

Syrian Refugees: Flight Into the Unknown

MARCH 2015

NATIONAL GEOGRAPHIC

CLIMATE CHANGE DOES NOT EXIST

EVOLUTION NEVER HAPPENED

THE MOON LANDING WAS FAKE

VACCINATIONS CAN LEAD TO AUTISM

GENETICALLY MODIFIED FOOD IS EVIL

THE WAR ON SCIENCE



A WORKER ADJUSTS A DIORAMA
OF A MOON LANDING AT THE
KENNEDY SPACE CENTER



Proboscis Anole (*Anolis proboscis*)

Size: Head and body length, 53 - 84 mm (2.1 - 3.3 inches); proboscis length, 10 - 20 mm (0.4 - 0.8 inches) **Weight:** Unknown **Habitat:** Found in a small stretch of vegetation along a major Ecuadorian highway **Surviving number:** Unknown



Photographed by Alejandro Arteaga

WILDLIFE AS CANON SEES IT

All for show. During courtship, the proboscis anole waves its horn from side to side to woo potential mates. Soft and flexible, the horn is not used for aggressive contact, but is conspicuous during foraging and displaying. Dominant males also show flamboyant colors, while subordinate males change color to match the twig they are on and flatten themselves against it. But the


twig lizard can't hide from habitat loss – a threat to which it is extremely vulnerable due to its limited range. If its habitat continues to disappear, it could very well follow.

As Canon sees it, images have the power to raise awareness of the threats facing endangered species and the natural environment, helping us make the world a better place.



EOS System

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MARCH 2015
VOL. 227 • NO. 3

A 12-year-old Syrian girl holds her weeks-old sister amid the tents of a camp in Nizip, Turkey, that is home to some 11,000 refugees.

48 Fleeing Terror, Finding Refuge

During his Out of Eden Walk, the author encounters “a vast panorama of mass homelessness”—thronged of desperate refugees escaping war-torn Syria.

By Paul Salopek Photographs by John Stanmeyer

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The Age of Disbelief

It's a phenomenon as old as Galileo. Scientists state truths and offer evidence, yet many of us remain unconvinced.

*By Joel Achenbach
Photographs by Richard Barnes*

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Luminous Life

More than four-fifths of Earth's organisms known to make light live in the ocean. Their glowing existence has perks and pitfalls.

*By Olivia Judson
Photographs by David Liittschwager*

88

Two Cities, Two Europes

The euro crisis cast two world capitals in opposing roles—Berlin the lender, Athens the borrower—with each resenting the other.

*By Adam Nicolson
Photographs by Gerd Ludwig
and Alex Majoli*

122 Proof | End of the Earth

One man embraces the “polished white emptiness” of the Greenland ice sheet.

By Murray Fredericks

On the Cover U.S. moon landings: real, or fabricated like this exhibit at Florida's Kennedy Space Center? Whether astronauts walked on the moon is one topic among science doubters. *Photograph by Richard Barnes*

Corrections and Clarifications Go to ngm.com/more.

The Refugee's Voice

Botol lives in Şanlıurfa, a dusty town in southern Turkey that is the reputed birthplace of Abraham. Urfa, as it is known, had been famed for drawing thousands of religious pilgrims to the cave where the prophet was supposedly born. Now the town is filled with 150,000 people who, like Botol, are seeking salvation of a different sort.

Botol is from Syria. Her husband fought against the Bashar al Assad regime in that country's ongoing civil war. More than a year ago he disappeared. Maybe the government arrested him, she says. Maybe it was the Islamic State (IS) militants. She believes he is dead.

She fears for her children back home, especially her eldest son, 19. "They are cutting heads in the streets," she said recently, through a translator. This is why Botol and about a million and a half other Syrian refugees have scattered across Turkey, fleeing the horrors of a bloody war and IS terrorists. As I write this, more people surge across the border every day and are crammed into refugee camps and Turkish cities, where their growing numbers cause resentment and unease among locals.

"There is no Syria anymore," Botol said. "No husband, no house." She will stay here. "Safety and security are most important." She shares three spotless rooms with 15 other Syrian refugees, seven of them children. There is no furniture. Mattresses and

rugs serve as seats. The kitchen consists of a sink, a hot plate, and a large electric pan to make flatbread. We retreated there to talk because Botol, out of modesty, would not speak in front of my colleague, Paul Salopek. Paul is on a seven-year journey on foot. He literally walked smack into this humanitarian crisis. Turkey has been so flooded by Syrian refugees that he and photographer John Stanmeyer stopped to chronicle the diaspora for this issue.

Botol won't talk to Paul, but the other women in the house—Aklas, Reem, and Hella—will. Their words spill out in a chaos of conflicting emotions, unimaginable losses, and palpable relief.

Botol speaks for them all. "Thank God I am here," she said. "Syria is not a good place anymore. But this is an unbearable life. Very difficult. Very hard. And it won't get better, because once you lose something, you can't get it back."

There were 51 million forcibly displaced people around the world in 2013, a UN report says—the largest number since the end of World War II. They are, like Botol, refugees of conflict. It is important that we hear their stories.



A Syrian family find shelter at an abandoned gas station in Suruç, Turkey. They fled Islamic State militants.

Susan Goldberg, Editor in Chief

SAVING THE DAY, ONE DOG AT A TIME.

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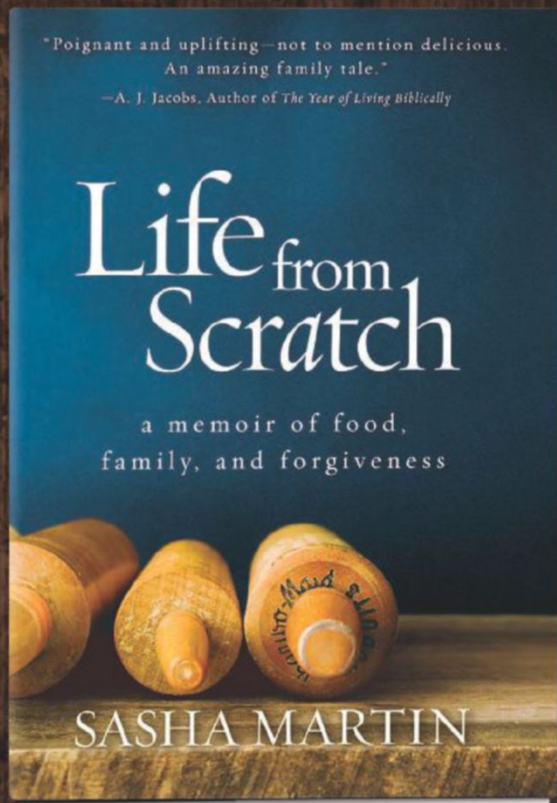
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Why National Geographic Is a Family Affair

When **Gilbert M. Grosvenor** retired from the board of trustees of the National Geographic Society on June 21, 2014—60 years to the day after he started working here—he left an organization built by five generations of his family. (His daughter, obstetrician Alexandra Grosvenor Eller, continues the tradition: She was elected to the National Geographic board in 2009.)

As the editor in chief of the magazine,

GARDINER GREENE HUBBARD (1822-1897)

A lawyer and financier, he helped fund Alexander Graham Bell's research, which eventually led to the invention of the telephone.



JANUARY 1888

Hubbard is among the founders of the National Geographic Society (NGS) and is named its first president.

ALEXANDER GRAHAM BELL (1847-1922)

Born in Edinburgh, Scotland, the inventor had an early interest in teaching the deaf.



1870

Immigrates to Ontario, Canada. Though he spent much of his time in Washington, D.C., Bell kept lifelong ties to Nova Scotia.

1876

Awarded the patent for the telephone

1877

Marries Mabel Hubbard, daughter of Gardiner Greene Hubbard

1898

Becomes president of National Geographic Society after death of Gardiner Greene Hubbard

president of the Society, and then chairman of the board, Grosvenor has helped broaden National Geographic's reach through children's publications, local-language editions of the magazines and books, television, and geography education.

You studied premed at Yale. What made you change course and come to work at the National Geographic Society?

Between my junior and senior years I went to the Netherlands on a summer program to rebuild dikes washed out by the great flood of 1953. I photographed and co-authored a story that was published in the magazine. Although I'm not sure I realized it at the time, it changed my life. I discovered the power of journalism. And that's what we are all about—recording those chronicles of planet Earth.

Your geography education foundation essentially restored the study of geography to the American classroom. Why is geography so important?

Geography is an essential part of STEM [science, technology, engineering, and mathematics] education. We need to do better with that. To understand environmental issues and the dynamics of Earth you have to understand geography. Why is it that a bottle released off the coast of Florida ends up in Ireland? That's the Gulf Stream at work. What about global warming, the dramatic shift north of flora and fauna, and the fact that Canada will become the breadbasket of North America? Patterns of immigration are also all about geography.

Your advice to successors?

Always do what we do best, not what others do.

GILBERT HOVEY GROSVENOR (1875-1966)

He pioneered the use of photography in the magazine and built NGS membership to more than two million.



1899
Hired as the National Geographic Society's first employee

1900
Marries Elsie May Bell, daughter of Alexander Graham Bell

1903
Named editor of *National Geographic* magazine

1920
Elected president of National Geographic Society

1954
Resigns as both president and editor, becomes chairman of the board

MELVILLE BELL GROSVENOR (1901-1982)

Son of Gilbert H. Grosvenor, he brought Louis Leakey, Jacques Cousteau, and Jane Goodall to NGS.



1924
Starts work at National Geographic a year after graduating from the U.S. Naval Academy. Shows a talent for photography.

1930
Takes first-ever color aerial photograph

1957
Elected president of National Geographic Society and editor of *National Geographic*

1967
Retires as editor of *National Geographic*, becomes chairman of the board

GILBERT MELVILLE GROSVENOR

Born in 1931, the son of Melville Bell Grosvenor increased NGS membership to nearly 11 million.



1954
Graduates from Yale, joins *National Geographic* staff

1970
Becomes editor of *National Geographic*

1974
Starts *World* magazine (now *NG Kids*)



1980
Resigns as editor, elected president of NGS

1985
Kicks off his geography education program, budgeting four million dollars to improve American kids' geographic literacy

1996
Retires as president of NGS

2004
Receives Presidential Medal of Freedom

2010
Named chairman emeritus of the NGS board

EXPLORE



Wild Things



Saving Stream Fish

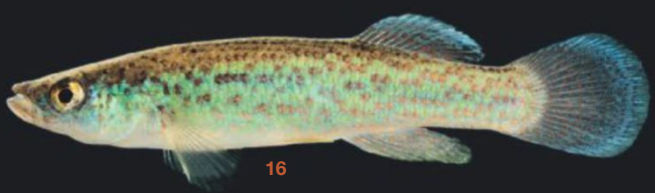
Since the early 1980s ichthyologists J. R. Shute and Pat Rakes have splashed through southeastern U.S. creeks and rivers hunting for tiny survivors. Because of chemical pollution, silt, and habitat loss, many species of small, native fish—some found in only a single creek—have nearly vanished from river systems. Today the nonprofit the men founded, Conservation Fisheries, Inc., works in ten states to preserve and propagate about 65 rare species, some shown here.

From a few fish and eggs, CFI raises hatchlings of threatened species, then places them in the species' streams of origin or other hospitable waters. For example: To stem the loss of spotfin chub (18, right) in the Tennessee River system, CFI spent years introducing hatchlings, which are now reproducing in the wild.

CFI is keeping a few rare fish "in an ark population, because there's no suitable place to put them back," Shute says. CFI's last chucky madtom (1) died in 2008, and since then, the tiny catfish have not been seen in the wild. "We hope they're still out there," he says, "but it's not looking good." —Patricia Edmonds

1. Chucky madtom 2. Blotchside logperch 3. Spring pygmy sunfish 4. Relict darter 5. Cumberland darter 6. Sickletfin redbhorse 7. Conasauga logperch 8. Spotted darter 9. Diamond darter 10. Cape Fear shiner 11. Blacksides dace 12. Ashy darter 13. Kentucky arrow darter 14. Roanoke logperch 15. Wounded darter 16. Barrens topminnow 17. Duskytail darter 18. Spotfin chub 19. Pearl darter 20. Slackwater darter

All fish are shown to scale. PHOTOS: JOEL SARTORE



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 - bleeding that is severe or you cannot control
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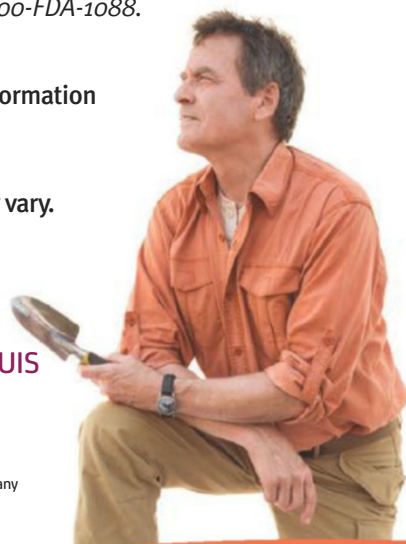
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The information below does not take the place of talking with your healthcare professional. Only your healthcare professional knows the specifics of your condition and how ELIQUIS may fit into your overall therapy. Talk to your healthcare professional if you have any questions about ELIQUIS (pronounced ELL eh kwiss).

What is the most important information I should know about ELIQUIS (apixaban)?

For people taking ELIQUIS for atrial fibrillation: Do not stop taking ELIQUIS without talking to the doctor who prescribed it for you. Stopping ELIQUIS increases your risk of having a stroke.

ELIQUIS may need to be stopped, prior to surgery or a medical or dental procedure. Your doctor will tell you when you should stop taking ELIQUIS and when you may start taking it again. If you have to stop taking ELIQUIS, your doctor may prescribe another medicine to help prevent a blood clot from forming.

ELIQUIS can cause bleeding which can be serious, and rarely may lead to death. This is because ELIQUIS is a blood thinner medicine that reduces blood clotting.

You may have a higher risk of bleeding if you take ELIQUIS and take other medicines that increase your risk of bleeding, such as aspirin, nonsteroidal anti-inflammatory drugs (called NSAIDs), warfarin (COUMADIN®), heparin, selective serotonin reuptake inhibitors (SSRIs) or serotonin norepinephrine reuptake inhibitors (SNRIs), and other medicines to help prevent or treat blood clots.

Tell your doctor if you take any of these medicines. Ask your doctor or pharmacist if you are not sure if your medicine is one listed above.

While taking ELIQUIS:

- you may bruise more easily
- it may take longer than usual for any bleeding to stop

Call your doctor or get medical help right away if you have any of these signs or symptoms of bleeding when taking ELIQUIS:

- unexpected bleeding, or bleeding that lasts a long time, such as:
 - unusual bleeding from the gums
 - nosebleeds that happen often
 - menstrual bleeding or vaginal bleeding that is heavier than normal

- bleeding that is severe or you cannot control
- red, pink, or brown urine
- red or black stools (looks like tar)
- cough up blood or blood clots
- vomit blood or your vomit looks like coffee grounds
- unexpected pain, swelling, or joint pain
- headaches, feeling dizzy or weak

ELIQUIS (apixaban) is not for patients with artificial heart valves.

Spinal or epidural blood clots (hematoma).

People who take a blood thinner medicine (anticoagulant) like ELIQUIS, and have medicine injected into their spinal and epidural area, or have a spinal puncture have a risk of forming a blood clot that can cause long-term or permanent loss of the ability to move (paralysis). Your risk of developing a spinal or epidural blood clot is higher if:

- a thin tube called an epidural catheter is placed in your back to give you certain medicine
- you take NSAIDs or a medicine to prevent blood from clotting
- you have a history of difficult or repeated epidural or spinal punctures
- you have a history of problems with your spine or have had surgery on your spine

If you take ELIQUIS and receive spinal anesthesia or have a spinal puncture, your doctor should watch you closely for symptoms of spinal or epidural blood clots or bleeding. Tell your doctor right away if you have tingling, numbness, or muscle weakness, especially in your legs and feet.

What is ELIQUIS?

ELIQUIS is a prescription medicine used to:

- reduce the risk of stroke and blood clots in people who have atrial fibrillation.
- reduce the risk of forming a blood clot in the legs and lungs of people who have just had hip or knee replacement surgery.

(Continued on adjacent page)



Bristol-Myers Squibb

PATIENT ASSISTANCE FOUNDATION

This independent, non-profit organization provides assistance to qualifying patients with financial hardship who generally have no prescription insurance. Contact 1-800-736-0003 or visit www.bmspaf.org for more information.

IMPORTANT FACTS about ELIQUIS® (apixaban) tablets *(Continued)*

- treat blood clots in the veins of your legs (deep vein thrombosis) or lungs (pulmonary embolism), and reduce the risk of them occurring again.

It is not known if ELIQUIS is safe and effective in children.

Who should not take ELIQUIS (apixaban)?

Do not take ELIQUIS if you:

- currently have certain types of abnormal bleeding
- have had a serious allergic reaction to ELIQUIS. Ask your doctor if you are not sure

What should I tell my doctor before taking ELIQUIS?

Before you take ELIQUIS, tell your doctor if you:

- have kidney or liver problems
- have any other medical condition
- have ever had bleeding problems
- are pregnant or plan to become pregnant. It is not known if ELIQUIS will harm your unborn baby
- are breastfeeding or plan to breastfeed. It is not known if ELIQUIS passes into your breast milk. You and your doctor should decide if you will take ELIQUIS or breastfeed. You should not do both

Tell all of your doctors and dentists that you are taking ELIQUIS. They should talk to the doctor who prescribed ELIQUIS for you, before you have any surgery, medical or dental procedure. **Tell your doctor about all the medicines you take, including** prescription and over-the-counter medicines, vitamins, and herbal supplements. Some of your other medicines may affect the way ELIQUIS works. Certain medicines may increase your risk of bleeding or stroke when taken with ELIQUIS.

How should I take ELIQUIS?

Take ELIQUIS exactly as prescribed by your doctor. Take ELIQUIS twice every day with or without food, and do not change your dose or stop taking it unless your doctor tells you to. If you miss a dose of ELIQUIS, take it as soon as you remember, and do not take more than one dose at

the same time. **Do not run out of ELIQUIS. Refill your prescription before you run out.** When leaving the hospital following hip or knee replacement, be sure that you will have ELIQUIS (apixaban) available to avoid missing any doses. **If you are taking ELIQUIS for atrial fibrillation, stopping ELIQUIS may increase your risk of having a stroke.**

What are the possible side effects of ELIQUIS?

- See **“What is the most important information I should know about ELIQUIS?”**
- ELIQUIS can cause a skin rash or severe allergic reaction. Call your doctor or get medical help right away if you have any of the following symptoms:
 - chest pain or tightness
 - swelling of your face or tongue
 - trouble breathing or wheezing
 - feeling dizzy or faint

Tell your doctor if you have any side effect that bothers you or that does not go away.

These are not all of the possible side effects of ELIQUIS. For more information, ask your doctor or pharmacist.

Call your doctor for medical advice about side effects. You may report side effects to FDA at 1-800-FDA-1088.

This is a brief summary of the most important information about ELIQUIS. For more information, talk with your doctor or pharmacist, call 1-855-ELIQUIS (1-855-354-7847), or go to www.ELIQUIS.com.

Manufactured by:

Bristol-Myers Squibb Company
Princeton, New Jersey 08543 USA

Marketed by:

Bristol-Myers Squibb Company
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An elephant that's 12.5 inches tall is part of an intricate mosaic floor with unusual themes.

Scenes From a Synagogue

When archaeologist Jodi Magness began to excavate a fifth-century synagogue at the site of Huqoq in Israel in 2011, the last thing she expected to see was a mosaic. In similar buildings found in the area, floors are paved in flagstones. But there, in an agricultural village near the Sea of Galilee, Magness's team has uncovered one stunning scene after another rendered in tiny colored stones.

