

SN

SCIENCE NEWS MAGAZINE
SOCIETY FOR SCIENCE & THE PUBLIC

APRIL 18, 2015

Fast 3-D
Printing

BP Oil's
Unsettled
Fate

Icelanders'
Genetic Saga

One-Pot
Recipe
for Life

COSMIC LANDSCAPES

Hubble celebrates 25 years of wonder



**LIMITED
AVAILABILITY**

Less Than
500 Sunburst
Tanzanite Rings
Available in This
Special Purchase.

**2 Carats of
Genuine Tanzanite
Save nearly \$550!**

African Gem Cutter Makes \$2,689,000 Mistake... Will You?

This story breaks my heart every time.

Allegedly, just two years after the discovery of tanzanite in 1967, a Maasai tribesman knocked on the door of a gem cutter's office in Nairobi. The Maasai had brought along an enormous chunk of tanzanite and he was looking to sell. His asking price? Fifty dollars. But the gem cutter was suspicious and assumed that a stone so large could only be glass. The cutter told the tribesman, no thanks, and sent him on his way. Huge mistake. It turns out that the gem was genuine and would have easily dwarfed the world's largest cut tanzanite at the time. Based on common pricing, that "chunk" could have been worth close to \$3,000,000!

The tanzanite gem cutter missed his chance to hit the jeweler's jackpot...and make history. Would you have made the same mistake then? Will you make it today?

In the decades since its discovery, tanzanite has become one of the world's most coveted gemstones. Found in only one remote place on Earth (in Tanzania's Merelani Hills, in the shadow of Mount Kilimanjaro), the precious purple stone is 1,000 times rarer than diamonds. Luxury retailers have been quick to sound the alarm, warning that supplies of tanzanite will not last forever. And in this case, they're right. Once the last purple gem is pulled from the Earth, that's it. No more tanzanite. Most believe that we only have a few years of supply left, which is why it's so amazing for us to offer this incredible price break. Some retailers along Fifth Avenue are more than happy to charge you outrageous prices for this rarity. Not Stauer. Staying true to our contrarian nature, we've decided to **lower the price of one of the world's**

**EXCLUSIVE
FREE**

Tanzanite Studs

-a \$295 value-
with purchase of
Sunburst Ring



rarest and most popular gemstones. Our 2-total carat Sunburst Tanzanite Ring features marquise-cut gemstones set dramatically in gorgeous sterling silver. Each facet sparkles with the distinct violet-blue hue of the precious stones.

Your satisfaction is completely guaranteed. For our client-friendly approach, Stauer has earned a rare A+ rating from the Better Business Bureau, a rating we wish to keep. So, of course, your satisfaction is 100% guaranteed. If you are not completely aglow with the Sunburst Tanzanite Ring, send it back within 30 days for a refund of the purchase price. But, please don't wait, our supply is dropping rapidly.

JEWELRY SPECS:

- 2 ctw genuine tanzanite - .925 sterling silver setting
- Ring sizes 5-10

Sunburst Genuine Tanzanite Ring (2 ctw)

Total value with FREE studs without offer code ~~\$644*~~

Now, Offer Code Price Only \$95 + S&P Save \$549!

1-888-201-7112

Your Offer Code: TZR572-08

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

Stauer® 14101 Southcross Drive W., Dept. TZR572-08,
Burnsville, Minnesota 55337 www.stauer.com



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

Smart Luxuries—Surprising Prices™

ScienceNews



Features

18 25 Years of Hubble

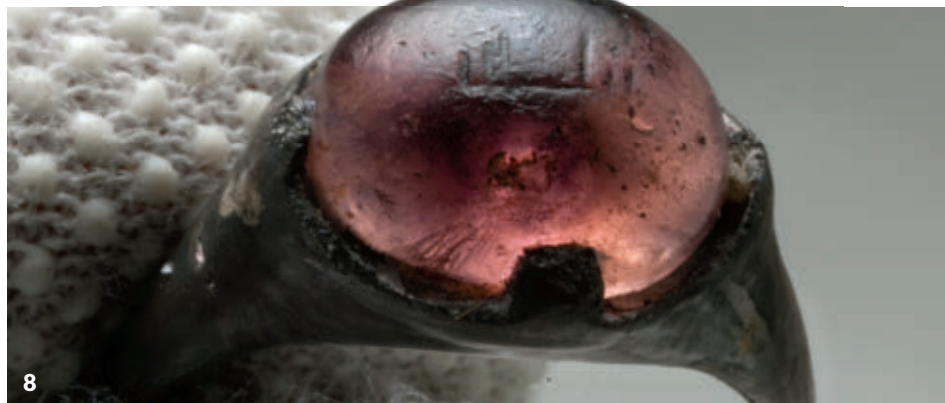
COVER STORY The space telescope has taken astronomers and the public to places that people had never imagined. Its updated cameras continue to capture surprises from the cosmos.
By Christopher Crockett

22 An Oil Spill's Aftermath

Five years after the Deepwater Horizon explosion, researchers are still studying the impacts and trying to get a handle on the oil's whereabouts. *By Beth Mole*

News

- | | | |
|--|---|---|
| <p>6 3-D printing when your need is speed</p> <p>7 Neandertal jewelry suggests symbolic sophistication</p> <p>8 Ring hints at Viking-Islam connection</p> <p>New hope for coping with Crohn's disease</p> <p>9 Pollution radicals initiate immune system ripples</p> <p>For clothes containing silver nanoparticles, skip the bleach</p> <p>Better batteries from packing-peanut power</p> | <p>10 Saturn moon's ocean feels the heat</p> <p>One-stop shopping for life's ingredients</p> <p>11 Putting a charge into the developing brain</p> <p>12 Rare variants in Icelanders' genes</p> <p>Flower responds to hummingbirds' bills</p> <p>13 Weaker storms, longer heat waves</p> <p>14 Quantum entanglement in a beam of light</p> <p>Supernova dust survival</p> | <p>15 More Mars surprises</p> <p>16 News in Brief</p> <p>Meet the Carolina Butcher</p> <p>'Metamirror' works on single wavelength</p> <p>New approach to silencing herpes</p> <p>Wrong genes raise painkiller cancer risk</p> <p>Two routes to super-Earths</p> <p>Lunar layers</p> <p>RNA for heart repair</p> <p>Britain's genetic history</p> |
|--|---|---|



5

Departments

2 EDITOR'S NOTE

4 NOTEBOOK

Why lattes spill less than black coffee

28 REVIEWS & PREVIEWS

Domestication brought behemoths into the barnyard

30 FEEDBACK

32 SCIENCE VISUALIZED

Drugs sent to the lungs

SOCIETY UPDATE

Awards for SN reporters

COVER The Horsehead Nebula, a dusty cocoon of new stars 1,500 light-years away, becomes transparent with Hubble's infrared camera. *The Hubble Heritage Team (STScI/AURA)/NASA, ESA*

One anniversary to celebrate, one to contemplate



As all readers of *Science News* know, scientific knowledge advances relentlessly. Whether it is news of a potential new drug for Crohn's disease (Page 8), an aurora detected on Mars (Page 15) or a science fiction–like 3-D printer that makes objects from a pool of goo (Page 6), each issue is chock-full of the latest exciting developments. But some-

times it's useful to look back and take stock of where we are and how we got here. In this issue, both feature articles focus on anniversaries, though of two very different kinds.

The story of the Hubble Space Telescope is an inspiring one. As astronomy writer Christopher Crockett describes on Page 18, scientists had ambitious plans for the telescope when it launched 25 years ago this month. By escaping Earth's atmosphere, the giant eye in the sky would be able to see deep into space more clearly than telescopes on the ground. Hubble eventually captured images of distant objects that no one even knew about a quarter-century ago. Exoplanets, now being studied by Hubble, offer a dramatic

example. The telescope has also achieved one of its main original missions: to measure how fast the universe is expanding, settling a long-standing astronomical controversy. And Hubble helped establish that the universe's expansion rate is accelerating, a surprise to many.

Hubble's success is clear. It has advanced astronomical understanding by leaps and bounds. And there will no doubt be more discoveries to celebrate when Hubble marks its 30th anniversary in five years' time.

On Page 22, chemistry and environment writer Beth Mole recounts a much more troubling anniversary: Just five years ago, the explosion of the Deepwater Horizon oil rig set off the globe's largest accidental oil spill. Scientists have responded with studies to track the disaster's long-term impacts. Much remains unclear, from the fate of three-quarters of the released oil to how the spill might have altered ecosystems in the Gulf of Mexico. Adding urgency to the work is the expectation that similar disasters are destined to happen again. Hopefully, by the 10-year mark, researchers will have a better idea of the best way to mitigate the damage.

—Eva Emerson, Editor in Chief

PUBLISHER Maya Ajmera
ASSOCIATE PUBLISHER/CHIEF DIGITAL OFFICER Mike Mills
EDITOR IN CHIEF Eva Emerson

EDITORIAL

MANAGING EDITOR Tom Siegfried
EDITOR, SCIENCE NEWS FOR STUDENTS Janet Raloff
DEPUTY MANAGING EDITOR, DEPARTMENTS Lila Guterman
DEPUTY MANAGING EDITOR, NEWS Macon Morehouse
DEPUTY MANAGING EDITOR, DIGITAL Kate Travis
DEPUTY MANAGING EDITOR, FEATURES Cori Vanchieri
PRODUCTION EDITOR Erin Wayman
ASSISTANT EDITOR Allison Bohac
WEB PRODUCER Helen Thompson
ASTRONOMY Christopher Crockett
BEHAVIORAL SCIENCES Bruce Bower
BIOMEDICINE Nathan Seppa
CHEMISTRY AND ENVIRONMENT Beth Mole
EARTH SCIENCES Thomas Sumner
LIFE SCIENCES Susan Milius
MOLECULAR BIOLOGY Tina Hesman Saey
NEUROSCIENCE Laura Sanders
PHYSICS Andrew Grant
STAFF WRITERS Meghan Rosen, Ashley Yeager
SCIENCE EDUCATION WRITER Bethany Brookshire
EDITORIAL ASSISTANT Teresa Shipley Feldhausen
SCIENCE WRITER INTERN Kate Baggaley
CONTRIBUTING CORRESPONDENTS
Laura Beil, Susan Gaidos, Alexandra Witze

DESIGN

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

BUSINESS SERVICES

SPONSORSHIP AND ADVERTISING Melissa Pewett
SUBSCRIBER AND MEMBER SERVICES Kerwin Wilson
PERMISSIONS Evora Swoopes

BOARD OF TRUSTEES

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

EXECUTIVE OFFICE

PRESIDENT AND CEO Maya Ajmera
CHIEF OF STAFF Angela Kim
EXECUTIVE ASSISTANT Amy Méndez

FINANCE CHIEF FINANCIAL OFFICER Charlie Feeney

CONTROLLER Muaz Ahmed
ACCOUNTING MANAGER Lisa M. Proctor

EXTERNAL AFFAIRS

CHIEF DEVELOPMENT AND COMMUNICATIONS OFFICER Rick Bates
DIRECTOR, DEVELOPMENT Rachel Alper
DIRECTOR, COMMUNICATIONS Sarah Wood
DIRECTOR, DATA ANALYTICS Alan Gordon
EXTERNAL AFFAIRS Nancy Moulding
ALUMNI COORDINATOR Carolyn Carson
DATABASE ADMINISTRATOR Krystal Robinson

EVENTS AND OPERATIONS

CHIEF, EVENTS AND OPERATIONS Cait Goldberg
EVENTS ASSOCIATE Marisa Gaggi
OPERATIONS MANAGER Anthony Payne
FACILITIES MANAGER Paul Roger
SPECIALISTS Randy Williams, Ashley Johnson

SCIENCE EDUCATION PROGRAMS

CHIEF PROGRAM OFFICER Michele Glidden
INTEL SCIENCE TALENT SEARCH MANAGER Caitlin Sullivan
BROADCOM MASTERS MANAGER Allison Stifel
INTEL ISEF MANAGER Lisa McClure
DOMESTIC FAIRS Laurie Demsey
VOLUNTEERS AND SPECIAL AWARDS Diane Rashid
AWARDS AND EDUCATION PROGRAMS June Kee

INTERNATIONAL FAIRS SPECIALIST Jinny Farrell
OUTREACH Victor Hall **ASSOCIATE** Sarah Conner

INFORMATION TECHNOLOGY

NETWORK MANAGER James C. Moore
DRUPAL DEVELOPMENT Craig Bozman
INFORMATION TECHNOLOGY Gregory A. Sprouse
WEB DEVELOPER Chris Rivieccio

EDITORIAL, ADVERTISING AND BUSINESS OFFICES

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

Customer service: member@societyforscience.org

Editorial/letters: editors@sciencenews.org

Sponsor content: snsals@sciencenews.org

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

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

Subscribe:

Web www.sciencenews.org/join
For renewals, www.sciencenews.org/renew

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

E-mail member@societyforscience.org

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

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

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

Society for Science & the Public is a 501(c)(3) nonprofit membership organization founded in 1921. The Society seeks to promote the understanding and appreciation of science and the vital role it plays in human advancement: to inform, educate, inspire. Learn more at societyforscience.org. Copyright © 2015 by Society for Science & the Public. Title registered as trademark U.S. and Canadian Patent Offices. Republication of any portion of *Science News* without written permission of the publisher is prohibited. For permission to photocopy articles, contact eswoopes@societyforscience.org. Sponsor content and advertising appearing in this publication do not constitute endorsement of its content by *Science News* or the Society.

The Fifth C?

Cut, Color, Carat, Clarity...Chemistry?

Is it possible that the mind of a scientist can create more beauty and romance than Mother Nature? The laboratories at DiamondAura® were created with one mission in mind: Create impeccably cut jewelry that allows everyone to experience more clarity, more scintillation and larger carat weights than they have ever encountered. So, we've taken 4 carats of our lab-created DiamondAura® and placed them in the most classic setting—the result is our most stunning, fiery, faceted design yet! In purely scientific measurement terms, the refractory index of the DiamondAura is very high, and the color dispersion is actually superior to mined diamonds.

Perfection from the laboratory. We named our faultlessly cut stones DiamondAura, because, "they dazzle just like natural diamonds but without the outrageous cost." We will not bore you with the incredible details of the scientific process, but will only say that it involves the use of rare minerals heated to an incredibly high temperature of nearly 5000°F. This can only be accomplished inside some very modern and expensive laboratory equipment. After several additional steps, scientists finally created a clear marvel that looks even better than the vast majority of mined diamonds. According to the book *Jewelry and Gems—the Buying Guide*, the technique used in DiamondAura offers, "The best diamond simulation to date, and even some jewelers have mistaken these stones for mined diamonds."

The 4 C's. Our Infinity DiamondAura Pendant retains every jeweler's specification: color, clarity, cut, and carat weight. The transparent color and clarity of DiamondAura emulate the most perfect diamonds—D Flawless—and both are so hard they will cut glass. The cushion cut maximizes the fire and radiance of the stone so that the light disperses into an exquisite rainbow of colors.

Rock solid guarantee. This .925 sterling silver pendant is set with a 3½ carat DiamondAura cushion princess cut stone in the center, showcased with 24 DiamondAura accents totaling another ½ carat. Adding to your 4 C's, we will include the DiamondAura stud earrings for **FREE!** Try the DiamondAura Infinity Pendant for 60 days. If for any reason you are not satisfied with your purchase, simply return it to us for a full refund of the purchase price and keep the stud earrings as our gift.



Receive these scintillating DiamondAura® sterling silver stud earrings **FREE** with pendant purchase.



COMPARE FOR YOURSELF AT 4 TOTAL CARATS			
	Mined Flawless Diamond	DiamondAura® Compares to:	
Hardness	Cuts Glass	Cuts Glass	
Cut (58 facets)	Brilliant	Brilliant	
Color	"D" Colorless	"D" Colorless	
Clarity	"IF"	Clear	
Dispersion/Fire	0.044	0.066	
4 ctw pendant	\$120,000+	\$8750	



Jewelry enlarged to show brilliant details.
Chain sold separately.

Not Available in Stores

Infinity DiamondAura® Pendant \$399*

Offer Code Price Only **\$8750** + S&P **Save over \$311!**

FREE 1 ctw DiamondAura® stud earrings with purchase of Infinity DiamondAura® Pendant—a \$99 value!

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

1-888-201-7657

Your Insider Offer Code: IDP167-01

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

Stauer® 14101 Southcross Drive W., Dept. IDP167-01, Burnsville, Minnesota 55337 www.stauer.com



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

3 ½ carat lab-created DiamondAura® center stone • .925 sterling silver setting and bail • 18" sterling silver chain sold separately

Smart Luxuries—Surprising Prices™



Excerpt from the
April 17, 1965, issue
of *Science News Letter*

50 YEARS AGO

Birth control pill found safe for 11,711 women

Women have used certain birth control pills for as long as 3½ years without developing new side effects, physicians from Planned Parenthood–World Population reported. In a study group of 11,711 women, the progestin-estrogen tablet taken as directed was “100% effective.”... No unplanned pregnancies occurred among women enrolled in the study.

