Ancient Horse DNA | Lost Memories Restored | Far-Out Planet

Science of the society for science & the public = July 27, 2013

WATER MET HARTS

The B G Dhan B G Dhan B B Antarctic warming raises

Antarctic warming raises questions about continent's link to global climate change

Cleaner Air, Stormier Weather

Meet the Tetraquark

Mammoth Hunters Wanted Ivory

AN IMPORTANT ANNOUNCEMENT FROM STAUER



Between 4pm 15th and 8:30am 16th July, 1913 whilst in transit from Rue de Provence, Paris to Hatton Garden, London...

WORLD'S MOST VALUABLE NECKLACE YOU GET A SECOND CHANCE AT THE HEIST OF THE CENTURY—STEAL OUR VERSION FOR \$99!

In the summer of 1913, the most valuable necklace in the world disappeared somewhere between Paris and London. The collection of natural pink pearls was said to be worth "twice as much as the Hope Diamond." The bold heist made headlines and the manhunt for the suspect made history. Now, more than 100 years later, we're stealing it all over again... so you can steal it from us for **ONLY \$99!**

The Heist of the Century. Joseph Grizzard, aka "The King of Fences," was a professional thief with style. By day, he worked as a wellregarded jeweler in Edwardian London. He led a comfortable life and had plenty of money. He didn't need to steal. He just enjoyed the sport of it. When Grizzard heard word that the "Mona Lisa of pearls" was to be shipped between Paris and London by regular post, he set his plan in motion.

He snatched the strand of 61 perfectly matched, natural pink pearls from its mailbag, and replaced it with a scrap of newspaper and a handful of French sugar cubes. After a dramatic, Sherlock Holmes-worthy pursuit through the underbelly of Edwardian London society, Scotland Yard finally nabbed their man.

It would be a crime not to share. We found the thrilling story and classic style impossible to resist. It was the perfect opportunity to bring this remarkable piece of jewelry back to life. That's why we created the *Voléur Necklace*, working directly from the

Stauer® 14101 Southcross Drive W., Dept. VPN134-01 Burnsville, Minnesota 55337 www.stauer.com



The Voléur (French for "steal") Necklace features graduated pink spheres (6-12mm) in a double-stranded, 23" length that secures with a .925 sterling silver lobster clasp.

specifications of the infamous original.

That 1913 necklace took years to assemble and was crafted from incredibly rare natural pink pearls. Even if we recruited an army of divers to scour every ocean on Earth, we might be lucky to find enough for one necklace. And the cost would be in the millions. So we turned to science for a solution...

Our strand of pink orbs begin with the same organic material found in cultured pearls.

Voléur Necklace Regularly \$399 Exclusive <u>Call-In</u> Price ONLY \$99 But our meticulous laboratory process gives you a much more durable necklace, with spheres of near-perfect shape and superior luster that nature can only dream about.

Your satisfaction is 100% guaranteed. Bring the stunning *Voléur Necklace* home and wear it for 30 days. If you don't fall in love, send it back for a full refund of your purchase price. It's that simple. Don't miss this chance to experience true luxury for only \$99... without the larceny!











ScienceNews

In The News

5 STORY ONE

• Frozen horse fossil yields oldest genome sequence

8 ATOM & COSMOS

- Possible planet orbits inexplicably far from its sun
- Extragalactic radio bursts settle one issue, raise another
- Exotic particle may be first with four quarks
- Hubble captures an intergalactic deformation

10 HUMANS

- Fossils suggest ancient Siberians hunted mammoths for ivory, not meat
- Pristine royal burial unearthed in Peru

11 MATTER & ENERGY

- Surface tension pulls floating objects upstream
- Spiraling light increases data capacity of optical fibers

12 LIFE

- Social lemurs make better thieves
- Elephants switched to grass long before their teeth adapted to chewing it

13 EARTH

• Faults may take years, not decades, to heal after big quakes

14 GENES & CELLS

- Picked vegetables retain circadian rhythms
- Study finds genetic resistance to cholera in Bangladesh

15 ENVIRONMENT

- Decreased air pollution may have fueled hurricanes
- Ancient wheat yields genetic weaponry against stem rust

16 HEALTH & ILLNESS

 Cancer, infertility drugs may do double-duty against Ebola

Features

18 TAKING ANTARCTICA'S TEMPERATURE

> COVER STORY: Scientists don't know much about climate trends on the planet's most isolated continent, but what they do know is troubling. *By Erin Wayman*

24 MEMORIES LOST AND FOUND Enzymes that clamp down on

> gene activity may be important in memory – and promising as a new approach to Alzheimer's. *By Susan Gaidos*

Departments

- 2 FROM THE EDITOR
- **4 NOTEBOOK**
- 30 BOOKSHELF
- 31 FEEDBACK
- 32 PEOPLE

Erich Jarvis argues that chimps could be made to learn speech.



COVER Sheathed in ice and isolated from the rest of the world's land masses, Antarctica largely remains terra incognita when it comes to climate change. NASA/Wikimedia Commons

ScienceNews

CHIEF EXECUTIVE OFFICER, INTERIM Rick Bates EDITOR IN CHIEF Eva Emerson

EDITORIAL

MANAGING EDITOR SENIOR EDITOR, SCIENCE NEWS FOR KIDS DEPUTY MANAGING EDITOR, NEWS DEPUTY MANAGING EDITOR, FEATURES DEPUTY MANAGING EDITOR, DEPARTMENTS DEPUTY MANAGING EDITOR, PUBLICATIONS BEHAVIORAL SCIENCES BIOMEDICINE CHEMISTRY/INTERDISCIPLINARY SCIENCES EARTH AND ENVIRONMENT LIFE SCIENCES MOLECULAR BIOLOGY NEUROSCIENCE PHYSICS STAFE WRITER EDITORIAL ASSISTANT SCIENCE WRITER INTERNS CONTRIBUTING CORRESPONDENTS

Matt Crenson Janet Raloff Lila Guterman Lynn Addison Erika Engelhaupt Kate Travis Bruce Bower Nathan Seppa Rachel Ehrenberg Erin Wavman Susan Milius Tina Hesman Saey Laura Sanders Andrew Grant Meghan Rosen Allison Bohac Cristy Gelling, Jessica Shugart Laura Beil, Susan Gaidos

Alexandra Witze

Erin Otwell

Tosh Arimura

Melissa Pewett

Kerwin Wilson

Evora Swoopes

DESIGN DIRECTOR Beth Rakouskas ASSISTANT ART DIRECTORS Marcy Atarod, Stephen Egts,

BUSINESS SERVICES

DESIGN

CIRCULATION AND MEMBERSHIP SPONSORSHIP AND ADVERTISING SUBSCRIBER SERVICES PERMISSIONS



BOARD OF TRUSTEES CHAIRMAN H. Robert Horvitz VICE CHAIR Jennifer Yruegas SECRETARY Alan Leshner TREASURER Robert W. Shaw Jr. AT LARGE Michela English MEMBERS Craig R. Barrett, S. James Gates Jr., Tom Leighton, Paul Maddon, Stephanie Pace Marshall, Patrick McGovern, Joe Palca, Vivian Schiller, Frank Wilczek

EXECUTIVE OFFICE CHIEF EXECUTIVE OFFICER, INTERIM Rick Bates CHIEF CONTENT OFFICER Mike Mills EXECUTIVE ASSISTANT Amy Méndez

FINANCE CHIEF FINANCIAL OFFICER Greg Mitchell ACCOUNTING MANAGER Lisa M. Proctor SENIOR ACCOUNTANT Sivakami Kumaran

EXTERNAL AFFAIRS CHIEF ADVANCEMENT OFFICER Rick Bates SENIOR COMMUNICATIONS MANAGER Sarah Wood SOCIAL MEDIA Patrick Thornton EXTERNAL AFFAIRS Nancy Moulding

EVENTS MANAGEMENT DIRECTOR Cait Goldberg ASSOCIATE Marisa Gaggi

SCIENCE EDUCATION PROGRAMS DIRECTOR Michele Glidden INTEL SCIENCE TALENT SEARCH MANAGER Caitlin Sullivan BROADCOM MASTERS MANAGER Allison Hewlett INTERNATIONAL FAIRS MANAGER Sharon Snyder DOMESTIC FAIRS Laurie Demsey VOLUNTEERS AND SPECIAL AWARDS Diane Rashid

AWARD AND EDUCATION PROGRAM ADMINISTRATION June Kee INTERNATIONAL FAIRS SPECIALIST Jinny Farrell PROGRAMS ASSOCIATE Laura Buitrago OUTREACH Victor Hall

INTERNAL OPERATIONS DIRECTOR Harry Rothmann

NETWORK MANAGER James C. Moore OPERATIONS MANAGER Anthony Payne FACILITIES Paul Roger BLACKBAUD ENTERPRISE ADMINISTRATOR Alan Gordon INFORMATION TECHNOLOGY James Chadwick, Gregory A. Sprouse, Divya Kanuparthi MAILROOM Randy Williams

EDITORIAL, ADVERTISING AND BUSINESS OFFICES

1719 N Street NW, Washington, DC 20036 Phone (202) 785-2255 Automatication Subscriptions subs@sciencenews.org Editorial/Letters editors@sciencenews.org

Advertising/Business snsales@sciencenews.org

Kexterity Digital edition provided by Texterity, www.texterity.com Science News (ISSN 0036-8423) is published biweekly, for \$54.50 for 1 year or \$98 for 2 years (international rate \$80.50 for 1 year or \$161 for 2 years) by Society for Science & the Public, 1719 N Street NW Washington, D.C. 20036. Preferred periodicals postage paid at Washington, D.C., and an additional mailing office.

Subscription Department: PO Box 1205, Williamsport, PA 17703-1205. For new subscriptions and customer service. call 1:800-552-4412.

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. Copyright © 2013 by Society for Science & the Public. Title regis tered as trademark U.S. and Canadian Patent Offices. Printed in U.S.A. on recycled paper.

FROM THE EDITOR

Data on Antarctic climate key to filling in unknowns



Antarctica is the last place on Earth that scientists thought they would see signs of climate change. As recently as 2007, the icy continent appeared to be so far removed from the rest of the globe as to have avoided the reach of global warming. It helps that it's not very warm to begin with. Even in summer, it's below freezing. Yet Antarctica's very remote-

ness and extreme cold have made it difficult to monitor. The long-term weather records that do exist are sparse. Without a lot of data, the full reality of how climate change is impacting the faraway land continues to be unclear. But now, as Earth and environment writer Erin Wayman reports on Page 18, ice cores and other climate indicators reveal signs of warming and dramatic increases in average temperature in certain regions. The changes are nowhere near the threshold needed to actually melt the huge Antarctic ice sheet. But the news of change is ominous. If even parts of the ice sheet were to melt, it could lead to major sea level rise around the world. It's too much of a risk to let it remain, as we say on the cover, one of the big unknowns.

And in the future it shouldn't be. Where there were just a smattering of outposts collecting information about Antarctic climate 60 years ago, there are now scores of weather stations, most of them automated, gathering data, as well as satellites remotely sensing the frozen landscape from on high. Added to new approaches for studying the climate there, this datagathering effort should help fill in some of the many unknowns.

Memory loss associated with Alzheimer's and other forms of dementia is another area beset with unknowns. On Page 24, correspondent Susan Gaidos reports on a small victory in better understanding memory creation and loss: Drugs that help mice recover lost memories. Though the compounds have yet to be tested in people, the drugs' activity has provided insights into the molecular mechanisms that govern memory. Chemical changes triggered by age, stress and disease can keep DNA wound up tight and block the molecular machinery necessary for the creation and recall of memories.

Other signs of scientific progress, including some real mind-benders, can be found in reports on how tea leaves flow upstream (Page 11), a link between clean air and more storms (Page 15), a set of radio bursts detected from beyond the Milky Way (Page 8) and, my favorite, how veggies in your fridge keep time (Page 14). – *Eva Emerson, Editor in Chief*

Society for Science & the Public is a 501(c)3 nonprofit corporation founded in 1921. The vision of Society for Science & the Public is to promote the understanding and appreciation of science and the vital role it plays in human advancement: to inform, educate, inspire. Visit Society for Science & the Public at www.societyforscience.org. Republication of any portion of *Science News* without written permission of the publisher is prohibited. For permission to photocopy articles, contact Copyright Clearance Center at 978-750-8400 (phone) or 978-750-4470 (fax). Advertising appearing in this publication does not constitute endorsement of its content by *Science News* or Society for Science & the Public.

Millions of Silver Dollars Bear His Mark. Only a Few Bear His Autograph.





An American Silver Masterpiece personally autographed by the artist himself—exclusively from New York Mint!

The American Eagle Silver Dollar is a certified legend—and a runaway best seller! Over 300 MILLION have been snatched up by collectors and silver dollar lovers since they were first struck in 1986. Every single dollar features the mark of the U.S. Mint's 12th Chief Engraver, John Mercanti—the man who personally designed the famous heraldic eagle and shield reverse of this American silver masterpiece. Mr. Mercanti's "JM" monogram appears to the right of the eagle's tail feathers.

First Time Ever

While over 300 million Silver Eagles bear John Mercanti's initials, this is the *first time ever* that he has personally autographed 2013 American Eagle Silver Dollars. And you won't find them anywhere else.

Each massive one Troy ounce 99.9% pure silver dollar has been certified and graded as near-flawless Mint State 69 (MS69) by Professional Coin Grading Service (PCGS). Mr. Mercanti has signed each coin directly on the label. His autograph and the coin are preserved forever within the archival acrylic holder.

These legal tender American Silver Dollars feature a nearly 100-year-old design of Lady Liberty striding confidently forward while draped in a U.S. flag, while Mr. Mercanti's design depicts a majestic U.S. eagle, thirteen stars, and an American shield.