Two sections depict Samson, a biblical hero not commonly portrayed in synagogues of the time. Another scene includes an even more uncommon subject: a pair of elephants decked out for battle. "There's no doubt that we have the very first nonbiblical story ever discovered decorating an ancient synagogue," says Magness. "In the Hebrew Bible there are no stories involving elephants." More surprises may lie ahead. The excavation has cleared only part of one aisle so far. The floor's main section, and its secrets, are yet to be revealed. —A. R. Williams

IN PERUVIAN DIGNITARY'S GRAVE, COSTUME CLAWS

At Huacas de Moche, a pre-Inca ceremonial center in the Peruvian desert, an intriguing grave from about 1,300 years ago has come to light. Near the skeleton of a man in his 30s lay a copper scepter, a symbol of power in the Moche culture. Also found: gilded feline claws of copper, probably from an animal costume used in ritual combat, with paws like the reconstructions at right. Archaeologists now plan to analyze the chemistry of this dignitary's bones. Clues about his diet may identify the city where he wielded his power. —ARW



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Dr. Cherukuri knew that untreated hearing loss could lead to depression, social isolation, anxiety, and symptoms consistent with Dementia and Alzheimer's disease. In his practice he knew that many of his patients would benefit from new digital hearing aids, but many couldn't afford the expense, which is not generally covered by Medicare or most private health insurance.

Same Digital Technology as \$3,000 Hearing Aids

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MDHearingAid[®] AIR for its virtually invisible, lightweight appearance. This sleek doctor-designed digital hearing aid delivers crisp, clear sound all day long and the soft flexible ear domes are so comfortable you won't realize you are wearing them.

This new digital hearing aid is packed with the features of \$3,000 competitors at a mere fraction of the cost. Now most people with hearing loss are able to enjoy crystal clear, natural sound — in a crowd, on the phone, in the wind — without “whistling” and annoying background noise.

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Of course hearing is believing, and we invite you to try it for yourself with our RISK-FREE 45-Day home trial. If you are not completely satisfied simply return it within that time period for a full refund of your purchase price.

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- ✓ Thousands of satisfied customers
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- ✓ Batteries Included! Comes Ready To Use
- ✓ 100% Money Back Guarantee!



Satisfied Buyers and Audiologist Agree, AIR is the Best Digital Value

“The AIRs are as small and work as well as a \$5,000 pair I had previously tried from somewhere else!”

—Dennis L., Arizona

“...my mother hasn't heard this well in years, even with her \$2,000 Digital! It was so great to see the joy on her face.”

—Al P., Minnesota

“I would definitely recommend them to my patients with hearing loss”

—Amy S., Indiana

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**Use Offer Code AX37 to get
FREE Batteries for a Full Year!**



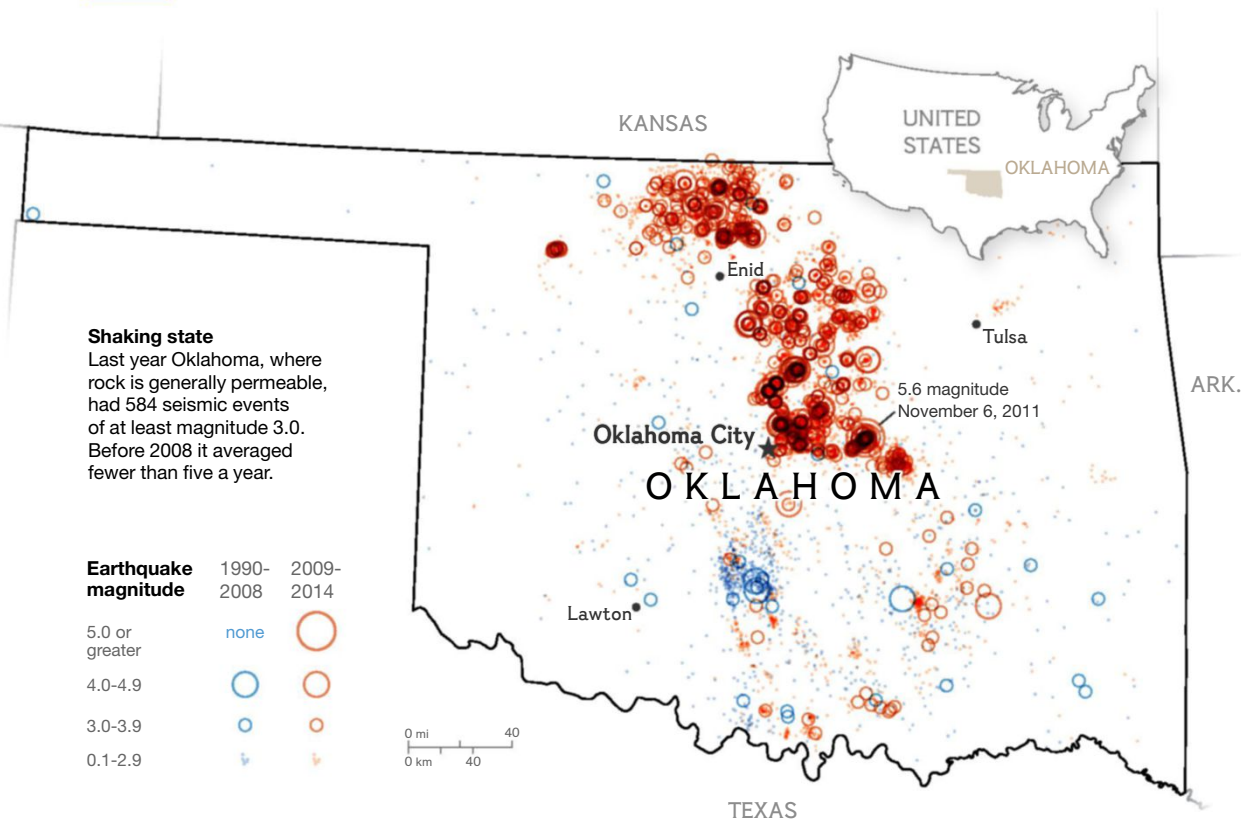
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TRIAL



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from Domestic & Imported Components.

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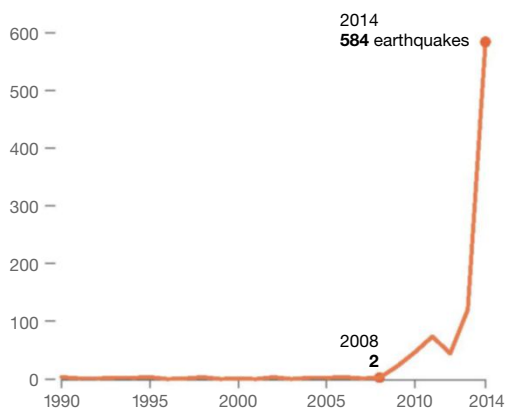
Quake Country

America's earthquake epicenter was once California. Now it's Oklahoma. In 2014 there were nearly 300 times as many magnitude 3.0 and greater earthquakes as there were in 2008—and more quakes of that magnitude than in the prior 30 years combined. The cause? Scientists can't say definitively, but new research funded by the U.S. Geological Survey notes that as quakes increased in number, so did the use of injection wells that bury wastewater from fracking and other oil and gas operations.

Driving that water deep underground is intended to keep it from creeping into shallow aquifers. But the process can be likened to forcing water into a lidded cup, says hydrogeology researcher Matthew Weingarten: "You can only push so much water through a straw before pressure builds." Increased subsurface water deposits can raise fluid pressure and cause geologic faults to slip.

Though other fossil-fuel-rich states—Kansas, Texas—also have injection wells, Oklahoma's faults seem more prone to quake-causing slips. Is more regulation needed? Mike Teague, Oklahoma's energy and environment secretary, says the state will decide once it has more data, which it gets from the oil and gas industry. —Daniel Stone

Earthquake frequency in Oklahoma
Magnitude 3.0 and greater, yearly total





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Alexander Graham Bell with his grandson Melville Beinn Bhreagh, Nova Scotia. Copyright © 2014 National Geographic Society



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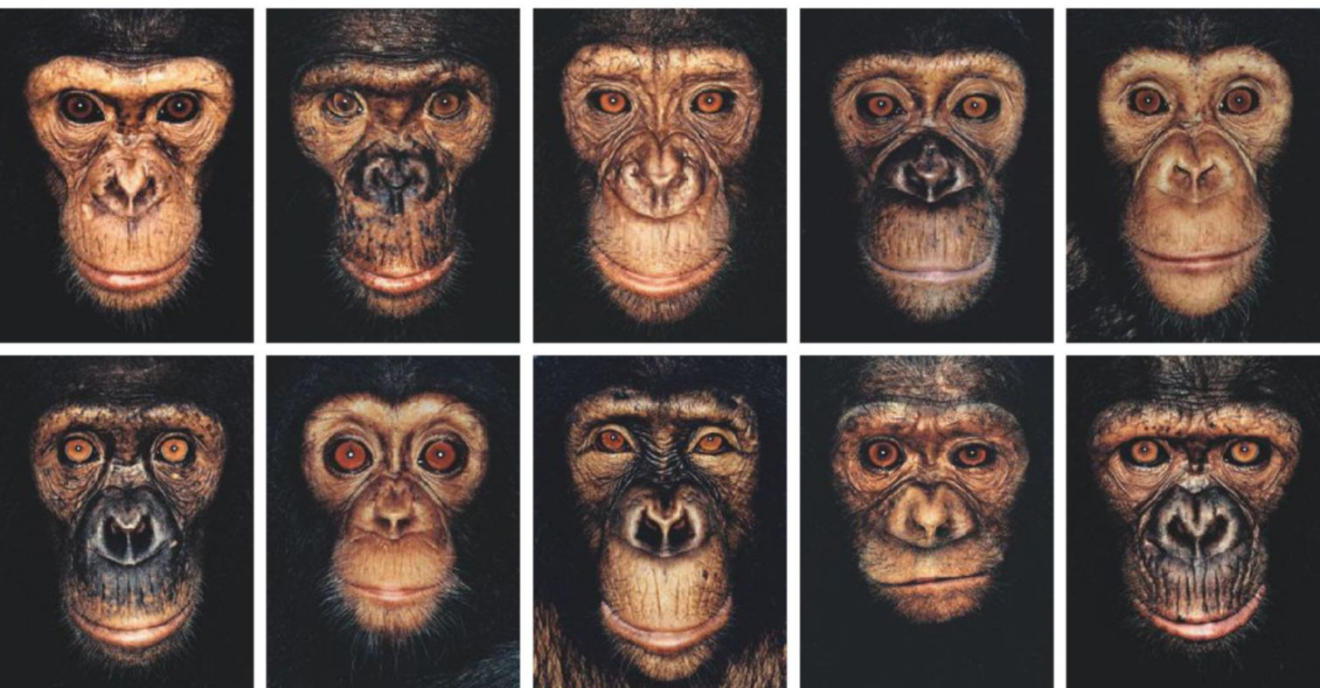
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Protecting Chimps From Ebola

Wild chimpanzees are not immune to the Ebola virus. With vaccination, they could be, researchers say.

Infectious diseases, both naturally occurring and from human spillover, are a top threat to endangered chimps and gorillas. In past localized Ebola outbreaks, the virus killed more than 90 percent of gorillas and untold numbers of chimps.

Recently, a vaccine was tested that mimics the Ebola virus's outer covering but doesn't carry live virus; injections gave captive chimps (such as those seen here) immunity without causing symptoms. Because administering shots to wild apes is impractical, researchers plan to develop an oral version to be delivered with bait.

Future testing is uncertain, as the National Institutes of Health has changed how it funds research involving chimps. If primate biomedical facilities close, says quantitative ecologist Peter Walsh, there will be nowhere to test vaccines that could help conserve wild apes. —*Alison Fromme*

GIVE GERMS THE BUMP

Greeting a friend doesn't have to mean meeting all her germs too. David Whitworth and Sara Mela from the U.K.'s Aberystwyth University studied the bacteria transferred in handshakes, high fives, and fist bumps—and found that handshakes transfer 10 to 20 times more bacteria than fist bumps. Although in health terms there's "a definite benefit to not shaking hands," Whitworth says, it could be hard to persuade the public to bump instead of clasp. History favors the handshake, a greeting seen in Greek art from the fifth century B.C. —*Lindsay N. Smith*





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EXPLORE

By the Numbers

Antibiotic Resistance

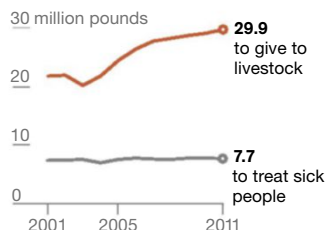
Since the 1950s farmers have fed antibiotic growth promoters (AGPs) to livestock. Overusing these substances can create superbugs, pathogens that are resistant to multiple drugs and could be passed along to humans. Mindful of that, companies such as Perdue Farms have stopped using the drugs to make chickens gain weight faster. Since Denmark banned AGPs in the 1990s, the major pork exporter says it's producing more pigs—and the animals get fewer diseases. Says Centers for Disease Control and Prevention epidemiologist Tom Chiller, "Antibiotics are miracle drugs that should only be used to treat diseases." —*Kelsey Nowakowski*

ANTIBIOTIC USE

80%

of all antibiotics sold in the U.S. are given to poultry and other livestock.

ANTIBIOTICS SOLD IN THE U.S.

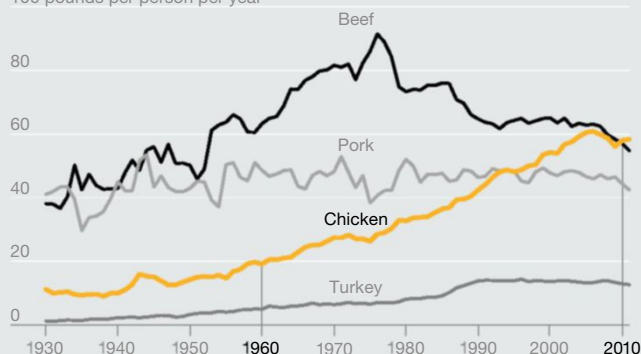


THE POULTRY CASE STUDY

Americans today eat three times as much poultry as they did in 1960. Since most U.S. chickens are raised in large, crowded facilities, farmers feed them antibiotics to prevent disease as well as speed their growth.

MEAT CONSUMPTION IN THE U.S.

100 pounds per person per year



ANTIBIOTICS AS GROWTH PROMOTERS

They help chickens grow bigger faster, making the meat...

...cheaper for the consumer.

In 1960 it took 63 days



to grow a 3.4-pound broiler.

\$3.24*
a pound

In 2011 it took 47 days



to grow a 5.4-pound one.

\$1.29
a pound

*2011 dollars, adjusted for inflation

COST OF ANTIBIOTIC-RESISTANT INFECTIONS TO U.S. HEALTH SYSTEM, 2013

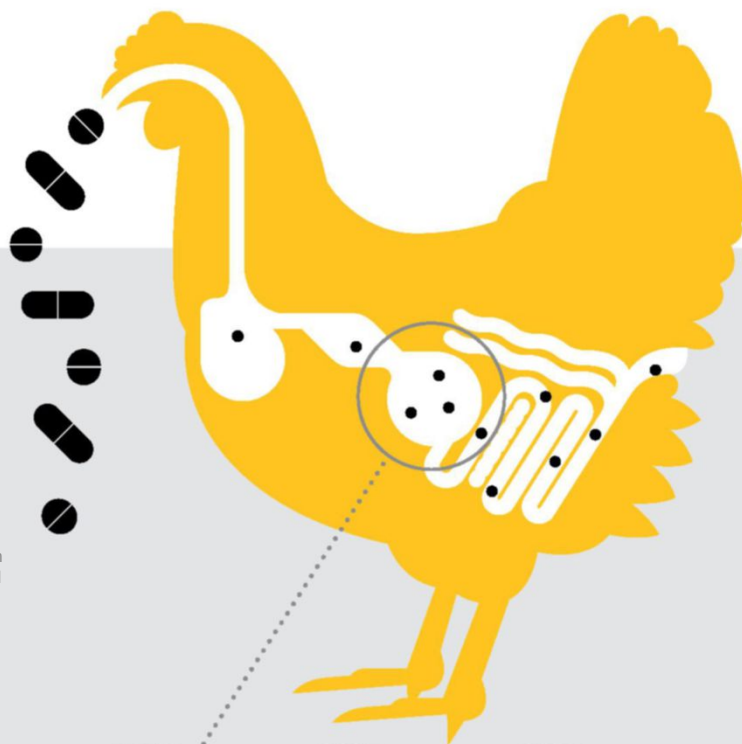
\$21-34 billion

The low-end figure is more than double the Centers for Disease Control and Prevention's 2013 budget.

HOW RESISTANCE DEVELOPS AND SPREADS

1.

Antibiotics can be given to livestock in their feed or sprayed on them, to be ingested when the animals groom themselves.



2.

The bacteria causing an infection are usually not resistant to drugs.



But some of them can be naturally drug resistant.



When antibiotics kill the nonresistant bacteria...



the resistant ones—the superbugs—can flourish.

53%

of grocery store chicken sampled in a 2013 study had resistant *E. coli*.

3.

Superbugs can be passed to humans in many ways.



Farmworkers often have direct contact with animals.



Drug-resistant bacteria can linger on improperly cooked meat.



Fertilizer or water containing animal feces can spread superbugs to food crops.

CASES OF ANTIBIOTIC RESISTANCE IN AMERICANS, 2013

2,049,400

Illnesses

23,000

Deaths

HOSPITALIZATION TIME



Resistant bacterial infections 12.7 nights

Nonresistant 6.4

Resistant bacterial infections double risk of death compared with nonresistant infections.



Only 7 percent of some 400 antibiotic drugs given to livestock have been reviewed by the FDA.



China's appetite for shark fin—traditionally used to flavor soup—has been waning since 2012.

Shark Fin Demand in Decline

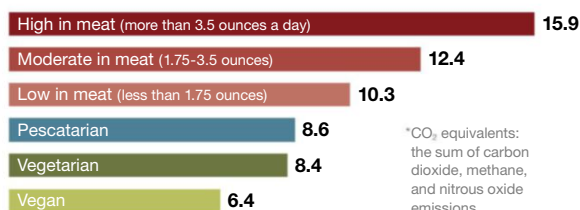
Hunted by generations of humans hungry to sell their fins, certain shark populations—including some hammerhead, mako, and tiger—have nearly collapsed over the past three decades. But according to a new report by the wildlife advocacy group WildAid, the tide may be turning for these top ocean predators as demand declines in China, the world's leading shark fin consumer.

Spurred by global outcry, many countries have banned “finning,” the practice of catching a shark, severing its fins, and tossing the animal back to die. Some nations have banned commercial shark fishing altogether. In southern China, ground zero for the fin trade, sales have dropped by 82 percent since 2012. Lead report author Samantha Whitcraft calls that a step in the right direction, away from cruelty and toward conservation. —Catherine Zuckerman

SKIP MEAT, CUT YOUR CARBON FOOTPRINT

Vegans and vegetarians have a new reason to feel virtuous. A recent U.K.-based study suggests diets low in meat—particularly beef and lamb—take less of a toll on the environment. In fact, if a typical carnivore switched to eating like a typical vegan, his or her dietary carbon footprint would be halved, says epidemiologist Peter Scarborough. Even consuming 50 percent less meat, he says, can trim annual emissions “by an amount equivalent to a jetliner flight from London to New York.” —CZ

Mean greenhouse gas emissions per 2,000 kilocalorie diet
pounds of CO₂ equivalents*



*CO₂ equivalents: the sum of carbon dioxide, methane, and nitrous oxide emissions

**"I WAS PRESCRIBED
LYRICA FOR MY
DIABETIC NERVE
PAIN AND IT
HELPED ME.
I'M GRATEFUL FOR IT."***

**—MICHAEL, FORMER PRO GOLFER
DIAGNOSED WITH DIABETIC NERVE PAIN.**



**Diabetes damages
nerves which
may cause pain.**



**LYRICA is FDA
approved to treat
Diabetic Nerve Pain.**

Artist
depiction

Get specific treatment for Diabetic Nerve Pain.

LYRICA®
PREGABALIN 
capsules

Diabetic Nerve Pain (or pain from Diabetic Peripheral Neuropathy) is characterized by shooting, burning, pins and needles symptoms.

In some patients, LYRICA has been clinically proven to provide effective pain relief.*

Some patients also had a significant reduction of pain in as early as one week. And, LYRICA is not a narcotic.†

Ask your doctor about LYRICA today.

