

# SN

SCIENCE NEWS MAGAZINE  
SOCIETY FOR SCIENCE & THE PUBLIC

APRIL 2, 2016

Literary  
Leech

Big Chill  
for Ancient  
Oceans

Your  
Mind on  
Microbes

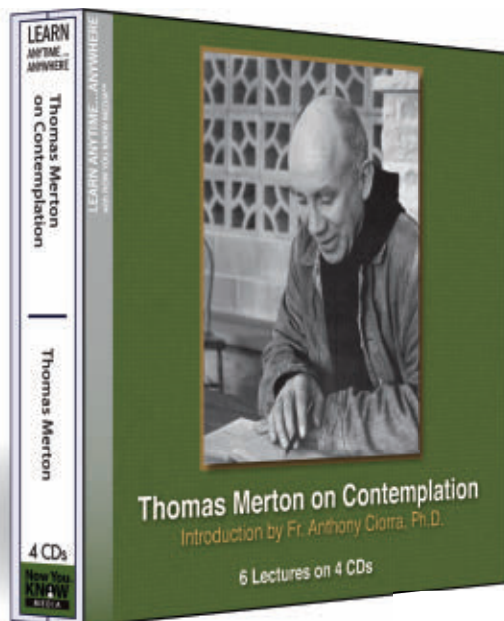
Sticky-Fingered  
Baby Jupiter



# GROWING THREAT

Zika's emerging dangers jump-start  
renewed war on mosquitoes

# Hear Thomas Merton's Lost Lectures



LIMITED TIME OFFER  
**73% off**  
FOR NEW CUSTOMERS



**Y**ou are invited to learn from one of the twentieth century's leading minds on social justice, authentic spirituality, and contemplative living.

Hear bestselling author and renowned mystic Thomas Merton express his deepest thoughts on prayer, meditation, silence, contemplation, and life as a spiritual journey. In these timeless recordings, you will be transported into a classroom in the monastery where Merton taught his students with love, humor, and respect. These six remarkable lectures, originally recorded by Merton in 1963-65, have been remastered and made available to the public through Now You Know Media's exclusive partnership with the Thomas Merton Center and the Thomas Merton Legacy Trust.

Throughout this series, Merton offers profound reflections on the church fathers, the monastic life as a journey, and solitude. His use of poetic images, scripture, and theology makes these lectures a treasure that you will want to listen to again and again. You may have read Merton's writings, but hearing his voice and manner of expression brings out another side of Merton that you haven't experienced before. Discover how time spent with Merton can be transformative.

**Offer expires 30 days from issue date**

**1-800-955-3904**

[www.NowYouKnowMedia.com/merton2](http://www.NowYouKnowMedia.com/merton2)

Now You Know Media, Inc. • 12115 Parklawn Dr., Unit B •  
Rockville, MD 20852

## Thomas Merton on Contemplation

**4-CD Set presented by Thomas Merton**

Introduction by Rev. Anthony Ciorra, Ph.D.

### Lecture Titles

1. The Spiritual Journey (1/16/1963)
2. Cassian on Prayer (5/19/1963)
3. Benefits of Religious Silence (12/14/1963)
4. Prayer and Meditation (1/28/1964)
5. Dealing with Distractions in Prayer (6/14/1964)
6. Solitary Life: A Life Without Care (8/20/1965)

**4-CD Set ~~\$109.95~~ SALE \$29.95**

**Coupon Code: A1947**

+ \$3.95 Shipping & Handling  
100% Satisfaction Guarantee

These special recordings are part of Thomas Merton's spoken word legacy. They are actual recordings of Thomas Merton and are part of the archives of the Thomas Merton Center at Bellarmine University in Louisville, Kentucky. This program was produced by Now You Know Media. Now You Know Media's mission is to bring you the best religion professors in America. Visit our website, [www.NowYouKnowMedia.com](http://www.NowYouKnowMedia.com), to browse our growing catalog of over 250 programs available in CD, DVD, and MP3 formats.

# ScienceNews



22

## Feature

### 22 Microbes and the Mind

Our bodies are having a conversation with our microbiome that may be affecting our mental health — for better or worse.

By Laura Sanders

## SPECIAL REPORT

### 26 In Search of Answers on Zika

As scientists tally Zika's dangers, including a potential link to birth defects and an autoimmune disease that can cause temporary paralysis, virus-carrying mosquitoes become a target for old-school and high-tech control efforts.

## News

**6** Gut microbe mix matters for childhood malnutrition

**7** Jupiter's travels might have shaped inner solar system

**8** Researchers duel over reproducibility of psychology results

**10** Ice sheet's history foretells Antarctic melting

Chewing sliced raw meat helped shape human faces

**11** Genetic trick exploited to counteract antibiotic resistance

**12** Shipwrecks and tree rings tell hurricane history

Extragalactic fast radio bursts on repeat

**14** Ant decisions swayed by insect version of social media

Remains in amber provide clues to lizard evolution

**16** Earth's early oceans were cool enough for life

**18 News in Brief**  
Engravings found on 11,000-year-old pendant from England

Dodo not so dumb, brain model suggests

Worsening acidification at Great Barrier Reef

Work-arounds for missing genes

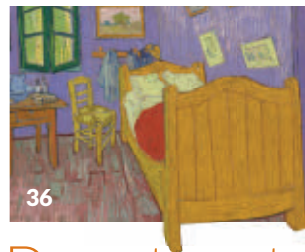
### 20 News in Brief

Countdown begins for cancer 'moonshot'

Pluto moon's rift a sign of underground sea

Mite, virus team up against honeybees

Sea level rise faster than in previous 28 centuries



36

## Departments

### 2 EDITOR'S NOTE

### 4 NOTEBOOK

Amy Tan's namesake leech; ancient Egyptian dress was tailored

### 32 REVIEWS & PREVIEWS

New book highlights hair's vital role in human history

### 34 FEEDBACK

### 36 SCIENCE VISUALIZED

Chemistry brings to light Vincent van Gogh's true colors

### SOCIETY UPDATE

Volunteer at Intel ISEF

**COVER** The *Aedes aegypti* mosquito, seen here emerging from its underwater pupa, can carry Zika, among other viruses. © Alex Wild

14



# Racing for answers on Zika



Sometimes science does not move fast enough, despite much hard work and effort. That's true in the case of the Zika virus outbreak currently marching through the Americas. As we report in a collection of stories beginning on Page 26, much remains unclear, including the relationship between Zika infection and microcephaly and how best to combat the mosquitoes that spread the disease. So far, however, evidence does suggest that this little-known (and previously largely ignored) virus may indeed target the

nervous system, probably triggering Guillain-Barré syndrome in a small percentage of patients. The virus could even pose as-yet undiscovered health risks that may take years to untangle. While scientists will no doubt eventually be able to answer many of the public's pressing questions, it may be too late for many.

It's not a global emergency, but the public is also apparently impatient with science's progress on providing practical advice about the human microbiome — the collection of bacteria and other microorganisms that live in and on us. This issue features two articles about new results from this hot field. On Page 22, Laura Sanders details surprising ways that gut microbes can meddle with the brain, hinting that certain microbial mixes may influence depression and other mental disorders. And on Page 6, Meghan Rosen describes the microbiome's role in malnutrition, suggesting that resetting children's microbes may be a useful treatment. It's hard not to conclude that manipulating the bacteria in your body could offer a path to better health and happiness.

Judging from the shelves at Whole Foods, that is what many makers of probiotic supplements would like you to believe. And it may well turn out to be true — studies have linked the microbiome to metabolic and digestive issues such as obesity, irritable bowel syndrome and inflammatory bowel disease. But science hasn't yet come up with broad recommendations for the best ways to tend your personal microfloral garden. And since the Food and Drug Administration regulates supplements as foods, not as medicines, probiotic pills may vary in quality and even in actual ingredients; makers don't have to prove that probiotics are safe or effective.

Notably, none of the researchers that Sanders asked while reporting "Microbes and the mind" said that they regularly take probiotic supplements. They also said that any effects on the brain, while fascinating, are probably subtle for most people — otherwise you'd notice a mood change every time you took antibiotics. In Rosen's story about malnutrition, researcher François Leulier says: "We can envision some therapy solutions, but we're still at the basic research level." It's just too early to start megadosing, he says, even for very sick kids.

To fill in the gap, people look to anecdote. Or, sometimes knowingly, they engage in uncontrolled self-experiments with an N of 1, fueled by the Internet (see the website Quantified Self) and DIY culture. The data gleaned from these personal trials may help individuals, but they can't answer big questions.

An eager public — and intriguing science — is propelling microbiome research along. Zika research is sprinting after an elusive and mysterious foe, trying to stop the damage from the virus and learn from a vast natural experiment. In both cases, science must move more swiftly if it is to catch up.

— *Eva Emerson, Editor in Chief*

**PUBLISHER** Maya Ajmera  
**EDITOR IN CHIEF** Eva Emerson

## EDITORIAL

**MANAGING EDITOR** Tom Siegfried  
**EDITOR, SCIENCE NEWS FOR STUDENTS** Janet Raloff  
**DEPUTY MANAGING EDITOR, NEWS** Macon Morehouse  
**DEPUTY MANAGING EDITOR, DIGITAL** Kate Travis  
**DEPUTY MANAGING EDITOR, FEATURES** Cori Vanchieri  
**DEPUTY MANAGING EDITOR, PRODUCTION** Erin Wayman  
**ENTERPRISE EDITOR** Elizabeth Quill  
**WEB PRODUCER** Helen Thompson  
**ASTRONOMY** Christopher Crockett  
**BEHAVIORAL SCIENCES** Bruce Bower  
**EARTH SCIENCES** Thomas Sumner  
**LIFE SCIENCES** Susan Milius  
**MOLECULAR BIOLOGY** Tina Hesman Saey  
**NEUROSCIENCE** Laura Sanders  
**STAFF WRITER** Meghan Rosen  
**REPORTER/RESEARCHER** Sarah Schwartz  
**SCIENCE EDUCATION WRITER** Bethany Brookshire  
**EDITORIAL ASSISTANT** Cassandra Martin  
**CONTRIBUTING CORRESPONDENTS**  
Laura Beil, Susan Gaidos, Alexandra Witze

## DESIGN

**CREATIVE DIRECTOR** Stephen Egts  
**DESIGN DIRECTOR** Erin Otwell  
**ASSISTANT ART DIRECTORS** Justine Hirshfeld, Molly Telfer  
**USER EXPERIENCE DESIGNER** Federico Castaneda

## SOCIETY FOR SCIENCE & THE PUBLIC

**PRESIDENT AND CEO** Maya Ajmera  
**CHIEF MARKETING OFFICER** Kathlene Collins  
**CHIEF FINANCIAL OFFICER** Charlie Feeney  
**CHIEF PROGRAM OFFICER** Michele Glidden  
**CHIEF, EVENTS AND OPERATIONS** Cait Goldberg  
**CHIEF ADVANCEMENT OFFICER** Bruce B. Makous  
**CHIEF TECHNOLOGY OFFICER** James C. Moore

## BOARD OF TRUSTEES

**CHAIRMAN** H. Robert Horvitz  
**VICE CHAIR** Alan Leshner **SECRETARY** Paul J. Maddon  
**TREASURER** Robert W. Shaw, Jr. **AT LARGE** Mary Sue Coleman  
**MEMBERS** Craig R. Barrett, Sean B. Carroll, Tom Leighton, Stephanie Pace Marshall, Joe Palca, Vivian Schiller, Frank Wilczek, Maya Ajmera, *ex officio*

## ADVERTISING AND SUBSCRIBER SERVICES

**ADVERTISING** Kamille Davis  
**SUBSCRIBER AND MEMBER SERVICES** Kerwin Wilson  
**PERMISSIONS** Evora Swoopes

*Science News*  
1719 N Street NW, Washington, DC 20036  
**Phone:** (202) 785-2255

**Customer service:** member@societyforscience.org

**Editorial/letters:** editors@sciencenews.org

**Sponsor content:** ads@societyforscience.org

*Science News* (ISSN 0036-8423) is published biweekly by Society for Science & the Public, 1719 N Street, NW, Washington, DC 20036.

**Online and iPad access:** Activate your subscribing member account, including digital access and the ability to opt out of print, at [www.sciencenews.org/activate](http://www.sciencenews.org/activate)

**Subscribe:** Web [www.sciencenews.org/join](http://www.sciencenews.org/join)

For renewals, [www.sciencenews.org/renew](http://www.sciencenews.org/renew)

**Phone** (800) 552-4412 in the U.S. or (570) 567-1191 outside of the U.S.

**E-mail** member@societyforscience.org

**Mail** *Science News*, PO Box 1205, Williamsport, PA 17703-1205

Subscribing memberships include 26 issues of *Science News* and are available for \$50 for one year (international rate of \$68 includes extra shipping charge). Single copies are \$3.99 (plus \$1.01 shipping and handling). Preferred periodicals postage paid at Washington, D.C., and an additional mailing office.

**Postmaster:** Send address changes to *Science News*, PO Box 1205, Williamsport, PA 17703-1205. Two to four weeks' notice is required. Old and new addresses, including zip codes, must be provided.

**Society for Science & the Public** is a 501(c)(3) nonprofit membership organization founded in 1921. The Society seeks to promote the understanding and appreciation of science and the vital role it plays in human advancement: to inform, educate, inspire. Learn more at [societyforscience.org](http://societyforscience.org). Copyright © 2016 by Society for Science & the Public. Title registered as trademark U.S. and Canadian Patent Offices. Reproduction of any portion of *Science News* without written permission of the publisher is prohibited. For permission to photocopy articles, contact [permissions@sciencenews.org](mailto:permissions@sciencenews.org). Sponsor content and advertising appearing in this publication do not constitute endorsement of its content by *Science News* or the Society.





Actual size  
is 40.6 mm

LOW AS  
**\$21.95**  
each

## An Ounce of Silver. A Ton of Prestige. *Australia releases new Eagle Silver Dollar to Americans*

**Y**ou might say that Australia just gave America the bird! But no worries, mate, the two countries are still on great terms. So great, in fact, that they've teamed up on this Australian legal-tender 99.9% pure Silver Dollar. A stunning new coin that's the newest in a historic FIRST EVER Silver Dollar series.

The 2016 Australian Eagle Silver Dollar is a hefty full ounce of 99.9% pure silver bearing tons of collector prestige. Minted by Australia's award-winning Perth Mint in gleaming Brilliant Uncirculated (BU) condition, this Silver Dollar hides an impressive American connection!

### Pride & Prestige

Chief Engraver John Mercanti created the timeless American Silver Eagle design in 1986. Now, Mr. Mercanti's boldly sculpted Australian Wedge-Tailed Eagle has been struck on this spectacular legal-tender 2016 Australian Silver Dollar. Mr. Mercanti is the *first U.S. Mint Chief Engraver to design a coin struck by another country.*

### A Runaway Best Seller

Tens of thousands of silver dollar lovers have already snatched up Australian Eagle Silver Dollars since the series was first launched in 2014. Now, thanks to its brand new

stunning 2016 design, demand is expected to explode again—especially at a price as low as \$21.95!

### Worldwide Exclusive

GovMint.com is the exclusive worldwide distributor for this exciting new Silver Dollar. Your satisfaction is assured with our no hassle 30-day guarantee.

### Buy More and SAVE More!

You can lock in your 2016 Australian Eagle Silver Dollar for the low price of just \$22.95 each (*plus s/h*).

#### Stock up and SAVE MORE!

1-4 Coins	-	\$22.95 ea. + s/h
5-6 Coins	-	\$22.75 ea. + s/h
7-9 Coins	-	\$22.75 ea. + <b>FREE SHIPPING</b>
10-19 Coins	-	\$22.50 ea. + <b>FREE SHIPPING</b>
20+ Coins	-	\$21.95 ea. + <b>FREE SHIPPING</b>

FREE SHIPPING: Limited time only. Product totaling over \$150 before taxes (if any). Standard domestic shipping only. Not valid on previous purchases.

Call today toll-free for fastest service  
**1-888-517-8646**

Offer Code AWE105-01  
Please mention this code when you call.

GovMint.com • 14101 Southcross Dr. W. Dept. AWE105-01 • Burnsville, Minnesota 55337

Prices and availability subject to change without notice. Facts and figures deemed accurate as of January 2016. NOTE: GovMint.com® is a private distributor of worldwide government coin and currency issues and privately issued and licensed collectibles, and is not affiliated with the United States government. GovMint.com is not an investment company and does not offer financial advice or sell items as an investment. The collectible coin market is speculative, and coin values may rise or fall over time. All rights reserved. © 2016 GovMint.com.



**GOVMINT.COM®**

**THE BEST SOURCE FOR COINS WORLDWIDE™**  
ADVERTISEMENT



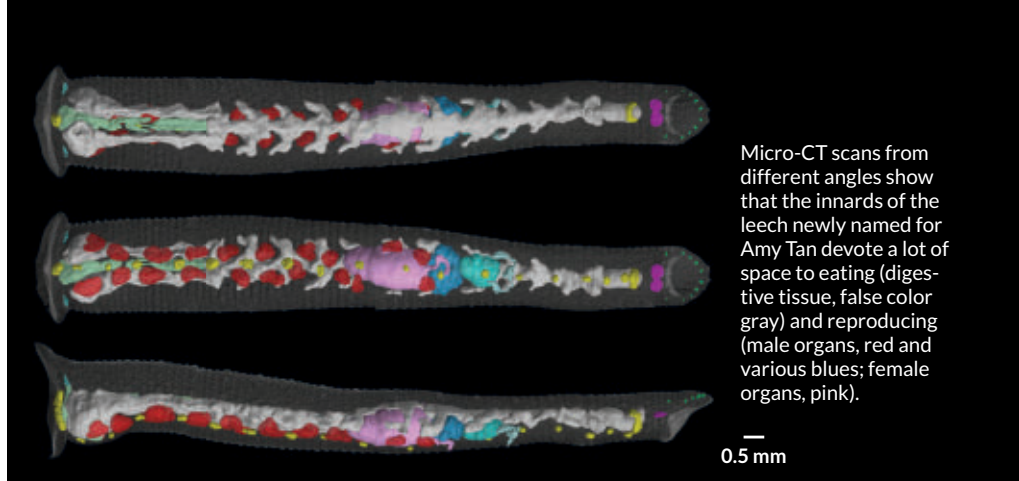
Excerpt from the  
April 2, 1966  
issue of *Science News*

50 YEARS AGO

## Doubt cast on quasars

Quasars are considered the brightest and most puzzling objects in the universe. They are also believed to be the most distant, some 10 billion light-years away. However, doubt was thrown on this picture of quasars by Dr. Halton C. Arp.... He reported that some quasars are not at the far reaches of the universe but are relatively close, astronomically speaking.

**UPDATE:** Quasars are luminous disks of gas and dust swirling around supermassive black holes. Quasar light is redshifted, stretched toward the red part of the spectrum, which astronomers now attribute to the expansion of the universe. High redshifts imply that quasars are billions of light-years away. Light from the farthest known quasar, which pumps out as much power as 63 trillion suns, takes about 13 billion years to reach Earth. Arp was a celebrated astrophysicist at California's Mount Wilson and Palomar observatories when he suggested that quasars are local. He remained a prominent critic of quasar distances and the Big Bang theory until his death in 2013.