Own the Silver Dollar Millions Will Covet!

New York Mint is honored to release these exclusive autographed 2013 Silver Eagles. But the supply is extremely limited and millions who own regular Silver Eagles will never even get the opportunity to secure these certified Mint State 69 coins bearing the artist's signature.

30-Day Money-Back Guarantee

You must be 100% satisfied with your 2013 American Eagle Autographed Silver

Dollars or return them within 30 days of receipt for a prompt refund (*less all s/h*). Don't miss out on this exclusive and extremely limited release. Call immediately to secure yours while there's still time!

CHIEF ENGRAVE

John M. Mercan

2013 American Eagle Autographed PCGS MS69 Silver Dollar Your cost: 1-4 Coins- \$99 each + *s/h*

four cost: 1-4 Coins- \$99 each + s/h5-9 Coins- \$95 each + s/h10-20 Coins- \$89 each + s/h

For fastest service, call toll-free 24 hours a day **1-888-870-6352**





14101 Southcross Drive W. Dept. MAD149-01 Burnsville, MN 55337 www.NewYorkMint.com

Prices and availability subject to change without notice. Past performance is not a predictor of future performance. NOTE: New York Mint® is a private distributor of worldwide government coin and currency issues and privately issued licensed collectibles and is not affiliated with the United States government. Facts and figures deemed accurate as of June 2013. ©2013 New York Mint, LLC.



Say What? | DUA'S LAYER \DOO-uhs LAY-uhr\ n.

The fourth of six layers that make up the human cornea, the dome-shaped outer lens that protects the eye. This newly discovered bit of human anatomy is strong but just 10 microns thick, making it difficult to find in a structure that's only around 550 microns from front to back. A team led by Harminder Dua of the University of Nottingham in England spotted the layer by blowing itty-bitty air bubbles into the corneas of eyes donated for research. A rip in Dua's layer may be responsible for corneal hydrops, a buildup of fluid in some patients with a corneal deformity, the researchers report May 28 in *Ophthalmology. — Sarah Zielinski*

The -est

FARTHEST SPACECRAFT COMMUNICATIONS Launched 35 years ago, the Voyager 1 space probe is still sending messages back to Earth from its vantage point near the solar system's edge. At 18.5 billion kilometers away from Earth and counting, signals from Voyager 1 take about 17 hours to get here. The messages contain information about



the new realm Voyager 1 has entered — a region between our solar system and the beckoning maw of interstellar space. Measurements from Voyager's distant transition, presented June 27 in *Science*, reveal that the probe no longer encounters particles emanating from the sun. But Voyager 1 still feels the effects of the sun's spiral-shaped magnetic field. Voyager team scientists think this new territory could represent the last leg of the spacecraft's journey out of the solar system. *— Jessica Shugart*



Science Stats | BRAIN GROWS BACK

You can grow new brain cells, and now scientists know just how quickly parts of the brain rebuild themselves. An international team used radioactive carbon produced by atomic bomb testing during the 1950s and '60s to carbon-date neurons collected from people after they died. Neuron creation rates declined slightly with age, the team reports in the June 6 *Cell. – Erika Engelhaupt*

50 Years Ago Excerpt from the

July 27, 1963,



issue of Science News Letter

CHROMOSOME VARIATIONS

The normal number of chromosomes in each human cell is 46, but it can vary in different cells ... Dr. D.G. Harnden of the Medical Research Council. Edinburgh, Scotland, told the International Conference on **Congenital Malformations** in New York.... Among others from the nine countries attending the conference was Dr. Mary L. Lyon, of the Medical Research Council Radiobiological Unit, Harwell, England, who originated the theory that woman is a genetic "mosaic".... Dr. Lyon's theory is that only one of the two socalled X chromosomes in any given normal female cell is active and functional. The other is inert. In roughly half the cells in a woman's body, it is the X chromosome inherited originally from her father that is active, while the active X in the other cells is the maternal X If the Lyon theory is correct, Dr. Murray L. Barr of the University of Western Ontario, Canada, said, it ... may "prove to have genetic and biological implications far beyond the expected."

UPDATE: Mary Lyon's theory, now known as X inactivation, was proved correct and is fundamental to understanding many genetic diseases. Today, scientists know that one X chromosome is silenced in each female cell by a long non-coding RNA molecule called Xist (*SN: 12/17/11, p. 22*). Murray Barr identified inactivated X chromosomes in female cells, masses now called Barr bodies.

In the News

STORY ONE

Ancient horse's DNA fills in picture of equine evolution

A 700,000-year-old fossil proves astoundingly well preserved

> Przewalski's horses (one shown in Mongolia) are the last truly wild species of horse, a new study of ancient DNA suggests.

Atom & Cosmos First four-quark particle

Humans Mammoths weren't just meals

Life Gregarious but stealthy lemurs

Genes & Cells Groceries tell time

Matter & Energy Tea leaves buck the flow

Health & Illness Old drugs take on Ebola

By Tina Hesman Saey

frozen fossil of a horse has yielded the oldest genome sequence ever compiled, providing a wealth of information about horses' provenance and relationship to zebras, donkeys and other related species. The research also helps solve a long-standing mystery surrounding a rare Mongolian breed that turns out to be the last of the truly wild horses.

Clocking in at about 700,000 years old, the horse DNA is much older than the previous record holder, the genome of an 80,000-year-old Denisovan, an extinct evolutionary cousin of Neandertals and modern people (see Back Story, Page 6).

The extreme age of the horse's genetic material has raised hopes that scientists can isolate and analyze even older DNA, perhaps a million years old or more. The ancient DNA also provides scientists with some of the first clues about the genetic changes that accompanied horse domestication.

An international team deciphered the genome of the horse from the Middle Pleistocene epoch, along with those of a 43,000-year-old horse, a modern donkey and five contemporary domestic horse breeds. Using those data, the researchers pushed back the emergence of the ancestor of horses, zebras, asses and donkeys to about 4 million to 4.5 million years ago. That makes the ancestor twice as old as previously thought, the team reports in the July 4 *Nature*.

Prior to the new work, researchers had retrieved snippets of DNA that were more than 100,000 years old from cave bear fossils and ice cores. But those snippets were very short, providing nothing like the information contained in the billions of chemical

IN THE NEWS

For the latest news, visit www.sciencenews.org

Researchers extracted DNA from these pieces of a 700,000-year-old horse bone and compiled the world's oldest genome.

units, or nucleotides, that make up a genome, an organism's complete set of genetic instructions. "It was literally nothing more than a few nucleotides," says study coauthor Ludovic Orlando, anevolutionarybiologistatthe University of Copenhagen.

So Orlando and his colleagues were astounded by how well preserved the biological molecules were in the ancient horse foot bone. The fossil was found in permafrost at the Thistle Creek site in the Canadian Yukon.

Experts on ancient DNA say that natural deep freezes such as permafrost are the place to look for really old specimens. "They took advantage of the best possible conditions," says Carles Lalueza-Fox of the Institute of Evolutionary Biology in Barcelona. But, he says, the question remains: "How far back can you go in nonpermafrost environments?"

The study may help settle a debate over whether a Mongolian equine called the Przewalski's (pronounced *sheh-VALskees*) horse is really wild and has no domesticated ancestry. Named for the Russian colonel who led an expedition in 1881 that found them, Przewalski's horses were extinct in the wild for decades until a captive breeding program reintroduced them to Mongolia in the mid-1990s.

Some experts consider these sturdy steppe animals a separate species (*Equus ferus przewalskii*) and the last wild horse. Others insist the wild horses are a subspecies, a feral offshoot of domestic horses (*Equus ferus caballus*) like the American mustang, Chincoteague pony or Australian brumby. The debate has been difficult to resolve because, until the new study, scientists had no examples of wild ancestral horses to compare with Przewalski's and domestic horses. and modern horses, the researchers concluded that Przewalski's horse is a separate, truly wild species that split sometime between 38,000 and 72,000 years ago from the lineage that led to domestic horses. Since that time the two groups have not interbred, the researchers found. "It is 100 percent wild," says Eske Willerslev of the University of Copenhagen. "There's not domestic genetics present in that horse."

Despite stemming from only 13 or 14 animals in zoo breeding programs, Przewalski's horses have retained more genetic diversity than the domestic horse breeds the team examined. That diversity is good news for conservation efforts. "It might mean we could have a very good chance at saving that horse population," Orlando says.

Meanwhile, the researchers are gleaning information about horse domestication by identifying genes that differ among domestic horses, Przewalski's horses and the fossils. So far, genes involved in production of blood and sperm, muscle organization and coat color show signs of being important for domestication. ■



By lining up the DNA from the ancient

Back Story | FROM HORSES TO HUMANS

The 700,000-year-old horse genome raises the possibility that scientists may one day read the genetic blueprints of human ancestors that are just as old. Researchers have already sequenced the DNA of two recent human cousins -Neandertals and Denisovans—using fossils dating to about 40,000 to 80,000 years ago (SN: 8/25/12, p. 22). These hominid fossils were found in cool, dry caves. Such environments preserve DNA by slowing its decay. Scientists don't know how long DNA can survive intact, but a recent study suggested it could last at least 1 million years if conditions were right. So researchers might find DNA lingering in fossils of Homo erectus, which lived in Africa and Asia some 1.9 million to 140,000 years ago, or Homo heidelbergensis, which lived in Africa and Europe 700,000 to 200,000 years ago. Some anthropologists think H. heidelbergensis (skull shown) gave rise to Neandertals and Homo sapiens; DNA would help clarify these relationships. Another important discovery would be genetic material from the earliest H. sapiens, which lived some 200,000 to 100,000 years ago. Sequencing such DNA would "transform our understanding of human origins," says anthropologist John Hawks of the University of Wisconsin–Madison. "We don't need to go back 700,000 years to have tremendously interesting insights into our evolution." - Erin Wayman



What Are the Greatest Orchestral Works?

Orchestral music is undoubtedly one of the supreme artistic traditions of Western culture. And, over the centuries, this amazing medium has given us special works that stand apart from the rest with their transcendent expressions of the human spirit.

In **The 30 Greatest Orchestral Works**, award-winning composer and Professor Robert Greenberg takes you on a sumptuous tour of masterpieces that, in his expert opinion, are the best of the best. In 32 lectures filled with musical excerpts, discover the wonders of landmark creations such as Haydn's Symphony no. 104, Beethoven's Ninth Symphony, and Stravinsky's *The Rite of Spring*. Designed for both seasoned music lovers and newcomers to orchestral music, this course is an accessible point of entry to a cherished repertoire.

Offer expires 09/25/13 1-800-832-2412 www.thegreatcourses.com/8sn

The 30 Greatest Orchestral Works

Taught by Professor Robert Greenberg SAN FRANCISCO PERFORMANCES

LECTURE TITLES

- 1. Game Plan and Preliminaries
- 2. Vivaldi—The Four Seasons
- 3. Bach—Brandenburg Concerto No. 2
- 4. Bach—Violin Concerto in E Major
- 5. Haydn—Symphony No. 104
- 6. Mozart-Piano Concerto No. 24 in C Minor
- 7. Mozart—Symphony in C Major, "Jupiter"
- 8. Beethoven-Symphony No. 3
- 9. Beethoven-Piano Concerto No. 4
- 10. Beethoven-Symphony No. 9
- 11. Schubert-Symphony No. 9
- 12. Mendelssohn—"Italian" Symphony
- 13. Schumann—Symphony No. 3
- 14. Brahms—Symphony No. 4
- 15. Brahms—Violin Concerto
- 16. Tchaikovsky—Symphony No. 4
- 17. Tchaikovsky—Violin Concerto
- 18. Bedřich Smetana—Má Vlast
- 19. Dvořák-Symphony No. 8
- 20. Dvořák-Concerto for 'Cello
- 21. Rimsky-Korsakov—Scheherazade
- 22. Richard Strauss—Thus Spoke Zarathustra
- 23. Mahler—Symphony No. 5
- 24. Rachmaninoff—Symphony No. 2
- 25. Debussy—La Mer
- 26. Stravinsky—The Rite of Spring
- 27. Ives—Three Places in New England
- 28. Holst—The Planets
- 29. Copland—Appalachian Spring
- 30. Shostakovich—Symphony No. 5
- 31. Shostakovich-Symphony No. 10
- 32. The Ones That Got Away

The 30 Greatest Orchestral Works Course no. 7330 | 32 lectures (45 minutes/lecture)

SAVE UP TO \$385

DVD \$519.95 NOW \$134.95 +\$20 Shipping, Processing, and Lifetime Satisfaction Guarantee CD \$359.95 NOW \$94.95 +\$15 Shipping, Processing, and Lifetime Satisfaction Guarantee Priority Code: 77674

Designed to meet the demand for lifelong learning, The Great Courses is a highly popular series of audio and video lectures led by top professors and experts. Each of our more than 400 courses is an intellectually engaging experience that will change how you think about the world. Since 1990, over 10 million courses have been sold.

Atom & Cosmos

For more Atom & Cosmos stories, visit www.sciencenews.org

Planet may have orbit twice Pluto's

Distant world far from its sun hard to explain—if it exists

By Andrew Grant

A mysterious gap in a star's dusty shell of debris could be the signature of a young planet circling its sun at twice the distance of Pluto's orbit. If the far-flung planet does exist, its birth may be hard for astronomers to explain.

"If this is a planet, it is extremely challenging for existing planet formation theories," says Katherine Kretke, an astronomer at the Southwest Research Institute in Boulder, Colo.

Most planets are thought to begin their lives as small clumps of hot, rapidly moving dust and gas within vast disks of debris that orbit newborn stars. As a planet grows it behaves like a snow plow, scooping up some material to bulk up while flinging other material away, until it has cleared a smooth orbital path.