*Individual results may vary. †Those who have had a drug or alcohol problem may be more likely to misuse LYRICA.

We asked Michael to tell us about his experience with LYRICA. To hear Michael's story, visit LYRICA.com.

Prescription LYRICA is not for everyone. Tell your doctor right away about any serious allergic reaction that causes swelling of the face, mouth, lips, gums, tongue, throat, or neck or any trouble breathing, rash, hives or blisters. LYRICA may cause suicidal thoughts or actions in a very small number of people. Patients, family members or caregivers should call the doctor right away if they notice suicidal thoughts or actions, thoughts of self harm, or any unusual changes in mood or behavior. These changes may include new or worsening depression, anxiety, restlessness, trouble sleeping, panic attacks, anger, irritability, agitation, aggression, dangerous impulses or violence, or extreme increases in activity or talking. If you have suicidal thoughts or actions, do not stop LYRICA without first talking to your doctor. LYRICA may cause swelling of your hands, legs and feet. Some of the most common side effects of LYRICA are dizziness and sleepiness. Do not drive or work with machines until you know how LYRICA affects you. Other common side effects are blurry vision, weight gain, trouble concentrating, dry mouth, and feeling "high." Also, tell your doctor right away about muscle pain along with feeling sick and feverish, or any changes in your eyesight including blurry vision or any skin sores if you have diabetes. You may have a higher chance of swelling, hives or gaining weight if you are also taking certain diabetes or high blood pressure medicines. Do not drink alcohol while taking LYRICA. You may have more dizziness and sleepiness if you take LYRICA with alcohol, narcotic pain medicines, or medicines for anxiety. If you have had a drug or alcohol problem, you may be more likely to misuse LYRICA. Tell your doctor if you are planning to father a child. Talk with your doctor before you stop taking LYRICA or any other prescription medication.

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

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

You are encouraged to report negative side effects of prescription drugs to the FDA.

Visit www.FDA.gov/medwatch or call 1-800-FDA-1088.

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IMPORTANT FACTS



(LEER-i-kah)

IMPORTANT SAFETY INFORMATION ABOUT LYRICA

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

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

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

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

- suicidal thoughts or actions
- new or worse depression
- new or worse anxiety
- feeling agitated or restless
- panic attacks
- trouble sleeping
- new or worse irritability
- acting aggressive, being angry, or violent
- acting on dangerous impulses
- an extreme increase in activity and talking
- other unusual changes in behavior or mood

If you have suicidal thoughts or actions, do not stop LYRICA without first talking to your doctor.

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

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

LYRICA may cause dizziness or sleepiness.

Do not drive a car, work with machines, or do other dangerous things until you know how LYRICA affects you. Ask your doctor when it is okay to do these things.

BEFORE STARTING LYRICA, continued

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

POSSIBLE SIDE EFFECTS OF LYRICA

LYRICA may cause serious side effects, including:

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

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

The most common side effects of LYRICA are:

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

If you have diabetes, you should pay extra attention to your skin while taking LYRICA.

ABOUT LYRICA

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

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

Who should NOT take LYRICA:

- Anyone who is allergic to anything in LYRICA

BEFORE STARTING LYRICA

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

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

Tell your doctor about all your medicines. Include over-the-counter medicines, vitamins, and herbal supplements. LYRICA and other medicines may affect each other causing side effects. Especially tell your doctor if you take:

HOW TO TAKE LYRICA

Do:

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Basic Instincts

A genteel disquisition on love and lust in the animal kingdom

Looking Hot, Then Not

The mandarin drake “possesses an amazing and bizarre plumage which makes him one of the most beautiful and striking ducks—indeed one of the most beautiful birds—in the world.” So says Christopher Lever, an eminent British conservationist and one of the world’s leading authorities on mandarin ducks (*Aix galericulata*).

His statement begs a footnote. A mandarin drake hoping to mate is definitely a looker—but after he’s achieved that goal? Not so much.

In Europe drakes sport what Lever calls “full breeding finery” in fall: green-and-copper head, purple breast, rust-colored ruff, orange-gold wings. Through the winter the courting male will preen, shake, and flash those feathers to entice the duller-hued female to mate. By April or May the connubial deed is done, and the duck lays 9 to 12 eggs.

The drake stays nearby for the 28- to 33-day incubation. But once ducklings hatch, females must rear them alone, while males adjourn to a summer-long molting party. Dropping their come-hither feathers leaves drakes in what’s called “eclipse plumage” (right). Having also shed their primary wing feathers, they’re temporarily flightless, so their drab looks serve as helpful camouflage from would-be predators.

As fall returns, the ugly-duck phase passes. Drakes suit up once more in nuptial plumage and go looking for love. —Patricia Edmonds

HABITAT

Native to East Asia, introduced in Europe and the U.S.

STATUS

Least concern

OTHER FACTS

Mandarins, which usually mate long-term or for life, are symbols of fidelity and marital bliss in Japan and China.



The mandarin drake in breeding plumage was photographed in a private collection; the molted mandarin drake (top) was photographed at Sylvan Heights Bird Park, Scotland Neck, North Carolina.

PHOTOS: JOEL SARTORE

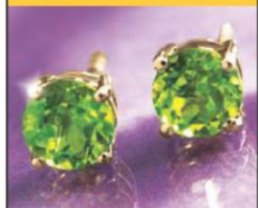
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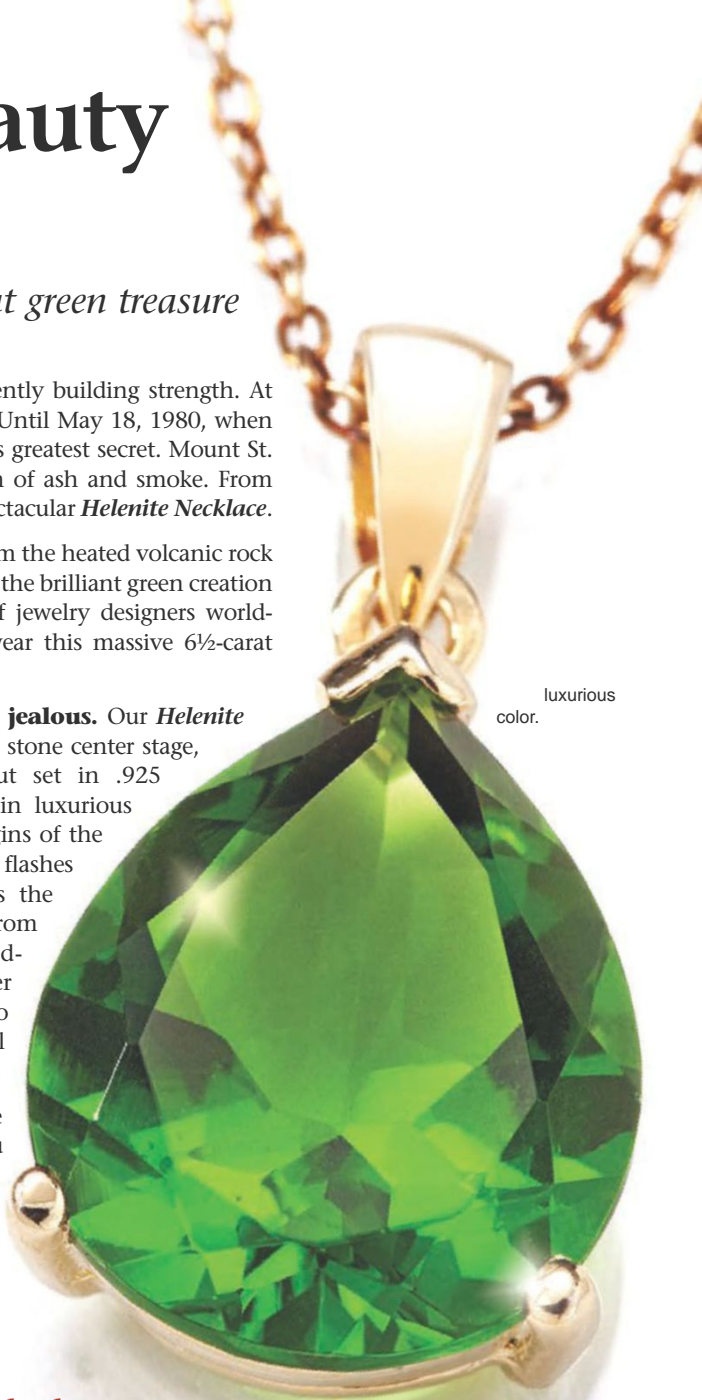
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VISIONS

A group of young women with exceptionally long, straight, light brown hair are standing in a field of white daisies. They are all looking upwards towards a large, leafy tree in the background. The scene is bathed in warm, golden light, suggesting late afternoon or early morning. The women are wearing casual clothing like jeans and shorts. The background shows a dense canopy of green leaves and a glimpse of a blue sky with some clouds.

Argentina

For "Pelo Largo Querido," a personal project featuring Argentines with exceptionally long locks, the photographer asked local women in Neuquén, Patagonia, to let their hair down.

PHOTO: IRINA WERNING





Turkey

A plastic curtain printed with a cityscape of Istanbul serves, when stretched taut, as a backdrop for a Turkish television show. TV dramas have become an important export for Turkey and are sent all over the Middle East.

PHOTO: GUY MARTIN, PANOS







Israel

Children frolic in the fountains at Jerusalem's Teddy Park, named in memory of the city's longtime mayor Teddy Kollek. The dancing jets of recycled water are coordinated with lights and music.

PHOTO: URIEL SINAI,
GETTY IMAGES

VISIONS

YourShot.ngm.com

Time Capsule

Assignment As the world changes, some parts stay the same. We asked to see images that transcend time.



José Bezerra
Mossoró, Brazil

Bezerra played with his son in Tibau, a beach town on Brazil's Atlantic coast. When a boat came on shore, he saw images of the past. "As a child, I also bathed in these waters," he says. "It was as if I was seeing history being replayed."

worldbeat

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VISIONS

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EDITOR'S NOTE

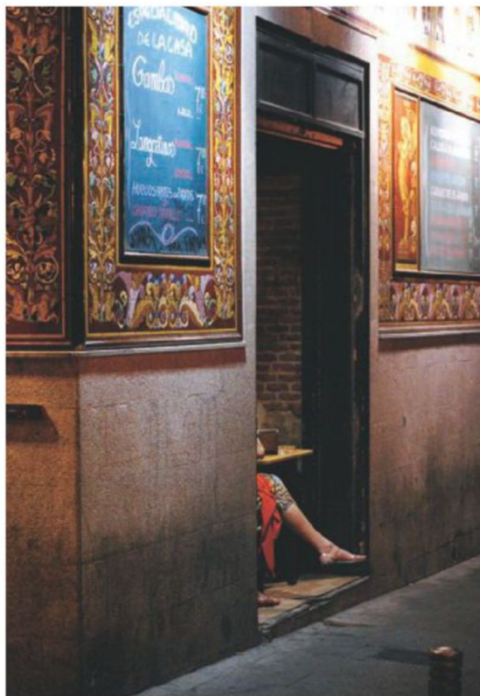
“Everyday things start to feel timeless
when they have an aura of mystery. A
woman’s leg, a family on a beach—these
scenes could be from any decade.”

—Janna Dotschkal, associate photo editor

Michael D. Young

Drexel Hill, Pennsylvania

On vacation in Madrid, Spain, Young was walking with his wife
around midnight. “There was something you don’t normally
see, a woman’s leg sticking out of a doorway.” He took about
six frames before the woman moved.



If You Bought an Airline Ticket between the U.S. and Asia, Australia, New Zealand, or the Pacific Islands, *You Could Receive Benefits from Class Action Settlements*

Settlements have been reached with eight airlines in a class action lawsuit involving the price of airline tickets. The Settling Defendants are: Air France; Cathay Pacific; Japan Airlines; Malaysian Airlines; Qantas; Singapore Airlines; Thai Airways; and Vietnam Airlines.

The lawsuit continues against five Non-Settling Defendant airlines: Air New Zealand; All Nippon Airways ("ANA"); China Airlines (Taiwan); EVA Airways; and Philippines Airlines.

What is the case about?

The lawsuit claims that the Defendants agreed to fix prices on tickets for transpacific air travel. As a result, ticket purchasers may have paid more than was necessary. The Settling Defendants deny the allegations, and deny that they have any liability. The Defendant airlines also deny liability, although ANA has pled guilty to fixing the prices of certain discounted tickets.

Am I included?

You are included if: (1) you bought a ticket for air travel from one of 26 airlines; (2) the ticket included at least one flight segment between the U.S. and Asia or Oceania; and (3) your purchase was made between January 1, 2000 and the present. A more complete description of eligibility requirements is available at the website or by calling the toll-free number.

What do the Settlements provide?

The Settling Defendants have agreed to pay \$39,502,000 (the "Settlement Fund"). Money will not be distributed yet, and will be distributed pursuant to a Plan of Allocation approved by the Court. Additional information is available on the website below. Class Counsel will pursue the lawsuit against the Non-Settling Defendants.

Class Counsel have not requested attorneys' fees and reimbursement of costs at this time but will do so in connection with the final approval hearing. For the current Settlements, Class Counsel will request up to one-third of the Settlement Fund plus up to \$7,500 for each of the class representatives. Class Counsel has asked the Court to set aside an additional \$3 million of the Settlement Fund to cover future expenses.

How can I get benefits?

Submit a Claim Form online or by mail. The earliest deadline to file a claim is **September 19, 2015**, but you will have until 120 days after the Settlements become final and effective to file your claim.

What are my rights?

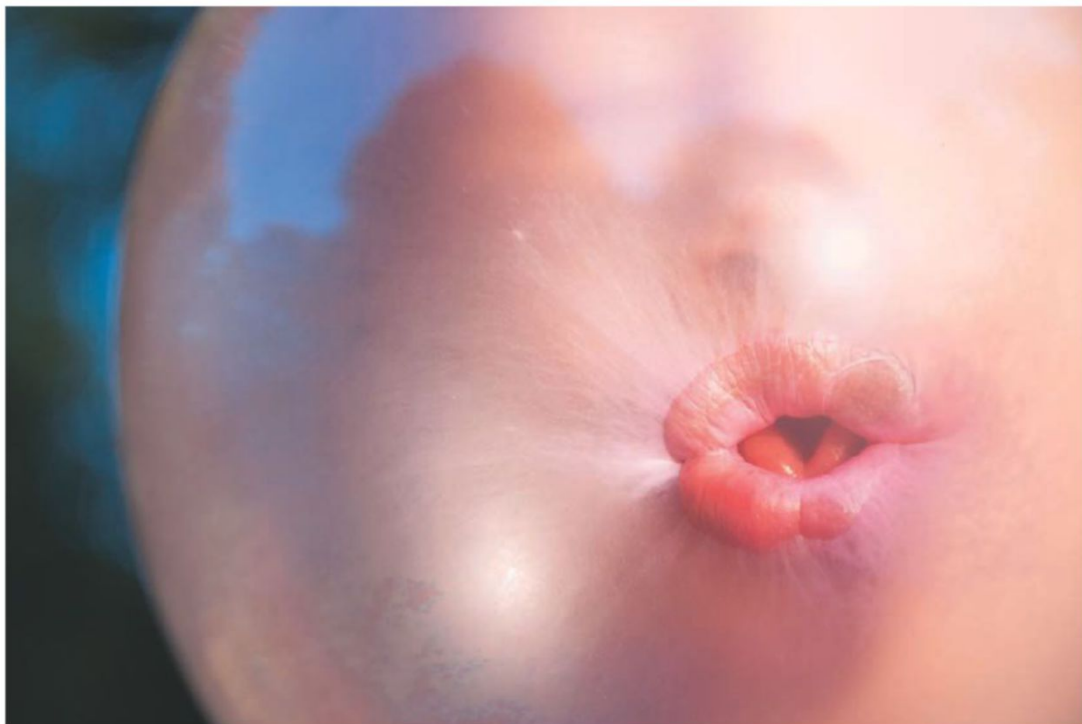
If you do nothing, you will be bound by the Settlements and the Court's decisions. If you want to keep your right to sue the Settling Defendants you must exclude yourself from the classes by **April 17, 2015**. If you stay in the classes, you may object to the Settlements by **April 17, 2015**. The Court will hold a hearing on **May 22, 2015** to consider whether to approve the Settlements. You or your own lawyer may appear at the hearing at your own expense, but you do not have to attend.

Please visit the website, www.AirlineSettlement.com for additional information, important documents, and case updates.

For more information: 1-800-439-1781 www.AirlineSettlement.com

Editor's Choice

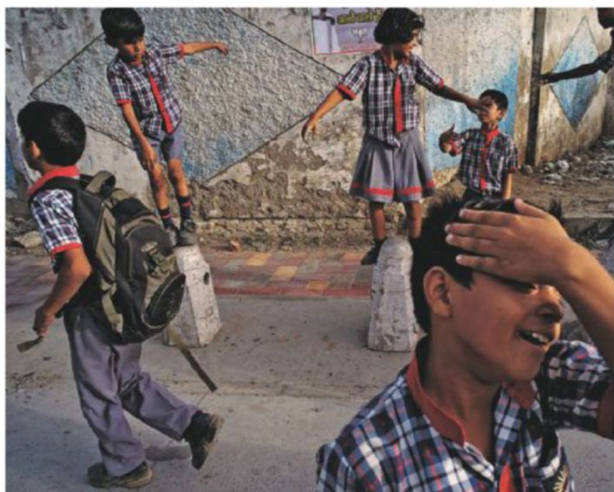
Daily Dozen Editors pick 12 photos from those submitted online each day. Here are our favorites this month.



EDITOR'S NOTE

“Great photography lets us see the world in new ways. Meredith turned a simple piece of bubble gum into something surprising, curious, beautiful, informative, and fun.”

—*Jessie Wender, senior photo editor*



Meredith Novario

Okinawa, Japan

While her husband was away, Novario entertained her three kids by teaching them to blow bubbles. “This is about three months’ worth of practice by my oldest son, Eli,” she says of the photograph.

Vineet Vohra

New Delhi, India

On his walk home from work, Vohra, a street photographer, often passed a school where students waited outside for their buses. He caught a playful moment the day before summer vacation.



THE AGE OF

**SKEPTICISM
ABOUT SCIENCE
IS ON THE RISE,
AND POLARIZATION
IS THE ORDER
OF THE DAY.
WHAT'S CAUSING
REASONABLE
PEOPLE TO DOUBT
REASON?**

DISBELIEF



A GIANT LEAP FOR DOUBTERS A worker adjusts an exhibit at NASA's Kennedy Space Center in Florida. Skepticism about established science is hardly new, but the Internet has been a boon to fringe beliefs. Think the moon landings were faked? Go online—you'll find plenty of people who agree.



By Joel Achenbach

Photographs by Richard Barnes



here's a scene in Stanley Kubrick's comic masterpiece *Dr. Strangelove* in which Jack D. Ripper, an American general who's gone rogue and ordered a nuclear attack on the Soviet Union, unspools his paranoid worldview—and the explanation for why he drinks “only distilled water, or rainwater, and only pure grain alcohol”—to Lionel Mandrake, a dizzy-with-anxiety group captain in the Royal Air Force.

RIPPER: Have you ever heard of a thing called fluoridation? Fluoridation of water?

MANDRAKE: Ah, yes, I have heard of that, Jack. Yes, yes.

RIPPER: Well, do you know what it is?

MANDRAKE: No. No, I don't know what it is. No.

RIPPER: Do you realize that fluoridation is the most monstrously conceived and dangerous communist plot we have ever had to face?

THE MOVIE CAME OUT in 1964, by which time the health benefits of fluoridation had been thoroughly established, and antifuoridation conspiracy theories could be the stuff of comedy. So you might be surprised to learn that, half a century later, fluoridation continues to incite fear and paranoia. In 2013 citizens in Portland, Oregon, one of only a few major American cities that don't fluoridate their water, blocked a plan by local officials to do so. Opponents didn't like the idea of the government adding “chemicals”

to their water. They claimed that fluoride could be harmful to human health.

