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ScienceNews

MAGAZINE OF THE SOCIETY FOR SCIENCE & THE PUBLIC ■ OCTOBER 20, 2012

#Politicalspam

Tracking truthiness in the Twitterverse

Reckless on Ritalin

Great Plate Breakup

Voyager 1 Nears Solar System's Outer Limit

What Stauer Clients Are Saying About Our Hybrid Watches

★★★★★

"Great watch... an impressive piece straight out of the box."
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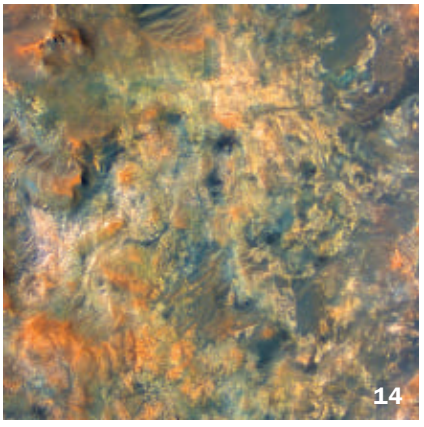

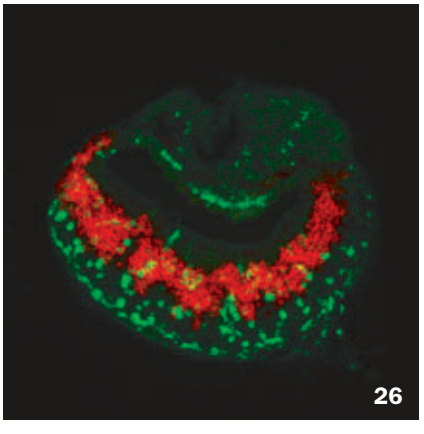

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Caroline Purser/Getty Images; B. Rakouskas, E. Feliciano

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FROM THE EDITOR

The good, great and ugly of the Twitterverse

In the realm of 140 characters, 333,722 people follow *Science News*, or, as we are known on Twitter, @ScienceNewsOrg. That's more than double the number that subscribe to this magazine; it's more than five times the average number of pages viewed each day on the *Science News* website. In other words, Twitter is one of the main avenues through which *Science News* reaches its audience, albeit in an extremely truncated form.

Perhaps because of my own reading habits — I still get a print newspaper delivered and think there's nothing better than flipping through the pages of an actual magazine or book — the existence of our ever increasing electronic audience always takes me by surprise. But our resident social media mavens explain the appeal to me thusly: You get information delivered in real time from trusted sources that you might not have found so quickly on your own. Astronomy writer Nadia Drake (@slugnads), for example, first found out about the detection of a fifth moon around Pluto (*SN: 8/11/12, p. 8*) through an early morning tweet from scientist Alan Stern of the Southwest Research Institute in Boulder, Colo.

Contributing editor Alexandra Witze (@alexwitze) notes that Twitter is particularly helpful for finding out what's happening at scientific meetings. Attendees tweet talks, allowing reporters at meetings to tune in to the most compelling sessions or, if they can't attend, to follow new developments from afar. Associate editor Kate Travis (@Kate_Travis) uses Twitter to follow and broadcast updates on unfolding events — like this summer's Curiosity rover landing on Mars (*SN: 8/25/12, p. 5*) or the Higgs boson discovery (*SN: 7/28/12, p. 5*), both of which she tracked and tweeted in the wee hours of the morning.

Of course, science journalists are not the only ones to take advantage of social media channels, as Rachel Ehrenberg (@REhrenberg) reports in this issue. On Page 12, she tells of a new study showing that Facebook friendships can influence voter turnout. And on Page 22, Ehrenberg describes scholars' efforts to track how political campaigns are using — and in some cases, abusing — Twitter. Scientists are also looking at how social media "bots" can be used to spread misinformation about candidates. Politics, journalism, science — all of it's happening in the Twitterverse. But much of the best of what's out there (well, maybe not the politics) is also right in these pages, in paper and ink, waiting patiently for you to thumb through. — *Eva Emerson, Acting Editor in Chief*

PHILIP CHANNING

WOW… A Computer Designed For YOU, Not Your Grandchildren!

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Have you ever said to yourself "I'd love to get a computer, if only I could figure out how to use it." Well, you're not alone. Computers were supposed to make our lives simpler, but they've gotten so complicated that they are not worth the trouble. With all of the "pointing and clicking" and "dragging and dropping" you're lucky if you can figure out where you are. Plus, you are constantly worrying about viruses, spam and freeze-ups. If this sounds familiar, we have great news for you. There is finally a computer that's designed for simplicity and ease of use. It's the WOW Computer, and it was designed with you in mind.