UPDATE: First marketed as contraception in 1960, the pill is very effective but not perfect. If users take a tablet every day, less than 1 in 100 will get pregnant each year. Typical use, including some missed doses, puts the rate closer to 9 in 100. Meanwhile, scientists have yet to create a birth control pill for men. One challenge is that while women release one egg per month, men produce sperm constantly. Researchers are investigating blocking sperm production, tampering with sperm so that they can’t fertilize eggs and halting the muscle contractions that lead to ejaculation.



SCIENCE LIFE

The art of astronomy

An astronomer by training but a photographer at heart, Zoltan Levay creates images of the cosmos with one of humankind’s most advanced optical instruments: the Hubble Space Telescope. Producing photos with the telescope, he says, is not that different from shooting mountains and rivers in national parks. “We’re just shooting landscapes of the universe instead,” he says.

Levay, 62, heads Hubble’s imaging group and is part of the Hubble Heritage Team, which works to share the telescope’s images with the public. Born in Pakistan, Levay moved with his parents to the United States in 1956. In high school, he built his own telescope to take pictures of planets and stars. He studied astronomy and astrophysics, and in 1983 he joined the Space Telescope Science Institute in Baltimore as a programmer for Hubble. A few years after the telescope launched in 1990, he began working with its photos.



Zoltan Levay uses Hubble to produce landscapes of the cosmos including the Pillars of Creation (above).

Levay transforms Hubble’s raw data into iconic images. Hubble’s cameras take black-and-white shots and record color with filters. Levay converts the data into reds, greens and blues of space. (For more on Hubble, see Page 18.)

A famous Hubble image is the Pillars of Creation, released in 1995. Its fingerlike projections show where stars are born. Using newer infrared cameras on Hubble, Levay and his team have now refashioned the image with greater clarity and a view inside the cloudy pillars (*SN Online*: 1/6/15). “It was a nice way to bookend Hubble’s mission,” he says. — Ashley Yeager

FROM TOP: HUBBLE HERITAGE TEAM/HUBBLE/NASA, ESA; PAT TIZZO/GODDARD SPACE FLIGHT CENTER/NASA

THE -EST

Earliest evidence of humans living in rainforests

In at least one part of the world, humans had adapted to living in rainforests by 20,000 years ago. New evidence of people inhabiting Sri Lanka is the earliest yet discovered in such a habitat — by about 10,000 years.

Archaeologist Patrick Roberts of the University of Oxford and his colleagues analyzed chemical signatures of teeth from the remains of 26 individuals who lived in Sri Lanka between 20,000 and 3,000 years ago. That evidence reflects year-round consumption of rainforest plants and fruits, the researchers report in the March 13 *Science*. At least on this South Asian island, Stone Age humans



Teeth excavated from this rock-shelter (right) in Sri Lanka provide evidence of long-term human rainforest occupation as early as 20,000 years ago.

found ways to survive full-time in and on the fringes of jungles that included a few open spaces, the researchers say.

Several previous finds had hinted that humans occupied South Asian rainforests as early as 46,000 years ago. But it was unclear whether those stays were brief or long-term. Some researchers have speculated that it took until around 10,000 years ago for foraging groups to figure out how to find enough food and fend off predators well enough to survive year-round in rainforests. — *Bruce Bower*

MYSTERY SOLVED

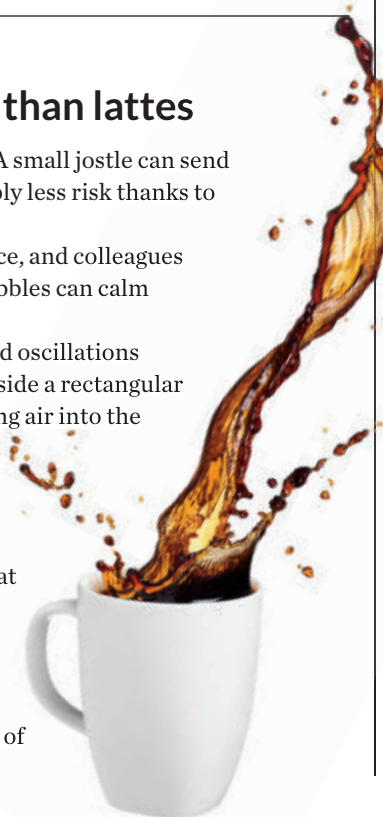
Why regular joe spills more than lattes

Carrying a cup of coffee can prove dangerous: A small jostle can send hot liquid flying. A latte comes with considerably less risk thanks to its bubbles.

Alban Sauret of CNRS in Aubervilliers, France, and colleagues report February 24 in *Physics of Fluids* that bubbles can calm sloshing liquid.

With a high-speed camera, the team recorded oscillations of a mixture of water, glycerol and dish soap inside a rectangular container after they jolted or rocked it. Pumping air into the liquid, the researchers created varied quantities of bubbles. Bubbles form in layers on top of a liquid, and five layers were enough to reduce sloshing as long as the bubbles touched the container's sides. The researchers think that foam bubbles absorb the energy driving the liquid waves by creating friction at the sides of the container.

The bubbles may give a boost to waiters carrying impossibly full cups of latte or glasses of beer without spilling them. — *Helen Thompson*



SCIENCE STATS

Winter storms 24 times as deadly as reported

Jack Frost's fury is deadlier than a major report implies, new research suggests.

Winter storm fatalities are tabulated in *Storm Data*, a report published by the National Oceanic and Atmospheric Administration. But *Storm Data* doesn't include deaths indirectly caused by winter storms, such as precipitation-related car and plane crashes. That's a glaring omission, say atmospheric scientists Alan Black and Thomas Mote of the University of Georgia in Athens. After combing through 15 years of U.S. fatality data, the researchers report March 9 in *Climate, Weather, and Society* an additional 13,281 storm-related deaths excluded by *Storm Data*.

— *Thomas Sumner*

571

U.S. fatalities caused by winter storms from 1996 to 2011, according to NOAA

13,852

U.S. winter storm fatalities from 1996 to 2011 taking into account storm-related car and plane crashes

SOURCE: A.W. BLACK AND T.L. MOTE/
CLIMATE, WEATHER, AND SOCIETY 2015

CLOCKWISE FROM TOP LEFT: P. ROBERTS; GABRIEL WIDYNA/WIKIMEDIA COMMONS; OKEA/ISTOCKPHOTO

Watch a video of bubbles slowing sloshing at bit.ly/SN_latte

News

MATTER & ENERGY

Superfast 3-D printer constructs objects from goop

New process creates items by manipulating oxygen, UV light

BY BETH MOLE

A new versatile method can produce three-dimensional objects from a puddle of goo in mere minutes — orders of magnitude faster than current 3-D printers.

The technique, reported in the March 20 *Science*, manipulates a liquid resin, ultraviolet light and oxygen to create objects with precision down to less than a tenth of a millimeter. The method could be used to manufacture products such as engine parts and medical devices.

The researchers “really thought about the chemical process,” says chemist Lee Cronin of the University of Glasgow in Scotland. The speed and chemical tricks will “definitely move the field forward,” he says.

Scientists have used 3-D printers since the 1980s to manufacture custom pieces, layer by layer (*SN*: 3/9/13, p. 20). Some versions, like this new one, use pools of resin and UV light in the manufacturing process. But speed has always

been a problem, says polymer chemist Joseph DeSimone of the University of North Carolina at Chapel Hill. “I know of mushrooms that grow faster than 3-D printers print,” he says.

Inspired by the movie *Terminator 2: Judgment Day*, in which the main villain forms from a puddle of liquid metal, DeSimone and colleagues turned to a group of goopy resins to come up with a chemical solution. When shot with UV light, the resins form chains, creating a hard polymer. But if oxygen seeps into the resin pool, researchers can say “Hasta la vista” to chain growth. (The gas prevents polymers from forming.)

DeSimone and colleagues created a resin chamber that has a clear Teflon plastic window on the bottom. The window lets in UV light and oxygen, much like new contact lenses. So the bottom layer of the resin pool ends up full of oxygen, where no polymerization can hap-

pen regardless of UV light exposure. Scientists refer to this region as the “dead zone.” UV light shot up through the window, however, reaches a sweet spot higher up in the resin, past the dead zone.

The new process begins by lowering a metal plate into that sweet spot. By projecting a stream of UV light patterns that represent an object, polymers can start linking up on the metal plate within the sweet spot. Then the researchers slowly raise the plate, allowing for more resin to enter the sweet spot and solidify based on the projected UV patterns.

The result looks like a scene from a

The result looks like a scene from a science-fiction movie: a solid, detailed object rising from a shallow puddle of ooze.



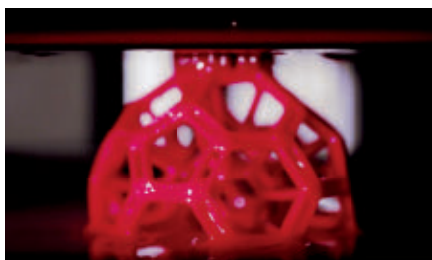
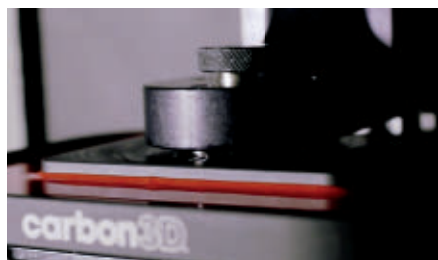
A mini-Eiffel Tower emerges from resin in just one hour, thanks to a new 3-D printing method that uses ultraviolet light and oxygen to create intricate objects.

science-fiction movie: a solid, detailed object rising from a shallow puddle of ooze. The researchers created complex structures, including a model of the Eiffel Tower. These structures formed quickly, some rising up as fast as 500 millimeters per hour. Typical 3-D printer speeds are just several millimeters per hour.

“The ability to obtain high print speeds — such as the 100 mm/hour over large areas while still preserving high-resolution complex geometries — is really impressive,” says materials engineer Joshua Pearce of Michigan Technological University in Houghton. This method could create a new paradigm for manufacturing, he says.

The new 3-D printing technology could hit the market by midyear. It’s unclear how much it will cost. ■

By dunking a metal plate into a pool of liquid resin (left), scientists can quickly build detailed 3-D objects such as this ball. The method works by carefully managing the resin’s exposure to ultraviolet light, which causes the resin to form solid polymers, and to oxygen, which prevents the resin from forming polymers. Both the UV light and the oxygen enter the resin pool from below.



TOP: LARS SAHL; BOTTOM: CARBON3D, INC.

Cache of eagle claws points to Neandertal jewelry-making

Extinct human relative had ability to create symbolic objects 130,000 years ago, researchers argue

BY BRUCE BOWER

Neandertals made the oldest known piece of jewelry in Europe, a 130,000-year-old necklace or bracelet featuring eight white-tailed eagle claws, a new study suggests.

The eagle claws came from a rock-shelter in Croatia called Krapina where Neandertal remains have also been unearthed. Toolmarks and polished spots showing wear on the claws indicate they were purposefully removed from eagles, strung together and worn, researchers report online March 11 in *PLOS ONE*.

This ornament was created at least 60,000 years before *Homo sapiens* reached Europe, say paleontologist Davorka Radović of the Croatian Natural History Museum in Zagreb and her colleagues. The timing means that Neandertals didn't have to wait for modern humans to move in and demonstrate necklace-making and other symbolic practices, as some researchers have argued, the team concludes. Given the difficulty of obtaining white-tailed eagles' talons, and the birds' fierce and majestic natures, a piece of eagle-claw jewelry must have had symbolic meaning for Neandertals, the scientists contend.

"To discover evidence of what's widely regarded as typical modern behavior at such an ancient Neandertal site is stunning," says paleoanthropologist and study coauthor David Frayer of the University of Kansas in Lawrence.

Radović noticed tool-produced incisions on the set of eagle talons in 2013 while conducting an inventory of fossils and stone tools recovered more than a century ago at Krapina. Decay rates of radioactive elements in Krapina

Neandertal teeth indicated that these individuals lived 130,000 years ago. No *H. sapiens* remains have been unearthed at the site.

Microscopic analysis indicated that the toolmarks were made while removing talons from eagles' feet. Neandertals wrapped string around the ends of talons and over the toolmarks to make a wearable object, Radović's team proposes. Incisions on strung claws developed polished edges from rubbing against the string, the researchers say.

Eagle claws on the Krapina ornament came in contact with each other when the jewelry was worn, creating more polished patches on talons' sides.

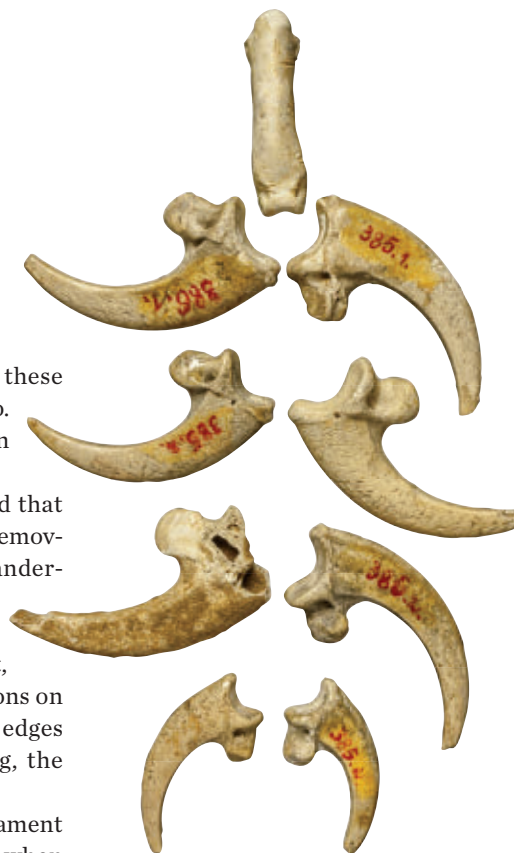
No remnants of string have turned up among the Krapina finds. A team led by paleoanthropologist Bruce Hardy of Kenyon College in Gambier, Ohio, reported in 2013 that Neandertals twisted fibers to make string at a cave in southeastern France nearly 90,000 years ago. "The evi-

dence for Neandertal symbolic behavior continues to mount, and the Krapina talons significantly push back the date of that behavior," he says.

In addition, individual eagle talons, possibly used as pendants, have been found at a handful of other Neandertal sites dating to as early as 90,000 years ago, Frayer says.

The Krapina eagle claws include three second talons from the right foot, so at least three birds are represented in the proposed ornament.

"The evidence points to a special relationship between Neandertals and birds of prey," says evolutionary ecologist Clive Finlayson of the Gibraltar Museum, who was not part of the new



Neandertals strung these eight fossilized white-tailed eagle claws into a necklace or bracelet 130,000 years ago, a new study concludes. A white-tailed eagle's foot bone (top) was found with the claws.

study. In a controversial earlier finding, Finlayson reported that Neandertals decorated themselves with bird feathers (*SN: 11/3/12, p. 8*).

Neandertals probably caught white-tailed eagles, Finlayson speculates. Present-day white-tailed and golden eagles frequently feed on animal carcasses, he says. Neandertals could have baited eagles with pieces of meat placed on covered traps or thrown nets over the animals as they fed on strategically placed snacks.

Krapina Neandertals probably made personal ornaments out of eagle claws, but the new study doesn't confirm that those items symbolized anything, say psychologist Fred Coolidge and archaeologist Thomas Wynn, both of the University of Colorado, Colorado Springs. Modern humans evolved a small but critical advantage over Neandertals in memory and long-term planning, Coolidge and Wynn contend. ■

"The evidence for Neandertal symbolic behavior continues to mount."

BRUCE HARDY

HUMANS & SOCIETY

Ring links Viking, Islamic civilizations

Inscription, style and lack of wear point to ancient contact

BY BRUCE BOWER

More than 100 years after its discovery in a ninth century woman's grave, an engraved ring has revealed evidence of close contacts between Viking Age Scandinavians and the Islamic world.

Excavators of a Viking trading center in Sweden called Birka recovered the silver ring in the late 1800s. Until now, it was thought that it featured a violet amethyst engraved with Arabic-looking characters. But closer inspection with a scanning electron microscope revealed that the presumed amethyst is colored glass (an exotic material at the time), say biophysicist Sebastian Wärmländer of Stockholm University and his colleagues.