Actually fluoride is a natural mineral that, in the weak concentrations used in public drinking water systems, hardens tooth enamel and prevents tooth decay—a cheap and safe way to improve dental health for everyone, rich or poor, conscientious brusher or not. That's the scientific and medical consensus.

To which some people in Portland, echoing antifuoridation activists around the world, reply: We don't believe you.

We live in an age when all manner of scientific knowledge—from the safety of fluoride and vaccines to the reality of climate change—faces organized and often furious opposition. Empowered by their own sources of information and their own interpretations of research, doubters have declared war on the consensus of experts. There are so many of these controversies these days, you'd think a diabolical agency



EVOLUTION ON TRIAL In 1925 in Dayton, Tennessee, where John Scopes was standing trial for teaching evolution in high school, a creationist bookseller hawked his wares. Modern biology makes no sense without the concept of evolution, but religious activists in the United States continue to demand that creationism be taught as an alternative in biology class. When science conflicts with a person's core beliefs, it usually loses.

had put something in the water to make people argumentative. And there's so much talk about the trend these days—in books, articles, and academic conferences—that science doubt itself has become a pop-culture meme. In the recent movie *Interstellar*, set in a futuristic, downtrodden America where NASA has been forced into hiding, school textbooks say the Apollo moon landings were faked.

In a sense all this is not surprising. Our lives are permeated by science and technology as never before. For many of us this new world is wondrous, comfortable, and rich in rewards—but also more complicated and sometimes unnerving. We now face risks we can't easily analyze.

We're asked to accept, for example, that it's

safe to eat food containing genetically modified organisms (GMOs) because, the experts point out, there's no evidence that it isn't and no reason to believe that altering genes precisely in a lab is more dangerous than altering them wholesale through traditional breeding. But to some people the very idea of transferring genes between species conjures up mad scientists running amok—and so, two centuries after Mary Shelley wrote *Frankenstein*, they talk about Frankenfood.

The world crackles with real and imaginary hazards, and distinguishing the former from the latter isn't easy. Should we be afraid that the Ebola virus, which is spread only by direct contact with bodily fluids, will mutate into an airborne superplague? The scientific consensus

MAP OF SQUARE AND STAGNANT

BY PROF. ORLANDO FERGOUSON,

HOT SPRINGS, S. D.

Four Hundred Passages in the Bible that Condemn the
This Map is the Bible

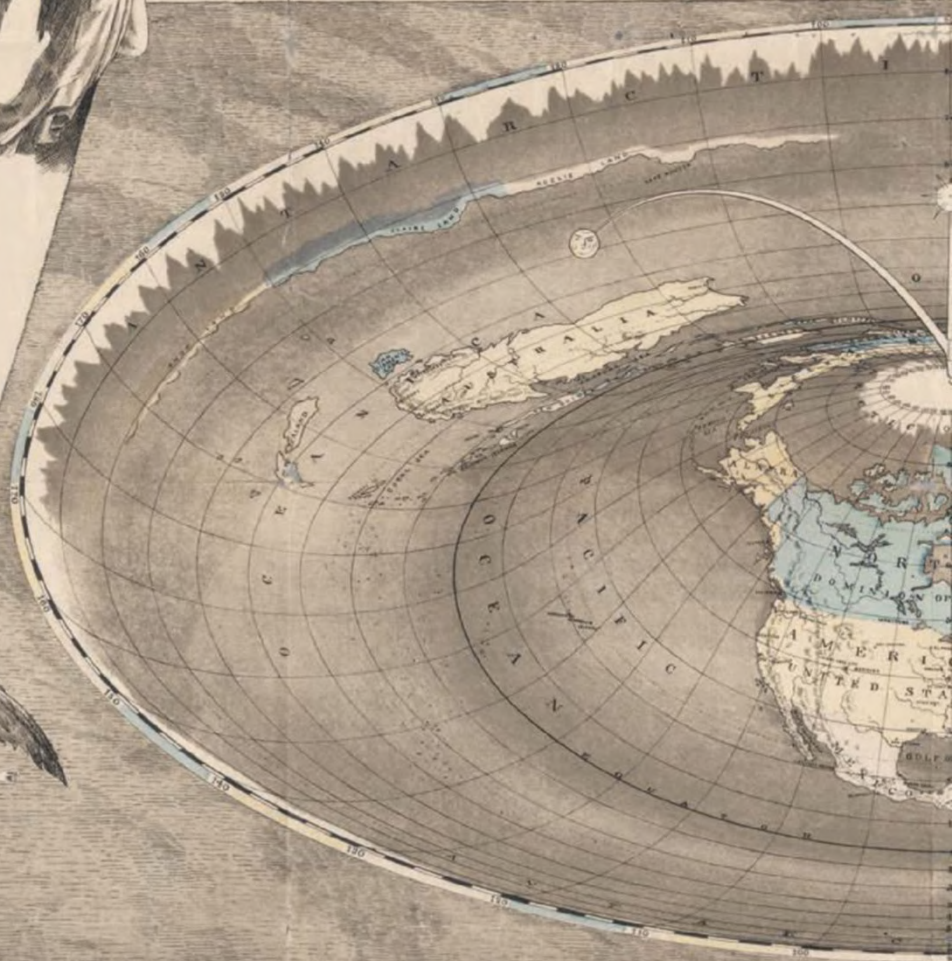
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Four Angels standing on the Four
Corners of the Earth—Rev. 7: 1.



PROF. ORLANDO FERGOUSON,
HOT SPRINGS, S. DAKOTA.

Four Angels standing on the Four
Corners of the Earth—Rev. 7: 1.



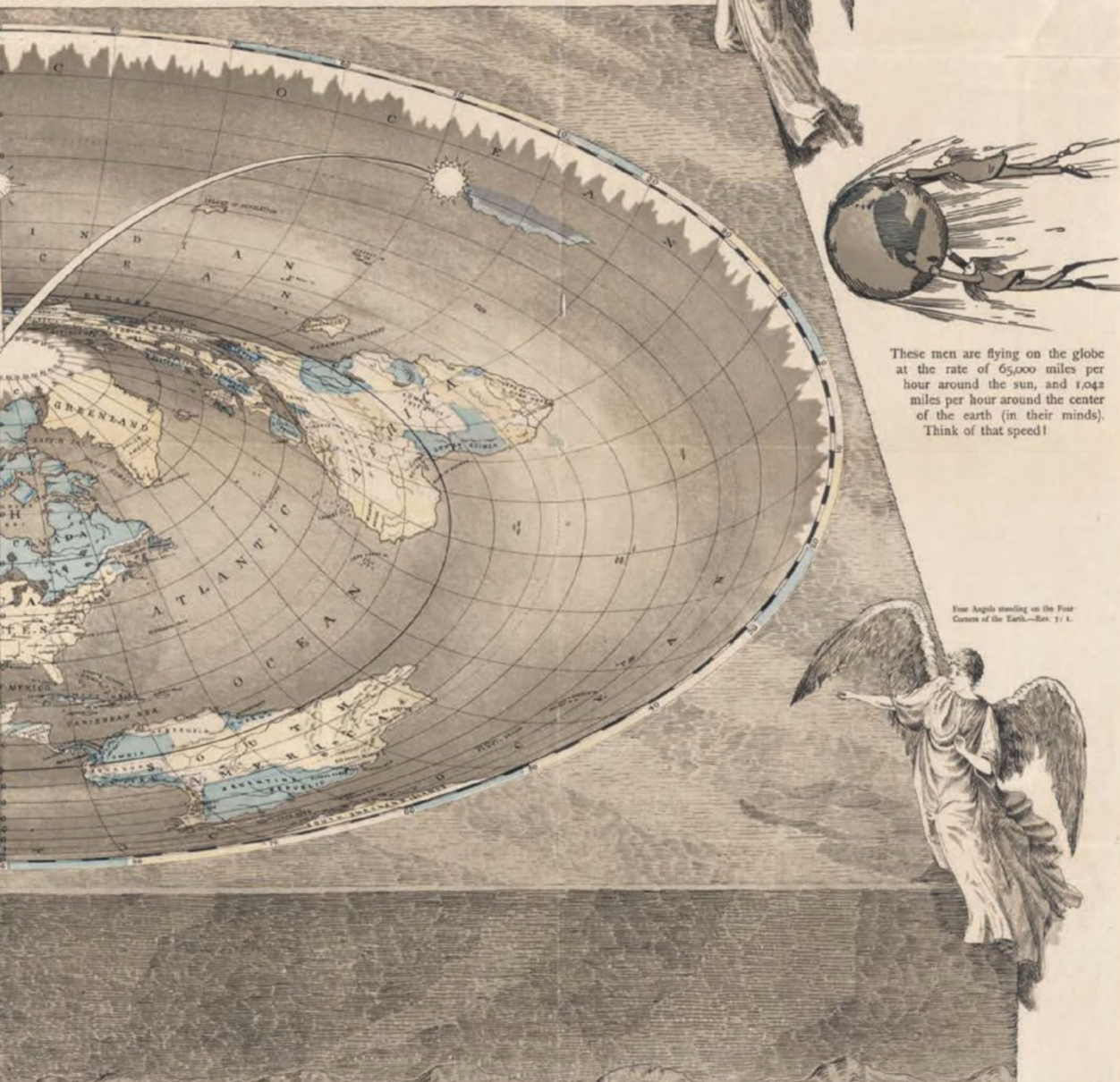
SQUARE INTUITIONS DIE HARD That the Earth is round has been known since antiquity—Columbus knew he wouldn't sail off the edge of the world—but alternative geographies persisted even after circumnavigations had become common. This 1893 map by Orlando Ferguson, a South Dakota businessman, is a loopy variation on 19th-century flat-Earth beliefs. Flat-Earthers held that the

OF THE STATIONARY EARTH.

AND FERGUSON,
SOUTH DAKOTA.

Globe Theory, or the Flying Earth, and None Sustain It.
The Map of the World.

AND FERGUSON, 1893.



Four Angels standing on the Four
Corners of the Earth.—Rev. 7: 1.

These men are flying on the globe
at the rate of 65,000 miles per
hour around the sun, and 1,042
miles per hour around the center
of the earth (in their minds).
Think of that speed!

Four Angels standing on the Four
Corners of the Earth.—Rev. 7: 1.

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planet was centered on the North Pole and bounded by a wall of ice, with the sun, moon, and planets a few hundred miles above the surface. Science often demands that we discount our direct sensory experiences—such as seeing the sun cross the sky as if circling the Earth—in favor of theories that challenge our beliefs about our place in the universe.





A DINOSAUR IN EDEN At the Creation Museum in Petersburg, Kentucky, Adam and Eve share Paradise with a dinosaur. Young-Earth creationists believe the planet was created with fully functioning adult humans less than 10,000 years ago. Science holds that Earth is 4.6 billion years old, that all life evolved from microbes, and that modern humans first appeared 200,000 years ago—65 million years after dinosaurs died out.

says that's extremely unlikely: No virus has ever been observed to completely change its mode of transmission in humans, and there's zero evidence that the latest strain of Ebola is any different. But type "airborne Ebola" into an Internet search engine, and you'll enter a dystopia where this virus has almost supernatural powers, including the power to kill us all.

In this bewildering world we have to decide what to believe and how to act on that. In principle that's what science is for. "Science is not a body of facts," says geophysicist Marcia McNutt, who once headed the U.S. Geological Survey and is now editor of *Science*, the prestigious journal. "Science is a method for deciding whether what we choose to believe has a basis in the laws of nature or not." But that method doesn't come naturally to most of us. And so we run into trouble, again and again.

THE TROUBLE GOES WAY BACK, of course. The scientific method leads us to truths that are less than self-evident, often mind-blowing, and sometimes hard to swallow. In the early 17th century, when Galileo claimed that the Earth spins on its axis and orbits the sun, he wasn't just rejecting church doctrine. He was asking people to believe something that defied common sense—because it sure looks like the sun's going around the Earth, and you can't feel the Earth spinning. Galileo was put on trial and forced to recant. Two centuries later Charles Darwin escaped that fate. But his idea that all life on Earth evolved from a primordial ancestor and that we humans are distant cousins of apes, whales, and even deep-sea mollusks is still a big ask for a lot of people. So is another 19th-century notion: that carbon dioxide, an invisible gas that we all exhale all the time and that makes up less than a tenth of one percent of the atmosphere, could be affecting Earth's climate.

Even when we intellectually accept these

precepts of science, we subconsciously cling to our intuitions—what researchers call our naive beliefs. A recent study by Andrew Shtulman of Occidental College showed that even students with an advanced science education had a hitch in their mental gait when asked to affirm or deny that humans are descended from sea animals or that Earth goes around the sun. Both truths are counterintuitive. The students, even those who correctly marked "true," were slower to answer those questions than questions about whether humans are descended from tree-dwelling creatures (also true but easier to grasp) or whether the moon goes around the Earth (also true but intuitive). Shtulman's research indicates that as we become scientifically literate, we repress our naive beliefs but never eliminate them entirely. They lurk in our brains, chirping at us as we try to make sense of the world.

Most of us do that by relying on personal experience and anecdotes, on stories rather than statistics. We might get a prostate-specific antigen test, even though it's no longer generally recommended, because it caught a close friend's cancer—and we pay less attention to statistical evidence, painstakingly compiled through multiple studies, showing that the test rarely saves lives but triggers many unnecessary surgeries. Or we hear about a cluster of cancer cases in a town with a hazardous waste dump, and we assume pollution caused the cancers. Yet just because two things happened together doesn't mean one caused the other, and just because events are clustered doesn't mean they're not still random.

We have trouble digesting randomness; our brains crave pattern and meaning. Science warns us, however, that we can deceive ourselves. To be confident there's a causal connection between the dump and the cancers, you need statistical analysis showing that there are many more cancers than would be expected randomly, evidence that the victims were exposed to chemicals from the dump, and evidence that the chemicals really can cause cancer.

Even for scientists, the scientific method is a hard discipline. Like the rest of us, they're

Washington Post science writer Joel Achenbach has contributed to National Geographic since 1998. Photographer Richard Barnes's last feature was the September 2014 cover story on Nero.

vulnerable to what they call confirmation bias—the tendency to look for and see only evidence that confirms what they already believe. But unlike the rest of us, they submit their ideas to formal peer review before publishing them. Once their results are published, if they're important enough, other scientists will try to reproduce them—and, being congenitally skeptical and competitive, will be very happy to announce that they don't hold up. Scientific results are always provisional, susceptible to being overturned by some future experiment or observation. Scientists rarely proclaim an absolute truth or absolute certainty. Uncertainty is inevitable at the frontiers of knowledge.

Sometimes scientists fall short of the ideals of the scientific method. Especially in biomedical research, there's a disturbing trend toward results that can't be reproduced outside the lab that found them, a trend that has prompted a push for greater transparency about how experiments

LAST FALL the Intergovernmental Panel on Climate Change, which consists of hundreds of scientists operating under the auspices of the United Nations, released its fifth report in the past 25 years. This one repeated louder and clearer than ever the consensus of the world's scientists: The planet's surface temperature has risen by about 1.5 degrees Fahrenheit in the past 130 years, and human actions, including the burning of fossil fuels, are extremely likely to have been the dominant cause of the warming since the mid-20th century. Many people in the United States—a far greater percentage than in other countries—retain doubts about that consensus or believe that climate activists are using the threat of global warming to attack the free market and industrial society generally. Senator James Inhofe of Oklahoma, one of the most powerful Republican voices on environmental matters, has long declared global warming a hoax.

The idea that hundreds of scientists from all

A THIRD of Americans believe humans have existed in their present form since time began.

are conducted. Francis Collins, the director of the National Institutes of Health, worries about the “secret sauce”—specialized procedures, customized software, quirky ingredients—that researchers don't share with their colleagues. But he still has faith in the larger enterprise.

“Science will find the truth,” Collins says. “It may get it wrong the first time and maybe the second time, but ultimately it will find the truth.” That provisional quality of science is another thing a lot of people have trouble with. To some climate change skeptics, for example, the fact that a few scientists in the 1970s were worried (quite reasonably, it seemed at the time) about the possibility of a coming ice age is enough to discredit the concern about global warming now.

over the world would collaborate on such a vast hoax is laughable—scientists love to debunk one another. It's very clear, however, that organizations funded in part by the fossil fuel industry have deliberately tried to undermine the public's understanding of the scientific consensus by promoting a few skeptics.

The news media give abundant attention to such mavericks, naysayers, professional controversialists, and table thumpers. The media would also have you believe that science is full of shocking discoveries made by lone geniuses. Not so. The (boring) truth is that it usually advances incrementally, through the steady accretion of data and insights gathered by many people over many years. So it has been with the consensus



SPIDER GOAT The Center for PostNatural History in Pittsburgh displays preserved specimens of genetically modified organisms—including Freckles, a goat bred to produce milk containing spider-silk protein, which could one day be turned into fiber for commercial uses. There's no evidence that GMOs are harmful to human health, but public concern has led 64 countries and three American states to pass laws that require foods containing them to be labeled.



OSTNATURAL HISTORY





STORMY DEBATE Hurricane Sandy was not caused by human-made climate change, but the damage it did to the Jersey Shore was exacerbated by sea-level rise—which is caused in part by climate change. For those who question the consensus on this and other polarizing issues of science, skeptical beliefs become “almost like badges of membership, of loyalty to the group,” says Yale researcher Dan Kahan.

on climate change. That’s not about to go poof with the next thermometer reading.

But industry PR, however misleading, isn’t enough to explain why only 40 percent of Americans, according to the most recent poll from the Pew Research Center, accept that human activity is the dominant cause of global warming.

The “science communication problem,” as it’s blandly called by the scientists who study it, has yielded abundant new research into how people decide what to believe—and why they so often don’t accept the scientific consensus. It’s not that they can’t grasp it, according to Dan Kahan of Yale University. In one study he asked 1,540 Americans, a representative sample, to rate the threat of climate change on a scale of zero to ten.

Then he correlated that with the subjects’ science literacy. He found that higher literacy was associated with stronger views—at both ends of the spectrum. Science literacy promoted polarization on climate, not consensus. According to Kahan, that’s because people tend to use scientific knowledge to reinforce beliefs that have already been shaped by their worldview.

Americans fall into two basic camps, Kahan says. Those with a more “egalitarian” and “communitarian” mind-set are generally suspicious of industry and apt to think it’s up to something dangerous that calls for government regulation; they’re likely to see the risks of climate change. In contrast, people with a “hierarchical” and “individualistic” mind-set respect leaders of

industry and don't like government interfering in their affairs; they're apt to reject warnings about climate change, because they know what accepting them could lead to—some kind of tax or regulation to limit emissions.

In the U.S., climate change somehow has become a litmus test that identifies you as belonging to one or the other of these two antagonistic tribes. When we argue about it, Kahan says, we're actually arguing about who we are, what our crowd is. We're thinking, People like us believe this. People like that do not believe this. For a hierarchical individualist, Kahan says, it's not irrational to reject established climate science: Accepting it wouldn't change the world, but it might get him thrown out of his tribe.

"Take a barber in a rural town in South Carolina," Kahan has written. "Is it a good idea for him to implore his customers to sign a petition urging Congress to take action on climate change? No. If he does, he will find himself out of a job, just

of powerful institutions—elite universities, encyclopedias, major news organizations, even *National Geographic*—served as gatekeepers of scientific information. The Internet has democratized information, which is a good thing. But along with cable TV, it has made it possible to live in a "filter bubble" that lets in only the information with which you already agree.

How to penetrate the bubble? How to convert climate skeptics? Throwing more facts at them doesn't help. Liz Neeley, who helps train scientists to be better communicators at an organization called Compass, says that people need to hear from believers they can trust, who share their fundamental values. She has personal experience with this. Her father is a climate change skeptic and gets most of his information on the issue from conservative media. In exasperation she finally confronted him: "Do you believe them or me?" She told him she believes the scientists who research climate change and

LESS THAN HALF

of all Americans believe the Earth is warming
because humans are burning fossil fuels.

as his former congressman, Bob Inglis, did when he himself proposed such action."

