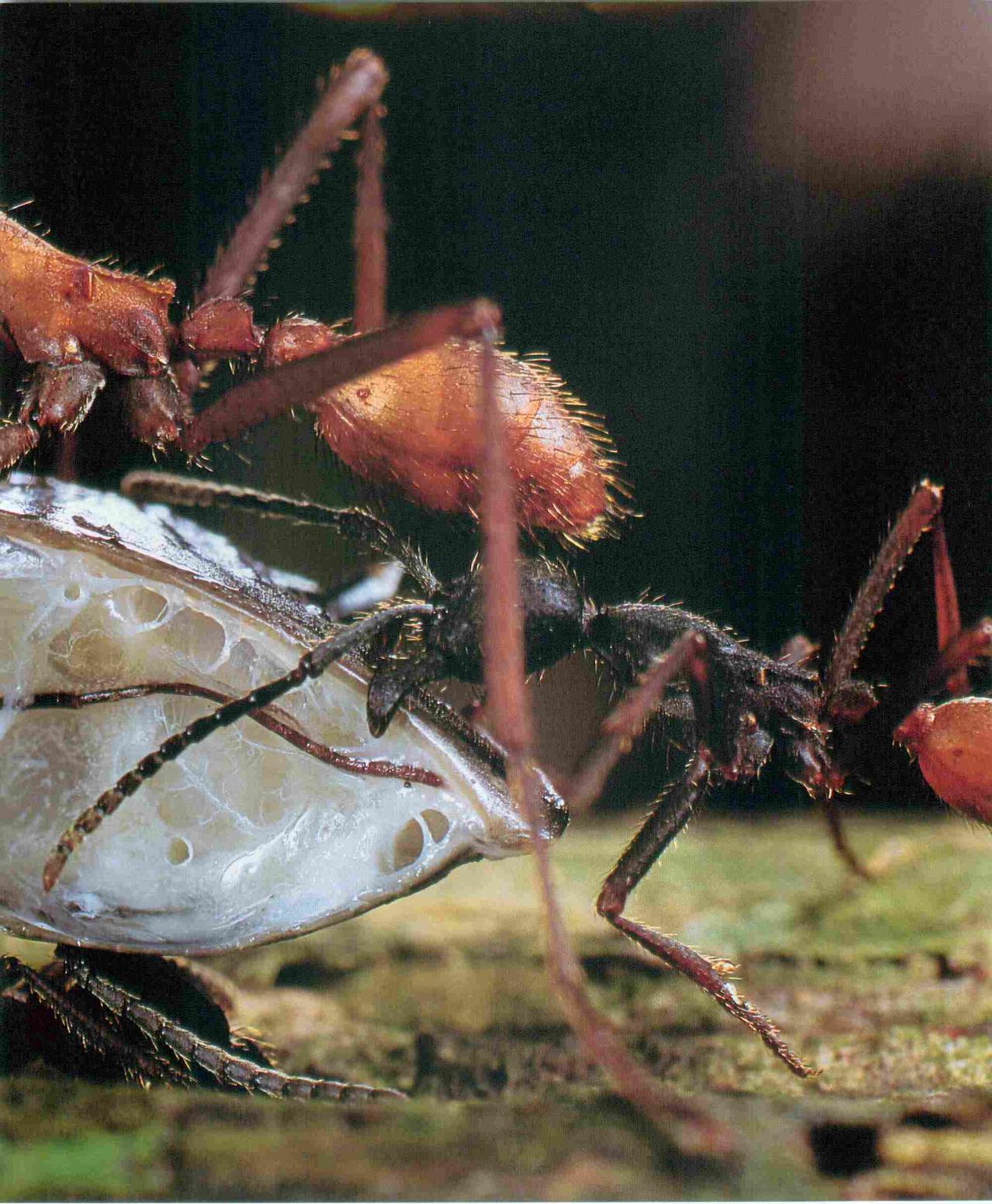
DAVID E. CHANDLER AND
SHELL T. KIMBLE, NGM MAPS

ART BY JOHN DAWSON
(FACING PAGE, TOP)



Teamwork Delivers the Catch

A fragment of what might have been a centipede, ripped apart during a swarm raid, comes back to the bivouac in the jaws of a submajor; a media worker lifts from behind to keep the end from dragging. The smallest workers, the minors, act as living roadfill, at bottom. Along with some media workers, they hunker down in potholes to smooth the path.