An inscription on the glass inset reads “for Allah” or “to Allah” in an ancient Arabic script, the researchers report



A ninth century ring from a Viking site in Sweden may have come from the Islamic world. Its colored glass is engraved in Arabic.

online February 23 in *Scanning*.

Scandinavians traded for fancy glass objects from Egypt and Mesopotamia as early as 3,400 years ago (*SN*: 1/24/15, p. 8). Thus, seagoing Scandinavians could have acquired glass items from Islamic traders in the same part of the world more than 2,000 years later rather than

waiting for such desirable pieces to move north through trade networks.

Ancient texts mention encounters around 1,000 years ago between Scandinavian and Islamic civilizations. However, archaeological evidence supporting those accounts is rare.

The inner surface of the Birka ring's silver body shows virtually no signs of wear. Filing marks made in the final stage of its production are still visible. That suggests that the ring, made by an Arabic silversmith, had few or no owners before the Viking woman, the researchers say.

The new study adds to previous evidence of extensive trade routes from the Islamic world through what's now western Russia to the Baltic Sea, then to Scandinavia, says Roman Kovalev, a historian of medieval Eurasian economics at the College of New Jersey in Ewing. Similar ninth and 10th century rings, some with Arabic inscriptions, have been found at Eastern European sites, he says, along with other luxury items. ■

BODY & BRAIN

Crohn's drug shows promise

In clinical trial, compound blocked gut inflammation

BY NATHAN SEPPA

An experimental drug for Crohn's disease has sent many patients into remission and kept them there for 12 weeks or more. The compound, called mongersen, shuts down inflammation in the gut.

Crohn's is an inflammatory bowel disease that causes pain, severe diarrhea and fatigue. Roughly 565,000 people in the United States have the condition, which has an unknown cause and no cure.

Some approved Crohn's drugs such as adalimumab (Humira) and infliximab (Remicade) block an inflammation-causing protein, TNF-alpha, by directly binding to it. But they fail to help many patients achieve or maintain remission. Mongersen works indirectly, via a domino effect. By inhibiting production of a

compound called SMAD7, it restores the activity of an immune-calming protein called transforming growth factor beta 1, which suppresses TNF-alpha, researchers report in the March 19 *New England Journal of Medicine*.

The chain reaction might give the experimental drug an advantage over existing drugs by restoring a “physiological mechanism of immunosuppression,” says study coauthor Giovanni Monteleone, a gastroenterologist at the University of Rome Tor Vergata in Italy.

Monteleone and colleagues gave 160 Crohn's patients a placebo or a small, medium or large dose of mongersen daily for two weeks. Two weeks after stopping these randomly assigned treatments, 22 of 40 patients who got the medium dose were in remission, as were 28 of 43 assigned the high dose. Only a handful of people getting the low-dose pills and a handful getting the placebo were in remission.

Twelve weeks after the study onset, improvement remained steady in the medium- and high-dose groups, with

roughly two-thirds of those patients in remission. In an earlier safety trial, some patients who got the higher doses remained in remission for at least six months, Monteleone says.

These heady findings come with caveats. Mongersen pills are coated to delay their release until they reach the end of the small intestine or the start of the large intestine. Accordingly, the researchers excluded people from the study who had Crohn's disease afflicting other parts of the digestive tract.

Patients were recruited using a scoring system based on abdominal pain and other symptoms. A better test is a colonoscopy to verify ulcers or other damage, gastroenterologist Séverine Vermeire of University Hospitals Leuven in Belgium writes in the same journal. It is unclear, she says, how many people in this trial might have lacked Crohn's lesions.

Nevertheless, Vermeire writes, “the impressive clinical effects of mongersen beg for follow-up studies to confirm that we have indeed entered a new phase of Crohn's disease treatment.” ■

MATTER & ENERGY

Air pollution flips immune response

Lowered defenses in mice lead to infections, chronic asthma

BY BETH MOLE

With the flip of a cellular switch, reactive molecules in air pollution can turn immune responses in the lungs topsy-turvy. When those reactive molecules fill baby mouse lungs, they can open the door to severe infections and set the stage for asthma later in life, researchers reported March 23.

The reactive molecules can damage cellular components such as DNA, proteins and lipids, causing oxidative stress and switching on an immune-regulating protein called aryl hydrocarbon receptor, or Ahr. In the lungs of infant mice, the reactive molecules dampened immune defenses, leaving the pups vulnerable to viral infections. These pups also grew up to have hyper-immune responses, leading to severe asthma.

The findings could explain why human infants who breathe bad air are at high risk of severe lung infections and developing asthma.

Scientists knew that oxidative stress contributed to these health problems, but no one knew how, said environmental health researcher Nora Triviss of Keene State College in New Hampshire, who was not involved in the researchers' study. "The depth that they're going into is really exciting," she said.

The reactive molecules, called free radicals, are created in the exhaust of burning fossil fuels and other materials, arising from cookstoves, car fumes, factories, wood fires and cigarettes.

Free radicals make up "a huge percentage of what might be in the air," said study coauthor Stephanie Cormier of the University of Tennessee Health Science Center in Memphis. For example, in Baton Rouge, La., home to many chemical

plants and refineries, the amount of free radicals on airborne particles is higher than that of cigarette smoke, she said.

In mouse lungs, those free radicals can swipe electrons from cellular components, creating more reactive molecules and oxidative stress, Cormier and colleagues discovered. This process turns on Ahr, which sets off rippling changes in the immune system.

The researchers exposed baby mice to a type of free radical found in air pollution, which triggered Ahr. The researchers then tested the pups' immune response by giving them flu virus. Compared with flu-ridden pups not previously exposed to pollution, these pups had more virus particles in their lungs and more severe illness; about 20 percent more of them died. Instead of fighting off the virus, the mice exposed to free radicals cranked up

an anti-inflammatory signal, interleukin-10, and immune cells called regulatory T cells. These turned off infection defenses, leaving the pups vulnerable.

Pollution exposure early in life also led to long-term health issues. When exposed mice grew up, their previously

suppressed immune response overreacted to allergens, causing severe asthma.

The researchers also created baby mice that produce an antioxidant enzyme and then exposed these mice to pollution. The free radicals had no impact on the pups' immune responses or their ability to fight the flu. This finding confirmed that free radicals and oxidative stress were responsible for derailing the immune system.

But that doesn't necessarily mean that feeding human babies antioxidants would help, said toxicologist Tammy Dugas of Louisiana State University in Baton Rouge, who collaborates with Cormier and led the work on Ahr. Certain antioxidants taken to quell oxidative stress can backfire, creating even more oxidative stress. Other antioxidants, she explained, stay outside cells, where they wouldn't be able to block Ahr. ■

MEETING NOTES

Suds turn silver nanoparticles in clothes into duds

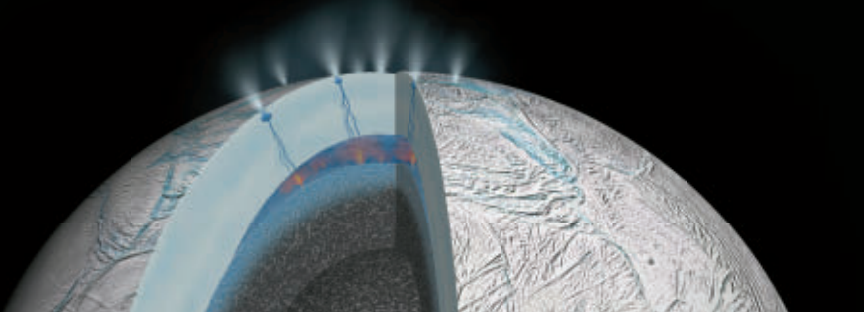
Life's bleachable moments may be a death sentence for bacteria-busting silver nanoparticles. The particles can shield clothes from smelly or infectious bacteria. But the tiny metal balls, which coat some athletic clothing and hospital gowns, can crack and crumble when washed in detergents with bleach or bleach alternatives, researchers led by Denise Mitrano of Empa, the Swiss Federal Laboratories for Materials Science and Technology in St. Gallen, reported March 25. The detergents probably widen tiny fissures on the particles' surfaces, causing bits to break off, Mitrano said. Milder detergents had no such effect. But they still washed particles out of the fabrics over time, possibly enabling release of toxic ions into wastewater. — *Beth Mole*

Foam peanuts boost batteries

Packed into boxes, foam peanuts provide gentle protection. But stuffed into a lithium-ion battery, they pack a powerful electrical punch, researchers reported March 23. When baked and crushed, packing peanuts made of starch or polystyrene transform into fragments of carbon-containing microsheets and nanoparticles. Squeezed into the negative end of a lithium-ion battery, the peanuts' remains provide lots of surface area for contact with battery fluids. In prototype batteries, the peanuts reduced charging times and increased the amount of charge that a battery can hold by about 13 percent compared with commercial lithium-ion batteries that use graphite. This use of packing peanuts could cut down on environmentally damaging waste, said chemical engineer Vilas Pol of Purdue University in West Lafayette, Ind., lead researcher of the study. Only about 10 percent of packing peanuts get recycled. — *Beth Mole*

Hydrothermal activity on Enceladus

Saturnian moon's ocean home to hot water, Cassini suggests



BY CHRISTOPHER CROCKETT

The core of Saturn's moon Enceladus may be cooking the water in its sub-surface sea.

Silicon-rich particles embedded in one of Saturn's rings originated in water on Enceladus that had been heated to at least 90° Celsius, researchers report in the March 12 *Nature*. The debris probably was dredged up from the bottom of the moon's ocean by water percolating through the rocky core, and then blasted into space through cracks in the

moon's icy shell (*SN: 5/3/14, p. 11*). Warm water-rock interactions are found in hydrothermal vents on Earth. If such interactions occur on Enceladus, it's yet another sign that the moon has conditions favorable for life.

Hsiang-Wen Hsu, a planetary scientist at the University of Colorado Boulder, and colleagues used data collected by the Cassini spacecraft, orbiting Saturn since 2004, to measure the size and composition of the particles. The debris was made mostly of silicon dioxide grains, or

Hot water mixing with a rocky core on Enceladus, seen in this artist's illustration, may be spewing a trail of silica nanoparticles into one of Saturn's rings.

silica, each just a few nanometers across. Silica is a common by-product of rock in contact with water. The Blue Lagoon in Iceland, for instance, gets its milky appearance from fine silica particles in the water. Hot water from a nearby geothermal power plant dissolves silica in the rocks, forming particles similar to those in Saturn's E ring, Hsu says.

To replicate the process, Hsu and colleagues let a powdery mix of minerals commonly found in asteroids and comets sit in pressurized cocktails of water, ammonia and sodium bicarbonate ranging from 120° to 300° C for several months. The resulting silica concentrations allowed the team to deduce the chemical reactions at play and calculate a minimum temperature at which silica particles form: 90° C. The results suggest that there is a tremendous source of heat at the bottom of Enceladus' ocean.

"This is an extraordinary claim," says Christopher Glein, a geochemist at the

MATTER & ENERGY

Life's ingredients forged all at once

Key cellular parts could be made by same set of reactions

BY BETH MOLE

Scientists have long mulled over whether the protein or its genetic code came first. Or maybe it was the cell that houses both. Now chemists may have the answer: The components for life all emerged together.

A series of primordial chemical reactions can generate the building blocks of the three necessary components for a living cell—genetic material, proteins and cellular compartments, researchers report March 16 in *Nature Chemistry*. It's the first experimental evidence that these chemical precursors to life could have arisen at the same place and time from the same ingredients.

That place and time could have been streams and pools on Earth's surface nearly 4 billion years ago, about the time when life started, the researchers say.

"It's a chemical tour de force," chemist Terry Kee of the University of Leeds in England says of the work. Finding that the genesis of life's components could have converged is an exciting step forward, says Kee.

For decades, many chemists theorized that the creation of cellular life's components occurred in isolation, requiring different chemicals and conditions. But picturing the chemical origins of one aspect of life absent the others is like imagining the evolution of a human arm that's been removed from the body, says chemist John Sutherland of the MRC Laboratory of Molecular Biology in Cambridge, England.

Sutherland and colleagues built on their earlier discovery that two chemicals likely to be found on a lifeless Earth,

hydrogen cyanide and hydrogen sulfide, could produce components of RNA. Through a series of transformations involving electrons, carbon-containing molecules and exposure to ultraviolet light, the researchers generated two of the four building blocks of RNA: uracil and cytosine nucleotides.

Still using hydrogen cyanide and hydrogen sulfide, the researchers sprinkled in a few other ingredients also likely to exist on a lifeless Earth, such as phosphates. The resulting chains of branched reactions, resembling a complex network, required occasional heating, irradiation and adding a new chemical or re-adding one of the two main chemicals.

"The key thing about the network is that although it looks complicated, it's all the same reactions," Sutherland says.

In addition to the two RNA molecules, the reactions led to 12 amino acids, the building blocks of proteins, and a precursor to lipids, the molecules that make

University of Toronto. While he agrees that the debris is created by interactions between rock and water on Enceladus, he's cautious about the idea of ongoing hydrothermal activity. It would be difficult, he says, to generate such high temperatures on Enceladus. The most likely source of heat is friction generated by the gravity of Saturn alternately squishing and stretching the moon. But there doesn't seem to be enough energy to crank the thermostat up to 90° C.

Still, he says, "Enceladus seems to be a master at defying expectations." One way to test Hsu's claim is to look for molecular hydrogen. Seawater interacting with rock at some hydrothermal vents on Earth produces high concentrations of hydrogen. If there is hydrothermal activity, Glein says, Cassini could detect molecular hydrogen in Enceladus' water plumes.

A lack of hot water on Enceladus isn't necessarily fatal to life. Even in the absence of high temperatures, Glein says, the interaction of the different chemical environments at a water-rock boundary creates a source of energy that organisms can tap into. ■

up cellular membranes.

Sutherland and colleagues envision these reactions occurring in streams of water that trickled over young Earth's cracked landscape. The reactions would progress as the water picked up molecules from the rocky terrain and meteorites that pummeled the planet. Occasionally, the streams may have partially evaporated and soaked up UV rays from the sun, spurring further reactions. Eventually, the chemicals could have pooled in puddles where the first life assembled.

"This is one of the best, most complete and most thoughtful papers ever written about how the building blocks could have formed," says Doron Lancet, a chemist at the Weizmann Institute of Science in Rehovot, Israel. But the next step — assembly — is really the crux of the origins of life mystery, he says. "The paper lays a solid foundation of the first step so that we can free our minds to think about the second step." ■

BODY & BRAIN

Cell voltage molds developing brain

Tweaking electric charge fixed defects in frog embryos

BY KATE BAGGALEY

A little electricity goes a long way in shaping the growing brain. The electric charge across cell membranes directs many aspects of brain development, scientists report in the March 11 *Journal of Neuroscience*. Harnessing these charges could eventually allow scientists to fix birth defects or grow new tissue.

By tinkering with the voltage in cell membranes of developing African clawed frogs, researchers found that the electric charge, also called membrane potential, plays a role in how big the brain grows and what kind of tissues developing cells grow into.

The work "highlights the importance of membrane potential and its role in development," says Simon Perathoner, a developmental biologist at the Max Planck Institute for Developmental Biology in Tübingen, Germany.

All cells have electrical activity in their membranes. "Cells use this electrical activity to communicate with each other in making decisions about growth," says study coauthor Michael Levin, a developmental biologist at Tufts University in Medford, Mass. "For the first time here, we also show that these bioelectrical signals are used to determine the size and location of the brain itself."

Levin and his colleagues stained developing embryos with dyes that glow more or less intensely depending on variations in electric charge in cell membranes. The researchers then flipped on or off genes that control cell growth by inducing the growth of tiny structures called ion channels in cell membranes.

"We put [ion channels] into cells as needed to move the voltage up or down," says Levin. "We were able to make the brain cells grow more, or less, as we wanted, thus showing that voltage controls the size of the primary brain."

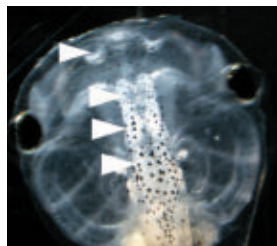
Changing the voltage also caused brain tissue to grow outside of the brain area — for instance, in a frog embryo's tail. "It switched the fate of other cell types into that of brain," Levin says.

Regenerative medicine could take advantage of cells' reliance on bioelectricity to grow new tissue to replace missing or damaged organs, Levin says.

In another experiment, the team used a genetic trick to manipulate brain voltage in frog embryos to mimic a mutation that causes much of the brain to be malformed or missing. When the researchers restored errant voltage in brain cell membranes, most of the embryos developed nearly normal brains.