Science appeals to our rational brain, but our beliefs are motivated largely by emotion, and the biggest motivation is remaining tight with our peers. "We're all in high school. We've never left high school," says Marcia McNutt. "People still have a need to fit in, and that need to fit in is so strong that local values and local opinions are always trumping science. And they will continue to trump science, especially when there is no clear downside to ignoring science."

Meanwhile the Internet makes it easier than ever for climate skeptics and doubters of all kinds to find their own information and experts. Gone are the days when a small number

knows many of them personally. "If you think I'm wrong," she said, "then you're telling me that you don't trust me." Her father's stance on the issue softened. But it wasn't the facts that did it.

IF YOU'RE A RATIONALIST, there's something a little dispiriting about all this. In Kahan's descriptions of how we decide what to believe, what we decide sometimes sounds almost incidental. Those of us in the science-communication business are as tribal as anyone else, he told me. We believe in scientific ideas not because we have truly evaluated all the evidence but because we feel an affinity for the scientific community. When I mentioned to Kahan that I fully accept evolution, he said, "Believing in evolution is just



VACCINE BACKLASH At the Cedarsong Nature School on Vashon Island, Washington, Kina and Kaia are among many children who haven't been vaccinated against contagious diseases such as measles. Vaccine avoidance has surged in the U.S.; 46 states allow religious exemptions from vaccination requirements, and 19 states allow philosophical ones.

a description about you. It's not an account of how you reason."

Maybe—except that evolution actually happened. Biology is incomprehensible without it. There aren't really two sides to all these issues. Climate change is happening. Vaccines really do save lives. Being right does matter—and the science tribe has a long track record of getting things right in the end. Modern society is built on things it got right.

Doubting science also has consequences. The people who believe vaccines cause autism—often well educated and affluent, by the way—are undermining "herd immunity" to such diseases as whooping cough and measles. The anti-vaccine movement has been going strong since the prestigious British medical journal the *Lancet* published a study in 1998 linking a common vaccine to autism. The journal later retracted the study, which was thoroughly discredited. But the notion of a vaccine-autism connection has been endorsed by celebrities and reinforced through the usual Internet filters. (Anti-vaccine activist and actress Jenny McCarthy famously said on the *Oprah Winfrey Show*, "The University of Google is where I got my degree from.")

In the climate debate the consequences of doubt are likely global and enduring. In the U.S., climate change skeptics have achieved their fundamental goal of halting legislative action to combat global warming. They haven't had to win the debate on the merits; they've merely had to fog the room enough to keep laws governing greenhouse gas emissions from being enacted.

Some environmental activists want scientists to emerge from their ivory towers and get more involved in the policy battles. Any scientist going that route needs to do so carefully, says Liz Neeley. "That line between science communication and advocacy is very hard to step back from," she says. In the debate over climate change the central allegation of the skeptics is that the science saying it's real and a serious threat is politically tinged, driven by environmental activism and not hard data. That's not true, and it slanders honest scientists. But it becomes more likely to be seen as plausible if scientists go beyond their

professional expertise and begin advocating specific policies.

It's their very detachment, what you might call the cold-bloodedness of science, that makes science the killer app. It's the way science tells us the truth rather than what we'd like the truth to be. Scientists can be as dogmatic as anyone else—but their dogma is always wilting in the hot glare of new research. In science it's not a sin to change your mind when the evidence demands it. For some people, the tribe is more important than the truth; for the best scientists, the truth is more important than the tribe.

Scientific thinking has to be taught, and sometimes it's not taught well, McNutt says. Students come away thinking of science as a collection of facts, not a method. Shtulman's research has shown that even many college students don't really understand what evidence is. The scientific method doesn't come naturally—but if you think about it, neither does democracy. For most of human history neither existed. We went around killing each other to get on a throne, praying to a rain god, and for better and much worse, doing things pretty much as our ancestors did.

Now we have incredibly rapid change, and it's scary sometimes. It's not all progress. Our science has made us the dominant organisms, with all due respect to ants and blue-green algae, and we're changing the whole planet. Of course we're right to ask questions about some of the things science and technology allow us to do. "Everybody should be questioning," says McNutt. "That's a hallmark of a scientist. But then they should use the scientific method, or trust people using the scientific method, to decide which way they fall on those questions." We need to get a lot better at finding answers, because it's certain the questions won't be getting any simpler. □

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NG NEWS

Science Doubt: What the Polls Say

What do Americans think about climate change, evolution, and GMOs? The latest polling data highlights the big differences between public and scientific opinion.



Millions of Syrians escape an apocalyptic civil war, creating a historic crisis.

Fleeing Terror, Finding Refuge

With their homes in Ayn al Arab, Syria, under attack, ethnic Kurds push toward a barbed wire fence at the Turkish border.



Hours after the Turkish military cut the fence at the border, refugees from Ayn al Arab continue to stream across. They bring only the clothes on their backs and a few bags packed in haste.





Five-year-old Ahmed breaks down in tears after arriving safely in Turkey with his family. Some 150,000 Kurds made the wrenching journey in three days, entering at multiple places along the border.





A dust devil picks up dirt and plant debris pulverized by the migration out of Syria. Relatives, friends, and helpful strangers—waiting to welcome the refugees as they walk into Turkey—were caught in the maelstrom.





What happens when you become a war refugee?

You walk.

True, in order to save your life—for example, as militants assault your village—you might first speed away by whatever conveyance possible. In the family car. Or in your neighbor's fruit truck. Aboard a stolen bus. Inside a cart pulled behind a tractor. But eventually: a border. And it is here that you must walk. Why? Because men in uniforms will demand to see your papers. What, no papers? (Did you leave them behind? Did you grab your child's hand instead, in that last frantic moment of flight? Or perhaps you packed a bag with food, with money?) It doesn't matter. Get out of your vehicle. Stand over there. Wait. Now, papers or no papers, your life as a refugee genuinely starts: on foot, in the attitude of powerlessness.

IN LATE SEPTEMBER near the Mürşitpınar border crossing in Turkey, Syrian refugees came pouring across the fallow pepper fields by the tens of thousands. They were ethnic Kurds. They were running from the bullets and knives of the Islamic State. Many came in cars, in sedans and hatchbacks, in delivery vans and pickup trucks, raising clouds of fine, white dust from some of the oldest continuously farmed fields in the world. The Turks would not allow such a motley caravan to pass. A parking lot of abandoned cars grew at the boundary. One day black-clad Islamist fighters came and got the cars, stole them from right under the noses of Turkish soldiers. The soldiers watched. They couldn't have cared less.

So it begins. You take a step. You exit one life and enter another. You walk through a cut border fence into statelessness, vulnerability, dependency, and invisibility. You become a refugee.

"THEY BURNED THE CITY TWICE," Atilla Engin said, standing atop Oylum Höyük, a barren man-made hill in southeastern Turkey. "We don't know who or why. There were many wars back then."

Engin is a Turkish archaeologist from the University of Cumhuriyet. He stared into a square pit being dug into the mound's summit by villagers working under the direction of his graduate students. The hole was 30 feet deep, and the mound was among the biggest in Turkey: 120 feet high and 500 yards long, a lopsided layer cake of time. Its oldest evidence of occupation dated from the Neolithic, some 9,000 years ago. But above that—built, abandoned, and long since forgotten—lies the debris of at least nine human eras. Copper Age masonry. Bronze Age cuneiform tablets. Hellenistic coins. Roman and Byzantine brickwork.

Many empires had seesawed back and forth across the often embattled heartland of Asia Minor. Engin was focused on a walled Bronze Age settlement, possibly a powerful city-state called Ullis, that was mentioned in ancient Hittite records and Iron Age papyri. To reach this lost city, his team had shoveled through strata that looked like cardiograms of upheaval—rumpled horizons of soil, ash, and rubble, 9,000 years of systole and diastole, construction and destruction.

"Things don't change," Engin said. He had the tired half smile of a man who thought in millennia. "Outside powers still fight over this area—the Mesopotamian plain. It is the meeting place of Africa, Asia, and Europe. It is the center of the Middle East. It is a gateway of the world."

From a ladder that he used to photograph his sprawling dig, Engin could almost see the refugee camp near Kilis, a nearby Turkish town on the Syrian border. Some 14,000 people who had fled Syria's apocalyptic civil war have been stewing for two and a half years in the camp, stupefied by boredom. An additional 90,000 Syrians have thronged the ramshackle town, doubling its original population and driving up the rents. (The previous week an anti-Syrian mob had attacked refugees and smashed their cars.)

There are about 1.6 million Syrian war refugees



In eastern Turkey, Paul Salopek leads his mule past the Karakuş royal tomb, built in the first century B.C. by one of the area's many ruling states. When Syrians began to pour over the border 70 miles to the south, he and photographer John Stanmeyer drove down separately to report on the situation.

in Turkey. Another eight million or more are internally displaced within Syria or eke out a hand-to-mouth living in such fragile way stations as Lebanon and Jordan. The war has bled into neighboring Iraq too, of course, where the zealots of the Islamic State have uprooted another two million civilians. All told, perhaps 12 million souls are adrift across the larger Middle East. Like the refugee crisis that festered during and after the Soviet-Afghan war of the 1980s—a Cold War contest that displaced and then utterly ignored millions of angry, hopeless people, spawning years of transnational Islamist terrorism—the political fallout in the region is unfathomable and will be lasting.

“This isn’t just about Turkey or Syria anymore,” Selin Ünal, a spokeswoman for UNHCR, the UN refugee agency, told me in the Kilis camp. “This is a problem that will affect the entire

world. There is something historic going on here.”

I had trekked to the Oylum mound in southeastern Turkey as part of the Out of Eden Walk, a seven-year journey that is retracing the first human diaspora out of Africa to our species’ land’s end at the tip of South America. Along my trail through the Middle East, I had encountered desperate men and women cast up everywhere, like flotsam, by Syria’s many-sided war. They picked tomatoes for \$11 a day in Jordan. They begged for pocket change on Turkish street corners. Some I discovered squatting under tarps on the Anatolian steppe, escapees from the wrath of nationalist mobs in the cities. Their ragged children tracked my movements with hard, appraising eyes.

The Oylum mound knuckles up from the heart of the Fertile Crescent—the ancient Levantine temperate zone where modernity was born. It

was here that humankind first settled down, founded cities, invented the idea of a fixed home. Yet for months I had been stumbling across a vast panorama of mass homelessness. I asked Engin what had befallen the pioneering urban dwellers at Oylum once their citadel had been breached and torched by some invader 3,800 years ago. He was unsure. "They went back into the countryside," he said. He placed a palm on the frail wall of his pit. "They forgot cities. They got poorer."

And, doubtless, some regrouped. Perhaps they even conquered their conquerors. Forced migration begets empire.

THE UNITED NATIONS CALCULATES that by the end of 2013, more than 51 million people worldwide were displaced because of warfare, violence, and persecution. More than half were women and children. Among Syrian refugees in Turkey, the proportion of women and children zooms to 75 percent. The men stay behind to fight or protect property. The women and children become destitute wanderers. Journalists rarely follow these women's fates into urban slums, crowded camps, plastic lean-tos pegged in watermelon fields. Into brothels. Their woes are not telegenic. There are few dramatic explosions. There are no flags or front lines to be contested by the dictator Bashar al Assad, by the countless rebels. Syria's women suffer their wars alone, in silence, in alien lands.

"It is a huge hidden issue," said Elif Gündüzyeli, a social worker with Support to Life, a Turkish relief organization. "And these women's vulnerability is transforming society."

In secular Turkey a tidal wave of unaccompanied Syrian women is reviving banned Islamic traditions such as polygamy. In Jordan refugee families marry off daughters as young as 13, hoping to leverage them out of camps, off the streets, out of poverty.

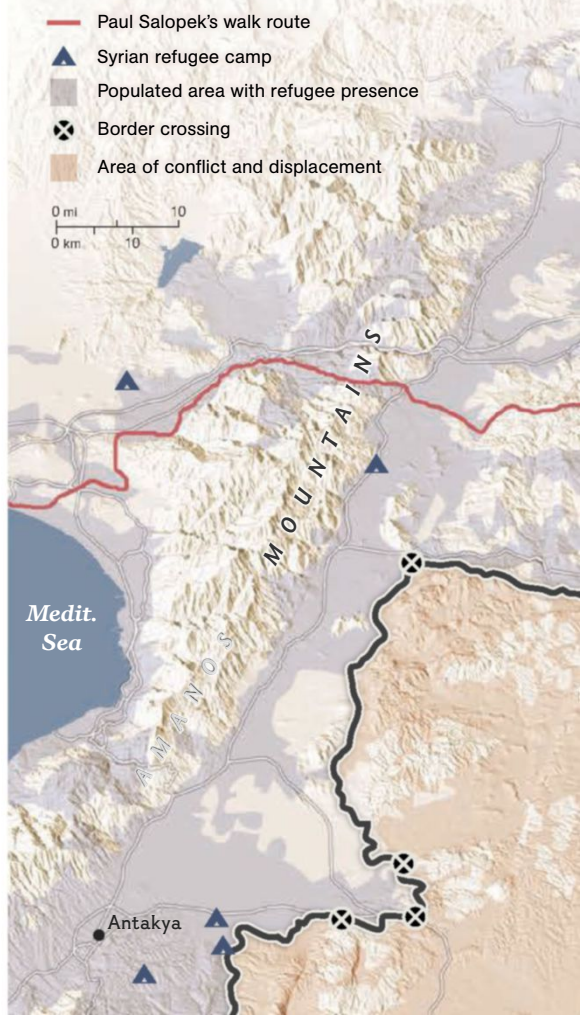
"Nobody protects you," said Mona (not her

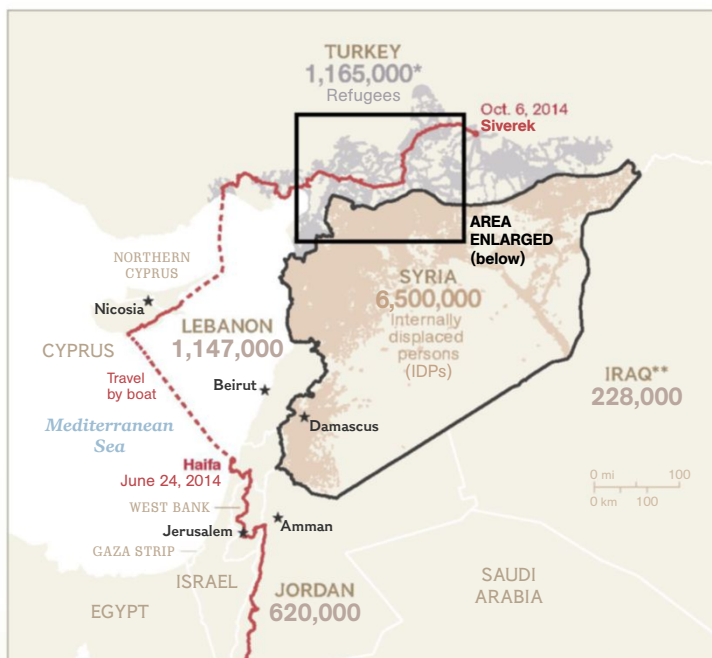
To experience National Geographic Fellow Paul Salopek's walk, visit nationalgeographic.com/edenwalk. Follow on Twitter: @outofedenwalk. Read John Stanmeyer's account of the Kurds crossing into Turkey at ngm.com/exodus.



A Walk Into Hardship

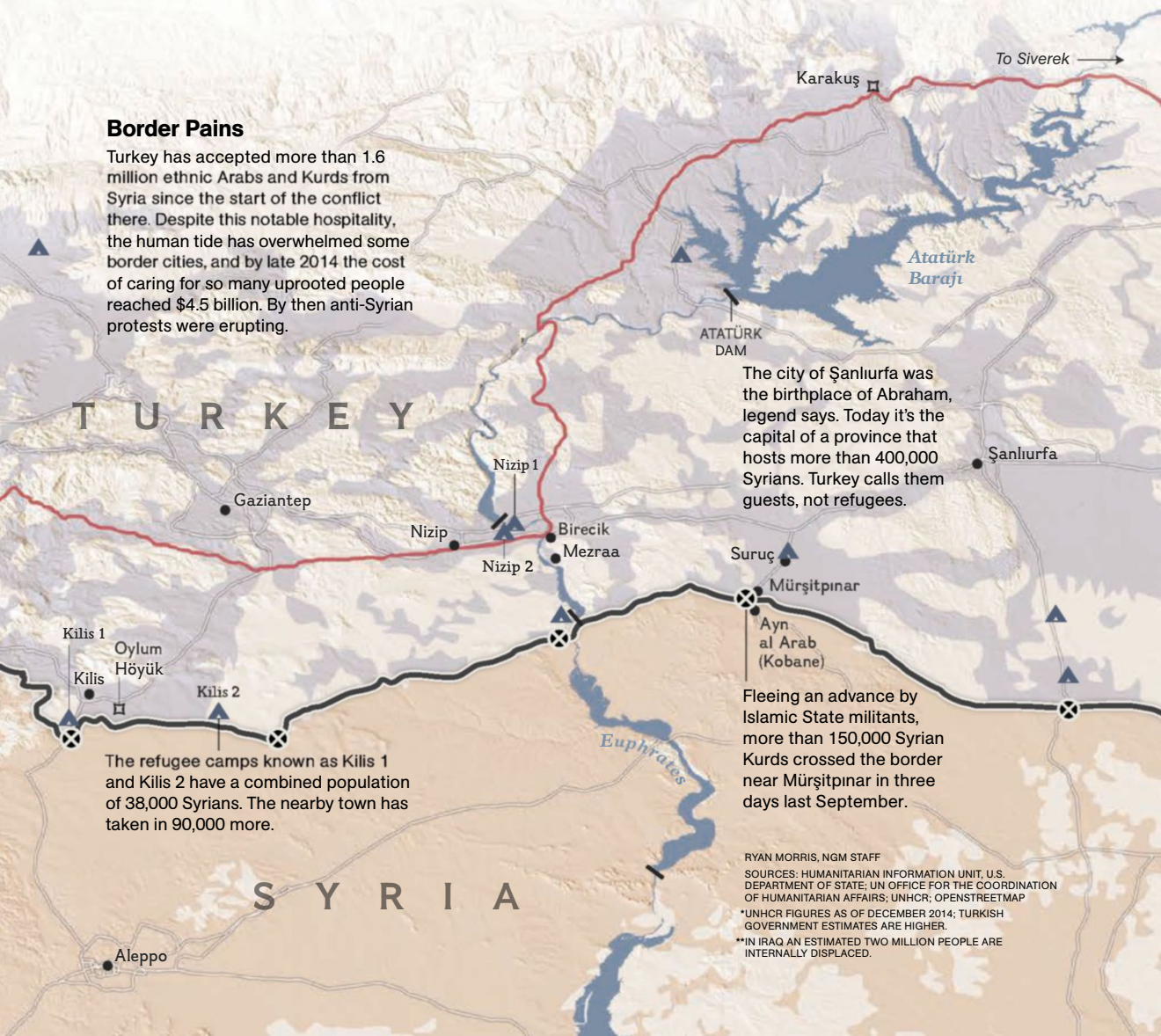
In the second year of the Out of Eden Walk, Paul Salopek's route meanders through one of the largest forced migrations in the world: almost 12 million people displaced in the Middle East by the four-year-long civil war in Syria, which has spilled over into Iraq.





Border Pains

Turkey has accepted more than 1.6 million ethnic Arabs and Kurds from Syria since the start of the conflict there. Despite this notable hospitality, the human tide has overwhelmed some border cities, and by late 2014 the cost of caring for so many uprooted people reached \$4.5 billion. By then anti-Syrian protests were erupting.





New container houses at the Kilis 2 camp line a spacious avenue used mostly by kids on bikes and adults on foot. Turkey has set up 22 living areas for refugees since the civil war began in Syria in 2011.



real name), a young Syrian woman stranded in the Turkish city of Şanlıurfa. “You get harassed constantly. Three men tried to pull me into a car. They grabbed my arm. I screamed. The people on the sidewalks did nothing. They did nothing. I want to leave this place. Can you help me? Where can I go?”

In other Turkish cities teeming with refugees, anti-Syrian protests have erupted. The spark in one case was the knifing of a Turk by a Syrian neighbor. So corrosive are the sexual politics of refugees in Turkey that a false rumor attributed the killing to the Turk’s demand for sex with the Syrian’s wife in return for rent.