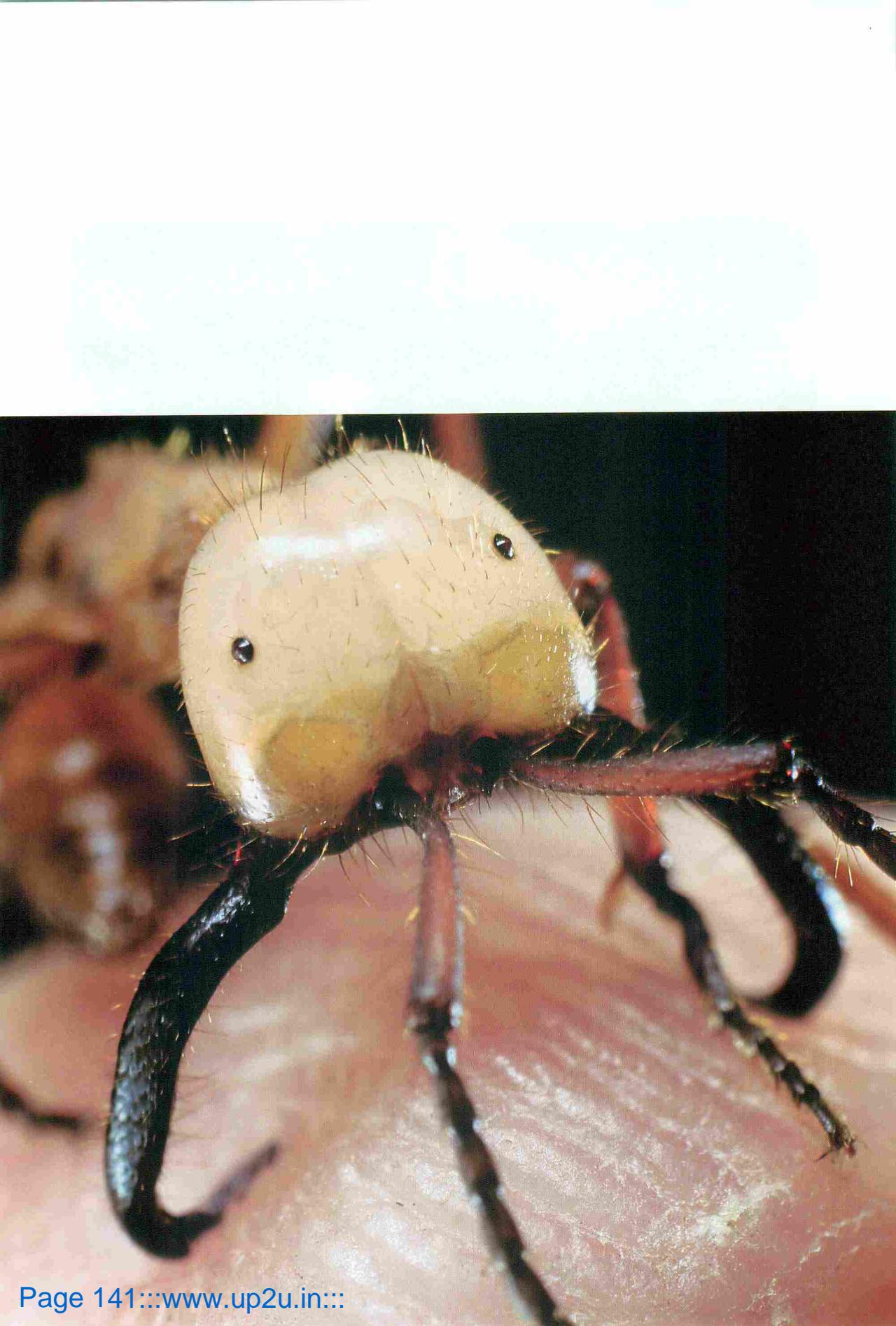




Warrior Caste

Terrorizing any potential enemy is the full-time job of *E. burchellii* soldiers. They don't hunt, they don't clean, they don't tend the young. They can seem clumsy as they patrol the edge of the trail (top left), flaring their oversize jaws. If intimidation tactics don't send foes running, soldiers bite—and the attack is often suicidal. Because the tips of their jaws are bent like a fishhook, with a knife blade along the inner margins (top right), the soldiers can't extract them. Amazonian tribes have used soldier ants to suture wounds, snapping off the bodies and leaving the heads in place. The *E. hamatum* soldier penetrating my thumb (right) also pivots her abdomen to sting, delivering a poison that turns my skin red.