Many drugs already exist to tweak ion channels, Levin says. The team's success in fixing an abnormality with bioelectricity indicates that ion channel drugs could treat birth defects or degenerative brain disease. ■

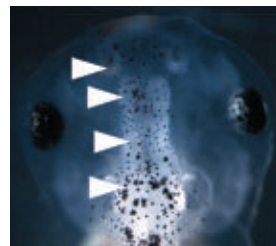
Changing the voltage in a frog embryo's brain cells can fix the damage caused by a defect that makes the brain grow abnormally, allowing the brain to develop like that of a normal embryo. Markers point to differences in brain development.



Normal frog embryo



Embryo with abnormal brain development



Abnormal embryo with tweaked cell voltage

GENES & CELLS

Iceland's genomes offer disease clues

Study identifies rare genetic variants linked to Alzheimer's

BY ASHLEY YEAGER

By pinpointing a suite of dysfunctional genes, a detailed genetic portrait of the Icelandic population has helped scientists identify rare gene variants associated with Alzheimer's disease and other medical problems.

An international team of researchers working with deCODE, a genetics company based in Reykjavik, Iceland, determined the complete genetic instruction manuals of 2,636 Icelanders. The team then used those genomes to fill in gaps in genetic information taken from about 100,000 other Icelanders. The result is the largest set of human genomes sequenced from a single population.

One thing the data revealed: Rare variants of a gene called *ABCA7* doubles Icelanders' risk of developing Alzheimer's disease, the team reports online March 25 in one of a series of papers in *Nature Genetics*. Previous studies had hinted at an association between *ABCA7* and Alzheimer's. In confirming that link, the new result offers a good starting point for figuring out how *ABCA7* influences the disease's pathology, says Alzheimer's expert Gerard Schellenberg of the University of Pennsylvania School of Medicine, who was not involved in the study.

Study coauthor Kári Stefánsson, a neurologist at the University of Iceland and CEO of deCODE, explained in a March 23 news briefing that the *ABCA7* variants can inactivate the gene. That inactivation appears to increase the risk of Alzheimer's.

The finding is just one example of the many insights the researchers expect to gain by studying genes commonly inactivated in a large group of people and comparing the results with detailed medical records. "We are at the beginning of a new process," Stefánsson said.

The new studies, says geneticist

Daniel MacArthur of Massachusetts General Hospital in Boston, "lay out a plan for how genomics will be done in the future."

Humans have over 20,000 genes, and scientists don't understand the role of the majority of them, MacArthur notes. Researchers usually use mice, rats and other lab animals to determine what happens biologically when specific genes are inactivated. These animals, called knockouts, are engineered so that specific genes don't work, allowing scientists to gain insight into a gene's function or its potential role in disease.

The Icelandic dataset allowed scientists to identify individuals who have versions of certain genes that make the genes inactive — essentially human versions of knockout models. Researchers

also had access to some people's medical records, helping the team to link certain genetic variants to health consequences.

In one of the new reports, Stefánsson and colleagues identified 8,041 Icelanders with genetic variants that completely knocked out a gene's ability to make a functional protein. Genes involved in smell discrimination were the most commonly affected, though these losses carried little to no health risks. Genes that work in the brain, and presumably are essential for health, rarely became completely inactive, the team reports.

While the data are limited to a specific population, the approach is potentially powerful and may provide a better sense of what many genes do and which ones are important, MacArthur says. ■

LIFE & EVOLUTION

Plant knows whose bill is in its flowers

Choosy shrub takes pollen only from certain hummingbirds

BY KATE BAGGALEY

Some plants prefer a long bird bill. One tropical plant can even recognize long-billed hummingbirds by how the birds slurp up nectar, scientists report in the March 17 *Proceedings of the National Academy of Sciences*.

In *Heliconia tortuosa*, long-billed hummingbirds can reach in and guzzle more nectar than shorter-billed birds and that prompts the plant to reproduce, the new study shows. The plant accepts the majority of pollen from birds with bills that match its flowers' shape.

The research indicates that "the fine-tuning of coevolution between plants and pollinators may be greater than we imagined," says ecologist Ethan Temeles of Amherst College in Massachusetts.

Matthew Betts of Oregon State University and colleagues caught in Costa Rica 148 pollinators from six hummingbird and one butterfly species. The team placed the animals in aviaries with *H. tortuosa*, a plant with tubelike flowers.

Not all pollinators enticed the plants to reproduce. The most successful were two hummingbird species with



Hummingbirds with long bills can trigger the tropical plant *Heliconia tortuosa* to reproduce.

long, curved bills.

Next, the scientists used pipettes to suck nectar out of hand-pollinated flowers. Flowers grew more pollen tubes as the team drew out more nectar, suggesting the plants use a bird's guzzle rate to recognize preferred pollinators.

Recognizing pollinators lets the plants reproduce only when birds bring pollen from unrelated *H. tortuosa* flowers, Betts suggests. When perusing data on tagged hummingbirds, the scientists saw that long-billed hummingbirds travel farther than do the short-billed species. "Pollen from a long way away is unlikely to be related," says Betts, which cuts down on inbreeding. ■

Rapid Arctic warming bolsters summer heat waves

Slowing jet stream spawns weaker continent-cooling storms in Northern Hemisphere

BY THOMAS SUMNER

Summer heat waves are on the rise across the Northern Hemisphere because of atmospheric changes brought on by Arctic warming, new research shows.

After examining 35 years of weather data, researchers spotted a decline in the strength of summer storms that carry cool, moist air across the northern continents. The sagging of the storms is the result of wind-pattern changes induced by the rapidly warming Arctic, the scientists report online March 12 in *Science*.

Without the relief offered by these storms, the Northern Hemisphere will face longer bouts of intense summer heat, notes lead author Dim Coumou of the Potsdam Institute for Climate Impact Research in Germany.

"It's the duration of heat waves that makes them devastating," he says. "If

you have several weeks of extremely high temperatures, then you tend to see massive damage to crops and heat-related deaths."

The temperature difference between the Arctic and the rest of the Northern Hemisphere powers high-altitude winds around the North Pole. Riding along this polar jet stream like eddies in a flowing river are the smaller, temporary wind patterns that make up storms.

The Northern Hemisphere has heated up over the last few decades, but the Arctic is warming twice as fast as lower latitudes. The rapid warming reduces the temperature disparity that drives the polar winds, weakening the jet stream.

Previous studies investigating the impacts of the dwindling jet stream on lower-latitude weather have focused on fall and winter, when the Arctic Ocean

warms up the overlying air. So Coumou and colleagues focused on summer, using meteorological data from 1979 to 2013.

The summer jet stream slowed by 5 percent during that period, the team discovered. This drop caused a 10 percent decline in the energy available to power summer storms. Climate simulations predict similar decreases in jet stream speed by the end of the century.

Arctic warming's impact on summer storms is dramatic and unlikely to change course in the near future, says atmospheric scientist Jennifer Francis of Rutgers University in New Brunswick, N.J.

"We don't expect the Earth to start cooling anytime soon," Francis says. "So this increasing frequency and intensity of heat waves that we've been seeing over both North America and Eurasia is probably only going to intensify." ■



Advertisement for RockAuto.com featuring various car parts and a list of benefits:

- ✓Yes (Headlight)
- ✓Yes (Engine component)
- xNo (Tricycle)
- ✓Yes (Wheel hub)
- ✓Yes (Brake master cylinder)
- ✓Yes (Air filter)
- ✓Yes (Coil spring)
- ✓Yes (Door handle)

Benefits:

- ✓ Reliably Low Prices
- ✓ Easy To Use Website
- ✓ Huge Selection
- ✓ Fast Shipping

www.rockauto.com

ROCKAUTO.COM
ALL THE PARTS YOUR CAR WILL EVER NEED

MATTER & ENERGY

Quantum entanglement in a crowd

Connections between photon pairs in beam of light measured

BY ANDREW GRANT

Intricate quantum connections between microscopic particles almost certainly underlie some phenomena perceivable at human scales. Physicists have finally measured these connections, called quantum entanglement, between pairs of photons within a macroscopic beam of light. It's a step toward understanding how the rules of quantum mechanics scale up to phenomena, such as superconductivity, that involve large numbers of particles.

In the experiment, described in a study to appear in *Physical Review Letters*, researchers filtered a specially prepared light beam to observe individual photons and chart the quantum links between them. "Nobody has looked at light in this manner before," says Alexander Lvovsky, a quantum physicist at the University of Calgary in Canada who wasn't involved in the study. The physicists confirmed theoretical predictions that all the photons would exhibit some degree of entanglement and that pairs striking photon detectors at the same time would be most strongly entangled. The study may offer a guide for probing entanglement in future lab experiments that imitate complex large-scale processes.

From flocks of birds to schools of fish, nature is full of examples of complex phenomena that emerge from collective interactions among individuals. Herds of particles are not entirely analogous — photons don't have brains or social interactions — but physicists do face the similar challenge of projecting their knowledge of small-scale quantum effects to macroscopic phenomena.

The small-scale research involves examining quantum entanglement between pairs or small collections of particles. Determining the polarization or certain other properties of one photon reveals what the value of that property for the particle's entangled partner would be if measured (*SN: 11/20/10, p. 22*). But studying entanglement between

a couple of isolated particles in the lab does not necessarily apply to larger collections of particles, just as examining two birds on the ground doesn't offer much insight into a flying flock.

Other physicists study the equivalent of flocks without getting to see the individual birds. These researchers investigate exotic phenomena such as superconductivity, the resistance-free transport of electrical current that, at least in some cases, is thought to result from entangled electrons. "Entanglement should be present in pretty much any situation with a lot of particles interacting with each other," says Morgan Mitchell, a quantum physicist at the Institute of Photonic Sciences in Barcelona.

Ideally, Mitchell says, physicists would bridge the gap between those lines of research to study how, with enough entangled particles, phenomena such as superconductivity emerge. But that's not

easy. Superconductors, for example, are so densely packed with electrons that measuring a small subset would be hard.

So Mitchell and his team worked with a simpler macroscopic quantum system: a beam of squeezed light. This light is not physically squeezed; it is sent through a crystal or other device in a process that enables physicists to measure a particular property of the light — in this case, polarization — with extreme precision. Theory suggests that squeezing entangles the light's photons.

Mitchell's team filtered the beam of squeezed light and probed it with polarization detectors. A click in a detector indicated the arrival of a photon with a particular polarization. As theory predicted, particles traveling together shared a tight quantum connection: Two photons arriving at the same time were likely to have corresponding polarizations (for example, both horizontally polarized). Timothy Ralph, who studies quantum optics at the University of Queensland in Brisbane, Australia, says he is skeptical that the results are relevant for phenomena other than squeezed light. ■



Dust lingers in the leftovers of a supernova that appeared in the sky 10,000 years ago. The finding shows that dust can survive a stellar explosion's reverse shock wave, astronomers report online March 19 in *Science*. So dust from supernovas could have provided the raw material for star and planet formation billions of years ago. Ryan Lau of Cornell University and colleagues found the dust (white contours) in Sagittarius A East, a supernova remnant. Previous work showed that a supernova's initial shock wave creates dust (*SN Online: 7/9/14; SN: 2/8/14, p. 7*). But it was unclear whether the dust also survives the reverse shock waves, some 1,000 years later. Based on infrared images, the team estimates that 10 to 20 percent of the dust made in Sagittarius A East survived both the initial (reddish orange) and reverse (blue) shock waves. — Ashley Yeager

Martian aurora, high-altitude dust surprise scientists

NASA's MAVEN mission offers insights, provokes questions about Red Planet's atmosphere

BY CHRISTOPHER CROCKETT

Martian auroras! Mystery dust clouds! Just a few months into its mission, NASA's newest Mars orbiter is finding an assortment of oddities in the Martian atmosphere, researchers reported March 18 at the Lunar and Planetary Science Conference in The Woodlands, Texas.

Shortly after arriving at Mars in September, the Mars Atmosphere and Volatile Evolution mission, or MAVEN, discovered a wispy layer of dust suspended several hundred kilometers above the Martian surface. And then for five days in December, the spacecraft detected an ultraviolet glow blanketing the northern half of the Red Planet. The light show, similar to the northern lights on Earth, coincided with a fierce solar storm, when the sun flooded the solar system with charged particles.

"Nobody expected to see auroras in the northern hemisphere," says Nick Schneider, a planetary scientist at the University of Colorado Boulder. "This changes our view of how the sun interacts with Mars."

In 2005, the Mars Express orbiter detected auroras in the Martian southern hemisphere, but they were concentrated over isolated magnetic spots on the surface. On Earth, auroras typically occur only at high latitudes. Earth's magnetic field funnels and accelerates solar electrons and protons toward the poles where they slam into oxygen and nitrogen in the atmosphere, producing an ethereal glow.

Mars doesn't have a global magnetic field to steer particles, so researchers didn't expect to see anything like the northern lights. But some solar particles pack such a punch that they burrow into the atmosphere without any help from a magnetic field, Schneider says. Earth's protective magnetic bubble deflects those high-energy particles away from the planet. Mars has no such defense.

"MAVEN is good at studying what happens to Mars when the sun throws stuff at it," Schneider says. The probe is slated to spend one year measuring the rate at which molecules leave the atmosphere to better understand what the ancient Martian climate might have been like (*SN: 1/10/15, p. 10*).

Because the UV light from the Martian aurora is about as bright as that from Earth's auroras, Schneider suspects the same holds true for visible light. "I'm willing to bet that future astronauts will be able to see this aurora," he says.

Although the aurora was a surprise, researchers think that they understand the cause. The hovering dust clouds, however, have them stumped.

"This was completely unexpected," says Bruce Jakosky, another University of Colorado planetary scientist.

MAVEN detected the dust as soon as it switched on its instruments. The dust preferentially hangs out where day turns to night, with a slight preference for the dayside of the planet. The bulk of the dust collects between 150 and 300 kilometers above the surface but flies as high as 1,000 kilometers.

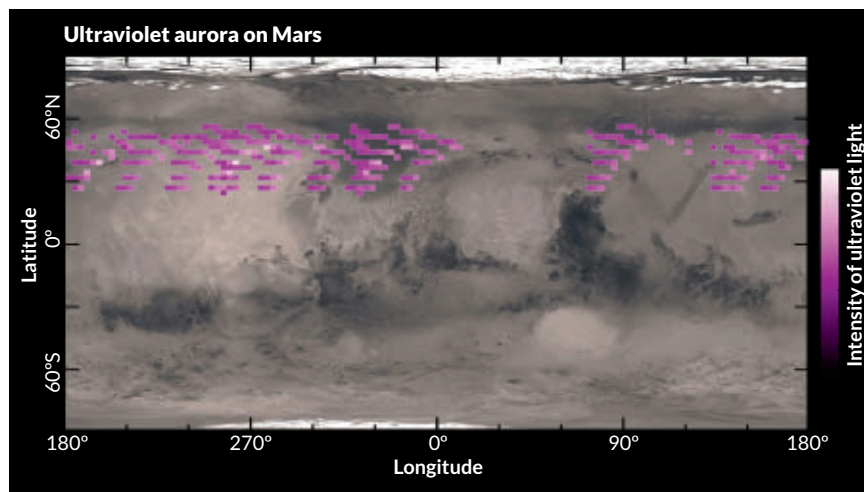
Jakosky, who is MAVEN's principal investigator, has no idea where the

dust comes from. Perhaps it is lofted up from the surface or knocked off of Mars' Lilliputian moons, Phobos and Deimos. Or it could be interplanetary detritus swept up as the planet orbits the sun.

"It's a real puzzle," Jakosky says. "It's a lot of dust to explain. And if the dust is not merely in transit, he says, 'I don't know what would hold it there.' He hopes the MAVEN team gets a better picture of where the dust lives and how it moves as the mission continues.

"It's clear that the upper atmosphere of Mars is way more dynamic than anybody could have anticipated," says Joel Hurowitz, a planetary scientist at Stony Brook University in New York who is not involved with the mission. Hurowitz is excited for MAVEN to reveal how the Martian atmosphere has changed (*SN Online: 4/13/14*) and how those changes tie into the record locked away in sedimentary rocks on the planet's surface.

With so much going on in the atmosphere and the amount of information coming in, it will be a while before scientists can disentangle what's going on in the skies over Mars, says Hurowitz. "We all have to sit back, be patient and give them some time to figure out what all the data's telling them." ■



For five days in December 2014, the MAVEN orbiter spied ultraviolet light (purple; lighter colors represent more intense UV light) from an aurora blanketing the Red Planet's northern hemisphere.