Micro-CT scans from different angles show that the innards of the leech newly named for Amy Tan devote a lot of space to eating (digestive tissue, false color gray) and reproducing (male organs, red and various blues; female organs, pink).

0.5 mm

INTRODUCING

## Amy Tan, are you really thrilled about the leech?

At last *Science News* is able — thanks to novelist Amy Tan — to answer a nagging question: When someone names a slime-mold beetle or a leech after you and you say you're honored — really?

Tan (whose novels include *The Joy Luck Club* and *The Valley of Amazement*) swiftly supplied a vivid description of her feelings about a *Zoologica Scripta* paper posted online in January naming a small, blood-sucking leech in her honor.

She felt a connection with that leech, she writes in an e-mail. Before she knew it would bear her name, she had happened upon a blog post written about 10 years ago by Mark Siddall, a curator at the American

Museum of Natural History in New York City, and his colleagues, who were looking for leeches, preferably new species, in the rainforests of Australia.

"They described conditions of sweat, mosquitoes, humidity and unwashed clothing," Tan reminisces. That blog entry from the expedition's second-to-last day, describes the scientists' reaching an area devastated by Cyclone Larry:

"There's so little left.

"Like a bomb went off.... Trees, regardless of size, lie twisted and snapped like matchsticks....

"Worse, the canopy is gone.... Gone. Like a lawnmower came by and simply hacked



Scholars have debated for decades why Henry VIII acted the way he did. Head trauma may be to blame.

HOW BIZARRE

## Explaining Henry VIII's erratic behavior

Hard knocks from jousting, hawking and horseback riding may have left Henry VIII with traumatic brain injuries that muddled his thinking. That suggestion, by Arash Salardini of Yale School of Medicine and colleagues, was published online February 5 in the *Journal of Clinical Neuroscience*. Head trauma may explain the British monarch's puzzling personality shift from a young charismatic king to a petty, cruel and capricious tyrant.

Long before football players had brain-damaging collisions (*SN: 6/14/14, p. 12*), people were sustaining head hits in other ways, the researchers note. And Henry had some doozies, historical records show. Several hard jousting knocks and a fall into a soggy ditch (the unfortunate result of a vaulting pole malfunction) left Henry dazed and, in one case, unable to speak for two hours. Memory problems, explosive anger and headaches could be explained by brain injuries. Other ailments including syphilis, Cushing's syndrome, diabetes and even a leg injury have been floated to explain Henry's erratic behavior, but traumatic brain injury seems to make the most sense, the researchers write. — *Laura Sanders*

off the upper layer of the rainforest.... On the positive side, we're sure we have a new species."

Tan comments: "That's how you do science — by mucking about in a vast rainforest with both beautiful and unpleasant conditions, all the while ... attuned to the smallest details that make up what we meant by uniqueness."

Tan knows the explorers and has let one of their lab leeches stroll on her skin (it did not bite). In the scientific paper christening Tan's namesake, *Chtonobdella tanae*, Siddall and his coauthors thank Tan for her support and her companionship on nature explorations.

"I spent quite a bit of time reading the paper," she writes, "and in doing so, I learned a few useful words, like annulate, epididymal, gonopore and nephridial."

Then, out-sciencing most news accounts of the *C. tanae* leech, Tan describes its features (without using epididymal or nephridial even once).

The first clue to its uniqueness, she notes, were the four rings on each body

segment instead of the normal five for the known leeches of the area. It's a hermaphrodite like other leeches, but with some unusually placed sexual organs. The leech has five pairs of eyes, two cutting-blade jaws, instead of the more typical three, and "the digestive tract has some neat features..." (Paper coauthor Michael Tessler, also at

AMNH, explains: The end of the digestive tract "is twisty and turny and doubles back on itself," startling anatomy for a leech.)

Tan adds, "I do know that it is not simply the leech that is special... It is also the way

in which it was thoroughly identified." *C. tanae*, only a few squishy millimeters wide, would have been a challenge to dissect without distorting internal organs, so the scientists developed ways to prepare a specimen so that CT scans can highlight subtleties of its innards. "It's a method that will be used with many specimens, maybe even those from a hundred years ago," Tan writes.

She signs off by adding, "Am I thrilled that this leech bears my name? You bet." — *Susan Milius*



Amy Tan



THE -EST

## Tailored Egyptian dress is the oldest ever found

It's the ultimate in retro fashion — an Egyptian woven dress (at least its remaining top half) that is now considered the oldest known piece of cut, fitted and tailored clothing. Radiocarbon dating puts the dress, recovered from an ancient Egyptian cemetery called Tarkhan, at between 5,100 and 5,400 years old.

Analysis of a 2-centimeter-long thread from the V-necked, linen dress with pleated sleeves yielded the age estimate. Examples of similar, floor-length Egyptian dresses date to nearly 5,000 years ago, says archaeologist Alice Stevenson, curator of University College London's Petrie Museum of Egyptian Archaeology, home to the Tarkhan Dress.

Stevenson and Michael Dee of the University of Oxford report the garment's age in the February *Antiquity Project Gallery*.

Stevenson suspects a socially elite woman wore the Tarkhan Dress shortly before Egypt's first dynasty of kings appeared around 5,100 years ago. Tailored clothes might have been made even earlier. Tailors and other craft specialists emerged in societies where royals sought prestige goods, Stevenson suggests. Comparably old woven fabric from Jordan and Peru was draped or wrapped around the body, rather than cut to fit, she adds.

— *Bruce Bower*

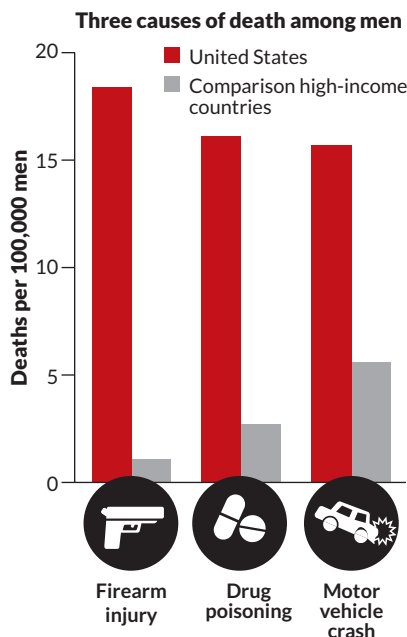
### SCIENCE STATS

## Living a shorter life

Guns, drugs, cars. Sounds like a formula for an action movie, but the list may explain why American men don't live as long as men in other high-income countries.

In the United States, average life expectancy among men is 76.4 years — about two years shorter than men who live in Germany, Sweden, the United Kingdom and nine other countries. Deaths due to injuries are the reason for much of the gap, researchers report in the Feb. 9 *JAMA*.

An analysis of U.S. and World Health Organization data revealed that deaths from injuries due to firearms, drug poisonings and auto crashes account for 48 percent of the difference in men's life expectancies. These causes of death are less of a problem for American women, the researchers found. — *Meghan Rosen*



SOURCE: A. FENELON, L.-H. CHEN AND S.P. BAKER/JAMA 2016



## BODY & BRAIN

# Malnutrition tied to lack of microbes

Proper mix of gut bacteria could help kids with poor diets

BY MEGHAN ROSEN

In children suffering from malnutrition, the right mix of microbes might be what's missing.

The bacteria living in kids' guts play a starring role in growth and development, three new studies published in *Science* and *Cell* suggest.

Food matters, too, but not as much as people once thought, says biologist Brett Finlay of the University of British Columbia in Vancouver, who was not involved in the new work. "People used to think if you just fed the kids they'd be fine," Finlay says. "But that didn't work." Instead, certain gut microbes might be needed to protect children suffering from poor diets. "It's extremely exciting," he says. "We know what causes malnutrition, and maybe now we can do something to fix it."

Each year, malnutrition contributes to the deaths of more than 2 million children worldwide. Millions of others survive, but a lack of calories or nutrients can stunt growth, delay brain development and harm the immune

system. Even after they receive adequate food, many of these kids don't bounce back, Finlay says. "Everyone's been kind of puzzled about why."

In recent years, scientists have seen several hints that microbes might have something to do with it. But no one knew if microbes could actually treat malnutrition, and if so, which strains of bacteria would help.

Biologist François Leulier and colleagues report in the Feb. 19 *Science* that they discovered the helpfulness of one microbe, a strain of *Lactobacillus plantarum*. The team fed two types of young mice — either with or without gut bacteria — a poor diet until young adulthood and measured the mice's development. "We started to see these amazing features in juvenile growth," says Leulier, of the Institute of Functional Genomics of Lyon in France. "The germ-free animals are stunted completely." Mice with gut microbes, on the other hand, were bigger all around: bones, organs and body size. Gut microbes give mice the green light to grow by cranking up production of a growth hormone called IGF-1, the team discovered. Just one strain of *L. plantarum* can do the job.

The strain's growth-boosting effects, even in the face of a poor diet, give Leulier hope for treating malnutrition — though that day is still a long way off. "We can envision some therapy solutions," he says, "but we're still at the basic research level."

A study of young Malawian children turned up more potentially helpful microbes, says physician and microbiologist Jeffrey Gordon of Washington University in St. Louis. He and col-

leagues analyzed gut bacteria of healthy and malnourished babies. Kids of similar ages typically share similar sets of bacteria, Gordon and colleagues have found. But malnourished Malawian babies had a microbial mix that resembled that of even younger babies, the team reports in the Feb. 19 *Science*. In 2014, Gordon's team reported similar "immature" microbiomes in malnourished Bangladeshi kids (*SN Online*: 6/4/14). These stunted microbiomes may be a universal red flag for poor nutrition. And they could be part of what's making malnourished kids so sick.

Germ-free mice that receive these kids' microbes don't grow as well as mice that get microbes from healthy kids. But supplementing the runty mice with two additional bacterial species, *Ruminococcus gnavus* and *Clostridium symbiosum*, can help solve the problem, the researchers discovered: The mice begin to grow again.

Like the work of Leulier's team, Gordon's findings hint at a potential treatment for malnutrition.

"It's the first step in the journey," he says. His team also wants to find foods that nourish healthy microbiomes.

The researchers have already had some success. In a separate study, they analyzed breast milk of Malawian mothers who had either healthy or stunted infants. Mothers with healthy babies had breast milk full of carbohydrates that contained a chemical called sialic acid, the team reports in the Feb. 25 *Cell*. These carbs could be key for normal growth.

But it's not easy to get enough human breast milk to manufacture large quantities of these carbohydrates, Gordon says, so the researchers turned to a cheese company in California. They purified structurally similar carbohydrates from whey, a by-product of making cheese from cow milk. Cow carbs boosted growth of mice and piglets with bad gut microbes, the team found.

Taken together, the new studies underscore microbes' contribution to human development, Gordon says.

Finlay agrees: "We know microbes play a major role in obesity, but this really confirms their role in malnutrition." ■



Bacteria living in the gut are essential for young animals' growth. Mice with certain bacteria (left) grow bigger than mice lacking the bacteria (right), new research shows.



Jupiter, seen in this Hubble Space Telescope image, might have once robbed the inner solar system of planet-building material, new simulations show.

ATOM & COSMOS

## Jupiter could have formed near sun

Scenario would explain why inner solar system has just 4 planets

BY CHRISTOPHER CROCKETT

A wandering baby Jupiter could help explain why there are no planets closer to the sun than Mercury and why that innermost planet is so tiny, a new study suggests.

Jupiter's core might have formed close to the sun and then meandered through the rocky planet construction zone. As the infant Jupiter moved, it would have absorbed some planet-building material while kicking out the rest. This would have starved the inner planets — Mercury, Venus, Earth and Mars — of raw materials, keeping the planets small and preventing any other planets from forming close to the sun. Planetary scientist Sean Raymond and colleagues propose the scenario online March 5 in *Monthly Notices of the Royal Astronomical Society*.

"When I first came up with it, I thought it was ridiculous," says Raymond, of the Laboratory of Astrophysics of Bordeaux in Floirac, France. "This model is kind of crazy, but it holds up."

Rocky planets snuggled up to their suns are common in our galaxy. Many systems discovered by NASA's Kepler

space telescope have multiple planets — several larger than Earth — crammed into orbits smaller than Mercury's. Though Kepler is biased toward finding scrunched-up solar systems, researchers wonder why there is a large gap between the sun and Mercury.

Scientists suspect that the inner planets of our solar system formed roughly 4.6 billion years ago from a belt of debris that stretched between the current orbits of Venus and Earth. Mercury and Mars were built out of material along the edges of this belt, which explains why they are relatively small. Jupiter, traditionally thought to have formed much farther out, gets the blame for creating the belt's outer edge. What shaped the inner edge has remained difficult to explain (*SN Online*: 3/23/15).

Raymond and colleagues ran computer simulations to see what would happen to the inner solar system if a body with three times the mass of Earth started inside Mercury's orbit and then migrated away from the sun. The researchers found that if the interloper didn't move too fast or too slow, it would sweep clean the innermost parts of the

disk of gas and dust that encircled the young sun and leave just enough material to form the four rocky planets.

Raymond and colleagues also discovered that young Jupiter could have corralled enough debris to form a second core — one that got nudged away from the sun as Jupiter migrated. This second core could be the seed that grew into Saturn, the researchers suggest. Jupiter's gravity could have dragged debris to the asteroid belt, too. Raymond says that process might explain the origin of iron meteorites, which some researchers argue should have formed closer to the sun.

Jupiter plowing through the inner solar system sounds plausible, says Sourav Chatterjee, an astrophysicist at Northwestern University in Evanston, Ill. "But there are several ways this can go wrong."

Building the rocky core of a giant planet inside the orbit of Mercury is not hard, he says. Pebbles and boulders in the nascent solar system probably drifted inward. They could have piled up close to the sun where solar magnetic fields created turbulence that trapped infalling material. If just a fraction of this debris stuck together, a rocky orb a few times as massive as Earth could form.

Having proto-Jupiter wander to the outer solar system, however, is asking a lot, Chatterjee says. Gravitational interactions with spiral waves in the gas and dust of the disk that surrounded the sun can propel a newborn planet either inward or outward. But how fast, how far and in which direction the planet travels depends on properties such as disk temperature and density, which Raymond and colleagues readily acknowledge. Their simulations assume and simplify disk characteristics to see if building the solar system inside-out is even plausible.

"We're building up a logical chain that shows [this idea] is not completely crazy," Raymond says. "We're not saying it happened. Just, if it happened, what would it do?" ■

## HUMANS &amp; SOCIETY

# Psychology's replication crisis debated

Analyses of reproducibility review reach conflicting conclusions

BY BRUCE BOWER

Psychology got rocked last year by a report that many of the field's published results vanish in repeat experiments. But that disturbing study sounded a false alarm, a controversial analysis finds.

The original investigation of 100 studies contained key errors, contend Daniel Gilbert, a Harvard University psychologist, and colleagues. After correcting for those errors, the effects reported in 85 of those studies appeared in replications conducted by different researchers. So an initial conclusion that only 35 studies generated repeatable findings was a gross underestimate, Gilbert's team reports in the March 4 *Science*.

"There's no evidence for a replication crisis in psychology," Gilbert says.

Psychologist Brian Nosek of the University of Virginia in Charlottesville and other members of the group that conducted the original replication study (*SN: 10/3/15, p. 8*) reject Gilbert's analysis. The 2015 report provides "initial, not definitive evidence" that psychology has a reproducibility problem, the group writes in a response published in the same issue of *Science*.

"The very best scientists cannot really agree on what the results of the most important paper in the recent history of psychology mean," says Stanford University epidemiologist John Ioannidis. Researchers' assumptions and expectations can influence their take on any results, "no matter how clear and strong they are," he says.

The details of many repeat studies in the 2015 paper differed dramatically from initial studies, stacking the deck against achieving successful replications, Gilbert says. Replications often sampled different populations, such as substituting native Italians for Americans in a study of attitudes toward black Americans.

Many studies also altered procedures. One replication effort gave older children the relatively easy task of locating items on a small computer screen, whereas the original study gave younger children a harder task of locating items on a large computer screen.

Repeat studies also generally included too few volunteers to make a statistically compelling case that a replication had succeeded or failed, Gilbert says. Another problem was that each original study was replicated only once. Multiple repeats of a study balance out differences in study procedures and increase the number of successful replications, the scientists argue.

In a replication analysis that often amounted to a comparison of apples and oranges, at least 34 replication studies should have failed by chance, assuming all 100 original studies described true effects, Gilbert and colleagues estimate. That makes the new estimate of 85 successful replications even more impressive, they say.

Nosek's group calculates that only about 22 replication attempts in the 2015 study should have failed by chance. Tellingly, Nosek says, even successful replications found weaker statistical effects than the original studies had. Published studies make statistically significant findings look unduly strong, he says. Journals usually don't publish replication failures and many researchers simply file them away.

A separate analysis of Nosek and his group's work suggests that initial study samples need to be beefed up before any conclusions can be made about the durability of psychology results. Failures to replicate in the

2015 investigation largely occurred because many original studies contained only enough participants to generate weak but statistically significant effects, two psychologists assert online February 26 in *PLOS ONE*. Journals' bias for publishing only positive results also contributed to replication failures, report Alexander Etz, at the University of Amsterdam at the time of the study, and Joachim Vandekerckhove of the University of California, Irvine.

Etz and Vandekerckhove statistically analyzed 72 papers and replication attempts from Nosek's project. Only 19 original studies contained enough volunteers to yield a strong, statistically significant effect. That's not enough adequately sized studies to generalize about the state of replication in psychology, the researchers say.

Researchers in psychology and other fields need to worry less about reproducing statistically significant results and more about developing theories that can be tested with a variety of statistical approaches, argues psychologist Gerd Gigerenzer of the Max Planck Institute for Human Development in Berlin. Statistical significance expresses the probability of observing a relationship between two variables — say, a link between a change in the wording of a charitable appeal and an increase

in donations — assuming from the start that no such relationship exists. But researchers rarely test any proposed explanations for statistically significant results.

Pressures to publish encourage researchers to tweak what they're studying and how they measure it to ensure statistically significant results, adds Gigerenzer. Journals need to review study proposals before any experiments are run to discourage such "borderline cheating," he recommends. ■

"The very best scientists cannot really agree on what the results of the most important paper in the recent history of psychology mean."

JOHN IOANNIDIS



# Affordable Hearing Aid Technology Only \$299!

Learn about our great digital technology at an affordable price.