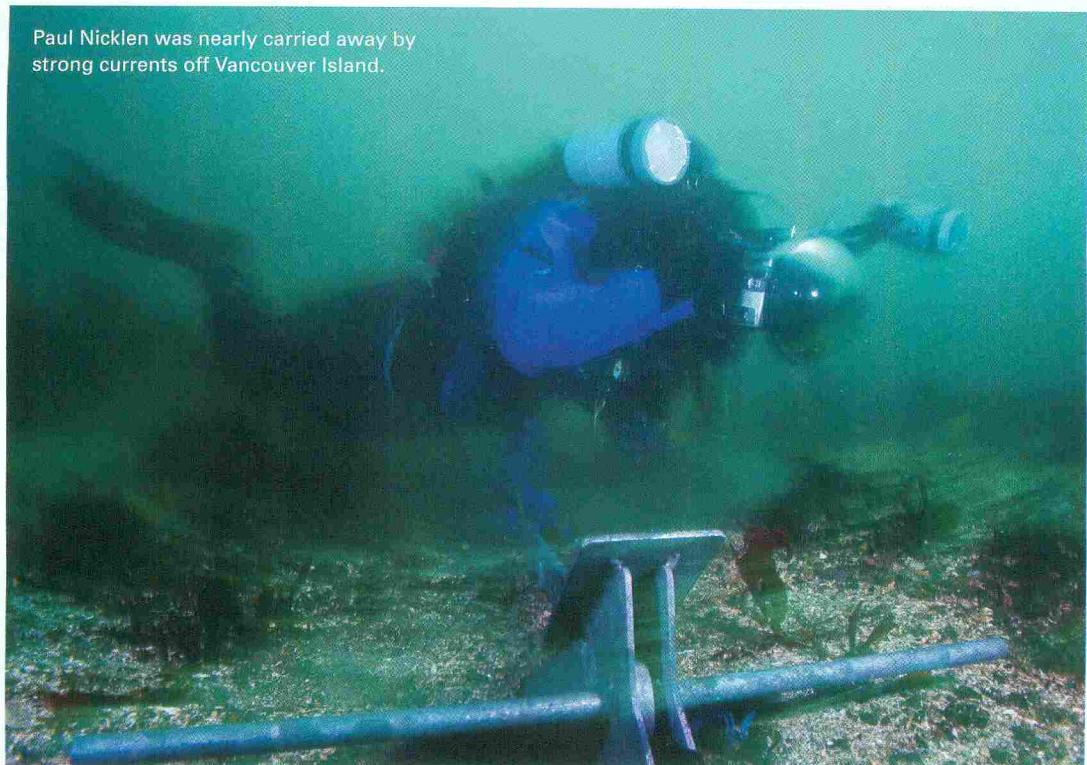
All for One, One for All

Back from the front lines of a swarm raid, a submajor (above) is cleaned of blood-like hemolymph shed by insect prey. Workers on a raid mark the trail with pheromones for others to follow and to find their way back to the colony. Ants returning laden with food use the middle of the trail, forcing unencumbered outbound ants to the sides. Other ant species that use the same trails for days or weeks take time to maintain them, clearing debris and moving soil. Nomadic *E. burchellii* don't have that luxury; each day brings new terrain. Faced with an engineering challenge, like a gap between leaves (left), minors and medias link their bodies to form a living bridge, and the army marches on. □

► **Swarm** Watch video of army ants in action, and send e-greetings at ngm.com/0608.



Paul Nicklen was nearly carried away by strong currents off Vancouver Island.