John Debes, an astronomer at the Space Telescope Science Institute in Baltimore, used the Hubble Space Telescope to study a disk around TW Hydrae, a 10-million-year-old star located about 176 light-years from Earth.

The Hubble images revealed an

unmistakable gap 12 billion kilometers from the star, 80 times farther than Earth is from the sun. "It's very striking," says Phil Armitage, an astrophysicist at the University of Colorado Boulder. "It looks like what you'd expect from a forming planet."

If the planet's existence is confirmed, astronomers have their work cut out to explain how it got there. Compared with particles in tighter orbits, ones near that gap are less densely packed and move much more slowly, Kretke says. As a result, it would be difficult for a potential planet to accrue enough material to clear its own orbit.

An alternative theory of planet formation posits that clumps of gas within a disk can rapidly collapse together in a process similar to the one that forms stars. That could account for the outer bulky planets recently discovered around the star HR 8799 (*SN Online: 12/3/10*). But Kretke says that process is capable only of building worlds more massive than Jupiter, while this potential planet would be the size of Neptune or a large Earth.

"No matter how you look at it, if there's



A dark ring in the middle of a dusty disk surrounding the star TW Hydrae may have been created by a growing planet.

a planet there it's going to change theories of how planets form," Debes says. His team's results appear in the July 1 *Astrophysical Journal.*

The next step is to find the planet, Debes says, which will be no easy task. Just identifying the gap in TW Hydrae's disk was akin to seeing a groove in an LP record from six kilometers away; now astronomers hope to find a speck hidden within that groove.

Debes notes that the Hubble photos were taken by an instrument installed in 1997; he is confident that next-generation telescopes will see the planet if it exists.

Distant radio pulses detected

Signals could help scientists calculate universe's mass

By Jessica Shugart

It may have taken billions of years for them to get here from deep space, but four recently detected radio signals disappeared only milliseconds after arriving at Earth. The fleeting signals, only the second detection ever of radio bursts emanating from beyond the Milky Way, could help scientists understand the vast unexplored areas that separate galaxies.

Picked up by an international team of astronomers at the Parkes Radio Telescope in Australia, the powerful radio pulses emanate from sources 5 billion to nearly 11 billion light-years away, the researchers report in the July 5 *Science*. The nature of these sources remains a mystery, says Benjamin Stappers of the University of Manchester in England, but "clearly they're very energetic events, probably cataclysmic."

One-time radio pulses have been hard to detect because today's telescopes capture radio waves from such a small fraction of the sky, and the instruments lack the ultrafast time resolution required to pinpoint the short-lived bursts. The four new blips may add weight to the only other extragalactic radio burst ever witnessed, reported seven years ago by Duncan Lorimer of West Virginia University in Morgantown and his team. "We only had one burst," Lorimer says. "So always in the back of our minds, we wondered whether it was some weird artifact."

Now Lorimer is convinced that extragalactic radio bursts are a bona fide phenomenon. Stappers' team estimates that 10,000 occur every day. Radio wave bursts get scattered by electrons floating in interstellar space, so Stappers envisions using them as tools to measure the mass of those electrons between galaxies.

First four-quark particle may have been spotted

Finding might shed light on how nucleus is held together

By Andrew Grant

An exotic particle could be the first amalgamation of more than three quarks — the fundamental building blocks of atomic nuclei — to be produced experimentally. If it is what physicists think it is, the particle could provide clues about the force that holds nuclei together and perhaps about the earliest moments of the universe.

"We have very solid evidence of an unconventional particle," says Ronald Poling, a physicist at the University of Minnesota in Minneapolis. "But it's the interpretation – the possibility that it has four quarks – that makes it very exciting." The details of the particle, inelegantly named $Z_c(3900)$, appear in the June 21 *Physical Review Letters*.

Physicists have known since the 1960s that protons and neutrons are made up of quarks, as are hundreds of other particles. All of these particles fall into two categories: mesons, which contain two quarks, and baryons (including protons and neutrons), which contain three.

Over the last decade many physicists, including those at the Belle experiment in Japan and the BESIII experiment in China, have fruitlessly searched for particles with more than three quarks. Probing a particle's insides is tough because physicists can't see quarks directly. Instead experimenters must rely on properties such as the mass, charge and decay products of particles produced by collisions, looking for unusual characteristics that can be explained only by a peculiar combination of quarks.

The Belle and BESIII teams were both studying an odd particle called

Y(4260) when they realized that it decayed to make another interesting particle, $Z_c(3900)$. Its mass, says Poling, who is part of the BESIII team, suggests that it is an electrically neutral meson made up of two quarks with opposite charges, called charm and anticharm. But surprisingly, both teams found that $Z_c(3900)$ has an electric charge.

In fact, Poling says, no two-quark or three-quark combinations can explain $Z_c(3900)$'s charge and mass. That is leading physicists to the more exciting conclusion that the particle consists of four quarks: a charm and an anticharm along with an up and an antidown, which are extremely light and create a net positive charge. "The particle's charge makes it a smoking gun for a four-quark state," says Tomasz Skwarnicki, a physicist at Syracuse University in New York.

Assuming the evidence for a fourquark arrangement holds up, the big question will be how those quarks are arranged. $Z_c(3900)$ could be a single entity of four quarks, Skwarnicki says, but it could also be a coupling of two mesons, analogous to two atoms linking up to form a molecule.

Poling says that understanding the particle's internal structure could improve physicists' grasp of the strong nuclear force, which dictates how quarks bond together to create protons, neutrons and other composite forms of matter.

In addition, physicists believe that just after the Big Bang, matter existed in the form of a hot soup of individual quarks and gluons, the particles that carry the strong force. Perhaps, as the universe cooled, that soup solidified into exotic multiquark combinations such as $Z_c(3900)$ before breaking up into the particles observed today. "The more complete our picture of all the elementary particles and their interactions," Poling says, "the better we'll understand where we started out and how we got to where we are."

Cradled galaxies

A Hubble Space Telescope portrait released June 20 reveals two galaxies interacting in a scene reminiscent of a penguin safeguarding its egg. But the placid pair—collectively called Arp 142—actually bears the scars of a destructive past. The galaxy NGC 2936 (top curved form) was once a spiral like the Milky Way, until the gravitational pull from the egg-shaped galaxy NGC 2937 (oval at bottom) warped it into avian form. Remnants of NGC 2936's spiral arms radiate out from the bird's eye, which once formed the galaxy's core. The system lies 326 million light-years away in the constellation Hydra. —Jessica Shugart



Humans

Siberians rarely ate mammoths

Stone Age folk mainly killed for ivory, fossils suggest

By Bruce Bower

Contrary to their hunting reputation, Stone Age Siberians killed mammoths only every few years when they needed tusks for toolmaking, a new study finds.

People living between roughly 33,500 and 31,500 years ago hunted the animals mainly for ivory, say paleontologist Pavel Nikolskiy and archaeologist Vladimir Pitulko of the Russian Academy of Sciences. Hunting could not have driven mammoths to extinction, the researchers report June 5 in the *Journal of Archaeological Science*.

On frigid tundra with few trees, mammoth tusks substituted for wood as a raw material for tools, they propose. Siberian people ate mammoth meat after hunts, but food was not their primary goal.

Several European and North American sites have yielded single mammoth carcasses lying amid stone tools. Such finds could reflect either hunting or scavenging. Finds at Siberia's Yana archaeological site provide an unprecedented window on the hunting and killing of mammoths over a long time period, says archaeologist John Hoffecker of the University of Colorado Boulder.

Mammoth bones appear in sufficient numbers at some sites in Europe to suggest that hunters there did seek more than ivory, says archaeologist Jiří Svoboda of Masaryk University in Brno, Czech Republic. Whatever happened at Yana, many groups were probably interested in obtaining mammoth meat, fat, bones, tusks and skin, Svoboda says.

Since 2008, scientists have unearthed 1,103 bones from at least 31 mammoths at Yana. Radiocarbon measurements indicate that mammoth remains gradually accumulated there over 2,000 years.



Excavated mammoth bones from Siberia's Yana archaeological site suggest that people hunted mammoths mainly for ivory, used to make tools.

Right shoulder blades from two mammoths contain pieces of stone spear points. An ivory splinter, possibly from a spear's shaft, pierced one of these bones. Another shoulder blade and a thigh bone display holes made by spears. Angles of these wounds suggest that hunters struck mammoths from behind. "Yana people definitely attacked from the mammoth's blind spot," Nikolskiy says.

"Yana people definitely attacked from the

mammoth's blind spot." - PAVEL NIKOLSKIY

Most mammoth bones at Yana come from animals with slightly curved tusks that were the best size and shape for making hunting weapons, Nikolskiy and Pitulko propose.

Researchers have found five mammoth bones from the base of the animals' tongues at a campsite not far from where remains were excavated. Meaty parts of the animals were probably consumed at the campsite, the investigators say.

While hunting was not the main cause of mammoths' extinction in Asia and Europe, it may have been the last straw as warming temperatures shrank livable areas for the creatures.

Pre-Inca empire tomb found untouched in Peru

Archaeologists have discovered a royal tomb of the Wari empire, a pre-Inca civilization that covered what's now western Peru from 700 to 1000.

A team led by Milosz Giersz of the University of Warsaw dug through debris at a Wari site near Peru's northern coast last September and entered an unlooted ceremonial room that contained a stone throne. There researchers found more than 1,000 objects, including gold and silver jewelry and bronze axes. A main chamber contained 60 human bodies buried in seated positions, possibly as ritual sacrifices. Bodies of three Wari queens rested in side rooms, along with possessions such as gold weaving tools and a ceramic flask decorated with a painted Wari lord (shown).

Discoveries in the tomb suggest that the Wari worshipped royal ancestors. Giersz's team suspects that the Wari periodically displayed mummies of their queens on the stone throne.

Giersz announced the discovery at a June 27 press conference at the South American site. — *Bruce Bower*

Matter & Energy

Tension behind tea leaf mystery

Property of water's surface allows unexpected motion

By Andrew Grant

Rogue tea leaves have led physicists to the discovery of a counterintuitive phenomenon: Particles can float upstream in moving water.

"It's interesting and very cool," says Eva Kanso, a physicist at the University of Southern California. "I'm going to have my students do an experiment like this."

The conventional wisdom that things always flow downstream started to unravel for Sebastian Bianchini one night in 2008. Then an undergraduate at the University of Havana in Cuba, Bianchini was pouring hot water over a cup of mate tea leaves when he noticed that by the time he filled his cup, a handful of tea leaves had invaded the pristine water in the kettle. He described his strange observation to University of Havana physicist Ernesto Altshuler, and they ran some experiments. Although they thought they understood what was going on, Altshuler says other physicists were skeptical, so the pair never published the findings.

Then last year Altshuler met Troy Shinbrot, a physicist at Rutgers University in Piscataway, N.J., who agreed to replicate the experiment. Shinbrot set up two tanks side-by-side and elevated one of them, with water flowing down through a channel. Sure enough, within seconds of adding chalk and mate tea to the bottom tank, particles began climbing up the channel to contaminate the upper tank.

Shinbrot's experiments led him to the conclusion that Altshuler's team had also reached: The particles overcome gravity and the current thanks to a property of water called surface tension. The linkup of hydrogen atoms among water molecules tends to create an elastic, trampoline-like surface. But small particles like tea leaves disturb that network, causing the hydrogen bonds to pull apart and thrust the particles toward purer water where the surface tension is higher. Physicists have long known that particles can get a push via this process, Shinbrot says, but they never considered the force strong enough to propel particles upstream.

The researchers describe the surface tension theory and experiments July 3 in *Proceedings of the Royal Society A*.

Shinbrot and Altshuler concede that they don't know whether their discovery has implications outside of tea preparation. But Shinbrot says it's possible that pollutants can also migrate upstream in a slow-moving river. He also demonstrated that particles can sneak into the tips of pipettes, potentially contaminating lab samples if the pipettes are reused. ■

Twisted light transmits more data

Spiral beams allow multiple information streams in one cable

By Andrew Grant

A new fiber-optic cable that shuttles multiple beams of light simultaneously could drastically speed data transfer over the Internet.

"It's like having more fibers without actually laying more fibers," says Andrew Weiner, a physicist at Purdue University in West Lafayette, Ind.

Telecommunications companies use light to encode and send data through fiber-optic cables. Over the last few decades, scientists have increased bandwidth by enabling a single beam to carry more information, but their progress soon will be outpaced by the vast amounts of data people exchange. Laying more fibers would be expensive. "We've gotten to the point where the [telecom] community has been asking what else we can do," says Siddharth Ramachandran, a physicist at Boston University.

The solution he and his team came up with was to dispatch multiple beams of light through a single fiber. The idea goes back nearly four decades, but it's not an easy thing to do because traditional fibers allow light beams moving in parallel to interfere with each other, jumbling the 1s and 0s encoded in each beam.

In the June 28 *Science*, Ramachandran and his team report building a 1.1-kilometer-long fiber that, for the first time, allows multiple beams to reach their destination intact. Their silica fiber is doped in places with other materials, which cause the beams to move at slightly different speeds and prevent them from mixing with each other. Using an instrument called a spatial light modulator to twist the beams, the researchers sent as many as four concurrent beams, transmitting data at speeds up to 1.6 trillion bits per second, through their custom fiber. They hope to squeeze more data into each of those beams using methods already exploited by the telecom industry. Ramachandran notes that the team manufactured its fiber at a commercial facility using standard methods, so if it were mass produced, the fiber should not cost much more than those now in use.