## The Revolutionary HCX!

- ▶ Digital sound processing chip provides **crystal clear sound** and **makes speech easier to understand** without feedback
- ▶ Multiple memory programs **adapt to most listening situations**
- ▶ Nearly invisible thin tube design
- ▶ Long lasting size 13 batteries and a **low battery warning**
- ▶ 10 bands of layered noise reduction helps to **emphasize voices while balancing out background noise**
- ▶ **100% Money Back Guarantee**

## 5 Star Reviews! ★★★★★

**They Are Fantastic!** "I just received my HCX hearing aids and they are fantastic. Advanced Affordable is far superior and far more affordable!" - **Chuck D.**

**Wonderful Company!** "I will definitely recommend your company to my patients." - **Dr. Arun P.**

**Extremely Satisfied!** "I am delighted with the HCX hearing aid. I bought a pair and I can finally hear so much better, in any situation! I cannot believe the low price I paid for so much improvement. And the batteries last such a long time!" - **Ralph H.**



- A) Microphone  
B) Volume Control Wheel  
C) Program Button  
D) Long Lasting Battery  
E) Digital Signal Processor  
F) Receiver (Speaker)  
G) Sound Tube

More Technical Information At:  
[www.AdvancedHearing.com/S64](http://www.AdvancedHearing.com/S64)

## Digital Hearing Aid Technology... For Only \$299!

All hearing aids work the same way. The **microphone** picks up the sound and sends an electrical signal to the digital signal processor. The **digital signal processor** is the "brains" of the hearing aid. It takes the sound it receives and adjusts the sound to amplify important speech sounds as well as filtering out unwanted noise. (To ensure the best in quality, our digital processor is designed and manufactured right here in the **United States**.) Once the processor has amplified the sound, it is passed to the **receiver** (also known as the speaker) which emits a corrected and amplified sound through the **sound tube** into your ear.



Most importantly, your new HCX hearing aids work at a **fraction of the cost** of name-brand hearing aids. In addition to the technical components of the hearing aid, you also have a **volume control** that can be modified with a light touch of the finger. Your new hearing aids come with **3 different audio programs** that help you listen in different sound environments. You will love the Open-fit design, that is so light you probably won't even feel that you are wearing your hearing aids – you'll just be hearing clearly!

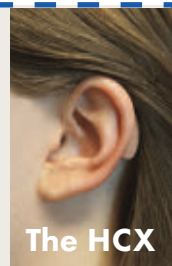
You can spend thousands for a high-end hearing aid or you can spend **just \$299** for a hearing aid that just plain works (**only \$279 each when you buy a pair**). We are so sure you will love our product, that we offer a **100% Money Back Guarantee - Risk Free** if you are not satisfied for any reason. It's time to get great digital technology at an affordable price!

**BUY A PAIR AND SAVE \$40!**

**1-888-448-4960**

**Free 1 Year Supply Of Batteries!**

**\*Use Coupon Code When You Order: S64**  
(Coupon Code & Price Valid For A Limited Time Only)



 **Advanced Affordable Hearing**  
Affordable Quality Since 1996!



**FDA**  
REGISTERED

Visit and Save: [www.AdvancedHearing.com/S64](http://www.AdvancedHearing.com/S64)

## EARTH &amp; ENVIRONMENT

# Tipping point for ice sheet looms

Antarctica's past may be a guide to future melting

BY THOMAS SUMNER

Assembling a detailed timeline of the Antarctic ice sheet's inception around 34 million years ago, scientists have identified a carbon dioxide "danger zone" that could trigger the ice sheet's demise.

Based on CO<sub>2</sub> levels at the time the ice sheet formed, the researchers report that Antarctica's ice will be "dramatically" more vulnerable to melting once CO<sub>2</sub> surpasses 600 parts per million in the atmosphere. Concentrations of the greenhouse gas reached 400 ppm last year, well above its 280 ppm preindustrial level.

"With present-day emission rates, it's expected that we'll reach 600 ppm before the end of this century," says Simone Galeotti, a paleoclimate scientist at the University of Urbino in Italy. The ice sheet stockpiles enough water to raise sea levels by about 60 meters and reshape Earth's coastlines.



A new record of the Antarctic ice sheet's formation suggests that carbon dioxide levels in the atmosphere could soon reach a tipping point that will make the ice sheet more vulnerable to melting. That includes ice in East Antarctica, such as Matushevich Glacier (shown).

The new work, published online March 10 in *Science*, provides the best estimate yet for the CO<sub>2</sub> threshold that fostered the Antarctic ice sheet's formation, says Galeotti, a coauthor of the study. Scientists previously traced the ice sheet's beginnings using indirect measurements such as falling sea levels. But those methods aren't definitive.

Galeotti and colleagues studied a roughly 900-meter-long ocean sediment core drilled in 1999 off the coast of East Antarctica. The core provided a detailed record of the Antarctic ice sheet's size from around 34 million to 31 million years ago. As the ice sheet expanded, sediments piled up along its

outermost edge. Using the sediment core, the researchers discovered that the ice sheet formed in two stages.

When CO<sub>2</sub> levels fell below 750 ppm and the Antarctic ice first appeared 34 million years ago, the ice sheet was small and only on land, the researchers find. Susceptible to fluctuations in the amount of solar heat that warmed Earth, this early ice sheet underwent large-scale changes in size.

Once CO<sub>2</sub> dropped below 600 ppm around 32.8 million years ago, the ice sheet became more resilient to climate change and expanded in size, lowering global sea levels. If CO<sub>2</sub> levels once again rise above 600 ppm, the Antarctic

## HUMANS &amp; SOCIETY

# Raw meat, tools drove facial evolution

Advantages of slicing food led to *H. erectus*' small teeth, jaws

BY BRUCE BOWER

Early members of the human genus had a flair for preparing sliced wild game tartare, a new study suggests. That meaty diet may have literally changed the face of *Homo* evolution and enabled advances in talking and walking.

By 1.8 million years ago, *Homo erectus* sliced up raw meat with stone tools before eating it, say Harvard University paleoanthropologists Katherine Zink and Daniel Lieberman. It was a momentous move, making it possible to consume more calories while reducing chewing effort, the researchers report online March 9 in *Nature*. Faces and jaws

got smaller while an energy-rich diet allowed brains and bodies to enlarge.

Evolutionary shrinkage of jaw bones and chewing muscles affected other parts of the body, the scientists say. An expanded vocal tract boosted the ability to make speech sounds. And a repositioned spinal cord, resulting from realignment of the base of the skull, increased the ability to walk and run long distances.

Cooking made it even easier to chew and digest meat and plants, Zink and Lieberman say. But they estimate that hominids began to regularly cook only about 500,000 years ago. Cooking stimulated further jaw and facial shrinkage in

*Homo sapiens*, but not, as has been suggested, in *H. erectus* (*SN Online*: 8/22/11), Zink and Lieberman say. Instead, a taste for sliced, raw meat got those facial changes off to a fast start in *H. erectus*.

Researchers have long noted that *H. erectus* skulls display relatively smaller jaws and faces than hominid species that preceded the *Homo* genus.

Using modern-day humans, Zink and Lieberman analyzed muscular effort and number of chews needed before swallowing different foods. A total of 34 adults chewed standardized portions of goat meat or three starch-rich plants — jewel yams, carrots and red beetroots. Food came either unprepared, pounded with a stone to soften it, sliced or cooked.

After an average of 40 chews, participants still couldn't break apart 3-gram chunks of raw or cooked goat meat. Slices

ice sheet will again become vulnerable to rapid melting, the researchers warn.

“As we go forward to a warmer world, we’re essentially running this in reverse,” says Thomas Wagner, a cryosphere scientist at NASA headquarters in Washington, D.C., who was not involved in the research. “This work shows us what the world looked like back then that we’re now heading toward.”

But Caroline Lear, a paleoclimate scientist at Cardiff University in Wales, says the 600 ppm threshold may not hold true in reverse. “Antarctica was different 34 million years ago,” she says.

Lear and Dan Lunt, a paleoclimate scientist at the University of Bristol in England, published a perspective piece on the research, also in *Science*. The work does reinforce the notion that dwindling atmospheric CO<sub>2</sub> facilitated the ice sheet’s formation, Lunt says. The expanding ice sheet may have in turn lowered CO<sub>2</sub> levels. Ice reflects sunlight that would otherwise warm the ground. This mirror-like effect could redirect winds and ocean currents, possibly boosting the drawdown of CO<sub>2</sub> into Earth’s oceans. Understanding these interactions will help scientists better predict how Antarctica’s ice will fare in the future, he says. ■

of raw meat, however, required an average of about 31 chews to break into pieces that could be easily swallowed and digested.

If one-third of total calories came from sliced meat, and the remaining calories came from stone-pounded plants such as jewel yams, *H. erectus* would have needed to chew its food 17 percent less often — more than 2.5 million fewer chews per year — and 26 percent less forcefully than if only consuming unprepared plants, the scientists estimate.

The study provides the first evidence for a decades-old assumption that tool-assisted meat eating prompted the evolution of smaller faces in early *Homo*, says Manuel Domínguez-Rodrigo, a paleoanthropologist at Complutense University of Madrid. “The key is the consumption of sliced meat, enabled by the use of stone tools.” ■

## BODY & BRAIN

# Molecules reverse antibiotic resistance

Genetic oddity exploited to restore drugs’ power against MRSA

BY SARAH SCHWARTZ

Even superbugs have their kryptonite.

Two types of lab-made molecules make drug-resistant bacteria susceptible to antibiotics again, researchers report in the March 9 *Science Translational Medicine*. The discovery could provide new tools in the fight against microbes such as methicillin-resistant *Staphylococcus aureus*, which causes serious infections.

MRSA and related resistant bacteria can withstand a group of antibiotics called beta-lactams, which includes penicillin and methicillin. “There’s this notion in the pharmaceutical industry that all the low-lying fruits in terms of discovery of antibacterials have been identified,” says Shahriar Mobashery, a biochemist at the University of Notre Dame in Indiana who was not involved with the study. “So any molecule that has the ability to resurrect beta-lactams, which are proven to be good antibacterials... would be fantastic.”

MRSA is vulnerable to beta-lactams when the bacterium’s ability to make a building block for its cell wall is disabled. Scientists at Merck Research Laboratories searched for molecules that interfered with the genes responsible for that building block, called wall teichoic acid.

A genetic oddity provided the team with a trick for identifying promising compounds. Blocking genes involved in either an early or a late stage of making teichoic acid foils the acid’s production. But hampering only early-stage genes won’t limit bacterial growth, while hindering late-stage genes forces MRSA to stop growing. Strangely, though, the growth-halting effects of blocking a late-stage gene disappear if an early-stage gene is blocked at the same time.

The team used this trick to find

early-stage gene blockers that would restore beta-lactams’ powers against MRSA. Such molecules wouldn’t need to be approved as antibiotics, as they don’t impede or kill bacteria. After treating MRSA cells with a known late-stage gene blocker to halt the superbug’s growth, the researchers tested millions of molecules, searching for compounds that reversed this effect and let the microbes grow again. That renewed growth was the calling card the researchers needed to know they’d found an early-stage gene blocker.

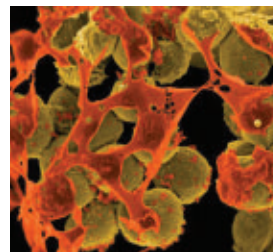
Less than 0.2 percent of the 2.8 million molecules the team tested had any effect

on growth. But two molecules successfully blocked the early-stage gene and hindered teichoic acid production. A chemically tweaked version of one of these molecules made 82 percent of tested MRSA strains vulnerable to a beta-lactam antibiotic. The molecule-antibiotic combination reduced the number of MRSA bacteria in infected mice, and the

new compounds appeared to be nontoxic.

The team has filed patents on the new compounds and close chemical relatives, says study coauthor Terry Roemer, a Merck geneticist in Kenilworth, N.J. But the study’s larger significance is conceptual, because it shows the value of targeting genetic relationships to find ways to combat resistance, he says. “I hope it inspires others to look more closely at other pathways to see whether a similar sort of genetic phenomenon occurs.”

Mobashery says the study is exciting because it could provide another weapon for combating serious bacterial infections. “Whether we are successful in the next 100 years in having effective strategies against pathogenic bacteria... comes down to whether we can have multiple classes of antibacterials,” he says. ■



Two types of lab-made molecules that interfere with the cell wall made methicillin-resistant *Staphylococcus aureus* (yellowish circles) sensitive to antibiotics again.



## EARTH &amp; ENVIRONMENT

# Old shipwrecks tell hurricane tales

Frequency of Atlantic storms declined during 'Little Ice Age'

BY THOMAS SUMNER

Using records of ships wrecked by Atlantic hurricanes dating as far back as the days of Christopher Columbus, researchers have extended the hurricane record by hundreds of years. The researchers estimate that hurricane frequency was one-fourth the long-term average in 1645 to 1715 — a period known as the Maunder Minimum, when the sun dimmed to its lowest recorded brightness.

"We didn't go looking for the Maunder Minimum; it just popped out of the data," says study coauthor Valerie Trouet, a paleoclimate scientist at the University of Arizona in Tucson.

The findings should help scientists better predict how hurricanes will behave under climate change, the researchers report online March 7 in the *Proceedings of the National Academy of Sciences*.

Detailed hurricane observational records go back to 1851. Scouring an

Atlantic shipwreck catalog, Trouet and colleagues identified more than 650 Spanish ships sunk by hurricanes from 1495 through 1825. The researchers bridged the shipwreck and observational records using tree rings from slash pines (*Pinus elliottii*) from the Florida Keys that date to as early as 1707. Hurricane damage stunts tree growth, narrowing the annual rings. All three records agreed, allowing the researchers to stitch together one long hurricane frequency record.

The number of hurricane-caused shipwrecks during the Maunder Minimum, which makes up a large portion of a period nicknamed the "Little Ice Age," was less than a third the number of wrecks in the preceding decades. A hurricane slowdown during the solar dim period makes sense, Trouet says. Warm seawater fuels hurricanes. As temperatures dropped during the Maunder Minimum, less heat was available to power storms.

The finding doesn't mean that global warming will increase hurricane frequency, says Gabriel Vecchi, an oceanographer at the National Oceanic and Atmospheric Administration's Geophysical Fluid Dynamics Laboratory in Princeton, N.J. Although both solar



Florida slash pines grow more slowly after being ravaged by a hurricane. Narrower tree rings, along with observational and old shipwreck data, allowed scientists to retrace hurricane activity back hundreds of years.

brightness and heat-trapping greenhouse gases cause warming, their effects on hurricanes "aren't perfect analogs," he says.

Still, the new data can provide a test for climate simulations, Vecchi says. "We can ask a model, 'When we give you less sun, what do you do?' If it doesn't give us fewer hurricanes, we can then ask why. This gives us something to aim at." ■

## ATOM &amp; COSMOS

# Repeating fast radio bursts recorded

Signals may help scientists identify sources of mysterious blasts

BY CHRISTOPHER CROCKETT

Fast radio bursts from deep space have never been seen to repeat — until now.

Ten blasts of radio waves recorded last May and June all come from the same direction, researchers report online March 2 in *Nature*. So did a signal detected in 2012, say Laura Spitler, an astrophysicist at the Max Planck Institute for Radio Astronomy in Bonn, Germany, and colleagues. All 11 signals were detected at the Arecibo Observatory in Puerto Rico.

Fast radio bursts, or FRBs, last a few milliseconds and, except for one, appear

to originate in other galaxies (*SN: 8/9/14, p. 22*). For the repeater, each of the signals encountered the same amount of intergalactic plasma, meaning they traveled the same distance. That shared feature makes an ironclad case for a common source, says Duncan Lorimer, an astrophysicist at West Virginia University in Morgantown and codiscoverer of the first FRB, reported in 2007. The question now is what fraction of sources repeat, he says. There may be multiple classes of FRBs, with some recurring and some not, each triggered by something different.

Explanations for what might cause

FRBs have included colliding stellar cores, overzealous pulsars and the collapse of obese neutron stars. One-off scenarios such as collisions won't apply to repeaters. More likely sources are radio eruptions from various types of neutron stars, such as pulsars and magnetars. Pulsars emit a steady beat of radio waves, but some young pulsars, such as the nearby Crab pulsar, occasionally blast out vigorous pulses. Radio telescopes could detect such large blasts from another galaxy, Spitler says.

With a known repeater, a facility like the Very Large Array near Socorro, N.M., could stare at the same patch of sky, wait for the next eruption and identify the host galaxy (*SN Online: 3/2/16*). "It's a wake-up call that there's a lot we can do with existing FRBs," Lorimer says. ■

# Jomira's Best Sellers, Great Items, Great Prices

•But read this entire ad for an even better deal!

*The spy glass that made naval history...*

## ADMIRAL FARRAGUT'S TELESCOPE

(with table top tripod)  
from us only \$69.95\*

• The optics of Admiral Farragut's Telescope are 25x30. This means that you get 25x magnification and the great light-gathering capacity of a 30mm objective lens. The scope is fully chromed (over brass) for extra beauty, protection and durability.



When Admiral Farragut fought his legendary naval battles he used a telescope just like this to monitor the movements of the enemies' fleets. This beautiful optical instrument, a faithful replica of the famous original is about 5" long in its collapsed position and 13" when extended to full operating length.

Enlargement is 25x, which means that it brings everything 25-times closer, and in needle-sharp focus, than if viewed with the unaided eye. ADMIRAL FARRAGUT'S TELESCOPE comes with a belt-loop vinyl carrying case. There is also a table-top tripod for extended observations.

**You have seen such zoom binoculars advertised nationally for \$150...**

## 6x to 18x JOMIRAZOOMS

from us only \$99\*

• JomiraZooms focus smoothly from 6x to 18x or anything in between, letting you see unexpected details. Porro prism construction and ruby-coated lenses are the best in optical construction. The 18mm objective lenses provide high light-gathering capacity. JomiraZooms come with a belt-looped carry case and strap.



JOMIRAZOOMS are the absolutely ultimate in binoculars. They fit in your hand and weigh less than 7 ozs. But they pack an enormous wallop in their small body. Porro roof-prism construction and ruby-coated lenses guarantee pinpoint sharpness at any distance. The 18mm objective lenses provide great light-gathering capacity making JOMIRAZOOMS utterly reliable even in the dim light of dawn or dusk. The zoom lever lets you smoothly change the magnification from 6x to 18x or anything in between. Are you watching the pitcher's windup on 6x? Zoom to 19x and you may be able to tell whether he is throwing a fastball or a slider. There can be nothing more useful for sports, nature watching, navigation, and so many other pursuits. JOMIRAZOOMS is an instrument that should be in every home.

*The only universal optical instrument...*

## PANSCOPE

(the complete optical system)  
from us only \$59.95\*

• PANSCOPE is beautifully gift-boxed, comes with its neatly fitted leather case and with a plastic "tripod" for extended observations at 15x and 30x.



This is a little optical marvel. PANSCOPE (only 2" long) contains a complete optical system in its tiny body. You may use it as a 3x telescope or as a unique 3x telescope-loupe. In its magnifying mode, it delivers magnifiers and loupes at 5x, 10x, and 15x enlargement. And to top it all, it also functions as a 30x microscope of laboratory quality.

A special stand for long-term observation for 15x and 30x microscope is included.

This marvelous little instrument, developed in Wet-zlar (Germany), home of famous Leica cameras, is the product of one of Asia's finest makers. Its coated optics are of superb quality, delivering the image with brilliant luminosity, in needle-sharp focus, with absolute clarity and with full chromatic correction.