“Four times—no, five,” a Syrian Kurdish woman named Rojin (also a pseudonym) told me, counting the number of marriage proposals she had received in Turkey over the past week. “Two,” her sister added. “Three,” said a third sister. The

women sat cross-legged in a barren room decorated with a dandelion in a Coke bottle. They rarely left the room. A fourth relative had not been propositioned—their senile grandmother. The old woman sat blinking, lost in dreams. She was hard to watch. She did not understand what she had lost. She had been born in Aleppo when Syria was a French mandate. Her granddaughters were hoping for asylum in France.

In the charred ruins of his ancient city under the Oylum mound, Engin has discovered two bodies. Both these victims of the city’s mysterious destruction were female. We know next to nothing about them except perhaps the pathos of their social status. Their skeletons lay curled inside the kitchen of a grand mud-brick palace.

JASON UR, AN ARCHAEOLOGIST at Harvard, studies the changing settlement patterns in ancient

Archaeologists delve into 9,000 years of upheaval at the site of Oylum Höyük in southeastern Turkey. This was once a region of fertile farms and important trade routes. “That’s why it’s been the scene of repeated conflict, occupation, and migration,” says dig director Atilla Engin.



Assyria. "Population displacements have a long and sad history in the region," Ur says. They happened "repeatedly over the last 3,000 years at least."

Bas-relief carvings from Mesopotamia depict Iron Age armies prodding entire populations before them. In these ancient scenes the civilians are captive, harnessed. They wear chains. In this way whole communities were relocated, by violence, to work as agricultural labor for one of the world's earliest empires. In a forthcoming paper, Ur and his colleague James Osborne suggest that settlements began to appear in eastern Syria between 934 and 605 B.C., in a "repeating pattern of evenly spaced small villages" laid out by the neo-Assyrian kings.

Saddam Hussein, the "butcher of Baghdad," did much the same thing in northern Iraq, replacing "unruly" Kurds with obedient ethnic Arab farmers. A century ago the Turks cleaned out "disloyal" Armenians, killing up to 1.5 million people and giving away their lands to Turkish neighbors. This is a story that would be familiar to the Sioux, to the Apache. Ethnic cleansing, ruthless social engineering, "homesteading"—these are not new concepts. They arose with the city-state.

Inscriptions from a temple built by neo-Assyrian King Ashurnasirpal II, who ruled Nimrud from 883 to 859 B.C., south of present-day Mosul, Iraq: "I captured many troops alive: from time to time I cut off their arms [and] hands; from others I cut off their noses, ears, extremities. I gouged out the eyes of many troops. I made one pile of the living [and] one of heads. I hung their heads on trees around the city."

And: "I cleansed my weapons in the Great Sea and made sacrifices to the gods."

Such primitive boasting sounds contemporary, like an Islamic State video posted on YouTube.

ANATOLIA—THE SPRAWLING Asian peninsula of eastern Turkey. A continental crossroads. The eternal frontier of empires. A palimpsest of forced migrations.

I walked its chalky roads past the broken

foundations of Assyrian cities. I saw pediments of Greek columns swallowed in weedy gardens. I passed derelict Armenian churches turned to mosques. I trod on highways of stone buffed by endless processions of Roman feet. In antique Harran, an ancient center of learning under the Romans, Byzantines, and Arabs just a dozen miles from the Syrian border, thousands of Muslim scholars once experimented with physics and engineering. A minaret stood there on an empty plain—all that remains of the city that was leveled by the Mongols. And I passed the white tents of the Syrians. They were everywhere. Their doleful presence on the antique landscape seemed a sign of tectonic change, some unfathomable portent. Like the Palestinian diaspora. Or the Jewish diaspora. History shook underfoot. The tents of the refugees glowed yellow in the night, a new constellation.

"Everyone thought this would be temporary," a Turkish baker named Mustafa Bayram told me in Kilis.

He threw up his hands. He wanted to be kind—Turkey had been kind, spending billions of dollars on housing and feeding refugees—but the Syrians were still coming. They were driving Bayram out of business. They worked for slave wages. They opened illegal shops, undercutting him. "I think," he said, bitterly, "we should gather them up. We should put them all into one giant camp."

The war in Syria boiled and boiled. Engin was losing his local workers. Each day a few didn't show up for roll call. They abandoned his archaeological dig at the Oylum mound and slipped over the border. They may have joined the jihad.

I walked on through autumn. Temperatures dropped. I found myself stepping over columns of ants that crawled manically through brittle yellow grass. They shone glossy black, as if oiled, and vanished down their holes. They carried enormous quantities of seeds. It seemed a message, to lay in provisions like this. After a false Arab Spring, a hard winter was coming to the Middle East. □



Mohammad Magelk grooms the oasis he has created in the dusty Nizip 1 camp, where more than 11,000 Syrians now live. "When I sit here in front of this tent, I remember my garden back home in Idlib," he says. In his two years here, he has met a woman, married her, and started a family.



The five members of the Helwa family share a 20-foot-long container in the Kilis 1 camp. They have kitchen appliances for preparing meals, beds for everyone, a bathroom, and a living room with a flat-screen TV.







Life isn't easy for the estimated 350,000 Syrians who have settled in and around the city of Gaziantep. Women and children crowd around a bakery worker handing out coupons for free bread (above). A desperate search for scarce housing led the family of these napping children (below) to a farm. The single room, where six people now live, rents for \$150 a month. In the historic city center 11-year-old





Adnan (below) has a job dipping newly finished copper cups and teapots into a bath to rinse off chemicals—using his bare hands. Like many of Gaziantep's refugee children, he and his younger brother Khalil, in the white tank top, work illegally to help support their family. Children in the camps, like this class of second graders at Nizip 1 (above), are more likely to spend their days in school.



Uncertainty hangs like a storm over the Syrians who have fled to Turkey. The conflict back home could drag on for years, leaving the refugees to wonder when they'll be able to return—if ever.







Fireflies flash and streak
through a Tennessee
summer night, putting on a
spectacular light show to
seduce prospective mates.

PHOTINUS CAROLINUS AND PHAUSIS RETICULATA

A glowing green root system is visible against a dark, textured forest floor. The root starts as a thick, vertical stem on the right side of the frame and branches out into a complex network of smaller roots that spread across the ground. The background is a dark, dense forest floor covered with fallen leaves and twigs, with some light filtering through the trees in the upper left.

Among the most abundant sources
of light on Earth is life itself.

Luminous Life





More than 90 species of fungi glow in the dark, including these Brazilian “coconut flower” mushrooms. The light may lure insects that spread mushroom spores.

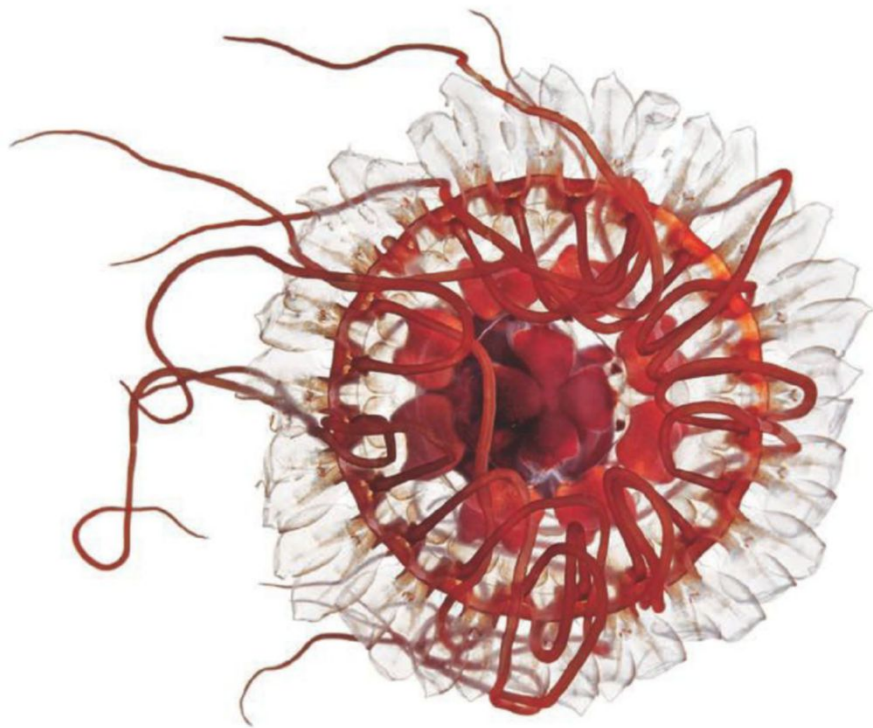
NEONOTHOPANUS GARDNERI



The luminescence of firefly squid makes them visible in an aquarium, but in the ocean it forms an invisibility cloak, so they blend in with the light from above.

WATASENIA SCINTILLANS





By Olivia Judson

Photographs by David Liittschwager

It's 10 p.m., and I'm standing in the darkroom of the *Western Flyer*, a research vessel belonging to the Monterey Bay Aquarium Research Institute. The room is tiny, and several of us are crammed inside. The light is off, the air is warm and stuffy, and—as we're at sea, 50 miles off the coast of California—the floor keeps rocking. I feel sick. But I don't care. On a table, in a small dish, is a newly captured animal. It's a sea creature known as a ctenophore (the *c* is silent). About two inches long, it looks like a gelatinous, transparent bell, with ridges down its sides. And when touched, it spews light.

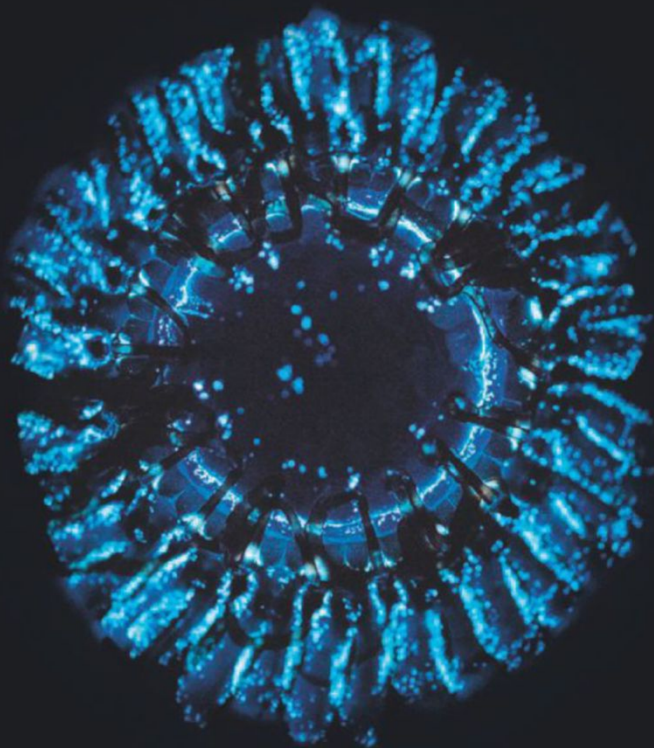
Watch. Steven Haddock, one of the world experts on life-forms that make light, is about to nudge the animal with a glass stick. We all lean forward, jostling each other to see. There. For a moment, a ghostly image of the ctenophore appears in the dish. An image made of bluish light that swirls and gradually dissipates, as if the animal itself has just dissolved.

It is gorgeous. Ethereal. And, in a way, secret.

For this particular ctenophore lives far below the surface of the sea, and few humans have ever seen its kind, let alone its light.

The ability to make light—bioluminescence—is both commonplace and magical. Magical, because of its glimmering, captivating beauty. Commonplace, because many life-forms can do it. On land the most familiar examples are fireflies, flashing to attract mates on a warm summer night. But there are other luminous landlubbers, including glowworms, a snail, some millipedes, and—you are not hallucinating—certain mushrooms.

But the real light show takes place in the sea. Here an astonishing array of beings can make light. Such as ostracods—tiny animals that look like sesame seeds with legs—flashing to attract mates, like seafaring fireflies. Or dinoflagellates—speck-of-dust-size beings named for their two whiplike flagella and the whirling motion they make (*dinos* means “whirling” in Greek). Dinoflagellates light up whenever the water around them moves; they are the critters



The crown jellyfish lives in the perpetual darkness of the deep sea. Undisturbed, its bell is transparent (left). But if another animal touches it, the bell lights up (above).

ATOLLA VANHOEFFENI

typically responsible for the sparks and trails of light you sometimes see when swimming or boating on a dark night.

Then there are lightmaking fish, squid, jellyfish, shrimp, the aforementioned ctenophores, several types of worms, and sea cucumbers. There are luminous siphonophores—sinister, stringlike predators with long, stinging tentacles that hang down like a curtain. And there are luminous radiolarians—amoeboid beings that typically live in colonies built on exquisite glass scaffolds. Not to mention glowing bacteria. Indeed, of all the groups of organisms known to make light, more than four-fifths live in the ocean.

So what is it about the ocean? That's what I've come aboard the *Western Flyer* to find out.

THE LARGEST HABITAT on the planet by far, the ocean covers more than seven-tenths of the globe and has an average depth of about 12,000 feet. Because of its alien and—to humans—inhabitable nature, it remains relatively unexplored,

especially the vast expanses that are neither rich fishing grounds, nor coral reefs, nor fashionable research spots such as deep-sea vents.

It is these vast expanses that interest Haddock, the leader of the expedition. "I want to look where no one else does," he tells me. On previous expeditions, he and his colleagues have been the first to find and describe a number of luminous species. Among the most famous are the "green bombers," deep-sea swimming worms that throw sacs of bright green light—"bombs"—when under attack.

To explore the deeper regions of the ocean, Haddock and his colleagues use a remotely operated vehicle, or ROV. Capable of capturing slow-moving animals and bringing them back alive, it has a stout metal frame decked out with video cameras, lights, sensors, and cables, as well as a couple of robotic arms, a set of clear plastic buckets with lids at both ends, and a plain old kitchen spatula. Kitchen spatula?

"What's that for?" I say, pointing.

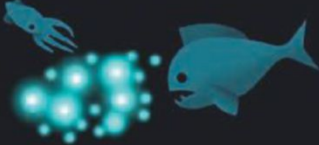
"Digging in the ocean floor," says Haddock.

DEFENSE



Surprise

The prey produces a bright flash that startles a predator, making it easy to escape.



Smoke screen

The prey emits a glowing fluid or a cloud of sparks to misdirect the predator from its real location.



Decoy

The prey jettisons one of its body parts. The luminescent limb distracts the predator, allowing escape.



Camouflage

A shining underbelly matching the light from the surface conceals prey from predators below.



Alarm

The prey's bioluminescence makes its predator visible—alerting the predator's predators.



Warning

Gleaming prey signals to a predator that its next meal could taste terrible—or even be toxic.

OFFENSE



Shock

A burst of bright light from a bioluminescent predator stuns prey and leaves it open to attack.



Lure

Like a moth to a flame, prey is drawn to the glow produced by a predator lurking all too close.



Beacon

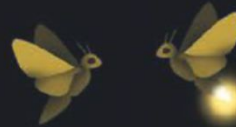
Predators seek out the glimmer that tells them that bioluminescent creatures are gathering.



Searchlight

A predator turns on its natural spotlight to locate prey in a dark ocean.

REPRODUCTION



Come-on

Flickers of light signal that a bioluminescent insect is ready to meet new mates.



Invitation

Mushrooms may spread their spores by using luminescence to entice insects to land on them.

Lightness of Being

An underwater glow. A fleeting gleam across a field. These lights seem mysterious, but organisms generate them for practical purposes. Bioluminescence fends off predators, lures prey, and attracts mates. Making light is such a useful trait that it has evolved independently at least 40 times. It occurs most commonly in the ocean, where bioluminescence is often the only source of light. Under the right conditions, a bioluminescent flash can be seen a hundred yards away.

It's 7 a.m., and the ROV is about to launch. Men in hard hats scurry about, making final checks. Then an enormous metal arm lifts the ROV off the floor of the boat. Next the floor where it had been sitting folds open, revealing a square of ocean several feet below. The metal arm lowers the ROV into the water; a moment later, the vehicle disappears beneath the waves.

AS A PLACE TO LIVE, the ocean has a couple of peculiarities. The first is that in most of it, there is nowhere to hide. This means invisibility is at a premium. The second odd thing is that as you descend, the sunlight disappears. First red light is absorbed. Then the yellow and green parts of the spectrum disappear, leaving just the blue. By 700 feet deep, the ocean has become a kind of perpetual twilight, and by 2,000 feet, the blue fades out too. This means that most of the ocean is pitch-dark. All day, all night. Together these factors make light uniquely useful as a weapon—or a veil.

Consider the problem of invisibility. In the upper layers of the ocean—the part where light penetrates—any life-form that does not manage, somehow, to blend in with the water is in danger of being spotted by a predator—especially a predator swimming beneath, looking up.

To get a sense of this, imagine that you're scuba diving in the middle of the Pacific. Above you, the place where the sea meets the sky looks silver. Below you, the water shades into a dark blue. In all other directions, it is a murky greenish gray. The seafloor, though you can't see it, is a vertiginous 11,000-plus feet below you. And wait—what's that shadow down there? Is it a shark? All of a sudden you become aware of how vulnerable you are: a great dark silhouette against the silvery surface, visible to any hungry animal that might be swimming about below.

Many life-forms solve this problem by not being there at all. They avoid the light zone during the day, rising toward the surface only at night.

Many others solve it by evolving into transparent, ghostly creatures. On the dive, the first thing you'd notice is that nearly all the life-forms you meet, from jellyfish to swimming snails, are see-through. In another approach, some fish—think sardines—dissolve their silhouettes by having silvery sides. The silver functions as a mirror and allows the animal to blend in by reflecting the water around it.

And some creatures—such as the shrimp *Sergestes similis*, certain fish, and many squid—use light. How? By illuminating their bellies so as to match the light coming down from above. This allows the animals to mask their silhouettes, donning a kind of invisibility cloak. The cloak can be turned on and off at will—and even has a dimmer switch. *S. similis*, for example, can alter how much light it gives off depending on the brightness of the water around it. If a cloud passes overhead, briefly blocking the light, the shrimp will dim itself accordingly.

But if the aim is to remain invisible, why do so many creatures, from ctenophores to dinoflagellates, light up when they are touched or when the water nearby is disturbed? A couple of reasons. First, a sudden burst of light may startle a predator, giving the prey a chance to escape. A deep-sea squid, for example, can give a big squirt of light before darting off into the gloom. The green bombers can throw their light grenades, and then disappear into the darkness while the predator is distracted by the light. The ctenophore can vanish while the predator lunges at its ghost.

Second, on the principle of the enemy of my enemy is my friend, giving off light may serve to summon the predator of the predator. Known as the “burglar alarm” effect, this may be especially important for tiny life-forms, such as dinoflagellates, that cannot swim fast: For such extremely small beings, water is too viscous to allow a quick getaway. (It would be as if you were trying to swim through molasses.) The chief defense for these creatures is not fight or flight—but light.

Their flashes summon fish, which hang out in the water, waiting. And when little shrimplike critters (eaters of dinoflagellates) disturb the water, causing the dinoflagellates to light up, the

Olivia Judson wrote on cassowaries in the September 2013 issue. David Liittschwager's portraits of life-forms appear frequently in National Geographic.



A millipede glows in the dark to let mice and other predators know what they're messing with. Any animal ignoring the warning gets a mouthful of cyanide.

MOTYXIA SEQUOIAE



fish are better able to spot, and eat, the shrimp.

When light-up-on-disturbance life-forms occur in large numbers—as they sometimes do—moving through them can be like traveling through a minefield of light. A fish moving fast lights up like a shooting star; a boat creates a bright, glowing wake. Any creature that doesn't want to be spotted would do better to avoid the area altogether. Thus, even in the deepest, darkest seas there's an art to remaining hidden. Indeed, most deep-sea animals have evolved to be black or red, to stay out of sight if a burglar alarm goes off. These colors also hide them from the searchlights of deep-sea hunters, scanning the darkness for prey. Although most bioluminescence is blue or green, some of these hunters, such as the loose-jaw dragonfish, use red light, which most deep-sea animals can't see.