LIFE & EVOLUTION

Fearsome croc dominated northern Pangaea

Before dinosaurs ruled what is now North America, the Carolina Butcher topped the predator charts. A reconstruction (shown) of this newly identified species suggests that *Carnufex carolinensis* was 3 meters long and looked a lot like living crocodiles — except it walked on two legs, not four. Researchers found its fossilized skull, spine, rib and arm bones in 231-million-year-old rock deposits in central North Carolina. *C. carolinensis* is one of the oldest and largest crocodile ancestors identified to date. Its size and stature also suggest that for a time, it was one of the top predators in the part of the supercontinent Pangaea that became North America, Lindsay Zanno of the North Carolina Museum of Natural Sciences and colleagues write March 19 in *Scientific Reports*. *C. carolinensis* and others like it may have dominated the northern regions of Pangaea without competition from early dinosaurs, the researchers write. The croc's reign probably ended 201 million years ago. That's when a mass extinction event wiped out most large, land-based predators, clearing the way for dinosaurs to dominate during the Jurassic period.

— Ashley Yeager

MATTER & ENERGY

'Metamirror' reflects selectively

Mirrors need not be equal-opportunity reflectors. A newly fabricated mirror reflects only a single wavelength of light; all other wavelengths pass through undisturbed. Introduced in the March 6 *Physical Review Letters*, the mirror is the latest device constructed from metamaterials — synthetic substances composed of structural elements that manipulate desired wavelengths of light. Conventional mirrors contain a silvery layer that reflects a broad range of light, including the entire visible spectrum. The metamirror designed by physicist Viktor Asadchy and colleagues at Aalto University in Finland looks very different: It consists of millimeter-sized loops



of copper wire embedded in plastic. Researchers illuminated the mirror with microwaves. The 60-millimeter-wavelength microwaves induced a current through the wires, which then emitted radiation that interacted with the other microwaves. By adjusting the sizes and shapes of the wires, the researchers could get the 60-millimeter-wavelength microwaves to reflect at any angle. Microwaves at other wavelengths did not get reflected. The team also built a metamirror that, despite being flat, mimicked a rooftop satellite television dish by reflecting and focusing microwaves toward a point. Asadchy says that a future device with nano-sized wires could reflect individual colors of visible light. — Andrew Grant

BODY & BRAIN

Test herpes vaccine works in mice

An experimental vaccine against genital herpes fully protects against the live virus in mice, researchers report March 10 in *eLIFE*. Previous herpes vaccine candidates contained a viral protein called gD-2, which herpesviruses use to invade cells. Such experimental vaccines succeeded in guinea pigs, but they failed in people. Researchers at Albert Einstein College of Medicine in New York City wondered if having a gD-2 component in a vaccine might “mask” other viral particles and allow them to escape immune detection. “A dominant protein like that is like a loud

person in a room,” says study coauthor Betsy Herold, a pediatric infectious disease doctor. “Other people speaking can’t be heard.” Similarly, the human immune system might respond to gD-2 but not the full array of herpes particles, she hypothesized. So Herold and her colleagues devised a vaccine without the “loud” protein. When injected with this weakened form of the virus, mice ginned up protection against herpes and were able to fend off the virus. The experimental vaccine awakens an antibody that binds to an immune protein called the FC-gamma receptor. Together, the antibody and immune protein latch on to infected cells and recruit an array of immune cells that kill the infected cells. Genital herpes affects more than 530 million people worldwide, the World Health Organization has estimated. — Nathan Seppa

Painkillers may not reduce colorectal cancer risk for everybody

Regular use of aspirin and other non-steroidal anti-inflammatory drugs seems to reduce colorectal cancer risk in population studies. Yet a new study finds that people who harbor one of two genetic variants seem to have a heightened risk of the cancer if they take aspirin or other NSAIDs, which include ibuprofen and naproxen. About 4 percent of people in the study carried one of these two rare variants, which are located in the vicinity of the *MGST1* gene on chromosome 12. In this analysis, which appears in the March 17 *JAMA*, researchers also detected other genetic variants in the neighborhood of the *IL-16* gene on chromosome 15. People carrying those, about 9 percent of participants, seemed to gain neither risk nor protection from the drugs. Both *MGST1* and *IL-16* belong to families of genes that have been linked to cancer. But the precise mechanisms that might associate these variants with colorectal cancer risk and aspirin or other NSAID use remain unclear. The study was based on data from more than 8,000 colorectal cancer patients and more than 8,000 others who didn't have the cancer. — Nathan Seppa

ATOM & COSMOS

Super-Earths may form in two ways

Planets that are several times as massive as Earth form in two distinct ways, a new study suggests. Stars with super-Earths huddled up close are enriched in heavy elements such as iron, while stars where the super-Earths keep their distance are slightly deficient in those elements. Since planets form from the same reservoir of gas and dust as their stars, astronomers use the chemical makeup of a star to see what material was available to the growing planets. Wei Zhu, an astronomer at Ohio State University, reports the research online March 8 at arXiv.org. Super-Earths are super baffling, and astronomers struggle to understand how these heavyweights formed. Zhu suggests that close-in super-Earths might have formed near where we see them today in disks brimming with planet-building material. The stellar enrichment reflects the bounty of heavy elements available. As for the more distant super-Earths, “honestly, I don’t know,” Zhu says. One idea is that some formed much farther from their stars, where ice grains could bulk up the planet, and then wandered in closer. But it’s not obvious that these planets can do that. — *Christopher Crockett*

Chinese rover reveals moon’s layers

Radar waves beamed into the moon’s surface by China’s Yutu rover (illustrated below) have revealed nine distinct subsurface layers directly beneath the rover’s landing site in the Sea of Rains.

The multitude of rocky layers suggests that the moon has a more storied geologic history than once thought, researchers report in the March 13 *Science*. Yutu rolled onto the lunar surface in December 2013 (*SN Online*: 12/16/13). Two radar-emitting antennas probed the lunar interior with radio waves. Whenever a burst of descending radio waves hit a boundary between two underground layers, a fraction of the waves reflected back to the rover. The data offer a peek roughly 400 meters into the moon’s innards at geologic features that formed as long as 3.3 billion years ago. The researchers attribute the outermost layers to accumulated dust and the debris from a nearby impact crater. Deeper layers include the remains of five lava outpourings that flooded the region during the moon’s hot youth, the youngest dating back about 2.5 billion years. The number and composition of these rocky deposits were distinct from those spotted at previous landing sites, the researchers note, suggesting that the moon’s geologic past has been eventful and varied. — *Thomas Sumner*

GENES & CELLS

For heart repair, call RNA

When people suffer a heart attack, they can’t regrow muscle cells that have died after being deprived of oxygen. But mice injected with small RNA molecules following heart attacks do regenerate cardiac muscle, researchers report March 18 in *Science Translational Medicine*. Scientists knew that a cluster of microRNAs, tiny molecules that keep genes from

being turned on, are active in animal embryos when heart cells grow and divide. The RNA suppresses signals that tell organs to stop making new cells, a team of American and Chinese researchers found. When the researchers deleted the microRNA group in mouse embryos, the rodents had less cell growth during the early stages of development. Making the microRNAs more active led to mice born with enlarged hearts. The researchers then switched on production of the RNA molecules in adult mice that had suffered heart attacks. The rodents grew back heart muscle cells and had little scarring, which normally prevents the healing heart from contracting well. After six to 12 weeks, though, the rodents’ hearts failed. But when the team injected post-heart attack mice for seven days with short-lived molecules that simulate the effects of the microRNA, most of the animals survived. — *Kate Baggaley*

History of the United Kingdom revealed in its genes

Invading Romans, Anglo-Saxons and Normans may have shaped the history, culture and language of the British Isles, but they left surprisingly few genetic traces behind. DNA samples from more than 2,000 people from rural parts of the United Kingdom reveal 17 subtly distinct groups that reflect the history of the islands, researchers report in the March 19 *Nature*. Among the surprises: Traditionally Celtic-speaking groups in Ireland, Scotland, Wales and Cornwall on the southwest tip of England are genetically distinct from each other. Researchers had previously assumed that Celts were a uniform group that spread throughout the islands. Welsh people appear to be descendants of the first British settlers after the Ice Age, the analysis found. The Welsh remained genetically isolated from the rest of Britain, and researchers found no trace of Anglo-Saxon heritage in their DNA. The study also reveals that after Roman rule, invading Anglo-Saxons didn’t wipe out and replace the Britons. Instead, they mixed and intermarried with them. — *Tina Hesman Saey*





25

Years of Hubble

The orbiting telescope has transformed our view of the COSMOS **By Christopher Crockett**

On a chilly Saturday evening in March, unfazed by more than 6 inches of new snow, hundreds of people crowded into Shriver Hall at Johns Hopkins University in Baltimore to hear the East Coast premiere of “Cosmic Dust,” an orchestral piece set to images of deep space. A trumpet fanfare conveyed the immense power of an exploding star; a cascade from the violins accompanied the flights of comets. As the symphony played, images of galaxies and nebulae scrolled by on a big screen.

Not many telescopes get a concert in their honor. But the Hubble Space Telescope is not just any telescope.

“Hubble is stargazing on steroids,” says Russell Steinberg, the Los Angeles-based composer who wrote “Cosmic Dust.” From its vantage point high above the blurring effects of Earth’s atmosphere, Hubble is one of the sharpest eyes ever to peer out at the universe.

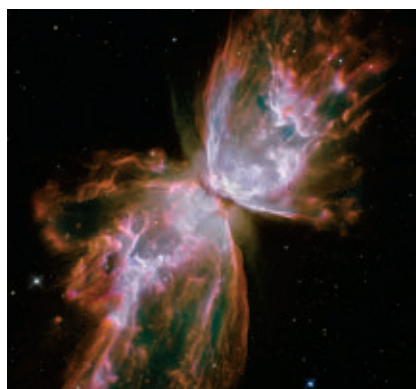
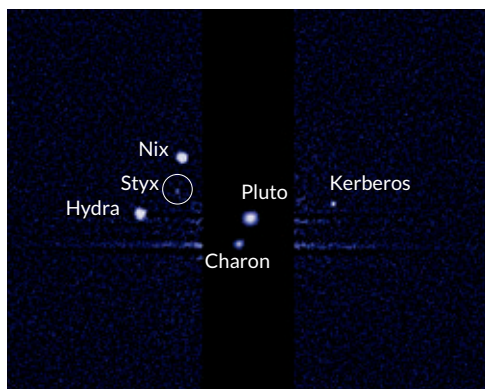
After 25 years in space, Hubble has seen it all. It witnessed fragments of a comet pummel Jupiter (*SN: 7/23/94, p. 55*). It spied planet nurseries silhouetted by the light of new stars in the Orion Nebula. It confirmed that in the center of every large galaxy lurks a supermassive black hole, an invisible behemoth weighing up to several billion suns. Hubble even monitored pulsating stars as far as 70 million light-years away. By doing so, it resolved a decades-long dispute about the expansion rate and age of the universe (*SN: 4/5/14, p. 18*).

And, of course, there are the pictures. From the Pillars of Creation, where newborn stars sculpt spires of gas several light-years high, to the Hubble Deep Fields, where more than 10,000 galaxies span vast expanses of space and time, Hubble’s iconic images set a new standard for how astronomers — and the public — see the universe.

Not too shabby for a telescope that started off as the butt

Sharper images In a 1993 repair mission, astronauts installed a fix for the misshapen mirror on the Hubble Space Telescope as it sits in the cargo bay of the space shuttle *Endeavour*. With clearer vision, the telescope imaged thousands of galaxies in the Hubble Deep Fields (top left), dying stars such as the Helix Nebula (middle) and pairs of entangled galaxies, including Arp 273 (bottom).

ALL PHOTOS: NASA, ESA



Near and far From 2005 to 2012, Hubble discovered four new moons around Pluto (left), raising the total to five. Farther afield in the Butterfly Nebula (middle), two cones of gas erupt from a dying star. More massive stars, however, will end up like the Crab Nebula (right), the remains of a star that was first seen in the year 1054.

of late-night TV jokes after its misshapen mirror sent home blurry early images.

Hubble has been such a “spectacular success,” says University of Chicago astronomer Wendy Freedman, “because it was just a huge step beyond what we were capable of doing before.”

Today, Hubble is exploring frontiers that were unimaginable when the telescope rode the space shuttle *Discovery* into orbit on April 24, 1990. “The vast majority of what we’re looking at now wasn’t even dreamt of,” says Howard Bond, an astronomer at Penn State. No one knew that the expansion of the universe was accelerating. Other solar systems existed only in people’s imaginations. And, of course, Pluto was still a planet.

“We didn’t have enough imagination at the beginning to think of all the things that nature does,” says Robert Kirshner, an astrophysicist at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass. A diverse package of cameras and spectrometers combined with the ingenuity of the telescope’s operators, he says, let Hubble try things that no one planned for.

Hubble’s longevity owes a tremendous debt to human spaceflight. Astronauts have returned five times — including a 1993 trip to install corrective optics for the flawed mirror. Each visit brought spare parts and more advanced instruments.

“The telescope right now at age 25 is working better than it has at any time in the past,” Kirshner says. The images are sharper and reach farther than before. Barring a catastrophic failure, Hubble will probably celebrate a 30th anniversary as well.

With an infrared camera added during the last servicing mission in 2009 (*SN Online*: 5/26/09), Kirshner is trying to solve one of astronomy’s thorniest mysteries: Why is the expansion of the universe speeding up? He’s using Hubble’s new infrared eye to observe a class of supernovas called type 1a in other galaxies. These exploding stars are useful distance markers because they

emit roughly the same amount of light. Such supernovas more consistently reach the same brightness in infrared light than they do in visible light, so Kirshner hopes the infrared camera will give a more precise look at how cosmic expansion has changed through time.

Astronomers are also pointing the new camera at galaxies near the far reaches of the visible universe to look back in time. The light has taken more than 13 billion years to reach Earth, so the galaxies appear as they did just a few hundred million years after the Big Bang. The expansion of the universe in that time has stretched the visible light from these galaxies to infrared wavelengths that Hubble’s new camera can detect (*SN*: 1/30/10, p. 5).

Piecing together Hubble observations with those from other telescopes, astronomers can see how galaxies have evolved throughout cosmic history. Galaxies start as oddly shaped clumps of gas and stars that repeatedly merge over the age of the universe, eventually building the large spiral and elliptical galaxies we see today.

“We know the universe formed stars furiously when it started, then reached a peak some 10 billion years ago, and it’s been declining ever since,” says Mario Livio, an astrophysicist at Hubble’s headquarters, the Space Telescope Science Institute in Baltimore. “Nobody knew that was something that would come out of Hubble.”

Neither did anyone know that Hubble would be sniffing around in the atmospheres of planets that orbited other stars. “People would have thought you were crazy if you’d even mentioned that,” Bond says.

Astronomers discovered the first planets outside the solar system two years after Hubble launched. In 2000, Hubble saw the first hints of an atmosphere around an exoplanet (*SN*: 12/1/01, p. 340). As the planet crossed in front of its star, certain wavelengths of starlight were blocked by gas in the planet’s atmosphere. Since then,

Eye wide open Hubble witnessed a comet pummel Jupiter in 1994 (top, dark circle). It also took some of the first pictures — in 2004 and 2006 — of a planet outside the solar system (middle, white box). New stars burst out of a maelstrom of gas and dust in the Orion Nebula (bottom), which, at about 1,300 light-years away, is the closest stellar nursery to Earth.

Hubble, along with other telescopes in space and on the ground, has tallied the chemical makeup of more than 50 worlds. “Hubble is right now the preeminent facility with which we can make those measurements,” says Caltech astronomer Heather Knutson.

Knutson is using Hubble to understand the origin of super-Earths, planets that are a few times as massive as Earth (see Page 17). Astronomers don’t understand how these heavyweights form. But the atmospheres might keep a record of where they formed, which is a first step to figuring out how.

Researchers aren’t the only ones who have fallen under Hubble’s spell. When the public thinks of astronomy, Knutson adds, Hubble’s images are one of the first things that come to mind. “Hubble has shaped our view of what astronomy is,” she says.

NASA has gone to great lengths to make Hubble’s images easily accessible to the public, says Jennifer Wiseman, an astrophysicist at Goddard Space Flight Center in Greenbelt, Md. The artistry of the iconic pictures owes a lot to the Hubble Heritage Project, founded by Bond and others in 1998 (see Page 4). Aside from showing the taxpayers what they paid for, Wiseman sees a much loftier outcome.

“It’s helped people around the world feel a sense of unity,” she says. “We’re all brothers and sisters on this one planet that’s part of an incredible larger universe.”