**Is this the famous Brand "X" watch that sells for over \$1,000?**

## No, it is the Argonaut™ Watch

- yours for only \$69



In contrast to many highly advertised watches, the Argonaut™ is not a mechanical watch. It is powered by an exquisite Japanese quartz movement. Besides the hands and the date disk, there are no moving parts. Nothing can go wrong or wear out. And no matter how many jewels they may have that inevitably happens with mechanical watches - sometimes as soon as within a year.

We guarantee the Argonaut™ for three full years. If you treat it reasonably well it should last you a lifetime. The Argonaut™ Watch is of solid stainless steel construction. It is guaranteed to be watertight to about 330 ft. You'll never dive that deep. Accuracy is guaranteed to 3 secs./month. You will need to change the battery in about two years. It shouldn't cost you more than \$5. The Argonaut™ Watch is a thing of rugged masculine beauty. It comes with a splendid adjustable stainless steel band.

# jomira

330 SW 43rd St., Ste. K 333, Renton, WA 98057

*Hold the whole world in your hand with...*

## JOMIRASCOPE

8 x 20 monocular  
from us  
only \$59.95



• The optics of Jomirascope are 8x20 - 8x magnification with 20 mm objective lens. It comes in a neat zippered carrying case. The objective lens can be used as an 8x magnifier. A 25x microscope attachment (\$29.95, 3 for \$59.90) is also available.

Jomirascope is so small that it fits unobtrusively in a man's coat pocket or a lady's purse. Yet it packs a tremendous wallop in its tiny body. Its 8 x 20 fully prismatic and hard-coated optics give you 8x magnification, with a remarkable field of 430 ft. at 1,000 yds. Its 20 mm objective lens affords unusual light gathering even at dusk or dawn. What was that rustling in the bushes? With JOMIRASCOPE you'll discover that it was an ivory-billed woodpecker. Do you wish to explore every feature on the moon? JOMIRASCOPE will be your instrument of choice. Much smaller than even "pocket" binoculars and with greater magnification than most, JOMIRASCOPE should be your constant companion. And do consider the 25x microscope attachment of laboratory quality, which makes JOMIRASCOPE a complete optical system.

**An incomparable timepiece, an incomparable value...**

## RADIO-CONTROLLED CLOCK

only \$59.95\*

• The sleek styling of R-C Clock makes it an adornment for any home or office. It works on one (included) AA-battery and is ready to go when you get it.



This beautiful clock is clad in brushed aluminum. Its sleek design makes it an adornment for any home or office. It measures 5-1/4" x 4" and can be set on your desk or hung on a wall. Time is displayed in inch-high digits. In addition to the time (hours, minutes, seconds), you also get the date, the day of the week, and the temperature in F (or in C). There is a melodious but insistent alarm, complete with snooze button for those extra winks. The clock is controlled by a radio signal emitted by a U.S. Government department; that ensures up-to-the-second accuracy.

RADIO-CONTROLLED CLOCK works on one AA-battery (included, of course). It's ready to go when you get it. You don't even have to set it - it sets itself.

**\*And here is our "special deal": You may buy any three of these items -- mixed or matched -- for the price of two. The least expensive item is on the house -- absolutely FREE!**

You may order by toll-free phone, by mail, and pay by check or AMEX/Visa/MasterCard. Please give order code shown. Add \$9.95 for ship./ins. for one and \$12.95 for three items, except one JomiraZooms or one Adm. Farragut's Telescope is \$12.95 and any three items containing one or more JomiraZooms or Adm Farraguts Telescopes is \$15.95. plus sales tax for WA delivery. You have 30-day refund and one-year warranty. We do not refund postage. For customer service or wholesale information, please call (425) 264-6393.

**We ship the same day we receive your order. Please give order code Z031!**

**Order by toll-free phone: 1-800/600-2777**  
**Visit our website at [www.jomira.com](http://www.jomira.com)**

## LIFE &amp; EVOLUTION

# Ants swayed by 6-legged social media

Colonies' collective choices change when scouts say 'follow me'

BY SUSAN MILIUS

Rock ants don't tweet, but they do recruit followers. And that social input can change the outcome of a group decision.

Colonies of *Temnothorax albipennis* ants decide as a group which craggy crevice to move into. They can even compare averages of a sort when choosing between nests that stay comfy for different proportions of time, an earlier study found. Yet such choices turn out differently if ants start leading nest mates to check out appealing sites, researchers say online February 8 in *Behavioral Ecology*.

"A small amount of social information can massively influence the outcome of a collective decision," says study coauthor Dominic Burns of the University of Bristol in England.

The Bristol lab of Nigel Franks has studied these small ants as examples of how social animals collectively make choices. In the basics of the process, "there are a lot of comparisons that can be made between collective decision making in humans and ants," Burns says. Analyzing decision making that evolution has honed in ants might spark insights into the human version, he says.

In picking nests, ants favor a dark crevice over one with light shining in. And narrow entrances appeal more than wide ones. Researchers have mixed those qualities to create ant nests with stable but "mediocre" conditions: unpleasantly constant light but an attractively narrow entrance. As an alternative to this stable site, researchers have offered colonies a changeable site with a not-great entrance and repeating 10-minute periods with some darkness and then bright light.

An earlier experiment with this setup found that ant colonies typically picked the stable site if the changeable site had only 2.5 minutes of darkness alternating with 7.5 minutes of light. But most colonies no longer preferred that stable site when the alternative was a better changeable site, with 7.5 pleasantly dark

minutes out of each 10-minute period.

For the most part, colonies reached their decisions as individual ants happened upon possible nesting sites without any guidance from nest mates and lingered longer in the more favorable nest. The decision to move into one site instead of the other solidified when a certain number of ants, a quorum, sensed each other poking around the same nest.

In the new study, Burns and colleagues set up the alternative nests far enough apart so ants didn't discover them rapidly without help. This slowdown evoked what's called tandem running: An ant that found a possible new nest site and judged it favorably led a nest mate over to take a look. In this scenario, ant colonies made different collective decisions.

Of 41 colony decisions, 40 favored the changeable nest even if it had only 2.5 minutes of darkness. The reason,

Burns says, is that ants finding the changeable site when it was good and dark were motivated to recruit a nest mate. Although on average only five tandem runs occurred per test, the influx eventually brought up ant numbers to the quorum threshold inside the changeable nests. In the nests with constant light, ants hardly ever even started to recruit a nest mate and the small number of explorers who discovered the nest on their own rarely reached the quorum threshold.

Whether the ants' decisions would prove wise choices in the real world is unknown, Burns cautions. In some other experiments, animals relying on information from neighbors have copied counterproductive choices, notes Guillaume Rieucan of Florida International University's campus in North Miami, who has studied collective decisions in fish and birds. Yet he knows of no experiments showing that blindly copying choices leads to full-blown cascades of dumb decisions among animals. Or not among animals other than humans. ■



## LIFE &amp; EVOLUTION

## Amber fossils give clues to lizard evolution

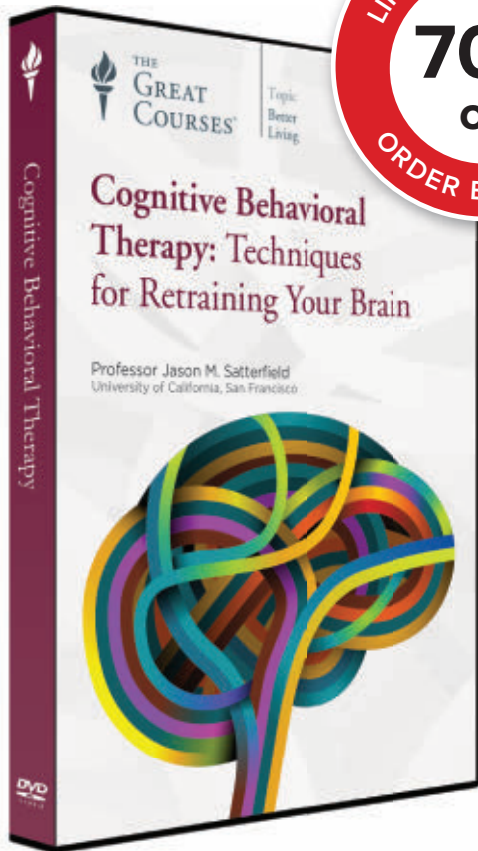
Some ancient lizards' bad luck has become a gold mine for scientists.

Reptilian remains in roughly 99-million-year-old amber provide unusually detailed insight into the evolutionary history of lizards, researchers report March 4 in *Science Advances*.

The 12 specimens, from Myanmar, hold parts of lizards that got trapped in tree resin. Amber-encased toe pads identified a few of the lizards as gecko ancestors. One of the preserved lizards may represent an intermediate form between known older relatives and modern geckos, the team says.

The skin and skeleton of a newborn lizard just over a centimeter long (shown above) is the most surprising fossil in the bunch, says study coauthor Juan Daza, a herpetologist at Sam Houston State University in Huntsville, Texas. A stout skull, big eye sockets and a short, curled tail suggest that the young lizard could be the oldest known relative of modern chameleons. — Sarah Schwartz





## Conquer Your Bad Thoughts and Habits

Why is it so hard to lose weight, stop smoking, or establish healthy habits? Why do couples argue about the same issues over and over? Why do so many people lie awake at night, stricken with worry and anxiety?

The answers to these questions—and the path to lasting change in your life—lie in cognitive behavioral therapy (CBT). Developed on a proven foundation of neurological and behavioral research, CBT is a well-tested collection of practical techniques for managing goal-oriented change. Build a toolkit of CBT techniques as you take on the role of medical student, physician, psychologist, and patient, and learn how to create lasting change in your life.

**Offer expires 04/17/16**

**THEGREATCOURSES.COM/8SN**

**1-800-832-2412**

## Cognitive Behavioral Therapy: Techniques for Retraining Your Brain

**Taught by Professor Jason M. Satterfield**  
UNIVERSITY OF CALIFORNIA, SAN FRANCISCO

### LECTURE TITLES

1. Cognitive Behavioral Foundations
2. Quantified Self-Assessment for Therapy
3. Setting Therapeutic Goals
4. Third-Wave Cognitive Behavioral Therapy
5. Stress and Coping
6. Anxiety and Fear
7. Treating Depression
8. Anger and Rage
9. Advanced Cognitive Behavioral Therapy
10. Positive Psychology
11. Healing Traumatic Injuries
12. Forgiveness and Letting Go
13. Digging Deep and Finding Meaning
14. Cognitive Behavioral Therapy and Medicine
15. Staying on the Wagon
16. Thinking Healthy: Weight and Nutrition
17. Behavioral Therapy for Chemical Addictions
18. Getting a Good Night's Sleep
19. Mastering Chronic Pain
20. Building and Deepening Relationships
21. Constructive Conflict and Fighting Fair
22. Thriving at Work through Behavioral Health
23. Developing Emotional Flexibility
24. Finding the Best Help

**Cognitive Behavioral Therapy:**  
Techniques for Retraining Your Brain  
Course no. 9631 | 24 lectures (30 minutes/lecture)

**SAVE UP TO \$190**

**DVD ~~\$269.95~~ NOW \$79.95**

**CD ~~\$199.95~~ NOW \$59.95**

+\$10 Shipping, Processing, and Lifetime Satisfaction Guarantee  
Priority Code: 126276

For over 25 years, The Great Courses has brought the world's foremost educators to millions who want to go deeper into the subjects that matter most. No exams. No homework. Just a world of knowledge available anytime, anywhere. Download or stream to your laptop or PC, or use our free mobile apps for iPad, iPhone, or Android. Over 550 courses available at [www.TheGreatCourses.com](http://www.TheGreatCourses.com).



EARTH &amp; ENVIRONMENT

## Ancient oceans were surprisingly cold

But isolated hydrothermal activity might have nurtured life

BY BETH GEIGER

About 3.5 billion years ago, Earth's oceans were cool, not inhospitably hot as previously thought. In fact, the entire planet was probably locked in a cold snap that lasted at least 30 million years, a new study concludes. The findings, published February 26 in *Science Advances*, could change the view of Earth's ancient climate and life's earliest years.

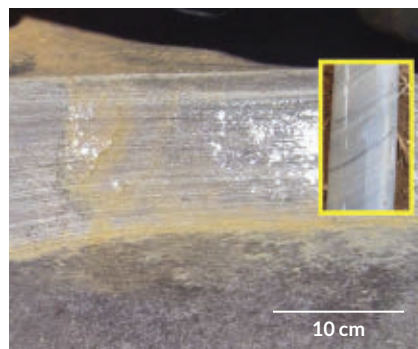
"This is the first evidence that over the entire [last] 3.5 billion years, Earth has operated within a temperature range that suits life," says Maarten de Wit, a geologist at Nelson Mandela Metropolitan University in Port Elizabeth, South Africa.

Evidence for this big chill was found in South Africa's Barberton Greenstone Belt, which contains some of the oldest, best preserved rocks on Earth. Along with Harald Furnes, a geologist at the University of Bergen in Norway, de Wit spent six years mapping and sampling the Barberton. The researchers studied volcanic rock and a kind of silica called chert that formed deep underwater. They also studied shallower sedimentary and volcanic rocks deposited roughly 30 million years after the deep ocean rocks.

De Wit and Furnes analyzed hundreds of rock samples for the concentration of

oxygen-18 isotopes, an indicator of what the temperature was like when the rocks formed. The researchers also found other temperature clues. In the younger rocks, they discovered diamictite, a clay-rich sedimentary rock typically formed in glacial environments. And in the older rocks, they found gypsum, which 3.5 billion years ago would have formed only in deep, cold seas. Together, these findings suggest that both the shallow and deep waters were cool. Ambient ocean temperatures must have been close to zero degrees Celsius, de Wit says.

Paleomagnetic data point to a colder-than-expected global environment, too, de Wit and Furnes found. As volcanic



Among the evidence pointing to cold oceans 3.5 billion years ago are varved sediments (shown). Varves are seasonal bands that typically form today when lakes freeze each winter.

Billions of years ago, localized hydrothermal activity, not globally warm oceans, heated and altered this South African chert (rocks in the foreground) that formed on the seafloor.

rock cools, minerals in the rock capture the prevailing magnetic pole direction, which reverses every few hundred thousand years. Scientists use the data to estimate the latitude at which rocks formed. In this case, the rocks bearing evidence of low temperatures formed near the tropics at a latitude of 20° to 30°. "Because there was ice near sea level at low latitudes," de Wit says, "the oceans and atmosphere were globally likely to be cold."

What's more, de Wit and Furnes figured out why previous researchers had interpreted ocean temperatures to be roughly 30° C to 80° C back then. Two periods of searing-hot hydrothermal activity had cooked both the seafloor cherts and the surface glacial sediments. In the older seafloor sediments from the Barberton, the team discovered hard evidence for hydrothermal vents. Earlier studies had focused mainly on oxygen isotopes from limited samples that happened to have been strongly affected by this hydrothermal activity, and those researchers had not recognized that the results revealed local, not ambient, ocean temperatures.

That, de Wit says, was like looking at data from Yellowstone hot springs and extending them to an entire ocean. By sampling a much broader area, he and Furnes determined that the superheating effects of hydrothermal activity had been strictly local. "You really have to map carefully and do a lot of isotope follow-up work to test it all," he says.

The study has implications for how life may have evolved. While hot oceans would have been largely inhospitable, de Wit says that hydrothermal fields in a cool ocean would have provided a nurturing environment, just as scientists see today around deep ocean hydrothermal vents.

"This study is quite significant," says Yale University geochemist Ruth Blake, who has also studied the Barberton. The researchers "present compelling new evidence that advances our understanding of one of the most highly debated periods in Earth's history." ■

# "To you, it's the perfect lift chair. To me, it's the best sleep chair I've ever had."

— J. Fitzgerald, VA

Easy-to-use remotes for massage/heat and recline/lift



Complete with battery backup in case of power outage

Sit up, lie down — and anywhere in between!

We've all had nights when we just can't lie down in bed and sleep, whether it's from heartburn, cardiac problems, hip or back aches – it could be a variety of reasons. Those are the nights we'd give anything for a comfortable chair to sleep in, one that reclines to exactly the right degree, raises feet and legs to precisely the desired level, supports the head and shoulders properly, operates easily even in the dead of night, and sends a hopeful sleeper right off to dreamland.

**Our Perfect Sleep Chair® is just the chair to do it all.** It's a chair, true – the finest of lift chairs – but this chair is so much more! It's designed to provide total comfort and relaxation not found in other chairs. It can't be beat for comfortable, long-term sitting, TV viewing, relaxed reclining and – yes! – peaceful sleep. Our chair's recline technology allows you to pause the chair in an infinite number of positions, including the Trendelenburg position and the zero gravity position where your body experiences a minimum of internal and external stresses. You'll love the other benefits, too: It helps with correct spinal alignment, promotes back

pressure relief, and encourages better posture to prevent back and muscle pain.

**And there's more!** The overstuffed, oversized biscuit style back and unique seat design will cradle you in comfort. Generously filled, wide armrests provide enhanced arm support when sitting or reclining. The high and low heat settings along with the dozens of massage settings, can provide a soothing relaxation you might get at a spa – just imagine getting all that in a lift chair! Shipping charge includes white glove delivery. Professionals will deliver the chair to the exact spot in your home where you want it, unpack it, inspect it, test it, position it, and even carry the packaging away! Includes one year service warranty and your choice of fabrics and colors. – Call now!

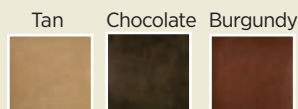
**The Perfect Sleep Chair®**  
Call now toll free for our lowest price.

Please mention code 103061 when ordering.

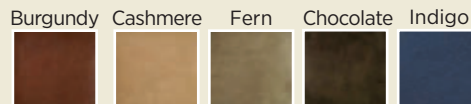
**1-888-757-0162**

46402

**Long Lasting  
DuraLux Leather**



**DuraLux II  
Microfiber**



This lift chair puts you safely on your feet!

© 2016 firstSTREET for Boomers and Beyond, Inc.



## HUMANS &amp; SOCIETY

## Ancient engraved pendant found in England

One of England's oldest known artworks turned up last year on a tiny piece of stone.

An engraved shale pendant unearthed at Star Carr, a site under excavation since 1947, dates to around 11,000 years ago, researchers report online February 25 in *Internet Archaeology*. The pendant, roughly the size and shape of a guitar pick, includes a carefully fashioned hole through which it may have been strung, say archaeologist Nicky Milner of the University of York in England and her colleagues.

Many of the pendant's etched lines are now barely visible. Microscopic analyses determined that the engraved pattern — which includes clusters of short lines connected to long lines — resembles etched designs on similarly aged amber pendants found in Denmark, southern Sweden and northern Germany.

Milner's group doesn't know who made or used the pendant, or what meaning the etched pattern had for its makers. One possibility is that the pendant belonged to a shaman. Headdresses made of red deer antlers found in earlier Star Carr excavations may have been worn by shamans, Milner says.

Star Carr has also yielded shale beads, a piece of perforated amber and two perforated animal teeth. Those finds contain no engravings.

Animal engravings and carved reliefs on the walls and ceilings of several British caves date to at least around 13,000 years ago. — *Bruce Bower*



An etched design on an 11,000-year-old pendant discovered last year is one of the oldest examples of art in England.