THE ROV IS OPERATED from a windowless control room, with banks of screens facing a row of seats ripped out of an old airplane. Watching the screens is strangely hypnotic. The cameras are high-definition and very clear—so you can see creatures that are truly tiny, and in astonishing detail. But most of the time all you see is “marine snow”—particles of gunk gradually sinking through the water. In the lights of the vehicle, this looks like dust.

Every so often, however, an animal appears. Perhaps a jellyfish. Or perhaps a small shrimp. Or—wait! Wow! I almost choked on my coffee. A fish has just appeared on the screen, one I've read about but never seen. For the most part, it looks like a regular fish. But attached to its head, it has a long stalk and at the end of the stalk, what looks like a fat, juicy, glowing worm. But the worm is not a worm. It's part of the fish, which uses the “worm” as bait, tempting the incautious and the hungry to their doom. This is an anglerfish, one of the most voracious predators of the deep. Unlike, say, sharks, which chase down their victims, anglerfish are ambush predators, enticing prey close by means of the glowing lure, then pouncing. (Lures work because, thanks to the burglar alarm effect, many creatures interpret light to mean food.)

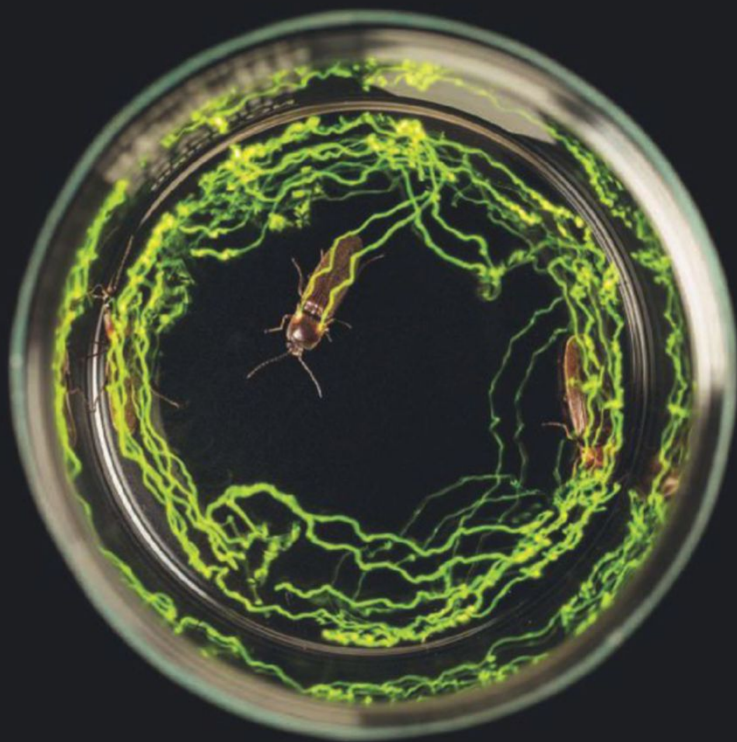
In this case, the fish doesn't make the light itself. Instead, luminous bacteria, which live within the lure, do the glowing. It's of mutual benefit: The bacteria get shelter, the fish gets light. A similar arrangement is found in a few other groups, but it is rare. Most luminous life-forms make their own light.

To make light, you need three ingredients: oxygen, a luciferin, and a luciferase. A luciferin is any molecule that reacts with oxygen and in doing so emits energy in the form of a photon—a flash of light. A luciferase is a molecule that triggers the reaction between oxygen and the luciferin. In other words, the luciferin is the molecule that lights up, while the luciferase is what makes it happen. (In English, Lucifer is a name for Satan before his fall from heaven; in Latin it means “bringer of light.”)

Evolving to make light seems to be relatively easy—it has happened independently in at least 40 different lineages. Perhaps that's not surprising: The ingredients are usually not hard to come by. Plenty of substances can act as a luciferase. Stand in the dark, mix egg white with oxygen and a luciferin from, say, a jellyfish, and you'll probably get a flicker of blue light. Moreover, in the ocean, only those life-forms at the bottom of the food chain must make luciferins. Everyone else can, in principle, get them from diet: Thus, as humans get vitamin C from eating oranges, some marine animals get luciferins from eating a luminous lunch. Which suggests the following possibility: Luminous life is more common in the ocean in part because the ingredients are easier to get.

Speaking of luminous lunch, here's a weird problem. As I mentioned, many animals that live in the open ocean have evolved to be transparent, because this makes them harder to see. But if you are transparent and you eat something glowing, all of a sudden—oops—you are highly visible. Which is why so many otherwise see-through animals have guts that are opaque.

As the ROV resurfaces, people start to hurry about. Any animals that have been captured are rushed into cool rooms, so that they remain comfortable while waiting to be examined. And once again, it's 10 p.m., and I'm standing in the



In a long exposure, bioluminescence creates streaks of light from the backs of three Brazilian click beetles. They use light to attract mates and, perhaps, to scare off potential predators.

ELATERIDAE

darkroom. On a table, in a small dish, is another example of living luminosity...

SEVERAL MONTHS AFTER the voyage on the *Western Flyer*, I visited Vieques, a small island that belongs to Puerto Rico. The island is famous for its *bahía bioluminiscente*, or “bio bay”—a flask-shaped inlet that is home to countless dinoflagellates, those speck-of-dust-size beings that light up when the water is disturbed.

The night is dark. The moon has not yet risen, and the island has just a smattering of streetlights, so the sky is full of stars. I am sitting in a transparent canoe, here as part of a tour—one of several tonight. Our group has eight canoes, two people in each; I’m sharing mine with a lawyer from Washington. We’re “parked” in the middle of the bay, looking at the dark sea and the starry sky, and listening to the guide explain the challenges the place faces—increasing numbers of tourists, and rising light pollution as more houses and roads get built on the island. Although there are few streetlights now, their impact is noticeable:

The edge of the bay away from the lights is visibly darker, the flashes from the dinoflagellates visibly brighter. While the guide talks, a fish darts through the water; it looks like a meteor.

Now we’ve started moving. Our canoe has fallen behind the group, and I have the illusion we are out here alone. As we paddle forward, the movement of the canoe disturbs the microbes, and they light up in a bright, flickering stream. Watching them through the transparent floor of the canoe, I have the powerful impression that the water is part of the sky, and we are paddling through the stars. □

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VIDEO

Why do some mushrooms glow?



Towers of light, towers of
doom. At night, larval click
beetles living in termite
mounds light up. Creatures
drawn to the glow will find
themselves devoured.

PHOTO: ARY BASSOUS







Berlin photographs by Gerd Ludwig

Berlin and Athens were forced
into a relationship neither wanted—
northern lender, southern borrower.
Now they're emblems of a divided
Europe longing for unity.

By Adam Nicolson

The Sony Center in Berlin (above) stands in the high-sheen Potsdamer Platz, where the Wall had split the city.

The streets around Athens's Omonia Square, once an elegant shopping district, now present a melancholy face.



Athens photographs by Alex Majoli

TWO CITIES TWO EUROPE



Cadets from the Hellenic Military Academy tour the Parthenon. Degraded by pollution, the ancient temple to the goddess Athena atop the Acropolis is being restored.

ATHENS

The city of Pericles and Plato, the cradle of philosophy and democracy, has struggled to find its place within the discipline of the European Union.





The neo-Nazi party Golden Dawn distributes onions and other vegetables to Athenians who can prove Greek nationality—a handout that's been called a “soup kitchen of hatred.”







THE UNRAVELING CITY

In crisis-struck Athens the foundations of civilized life have been shaken. For some, foraging for edible garbage (top left) is a necessity, and every day the Greek Orthodox Church feeds 10,000 people. In many central Athens basements, immigrants such as these Bengalis (bottom left) experience Dickensian conditions, six or seven to a room. Economic and social strains have also brought violence in their wake. Fans of the hip-hop star MC Yinka, born in Greece of Nigerian parents, enjoy a concert of his (above) not long after his friend, the antifascist rapper Pavlos Fyssas, was murdered by a member of the far right group Golden Dawn. "We need to show immigrants' positive side, their soul," Yinka has said. "These people have come here to provide for themselves, for their families. They're not here to take away from Greece."

Modern symbol of national pride, the Acropolis Museum (at left), partly funded by the European Union and finished in 2007, looks up to Greece's iconic monument, the Parthenon.





A family celebrates a birthday in the taverna Diporto Agoras "two doors in the market," dedicated to the intimacy of old Athens: talk, wine, tobacco, food from earth and sea.







Μανώλης Κα

ΧΡΥΣΗ ΑΥΓΗ

A photograph showing a person holding a large Greek flag (blue and white stripes) in the foreground. In the background, there is a large mural of a man's face on a wall. The scene appears to be outdoors, possibly at a memorial or protest. A person's arm and hand holding a camera are visible in the bottom left corner. Some Greek text is visible on the wall and a sign in the background.

A member of Golden Dawn memorializes Manolis Kapelonis and Giorgos Fountoulis, shot dead in November 2013 in retaliation for the killing of antifascist rapper Pavlos Fyssas.

YOU MIGHT THINK OF BERLIN AND ATHENS AS THE TWO EMBLEMATIC POLES OF EUROPE—

one northern, gray, landlocked, rich; the other on the shores of the Aegean, with bougainvillea in its gardens and oranges hanging from the trees in its streets.

But neither quite fits its image. The Teutonic capital buzzes with the surge of postcommunist freedom, thriving on its reputation as the turbulent dance capital of Europe, while the ancient capital of Greece, sparkling in the Aegean light, has yet to emerge from the great euro crisis of the past few years into anything like full health—or to shrug off the conditions that precipitated it. The sun is shining in Berlin; clouds of anxiety still hang over Athens.

In many ways the two capitals turn out to be the opposite of what you might expect: Athens, sclerotic, tense, stuck, with no more than a murky view of its future; Berlin, loose, post-authoritarian, the most open and absorbent of European cities, troubled, if at all, only by the problems of success—and almost careless about what the future might bring.

These cities, the alpha and omega of modern Europe, are bound together in one common destiny. The great European Union (EU) project, designed to mend the horrors and damage of Hitler's Holocaust and war and make the continent whole, has involved six decades of moves toward integration and enlargement. But there's a mismatch in the 19 countries that now belong to the eurozone. They share a single currency—the euro—but taxation and public financing are done differently in every country.

In Athens the demands of the present seem overwhelmingly urgent. Amalia Zepou, an anthropologist and filmmaker who's making waves as the deputy mayor for civil society, talks of the "complete disillusionment about the political system as a whole, a lack of empowerment in the sense that decisions are taken so far away from where you live, where you are. Why should you vote? For what?"

Manipulation of elections remains universal in Athens. Candidates for places in the city council or in parliament can win only by coming to an arrangement with the chiefs of unofficial, vote-controlling networks. Deals are done. Priests offer up their congregations. The men who control open-air markets gather up the votes of the stallholders. Large quantities of voting slips are regularly submitted premarked for a chosen candidate. "If I say no," one candidate in the local elections this spring told me, "they say, 'My dear girl, this is how things are done. Grow up.'"

"It has always been the way in Greece," Zepou explains. "It is the system of the family in the village, and it has the most human side to it. It has always been the way that Greece has worked—to know somebody. Because you will always need someone, and they will pull you out of trouble when that trouble comes."

Somewhere under all the stories of crisis and corruption, of the high level of tax evasion, of doctors found to be cheating the national health service to the tune of 35 percent of the prescription budget, lies this residue of the personal network,

of believing more in the value of human contact than the propriety of an institution—or the ability of a bureaucracy to deliver fairness.

“In Berlin,” the poet and journalist Kostas Kanavouris said to me through the cigarette smoke as we sat talking in an Athens café, “everyone thinks they are a Berliner—whoever they are, wherever they have come from, however long they have been there. In Athens no one ever quite thinks they are an Athenian. That’s the difference. In Berlin everyone assumes they belong. In Athens everyone is thinking of the village they started out from. And how they can survive in the city where they are not really at home.” Those are the polarities: the authority city that welcomes everyone; the personal-network city where anxiety walks every street.

IN THE GLOBAL FINANCIAL CRISIS that started to unfold in 2008, the continent’s natural fissiveness, the deep economic and cultural differences between north and south, began to show. The Germans, on average earning 50 percent more than the Greeks, with a gross domestic product (GDP) ten times as big, were inevitably cast in the role of leaders, while in Greece the crisis brought to the surface problems that had been gestating for decades.

With slow inevitability, the house of cards began to tumble. In 2009 the Athens government revealed that the annual deficit it had been running was not 6.7 percent of GDP, as had been stated by the outgoing government, but some 12.5 percent, with the national debt standing at \$400 billion. Greek credit imploded, and capital drained out of Athens, much of it into German safe havens. The biggest loans in history

were then made to the Athens government: \$146 billion in May 2010 and \$162.7 billion in March 2012. But the conditions were tough. The Greeks would have to change their way of life, cut spending, raise and enforce taxes, trim their bloated pension system, regulate affairs more tightly—the Greek government still doesn’t know exactly how many people it employs—and accept supervision of all this from the troika of the International Monetary Fund, the European Central Bank, and the Berlin-dominated European Commission.

The social price in Greece was enormous. Unemployment climbed to 27 percent and has scarcely shifted since. In Athens unemployment among those between 15 and 24 years old nearly hit 62 percent. During the past six years the Greek economy has shrunk by 30 percent. Central Athens was torn open by riots. Violence against immigrants soared. The worst may, for the time being, be over. But it’s little wonder that an air of trouble and exhaustion hangs over the Greek capital.

Talk to leading intellectual figures in either city, and you find a deep and troubled reflectiveness. Nowhere on Earth can the examples of overweening political ambition, tyranny, repression, division, and human failure be quite so obvious as in Berlin. Walk its streets, and you find yourself reminded at every corner of the history of the 19th and 20th centuries. This was the great power node. Here are the lessons, written in urban geography—in the big, half-empty Nazi air terminal at Tempelhof, in the bullet-scarred masonry left visible on Museum Island, in the inescapable fragments of the Wall. Attempt to dominate, and you will suffer; attempt to destroy, and you will be destroyed; attempt

to become the center of the world, and you will find your city carved up and divided.

Wolfgang Thierse, a former president and vice president of the German parliament and one of the most formative voices in the reunification of the city after 1989, is insistent that “Germans and their capital are still caught within their history and are still not ready to consider themselves an important power. In Berlin the evil history of the 20th century is as visible as it would not be in any other capital. We do not want to hide and escape from our history here in Berlin but to face it.”

“Berlin invents itself again and again,” Richard Meng, spokesman for the city’s governing senate says. “It took ten years after ’89 to find the way for Berlin.” The formula arrived at was, in Meng’s words, “an open-minded city that lets the international community in and makes it possible for young people to live their life here and find their ideas.” That is, the very opposite of any previous idea of Berlin as a showplace for power. Opportunity replaced authority as the central element in Berlin’s DNA.

But there was a problem. Berlin’s lack of industry and big business meant that its tax base was, and remains, inadequate. Even now Berlin is carrying a debt of \$77 billion and would be running an annual city budget deficit of 20.7 percent if not for grants from other German states and the federal government. Without the rest of Germany to support it, Berlin would go bust. The annual deficit is shrinking, and new enterprises are being encouraged, but still there seems to be little urgency, in Berlin anyway, to plug the gap. A fine kind of carelessness governs Berlin’s view of its future as the city that, as the former mayor has said, is “poor but sexy.”

Berlin’s deep shift from Europe’s great troubled power city to its emblem of liberation is shadowed by the story of Athens to the south.

Adam Nicolson’s book Why Homer Matters is about Europe’s Greek roots. Gerd Ludwig’s latest book documents the aftermath of the Chernobyl disaster. Alex Majoli’s photographs illustrated “Rethinking Nero,” in the September 2014 issue.

When the Greeks joined the EU in 1981, it was—according to Vassilis Papadimitriou, press secretary to George Papandreou, prime minister during the peak of the economic crisis, from 2009 to 2011—“like a ship arriving in port.” It was the moment when the Greeks—previously isolated by the Soviet bloc to the north, in an unsustainable arms race with Turkey to the east, and irredeemably poor—“felt that they were being treated as a proper part of Europe for the first time.”

Membership in the European club ushered in a long swing of optimism, grants, and growth for the city, culminating in its hosting of the 2004 Olympics and building of the magnificent new Acropolis Museum, through which the world could be shown just how modern and sophisticated Greece had become.

The euro crisis was, according to Elli Papakonstantinou, a director of experimental theater in the abandoned industrial suburb of Elaionas, “a moment of guilt, shared by all of us, a sense that somehow we were all responsible for the bad things that were happening to us.” It was a huge, national blow to self-esteem. Papadimitriou says it was “confirmation of the Greeks’ worst fears, that they didn’t really belong in Europe at all.”

The social and personal pain brought on by the ensuing austerity regime remains intense. Ermina Kontaratos, who looks after her severely disabled teenage daughter, wrings her hands in despair at the daily struggle she now has to undergo to get anything out of the welfare system. Since June 2013 she has had nothing. Until then she’d been receiving \$1,300 every two months. Then the doctors went on strike. Then she was sent to the wrong doctors, who fobbed her off, and then again to others in distant offices, impenetrably bureaucratic, almost impossible to get to on public transport. She has no car. “The officials have all been turned upside down. They don’t know what they’re doing.”

Her daughter had been receiving a pension of \$200 a month since her father’s death five years ago. That too has stopped. How will they live? “I will pray to God,” Kontaratos said. “My son

Antonis brings me a bit of fish. I have a vegetable garden, some chickens. I'm much better off than a lot of people. I have some olive trees."

There has been a tectonic shift of the middle class into poverty. Grandparents have moved in with their families; the young are leaving the city and going back to the villages. For many families, there isn't enough money for the private tutors who've always been part of the Greek education system. The population of central Athens has been dropping; the 2011 census reported nearly a third of the city's apartments as vacant. Property prices in some parts have fallen by more than 40 percent. For all the boosterish publicity highlighting new clubs in Kerameikos or the burgeoning art scene, the collapse is real and pervasive.

The streets around the anarchist-dominated Polytechnion, Athens's most radical university campus, are still littered with graffiti—Eat the

the eruption of xenophobia in parts of the city. I spoke with the president of the local residents association in Aghios Panteleimon, one of the districts where the fascist group Golden Dawn has received its most support. He took me to see the blackened hole where a pop-up mosque had been until it was burned out in a fire in 2011. "Can you think of anything more disgusting than 70 pairs of shoes on the pavement outside a mosque?" he said. "Of course it was burned down." Athens, he thought, might allow a mosque to be built, but none would have a minaret. "It reminds us of Ottoman shame"—the centuries before independence, when Athens was merely another city in the Turkish empire.

THE DAYS OF RAGE HAVE RECEDED. Last spring the most violent demonstration was the sit-in held by cleaning workers from the finance ministry over jobs. They sat smoking and chatting for a morning in the street next to the ministry. Here and there some commercial optimism has emerged. Internet start-ups like Taxibeat—"Be a 21st-century taxi driver. Make your smartphone a new source of revenue"—are raising millions of dollars in venture capital. All kinds of e-commerce schemes are entering the mix. And street artists have started flogging their canvases to international collectors. A man called Cacao Rocks put a sticker on one of the graffiti works that he'd sprayed all over the wall of an abandoned factory in Psiri: "If you want to buy any of my work, you can find me at the gallery at No. 12 down the road."

Alongside all this, bubbling up throughout Athens are local organizations looking for local solutions, cleaning up garbage, planting trees on abandoned plots, painting children's parks, giving Athenians guided tours of parts of the city they don't know, putting up brief histories in simple Greek on the walls of buildings, yarn bombing the trees in Kolokotroni Square to celebrate them and their beauties.

Such transient uses of abused or abandoned city spaces are a global phenomenon. They're everywhere in Berlin too, but the same actions have different meanings in different places. In Athens

THE EURO CRISIS WAS "A MOMENT OF GUILT...A SENSE THAT SOMEHOW WE WERE ALL RESPONSIBLE FOR THE BAD THINGS HAPPENING TO US."