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Say What?

Mixotroph ***MIKS-oh-trohf**\ ***n.*** An organism that is both a producer and a consumer in an ecosystem. A mixotroph gets energy both by eating other organisms and by making its own food. The sea slug *Plakobranchus ocellatus* (right), for example, grazes on algae. But it also stores the algae's sunlight-processing chloroplasts in its digestive tract, providing an added energy kick from photosynthesis. Wild slugs don't use these appropriated chloroplasts while algae supplies are good, an international team of researchers reports July 25 in *PLOS ONE*. After being starved in the lab for five months, however, hungry slugs relied more on photosynthesis to get a nutritional boost. —*Allison Bohac*

Science Past | FROM THE ISSUE OF OCTOBER 20, 1962

U.S. NOW HAS CAPABILITY FOR TWIN SPACE SHOT — The United States now can equal the Soviet manned twin space shot, SCIENCE SERVICE learned at Cape Canaveral. The systems and power to do this are now available, J. Merritt, operations director of Project Mercury at Cape Canaveral, said. Although we do not have the vehicle or booster to keep two men up as long as the Russians did, we can launch two men into orbit at different intervals and return them to earth almost simultaneously.... The astronauts would be able to communicate with each other in space, and the return to earth could be coordinated just as the Russians did. The engineering ability was evident in the almost "bulls-eye" landing of Astronaut Walter M. Schirra.

Science Future

November 3
The dress code is caveman chic at the Orlando Science Center's Neanderthal Ball. Enjoy wine, music, fine dining and a "diamond dig" at this upscale event. Details at bit.ly/SFball

November 7
Cocktails accompany a discussion by biological anthropologist Fatimah Jackson, who studies medicinal African plants, as part of the American Museum of Natural History's SciCafe series. See bit.ly/SFscicafe

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MATTER & ENERGY
Chemists find more evidence of the existence of ununtrium in "News in Brief: Japanese lab lays claim to element 113."

ON THE SCENE BLOG
Middle-schoolers tackle scientific challenges at the Broadcom MASTERS competition. Read "Building a funner mousetrap."

HUMANS
Pastoralists may have constructed England's ancient stone monuments. See "Herders, not farmers, built Stonehenge."

BODY & BRAIN
Magnetic resonance imaging can detect heart attacks that EKGs often miss. Read "MRI spots silent heart attacks."

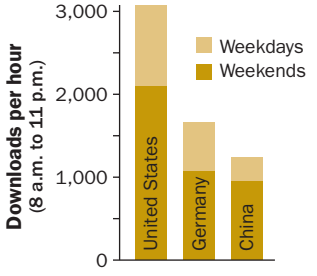
The -est | HARD-BITTEN MICROBES

Think you're tough? A few hardy microbes in Chile's Atacama Desert are tougher. In the highest altitude microbial survey so far, researchers found bacteria, fungi and ancient organisms called archaea scratching out an existence 6,000 meters above sea level in harsh conditions on volcanoes (shown). Daily temperatures swing from below freezing at night up to as high as 56° Celsius (133° Fahrenheit) during the day, ultraviolet radiation is among the highest on Earth and nutrients are almost nonexistent. Soil samples turned up fewer than 20 microbial types, which may eke out a living extracting energy from carbon monoxide, Steve Schmidt of the University of Colorado Boulder and colleagues report June 26 in the *Journal of Geophysical Research*.
— Erika Engelhaupt

Science Stats

SCIENCE-AHOLICS
Scientists work around the clock, a new study finds by looking at the number of scientific papers downloaded throughout the day in various countries. U.S. scientists tend to work through mealtimes and late into the night, while Chinese researchers don't get much of a weekend.
SOURCE: X. WANG *ET AL/JOURNAL OF INFORMETRICS* 2012

Downloads per hour during weekdays and weekends



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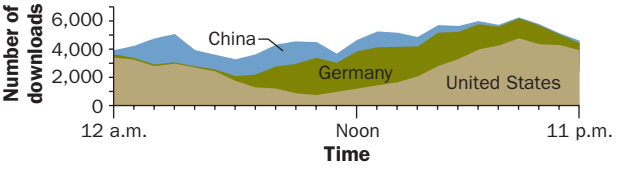


CLOCKWISE FROM TOP: WWW.DAVEHARASTI.COM; GUENTER WIESCHENDAHL/WIKIMEDIA COMMONS; S. SCHMIDT

“It’s amazing that these little creatures are as flexible as they are and have evolved these solutions that make maximum use of these little brains they are carrying around.” —FRED DYER, PAGE 17