## LIFE &amp; EVOLUTION

### The dodo was no dummy

A 3-D model of the brain of the extinct dodo suggests that the bird may have been fairly intelligent — by bird standards.

Overhunting and habitat loss drove dodos (*Raphus cucullatus*) extinct about a century after humans invaded the birds' island home, Mauritius, in 1507. The flightless birds appeared unafraid of humans, hence their reputation for stupidity.

Researchers at the American Museum of Natural History in New York City and the Natural History Museum of Denmark performed CT scans on a dodo's skull and digitally reconstructed its outer brain.

Dodos had unusually large olfactory bulbs, which may have helped them sniff out fruit, tiny mollusks and insects. Overall, the ratio of the dodo's brain size to its body size — an indirect indicator of intelligence — is on par with that of its pigeon relatives, the team reports online February 23 in the *Zoological Journal of the Linnean Society*. — *Helen Thompson*

## EARTH &amp; ENVIRONMENT

### Ocean acidification worse than thought in Great Barrier Reef

The Great Barrier Reef is in worse shape than suspected thanks to ocean acidification, Mathieu Mongin of Australia's CSIRO and colleagues say February 23 in *Nature Communications*.

Driven by rising amounts of atmospheric carbon dioxide, acidification lowers seawater levels of the mineral aragonite, which corals use to build exoskeletons. Mongin's team used carbon, salinity and temperature data and simulations to estimate aragonite levels across the Great Barrier Reef's 3,581 individual reefs.

Aragonite levels drop by about 50 percent around individual reefs compared with levels in the open ocean, the analysis suggests. Those levels are more variable across the Great Barrier Reef than once thought. Because of ocean circulation patterns, northern reef corals use up resources and leave southern reef corals with less aragonite. — *Helen Thompson*

## GENES &amp; CELLS

## Humans compensate for missing genes

Many genes may be dispensable.

Each of 3,222 British people with Pakistani heritage carries, on average, mutations in 140 genes that stop those genes from working, researchers in England and the United States report online March 3 in *Science*. Examination of those people's exomes, the small portion of the genome that codes for proteins, revealed that among a subset of 821 participants, a total of 781 genes were rendered obsolete by "loss-of-function" mutations. Those genes include 422 that scientists didn't know people could live without and still be healthy.

Previous research had indicated that some genes are commonly missing in healthy people. The new study suggests that even rare mutations that disable both copies of a gene, something scientists thought would be associated with disease, aren't necessarily a problem.

The researchers also compared the health records of 638 study participants who have mutations that disable both copies of a gene with the records of 1,524 people who don't have such mutations. People with these rare mutations were no more likely to have health issues than those without, the researchers found.

Even really important genes may go missing with no harm. One woman had mutations in the *PRDM9* gene, which is important during the formation of eggs and sperm. Mice without their version of the gene are sterile. Dogs have a fallback mechanism to compensate for losing the gene. The woman had a child, indicating that she is fertile, so humans must have a way to compensate for the missing gene, too — though it appears to be different than dogs' way.

Compensatory mechanisms could complicate the search for genes responsible for rare genetic diseases, the researchers say. — *Tina Hesman Saey*

# Introducing the “*Just My Height*™” Adjustable Bed...

## A Recliner for The Bedroom

**NEW!**

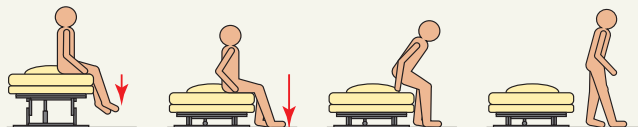


Sit-up, Lie down or anywhere in-between with just the touch of a button---for the most comfortable, restful night's sleep you've ever experienced.

Plus, it can be raised, or lowered(also with the touch of a button) to allow you to easily and safely enter and exit the bed.

Lately there has been a lot of press about the many benefits of a good night's sleep. When you wake up rested, everything from your memory and focus to your diet and stress levels can improve. Some even believe it can help you live longer. Unfortunately, many older Americans have to choose between comfort and safety in a bed. If it's too high or too low, getting in and out of bed (particularly in the middle of the night) can be dangerous. Hospital type beds feature adjustable heights and railings, but they are hardly comfortable. Now, thanks to innovative design and superior engineering, you get the best of both. Plus, with an infinite number of positions controlled by remote control, you can pick a custom position for sleeping, reading watching TV or just relaxing with your feet up! It looks just like a regular bed... not institutional, and the mattress is luxurious and features a natural bamboo quilted cover that's anti-bacterial, deodorizing and breathable.

Considering we spend (or should spend!) a third of our life sleeping, why spend another restless night or risk injury getting in and out of bed? Call now and find out more. Call today!



This height-adjustable bed raises or lowers to a level that makes it easier to glide into or out of bed—even when transferring from a wheelchair, rollator or walker. When you're ready to get up, you adjust the bed height with the wireless remote control until you can place both feet firmly on the floor. What a great aid to safety and independence! The mattress height adjusts from 28" to 18" and anywhere in between.

**Call now**  
to find out how you can get the

*“Just My Height”™*  
**Adjustable Bed**

Please mention code 103060  
call toll free for our lowest price

**1-888-205-5334**

© 2016 firstSTREET for Boomers and Beyond, Inc.

82902

## BODY &amp; BRAIN

## Preparations under way for cancer ‘moonshot’ launch

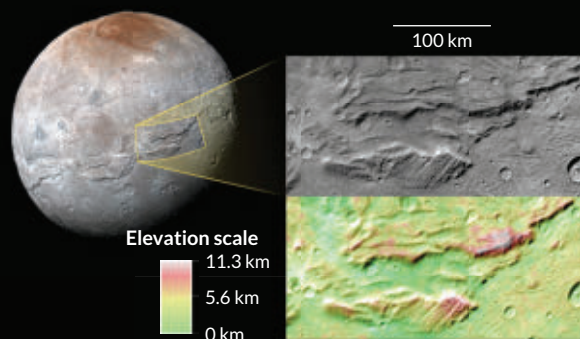
When President Barack Obama called for a cancer “moonshot” during his State of the Union address in January, the idea was big on vision and low on specifics. The goal, he said, was to make the United States “the country that cures cancer once and for all.” Details have begun to trickle out, but a true plan for launch won’t be ready until June.

In February, the White House released a list of cancer research areas to target. Many of those, such as therapeutic vaccines and cancer genomics, are already the subject of intense research. The administration also announced that the “initiative will begin immediately with \$195 million in new cancer activities at the National Institutes of Health” this year. Not all of that money is moonshot money, though.

Only \$55 million is earmarked to jump-start the new cancer initiative, Doug Lowy, acting head of the National Cancer Institute, part of NIH, noted February 24. The rest would be divvied up among new research project grants (\$80 million), given to 21 cancer research institutions (\$10 million) and used to cover such costs as rent and utilities (\$50 million).

More money may be on the way. Obama’s proposed 2017 budget (which faces congressional hurdles before approval) includes an extra \$680 million for NIH for cancer-related research, plus \$75 million for the U.S. Food and Drug Administration to try to speed the progress of cancer clinical trials.

It’s not known how that funding would be distributed. A yet-to-be-named panel of advisers will present recommendations in June. — *Laura Beil*



Parts of Charon’s surface, seen in this image from the New Horizons spacecraft, appear to have been pulled apart, possibly by the freezing and expanding of a subsurface ocean.

## ATOM &amp; COSMOS

## Charon’s rifts hint at ancient sea

Pluto’s largest moon, Charon, is busting at the seams, and an ancient subsurface ocean might be to blame.

Ridges and valleys more than 6 kilometers deep, seen during the July 14 flyby of the New Horizons spacecraft (SN: 12/26/15, p. 16), suggest that the moon swelled at some point in its past. The rifts could have been carved by a belowground ocean that froze and expanded, tearing apart the satellite’s surface, NASA announced February 18.

Today, Charon is laden with water ice. But long ago, heat left over from the moon’s formation and from the decay of radioactive elements could have melted some of the ice and sustained an underground ocean. As the moon cooled and the water froze, the ice would have expanded, creating the cracks.

One of these fractures is part of Serenity Chasma, the informal name for one of the longest series of chasms in the solar system. With a length of 1,800 kilometers, Serenity is about four times as long as the Grand Canyon. — *Christopher Crockett*

## LIFE &amp; EVOLUTION

### Mite-virus alliance targets bees

A mite and a virus are in cahoots in an attack on honeybee health.

The parasitic mite *Varroa destructor* feasts on bees of all ages and reproduces on developing bees. As the mite travels through bee colonies, it spreads deformed wing virus, which can cripple and ultimately kill bees. By suppressing a bee’s immunity, the virus may improve a mite’s ability to feed and breed on baby bees, researchers in Italy report online March 7 in the *Proceedings of the National Academy of Sciences*.

Italian honeybee larvae with high levels of viral infection make good mite breeding grounds, the team found. The number of mites that successfully laid eggs soared from 22 percent on bee larvae that developed normally to 40 percent on bees with

infections severe enough to cripple wings. Still, mite fertility decreased on bees with very high levels of viral infection. Understanding the complexities of this mite-virus collusion could help explain factors leading to colony losses and protect honeybees in the future. — *Sarah Schwartz*

## EARTH &amp; ENVIRONMENT

### 20th century sea level rose at fastest rate in millennia

Sea levels rose faster last century than during any time since Rome was founded around 2,800 years ago. Reconstructing past rises and falls in global sea levels, researchers estimate that more than half of the 13.8 centimeters of sea level rise recorded in the 1900s resulted from global warming effects, such as glacial melt. The work appears online February 22 in the *Proceedings*

of the *National Academy of Sciences*.

An international team of researchers analyzed a variety of measurements of ancient sea levels collected from 24 locations worldwide. The team calibrated the data using modern ocean tide measurements. Sea levels rose by about 0.1 millimeters per year from the first through the eighth centuries and fell around 0.2 millimeters per year during the 11th through 14th centuries. Around the start of the industrial revolution, sea levels rose abruptly, with about 1.4 millimeters of sea level rise per year in the 20th century.

Simulating sea level in the absence of global warming, the researchers estimate that the 20th century average rise would have been at most 0.7 millimeters annually. Rising sea levels worsen coastal flooding and threaten island nations.

— *Thomas Sumner*



# Guaranteed the most comfortable pillow you'll ever own!™

## How Well Did You Sleep Last Night?

Did you toss and turn all night? Did you wake up with a sore neck, head ache, or was your arm asleep? Do you feel like you need a nap even though you slept for eight hours? Just like you, I would wake up in the morning with all of those problems and I couldn't figure out why. Like many people who have trouble getting a good night's sleep, my lack of sleep was affecting the quality of my life. I wanted to do something about my sleep problems, but nothing that I tried worked.

## The Pillow Was the Problem

I bought every pillow on the market that promised to give me a better night's sleep. After trying them all, with no success, I finally decided to invent one myself. I began asking everyone I knew what qualities they'd like to see in their "perfect pillow." Their responses included: "I'd like a pillow that never goes flat", "I'd like my pillow to stay cool" and "I'd like a pillow that adjusts to me regardless of my sleep position." After hearing everyone had the same problems that I did, I spent the next two years of my life inventing MyPillow..



In the early days, Mike and his family spent countless hours hand-making each MyPillow. This hard work and dedication to "doing it right" helped MyPillow become a classic American success story.

## MyPillow® to the Rescue

Flash forward eleven years and MyPillow, Mike Lindell's revolutionary pillow design, has helped 12 million people improve the quality of their sleep. MyPillow has received thousands of testimonials from customers about how MyPillow has changed their lives.

*"Until I was diagnosed with various sleep issues, I had no idea why my sleep was so interrupted throughout the night. I watch Imus each morning and heard endless testimonials about MyPillow. I took his advice and ordered a MyPillow. Now I wake up rested and ready to conquer the day ahead. Thank you for helping me remember what it's like to sleep like a baby!" - Jacqueline H.*

Lindell has been featured on numerous talk shows, including *Fox Business News* and *Imus in the Morning*. Lindell and MyPillow have also appeared in feature stories in major magazines and newspapers across the country. MyPillow has received the coveted "Q Star Award" for *Product Concept of the Year* from QVC, and has been selected as the Official Pillow of the National Sleep Foundation.

MyPillow's patented interlocking fill allows you to adjust the pillow to your individual needs regardless of sleep position.



## Unprecedented Guarantee and Warranty

I do all of my own manufacturing in my home state of Minnesota and all materials are 100% made in the U.S.A. I'm so confident MyPillow will help you, I'm offering an unprecedented 60-day money back guarantee and a 10-year warranty not to go flat! I truly believe MyPillow is the best pillow in the world and that if everyone had one, they would get better sleep and the world would be a much happier place. God Bless.

*Michael Lindell*

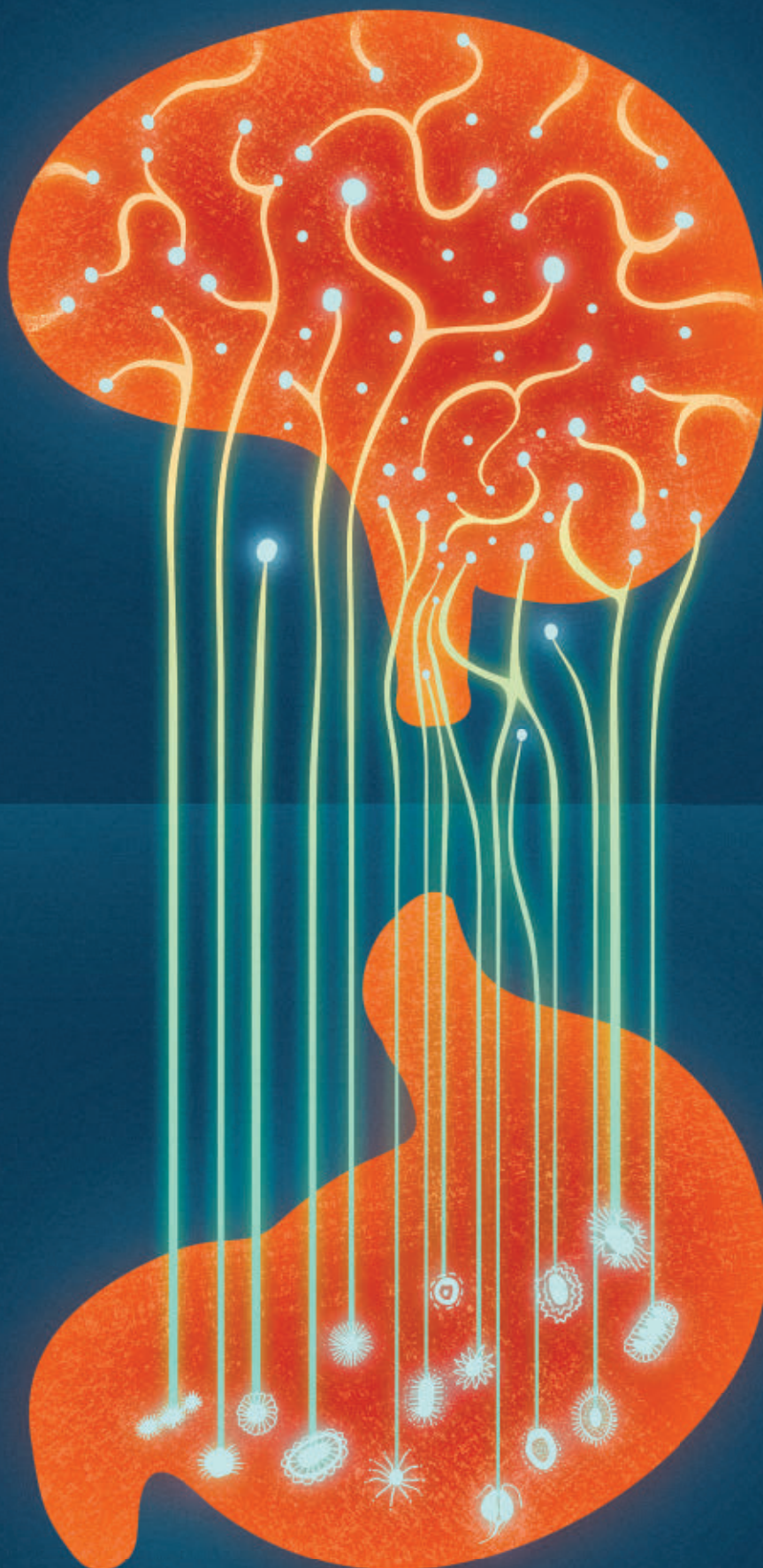


**Don't wait—Order MyPillow and get sleep you've been dreaming about!**

Save 50% when you use promo code "science12"

**BUY NOW AT: [mypillow.com](http://mypillow.com) OR call 800.873.7520**





Through several lines of communication, gut bacteria and the brain affect each other.



# Microbes and the Mind

The bacteria in our guts may help decide who gets anxiety and depression **By Laura Sanders**

**T**he 22 men took the same pill for four weeks. When interviewed, they said they felt less daily stress and their memories were sharper. The brain benefits were subtle, but the results, reported at last year's annual meeting of the Society for Neuroscience, got attention. That's because the pills were not a precise chemical formula synthesized by the pharmaceutical industry.

The capsules were brimming with bacteria.

In the ultimate PR turnaround, once-dreaded bacteria are being welcomed as health heroes. People gobble them up in probiotic yogurts, swallow pills packed with billions of bugs and recoil from hand sanitizers. Helping us nurture the microbial gardens in and on our bodies has become big business, judging by grocery store shelves.

These bacteria are possibly working at more than just keeping our bodies healthy: They may be changing our minds. Recent studies have begun turning up tantalizing hints about how the bacteria living in the gut can alter the way the brain works. These findings raise a question with profound implications for mental health: Can we soothe our brains by cultivating our bacteria?

By tinkering with the gut's bacterial residents, scientists have changed the behavior of lab animals and small numbers of people. Microbial meddling has turned anxious mice bold and shy mice social. Rats inoculated with bacteria from depressed people develop signs of depression themselves. And small studies of people suggest that eating specific kinds of bacteria may change brain activity and ease anxiety. Because gut bacteria can make the very chemicals that brain cells use to communicate, the idea makes a certain amount of sense.

Though preliminary, such results suggest that the right bacteria in your gut could brighten mood and perhaps even combat pernicious mental disorders including anxiety and depression. The wrong microbes, however, might lead in a darker direction.

This perspective might sound a little too much like our minds are being controlled by our bacterial overlords. But consider this: Microbes have been with us since even before we were humans. Human and bacterial cells evolved together, like a pair of entwined trees, growing and adapting into a (mostly) harmonious ecosystem.

Our microbes (known collectively as the microbiome) are "so innate in who we are,"

says gastroenterologist Kirsten Tillisch of UCLA. It's easy to imagine that "they're controlling us, or we're controlling them." But it's becoming increasingly clear that no one is in charge. Instead, "it's a conversation that our bodies are having with our microbiome," Tillisch says.