Ramachandran says he is unsure whether the new fiber will work for communicating data over long distances, but hopes that it will improve transmission in dense metropolitan areas. It could also replace fiber in vast data server farms, where thousands of computers that store data for companies like Google and Facebook require tight, fast networks to exchange information. ■

Life



For more Life stories, visit www.sciencenews.org

Social lemurs are sneakier

Animals from big groups steal when competitor isn't looking

By Cristy Gelling

Never turn your back on a lemur – especially if it's a member of a big gang.

Lemur species that live in large groups can tell when to steal food from a competitor in a lab experiment, researchers report June 26 in *PLOS ONE*. The finding supports the idea that brainpower in primates evolved to fit their complex social lives. Because the sneakier lemurs don't have bigger brains than less sneaky ones living in smaller groups, researchers suggest that social smarts don't always depend on brain size.

Much of the evidence for sociality's role in the evolution of intelligence comes from indirect measures such as brain size, says study coauthor Evan MacLean of Duke University. But brain size does not always correspond to brainpower, so MacLean uses behavioral tests.

He and his colleagues tested the social intelligence of six species of lemur, primates from Madagascar distantly related to monkeys and apes. Each of the species lives in social groups ranging from families of just three, mongoose lemurs' preferred posse, to gangs of about 16, a typical size for a group of ring-tailed lemurs.

MacLean and his colleagues trained lemurs to view humans as competitors for food, then presented the animals with a choice between pilfering treats from one of two people: one facing the animals or another with his or her back turned. Species that live in small groups reached for the food under a competitor's nose as often as they did behind people's backs. But the ring-tailed lemurs were much more likely to choose the unguarded food.

Most intriguing, says Susanne Shultz, a biological anthropologist at England's University of Manchester, is that group size was much better than brain size at predicting which species would perform well in the social intelligence test. "We assume that if you have a bigger brain you should be better at solving problems," she says.

Her own research suggests that brain size in primates does correspond to cognitive ability, but she used a different



Ring-tailed lemurs like those pictured were less likely to steal food with a human watching than were lemurs that live in smaller groups.

set of intelligence tests and more kinds of primates. She says she would be interested to see how other species perform on MacLean's tests.

MacLean agrees that a general relationship probably exists between brain size and cognition. But he speculates that this might not be the case with very closely related species like the lemurs. "Cognition might evolve a little bit ahead of brain size," he says. ■



Elephants' chomper change

The ancestors of African elephants grazed on grasses millions of years before they evolved teeth that could grind the tough, gritty plants, a new analysis finds. Some 20 million years ago, elephant ancestors inhabited forests and nibbled on leaves with low-crowned, rounded teeth. Roughly 8 million years ago, while grasslands were expanding across East Africa, ancient elephants switched to a grass diet, paleontologist Adrian Lister of the Natural History Museum in London reports June 26 in Nature. Lister computed the timing of the shifts in dining habits and the environment by analyzing the chemistry of fossilized elephant teeth and soils in East Africa. He also found that elephants didn't evolve high-crowned teeth with ridges suitable for grinding grass (like those inside the elephant's mouth at left) until after 5 million years ago. Lister wonders what could explain the 3-million-year lag between elephants' behavioral and anatomical changes. Perhaps, he says, the amount of dust and soil grit that make grasses abrasive was too small to force the animals to adapt until after Africa became really arid and dusty a few million years ago. - Erin Wayman

Earth

For more Earth stories, visit www.sciencenews.org

Earthquake faults may heal quickly

Southern China saw speedy recovery after big quake

By Erin Wayman

After an earthquake, fractured rocks in some fault zones may need no more than a couple of years to repair themselves, research suggests. But the recovery is not without setbacks: Large, distant quakes can redamage fragile faults.

A fault weakened by a rupture won't begin to build up stress again until it's strong enough. So the new findings, published in the June 28 *Science*, should help researchers understand the timing of earthquake cycles in a fault zone.

After a magnitude 7.9 earthquake devastated southern China in 2008, scientists drilled a borehole 1,201 meters into the Longmen Shan fault zone to monitor the healing process. Researchers have previously analyzed fault strengthening in the laboratory or with surface measurements. But this is the first time anyone has peered directly into a fault to observe recovery. "We're very hard up for evidence about what's happening down there," says seismologist John Vidale of the University of Washington in Seattle.

Researchers indirectly measured the Chinese fault's strength by looking at how easily water flowed through the rock. When a fault fails during a quake, rocks break. Many processes can reseal the cracks, such as the crystallization of minerals dissolved in groundwater. The more cracks a fault has, the weaker it should be, says coauthor Emily Brodsky, a geophysicist at the University of California, Santa Cruz. From January 2010 to August 2011, Brodsky, Lian Xue, also of UC Santa Cruz, and colleagues observed changes in the rock's permeability by measuring shifting groundwater levels in the borehole. Permeability plummeted, and the team calculated that recovery after an earthquake in the Longmen Shan fault zone should have taken anywhere from seven months to 21/2 years. Some previous studies indicated that faults should take decades or more to heal.

In the case of Longmen Shan, recovery was interrupted by periodic spikes in permeability that coincided with big, faraway quakes. Seismic waves unleashed by those events probably fractured the still-delicate fault, Brodsky says.

One open question, says Elizabeth Cochran of the U.S. Geological Survey in Pasadena, Calif., is whether seismic waves from distant temblors can also damage strong, fully repaired faults. ■



www.sciencenews.org

Genes & Cells

Veggie bioclocks tick after picking

Daily cycles help crop plants ward off hungry pests

By Cristy Gelling

Cabbages with jet lag are less nutritious and more vulnerable to insect pests.

Fruits and vegetables have an internal clock that can be reset by a daily cycle of light and dark, but storing produce in darkened refrigerators could disrupt this natural rhythm, researchers report June 20 in *Current Biology*.

Plants, even after being cropped from the stalk, are much more responsive to their external environment than we give them credit for, says Janet Braam, a plant biologist at Rice University. "When we harvest them they're still metabolizing," she says. "They're still alive."

Braam normally studies circadian rhythms in plants that are growing, but an offhand comment by her son inspired her to turn to the grocery store for new research subjects.

She and her colleagues had previously found that the plant *Arabidopsis thaliana*



For more Genes & Cells stories, visit **www.sciencenews.org**

schedules production of insect-repelling chemical defenses to match caterpillar feeding peaks. These defenses include compounds called glucosinolates, which are thought to have anticancer and antimicrobial properties in addition to caterpillar-discouraging ones.

When Braam told her son about these experiments, he joked that now he knew the best time to eat his vegetables. She realized that cabbages — which also produce glucosinolates — might have similar daily cycles even after being picked, packed and shipped.

"So we went to the grocery store, bought some cabbage and put them under dark/light cycles that were either in phase or out of phase with our insects, and then asked whether the insects could tell the difference," says Braam.

Like *Arabidopsis*, the cabbage leaves had daily glucosinolate cycles if the vegetables were exposed to alternating 12-hour periods of light and dark. Caterpillars on a cycle offset by 12 hours

> Cabbage stored in constant light or constant darkness is more vulnerable to being eaten by pests such as the cabbage looper caterpillar.

to the cabbages' (so the cabbages' dawn was the caterpillars' dusk) ate about 20 times more than did caterpillars on a schedule synchronized to their food. Caterpillars also ate twice as much cabbage if the vegetable had been kept either in constant light or constant darkness.

It's not just cabbages that adjust daily rhythm to better fend off caterpillars; the team found similar results for spinach, zucchini, sweet potatoes, carrots and blueberries. These fruits and vegetables don't produce glucosinolates, so they must make some other kind of defenses on a daily cycle, says Braam.

The researchers suggest that we might improve the health benefits and pest resistance of fruits and vegetables by storing them under lighting conditions that mimic day and night. But Cathie Martin, a plant biologist at the John Innes Centre in England, is skeptical. She says most postharvest vegetable losses are from fungal infections, not the insects that eat vegetables in the field. And cabbages are sometimes cold-stored for months in the dark before being sold. Cabbages lose the clock-regulated pest resistance about a week after harvesting, the new study shows.

"But maybe I'll be proven completely wrong," says Martin. "Maybe one day we'll all have little LEDs in the fridge." ■

Cholera spurs human evolution

In Bangladesh, genetic variations might protect people

By Nathan Seppa

Some people in Bangladesh carry genetic alterations that seem to protect against cholera, a study shows. These changes apparently occurred over thousands of years as exposure to the disease exerted a form of natural selection on people in the Ganges River Delta.

Although cholera can cause lethal, dehydrating diarrhea, 60 to 90 percent of people infected with it experience few or no symptoms. That often happens when people have had prior exposure to the microbe that causes the disease, says Glenn Morris of the University of Florida in Gainesville. But some of that protection may reflect underlying genetic differences in susceptibility to cholera, he says, and the new study is a starting point for understanding such safeguards.

Regina LaRocque of Harvard Medical School and her colleagues identified genetic variants in families from Dhaka, Bangladesh, that stood apart from variants in people from East Asia, West Africa and Europe.

The researchers then tested the DNA of 105 cholera patients in Dhaka and 167 people who shared households with them but who didn't have the disease. When the team looked closely at 28 of the genetic regions, five genes differed between the people who were sick and those who weren't, the researchers report in the July 3 *Science Translational Medicine*. Some of the genes are implicated in inflammation, which runs amok in the intestines in response to the cholera toxin.

Environment

Cleaner air may bring on storms

Models show hurricane rate increased as pollution fell

By Cristy Gelling

The Clean Air Act, which has benefited breathing in many American cities over the last few decades, may have worsened the weather in some places.

New climate simulations suggest that reducing the level of atmospheric aerosol particles produced by human activity might have been the main cause of a recent increase in tropical storm frequency in the North Atlantic.

Aerosol levels have increased since the industrial revolution began, but there have been periods when emissions stalled, such as during the Great Depression and World War II, or fell, as they did after clean air legislation was enacted.



For more Environment stories, visit **www.sciencenews.org**

These periods of low emissions eventually increased tropical storm frequency, suggest climate simulations published June 23 in *Nature Geoscience*. "It seems the Clean Air Act in particular has led to an increased number of hurricanes over the last decade or so," says

study coauthor Doug Smith of Met Office Hadley Centre in England.

Aerosol particles from volcanoes, sea spray, burning fuel and other sources can cool the Earth's surface by scattering the sun's energy back into space and seeding brighter and more long-lived clouds. High levels of aerosols cooled the

surface of the North Atlantic, the authors suggest. This cool patch then shifted the position of a major air current, suppressing the formation of hurricanes.

This mechanism is credible, says Venkatachalam Ramaswamy of the National Oceanic and Atmospheric Administration and Princeton University. He finds the work impressive because it carefully incorporates information on aerosols' effects on clouds. Such effects are emerging as a major influence on regional climate, he says.

In the 20th century, aerosols prob-

"We don't

want to

give the

impression

pollution

is a good

thing."

DOUG SMITH

ably had more effect on storm frequency than did greenhouse gases like carbon dioxide, Smith says. But greenhouse gases hang around for many decades, whereas aerosols stay in the atmosphere for weeks. Simulations suggest that the climate effects of greenhouse gases will again reduce tropi-

cal storm frequency later this century.

Smith cautions that atmospheric aerosols' effects on storms are not a good reason to let them increase again because they are hazardous to human health. "We don't want to give the impression pollution is a good thing," he says. (i)



Genes battle stem rust

A scrappy, ancient species of wheat may help today's widely cultivated bread wheat fight the devastating fungus known as stem rust (shown growing on wheat stems). A gene isolated from one of the earliest cultivated wheat species, Einkorn wheat (Triticum monococcum), confers resistance to a deadly version of stem rust, scientists report June 27 in Science. A second gene found in the wild grass Aegilops tauschii, a botanical parent of today's bread wheat (T. aestivum), also helps fight the fungus, another research team reports. Both genes are thought to help wheat recognize an invader, kick-starting the plant's defenses. After mapping the whereabouts of the resistance genes in the bread wheat relatives' genomes, each research team inserted a copy of each gene, called Sr35 and Sr33, into bread wheat. Exposing the plants to stem rust revealed new resistance, even to the deadly Ug99 strain of the fungus. Stem rust, which spreads via windborne spores, can quickly turn a healthy crop into a decrepit mess of broken stems and shriveled grains. Scientists hope to breed several resistance genes into cultivated varieties, minimizing the odds that the fungus can mutate and overcome the wheat's new defenses. - Rachel Ehrenberg

Health & Illness

For more Health & Illness stories, visit **www.sciencenews.org**

Ebola thwarted by existing drugs

Mice survive up to a month on cancer, infertility meds

By Nathan Seppa

Two drugs already on the market for other purposes can halt Ebola virus in mice. The findings open the way for further testing of the drugs, clomiphene and toremifene, against the deadly virus.

Scientists screened more than 2,000 drugs against Ebola, a process that required the highest level of safety precautions because the virus is so lethal. Several drugs called selective estrogen receptor modulators showed promise, including clomiphene, marketed as Clomid and prescribed to treat infertility, and toremifene, used to treat advanced breast cancer.

In the June 19 *Science Translational Medicine*, researchers report that each drug prevented Ebola virus from commandeering cells in lab-dish experiments. The researchers also injected mice with one form of the Ebola virus, and nine of 10 mice given clomiphene one hour after exposure survived a month-long observation period.

The best

strategy

against

Ebola is to

repurpose

drugs already

cleared for

other uses.

Five of 10 mice getting toremifene died within 10 days, but the other five survived the month. All mice given the virus without the drugs died within a week.

The drugs bottled up Ebola in a cell compartment called an endosome, which the virus uses as a way station when it invades a cell.