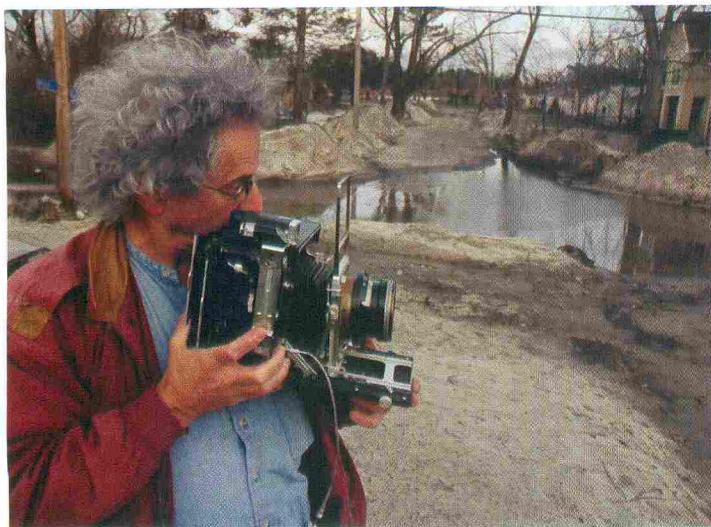


ON ASSIGNMENT Anchored Away "The current was so strong I couldn't control my legs. They were whipping around like pieces of plastic in the wind," says Paul Nicklen, photographer for "Where Currents Collide." The waters off Vancouver Island roared with dangerously fast currents, some of which, he remembers, "could take you straight to the bottom." Nicklen first tried to stabilize himself by sticking one arm in the mud while taking photos with the other. Other times, he clung tenaciously to underwater ledges like a dry-land rock climber. But he knew he needed another way. "I got an idea from how the animals in the story anchor themselves," he says. Nicklen finally took a boat anchor and a rope, and secured himself to the bottom.



The mandibles on an army ant's head grasp Mark Moffett's thumb.

ON ASSIGNMENT Ant Man "Ants provide an alien continent to explore," says Mark Moffett. "There is high drama at our feet." He should know: "For three years I was in charge of Harvard's ant collection, which is the biggest in the world." Moffett, who wrote and photographed this issue's story and is working on a book about the insects for the Harvard University Press, observes the creatures with a very special tool—his camera. "For me, a camera is a portable microscope. If the ants happen to do something cool, I press the button," he explains. He also lets them run right over him. "You have to ignore discomfort while taking pictures. Ants can attack in huge numbers, but I don't notice it." He recently received an honor worthy of notice. Eminent biologist—and Moffett's doctoral adviser at Harvard—Edward O. Wilson named a new species of ant for him: *Pheidole moffetti*.



David Burnett photographs a ruined neighborhood near the London Avenue Canal in New Orleans.

ON ASSIGNMENT

One Shot

To make his haunting photographs of New Orleans, David Burnett used a 1950s-era Speed Graphic. Once focused, the large-format camera can usually only record one or two images before a subject moves—and refocusing is necessary.

"Having just one shot at it forces you to figure out what you want to say and how you want to say it," he explains. Yet no picture could capture the extent of the damage done to the region—or its people. Says Burnett, "You just can't imagine what water can do when it's angry."

August Contributors

David Burnett captured a drowned Gulf Coast for his photographic portfolio, "Home No More" (page 42). The prizewinning photojournalist is a cofounder of Contact Press Images photo agency.

Ernest J. Gaines, a native of Louisiana, wrote the essay, "Where Have You Gone, New Orleans?" (page 54). The novelist is a professor of English and writer-in-residence at Louisiana State University.

Thomas Hayden delved into the science of hurricanes to write "Super Storms" (page 66). He is a former staffer at *U.S. News & World Report* and *Newsweek*.

David Roberts wrote about Utah's ancient Fremont culture in "Guardian of a Ghost World" (page 78). His most recent book is *On the Ridge Between Life and Death*.

Ira Block, a longtime contributor to the *GEOGRAPHIC*, photographed "Guardian of a Ghost World."

Adam Goodheart, author of "Seasons of Smoke" (page 90), is a fellow at Washington College's C. V. Starr Center for the Study of the American Experience.

Michael Melford is known for his lyrical images of landscapes. He was the photographer for the story on the Great Smoky Mountains National Park.