Figuring out what's being said in this body-microbe exchange, and how to shift the tone in a way that improves mental health, won't be easy. For starters, no one knows the exact ingredients for a healthy microbial community, and the recipe probably differs from person to person. And it's not always simple to deliver microbes to the gut and persuade them to stay. Nor is it clear how messages travel between microbes and brain, though scientists have some ideas.

It's early days, but so far, the results are compelling, says neuroscientist John Cryan of University College Cork in Ireland, who has been trying to clarify how microbes influence the brain. "It's all slightly weird and it's all fascinating," he says.

Cryan and others are amassing evidence that they hope will lead to "psychobiotics" — bacteria-based drugs made of live organisms that could improve mental health.

## We're not alone

Ted Dinan, the psychiatrist who coined the term "psychobiotics," was fascinated by a tragedy in Walkerton, Canada, in May 2000. Floods caused the small town's water supply to be overrun with dangerous strains of two bacteria: *Escherichia coli* and *Campylobacter*. About half the town's population got ill, and a handful of people died. For most residents, the illness was short-lived, about 10 days on average, says Dinan,

who collaborates with Cryan at University College Cork. But years later, scientists who had been following the health of Walkerton residents noticed something surprising. "The rates of depression in Walkerton were clearly and significantly up," Dinan says. That spike raised suspicion that the infection had caused the depression.

Other notorious bacteria have been tied to depression, such as those behind syphilis and the cattle-related brucellosis, and not just because ill people feel sad, Dinan says. He suspects there's something specific about an off-kilter microbiome that can harm mental health.

This possibility, though it raises troubling questions about free will, is certainly true for

**Bacteria that make brain chemicals**

Type of bacteria	Neural messengers
<i>Bacillus</i>	Dopamine, norepinephrine
<i>Bifidobacterium</i>	Gamma-aminobutyric acid (GABA)
<i>Enterococcus</i>	Serotonin
<i>Escherichia</i>	Norepinephrine, serotonin
<i>Lactobacillus</i>	Acetylcholine, GABA
<i>Streptococcus</i>	Serotonin

SOURCE: T.G. DINAN ET AL./J. PSYCH. RES. 2015



### Studying germ-free mice

Bacteria in the gut may help brains develop, based on studies from mice born and raised without bacteria. These mice are different from normal mice in several key brain areas.

SOURCE: S.M. COLLINS, M. SURETTE AND P. BERCIK/NAT. REV. MICROBIOL. 2012

**Striatum:** In mice without bacteria, the flux of the neural messengers dopamine and serotonin is altered in the striatum, a brain area involved in movement and emotional responses. New connections may form more readily in the striatum too. These changes may cause bacteria-free animals to move and explore abnormally.

**Hippocampus:** Involved in memory and navigation, the hippocampi of germ-free mice have reduced levels of molecules that sense serotonin and the growth factor BDNF. These mice display memory problems.

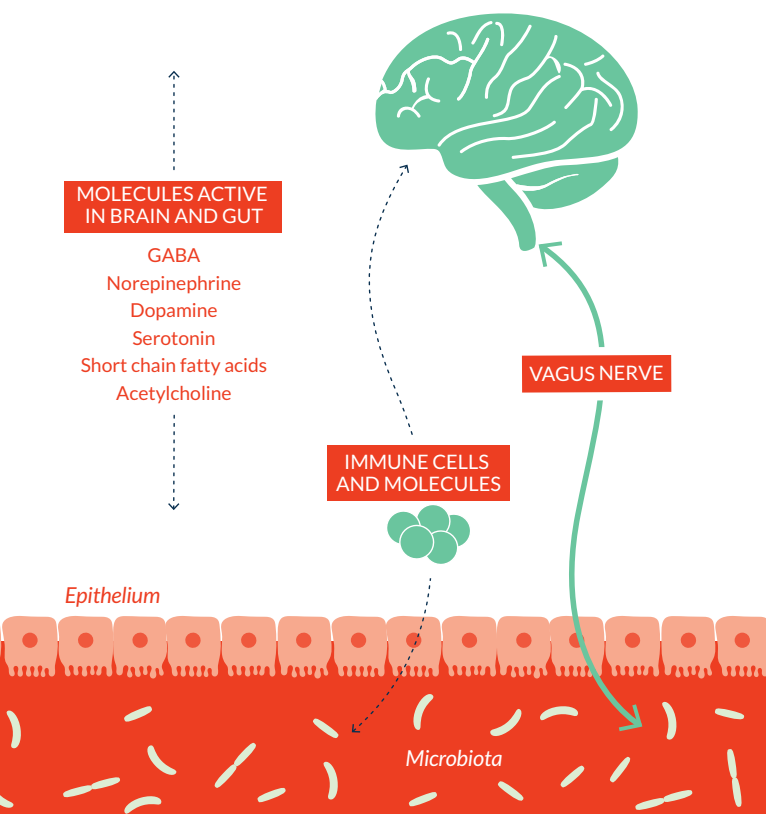
**Amygdala:** Germ-free mice have changes in the levels of serotonin, BDNF and other signaling molecules in the amygdala, a brain structure involved in emotions. These alterations might contribute to an increase in risk-taking behavior.

**Hypothalamus:** The brain's stress responder, the hypothalamus, shows boosts in corticotropin-releasing factor and adrenocorticotrophic hormone in germ-free mice. The changes might be related to the animals' heightened stress responses.

lab animals. Mice born and raised without bacteria behave in all sorts of bizarre ways, exhibiting antisocial tendencies, memory troubles and recklessness, in some cases. Microbes in fruit flies can influence who mates with whom (*SN*: 1/11/14, p. 14), and bacteria in stinging wasps can interfere with reproduction in a way that prevents separate species from merging. Those findings, some by evolutionary biologist Seth Bordenstein of Vanderbilt University in Nashville, show that “there’s this potential for [microbes] to influence behavior in this complex and vast way,” he says.

By sheer numbers, human bodies are awash in bacteria.

**Open channels** Although the communication lines aren’t fully understood, bacteria in the gut and cells in the brain may stay in touch in several ways. Signals can move along the vagus nerve or be carried by chemical messengers, such as serotonin, and by molecules that travel via the immune system. SOURCE: T.G. DINAN ET AL./J. PSYCH. RES. 2015



A recent study estimates there are just as many bacterial cells as human cells in our bodies (*SN*: 2/6/16, p. 6). Just how legions of bacteria get messages to the brain isn’t clear, though scientists have already found some likely communication channels. Chemically, gut microbes and the brain actually speak the same language. The microbiome churns out the mood-influencing neurotransmitters serotonin, norepinephrine and dopamine. Bacteria can also change how the central nervous system uses these chemicals. Cryan calls microbes in the gut “little factories for producing lots of different neuroactive substances.”

Signals between the gut and the brain may zip along the vagus nerve, a multilane highway that connects the two (*SN*: 11/28/15, p. 18). Although scientists don’t understand the details of how messages move along the vagus nerve, they do know that this highway is important. Snip the nerve in mice and the bacteria no longer have an effect on behavior, a 2011 study found. And when the gut-to-brain messages change, problems can arise.

### New bacteria, new behavior

Wholesale microbe swaps can also influence behavior. In unpublished work, Dinan and his colleagues took stool samples from people with depression and put those bacteria (called “melancholic microbes” by Dinan in a 2013 review in *Neurogastroenterology and Motility*) into rats. The formerly carefree rodents soon began showing signs of depression and anxiety, forgoing a sweet water treat and showing more anxiety in a variety of tests. “Their behavior does quite dramatically change,” Dinan says. Rats that got a microbiome from a person without depression showed no changes in behavior.

Cryan and colleagues have found that the microbiomes of people with depression differ from those of people without depression, raising the possibility that a diseased microbiome could be to blame.

The fecal-transplant results suggest that depression — and perhaps other mental disorders — are contagious, in a sense. And a mental illness that could be caught from microbe swaps could pose problems. Fecal transplants have recently emerged as powerful ways to treat serious gut infections (*SN Online*: 10/16/14). Fecal donors ought to be screened for a history of mental illness along with other potentially communicable diseases, Dinan says.

“Gastroenterologists obviously check for HIV and

hepatitis C. They don't want to transmit an infection," he says. The psychiatric characteristics of the donor should be taken into account as well, he says.

A fecal transplant is an extreme microbiome overhaul. But there are hints that introducing just one or several bacterial species can also change the way the brain works. One such example comes from Cryan, Dinan and colleagues. After taking a probiotic pill containing a bacterium called *Bifidobacterium longum* for a month, 22 healthy men reported feeling less stress than when they took a placebo. The men also had lower levels of the stress-related hormone cortisol while under duress, the researchers reported at the Society for Neuroscience meeting in Chicago last October. After taking the probiotic, the men also showed slight improvements on a test of visual memory, benefits that were reflected in the brain. EEG recordings revealed brain wave signatures that have been tied to memory skill, Cryan says.

The researchers had previously published similar effects in mice, but the new results move those findings into people. "What's going to be important is to mechanistically find out why this specific bacteria is inducing these effects," Cryan says. And whether there could be a benefit for people with heightened anxiety. "It's a very exciting study, but it's a small study," Cryan cautions.

Bacteria in an even more palatable form — yogurt — affected brain activity in response to upsetting scenes in one study. After eating a carefully concocted yogurt every morning and evening for a month, 12 healthy women showed a blunted brain reaction to pictures of angry or scared faces compared with 11 women who had eaten a yogurtlike food without bacteria.

Brain response was gauged by functional MRI, which measures changes in blood flow as a proxy for neural activity. In particular, brain areas involved in processing emotions and sensations such as pain were calmed, says Tillisch, coauthor of the study, published in 2013 in *Gastroenterology*. "In this small group, we saw that the brain responded differently" when shown the pictures, she says. It's not clear whether a blunted response would be good or bad, particularly since the study participants were all healthy women who didn't suffer from anxiety. Nonetheless, Tillisch says, the results raise the questions: "Can probiotics change your mood? Can they make you feel better if you feel bad?"

So far, the human studies have been very small. But coupled with the increasing number of animal studies, the results are hard to ignore, Tillisch says. "Most of us in this field think there is something definitely happening," she says. "But it's pretty complicated and probably quite subtle.... Otherwise, we'd all be aware of this." Anyone who has taken a course of antibiotics, or fallen ill from a bacterial infection, or even changed diets would have noticed an obvious change in mood, she says.

## Two-way traffic

If it turns out that bacteria can influence our brains and behaviors, even if just in subtle ways, it doesn't mean we are passive vessels at the mercy of our gut residents. Our behavior

"Prebiotic" foods, such as asparagus and garlic, may help cultivate beneficial bacteria in the gut.

can influence the microbiome right back.

"We usually give up our power pretty quickly in this conversation," Tillisch says. "We say, 'Oh, we're at the mercy of the bacteria that we got from our mothers when we were born and the antibiotics we got at the pediatrician's office.'" But our microbes aren't our destiny, she says. "We can mess with them too."

One of the easiest ways to do so is through food: eating probiotics, such as yogurt or kefir, that contain bacteria and choosing a diet packed with "prebiotic" foods, such as fiber and garlic, onion and asparagus. Prebiotics nourish what are thought to be beneficial microbes, offering a simple way to cultivate the microbiome, and in turn, health.

That a good diet is a gateway to good health is not a new idea, Cryan says. Take the old adage: "Let food be thy medicine and let medicine be thy food." He suspects that it's our microbiome that makes this advice work.

Combating stress may be another way to change the microbiome, Tillisch and others suspect. Mouse studies have shown that stress, particularly early in life, can change microbial communities, and not in a good way.

She and her colleagues are testing a relaxation technique called mindfulness-based stress reduction to influence the microbiome. In people with gut pain and discomfort, the meditation-based practice reduced symptoms and changed their brains in clinically interesting ways, according to unpublished work. The researchers suspect that the microbiome was also altered by the meditation. They are testing that hypothesis now.

If the mind can affect the microbiome and the microbiome can affect the mind, it makes little sense to talk about who is in charge, Bordenstein says. In an essay in *PLOS Biology* last year, he and colleague Kevin Theis, of Wayne State University in Detroit, make the case that the definition of "I" should be expanded. An organism, Bordenstein and Theis argued, includes the microbes that live in and on it, a massive conglomerate of diverse parts called a holobiont. Giving a name to this complex and diverse consortium could shift scientists' views of humans in a way that leads to deeper insights. "What we need to do," Bordenstein says, "is add microbes to the 'me, myself and I' concept." ■

## Explore more

■ Kirsten Tillisch. "The effects of gut microbiota on CNS function in humans." *Gut Microbes*. May/June 2014.



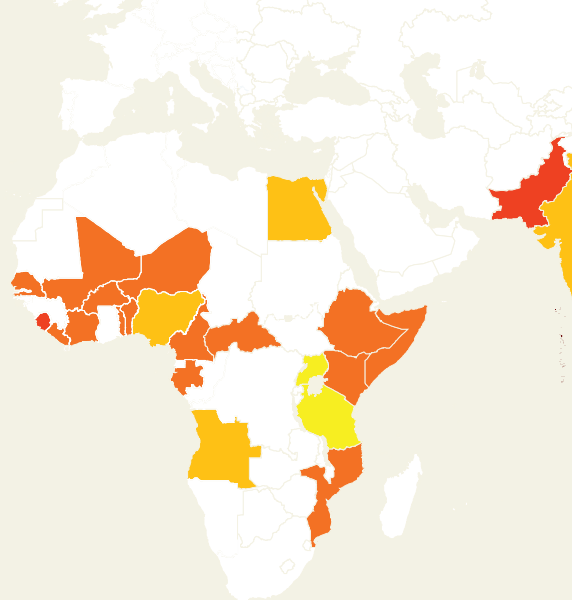
## In Search of Answers on Zika

A stealth virus, most often borne on the wings of a ubiquitous predator, is spreading across the Americas. Zika virus is the latest of several that are carried by mosquitoes. But Zika isn't a new foe. Discovered in Uganda in 1947 in a rhesus monkey (during an infectious-disease study), the virus was found in humans a decade later in Nigeria. Zika has existed in Africa and Asia since the 1950s without raising the kind of alarm seen today, perhaps because of a built-up immunity there. But in the Americas, Zika appears to have found a more vulnerable population. Two rare conditions — a birth defect (microcephaly) and Guillain-Barré syndrome — are undeniably on the rise. Whether Zika is to blame isn't yet a sure thing. But concern is rising. "The more we learn, the worse it gets," Anthony Fauci, director of the National Institute of Allergy and Infectious Diseases, said at a March 10 news briefing.

To combat further spread, scientists will need to delve deep into the biology of two opportunists: the virus itself and the mosquito. In the meantime, efforts to limit exposure to mosquitoes are under way. And preemptive attempts to protect future victims include travel advisories, especially for pregnant women, and

Zika and microcephaly .....	26
Guillain-Barré syndrome .....	29
Science versus mosquito .....	30

warnings about unprotected sex (a transmission path in some cases). Human safety trials for a vaccine to jump-start immunity could begin later this year; larger efficacy trials may be a year and a half away. — *Macon Morehouse*



**Global traveler** First found in Uganda in 1947, the Zika virus has traveled via mosquito through Africa and Asia, picking up steam in recent years to blow across the Pacific and the Americas.

SOURCES: WHO; CDC; A.D. HADDOW ET AL/PLOS NEGL. TROP. DIS. 2012



A doctor measures the head circumference of a baby girl in Brazil. The measurement offers a quick, if imperfect, way to gauge whether a newborn has microcephaly.

# MICROCEPHALY: Building a case against Zika

Virus can damage key cells in developing brains **By Meghan Rosen**

**T**he prime suspect in Brazil's recent surge in birth defects may be convicted this summer, in the sweltering cities of Colombia.

That's when the first big wave of pregnant women infected with Zika virus last fall will begin to give birth. Whether or not these babies are born with shrunk brains, a condition known as microcephaly, may offer the best evidence yet of Zika's guilt — or innocence.

While the world waits, molecular evidence is starting to come in. Zika virus readily infects (and kills) one kind of brain cell found in developing embryos, researchers reported online March 4 in *Cell Stem Cell*. "It's the first step to show that Zika is actually doing something in the brain," says study coauthor Guo-Li Ming, a neuroscientist at Johns Hopkins School of Medicine. Previous studies have found traces of Zika in some damaged fetal brains, but that's just a correlation.





Still, correlations like these are why the mosquito-borne virus has sparked so much panic. In the last year, Zika has torn through Brazil and invaded more than 40 other countries and territories. Now, Zika infection during pregnancy is the leading theory for why so many babies have been born with microcephaly. Suspected cases of the rare birth defect are showing up in Brazil at more than 30 times the rate of previous years.

Seeing microcephaly numbers skyrocket in other countries could make or break the case. So far, only Brazil has reported an uptick in microcephaly (though French Polynesia did in an earlier outbreak). Still, evidence that Zika is to blame remains largely circumstantial.

“We don’t have absolute proof,” says Christopher Dye, strategy director of the World Health Organization. But, he says, there’s enough evidence to say the virus is “guilty until proven innocent.”

University of Pittsburgh public health researcher Ernesto Marques agrees. “We have a victim, and we have a suspected criminal with a gun.” Now, he says, “we have to prove who pulled the trigger.”

## Mounting evidence

Zika virus has topped the suspect list from the start. “There’s a very real possibility that this virus could be responsible for some of the horrific consequences” seen in children, Bruce Aylward, head of WHO’s outbreaks investigations, said in a news conference February 19.

In late 2014, the first cases of Zika infection emerged in Brazil’s northeast corner. By fall 2015, women started giving birth to babies with small heads. That’s a clue that infection during early pregnancy may be a problem, Dye says.

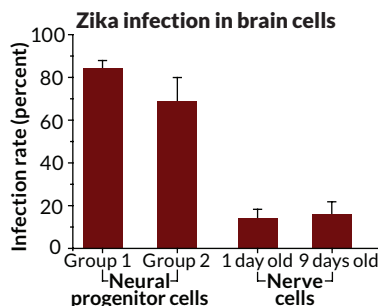
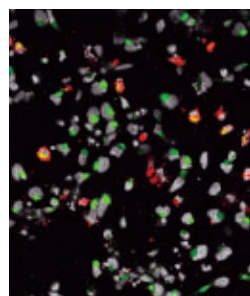
Biological evidence is building too. “Virus RNA has been found in placenta, amniotic fluid and brain tissues of still-born babies with microcephaly,” Marques says. And new case reports keep rolling in. On February 26, the U.S. Centers for Disease Control and Prevention reported Zika infection in nine pregnant U.S. travelers. Two women miscarried, one gave birth to a baby with microcephaly, two had abortions (fetal imaging revealed severe brain abnormalities in one case; the CDC hasn’t released details about the other) and two had apparently healthy babies. Two more await delivery.

On March 4, scientists published results from the largest study yet of pregnant women exposed to Zika. In nearly 30 percent of the Brazilian women (12 out of 42), ultrasound images revealed fetal abnormalities, researchers reported in the *New England Journal of Medicine* (SN Online: 3/4/16).

Recent studies have begun to hint at how the virus might harm the brain. For the study reported in *Cell Stem Cell*, Ming and colleagues grew different types of human cells in the lab and then gave them a dose of Zika. The virus went wild in neural progenitor cells (very early cells that give rise to the bulk of the brain), infecting up to 90 percent of cells in a dish.