How the drugs thwart the virus there is unclear, says study coauthor Gene Olinger, a virologist at the U.S. Army Medical Research Institute of Infectious Diseases in Frederick, Md. But the results suggest that the drugs might stop other versions of the Ebola virus and the related Marburg virus, another deadly pathogen. In theory, the drugs would be given to patients and health care workers in an outbreak, he says.

"This is an interesting study, and it's the way one wants to go with these viruses," says Stephan Becker, a virologist at Philipps University in Marburg,

> Germany. Ebola burst on the scene in 1976 with deadly outbreaks in Zaire and Sudan. But it has been a sporadic menace, racking up about 2,300 victims worldwide. Despite a stunning mortality rate, Becker says, the small numbers suggest that the best strategy against Ebola is to repurpose drugs

already cleared for other uses.

While testing an established drug for a new use is faster than starting from scratch, Olinger says, approval of these drugs for Ebola might still take five to 10 years. There is currently no cure for an Ebola infection. ■

NEWS IN BRIEF

Head wobble a heart telltale

A new computer algorithm can detect the nods, bobs and wiggles people make as blood rushes in and out of their skulls, and then translate the motions into heart rate. Results from the motion-sensing technique are nearly identical to those from an electrocardiogram, a test that uses electrodes stuck to the skin to pick up signals from the heart, report MIT computer scientist Guha Balakrishnan and colleagues. They presented the work June 27 at the Computer Vision and Pattern Recognition conference in Portland, Ore. Using a video, the researchers' algorithm tracks up to 1,000 points on a person's face, zeroes in on the regular twitches that accompany blood pumping to the head and then calculates heart rate from

the timing of the twitches. Though the motions are barely perceptible by eye, Balakrishnan amplifies the movements to show people's heads bouncing and shimmying like bobblehead dolls. Doctors could use the algorithm as a hands-off way to measure the pulses of patients with delicate skin, such as babies and elderly people. The technique might also spot heart blockages, the researchers suggest. If blood flows unevenly through the heart, the head may shake in a telltale way. — Meghan Rosen

No link seen between vaccines and nerve-damaging condition

Shortly after getting a vaccination, people are no more likely to develop a dangerous nerve-damaging condition called Guillain-Barré syndrome, or GBS, than they are at other times,

a new analysis finds. Roger Baxter of Kaiser Permanente Northern California in Oakland, and his colleagues reviewed medical records from 1994 to 2006 of more than 3 million Kaiser members and found 415 diagnoses of GBS. Only 25 of these people had received any vaccine in the six weeks prior to being diagnosed with the condition. None were children. Analyses showed that people were no more likely to develop GBS during those six weeks than they were $1\frac{1}{2}$ to nine months following a vaccination, the researchers report in the July 15 Clinical Infectious Diseases. An earlier study had found an association between receiving the 1976 swine flu vaccine and increased GBS risk, but nearly all studies since then have failed to find a GBS link to flu shots or other vaccinations. - Nathan Seppa

Breakthrough technology converts phone calls to captions.

New amplified phone lets you hear AND see the conversation.

The Captioning Telephone converts phone conversations to easy-to-read captions for individuals with hearing loss

Do you get discouraged when you hear your telephone ring? Do you avoid using your phone because hearing difficulties make it hard to understand the person on the other end of the line? For many Americans the telephone conversation - once an important part of everyday life – has become a thing of the past. Because they can't understand what is said to them on the phone, they're often cut off from friends, family, doctors and "For years I avoided phone calls because

innovative technology there is finally a better way.

A simple idea... made possible with sophisticated technology. If you have trouble understanding a call, the Captioning Telephone can change your life. During a phone call the words spoken to you appear on the phone's screen - similar to closed captioning on TV. So when you make or receive a call, the words spoken to you are not only amplified by the phone, but scroll across the phone so you can listen while reading everything that's said to you. The captioning function can be turned on as needed. Each call is routed through a call center, where computer technology aided by a live representative – generates immediate voice-to-text translations. The captioning is real-time, accurate and readable. Your conversation is private and the captioning service doesn't cost you a penny all you need is a high-speed Internet connection from any Internet provider and a standard phone line. Callers do not need special equipment or a captioning phone in order to speak with you.

Hello mrs fleming this is dr martin how are you today? I just wanted to give you an update on your new prescription

been missing!

SEE what you've



I couldn't understand the caller... now I don't miss a thing!"

allen

Finally... a phone you can use **again.** The Captioning Telephone is also packed with features to help make phone calls easier. The keypad has large, easy to use

buttons. You get adjustable volume amplification along with the ability to save captions for review later. It even has an answering machine that provides you with the captions of each message.

See for yourself with our exclusive home trial. Try the Captioning Telephone in your own home and if you are not completely amazed, simply return it within 30-days for a refund of the product purchase price.

Captioning Telephone

Call now for our special introductory price!

Call now Toll-Free

1-877-505-4273

Please mention promotion code 46933.

The Captioning Telephone is intended for use by people with hearing loss. In purchasing a Captioning Telephone, you acknowledge that it will be used by someone who cannot hear well over a traditional phone.

Antarctica's Temperature

Frozen continent may not be immune to global warming

By Erin Wayman

Antarctica is a land of extremes: the driest, windiest, coldest place on Earth. The ice sheet that blankets the continent is, on average, 2 kilometers thick and covers nearly 14 million square kilometers. Antarctica is so remote and so isolated that as recently as 2007 scientists thought that it might be unaffected by global warming.

That year the Intergovernmental Panel on Climate Change concluded in its Fourth Assessment Report that Antarctica was the only continent where anthropogenic temperature change had not been detected. In contrast to the Arctic, the report said, ice in the far south wasn't experiencing alarming, widespread melting. Some data even suggested that the continent was moderately cooling. "As best we knew," says David Bromwich, a climate scientist at Ohio State University, "there was not much changing."

Climate change skeptics latched onto the report to bolster their own conclusions. But in truth scientists didn't really know much about Antarctica's climate, past or future, at the time. Few long-term, on-the-ground temperature records exist, and those that do date back only to the 1940s and '50s. And most of the longrunning research stations that collected these data line the coastal perimeter; just a handful dot the expansive interior. It's like trying to measure what's happening on the coasts of the United States to determine what's going on in North Dakota, Bromwich says.

Yet, over the last six years researchers have found clever ways to take Ant-

Various types of ice form off the coast of East Antarctica, as shown in this satellite image. In contrast to the rest of the continent, this region has seen no significant warming. arctica's temperature and piece together its complicated climate history. Those efforts reveal that the continent is home to some of the most rapidly warming places on Earth. Whether natural or human-caused, Antarctica's changing climate makes it clear that the continent isn't as isolated as was once thought.

If these warming trends continue, what happens in Antarctica will have important consequences for the rest of the world. The Antarctic ice sheet stores roughly 70 percent of the planet's freshwater. If it melted entirely and drained into the ocean, global sea level would rise more than 60 meters — enough to submerge New York City, London, Copenhagen, Bangkok, all of Florida, much of the Netherlands, Bangladesh and many other low-lying coastal and island locales.

Fortunately, researchers don't expect the massive ice sheet to disappear anytime soon. But to plan for the future, officials need to know how much ice will melt and how quickly sea level will rise. When it comes to these sorts of estimates, Antarctica is the biggest unknown.

Geographic differences between Antarctica and the Arctic help explain why it has been easier to spot signs of climate change in the North. The Arctic is naturally warmer than the Antarctic — Greenland, for example, sits at a lower latitude than Antarctica — so it doesn't require as much warming to thaw out. Thus, rising Arctic temperatures have already caused startling changes. Last summer, 97 percent of Greenland's ice sheet experienced some degree of surface melting.

Another difference is that Antarctica is land surrounded by ocean while the Arctic is ocean surrounded by land. Much of the Arctic's melting ice is sea ice, or frozen seawater. When sea ice melts, nothing happens to sea level because the ice is already in the ocean and its melting doesn't change the ocean's volume. Disappearing sea ice does lead to more warming, however. As the white ice thins and reveals the darker ocean below, the







Comparing the poles The Antarctic ice sheet (bright white, top, surrounded by sea ice) is the largest single mass of ice on Earth. Should recent warming trends there continue, the glacial ice could begin sliding into the oceans and raise global sea level. Seasonal melting of sea ice (bright white, bottom) in the Arctic is more dramatic, but has little impact on sea level. Last summer, the Arctic's sea ice reached the smallest extent ever recorded by satellites.

Arctic absorbs more solar radiation, leading to more warming and ultimately more melting.

The Arctic is also just simpler to study. A trip to the far north is effortless compared with the journey to Antarctica. And people live in the Arctic, so scientists have a much longer history of climate observations and measurements, including knowledge from native

FEATURE | TAKING ANTARCTICA'S TEMPERATURE



The Transantarctic Mountains stretch 3,500 kilometers between the Ross Sea and the Weddell Sea and form the boundary between East Antarctica and West Antarctica. The summits (the tallest is 4,500 meters above sea level) are some of the few places on the continent not covered by ice. East Antarctica's higher elevation helps keep warm air out and stabilizes climate.

cultures that have inhabited the region for thousands of years.

"Antarctic science tends to lag at least a decade behind Arctic science," says climate scientist David Schneider of the National Center for Atmospheric Research in Boulder, Colo. But Antarctic researchers are beginning to catch up.

Uneven warming

Almost twice the size of Australia, Antarctica is divided into three regions. East Antarctica accounts for two-thirds of the continent and touches the Indian and Atlantic oceans. With a higher elevation than the rest of Antarctica, the region is like a giant, flattened mountain, says Eric Steig, a geochemist at the University of Washington in Seattle. So far, scientists haven't found much warming here. The east's tall, steep coastline helps keep out warmer air coming from the north, he says. The westerly winds that flow around the continent also seem to prevent warmth from penetrating.

Separated from the east by the Transantarctic Mountains, West Antarctica abuts the Pacific Ocean, and much of the region lies below sea level. The warming that's been observed in Antarctica has occurred here and on the mountainous Antarctic Peninsula, the most northern part of the continent that sticks up from West Antarctica like a tail pointing toward South America.

The peninsula was the site of one of

the earliest clues that warming might have reached Antarctica. Over 35 days in 2002, a chunk of floating ice covering an area larger than Rhode Island crumbled into countless icebergs that broke free from the coast. Tracked by satellite imagery, the breakup of the Larsen B Ice Shelf was Antarctica's largest ice collapse in three decades. Scientists blamed surface melting for the demise of the ice shelf, an extension of an ice sheet or glacier that floats on the ocean. Pools of water on the surface probably filtered through cracks in the ice, triggering more melting. The water's weight further fractured the shelf.

Scientists had corroborating data of warming elsewhere on the peninsula,



where average temperatures in some areas have risen almost 3 degrees Celsius since the 1950s. Still, many researchers considered the region an outlier. Just looking at a map, Steig says: "It's pretty easy to connect East and West Antarctica as one thing and the peninsula as something else."

But maps can deceive.

In 2009, Steig and colleagues reported in *Nature* that Antarctica as a whole has warmed about 0.12 degrees per decade since 1957, although warming across the continent hasn't been uniform. The team found a statistical way to make up for the lack of long-term records. Since the 1980s, satellites have peered down on the South Pole to remotely take temperature measurements across all of Antarctica.

The team compared those data with ground-based measurements compiled at a few dozen weather stations from the same time period and figured out a mathematical relationship that links the satellite and ground data. Looking at ground data back to the 1950s, the researchers used the mathematical relationship to infer what satellite data would have looked like all across Antarc-

Windy continent The westerly winds circle Antarctica, bringing warm air to the Antarctic Peninsula while shielding the higher eastern reaches. Starting in the 1940s and '50s, a handful of research stations (shown) began collecting weather data, providing the continent's few long-term climate records. Today, scientists keep better tabs on the far south with satellites and more than 160 automated weather stations.

SOURCES: COMNAP, P. FRETWELL ET AL/THE CRYOSPHERE 2013

Elevation (meters from sea level)

-2,800 Pre-1960 research stations 2,800

Satellite images show the rapid collapse of the Larsen B Ice Shelf on the east coast of the Antarctic Peninsula in 2002. As air temperature warmed, ponds of meltwater formed on the ice shelf surface, flowing into cracks and splitting the shelf apart. Warmer oceans may also have contributed.

tica had there been satellites focused on the continent back to that time.

The results were striking: West Antarctica has been warming along with the peninsula, about 0.17 degrees per decade since the late '50s. Other studies relying on an assortment of methods have confirmed this, although the magnitude of the heat-up varies by study.

Most recently, Bromwich, Julien Nicolas, also of Ohio State, and colleagues calculated a temperature rise for West Antarctica that's almost triple what Steig's team found. They used a more direct approach to assess trends, analyzing temperatures collected by various methods at Byrd Station over the last half-century. Because Byrd Station sits on an exposed, flat area near the top of the ice sheet, its weather is representative of a large chunk of West Antarctica, Bromwich says. The team estimated that the region warmed an average of 0.47 degrees per decade from 1958 to 2010, for a total rise of 2.4 degrees. That puts both West Antarctica and the Antarctic Peninsula in the race for fastest-warming place on Earth, the researchers reported in February in *Nature Geoscience*. The global average is only 0.13 degrees of warming per decade over the same time period.

The warming trend is most notable in West Antarctica during the spring, but temperatures are also on the rise in winter and summer. Summer warming is crucial, Bromwich says, because if the trend continues air temperatures could climb above freezing — and West Antarctica could begin to melt. "If we get a lot more melting in West Antarctica than we've got today, that may become a significant issue for the health of the ice sheet itself," he says.

Frozen in time

With only 50 or 60 years of data, it's difficult for scientists to gauge whether current temperature trends are the result of human activity or just natural climate patterns. "If anything varies [naturally] on a timescale of decades,

we have a problem



www.sciencenews.org

EGTS

ADAPTED BY

aEOATLAS/GRAPHI-OGRE,



because we have very short records," Bromwich says.