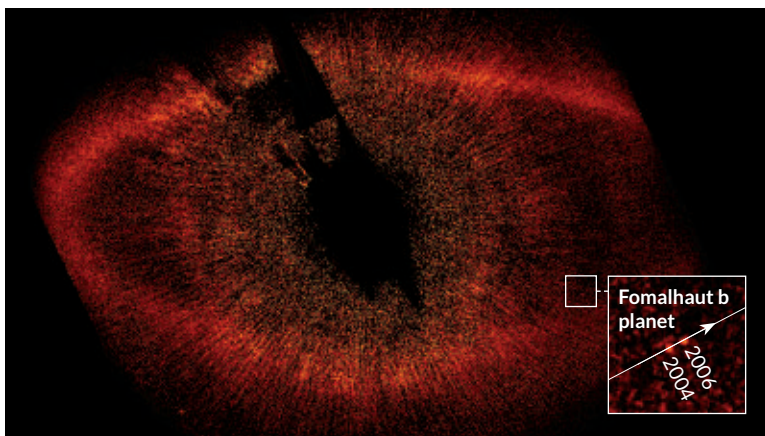
Given the public’s response to Hubble, that philosophy seems to resonate. The images have inspired poetry, dance and, of course, music.

After the March concert, Steinberg seems almost giddy as he shakes hands with Hubble astronomers and former astronaut John Grunsfeld, who visited Hubble three times.

For Steinberg, the music is his way of helping people grapple with the immensity of what Hubble has revealed during its 25 years and to connect it to ourselves. The reason we yearn to look at the heavens, he says, is that we’re seeking our origins. “That curiosity we have to look at the sky,” he says, “is so primal to what makes us human beings.” ■

Explore more

■ Hubble Space Telescope: bit.ly/NASA_Hubble



Deepwater Horizon's fifth anniversary greeted with more questions than answers

By Beth Mole

In a steamy Louisiana marsh, crickets do their best impersonation of a canary in a coal mine.

Afloat in orange cages on the coastal wetland, the featherless chirpers warn researchers of toxic fumes rising from oil. Oozing oil is a recurring yet elusive problem on the marsh in Barataria Bay, just south of New Orleans. One day, a patch of the wetland is green and lush, the next it's drenched in thick, noxious goo. It's a haunting vestige of North America's largest marine oil disaster: the 2010 Deepwater Horizon spill.

At first, the possibility that the oil was still surfacing and releasing killer vapors years after the spill seemed far-fetched; everything scientists know about spills suggests that fuming oil would have vanished almost immediately after the oil was released. But the Louisiana crickets are quietly telling a different story. They're dying.

"It's this huge mystery," says environmental scientist Linda Hooper-Bùi of Louisiana State University in Baton Rouge. Researchers don't know what compound or set of compounds is wafting from the oil to kill the crickets. But if the fumes can kill insects, what can they do to people on the marsh? "It keeps me up at night," she says.

This month marks the fifth anniversary of the explosion of the Deepwater Horizon oil rig, operated in the Gulf of Mexico by the oil and gas company BP. The April 20 blast killed 11 rig workers and started an 87-day eruption of oil and gas (*SN*: 7/3/10, p. 5). Around 5 million barrels

of oil and hundreds of thousands of metric tons of gas gushed from the well, known as Macondo, located 1,500 meters below sea level. The spill was so large that a swirl of oil in the Gulf could be seen from space.

Scientists immediately mobilized research crews, vessels and even aircraft to study the impact of such a large disaster. Since 2010, BP has provided

more than \$1.3 billion for research and the federal government has chipped in upwards of \$30 million. With mounds of data, scientists now have a better handle on life in the Gulf. Yet plenty of unanswered questions remain. And new mysteries, like the dying crickets, continue to surface.

"It takes a very long time to sift through the impacts" of a typical oil spill, says oceanographer Ian MacDonald of Florida State University in Tallahassee. No one was ready for a spill the size of the Macondo blowout, he says.

Of the lingering unknowns, perhaps the most striking is that scientists still don't know exactly what happened to most of the oil. Only a quarter is neatly accounted for. The fate of up to 3.75 million barrels of the reddish-brown liquid is still murky. Researchers continue to find some of it in snotlike blobs on the Gulf's seafloor and coastlines, including in the marshes that are home to those sentinel crickets and other creatures.

The spill was certainly dramatic, but the long-term toll on wildlife has been mixed; some species in the Gulf are struggling while others are doing fine. Instead of a dramatic collapse of life, researchers are finding subtle effects — some that only emerged three or four years after the spill — that they are still trying to sort out, says coastal ecosystem scientist R. Eugene Turner of Louisiana State.

With thousands of active oil and gas platforms still pumping in the Gulf, there is plenty of pressure to find answers and better prepare for the inevitable next spill.

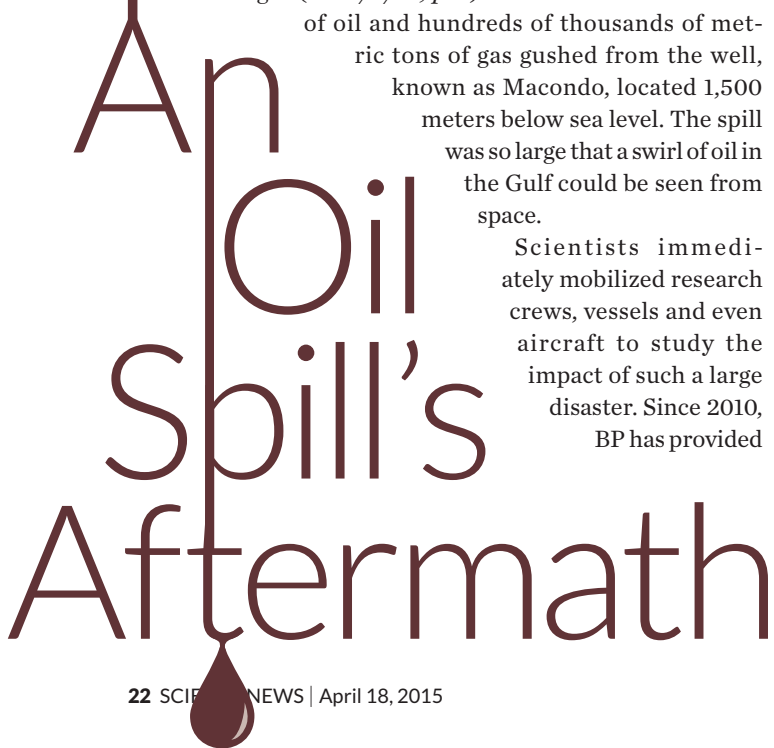
Coated in questions

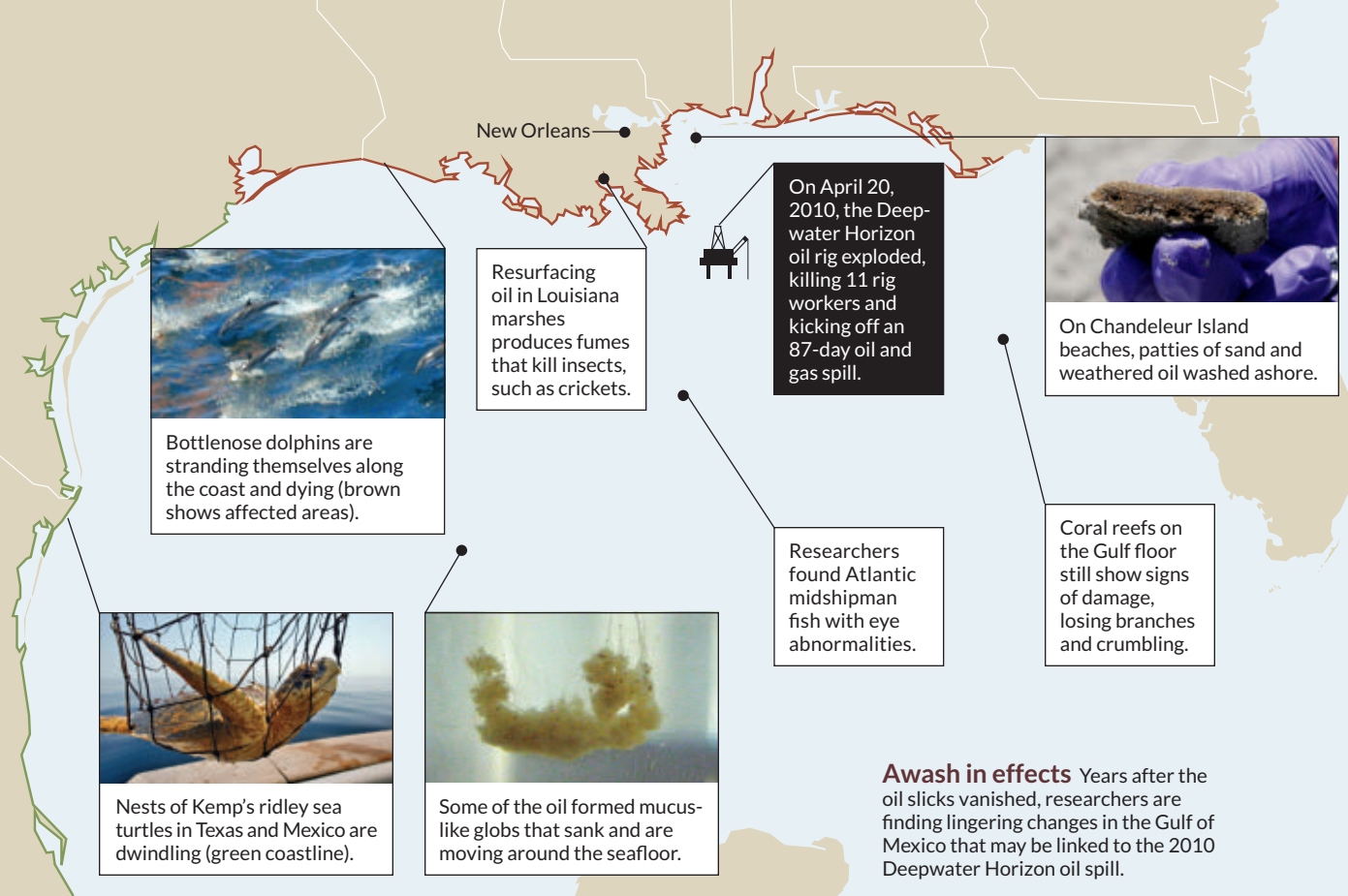
After birds were "degreased" and oil slicks vanished from the surf, researchers began to tally the less-obvious impacts of the oil on wildlife. They found that oil can alter development and change the swimming behavior of aquatic creatures (*SN Online*: 11/19/12). It can also fatally disrupt the beating of fish hearts (*SN Online*: 2/14/14).

More recently, Gulf researchers have found fish with sunken eyes and other eye abnormalities. It's unclear, however, if Macondo oil is to blame, say aquatic researcher Stephen Bullard of Auburn University in Alabama and colleagues. In February, Bullard and hundreds of other researchers met in Houston to discuss their latest findings. The event was organized in part by the Gulf of Mexico Research Initiative, a BP-supported effort that funds independent research on the consequences of the Macondo blowout.

At the meeting, ecologist Selina Heppell reported a crash of the Gulf's population of Kemp's ridley sea turtles. The endangered turtles were rebounding between 1990 and 2010, with nest numbers expected to reach 50,000 by 2014. Instead, last year's count was around 11,000. Because the researchers monitor only nests, it's difficult to pinpoint when in the animals' life span problems arise, says Heppell, of Oregon State University in Corvallis. Are turtles dying or are they just not breeding?

Bottlenose dolphins also may be experiencing long-term effects, according to a study published in *PLOS ONE* on February 11. Researchers led by Stephanie Venn-Watson of the





Awash in effects Years after the oil slicks vanished, researchers are finding lingering changes in the Gulf of Mexico that may be linked to the 2010 Deepwater Horizon oil spill.

National Marine Mammal Foundation in San Diego reported an unusual ongoing die-off of dolphins, whales and porpoises in the Gulf. Since 2010, more than 1,300 of the animals have stranded themselves along the coast, including 221 in 2014. More than 90 percent of the animals died.

Researchers are also puzzling over more subtle changes in the ocean basin. For example, sperm whales still hunt in the Gulf, lunging deep down to gulp squid and other bottom-dwelling prey. However, the whales are no longer feasting near Macondo. They avoid an approximately 4,000-square-kilometer area around the well, according to marine mammal researcher Bruce Mate and colleagues at Oregon State, who reported at the Houston meeting.

A slew of Gulf marine life, from tiny killifish to sharks, shows molecular signs of exposure to oil. How the exposure affects populations overall, their predators or rival species and the rest of the food web is difficult to determine, especially with all of the other pollution and disturbances in the Gulf. Without a lot of data about the ecosystem before the spill, scientists can't say if what they see now is normal or a subtle effect of the spill. "We didn't have baseline data," Turner says with disappointment.

While some scientists struggle to understand the complexities of population and ecosystem changes, others try to tackle a question that might seem simpler: What's in the oil?

A chemical mash-up

Petroleum that gurgles up from deep in the Earth contains a complex cocktail of chemicals, which can include toxic polycyclic aromatic hydrocarbons (sturdy conjoined rings of

carbon and hydrogen) and gases such as methane and propane. Different oil wells have distinct chemical signatures — a specific set of compounds at specific ratios. Marine chemist Christopher Reddy of the Woods Hole Oceanographic Institution in Massachusetts and others are still working on the exact chemical fingerprint of Macondo oil. They need that fingerprint to accurately trace the oil's fate.

The researchers are closing in on a consensus fingerprint of pure Macondo oil, but they'll need more than that. As oil basks in the sun or mingles with other chemicals in the environment, it mutates, forming a more complex — and potentially more toxic — set of chemicals. Much of the oil still surfacing on the coasts, as in the Louisiana marshes, isn't fresh Macondo oil — it's weathered. And weathered oil is trickier to analyze.

In 2010, Reddy and colleagues sailed out to the Chandeleur Islands, thin strips of land east of New Orleans, to scoop up some of that weathered oil. Tagging along with a cleanup crew, they collected asphaltlike patties of oil dotting the beaches. Back in the lab, they got their first glimpses of weathered oil.

Many Macondo chemicals are missing from the weathered samples, Reddy says. They probably evaporated in the summer heat or broke down in the sun. "The majority of what we're seeing was not originally in there," he says. Some of the chemicals that remain have sucked in oxygen and morphed into big, undefined compounds. Reddy jokes that they could call them "spilspaltenes," a mash-up of spilled asphalt-looking chemicals.

The signature of those weathered chemicals will help researchers track the oil in years to come and calculate just

how much is still sloshing around in the Gulf. This is especially important since the amount of missing oil is unresolved, except in court.

On January 15, 2015, U.S. District Judge Carl Barbier of the Eastern District of Louisiana in New Orleans ruled that 4 million barrels of oil spewed into the Gulf during the 2010 spill. The count was a compromise between BP's numbers and estimates by independent scientists.

Slippery tallies

BP has consistently given the lowest estimates of how much oil gushed into the Gulf. In the days after the rig exploded, BP reported that 1,000 to 5,000 barrels of oil was escaping each day. In court, the company argued that 3.26 million barrels in total (more than 37,000 barrels a day) were released during the 87 days. Outside scientists were quick to dispute BP's count and settled on a tally of around 5 million barrels (nearly 58,000 barrels a day) plus about 500,000 metric tons of gas.

Independent researchers used satellite images, water sampling, atmospheric samples and video analysis to dispute BP's estimates. One fast and cheap method came from atmospheric chemist Thomas Ryerson of the National Oceanic and Atmospheric Administration in Boulder, Colo., and colleagues. During the spill, Ryerson was in California with a WP-3D airplane bedecked with analytical chemistry equipment for assessing air quality. By early June, he and his team were flying over the Gulf, measuring methane, aromatic hydrocarbons and other compounds in the plume of vapors downwind of the spill.

To come up with an oil estimate, Ryerson likens the situation to pouring buckets of chicken soup into a swimming pool and then trying to figure out how much soup is in there. You don't know how many buckets of soup went in, but you do have a recipe for chicken soup. "If you know that the recipe says that it's one carrot per gallon of soup and you find 10,000 carrots, you know that you have at least 10,000 gallons of soup in your pool," he says. Using hydrocarbon measurements as their carrots and other soup ingredients, Ryerson and his colleagues estimated that up to 47,700 barrels of oil made a mark on the atmosphere each day.

The next step was to figure out where else the oil and gas went. Aboard research vessels floating around the Gulf through the fall of 2010, researchers tracked underwater plumes of gas — mostly methane plus some propane and ethane — trapped in deep layers of the ocean. The researchers saw oxygen levels in the plume sink, suggesting that microbes, such as species of the bacteria named *Methylosinus*, were sucking in oxygen as they gobbled up spilled propane, ethane and methane (*SN*: 1/29/11, p. 11). Some scientists estimate that most of the gases, if not all, were consumed, though not all researchers agree (*SN Online*: 5/13/14).