**Abnormally small** The head circumference of a baby with microcephaly (middle) is two standard deviations below average (left). Three standard deviations below average is considered severe microcephaly (right).



**Killer infection** When Zika (green) infects human neural progenitor cells (a key part of embryonic brains), some cells die (red). The virus more readily infects progenitor cells than it does more developed brain cells (graph), a new study shows. SOURCE: H. TANG ET AL./CELL STEM CELL 2016

But Zika floundered in more developed nerve cells, infecting fewer than 20 percent.

If these findings hold in people, “it means that fetal brains are much more susceptible to Zika than adult brains,” says stem cell biologist Kristen Brennand of Mount Sinai Hospital in New York City.

The virus killed some cells outright and messed with others’ growth cycles, Ming and colleagues found. That’s “pretty consistent with what you’d expect if Zika causes microcephaly,” Brennand says. “If you have more cells dying, you’re going to have a smaller head.”

Ming cautions that her study doesn’t prove Zika’s guilt. Scientists still need to identify whether infected brain cells lead to abnormal brain structures. “That would give you more direct evidence,” she says.

Brazilian researchers reported similar results in March. In minibrains grown in the lab (tiny balls of cells somewhat similar to growing human brains), Zika infection killed cells and slowed growth, they described in *PeerJ Preprints*.

Marques recently wrapped up a study on the earliest cases of microcephaly reported in Brazil. He and colleagues analyzed samples collected from the first group of babies born with the birth defect last October. “This was before Zika became famous,” he says.

Hospitals in the state of Pernambuco sent his team cerebrospinal fluid, the liquid that cushions the brain and spinal cord. In 30 out of 31 samples, the team found antibodies indicating Zika virus infection. But the case against Zika isn’t airtight. In fact, “there are many weak spots,” Dye says, including how hard it can be to measure both microcephaly and Zika virus infection.

## Burden of proof

Judging whether a microbial suspect is guilty of causing a disease is simple, in theory.

Robert Koch, the famous 19th century German microbiologist, established a few straightforward guidelines in 1890. First, the microbe in question must be found in all cases of the disease. Additional criteria (involving lab tests in culture

and animals) round out “Koch’s postulates.” But with Zika, scientists are still getting hung up on that first guideline.

Zika virus infection isn’t always easy to confirm. Antibody-based blood tests can give false positives, or fail if too much time has passed since symptoms started. The Brazilian Ministry of Health puts infection estimates at roughly 400,000 to 1.3 million, but officials have stopped counting. So scientists can only guess how many people in Brazil have been infected.

“We don’t have a good diagnostic test,” WHO’s Dye says. On top of that, microcephaly itself can be challenging to identify. So in the theory that Zika virus is responsible for microcephaly, both cause and effect are slippery.

As of March 5, Brazil has reported 6,158 suspected cases of microcephaly (or other brain and spinal cord malformations) since November. But hundreds, if not thousands, of those babies might not actually have the birth defect. That’s because doctors have been flagging cases with a quick and dirty method: a head circumference of less than 32 centimeters. “Many children with normal heads are going to fall within that category,” Aylward said, because the measurement doesn’t factor in gender and gestational age.

Public health officials in Brazil have already examined 1,927 cases. So far, they’ve confirmed just 745. On February 25, WHO released guidelines for making microcephaly assessments more orderly, but even 745 confirmed cases is huge — more than four times the number of cases Brazil usually reports in a year. “There’s no question that they have a cluster of microcephaly,” Aylward said.

Dye has different concerns. He worries that scientists might be counting only the babies with severe defects. “The concern is that we’re seeing the tip of a larger phenomenon,” he says. Thousands of babies with less obvious brain damage might be slipping under the radar. “It could take years to evaluate the full spectrum of conditions,” he says.

Dye has different concerns. He worries that scientists might be counting only the babies with severe defects. “The concern is that we’re seeing the tip of a larger phenomenon,” he says. Thousands of babies with less obvious brain damage might be slipping under the radar. “It could take years to evaluate the full spectrum of conditions,” he says.

sands of babies with less obvious brain damage might be slipping under the radar. “It could take years to evaluate the full spectrum of conditions,” he says.

## New theories, new studies

In recent weeks, alternative theories for Brazil’s birth defects have bubbled up and caught the public’s eye. One blamed microcephaly on a pesticide called pyriproxyfen that Brazil had been adding to the water supply to combat mosquitoes.

Some of these theories “may seem very strange, but they all have to be evaluated,” Dye says.

WHO has released an online rebuttal to some rumors. The pesticide, for instance, is bad news for mosquitoes (it sabotages larval development), but there’s no evidence that it’s harmful to humans — or any other animal with a spine.

“Pyriproxyfen has gone through an enormous number of safety tests over the years,” says public health entomologist Steve Lindsay of Durham University in England. In mice, rats and dogs, there’s no evidence that the pesticide is neurotoxic. For a pesticide, he says, “it’s as safe as you can get.”

WHO also swatted down a theory about genetically modified

### Known causes of microcephaly

Genetic mutations

Exposure to alcohol, drugs or toxic chemicals during pregnancy

Malnutrition during pregnancy

Infections, such as rubella, during pregnancy

Lack of blood supply to the fetus’s brain

mosquitoes. Releasing males that can't reproduce could help Brazil tamp down mosquito populations. But "it's virtually impossible" that GM mosquitoes are transmitting Zika or causing microcephaly, says entomologist William Walton of the University of California, Riverside. "Male mosquitoes don't bite," he says. So they don't pass what they're carrying on to humans like females do.

## Beyond a reasonable doubt

Establishing that Zika really is behind the current microcephaly outbreak will require more work — and time. CDC scientists are planning to examine 300 to 500 babies born with or without microcephaly in the Brazilian city of João Pessoa. One goal is to tally the babies with microcephaly and evidence of Zika infection. Marques and collaborators have begun a similar study on babies born in Pernambuco (*SN*: 2/20/16, p. 16).

The CDC is also working with Colombian health officials to gauge the effects of Zika infection during pregnancy. Since October, Zika virus case numbers have soared: 47,771 total

so far, and 8,890 infections are in pregnant women.

In the current outbreak, Colombia is just the second country to have such a large group of women face Zika during pregnancy. Roughly four months have ticked by since many of these women were exposed. If, as suspected, Zika strikes developing brains in the first trimester, the most incriminating evidence could come in about five months, when these babies are born.

"People are going to be looking for increasing numbers of microcephaly," says vaccine researcher Anna Durbin, of the Johns Hopkins School of Public Health. Such a finding could sew up the case against Zika.

"If there's going to be smoking gun," she says, "it's going to come out of Colombia." ■

## Explore more

■ Hengli Tang *et al.* "Zika virus infects human cortical neural precursors and attenuates their growth." *Cell Stem Cell*. March 4, 2016.

## Scientists track Zika's link to neurological disorder

For some adults, infection with Zika virus produces a rashy, flulike nuisance. But in a handful of people, the virus may trigger a severe neurological disease.

About one in 4,000 people infected by Zika in French Polynesia in 2013 and 2014 got a rare autoimmune disease called Guillain-Barré syndrome, researchers estimate in a study published online February 29 in the *Lancet*. Of 42 people diagnosed with Guillain-Barré in that outbreak, all had antibodies that signaled a Zika infection. In a control group of hospital patients without Guillain-Barré, just 54 out of 98 patients tested showed signs of virus exposure.

That "tells us what I think a lot of people already thought: that Zika can cause Guillain-Barré syndrome," says public health researcher Ernesto Marques of the University of Pittsburgh. But he stresses that "it's important that people don't think that if you get Zika, you are going to get Guillain-

Barré." The chance is much less than 1 percent, he says.

More work needs to be done to definitively prove the link. And it's too early to say whether the rate of Guillain-Barré estimated by the researchers will be the same in ongoing Zika outbreaks, says Anna Durbin, a vaccine researcher at Johns Hopkins School of Public Health.

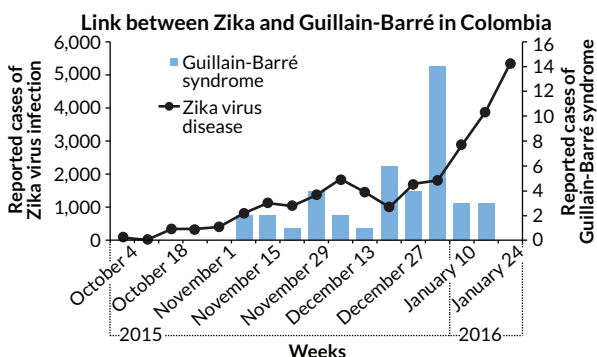
Several countries currently hard-hit by Zika have reported upticks in Guillain-Barré syndrome. In Colombia, which usually sees about 220 cases of the syndrome a year, doctors recently diagnosed 86 cases over a five-week period, the World Health Organization reports. Brazil, El Salvador, Venezuela and several other countries have also reported unusually high numbers of cases.

The syndrome begins as the body's immune system attacks peripheral nerves, often causing weakness or tingling in the lower extremities. In severe cases, paralysis can result. While most recover, 3 to 5 percent of people die from complications, scientists estimate.

Other viruses, including HIV, influenza and dengue, are known to spark Guillain-Barré, possibly through their interactions with the body's immune system.

The timing of Guillain-Barré's onset may make it easier for scientists to pin the disorder on Zika. The syndrome shows up days or weeks after an infection subsides.

Scientists conducting a multinational Guillain-Barré study may soon expand their study into Brazil and Colombia to look for signs of Zika infection in people with the syndrome. Further studies could also help explain why some people are susceptible to Guillain-Barré. Genetics, previous viral infections or toxins may all play a role. — *Laura Sanders and Meghan Rosen*



**In tandem** As suspected and confirmed Zika infections climbed in Colombia (black line), cases of Guillain-Barré syndrome rose too (blue bars). New cases of Guillain-Barré may be added retrospectively as they are confirmed. SOURCE: WHO



Geniuses at growing in tiny containers of water, larvae of Zika-spreading mosquito *Aedes aegypti* dangle head down at the water's surface.

# SCIENCE versus MOSQUITO

Controlling one of the world's most dangerous animals takes on new urgency **By Susan Milius**

**B**razil, now a poster child for mosquito-borne virus spread, was once a model for mosquito eradication. "It was amazing," says Dan Strickman, medical entomologist with the Bill and Melinda Gates Foundation. The *Aedes aegypti* mosquito, today identified by epidemiologists as one of the carriers of the Zika virus, was attacked in the 1930s with the simple tools then available. By 1965, the mosquito was certified as eradicated from Brazil and 17 other countries in the Americas (but not the United States). The feat took ferocious effort, but as the threat dwindled, so did money and the political will to stay vigilant.

Whether eradication would even be possible now is unclear. But the question of how to cope with *Ae. aegypti* has taken on new urgency as that mosquito species sweeps Zika virus through South and Central America and into parts of North America. Known as the yellow fever mosquito, *Ae. aegypti* can also spread dengue, chikungunya and West Nile viruses (*SN*: 6/13/15, p. 16).

It's "the most difficult mosquito in the Americas to control," says Michael Doyle, director of mosquito control for the Florida Keys. The mosquito's resistance to major pesticides and its unusual biology foil many standard control measures. Some scientists have developed high-tech control approaches. Other specialists are going back to the basics to search for biological vulnerabilities that have been overlooked.

Casual slappers of mosquitoes tend to lump all of them into

one annoying category, but there are 3,500 or so species, with a wide range of idiosyncrasies. Some species, for instance, don't drink blood. As a group, though, mosquitoes are among the most dangerous animals on Earth, claiming more than 400,000 lives a year just from spreading malaria.

Researchers propose that several species might spread Zika, depending on location: *Ae. hensilli* was suspected in a previous outbreak on Yap in Micronesia and *Ae. polynesiensis* in French Polynesia. In the Americas, epidemiologists are watching two widespread invasives: the Asian tiger mosquito *Ae. albopictus* (*SN*: 6/29/13, p. 26) as well as the notorious *Ae. aegypti*.

A forest-dwelling form of *Ae. aegypti*, native to Africa, frequents tree holes and sucks blood from animals. The worldwide invaders, however, have become domesticated. "They bite almost exclusively humans; they live almost exclusively within feet of humans," Doyle says.

For many mosquitoes, blood is for motherhood, usually one drink per batch of eggs. The insects meet everyday energy needs with plant sugars such as flower nectar. *Ae. aegypti* females, however, sip blood often, raising the chances of passing on disease. That's because they're unusually adept at extracting energy from blood instead of nectar, Laura Harrington, who studies mosquito biology at Cornell University, and her colleagues found.

A common way to fight bloodsuckers is spraying pesticides from trucks or aircraft. But spraying often does little to *Ae. aegypti* holing up in houses, resting on clothing in closets or hiding under beds. And don't count on nighttime protection from bed nets. *Ae. aegypti* readily bite during the day.

To fight such a foe, crews start by trying to kill larvae before they reach vampire age. Mosquitoes generally go through their

first life stage in water, and *Ae. aegypti* needs only a little containerful. So Doyle sends inspectors on house-by-house quests for stray minipools: in a bucket, a Fritos bag, old tires, a kayak and plant saucers by the dozens. And that could be in just one yard. His difficulties make a fine case study in how hard — and expensive — fighting a human-specialist mosquito can be.

The human-versus-mosquito battle isn't all door-to-door. The company Oxitec, based in the United Kingdom, engineered male *Ae. aegypti* mosquitoes to carry genes that cause their offspring to die (SN: 7/14/12, p. 22). Using an old insect-control strategy, mass releases of dysfunctional males seduce wild females and, in time, shrink the problem population.

Experimental releases of Oxitec's genetically modified *Ae. aegypti* males have reduced the size of mosquito populations by more than 80 percent in a test site of about 5.5 hectares in a suburb of Juazeiro, Brazil. The Brazilian government has approved these engineered mosquitoes for widespread use. Oxitec has applied for U.S. Food and Drug Administration approval to do a similar test in the Florida Keys. On March 11, the FDA released a draft statement predicting “no significant impact” to the environment from the test (SN Online: 3/11/16).

Efforts to genetically sterilize mosquitoes may improve with advances in CRISPR/Cas9 techniques to cut and paste genes (SN: 12/12/15, p. 16). And an advance in the genetics of sex determination last year opens new possibilities for refining sterile-male releases. What's called an M factor determines maleness in certain insects, and for the first time in any mosquito, researchers determined the sequence of the genetic components of *Ae. aegypti*'s M factor. Manipulating it to produce entire generations of only males could have many uses, says Virginia Tech's Zach Adelman.

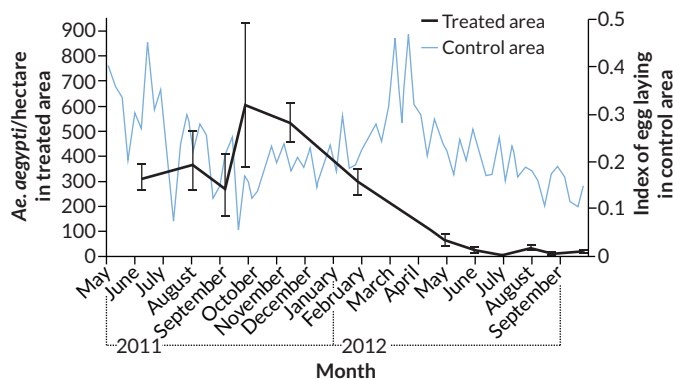
In a different approach to reengineering mosquitoes (SN: 7/14/12, p. 7), researchers with the international consortium called Eliminate Dengue are testing a nongenetically modified mosquito in Brazil among other places. Instead of wiping out a population, the goal is to reduce its disease-spreading power. Infection with a strain of *Wolbachia*, bacteria common in insects, can render these mosquitoes less likely to transmit dengue virus. A paper due out soon will show that the *Wolbachia*-carrying mosquitoes are also less likely than uninfected ones to transmit chikungunya, as well as Zika, says *Wolbachia* project leader Scott O'Neill at Monash University in Melbourne, Australia.

## Search for an Achilles' heel

What interests Cornell's Harrington are the undiscovered mosquito-fighting targets. Her lab studies courtship and reproduction in mosquitoes. “I really believe that's where their Achilles' heel is,” she says.

Courtship among *Ae. aegypti* is unusual and more complex than anyone had imagined, Harrington, her student Lauren

**High-tech** In a test near Juazeiro, Brazil, the density of adult *Aedes aegypti* mosquitoes dwindled (black line) with releases of genetically sterilized Oxitec male mosquitoes. In untreated areas, egg-laying (blue line) continued. SOURCE: D.O. CARVALHO ET AL/PLOS NEGL. TROP. DIS. 2015



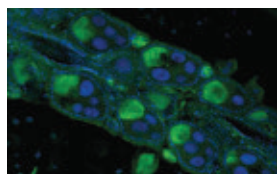
Cator and colleagues reported in 2009. The scent of a human host attracts amorous male mosquitoes, which fly nearby until a female arrives looking for a blood meal. Male mosquitoes' wide, feathery antennae pick up harmonic overtones of the whine of female wingbeats. The mosquitoes then synchronize one of the wingbeat overtones. “They're singing to each other,” says Ethan Degner, a Harrington graduate student. Perhaps there's a way to disrupt this courtship.

Another of the Harrington lab's findings might be more immediately relevant. Conventional wisdom is that *Ae. aegypti* mosquitoes mate only once in their lives. Degner offered lab females a second chance to mate, but with a collaborating lab's genetically engineered males that produce fluorescent red sperm. In lab conditions, a low percentage of females showed red in their reproductive tracts, indicating they mated twice. Degner and Harrington reported online February 15 in the *American Journal of Tropical Medicine and Hygiene*. This result agrees with observations of what looked like occasional second matings in the wild. With millions of dollars going into mass releases of sterile competitors to local fertile males, female willingness takes on new importance.

If biologists come up with some new way to eradicate *Ae. aegypti*, then humankind would have to decide whether to use it. Aside from moral questions, removing any species from an ecosystem can have unexpected risks and consequences. The weighing of arguments will differ species by species, even for mosquitoes. But the human-seeking form is a relative newcomer to the Americas. So in this era of Zika and other rampant mosquito-borne diseases, whether to blast this mosquito out of the hemisphere, should it ever be possible, might not be a difficult decision at all. ■

## Explore more

■ CDC. “Surveillance and control of *Aedes aegypti* and *Aedes albopictus* in the United States.” [bit.ly/CDC\\_mosquito](http://bit.ly/CDC_mosquito)



*Wolbachia* bacteria (green, in a mosquito ovary) can pass along their virus-blocking ability to the next generation.





**Hair: A Human History**  
Kurt Stenn  
PEGASUS BOOKS,  
\$26.95

# BOOKSHELF

## Treatise on hair gives locks a chance to shine

After the *Exxon Valdez* dumped more than 10 million gallons of oil into the Gulf of Alaska, hairdresser Phil McCrory got an idea.

He gathered up human hair from his salon, stuffed it into a pair of pantyhose and dunked the bundle into a solution of motor oil and water. The hair sopped up the oil — a discovery that has since inspired environmentalists to create

“hair blankets” to clean up oil spills.