To clarify the situation, polar researchers have found ways to travel back in time by looking for clues trapped in Antarctica's ice. Ice sheets grow as layers of snow are compacted over time and turn to ice. The chemistry of the ice layers and air bubbles trapped in them archive information about climate at the time they formed. So scientists can drill long tubes of ice out of an ice sheet to assess changes in temperature over thousands of years. **"The current high**

levels of melting

on the Antarctic

Peninsula are

unprecedented

over at least the

last 1.000 vears."

NERILIE ABRAM

In 2008, researchers drilled an ice core from James Ross Island, off the northeastern tip of the Antarctic Peninsula. The 364-meter-long tube records climate history back 50,000 years. Last September, researchers led by Robert Mulvaney

of the British Antarctic Survey reported in *Nature* that temperatures were as warm as they are today during a stable period 9,200 to 2,500 years ago. The rate of temperature rise over the last century, however, is unusual. In the last 100 years, the average temperature on the island shot up nearly 1.6 degrees; over the last 50 years, the rate increased to 2.6 degrees per century. These are among the fastest known temperature increases for the peninsula, ranking in the top 0.3 percent of all century-scale warming events in the region over the last 2,000 years. If the warming continues at this pace, researchers warn, temperatures will surpass those of the previous

warm period that ended 2,500 years ago.

1600

Year

1600

Year

1800

1800

2000

2000

In a related study, published in May in Nature Geoscience, Mulvaney's team considered the impact of warming. It assessed summer melting trends by looking at the thickness of melt layers - ice that melts and refreezes. "The current high levels of melting on the Antarctic Peninsula are unprecedented over at least the last 1,000 years," says study leader Nerilie Abram of the Australian National University in Canberra. In line with rising temperatures, melting has

> particularly sped up over the last half-century.

Scientists have also collected ice cores in West Antarctica. As on the peninsula, recent temperatures have been anomalously warm compared with the norm over the last 2,000 years. But, as observed with the

James Ross Island core, the temperatures haven't yet surpassed the upper limit of natural variability, Steig and colleagues reported in May in Nature Geoscience. For example, warm spikes in the 1830s and 1940s come close to recent temperature hikes.

For some researchers, the fact that Antarctica's temperatures haven't yet tipped beyond the realm of natural variation means it's still too soon to say with certainty that the changes there are driven by people. Others are more confident. Since places all over the globe are simultaneously being pushed near or past normal variability, it strengthens the case that Antarctica has also been

influenced by anthropogenic climate change, Steig says. But that doesn't mean human activity is the only, or even the strongest, force shaping the region's climate. "It's the details of what that [human] impact will be and how large it will be relative to other things - that's really the important question," he says. Disentangling the anthropogenic and natural forces responsible for Antarctica's recent temperature changes is now the focus of intense scrutiny.

Devil in the climate details

During the last few years, researchers have identified several drivers of Antarctica's warming. The most surprising influence: the tropics. Through statistical analyses and climate simulations, Steig and colleagues have linked West Antarctica's rising temperatures to unusual warmth in the central tropical Pacific relative to nearby parts of the ocean. When the sea surface heats up, warm air rises, boosting activity in the atmosphere above. The atmospheric changes alter circulation in such a way that more heat is transported to the South Pacific near West Antarctica, Steig and colleagues reported in 2011 in Nature Geoscience.

That means the fate of West Antarctica depends on how the tropical Pacific responds to global warming. Unfortunately, the ocean's climate future is just as murky as Antarctica's. It's possible, Steig notes, that as global temperatures continue to climb, the central tropical Pacific may or may not keep warming relative to other parts of the tropics. So far, climate simulations have predicted both scenarios. "The uncertainty about future changes in the tropics translates to uncertainty in changes all over the globe," Steig says. But, he adds, "If I had to bet, I'd say it will keep warming in West Antarctica."

If Steig is right, parts of the Antarctic Peninsula will continue to warm, too. The western side of the peninsula faces the South Pacific, and winter, fall and spring temperatures there also appear to be governed by changes in the tropical Pacific, Steig and his University of Washington

colleague, Qinghua Ding, reported in May in the *Journal of Climate*.

Summer warming on the eastern side of the peninsula, however, "seems to be a different beast," Steig says. Stronger westerly winds seem to push warm air over the peninsula to its eastern side, says climate scientist Gareth Marshall of the British Antarctic Survey. As the air sinks, it heats the surface. This process is probably what caused the catastrophic collapse of the Larsen B Ice Shelf, he says.

Summer's stronger westerly winds are one phenomenon that scientists have definitively tied to human activity. The seasonal depletion of the ozone layer above Antarctica, and to a lesser extent the influx of greenhouse gases, have lowered atmospheric pressure over the South Pole relative to the midlatitudes. This has boosted the westerly winds and shifted them farther south toward the Pole. With global restrictions on ozone-destroying chlorofluorocarbons, scientists expect the ozone hole to recover during the 21st century. The recovery could weaken the winds and halt the peninsula's warming – unless rising greenhouse gases compensate for the ozone hole's disappearance. "Which of these two effects will win out adds another layer of uncertainty" to

Antarctica's future, Marshall says.

That uncertainty extends to East Antarctica, where the westerly winds have a very different effect. Here the westerlies act as a barrier to warm air. But in the last decade, Marshall and his colleagues have uncovered an unexpected relationship between East Antarctica's temperatures and the winds encircling the continent. Before 2000, when atmospheric pressure above East Antarctica was low relative to the mid-latitudes and the westerlies were enhanced, temperatures remained cool, the researchers noted in February in the Journal of Climate. During most of the first decade of the 21st century, the team found the opposite effect: summer and fall warming in East Antarctica despite strong westerly winds. Marshall suspects some type of natural climate variability accounts for the reversal. Better predictions for the future will rely on figuring out the source of this climate variability and how it interacts with anthropogenic activity to modify the region's temperatures. "What it does really is make life more complicated," he says.

Time will tell

The only way to unravel Antarctica's complicated climate and predict its future will be to gather more observa-

Warming may threaten both Antarctica's coastal ice shelves and the glaciers behind them. When shelves disintegrate, glacial flow can accelerate, delivering more ice to the ocean. Colors represent speed of ice movement, where brown to green are slowest (1 meter per year) and blue and red are fastest (3,000 meters per year).



tions over time. But polar researchers aren't waiting to consider the consequences of warming. If the trend continues in West Antarctica and the Antarctic Peninsula, the continent could see more ice shelf breakups like Larsen B. The ice shelves that ring the continent act like dams to keep Antarctica's ice sheets in place. If those dams break, glaciers from the continent's interior can surge into the ocean and raise sea level.

Melting on the tops of ice shelves is not the only concern. Scientists estimate that the oceans around Antarctica have warmed at a rate twice the global average over the last few decades. The warmer water can melt ice shelves from below. In June, researchers reported in *Science* that this is indeed happening: Slightly more than half of Antarctica's ice shelf losses from 2003 to 2008 were the result of ocean warming. The basal melting isn't limited to West Antarctica and the Antarctic Peninsula; it's occurring in East Antarctica, too.

Along with sea level rise, scientists fear that climate change will interfere with the ocean's ability to store carbon dioxide. The ocean surrounding Antarctica soaks up about 40 percent of the oceans' anthropogenic carbon and transports much of it to the deep sea, where the element can stay put for centuries. Earlier this year, researchers documented that the fiercer winds around the continent are, in some parts of the southern oceans, bringing deep water to the surface faster than they once did, raising concerns about the release of sequestered carbon. Another worry, Schneider notes, is that stronger winds could also disrupt the ocean currents in the Antarctic that circulate heat to other parts of the world.

Although the ramp-up in research hasn't yet provided a detailed climate forecast for Antarctica, the work does reveal that the remote landmass is not as isolated as once thought. Its fate is linked with every corner on Earth.

Explore more

 U.S. Antarctic Program: www.usap.gov/



Nemories LOST AND FOUND

Drugs that help mice remember reveal role for epigenetics in recall **By Susan Gaidos**

or nearly a decade, neuroscientist Li-Huei Tsai and her colleagues have been studying senile mice. In a lab at MIT her team has genetically fast-forwarded the mice into a condition much like dementia: They have problems making new memories and retrieving old ones. The mice forget how to navigate water mazes they had mastered; they don't recognize signs of imminent danger they had once responded to fearfully.

Last year, Tsai's group found a way to reverse the process. When given a drug known to strengthen nerve cell connections in the brain, the mice not only gained back the ability to learn new tasks, but also remembered many forgotten behaviors.

On the opposite coast, researchers are using a similar drug to rewire long-held memories in mice facing another kind of mental challenge: drug addiction. Neurobiologist Marcelo Wood of the University of California, Irvine coaxes cocaineseeking mice to view the sights and sounds they've learned to associate with getting cocaine. He then creates a new, harmless memory around those cues. After a single treatment, mice placed near their drug den forget their cravings.

Though Tsai and Wood use different drugs in their studies, both draw on research showing that the ability to learn and remember can be influenced by subtle changes to DNA – changes that affect how genes turn on and off without altering the underlying genetic information. Such epigenetic modifications, it turns out, might have a profound impact on long-term memory.

Exploring these methods has opened a growing field of research, called neuroepigenetics, aimed at finding ways to boost memory in humans. Results so far offer the prospect of new types of medication to improve memory and even restore long-forgotten information in disorders such as Alzheimer's disease, Huntington's disease or other types of dementia. Someday drugs might also treat other memory impairments, including the fogginess that plagues many people as they age, and developmental deficits such as autism. The findings also suggest potential new strategies to treat drug addiction in people.

Memory lane

Memory provides a link between the present and past, and it creates a foundation for learning throughout life. Without your memory, you couldn't read this sentence or find your way home at night. Recall helps animals, from the lowly sea slug to mice to humans, navigate through life. But only in recent decades have scientists begun to unravel the mysteries of how memories are created and stored for the long haul.

For years, memory research was largely confined to studies of animals and to a few people whose memory had dramatically unraveled. One of the most famous human cases was a man named Henry Molaison, known as H.M. in scientific studies (see sidebar, Page 28). Scientists learned from H.M. that the hippocampus is an essential part of the brain for making and retaining memories. Newer studies focus on the part of the memory process that involves strengthening links between nerve cells. For this job, cells have to make proteins.

Several mechanisms can turn protein production on and off in brain cells. One employs various enzymes that change how genes, segments of DNA, are bundled together. DNA is tightly intertwined with proteins known as histones, assembled in a complex called chromatin. Through a process called acetylation – the attaching of a little molecule called an acetyl group - some enzymes relax chromatin. This allows it to open so machinery can access the genetic blueprint for a protein. Other enzymes clamp down on chromatin, blocking genes from being activated when they're not needed.

One enzyme family — called "histone deacetylases," or HDACs — helps keep DNA and histones tightly bound by keeping acetyl groups off. In the late 1990s, researchers developed HDAC inhibitors as chemotherapy agents against cancer. Working in a way that sounds like a double-negative, the chemo agents repress the DNAinhibiting action of the HDACs, resulting in free-flowing gene activity. These anticancer agents proved helpful for treating some tumors in people.

When J. David Sweatt, a neurobiologist at the University of Alabama at Birmingham, gave the agents to lab animals, he found that the drugs turned absent-minded subjects into attentive ones. Intrigued by these findings, scientists tested the idea that histone acetylation might come into play when new memories are formed.

In 2004, Sweatt's group showed that HDAC inhibitors helped boost memory in rats learning to navigate in an unfamiliar situation. The rats' improved memory was accompanied by changes in nerve cells, or neurons, in the hippocampus. In 2007, Tsai's group gave HDAC inhibitors to mice with memory problems and found that they were able to recall things they had forgotten — in this case, dangers associated with certain environments.

DLAF HAJEK

Making memories and getting them back

Billions of neurons create and retrieve memories by storing and then tapping into patterns of connections in the brain.

1. Input

A memory begins when information from the senses, such as a whiff of blueberry muffins or the sound of an ice cream truck's jingle, arrives in the brain's sensory cortex.

2. Processing

The frontal cortex can tap into the sensory information immediately for use as a short-term, or working, memory.

3. Encoding

The hippocampus and areas of the medial temporal lobes begin to encode this new information into a long-term memory by growing new neural connections and strengthening the brain's existing circuitry.

4. Storing

Time and sleep help these new memories move to long-term storage regions throughout the brain. Facts, events, emotions and motor skills (such as riding a bike) take up permanent residence in brain regions involved in processing the original scent, sound or other sensory information.

5. Retrieving

When a memory is needed, or triggered by sensory information or emotions, the hippocampus and cortical brain regions help pull it out of long-term storage and relay it to the frontal cortex as working memory.

SOURCES: LILA DAVACHI/NYU, CAROLEE WINSTEIN/USC

Since then, several labs have begun studying how histone acetylation and deacetylation work to activate or shut down learning and memory. It's now clear, Sweatt says, that the epigenetic mechanisms are key in controlling gene activity that's necessary for many different forms of long-term memory.

Ordinarily, the chromatin in brain cells responds to all kinds of activity and stimulation, Sweatt says. When experiencing an event — a child's birthday party, a lively lecture or even a good book — some chromatin relaxes, some genes are turned on and the brain pumps out proteins that help store the memory. But disruptions of epigenetic mechanisms can lead to gene silencing, changing a neuron's behavior for months or even years. In some cases, genes needed for memory and learning can be permanently deactivated. Tsai says this appears to happen in the brains of people with Alzheimer's.

Making connections

Though it's hard to fully re-create Alzheimer's disease in a rodent, Tsai and colleagues found a way to genetically induce similar conditions in mice. Their method causes a mouse to lose 30 to 40 percent of the brain cells in its hippocampus.