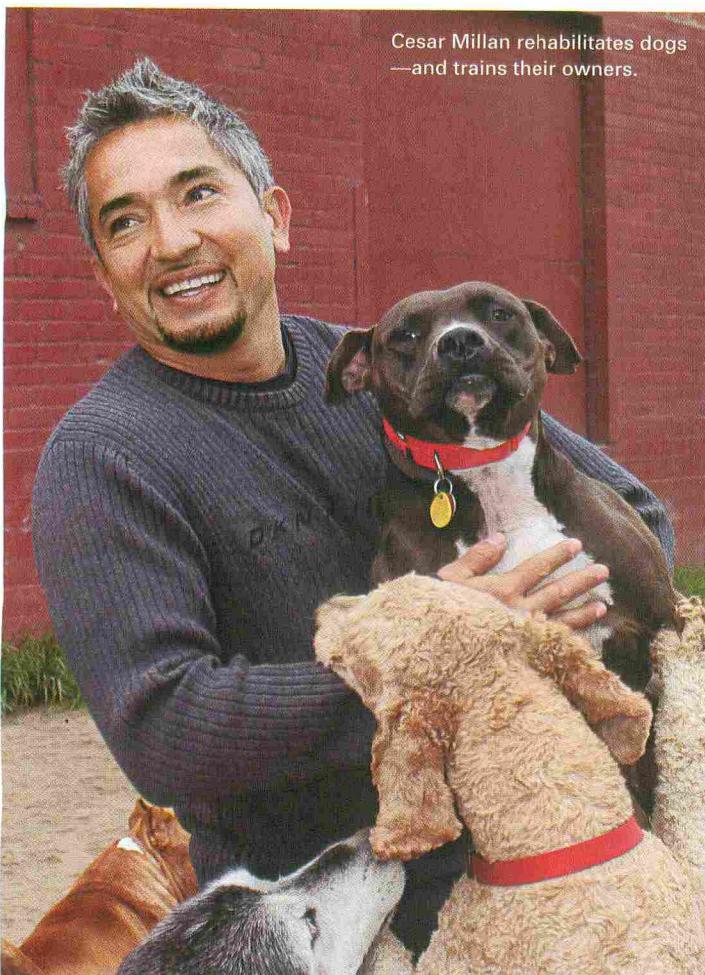
Don Belt wrote "A Geographic Life," a tribute to the late *NATIONAL GEOGRAPHIC* staff writer and photographer Thomas J. Abercrombie (page 108). Belt is the magazine's Senior Editor for Geography & World Affairs.

Paul Nicklen braved some of the world's fastest currents off Canada's Vancouver Island to photograph and write "Where Currents Collide" (page 120).

Edward O. Wilson wrote "Ants: The Civilized Insect" (page 136). The famed biologist is a professor emeritus at Harvard and has twice won the Pulitzer Prize.

Mark W. Moffett wrote, photographed, and was bitten by his tiny subjects for "Army Ants" (page 138). This article is the first in Moffett's new occasional series on ants for the magazine.

► **Tales From the Field** Learn more about *NATIONAL GEOGRAPHIC* contributors in Features at ngm.com/0608.



Cesar Millan rehabilitates dogs—and trains their owners.



Meet the Dog Whisperer

In the span of a single day, Cesar Millan transforms badly behaved dogs and their well-meaning but often hapless owners into disciplined

packs. The shepherd no longer cowers under a desk. The mutt ends her quest to kill the neighborhood cats. It's a miracle, his clients say. No, says Millan: "It's energy. The language that I use is universal—calm, assertive energy. Dogs are pack animals. Humans need to establish the leadership role, and once they do, their dogs will follow."

While growing up on a farm in Mexico, Millan spent time observing dogs and other animals. At 13 he told his family that he intended to become the best dog trainer in the world. By the age of 21, he had moved to California, found a job at a dog grooming parlor, and bonded with a rottweiler named Psycho. Many dogs later, Millan just might be the most famous—some would say the best—dog trainer in the world. See him in action on *Dog Whisperer*, Friday nights at 9 p.m. ET/PT on the National Geographic Channel.

NG Exhibits

One World, One Tribe

From a Rwandan refugee's look of desperation to the joyful energy of a Turkish whirling dervish (below), photojournalist Reza has captured images of the world's struggles and triumphs. "The many paths that I have trod over the past 30 years enabled me to meet people whose unique destinies have deeply influenced me," Reza says. "I was close to each of them to the point that I could feel their suffering as well as their joy."