Of the estimated 5 million barrels of oil, roughly 25 percent is accounted for: Responders collected 17 percent as it spewed

out of the well, burned 5 percent and skimmed 3 percent from the surface, according to government estimates. The remaining 75 percent is missing. Some probably evaporated or dissolved into deep layers of the ocean where it scattered in currents or succumbed to oil-eating microbes. Recent calculations put a substantial percentage of the spilled oil on the floor of the Gulf.

"We're not going to be able to track down each and every drop of oil," says biogeochemist David Valentine of the University of California, Santa Barbara. But he and others are working to piece together a reasonable picture.

To get at how much of the oil might have sunk, Valentine and colleagues analyzed sediment from the seafloor collected in 2010, 2011 and 2012. The group traced a component of the oil called hopane and measured how much of it is in Macondo oil. In a study published last November in the *Proceedings of the National Academy of Sciences*, the researchers back-calculated that from 1.8 to 14.4 percent of the total oil released ended up coating the Gulf floor. A study reported January 20 in *Environmental Science & Technology* reached similar conclusions. Led by chemical oceanographer Jeff Chanton of Florida State University in

Tallahassee, the researchers traced the carbon isotope signature of the oil in sea sediments and found that 0.5 to 9.1 percent of the oil is on the Gulf floor.

"I think I've lowballed it," Chanton says. Though he's comfortable giving a conservative estimate rather than an overestimate, he suspects more oil will be found in the Gulf in the coming years.

Now that scientists know that oil is lying at the bottom of the Gulf, they want to know how likely it is to reemerge.

A snotty undertow

Some of the oil on the seafloor arrived in mysterious mucus-like blobs. Researchers suspect that the blobs formed when oil compounds clumped with phytoplankton or with slime from oil-degrading microbes, such as *Cyclocasticus* bacteria. The blobs also could have formed around charred particles from the burned oil, or around chemicals called dispersants that were sprayed during the spill to help break up oil slicks (see sidebar, Page 26).

"When we were out on the water in May of 2010, early on in the Macondo blowout, we observed a tremendous amount of this ... 'sea snot' on the surface," says marine scientist Samantha Joye of the University of Georgia in Athens. "After six or seven weeks," she says, "it was all gone."

Joye and her team tracked the blobs as they sank about 300 to 400 meters per day (the mass sinking of the blobs is sometimes referred to as the "dirty blizzard" or "marine snow"). The researchers returned to the Gulf in September and December of 2010, and every year since, to collect hundreds of blob-covered sediment cores from the seafloor around Macondo.

With each survey, the researchers noticed something odd.

"We're not going to be able to track down each and every drop of oil."

DAVID VALENTINE

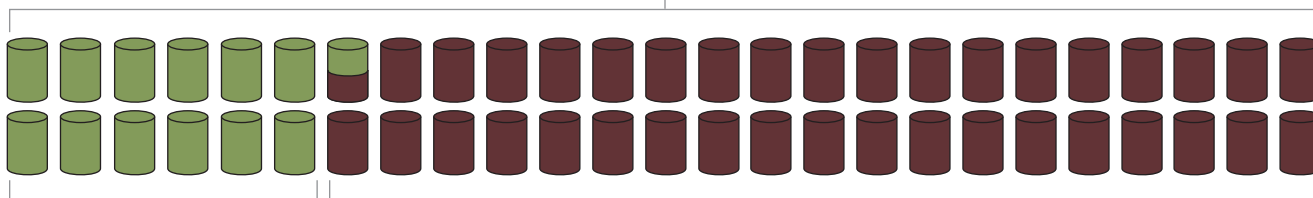
Gone goo Most researchers estimate that nearly 5 million barrels of oil gushed out of the Macondo well. Only 25 percent of the oil is neatly accounted for. Researchers have only rough estimates for the rest.

SOURCE: FEDERAL INTERAGENCY SOLUTIONS GROUP, "OIL BUDGET CALCULATOR: DEEPWATER HORIZON," NOVEMBER 2010.

 = 100,000 barrels  Oil accounted for  Oil unaccounted for

~5,000,000

Barrels of oil spewed from the Deepwater Horizon oil rig

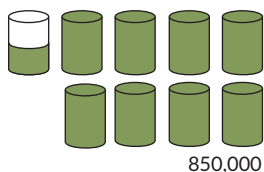


25%

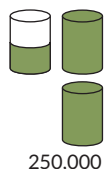
Fraction of oil that is accounted for

75%

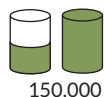
Fraction of oil that is unaccounted for*



17%
Collected as it gushed from well

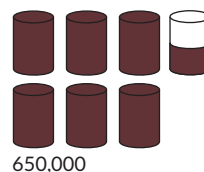


5%
Burned

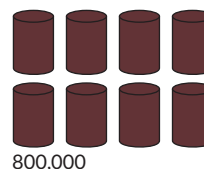


3%
Skimmed from water's surface

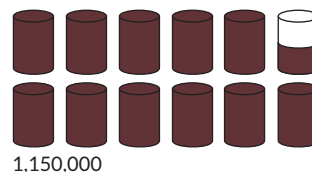
13%
Dispersed naturally



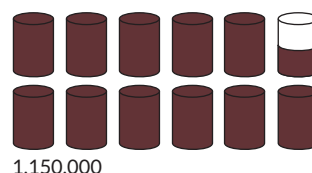
16%
Dispersed with chemicals



23%
Evaporated or dissolved



23%
Other, such as washed ashore or sunk to the seafloor



* These figures are researchers' best estimates and fit within a range of best case to worst case.



During the Deepwater Horizon spill, oil washed up on the coast of Barataria Bay in southeastern Louisiana.

No clear verdict on oil dispersants

Amid the torrent of questions lingering about the Deepwater Horizon oil spill, the most contentious by far concerns the use of oil dispersants. These chemicals are a mixture of hydrocarbons and soaplike compounds that break the oil into small droplets that sink. When dispersants are sprayed, long slicks and bobbing balls of oil vanish from sight, becoming less likely to coat coastal creatures or roll onto beaches.

The downside is that the tiny, mostly invisible droplets of oil are left to freely float in the depths of the ocean, their movements and final destination difficult to track.

During the Macondo blowout, first responders dumped, sprayed and injected nearly 7 million liters of dispersants into the Gulf. Scientists are still torn on whether that was the right thing to do.

"It's a worse idea not to disperse," says Louisiana State's Edward Overton. Overton and others argue that the chemicals kept some of the oil at bay, sparing birds, turtles and other creatures. Coastal communities, such as the Louisiana marshes, are arguably the most vulnerable to the effects of toxic oil. Marshes "act like chemical sponges," says Christopher Reddy of Woods Hole Oceanographic Institution in Massachusetts. Also potentially spared were coastal economies that rely on tourists, which may have

The spots that were oiled seemed to change from year to year. After some chemical analysis, the researchers figured out what was happening: "These layers are still there, except they're moving," Joye reported at the meeting in Houston in February.

Whether the oily globs will keep moving is a key question, Joye says. She and her team think that the knolls and trenches on the seafloor around Macondo create sharp currents that stir up the snot. The finding opens the potential for oil to be hurled onto marshes and beaches during storms or heavy winds, or slogged into new seafloor communities. Many other researchers at the meeting reported that deep-sea corals around the Gulf are still dying, losing branches and crumbling in the years after the spill, possibly due to this movement of the oil.

It's also possible, says Joye, that the oil globs could eventually settle into a low spot in the Gulf and do no more harm.

Asphalt marshes

Back in the Louisiana marshes, Linda Hooper-Bùi isn't sure where the oil she's still seeing is coming from. It could be stuck in the marsh and resurfacing in storms or it could be snot balls washing ashore from the deep. Regardless, when it shows up it sometimes forms a crust on the surface. "It looks almost like the marsh is paved," she says. Some grasses grow through the asphaltlike layer, so overall the marsh might look fine. But, in the heat, the fake pavement cracks and reddish-brown oil oozes up. That ooze is what Hooper-Bùi

suffered if more shoreline had become coated.

But the chemical dispersants are toxic, causing skin and eye irritation and liver and kidney damage in humans. Joining forces with oil, the dispersants can become more toxic, some researchers say, though the data are mixed.

Dispersants may even get in the way of natural cleanup mechanisms. Samantha Joye of the University of Georgia and her colleagues have found evidence that dispersants may discourage the best oil-gobbling microbes, slowing natural degradation.

Researchers are still arguing over the decision to use dispersants, Overton says, "and probably will be forever."

— *Beth Mole*

thinks is the source of the killer fumes.

Hooper-Bùi and colleagues reported in the October 15 *Marine Pollution Bulletin* that levels of oil chemicals in Louisiana's coastal wetlands were 33 times as high in 2013 as they had been in May 2010.

With those kinds of numbers and so many questions remaining five years after the spill, some researchers are pessimistic that the Gulf community is any better prepared for another Macondo-sized disaster. But researchers like Hooper-Bùi are hopeful that the new data on the Gulf will at least give them a better starting point for the next spill. "We really didn't know anything about the ecosystem," she says. "Now we have some idea." The new data provide the baseline that ecologist Eugene Turner and other researchers wished they'd had before the Deepwater Horizon explosion.

"Oil is a natural component of the Gulf of Mexico ecosystem," says environmental chemist Edward Overton of Louisiana State, who works with Hooper-Bùi. "Unfortunately, there's going to be another spill sooner or later." Researchers need to continue to collect data and track long-term effects, he says.

Meanwhile, oil and gas production marches on in the Gulf. An American company, LLOG Exploration, has begun pumping oil just 900 meters northeast of Macondo. ■

Explore more

■ Gulf of Mexico Research Initiative: gulfresearchinitiative.org



A Basler BT-67 aircraft releases dispersant over oil discharged from the Macondo well on May 5, 2010.



Learn How A Digital **Hearing Aid** For Only **\$299^{ea}** Can Help You Hear More Clearly



Introducing the HCX!

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

★ Customer Reviews ★

"I will definitely recommend your company to my patients."

- Dr. Arun P.

"We had no idea it would be such a fast, simple and enjoyable process..."

- Monique S.

Studies Show: Hearing Aids MAY HELP Prevent DEMENTIA.

A study by Dr. Frank Lin at the John Hopkins University, found that patients with only mild hearing loss were two times more likely to develop dementia. Fortunately, hearing aids help address hearing loss and may help prevent cognitive health due to hearing loss.

Get A Great Digital Hearing Aid For Only \$299 each!

New breakthroughs in digital hearing allow you to experience remarkable improvements in your hearing without spending thousands, for a more expensive brand. All hearing aids work the same way. The microphone picks up the sound and sends an electrical signal to the digital signal processor. The digital signal processor is the "brains" of the hearing aid. It takes the sound it receives and adjusts the sound to amplify important speech sounds. To ensure the best in quality, the digital processor is designed and manufactured right here in the United States. Once the processor has amplified the sound, it is passed to the receiver (also known as the speaker) where it produces a corrected and amplified sound through the sound tube into your ear.

The Advanced Affordable Hearing HCX digital hearing aid is simply the best value in the hearing market today. For only \$299 per ear (save \$50 when buying two). We believe so strongly in the value of our hearing aid that we offer a 100% money-back-guarantee. If you are not satisfied in your hearing aid for any reason, call us and will immediately issue a return code to you. The risk free offer allows us to prove to you the quality and craftsmanship of our products.

The HCX Hearing aids has a nearly invisible thin tube design that is extremely discreet and is comfortable enough to wear all day. Expert hearing researchers and technicians have spent years perfecting our products. We guarantee the best value in the hearing aid market today. In addition to our money back guarantee, we also include a FREE box of hearing aid batteries (use coupon code below). We have set a high standard to make sure YOU are happy with your new hearing aid.



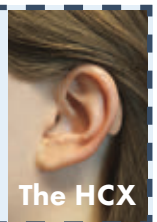
100% Money Back Guarantee - Risk Free!

BUY A PAIR AND SAVE \$50!

1-877-666-3670

Use Coupon Code For FREE Batteries: **S54B**

Visit Us: www.advancedhearing.com/S54B



The HCX





Domesticated
Richard C. Francis
W.W. NORTON & CO.,
\$27.95

Docile dairy cows don't inspire a lot of respect or awe. But Stone Age people must have had a different view of Bessie's ancestors, the aurochs. Males could weigh 1.5 metric tons, and hunting the aggressive beasts was perilous.

The taming of the auroch probably began with rounding up those animals that would tolerate humans. Eventually, people could have selected mild-mannered aurochs for breeding. By contrast, now-tame predators such as dogs and cats may have kick-started their own domestication, with friendlier animals thriving on food they found in camps and settlements.

These are just a few of the evolutionary origin stories that science journalist Richard Francis shares in *Domesticated*. New studies are shedding light on the process that has

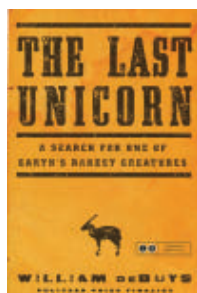
BOOKSHELF

Exploring the genetics behind domestication

turned a wolf into a Pekingese, or a wildcat into a purring tabby (*SN*: 12/27/14, p. 24). Francis provides an in-depth look at the changes — genetic, physical and behavioral — that people have brought about in dogs, cats, sheep, goats, horses, camels, pigs and more. (Chicken fans will be disappointed, since the book is a mammals-only affair.)

Each animal gets a chapter, which describes its evolutionary history, before and after human meddling began, and the nitty-gritty of domestication's effect on the animal's genetic blueprint. The book is meticulously researched but not a light read; Francis tackles complex evolutionary and genetic topics, so readers may want to have a biology primer nearby.

Without animals to provide transportation and a steady supply of meat, milk and wool, human civilization wouldn't have gotten far, Francis writes. And people weren't the only ones to benefit. In a human-ruled world, domestic animals have the best chance of dodging extinction. The aurochs are long gone. Wild goats, sheep, camels and wolves have dwindled in number. "In an evolutionary sense," Francis writes, "it pays to be domesticated." — *Allison Bohac*



The Last Unicorn
William deBuys
LITTLE, BROWN & CO.,
\$27

Long, beautiful horns. A sturdy but svelte figure. Extremely elusive. In *The Last Unicorn*, nature writer William deBuys rekindles our love affair with unicorns by introducing readers to the saola. In many ways, these creatures are like unicorns, except that saola actually exist.

DeBuys takes readers on an expedition as he tries to become one of the few people to have seen a living saola. Among the rarest mammals, the antelope-like animals, *Pseudoryx nghetinhensis*, live deep within forested mountains of Laos and Vietnam. When scientists saw horns on a hunter's wall in 1992, a race began to capture and study the animals.

One captive was Martha. She was calm and patient, letting Bill Robichaud, a no-nonsense field biologist, pick ticks from her ears and stretch a tape measure around her. She was 152 centimeters long and carried 43-centimeter-long horns. Martha was chocolate brown, pale at her neck and belly, and sported a black stripe along her back and fluffy tail. She had bold splashes of white across her face.

Despite deBuys' detailed descriptions, he never actually saw Martha. She died in 1996, not quite three weeks after being captured. The locals who had cared for her then cooked and ate her. The other dozen or so captive saola lived similarly short lives, leading local governments to make capturing them illegal.

Frustrating to scientists, saola in the wild are exceedingly private. They rarely wander in view of cameras set up to observe them. Even today, it's not clear how many of the animals roam in the Annamite Mountains, but it's estimated to be fewer than 750. Saola's elusiveness led Robichaud and deBuys on a search in 2011. With local guides, the two relied on nearly every means of transportation imaginable to get deep into the woods. Drama ensued when the team spent days on daunting hikes and a few in the group pilfered food rations from their own team members.

The Last Unicorn is an easy read at times, dense at others, and driven by the question of whether deBuys sees a living saola. Read it and find out. — *Ashley Yeager*

BOOKSHELF

On a quest to see a saola

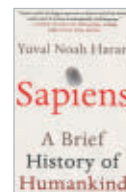
Big Data, Little Data, No Data. Christine L. Borgman. Don't believe the hype. Bigger isn't always better with data, an information studies professor argues: The value of data lies in their use. MIT, \$32

BOOKSHELF



Big Data, Little Data, No Data

Christine L. Borgman
Don't believe the hype. Bigger isn't always better with data, an information studies professor argues: The value of data lies in their use. MIT, \$32



Sapiens

Yuval Noah Harari
A historian traces human dominance to the emergence of cognitive abilities, particularly the ability to create and share myths. Harper, \$29.99



Junk DNA

Nessa Carey
Not garbage, the DNA outside of genes plays important roles in disease, health and evolution, a biologist explains. Columbia Univ., \$29.95

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



Volunteer at Intel ISEF

Every year, thousands of individuals contribute their time and energy to the Intel International Science and Engineering Fair as judges, interpreters and event volunteers. Intel ISEF, a program of Society for Science & the Public, is the world's largest international pre-college science competition. More than 1,700 high school students from nearly 80 countries, regions and territories showcase their independent research as they compete for more than \$5 million in prizes.