To test the effects of this loss, the researchers first trained the mice to perform various tasks with their hippocampi still intact, then waited four weeks for the memories to consolidate and become stored in various parts of the brain. The team then triggered brain cell loss and allowed several more weeks for changes in the hippocampus to unfold.

As their brains began to shrink and shrivel, the mice forgot how to do jobs they had previously mastered. In one task, mice had learned to associate a shock with moving in a certain cage and would freeze in place to avoid pain. After losing hippocampus cells, the same mice forgot to associate fear with the cage and kept walking. In another test, the mice learned to escape from a pool of murky water by finding a submerged platform. The brain-damaged mice couldn't remember where the platform was.

When Tsai treated the mice with the HDAC inhibitors that had been designed to attack cancer, their memory improved. But there was a problem: Tsai wasn't sure which enzymes the drugs were targeting in the brain. The HDAC family comprises 11 different enzymes, sequentially named HDAC1 through HDAC11. The cancer drugs contained a cocktail of the HDAC inhibitors targeting a mix of the enzymes.

So Tsai gave the brain-damaged mice a small molecule that targeted only one of the HDAC enzymes, HDAC2. Studies had shown that HDAC2 levels rise in the aging brain, even in healthy people. After treatment with HDAC2 inhibitors, the mice again went through their training paces.

Remarkably, brain-damaged mice given HDAC2 inhibitors performed nearly as well as healthy mice in the water experiment. When the mice were placed in the cage where they had once been shocked, their memories again kicked in: They froze just as often as healthy mice.

"That was a remarkable piece of information," Tsai says. "After the smallmolecule treatment, we found that the seemingly lost memory somehow was recovered."

In the mice given HDAC2 inhibitors, the scientists found an increase in the number of connections between nerve cells in the hippocampus. Tsai believes that by activating the genes used in learning and memory, the brain rewires surviving neurons, helping them reconnect to cells that may have been damaged. "We think that the key to memory formation and memory retrieval, even in the Alzheimer's brain, is the healthy connection between neurons," she says.

Despite how dissimilar mice are to humans, Tsai's data may also apply to people. "These results suggest that perhaps even in humans, when people start to show signs of dementia, there are still memory traces left somewhere in the brain," she says. Her group also examined HDAC2 levels in autopsied human brain tissue and found that even people in the earliest stages of Alzheimer's disease had elevated HDAC2 levels.

Tsai says the findings, published last year in *Nature*, suggest that gene regulation at the epigenetic level works as a sort of master switch, coordinating a variety of genes needed for learning and memory. If this switch is turned off, memories fade.

Molecular brake pad

When it comes to creating a memorable event, it's not just what the brain does that matters. What it doesn't do also affects long-term memory. Studies of how the brain selectively decides what to keep are illuminating how this process works. At UC Irvine, Wood studies a protein that causes chromatin to relax called the CREB-binding protein. In this state, genes needed for memory formation are easily accessed. But one member of the HDAC enzyme family – HDAC3 – counteracts this effect, clamping down on chromatin and turning genes off.

In 2011, Wood's group deleted the *HDAC3* gene in a small group of hippocampal neurons in mice. This genetic manipulation transformed ordinary events into unforgettable ones. Later, Wood's group used a drug to selectively inhibit HDAC3 activity in the brain. The results were the same: New environments or experiences were immediately committed to the animal's memory, and easily summoned days or weeks later.

Wood says HDAC3 and HDAC2 appear to serve as brake pads that are always engaged, working to slow down or stop the steady stream of information encoded into memory. This mechanism allows you to hold onto information if it's important, but discard it if it's not.

"Our long-term memory is very, very selective," he says. "One of the most important things your brain does with respect to memory is to actively prevent you from encoding everything that you experience."

So inhibiting HDAC3 doesn't just simply enhance memory, Wood says. "This was fundamentally different. It was like you had released a molecular brake

Memory machinery Within the nucleus of a brain cell, the enzyme histone deacetylase (HDAC) helps keep DNA wrapped neatly around histones for orderly storage in the form of chromatin. For a memory to form and be stored, the DNA must be unwrapped, allowing genes to be read and transcribed into mRNA molecules for making proteins involved in memory. The presence of chemical tags called acetyl groups relaxes the chromatin so DNA can be read. In a defective cell, HDAC removes acetyl groups, preventing the chromatin from relaxing. Machinery then can't access the DNA and memory proteins aren't made.

SOURCE: J. GRÄFF AND L.-H. TSAI/ NATURE REVIEWS 2013 pad so that information that is being acquired enters the realm of long-term formation without any constraints."

Wood's group is now working on ways to harness this gating mechanism to manipulate certain kinds of memories, such as those associated with addictive drugs. Studies show that as drugs take over the brain's reward system, they change the way neurons communicate with each other. Then the mere sight of the location where the owner of the brain indulged — or even sounds and odors associated with drug use — can trigger an intense desire for the drug. Such changes are long-lasting and persistent.

Wood's group designed an experiment to try to override the changes produced by addictive drugs such as cocaine. First, mice were taught to associate a particular environment with the drug. Upon entering a chamber with checkered walls and scented bedding, the mice received a drug reward. After several visits, mice develop what's called a cocaine-associated memory and a preference for the environment. Given a choice, the animal will spend time in the chamber. Such behavior is central to addiction and poses and obstacle to therapy for many individuals, Wood says.

The mice then go through a process called extinction learning where they no longer receive any drug in the chamber. After many trials, the animals replace drug-related memories with associations that have no drug reward. "In a sense they are re-writing their original cocaine-associated memory," Wood says.

But mice given an HDAC3 inhibitor shortly after their first drug-free visit to the chamber re-write their memory much faster. After a single treatment with the HDAC3 inhibitors, the mice forgot the urge to indulge. This new memory is persistent. Days and weeks later, the scientists tried to initiate relapselike behavior, but the mice continued to show no preference for the drug den, the researchers reported in the Feb. 12 *Proceedings of the National Academy of Sciences*.

The study suggests that boosting the activity of memory-related genes during a trial with no reward helps wipe out any drug associations with the cues, Wood says.

Though scientists have yet to figure out how manipulations of HDAC3 produce the long-lasting change, Wood says timing is the key. Giving mice HDAC3 inhibitors immediately after a drug-free visit to the chamber resulted in a longlasting effect. But treatment delayed by several hours elicited no long-term change in drug-seeking behavior. The timely treatment came during a critical period in memory processing, called the consolidation phase, when certain genes must be coordinated and turned on to strengthen communication between neurons, Woods says.



Amazing brain

Studies of how human memory works often focus on individuals whose memories have crumbled. Perhaps the most famous of all such people was Henry Molaison, known by researchers as H.M., an amnesiac who collaborated on hundreds of studies of memory for more than half a century until his death in 2008 at age 82.

H.M.'s memory largely disappeared in one day in 1953, when as a 27-year-old with epilepsy he underwent experimental brain surgery meant to relieve his debilitating seizures. During the operation, surgeons extracted two slivers of tissue, one from each side of the brain: the front half of the hippocampus along with nearby entorhinal, perirhinal, and parahippocampal cortices. Surgeons also removed most of H.M.'s amygdala, an almond-shaped structure that supports emotion. Together, these brain structures make up a region known as the medial temporal lobe.

The operation did curtail H.M.'s seizures. But he could no longer remember new words or experiences. He could, however, remember some of what he had learned before the operation. He recognized his parents and could recall childhood experiences or facts he had learned in school.

At the time of H.M.'s surgery, scientists were debating the nature of memory creation. Some thought it occurred as a single process in which information started off in the brain as a short-term trace and then, over time, consolidated and moved into a long-term memory bank. But studies of H.M. showed that by losing most of his hippocampus and the surrounding structures, he had no way to turn newly learned information into long-term memories. Researchers now realize that there are differences between short-term and long-term memory creation and that they involve separate processes.



Henry Molaison, age 60 in 1986, prepares for tests at the MIT Clinical Research Center. At this time he had been participating in brain studies for more than half his life.

Studies of H.M. also showed that the brain processes different types of memories through different circuits. Notably, H.M. could learn new motor skills—such as drawing techniques—even without the parts of his brain that had been removed. And he could repeat his performance months or years later. This led scientists to make a distinction between declarative memory—recalling what you had for breakfast or dredging up historical facts—and nondeclarative memory, which includes motor-skill learning, classical conditioning and perceptual learning.

When H.M. died, scientists took detailed MRI scans of his brain and preserved it for future study. Today, studies of his brain continue at the University of California, San Diego through a project at the Brain Observatory. — *Susan Gaidos*

Down the road

Scientists might be able to help addicts create new memories around cues associated with drugs. But there are many hurdles to overcome before HDAC inhibitors of any type make it to human trials. Tsai says drugs currently used in animal studies are too destructive for use in the human brain. And histone acetylation has many roles in the body; a viable drug would somehow have to target specific processes in the brain.

And not all HDAC inhibitors work in the brain to enhance memory. Scientists are still unraveling the effects that various HDAC enzymes have. André Fischer of the University of Göttingen in Germany says that inhibiting certain histone deacetylase enzymes, such as HDAC5, can make memory problems worse.

Some labs are now turning their attention to finding other targets, such as the genes that the HDACs regulate. So far, Wood's group has identified at least one key gene, *NR4a2*, that must be turned on. This gene probably sets off another wave of genes, some of which may be involved directly in the brain's reward system, he says.

Identifying molecules and targets that act "downstream" of memory genes could boost efforts to develop effective therapies. It might also help physicians tailor treatments to the memory deficits that occur in a long list of disorders, including Alzheimer's, Parkinson's, addiction, depression and neurodevelopmental disorders such as fragile X syndrome and Rett syndrome.

Tsai says additional targets will probably be discovered in the next few years. In the meantime, results from her lab mice suggest that even in cases where memories seem to be lost, there may be ways to regain the power of recall.

"It's like a telephone line that gets broken so you lose communication," she says. "But if that line can be repaired, there's hope that long-term memory can be recovered." ■

Explore more

 Podcast with J. David Sweatt: bit.ly/SN_memory

Three outstanding optical instruments from Jomira. Our exclusive imports, our exclusive prices*

*But be sure to read this entire ad for our "Special Deal!"

The spy glass that made naval history...

ADMIRAL FARRAGUT'S TELESCOPE (with table top tripod) from us only \$69.95 (Why pay more?) *

• 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. Admiral Farragut's Telescope comes with a vinyl belt-looped carry case and a table-top tripod for extended observations.

When Admiral Farragut ("Damn the torpedoes; full speed ahead!") 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 (except that Admiral Farragut's was made of brass – ours is fully chromed over its pure brass body), 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. Compare that to binoculars, which usually give you not more than 6x or perhaps 8x magnification. ADMIRAL FARRAGUT'S TELESCOPE comes with a belt-loop vinyl carrying case. There is also a table-top tripod for extended observations. This beautiful instrument is something you always wanted but thought you couldn't afford. It is a small luxury that you will really enjoy and that will give you wonderful service for many years. It is now available from us at a most affordable price. The only universal optical instrument...

PANSCOPE (the complete optical system) from us only \$59.95 (why pay more?) *



• 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 Wetzlar (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. PANSCOPE is the indispensable first choice of scientists and professionals and of just about everybody who wants and needs to see the infinite detail in life that is not readily available to the unaided eye.

Hold the whole world in your hand with...

Jomirascope 8 x 20 monocular from us only \$59.95 (Why pay more?) *



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.

omirascope is so small that it fits Junobtrusively 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 366 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, or (with some luck) discern the rings of Saturn? 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, for enjoyment and exploration. You can use the objective lens of the jomirascope as an excellent 8x magnifier. And do consider the 25x microscope attachment of laboratory quality, which makes jomirascope a complete optical system.



* And here is our "special deal": You may buy any three of these outstanding optical instruments (mixed or matched) for the price of two, only \$119.90 — even the somewhat more expensive Telescope. (Note: Three Telescopes are \$139.90)

You may order by toll-free phone, by mail, or by fax and pay by check or AMEX/Visa/MasterCard. Please give order code shown. Add \$6.95 for ship./ins. for one and \$9.90 for three instruments - except one Adm. Farragut's Telescope is \$9.90 and any three instruments containing Adm. Farragut's Telescope \$12.95 - and sales tax for CA delivery. You have 30-day refund and one-year warranty. We do not refund postage. For customer service or wholesale information, please call (415) 356-7801. We ship the same day we receive your order. Please give order code Z378!

Order by toll-free phone: 1-800/600-2777, or (fastest!) by fax: 1-415/356-7804. Visit our website at www.jomira.com

Permanent Present Tense

Suzanne Corkin

Sixty years ago, 27-year-old Henry Molaison underwent an experimental operation in a last-ditch attempt to stop his debilitating epileptic seizures. By removing tissue from each side of Molaison's brain, the surgeon helped quell the attacks but destroyed his patient's ability to form new memories.

At the time, scientists didn't know that the ability to establish long-term memory was centered in a specific part of the brain. In fact, they knew little about the workings of memory. Molaison's unique condition made him a rich subject for study (Page 24), and Corkin gives readers a riveting account of those investigations.

Corkin, a neuroscientist, studied Molaison from 1962 until his death in 2008. Part memoir, part scientific history, Corkin's book weaves together tales of working with Molaison and a vivid backstory on the scientific approach, taking readers through 60-plus years of memory research.

A Piece of the Sun: The Quest for Fusion Energy Daniel Clery

It's not a great time to be a scientist studying fusion. U.S. experiments such as the \$3.5 billion National Ignition Facility are losing funding

(*SN*: 4/20/13, *p*. 26), while a \$20 billion international project called ITER is delayed and over budget. Clery, a science writer, chronicles these setbacks,



along with 70 years' worth of others, in efforts to harness the process that lights up the stars.