Last year the French government honored Reza with the French Order of National Merit for pictures that "contribute to our understanding of the world" as well as for the work of Aina, an organization he founded to help develop an independent press in Afghanistan. At that time, more than a million people came to see an exhibition of Reza's photos that hung in the Luxembourg Gardens, outside the French Senate in Paris.

Now his exhibition is in Washington, D.C. "One World, One Tribe," an outdoor display at the National Geographic Society through October 8, celebrates his work and his vision of the world. Says Reza, "This exhibition is the story of the human family—our family."



FLASHBACK



Rider on the Storm "If New Englanders noticed the obscure news stories . . . telling of a tropical hurricane crossing the South Atlantic, they probably thought, 'Too bad for Florida,'" noted NATIONAL GEOGRAPHIC. But on September 21, 1938, that "obscure" cyclone roared north, slamming the U.S. Northeast coast with 120-mile-an-hour winds and a storm surge that left parts of Providence, Rhode Island, under nearly 14 feet of water. Eighty-eight percent of the New England Power Association's customers had no electric service—including this New London, Connecticut, gas station. Then, according to the April 1939 GEOGRAPHIC, where this photo appeared, "Yankee ingenuity" rode to the rescue. "Hundreds of automobiles were stalled for lack of fuel on New England roads until somebody thought of this solution," claimed the picture's caption. —Margaret G. Zackowitz

► **Flashback Archive** All the photos plus e-greetings, in Fun Stuff at ngm.com/0608.

PHOTO: THE DAY, NEW LONDON, CT

NATIONAL GEOGRAPHIC (ISSN 0027-9358) IS PUBLISHED MONTHLY BY THE NATIONAL GEOGRAPHIC SOCIETY, 1145 17TH ST. NW, WASHINGTON, DC 20036-4688. \$34.00 A YEAR FOR U.S. DELIVERY; \$6.00 PER SINGLE COPY (INCLUDES POSTAGE AND HANDLING). IN CANADA, AGREEMENT NUMBER 40063649. RETURN UNDELIVERABLE CANADIAN ADDRESSES TO NATIONAL GEOGRAPHIC, PO BOX 4412 STN. A, TORONTO, ONTARIO M5W 3W2. UNITED KINGDOM NEWSSTAND COVER PRICE £3.85. PERIODICALS POSTAGE PAID AT WASHINGTON, DC, AND AT ADDITIONAL MAILING OFFICES. POSTMASTER: SEND ADDRESS CHANGES TO NATIONAL GEOGRAPHIC, PO BOX 63002, TAMPA, FL 33663-3002. 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.



Mitsuaki Iwago.
Striking a Pose in the Digital Future.

Global Warming
Witness

Even in Africa, the effects of global warming are being felt. In the past three decades, the glacier atop Kilimanjaro has shrunk by almost half. Glaciers play an important role as a natural reservoir. If the glaciers disappear, the natural consequence is a water shortage for humans and wildlife alike. If the climate changes due to global warming, many species will be forced to move out of their present habitats. For species whose habitats are already shrinking, finding a new sanctuary can be exceptionally difficult.

An Olympus website about global warming is coming soon.

A bontebok stands tall on the crest of a small hill, proudly displaying its magnificent horns. Both males and females boast comparable horns, making it difficult to tell them apart. Judging by the way this one was showing off, photographer Mitsuaki Iwago was pretty sure it was a male. Once driven to the very brink of extinction by hunters in pursuit of their horns, these rare antelopes are now found only in South Africa. Iwago was especially impressed by the sharp contrast between the white markings and the reddish-brown coloring of the upper body. Thanks to Olympus digital technology, such striking moments as this can now be preserved forever.

Shot in Bontebok National Park in South Africa, on September 2, 2004, at 8:24 a.m., with the Olympus E-1, Zuiko Digital ED300mm, f4.0, 1/800 sec.

Digital SLR
Camera
OLYMPUS E-1



OLYMPUS CORPORATION Shinjuku Monolith, 3-1 Nishi-Shinjuku 2-chome, Shinjuku-ku, Tokyo 163-0914, Japan <http://www.olympus.com/>