You can help provide a stellar experience for young scientists from all over the globe. The Society is currently recruiting volunteers for the 2015 event, to be held in Pittsburgh from May 10–15. We need more than 1,000 judges, 200 interpreters and 500 general volunteers. Visit bit.ly/SSP_volunteer for more information about volunteer opportunities.

Science Talent Search alumni event

Washington, D.C.-area alumni of the Science Talent Search enjoyed a meet-and-greet with Intel STS 2015 finalists at the National Geographic Museum in March. The event marked the launch of the Society's new alumni program. Additional alumni events are already being planned for 2015, with the aim to expand to more locations in the coming years. The goal is to reconnect with the more than 55,000 alumni who have taken part in the Society's science competitions over the last 70-plus years.

At the event (right), Tanay Tandon, Intel STS 2015, explains his project to Todd Waldman, STS 1987. Tandon attached a low-cost lens to a smartphone and combined it with machine-learning software to provide rural doctors

with a new parasite detection tool. Using his system, medics can photograph a blood sample, send the image to a special computer and then quickly get the pathology results over the phone.

Are you an alum of one of the Society's programs? Please reconnect with us by filling out a profile at bit.ly/SSP_alumni



Awards for Science News in 2014

A number of *Science News* reporters gained recognition and praise for their stories last year.

The American Geophysical Union honored physics writer **Andrew Grant** (below) with its 2014 David Perlman Award for Excellence in Science Journalism – News. His article, "At last, Voyager 1 slips into interstellar space" (*SN Online*: 9/12/13; *SN*: 10/19/13, p. 19), used the space probe's journey to shine light on the debate about the boundaries of the solar system. AGU said Grant's compelling story made the cut because it provided unusually deep context

and background "without lessening the significance of the new findings."

Biomedicine writer **Nathan Seppa** got a nod from Folio's 2014 Eddie & Ozzie Awards, which honor editorial and design excellence in the magazine industry. His feature, "Impactful distraction" (*SN*: 8/24/13, p. 20), won the Eddie Award for best consumer single article in science and technology. Seppa reported that the dangers of driving while distracted go beyond texting — even chatting on a cellphone with both hands on the steering wheel takes a driver's focus off the road, detracting from reaction time and driving acumen.

Contributing writer **Alexandra Witze** won the American Institute of Physics 2014 prize in Science Writing – Articles. Her feature, "Spinning the core" (*SN*: 5/18/13, p. 26), described an ambitious attempt to re-create the Earth's magnetic field in the laboratory. The award committee praised Witze's article for its easy-to-understand discussion of a complex subject.



SUPPORT SCIENCE

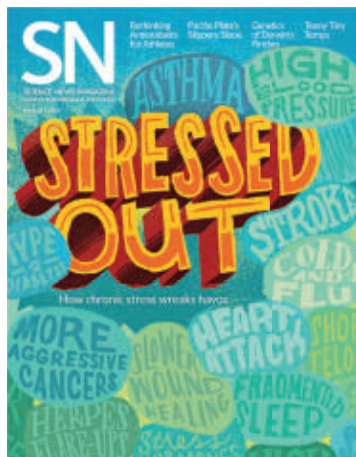
Help SSP fulfill its mission to **inform, educate and inspire** the public about science.

DONATE NOW

www.societyforscience.org/donate

SOCIETY FOR SCIENCE & THE PUBLIC
INFORM. EDUCATE. INSPIRE.





MARCH 7, 2015



Many museums are digitizing their collections and giving web surfers a peek at items that otherwise might not be displayed. One such offering is the Darwin Manuscripts Project at the American Museum of Natural History in New York City, which catalogs more than 16,000 high-resolution images of Charles Darwin's handwritten notes. Find out more at bit.ly/SN_DMP

Join the conversation

E-MAIL editors@sciencenews.org

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

Connect with us



Museums for web surfers

Lila Guterman's "Enjoy scientific curios collected over decades" (SN: 3/7/15, p. 28) invited readers to check out a chemist's online collection of fascinating objects and watch videos showing how they work. "It's been said that 90 percent or more of the objects that museums like the American Museum of Natural History own are hidden away in storage," commented **Mark S.** "With the dropping cost of online storage, it seems like more of these could be made available to the public as catalogs of high-resolution images. Then, when a researcher wanted to find bones that match a particular pattern — scratch marks made by stone knives, for instance — she could call upon members of the lay science community to [search the digital archives] in a fashion similar to the SETI and Galaxy Zoo projects." Reader **Shawn Simpson** liked the sound of this plan, calling it a "great idea whose time is at hand!" See the sidebar for one museum's foray into digitization.

Dry times ahead

In "Megadroughts predicted for U.S." (SN: 3/7/15, p. 10), **Ashley Yeager** relayed some bad news for the Central Plains and Southwest. New forecasts say that by the end of the 21st century, those parts of the country could experience the driest conditions in a millennium. Reader **conradseitz** provided some insight into what it's like to deal with dry conditions. "Living at the center of the drought area, I can tell you that it is really happening. We have had three and a half years already of little or no rain. It's nice and sunny, but that's not really a good thing. Our well has become sketchy (many others nearby are dry) and we are having it dug much, much deeper," he wrote. "Maybe it's natural, maybe it's got something to do with global warming. More important than the cause is a concerted attempt to adapt to it before it gets too bad."

Number lines are for the birds

Chicks may mentally sort quantities from left to right, as many people do. In "Chicks

look to left for tiny quantities" (SN: 3/7/15, p. 15), **Susan Milius** reported that the birds expected to find smaller numbers of items to the left and larger numbers to the right. "So if you had to teach chicks how to read, you would choose a language that writes from left to right, I suppose," wrote **Edric Cane**. The article asserts that many humans have a left-to-right mental number line. "I hope your affirmation is based on solid science and tested on Arabic and Hebrew writers, not only with those of us who write from left to right."

Evidence suggests that culture does have an influence on the direction of mental number lines, though researchers are still debating the issue, **Milius** says. A study in 2009 found right-to-left number lines among Arabic speakers, who read words and numbers in that direction. Hebrew speakers, who read words right to left but Arabic numbers left to right, did not show any particular directional preference. But some results are counterintuitive: Another group of researchers reported finding a vertical number line among native Japanese speakers, perhaps reflecting their vertical reading. Yet the participants seemed to prefer placing small numbers at the bottom, even though Japanese writing reads top-down.

With the chicks, she says, the researchers focused on whether any kind of mental number line would show up at all, regardless of direction. The bird's left-to-right bias agreed with tests in other animals, but the factors that influence this direction need to be investigated further.

Correction

In **Laura Beil's** feature "Tough to swallow" (SN: 3/7/15, p. 24), several readers noticed an error of chemistry. During chemical reactions in the mitochondria, oxygen becomes unstable not by losing an electron but by gaining one. This process creates a free radical, a compound so unstable that it will react with nearby molecules to scavenge another electron.

At first and even second blush, you will think this is the famous brand "X" watch that sells for over \$1,000. But this is the Rodell-7 Argonaut™ Watch, the last watch you will ever need to buy. And, incredibly, it can be yours for only ~~\$129~~ **\$69** (or even less) – read on!*

Fairy Tales

You may have seen ads telling you of watches of which only a few were laboriously handmade by "little old watchmakers" somewhere in Germany or Switzerland or watches that will lose only one second in a million years (you should live that long!), that wars were fought over them and that recently one of them was sold for over \$1 million by one of the great auction houses.

A Unique and Wonderful Watch

We won't insult your intelligence with such fantastic stories. But we will tell you one very important and sobering fact: Virtually all those fancy watches have mechanical movements. And mechanical movements have scores of tiny parts. Their wear and tear are mitigated by jeweled bearings. But that will help only for so long. Ultimately – and that sometimes may be as little as a year – these movements will wear out and that is the end of them. Because it is not possible or practical to repair them you have to throw those watches away or keep them as a reminder of your folly.

The Argonaut™ Watch is powered by the finest Japanese quartz movement. The only moving parts are the hands and the date disk. Nothing will wear out. We guarantee its proper functioning for three years. Once every two years or so, you'll need a new battery. It shouldn't cost you more than \$5.

The Watch is of quality solid stainless steel construction. It is as watertight as an oyster. It is tested to 10atm, and that means that it will be water-tight to about 330 ft. It comes with a most elegant stainless steel band that is virtually indestructible.

A **Ladies Argonaut™**, same but dainty, is available at the same price. You can mix if you buy three watches.

A Great Deal

Selling the **The Argonaut™ Watch** by mail and in very large quantities and cutting profits to the proverbial bone, we have been able to reduce the price of this wonderful watch from \$129 to just \$69. But we have an even much better deal. Here it is:

***Buy three of these great watches and we'll sell them to you for the price of just two – for only \$138. The third watch is with our compliments – absolutely**



Do not get misled by similar looking "discounted" watches. There is only one Argonaut™.

A fine watch is a lifetime investment. Be sure you get what you pay for!

FREE! That works out to \$46 per watch. Incredible, isn't it?

So don't let yourself be bamboozled by fanciful tales of watches by "little old watchmakers" and by other nonsense. Buy a watch (or watches) that will last you a lifetime and that you will in all likelihood be able to bequeath to your son or grandson in as good condition as when you bought it, a watch with an accuracy of 2 or 3 seconds per month, a watch that will never need repair, that will let you play with the mermaids and that has a no-questions-asked 3-year warranty. Forget about those \$200+ mechanical watches. They are nothing but trouble. Order your quartz Argonaut™ Watch(es) today.

RODELL-7 ARGONAUT™ WATCH
From Us Only ~~\$129~~ \$69
(why pay more?)

*** BUT READ THIS AD AND SEE HOW IT CAN BE YOURS FOR JUST \$46!**



Buy three Argonaut™ Watches (for the price of two) and we'll send you this splendid Faux Fabergé Egg Pendant with our compliments – absolutely FREE!

The egg measures 1-5/8" x 7/8" and comes with a 22 kt. gold-plated chain. It is adorned with 22 kt. gold-plated filigree and Swarovski crystals – about the closest thing to real diamonds!

Short on Cash?

With your credit card, you can buy three Argonaut™ Watches for the price of two – in two equal monthly installments. Shipping/insurance of \$12.95 plus \$10 for additional processing and billing will be added to the first installment.

How to Order

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 below. Add \$6.95 for one, \$12.95 for three watches for shipping/insurance (and sales tax for CA delivery only). You have thirty days refund and three-year warranty. We do not refund postage. For customer service or wholesale information, please call 415/356-7801. **Please give order code Z373.**

jomira

division of jomira/advance
470 3rd St., #211, San Francisco, CA 94107

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



Pink blobs of hope in cancer-targeting quest

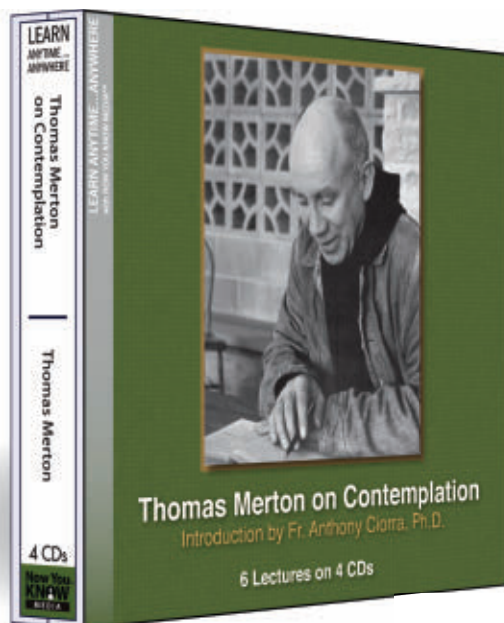
An award-winning image illustrates the promise and challenge of delivering drugs to tumors inside the body. The pink blotches in this micrograph are fluorescent dye attached to biodegradable polymer microcapsules. The capsules gathered in a mouse's lungs over the course of about a week. The polymer gradually erodes like the candy shell on a Tootsie Pop, releasing the cancer-fighting drug inside. The photo was honored by the 2015 Wellcome Image Awards, an annual contest for scientific and medical images.

MIT immune engineer Gregory Szeto and his team used

a catheter to insert drug-filled, dye-carrying capsules into the mouse's trachea and observed how far the treatment infiltrated the rodent's lungs. The image reveals that the medicine didn't make it to the lungs' lower parts. Scientists face the challenge of designing capsules that last long enough to release the drugs they carry only once they have reached desired areas of the body. Szeto focuses on the lungs because many cancers, including breast and kidney, spread through the respiratory organ. He hopes that one day patients will breathe in similar cancer-fighting microcapsules with an inhaler. — *Kate Baggaley*

G. SZETO, ADELAIDE TOVAR, JEFF WYCKOFF/MIT, WELLCOME IMAGES (CC BY-NC-ND 4.0)

Hear Thomas Merton's Lost Lectures



LIMITED TIME OFFER
73% off
FOR NEW CUSTOMERS



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

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

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

Thomas Merton on Contemplation

4-CD Set presented by Thomas Merton

Introduction by Rev. Anthony Ciorra, Ph.D.

Lecture Titles

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

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

Coupon Code: A1842

+ \$3.95 Shipping & Handling
100% Satisfaction Guarantee

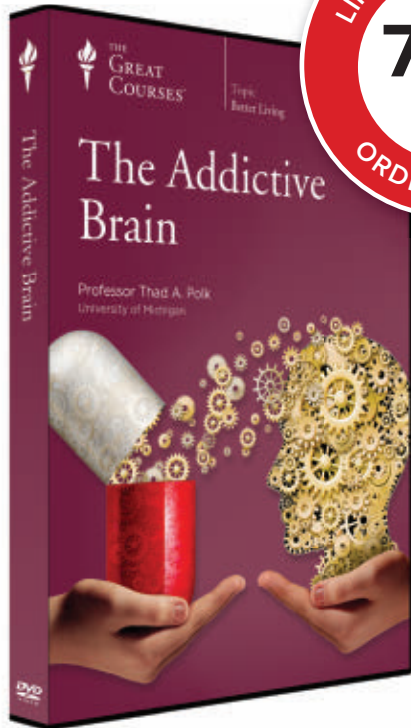
Offer expires 30 days from issue date

1-800-955-3904

www.NowYouKnowMedia.com/merton2

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

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



What Happens in the Addictive Brain?

Addiction touches us all. Whether it's a friend who can't quit smoking, a colleague afflicted with alcoholism, or a relative abusing prescription drugs, we all know someone who suffers from some form of addiction—we may even have an addiction ourselves. But what actually happens to the brain on drugs, and why do addicts behave the way they do? What can neuroscience tell us about addiction?

The Addictive Brain explains what happens at a neural level when someone sips coffee, smokes a cigarette, snorts cocaine, and more. Taught by Professor Thad A. Polk of the University of Michigan, these twelve eye-opening lectures reveal what happens when drugs enter the brain and the way drug molecules induce pleasure and shut down the ability to make sound decisions. You also investigate addictive behaviors such as gambling, binge eating, and excessive video gaming—as well as potential treatment options. Insights into the underlying mechanisms of addiction can help motivate people to seek treatment, and can provide friends and loved ones with a deeper understanding.

Offer expires 05/03/15

THEGREATCOURSES.COM/8SN
1-800-832-2412

The Addictive Brain

Taught by Professor Thad A. Polk
UNIVERSITY OF MICHIGAN

LECTURE TITLES

1. Addiction 101
2. The Psychology and Neuroscience of Reward
3. How Addiction Hijacks the Brain
4. Genetics—Born to Be an Addict?
5. Your Brain on Drugs
6. Why We Crave Coffee and Cigarettes
7. Alcohol—Social Lubricant or Drug of Abuse?
8. The Science of Marijuana
9. Stimulants—From Cocaine to Ritalin
10. The Science of Poppies, Pleasure, and Pain
11. The Gambler's Brain
12. Junk Food, Porn, Video Games—Addictions?

The Addictive Brain

Course no. 1668 | 12 lectures (30 minutes/lecture)

SAVE UP TO \$155

DVD ~~\$199.95~~ **NOW \$44.95**
CD ~~\$134.95~~ **NOW \$29.95**

+\$5 Shipping, Processing, and Lifetime Satisfaction Guarantee
Priority Code: 108512

For 25 years, The Great Courses has brought the world's foremost educators to millions who want to go deeper into the subjects that matter most. No exams. No homework. Just a world of knowledge available anytime, anywhere. Download or stream to your laptop or PC, or use our free mobile apps for iPad, iPhone, or Android. Over 500 courses available at www.TheGreatCourses.com.