—Elli Papakonstantinou

Rich, Kill the Past, Burn the Cells—and a third of the shops in the smartest shopping streets of Kolonaki are empty. Police wearing protective rubber armor and stab-proof vests and armed with three-foot-long truncheons still wait in huddles outside cafés around Alexandros Grigoropoulos Street, renamed informally for a 15-year-old boy who was shot and killed by an officer in a scuffle on December 6, 2008.

The social and economic stress has meant

the enemy they're addressing is a sense of failure and disillusion. In Berlin it's the opposite, the threat that too much success will start to erode Berlin's famous freedoms. Demonstrations are held there against the building of new apartment blocks. In parts of the city, such as Kreuzberg and, even more, Mitte, which were the great squat hangouts and art centers of the '90s in the years after the Wall came down, the new problem is money. The power of capital, the gentrifying flood of new cash drawn to Berlin's cool image, is what threatens to alter the precious, inclusive social fabric of the city.

THIS IS BERLIN'S OWN VERSION of the escape from failure. Only by integration and participation, by a version of intimacy, can the modern city hope to be a humane one. You hear that message from all corners. Since 2009 Marco Clausen, a social historian, and Robert Shaw, a filmmaker, have run a community garden called the Prinzessingärten right in the middle of urban Berlin, on the site of a large, Jewish-owned department store that was bombed in the war and never rebuilt. If people suggest that the 1.5-acre garden is not very productive in terms of food, Clausen has an answer: "No. What we produce is social exchange. What we produce is a neighborhood." The garden is, he says, "a symbol of a lot of the things that people desire."

For many, this Berlin culture, which had its roots in the pre-1989 squats of West Berlin, is under threat. "What will this city look like in the future," Clausen asks, "if we just go on selling to the highest bidder? The city is not made by its planners and architects; it is made by its culture and everyday connections." That's a powerful vision of what a good city might be: Don't let money or power dominate, don't let property drive out humanity. The irony is that Clausen is voicing precisely the ideal of human connection and human networking that lies at the root of Greek culture and that has proved so difficult to integrate with the systems of the modern state: How to reconcile human connection with a pan-European economy?

Wolfgang Thierse, the veteran politician who for decades has been intimately involved in the

making of the new Germany, recognizes that "the attractive thing about this city was that it was not finished. There were these empty spots and all this chaos. But the attractiveness of the messiness is disappearing." In Prenzlauer Berg, where he lives, Thierse estimates that 90 percent of the residents moved there in the past 25 years. "Which means another 90 percent have been pushed out. Gentrification is an experience of the last ten years, and a painful experience," he says. "People expect the city to put brakes on that process, precisely to make it less painful." The great German success since 1945 has been a product of what the Germans call capitalism with a social dimension.

One young mother I met in Kreuzberg—she wouldn't give me her name—told me how the rich would park outside her apartment block, sizing it up for gentrification. "They don't need schools," she said. "They just want parking spaces." She said that whenever she sees a limousine full of prospectors, she shouts, "Go away. This is my house—not your money."

Keeping the inclusive social fabric of the city intact is central to Berlin's own escape from the pressures of modernity. The London model (a destructively free market in housing) and the Paris model (a superchic white core surrounded by poor and troubled immigrant suburbs) are to be avoided at all costs.

This is the central paradox. Berlin thrives on the careful organization of an apparently liberated city. Athens suffers the constrictions and baffles of a culture that, at its deepest level, doubts the value of authority—and consistently undermines it. The twin questions facing these cities are: How to resist the increasing dominance of the market? And how to create institutions in which people will believe? There is no sleek answer at hand. □

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INTERVIEW

Two Cultures, One Family

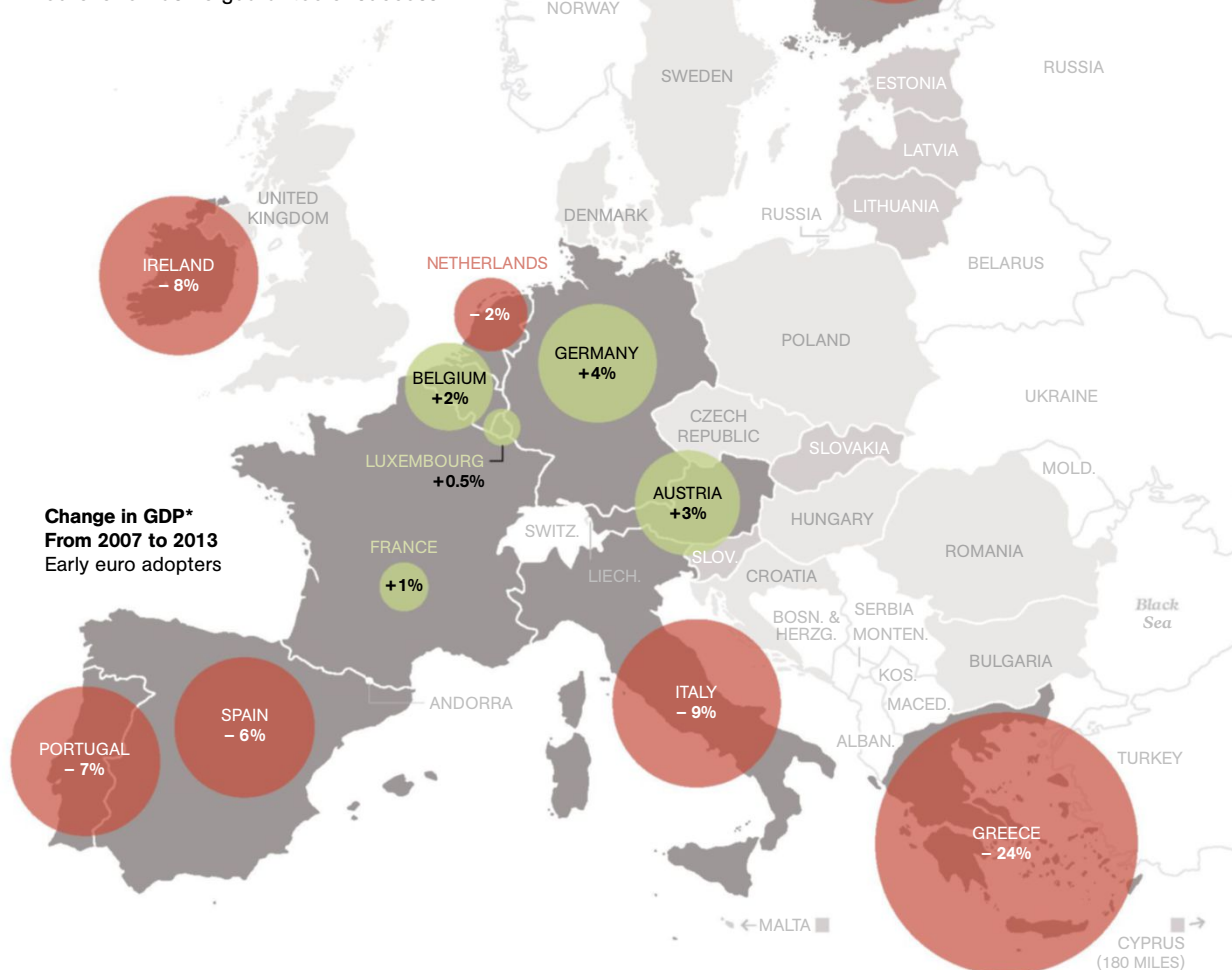
Irini Paicos's Greek family members have been living in Germany for generations, and she and her husband split their time between Athens and Berlin. Straddling the two cultures during the crisis has been complicated.



Police frisk young men (top) on Aeschylus Street, near Omonia Square in Athens. Rates of drug use, prostitution, and HIV infection have risen in the area since the crisis began. In central Berlin, a different vision: “Barbie: The Dreamhouse Experience,” a life-size canvas dollhouse with a pink high-heel fountain.

JOINED AT THE EURO

Germany and Greece were two of the 12 earliest members of the eurozone, countries that had cast off their historic currencies in favor of the euro by 2002. In the years that followed, however, they made starkly different economic choices. By the time the global financial crisis hit in 2008, it was clear that joining the eurozone was no guarantee of success.



Bouncing Back, or Not

Of all the early euro adopters, Greece was hardest hit by the world financial crisis. Its annual gross domestic product (GDP)—the value of all goods and services produced—saw a precipitous decline between 2007 and 2013. During the same period Germany enjoyed the most growth.

- Early adopter (1999-2001) of the euro
- Late adopter (2007-2015) of the euro
- European Union member not using the euro
- Not in European Union

GREECE, GERMANY, AND THE GLOBAL FINANCIAL CRISIS

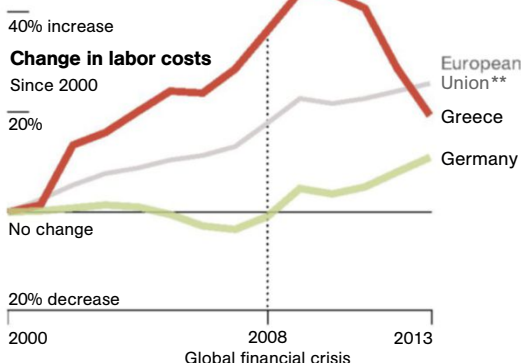
Before the Crisis

As its economy stagnated in the early 2000s, Germany increased competitiveness by working with unions to keep wage increases below productivity growth. Greece, its economy fueled by the cheap government loans that came with eurozone membership, saw labor costs soar.

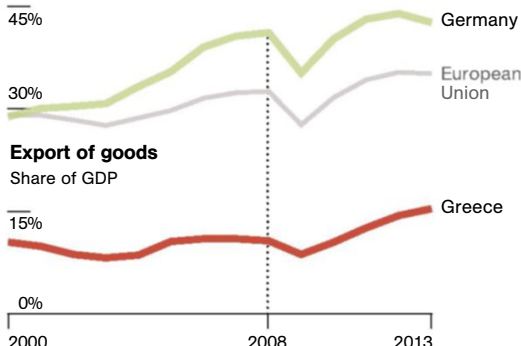
The euro made business across borders much easier but led to less buying power for strong, export-oriented economies like Germany and more buying power for weak countries like Greece. Germany's exports became more affordable, boosting its economy longer term, while Greece's export economy remained flat.

Many Greeks found jobs in the early 2000s, as the government, flush with cash from the cheap loans, improved infrastructure and went on a hiring spree. Meanwhile many Germans found themselves out of work because of an economic slump that affected several developed nations.

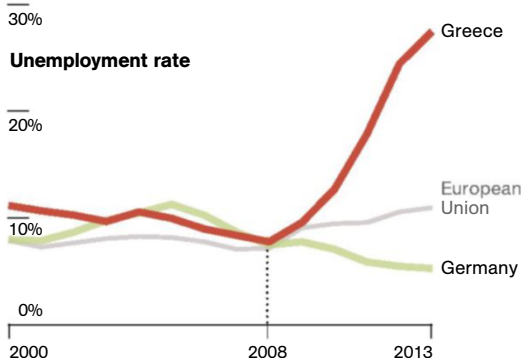
The euro and competitive differences...



caused one economy to grow, the other to stumble...



resulting in two very different social outcomes.



After the Crisis

Greece

After the financial crisis hit in 2008, painful austerity measures linked to bailout funds resulted in smaller paychecks.

Germany

A strong economy led to a healthy balance sheet, allowing unions to demand higher wages.

Greece

The uptick in exports as a percentage of GDP after 2009 reflects a slight rise in goods sold but mostly the shrinking of the overall economy.

Germany

German machinery dominates the eurozone. That and increased sales to emerging markets boosted the percentage of Germany's GDP driven by exports.

Greece

Austerity measures and a slowing economy have led to the highest unemployment rate in the European Union.

Germany

When labor costs dropped in the mid-2000s, so did unemployment. Germany also adopted flexible work options and now has one of the lowest unemployment rates in Europe.

**EU15 DATA; INCLUDES THE ORIGINAL 12 EUROZONE MEMBERS, ALONG WITH DENMARK, SWEDEN, AND THE U.K., NONE OF WHICH ADOPTED THE EURO

JOHN TOMANIO AND JEROME N. COOKSON, NGM STAFF; FARHANA HOSSAIN
SOURCES: MEGAN GREENE, MAVERICK INTELLIGENCE;
ANDREAS WÖRGÖTTER, OECD. DATA: WORLD BANK; OECD; EUROSTAT



Miloš Kmošek (at left), a Slovakian street artist, poses as an East German border guard in front of the Brandenburg Gate in the summer of 2013. Such playacting has since been banned as unsuitable here.

BERLIN

The imposing power city at the heart of Europe's 20th-century tragedy is learning to live with its troubled inheritance.







In summer an artificial cascade runs through leafy Viktoriapark in Kreuzberg, named after the iron cross (*Kreuz*) atop the hill (*Berg*) that celebrates Napoleon's defeat in 1815.



LIFE ISN'T EASY

For all its laid-back social tolerance, Berlin has a hard edge. Memories of its agonized past leak into the present. The Boros art collection, housed in a concrete Nazi bunker (above), plays on Berlin's obsession with the relationship between past and present. In Michael Sailstorfer's "Forest," trees hang upside down and rotate. In Awst & Walther's "Latent Measures," a brushed-metal tube drives through the concrete walls of six rooms. On the wall of the St. Oberholz web-hub café on Rosenthaler Strasse (top right) is the saying "*Das Leben ist kein Ponyhof*"—life isn't easy. The face of Dieter Weckeiser (bottom right), killed in 1968 at age 25 while attempting to swim across the River Spree to West Berlin, forms part of a memorial on Bernauer Strasse, where a graffiti-covered stretch of the Wall has been preserved as a reminder of the divided city. Weckeiser was with his wife: 17 shots, both died.





In the 1990s British architect Norman Foster restored Germany's 1894 parliament building, the Reichstag, damaged in World War II. He added a central glass dome to symbolize transparency.







Every summer the president of Germany holds a *Bürgerfest*, or citizens' festival, on the grounds of Schloss Bellevue, the official presidential residence.



Close to the Brandenburg Gate, Berlin's Holocaust Memorial is a city-block-filling maze of solid gray sarcophagi. Visitors can find themselves sunk into lifeless canyons of grief.







End of the Earth

Story and Photographs by
MURRAY FREDERICKS

What does nothing look like? I traveled all the way to Greenland to find out. In the space of three years, I made six trips there from my home in Australia. I was drawn to the polished white emptiness of the place—a landscape devoid of features, perfectly flat, with ice extending to the horizon in every direction.

Shooting in this remote location was cold, hard work. I lived for months at a time in a tent on the Greenland ice sheet, where windchills plunged below -60°F and ground blizzards blew for days. At the worst times I imagined my family, my children, and I thought, I can't do this. It's not worth the risk.

But I stuck it out, and as the weather improved, so did my mood—and my pictures. When you exist for long periods in a void, the external and internal worlds blur together. The mind slows and becomes sensitive to any change; the slightest shift in light or weather is dramatic. The photography I created during those long months became an exhibition series and a documentary that capture the feeling of being there: It was, as the film's title says, like *Nothing on Earth*. □

A constellation of orbs, rings, and halos hangs above the Greenland ice sheet. These optical phenomena occur when ice crystals—suspended by powerful winds called *piteraq*s—refract sunlight.

ICESHEET #4724, 22° AND 46° HALO, TANGENT ARC, PARRY ARC, CIRCUMZENITHAL ARC, AND PARHELIC CIRCLE





As dusk becomes night, a cloud bank and an aurora (above, at right) share the darkening sky. Auroras appear when solar electrons excite oxygen and nitrogen atoms in the Earth's upper atmosphere. You can also see lenticular clouds at high latitudes. This panorama (left) shows what happens when high-speed winds in frigid air are forced up over the ice sheet.

ICESHEET #3373, CLOUD BANK AND AURORA, PANORAMA COMPOSED OF FOUR IMAGES (ABOVE); ICESHEET #2338, PANORAMA COMPOSED OF THREE IMAGES



There are actually a few signs of habitation on the Greenland ice sheet. I chanced upon deserted radar stations, like this one (above), sitting below the snow line. What fascinated me was how these places—once used as missile-detection sites—were hastily abandoned 25 years ago, when the Cold War ended. The people who worked here left posters on walls, beds unmade, and remnants of their lives scattered all around (right).

DYE2, ABANDONED MISSILE-DETECTION STATION, GREENLAND ICE SHEET, PANORAMA COMPOSED OF THREE IMAGES (ABOVE); DYE3, INTERIOR #4, BEDROOM (RIGHT)









When there are no features to obscure the view, you can see where air masses with different temperatures, dew points, and moisture levels meet over the landscape.

ICESHEET #5649





On a cloudy day, a blue horizon line is all that separates ground and sky. This project was an experiment: I wanted to see if it was possible to make a photographic series with almost no visual information.

ICESHEET #2426

MORE ONLINE

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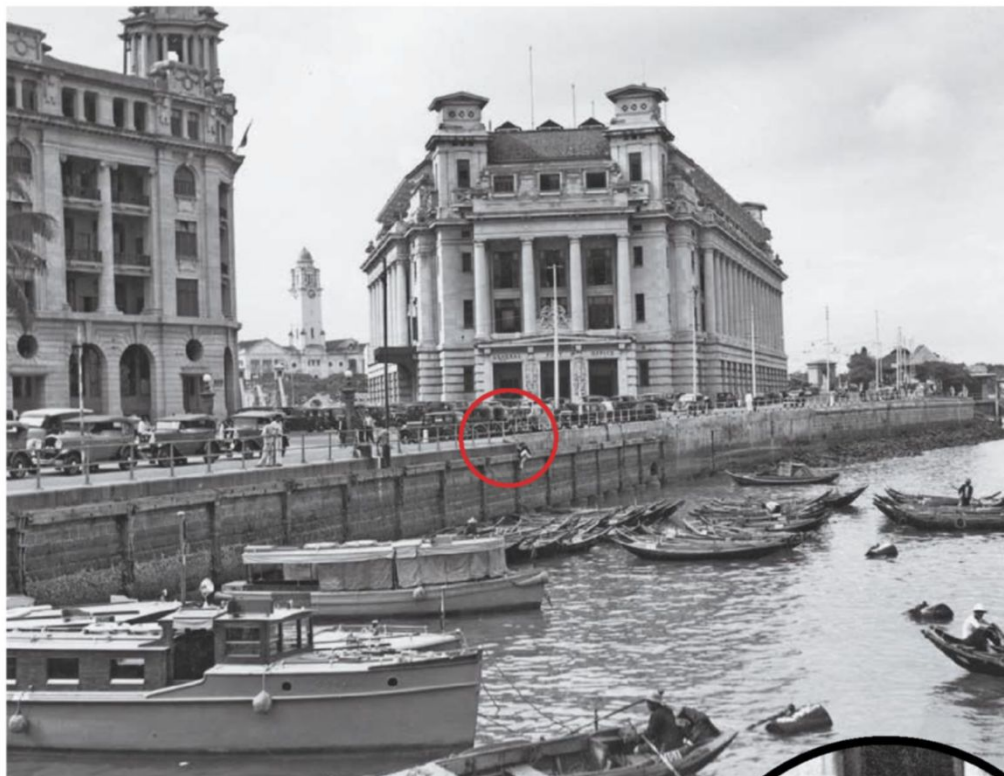
VIDEO

***Landscapes
in Motion***

Murray Fredericks's time-lapse video brings Greenland's landscapes to life, with dark clouds rushing over icy seas and northern lights dancing across the nighttime sky.

In the Loupe

With Bill Bonner, National Geographic Archivist



Social Climber

A barge “can carry many tons of cargo,” noted *National Geographic*’s May 1938 article on Singapore, a story for which this photo was likely taken. “Across the dark waters of the mother river, coveys of boats work their way into the very heart of the modern metropolis, just as they did before the age of steam.”

This view of the Fullerton Building—now a luxury hotel—was taken from Singapore’s Clifford Pier. But a look through the loupe offers a glimpse of something else: a solitary seaman working his own way from the harbor into the city’s heart. —Margaret G. Zackowitz



PHOTO: MAYNARD OWEN WILLIAMS, NATIONAL GEOGRAPHIC CREATIVE

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