Clery gives a detailed and workmanlike history of the worldwide quest

to exploit fusion as an energy source. He describes persuasively how politics and economics, particularly during the Cold War, stalled progress. Clery is far less critical of the key scientists In the process, she puts a human face on Molaison, who for decades was referred to in studies only as H.M., a patient with severe amnesia.

In Corkin's portrait, H.M. is patient, friendly and resourceful: Deprived of his memory hub, he recruits other brain structures to compensate. In one touch-



ing account, Corkin describes how he comes to terms with the death of his father, though he had lost much of the brain structure needed to process emotion. In another,

he stuns researchers by creating a mental floor map of his house, accomplished through hours of walking room to room.

"Studying how Henry forgot gave us a better understanding of how we remember," Corkin writes. And her story of the scientific process leading to these insights makes Molaison unforgettable. — Susan Gaidos Basic Books, 2013, 364 p., \$28.99

involved than was his former colleague Charles Seife, who argued in his entertaining 2008 book *Sun in a Bottle* that fusion research is plagued by narcissists and wishful thinkers.

Clery optimistically claims early in the book that "one day the operators of ITER, or some other reactor, will get their settings just right, the plasma will get hot, stay hot and burn like a piece of the sun." That would be a big achievement, but it's not the same thing as creating a practical fusion power plant, as Clery himself later points out. In fact, Clery never follows through on his initial optimism; he seems resigned to the idea that fusion won't become a research priority until all other energy options are exhausted.

Clery's book is a solid no-nonsense primer for those interested in fusion's history, but it won't change many minds about whether fusion has a place in our energy future. — Andrew Grant Overlook Press, 2013, 320 p., \$27.95

Black Code

Ronald J. Deibert A digital security expert exposes the criminal underbelly of the Internet and discusses the future

of efforts to monitor illegal activity online. Signal, 2013, 312 p., \$29.99

Full Rip 9.0



Sandi Doughton A look at seismic science suggests that the Pacific Northwest is at risk for the biggest earthquake in

continental United States history. Sasquatch, 2013, 288 p., \$23.95



Risk, Chance, and Causation

Michael B. Bracken An epidemiologist explores why many studies linking causes to health effects turn

out not to be true. Yale Univ., 2013, 330 p., \$60



Alexander Wilson

Edward H. Burtt Jr. and William E. Davis Jr. This biography explores how a Scottish illustrator set the standard for the

study of North American birds in the early 19th century. *Belknap Press*, 2013, 444 p., \$35



The Lost World of Fossil Lake

Lance Grande Photos chronicle more than 150 years of paleontological finds in the limestone quarries

of southwestern Wyoming. Univ. of Chicago, 2013, 432 p., \$45

How to Order To order these books or others, visit www.sciencenews.org/bookshelf. A click on a book's title will transfer you to Amazon.com.

European family ties are knotty

I have trouble understanding "Europeans are one big family" (SN: 6/15/13, p. 8). It says that every person living in Europe today shares a common set of ancestors. First, what does "set" mean? "Set" implies there are certain common characteristics of the members, but people living in Europe 1,000 years ago had only one thing in common: living in Europe. Second, I interpret the article to mean that everybody now living in Europe is descended from people who lived in Europe 1,000 years ago. But this cannot possibly be true. Immigration has been more or less continuous, has it not? The ancestors of many present-day Europeans lived in Africa and Asia a lot more recently than 1,000 years ago. Fredric Blum, Merion, Pa.

The reader is right that recent immigrants to Europe might not share ancestors in this time range. Study author Graham Coop notes, however, that these

immigrants (and everyone in the world) are probably related to one another over the past 3,000 years or so. The conclusion of the study, though, is that every person who lived in Europe 1,000 years ago and left descendants is an ancestor of anyone with European ancestry today. In other words, everyone with any roots in Europe is related to the same set of ancestors. We used the word "set" to define a specific group of people: all those living in Europe 1,000 years ago who left descendants. It might seem that a Larsson in Sweden and a Rossi in Italy would trace back to different groups of people 1,000 years ago, but actually they would not. The concept is a little mindboggling! - Meghan Rosen

Counting cracks

The article "Cracked glass tells tales" (*SN*: 6/1/13, p. 15) reminded me of a high school science fair project I did five years ago — except I impacted Skittles candies with a drop weight

instead of firing at glass squares. As it turns out, Skittles are essentially sugar glass, so they crack radially when impacted at high speed. The number of cracks increases with speed, just as the researchers found for glass. Thanks for bringing back fond memories! **Daniel Duncan,** St. Charles, Mo.

Clarification

A chart accompanying the story "Mystery meteorite" (*SN: 6/29/13, p. 20*) reported that there are 177 confirmed meteorites from the moon. To clarify, there are 177 specimens of lunar meteorites. Many of them are paired with other specimens, meaning that the individual rocks were found close together and are probably part of the same fall. All 177 specimens are thought to derive from approximately 85 lunar meteorites.

Send communications to: Editors, Science News, 1719 N Street, NW, Washington, D.C. 20036 or editors@sciencenews.org. Letters subject to editing.

Two NEW Roadside Geology Books just in time for Summer Travel



www.mountain-press.com

ROADSIDE GEOLOGY OF GEORGIA

PAMELA J. W. GORE WILLIAM WITHERSPOON

From piles of sand to mountains of granite— Georgia's magnificent geology encompasses it all.

360 pages • 6x9 full-color illustrations \$24.00, paper • Item #242

ROADSIDE GEOLOGY OF NEW JERSEY

DAVID P. HARPER

Home to extraordinarily varied terrain for such a small state, New Jersey has many geologic wonders to discover.

360 pages • 6x9 full-color illustrations \$24.00, paper • Item #241



Give the gift of ScienceNews

Save time, save money and give the magazine that covers science in a biweekly, user-friendly format.

www.sciencenews.org/gift

The Science Life

For more of The Science Life, visit People at www.sciencenews.org/people

To learn how speech evolved, Erich Jarvis studies the brains of birds such as canaries that can imitate sounds.

Finding the brain's common language

Erich Jarvis dreams of creating a talking chimpanzee. If his theories on language are right, that just might happen one day.

Jarvis says that the ability to imitate sounds, not higher intelligence, is the key to language. Most animals are born already knowing the calls they'll croon, but human babies



learn words by mimicking how others talk. "I argue it's what makes spoken language unique," says Jarvis, a neurobiologist at Duke University Medical Center.

That realization came from an unlikely place: bird brains. Jarvis has spent more than a decade studying the brain circuitry of songbirds, parrots and hummingbirds, which are among the few critters that imitate and learn new vocalizations, a skill called vocal learning. Although humans and birds split evolutionarily from one another more than

300 million years ago, Jarvis and his colleagues have discovered that the brain circuitry for speech and birdsong is remarkably similar.

Humans and vocal-learning birds have networks of neurons that connect analogous brain regions. One of these connections hooks up a brain area related to speaking and singing to neurons in the brain stem that control the muscles of the voice box (called the larynx in humans). Animals incapable of vocal learning don't have such connections.

These networks, Jarvis says, "are imbedded within a more ancient pathway that controls learning how to move." He suspects that the crucial moment in the origin of language occurred when a genetic mutation created a new pathway from the brain's motor-learning region to the vocal organs. This link may allow people to voluntarily control their voice box in the same way they can control their legs while walking or their hands while typing. Speech, then, is just another motor skill, Jarvis says.

Now, he's working to identify the genes that oversee the development and maintenance of these brain connections. He and his colleagues have already discovered dozens of genes that might play a role. Once the genetics is worked out, Jarvis hopes that researchers can learn to manipulate the genes to repair brain damage in people with speech disorders.

He also wants to use genetic engineering to re-create the brain connections for vocal learning in animals that naturally lack them, such as chimps, to see if he can transform them into vocal learners, he says. "That's my ultimate goal." – *Erin Wayman*



Song and dance

Snowball the cockatoo (above) is a YouTube sensation, performing a song-and-dance routine that puts the bird among a select group of animals capable of moving to a musical beat. "Vocal-learning species are the only species that can synchronize their bodies to the rhythm of music," says neurobiologist Erich Jarvis, who is now looking for genetic changes in the brain that may account for the origins of dance. Jarvis is in a unique position to study the relationship between movement, song and the origin of language. Before he chose a science career, Jarvis attended the High School of Performing Arts in New York City, made famous by the movie Fame. He turned down an invitation to audition for the Alvin Ailey modern dance company to go to college, but still dances as a member of the North Carolinabased Cobo Brothers salsa dance team.

Monor Contract I love mine!" Here's why.

Say good-bye to everything you hate about cell phones. Say hello to Jitterbug.

"Cell phones have gotten so small, I can barely dial mine"

Not Jitterbug[®], it features a larger keypad for easier dialing. It even has an oversized display so you can actually see it.

"I had to get my son to program it"

Your Jitterbug set-up process is simple. We'll even pre-program it with your favorite numbers.

"I tried my sister's cell phone... I couldn't hear it"

Jitterbug is designed with an improved speaker. There's an adjustable volume control, and Jitterbug is hearing-aid compatible

"I don't need stock quotes, internet sites or games on my phone, I just want to talk with my family and friends" Life is complicated enough... Jitterbug is simple.

"What if I don't remember a number?" Friendly, helpful Jitterbug operators are available 24 hours a day and will even greet you by name when you call.

"I'd like a cell phone to use in an emergency, but I don't want a high monthly bill"

Jitterbug has a plan to fit your needs... and your budget



	Basic 14	Basic 19
Monthly Minutes	50	was 100 NOW 200
Monthly Rate	\$14.99	\$19.99
Operator Assistance	24/7	24/7
911 Access	FREE	FREE
Long Distance Calls	No add'l charge	No add'l charge
Voice Dial	FREE	FREE
Nationwide Coverage	YES	YES
Friendly Return Policy ¹	30 days	30 days

More minute plans available. Ask your Jitterbug expert for details.

"My cell phone company wants to lock me in on a two-year contract!"

Not Jitterbug, there's no contract to sign and no penalty if you discontinue your service.

"I'll be paying for minutes I'll never use!"

Not with Jitterbug, unused minutes carry over to the next month, there's no roaming fee and no additional charge for long distance.

"My phone's battery only lasts a couple of days"

The Jitterbug's battery lasts for up to 25 days.

Enough talk. Isn't it time you found out more about the cell phone that's changing all the rules? Call now, Jitterbug product experts are standing by.

Order now and receive a FREE Car Charger for your Jitterbug – a \$24.99 value. Call now!



Jitterbug Plus Cell Phone

Call today to get your own Jitterbug Plus.

Please mention promotional code 46934.

1-877-624-4134

VISA

itterbus

www.jitterbugdirect.com We proudly accept the following credit cards.

47592

IMPORTANT CONSUMER INFORMATION: Jitterbug is owned by GreatCall, Inc. Your invoices will come from GreatCall.All rate plans and services require the purchase of a Jitterbug phone and a one-time set up fee of \$35. Coverage and service is not available everywhere. Other charges and restrictions may apply. Screen images simulated. There are no additional fees to call Jitterbug's 24-hour U.S. Based Customer Service. However, for calls to an Operator in which a service is completed, minutes will be deducted from your monthly balance equal to the length of the call and any call connected by the Operator, Jou and Additional 5 minutes. Monthly minutes carry over and are available for 60 days. If you exceed the minute balance on your account, you will be billed at 355 for each minute used over the balance. Monthly returned within 30 days of purchase in like-new condition. We will also refund your first monthly service charge if you have less than 30 minutes of usage. If you have more than 30 minutes of usage, a per minute charge of 35 cents will apply for each minute over 30 minutes. The activation fee and shipping charges are not refundable.]Itterbug and GreatCall are registered trademarks of GreatCall, Inc. Samsung is a registered trademark of Samsung Electronics Co., Ltd. @2013 Samsung Telecommunications America, LLC. @2013 GreatCall, Inc.

Available in Silver and Red.

Send in the Aquamarines

Claim your share of the legendary "sailor's gem" that was once considered more valuable than diamonds or gold!



VThen the sun turns up the heat, you need a necklace that will make a splash. Ever since ancient times, sailors have sworn by aquamarine for protection on the open water. We guarantee it to turn heads, by land or by sea. And today you don't have to leave shore to reap the benefits of this leg-

endary blue gem, because your ship has come in. Today, you can wear this spectacular 300-carat Maré Aquamarine Necklace for only \$99!

Claim your "Mermaid's Treasure." On any vessel crossing the oceans, there was no more precious cargo than aquamarine. Sailors paid handsomely for its power, considering it their most valuable commodity. In scientific terms, the chemical composition of our Maré Necklace beads are cousins to precious emeralds. They begin life as geological twins underground, colorless until something sparks a change. Sprinkle in a dash of minerals and one becomes vivid green and the other becomes brilliant blue. That's the beauty of chemistry.

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

Your satisfaction is 100% guaranteed. Try the Maré Necklace for 30 days. If you don't fall in love, send it back for a complete refund of your purchase price. It's that simple. But once your wear 300 carats of aquamrine, you'll find that there's no better way to make a splash without getting wet!

94% Less than appraisal value!*

> Yours for only \$99!

*Necklace Independently Appraised at \$1,590**

This is how you make a splash...

Maré Necklace (300 ctw) \$179

Now Only **\$99** Save \$80

Call now to take advantage of this fantastic offer.

-888-373-0654 Promotional Code MAN271-06 Please mention this code when you call.



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

Stauer® 14101 Southcross Drive W., Dept. MAN271-06, Burnsville, Minnesota 55337 www.stauer.com