It's not the most bizarre use of hair that Kurt Stenn describes in his new book, *Hair: A Human History*, or even the most surprising. From the felted wool covers of tennis balls to the horse-tail hair of a violin's bow, Stenn, a former dermatologist and hair follicle scientist, digs up the myriad ways that hair has threaded its way into humans' lives — and history.

A thriving wool trade starting in the 13th century, for example, helped some Italians amass enough wealth to later support famous artists of the Renaissance, including Michelangelo. And in 17th century Europe, beaver fur was so in demand (felted hats were a must for stylish gentlemen)

that traders hunted beavers to near extinction.

Stenn jams an encyclopedia's worth of material into a mere 256 pages, all the while shedding facts like a golden retriever sheds fur. But the book has more than just history. Stenn details the molecular biology of hair, those packed piles of cells that push out of nearly every square inch of human skin (except for the palms, soles and a few other areas). Hair conditioner, he explains, works by leaving positively charged molecules on strands, so that they repel each other rather than tangling together.

Stenn roots his story in science, discussing evolution, development and disease, among other topics. (The book could give readers a sure win for any hair category on *Jeopardy!*.) But *Hair* shines when Stenn steps out of the lab and into the world. He visits a wigmaker's workshop in London, tours a modern barbering institute in Pennsylvania and learns about synthetic fibers at the laboratories of a Tokyo-based wig company.

These interludes are subtle highlights in a densely woven tale. But throughout, Stenn manages to convey a sense of wonder for a seemingly mundane material so tough, so strong and so versatile that it can be used for virtually anything — even mopping oil from the sea. — *Meghan Rosen*

**Buy Books** Reviews on the *Science News* website include Amazon.com links that generate funds for Society for Science & the Public programs.



# TO DO

## Dinosaurs Among Us

NOW OPEN

With help from fossils and life-size models, this exhibit lays out the evidence — from feathers to nesting behavior — that links dinosaurs to birds.

AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK CITY

## Life in One Cubic Foot

NOW OPEN

In this interactive exhibit, count up the different types of organisms that pass through a cubic foot of land or water in a single day in various habitats, including a coral reef in French Polynesia.

SMITHSONIAN NATIONAL MUSEUM OF NATURAL HISTORY, WASHINGTON, D.C.

## Benjamin Dean Astronomy Lectures: Tiny Moons Around Asteroids

APRIL 4

A researcher from the SETI Institute will discuss the technology that astronomers use to image asteroids that have satellites, as well as describe potential future missions to these space rocks.

CALIFORNIA ACADEMY OF SCIENCES, SAN FRANCISCO

## Leisure and Luxury in the Age of Nero: The Villas of Oplontis Near Pompeii

THROUGH MAY 15

Opulent jewelry and art, along with a collection of more mundane artifacts, recovered from ruins near Pompeii help visitors appreciate the economic disparities between ancient Rome's wealthy elite and lower socioeconomic classes.

UNIVERSITY OF MICHIGAN KELSEY MUSEUM OF ARCHAEOLOGY, ANN ARBOR

## Invisible Boundaries: Exploring Yellowstone's Great Animal Migrations

OPENS MAY 27

The migrations of elk, deer and other animals of Yellowstone National Park are highlighted in this exhibit, which also examines conservation efforts to protect these creatures, whose travels take them well beyond the park's boundaries.

BUFFALO BILL CENTER OF THE WEST, CODY, WYO.



FROM LEFT: © DAVID LITTSCHWAGER; COURTESY OF U-M KELSEY MUSEUM OF ARCHAEOLOGY



# THINK BEYOND



Volunteer, Judge, Interpret at the

## INTEL INTERNATIONAL SCIENCE AND ENGINEERING FAIR (INTEL ISEF)

Phoenix, May 8–13, 2016



**Dieuwertje Kast (far right)**, was a Grand Awards judge in the plant biology division at the Intel ISEF 2011 and 2014. As an outreach educator at the University of Southern California, Kast encourages underrepresented and low-income grade school students to explore science, technology, engineering and mathematics (STEM) fields. She was inspired by Intel ISEF to help her students do ISEF-caliber research by creating access to labs, information, resources, local science fairs and more.

**Join her and 1,500 others by volunteering at the upcoming Intel ISEF in Phoenix, Ariz., from May 8–13, 2016.**

The Society for Science & the Public seeks interpreters, general volunteers and judges for Intel ISEF 2016. More than 500 volunteers and 1,000 judges are needed to help make the science fair possible. Students from more than 75 countries, regions and territories participate in Intel ISEF. About 200 interpreters are needed to work with students in conversational or scientifically informed interpretation.

*"I was inspired as a judge to host many local science fairs, and judged in local, regional and national science fairs."*

**DIEUWERTJE KAST, OUTREACH EDUCATOR**



PHOTOS COURTESY OF D. KAST

**APPLY TO VOLUNTEER AT INTEL ISEF 2016:**

<https://student.societyforscience.org/volunteers>



FEBRUARY 6, 2016

## Elemental naming

Readers online suggested names for the seventh-row elements now receiving permanent seats in the periodic table (SN: 2/6/16, p. 7). Proposals included the Marx Brothers (pictured) and the English chemist Rosalind Franklin.



Grouchonium, Chiconium, Zepponium and Harponium.  
Richard L. Kent

Janetium after Charles Janet, who proposed a radically new representation of the periodic system....  
Philip Stewart

What about Franklinium?  
Zvonimir Mlinarić

"Ah" ... The element of surprise!  
Sok Kok

## Join the conversation

E-MAIL [editors@sciencenews.org](mailto:editors@sciencenews.org)

MAIL Attn: Feedback  
1719 N St., NW  
Washington, DC 20036

## Connect with us



## Unending debate

Foods containing genetically modified organisms have been on grocery store shelves for decades, with plenty of evidence that eating them is no more dangerous to health than eating conventional foods. **Rachel Ehrenberg** concluded in "GMOs under scrutiny" (SN: 2/6/16, p. 22). Reader response to the article was overwhelming, with many thanking **Ehrenberg** for her well-balanced approach and other readers still not convinced of the story's conclusions. Again and again, readers expressed worries over potential health risks associated with the commonly used herbicide glyphosate. **Ehrenberg**, who discussed some of these concerns in a recent news story (SN: 3/19/16, p. 7), notes that glyphosate is not a GMO and so its health effects were outside the scope of her original article. "The overuse of herbicides and pesticides is not unique to GM crops," she adds. "It also happens with conventional crops."

Other readers had more specific questions. **Linda Mix** was surprised to learn that GM wheat is not currently on the market and wanted to know why not. "That knowledge is certainly not out in the public arena," she wrote.

Though Monsanto developed a genetically modified wheat that tolerates glyphosate several years ago, **Ehrenberg** says, the company halted efforts to bring it to market, calling it "less attractive relative to Monsanto's other commercial priorities." In 2013 and 2014, strains of this "Roundup Ready" wheat were found growing in an unplanted field in Oregon and at an agricultural research center in Montana, where Monsanto GM wheat had been grown previously in field trials.

The U.S. Department of Agriculture launched an investigation and concluded that the Oregon plants were an isolated incident; the agency is still investigating the GM wheat in Montana. But no GM wheat varieties are for sale or in commercial production in the United States, and the USDA investigation found that no GM wheat had made it into commercial circulation.

## Future of fusion

In "Renegade fusion" (SN: 2/6/16, p. 18), **Alan Boyle** described the work of several private-sector start-ups attempting to make nuclear fusion a viable power source. **Boyle** quoted **Nathan Gilliland**, CEO of General Fusion, who praised the benefits of hydrogen fuel. "You'd have abundant fuel for hundreds of millions, billions of years," **Gilliland** said.

Some readers wondered how **Gilliland** arrived at these numbers. "While 'hundreds of millions of years' sounds good," wrote **Steve Goldhaber**, "is it realistic?"

The figure often quoted for the deuterium-deuterium fusion energy content of the world's oceans is roughly  $10^{31}$  joules, **Boyle** responds. The International Energy Agency estimates that annual world energy consumption for 2012 and 2013 was roughly  $6 \times 10^{20}$  joules. That would suggest, theoretically, a more than 10-billion-year supply. It is difficult to know how much energy consumption will increase in the future, **Boyle** says, but **Gilliland's** assumption appears to be based on current levels, give or take an order of magnitude. For more detail, **Boyle** recommends two books: *A Piece of the Sun* by Daniel Clery (SN: 7/27/13, p. 30) and *Sun in a Bottle* by Charles Seife (SN: 10/24/08, p. 38).

## Cosmic orientation

"Supermassive black hole is extreme recycler" (SN: 2/6/16, p. 9) described a cosmic jet shooting gas 30,000 light-years away. "Most of the ejected gas falls back down onto the central region of the galaxy," **Christopher Crockett** wrote.

**Michael Dovichi** asked, "Is there really an up and down in space?"

Up and down are human constructs, but they can be useful as relative terms in space, **Crockett** says. "It's not uncommon to think of up and down in space the same way we do on Earth — as movement against or along with a gravitational field." Astronomers also sometimes refer to locations above and below a galaxy, where "above" is in the northern hemisphere and "below" in the southern. Here, the terms are based on the system's direction of rotation.

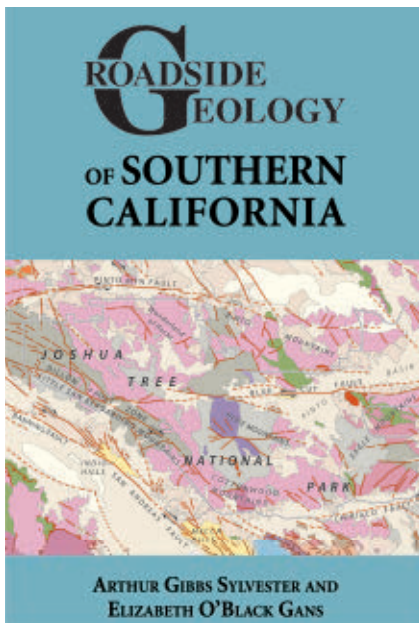


## The Roadside Geology book you've all been waiting for!

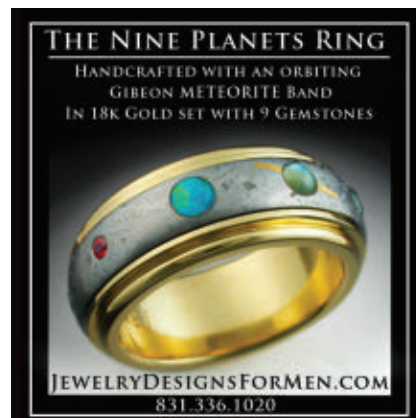
EXPLORE SOME OF THE MOST DIVERSE GEOLOGY IN THE WORLD WITH THIS NEW GUIDE . . .

*"Within an eight-hour drive of any point in southern California, you may view the results of almost every type of geologic process, from desert erosion to glaciation, from ancient to recent volcanism, and from prehistoric landslides to active earthquake faults."* —FROM THE INTRODUCTION OF *Roadside Geology of Southern California*

- 6 x 9, full color
- 400 pages
- \$26.00



**MP Mountain Press**  
PUBLISHING COMPANY  
P.O. Box 2399 • Missoula, MT 59806 • 406-728-1900  
800-234-5308 • info@mtnpublish.com  
www.mountain-press.com



✓Yes



✓Yes



xNo



✓Yes



✓Yes



✓Yes

✓ Reliably Low Prices  
✓ Easy To Use Website  
✓ Huge Selection  
✓ Fast Shipping  
www.rockauto.com

**ROCKAUTO.COM**  
ALL THE PARTS YOUR CAR WILL EVER NEED





## Seeing *The Bedroom* as van Gogh did

Though science and art are vastly different disciplines, one can shed light on the other. That connection is on display in a recolored version (above) of Vincent van Gogh's *The Bedroom*.

The colors in the original work (right), painted in 1889, have faded over time. For an exhibit on display through May 10 at the Art Institute of Chicago, conservation scientist Francesca Casadio and colleagues conducted a number of tests to reveal the pigments van Gogh used. A macro X-ray fluorescence scanner gave scientists a broad picture of the elements and minerals in the paint. A technique called surface-enhanced Raman spectroscopy — which uses laser light to make molecules vibrate in a way that betrays their identity — gave clues to other pigments in the paint. Finally, a microscopic sample taken from the painting (bottom right) was especially revealing: The underside divulged the original purple color of the walls.

Casadio and colleagues then worked with a color theorist to simulate van Gogh's paints, and with conservators and curators to create a digital version of the original painting that brings back “the emotional landscape of van Gogh,” Casadio says. “It’s a visualization that is not arbitrary; it’s informed by the science. But there’s still a process where you have to have the interpretive eye of those who know the artist.” — *Kate Travis*



Van Gogh described the walls he painted for *The Bedroom* as pale violet, though now they appear blue. Flipping over a tiny paint sample (left) — less than a millimeter across — revealed its original purple color.

RECOLORIZATION: ROY S. BERNIS AND BRITTANY COX/MUSELL COLOR SCIENCE LABORATORY/ROCHESTER INST. OF TECH.; KELLY KEEGAN/ART INST. OF CHICAGO; ORIGINAL PAINTING: V. VAN GOGH, *THE BEDROOM*, SEPT. 5, 1889; HELEN BIRCH BARTLETT MEMORIAL COLLECTION/ART INST. OF CHICAGO; PAINT CHIPS: INGE FIEDLER/ART INST. OF CHICAGO



Wear it  
today  
for only  
**\$29**

Our Lowest Price  
**EVER** on a Classic  
Dress Watch!



**TAKE 85% OFF  
INSTANTLY!**

When you use your  
INSIDER OFFER CODE

## Back Again for the First Time

*Our modern take on a 1929 classic, yours for the unbelievably nostalgic price of **ONLY \$29!***

You have a secret hidden up your sleeve. Strapped to your wrist is a miniature masterpiece, composed of hundreds of tiny moving parts that measure the steady heartbeat of the universe. You love this watch. And you still smile every time you check it, because you remember that you almost didn't buy it. You almost turned the page without a second thought, figuring that the **Stauer Metropolitan Watch for only \$29** was just too good to be true. But now you know how right it feels to be wrong.

**Our lowest price EVER for a classic men's dress watch.** How can we offer the **Metropolitan** for less than \$30? The answer is simple. Stauer has sold over one million watches in the last decade and many of our clients buy more than one. Our goal isn't to sell you a single watch, our goal is to help you fall in love with Stauer's entire line of vintage-inspired luxury timepieces and jewelry. And every great relationship has to start somewhere...

**Tells today's time with yesterday's style.** The Metropolitan is exactly the kind of elegant, must-have accessory that belongs in every gentleman's collection next to his British cufflinks and Italian neckties. Inspired by a rare 1929 Swiss classic found at auction, the **Metropolitan Watch** revives a distinctive and debonair retro design for 21st-century men of exceptional taste.

The **Stauer Metropolitan** retains all the hallmarks of a well-bred wristwatch including a gold-finished case, antique ivory guilloché

face, blued Breguet-style hands, an easy-to-read date window at the 3 o'clock position, and a crown of sapphire blue. It secures with a crocodile-patterned, genuine black leather strap and is water resistant to 3 ATM.

**Your satisfaction is 100% guaranteed.** We are so sure that you will be stunned by the magnificent **Stauer Metropolitan Watch** that we offer a 60-day money back guarantee. If you're not impressed after wearing it for a few weeks, return it for a full refund of the purchase price. But once the first compliments roll in, we're sure that you'll see the value of time well spent!

**Stauer Metropolitan Timepiece— ~~\$199~~**

**Offer Code Price ~~\$29~~ + S&P Save \$170**

*You must use the insider offer code to get our special price.*

**1-800-333-2045**

**Your Offer Code: MTW432-02**

Please use this code when you order to receive your discount.

**Stauer®**

14101 Southcross Drive W.,  
Dept. MTW432-02  
Burnsville, Minnesota 55337  
[www.stauer.com](http://www.stauer.com)



**Rating of A+**

*Smart Luxuries—Surprising Prices™*

Luxurious gold-finished case with sapphire-colored crown - Crocodile-embossed leather strap - Band fits wrists 6 1/4"-8 3/4" - Water-resistant to 3 ATM



340 carats of the "chameleon  
gemstone" for only \$8750

"Very few gems match tourmaline's  
dazzling range of colors."

— Gemological Institute  
of America

# The Gemstone Worth Staking Your Reputation On

From show stopping reds and vivid blues to deep greens and fragile pinks, tourmaline is the chameleon of the gem world. This gemstone comes in such a dazzling range of colors that its name literally means "mixed gems."

This stone is of such high quality that famed gemologist George Frederick Kunz staked his reputation on it. Walking into the offices of one of the biggest jewelers on 5th Avenue with green tourmaline in tow, he convinced the owner to purchase it. It was this interaction that led to Kunz becoming the company's resident gem expert for 53 years.

Like Kunz, we know a winner when we see it, so we created the **Chameleon Tourmaline Necklace**. We've gathered 340 carats of tourmaline in shades of blue, green, pink, and gold. The result? A show-stopping torsade. The stones verily leap over each other in flashes of rich color.

With its stunning array of colors and sheer amount of carat weight, there are many a jeweler out there that would price this beauty through the roof. But overpaying for luxury is something you'll never do with Stauer. We're offering you the *Chameleon Tourmaline Necklace* for **only \$8750**.

**Your satisfaction is 100% guaranteed.** Kunz took a risk on tourmaline and it paid off big. At Stauer, there's zero risk to embracing the finer things in life. Experience the gorgeous colors of the "chameleon gemstone". If you're not convinced you got excellence for less simply send it back within 60 days for a complete refund of the sale price (less S&P). But we're betting it's a keeper. We'd stake our reputation on it.

While there's no risk in purchasing the *Chameleon Necklace*, don't run the risk of missing out. These necklaces are in limited supply already. Call today and catch the rare chameleon gemstone before it's gone. ***Ask how to get an additional 50% OFF!***

TOURMALINE VARIETIES ARE AMONG THE RAREST & MOST  
EXPENSIVE GEMSTONES IN THE WORLD

"High quality paraiba tourmaline will sell for  
around \$12,000 per carat."

— GemstoneAdvisor.com

CALL NOW  
AND ASK ABOUT  
GETTING...

...an additional  
**50% OFF**  
sale price!

**Chameleon Tourmaline Necklace \$399\***

Offer Code Price Only **\$8750 + S&P** Save \$31150!

You must use the insider offer code when  
you call to get our special sale price.

**1-800-333-2045**

**Offer Code: CTN103-01**

Please use this code when you  
order to receive your discount.

**Stauer®**



14101 Southcross Drive W., Dept. CTN103-01,  
Burnsville, Minnesota 55337 [www.stauer.com](http://www.stauer.com)



\* Special price only for customers using  
the offer code versus the price on  
Stauer.com without your offer code.

340 ctw genuine tourmaline • Gold-finished .925 sterling silver bead connectors • 18" plus 2" extender; lobster clasp

*Smart Luxuries—Surprising Prices™*