In the News

Genes & Cells Evolution according to *E. coli*

Science & Society Better digs lift spirits

Atom & Cosmos Voyager 1 on the brink

Matter & Energy Heisenberg updated

Life The value of a mother’s love

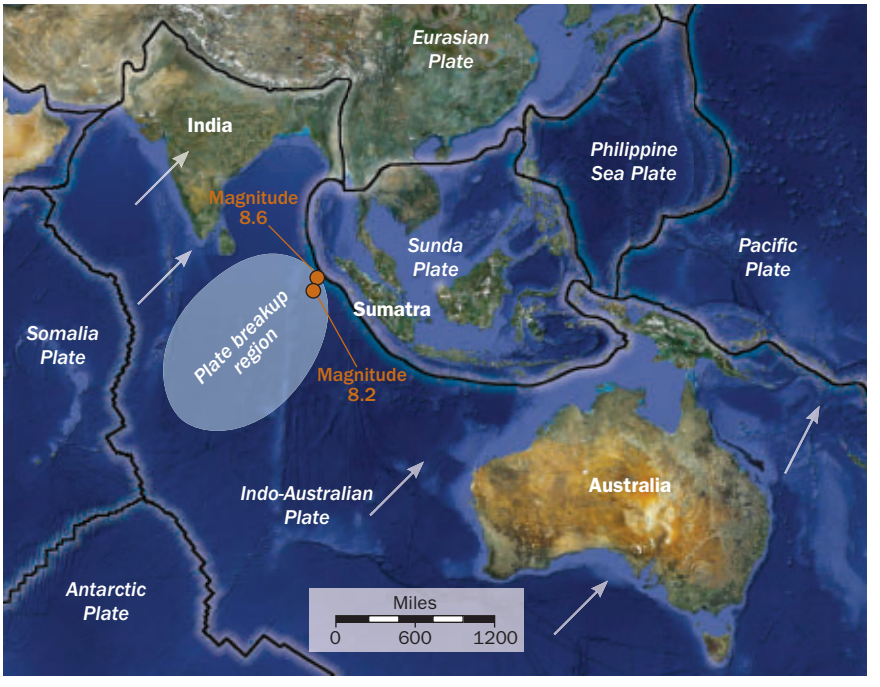
Body & Brain Dengue vaccine falls short
New MS pill shows promise

STORY ONE

Quakes signal Indo-Australian plate breakup

April temblors released energy west of Sumatra

By Alexandra Witze



Two magnitude 8+ earthquakes (orange circles) that struck in the eastern Indian Ocean in April and triggered aftershocks half a world away are indicators of the ongoing breakup of the Indo-Australian plate. Over millions of years, the split will put India and Australia on different continental courses.

Two giant earthquakes in the eastern Indian Ocean have shown geologists that breaking up is easy to do—for tectonic plates, that is.

The pair of quakes hit on April 11 (*SN Online: 4/11/12*), startling seismologists with their size (magnitudes 8.6 and 8.2) and location (hundreds of kilometers from the active seismic zone that spawned the deadly 2004 magnitude 9.1 earthquake and tsunami). Now, three studies reveal that the April quakes were an indication that one great slab of Earth’s crust is slowly fracturing into two.

The work, reported online September 26 in *Nature*, confirms that seismic risk remains high in the area.

“You’d be nuts to think it was all over in offshore Sumatra,” says Kerry Sieh, a seismologist at the Earth Observatory of Singapore who was not involved in the new research.

The bigger April quake leapt straight into the record books. It was the largest ever recorded in the middle of a tectonic plate, rather than at a plate’s edges where most quakes happen. It was also the largest earthquake recorded along a strike-slip fault, in which two chunks of Earth’s crust slide past each other horizontally, like along California’s San Andreas. And it was the most complex strike-slip rupture ever seen, breaking along at least four separate faults interlaced like a geological lattice.

Add together the 2004 killer Sumatra quake, two nearby great quakes in 2005 and 2007, and these April Indian Ocean quakes, says Sieh, and “you get the greatest release of seismic energy anywhere on Earth in the past half-century.”

Blame it on the massive Indo-Australian plate, which stretches from the Himalayas in the north to well below Australia in the south. You can think of the plate like a motorcycle with a sidecar, says Matthias Delescluse, a marine geophysicist at the École Normale Supérieure in Paris. The motorcycle—the part of the plate carrying Australia—is driving quickly northeast. But the sidecar—the part carrying India—is slamming into the Himalayas. The motorbike and sidecar are thus shearing apart. Millions of years from now, the Indo-Australian plate will split into an Indian and an Australian plate.

April’s quakes reminded scientists that this is happening, maybe even faster than once thought. The 2004 quake, to the east, sped up the rate of earthquakes across the region and probably hastened the April quakes, Delescluse and his colleagues report in *Nature*. They calculated

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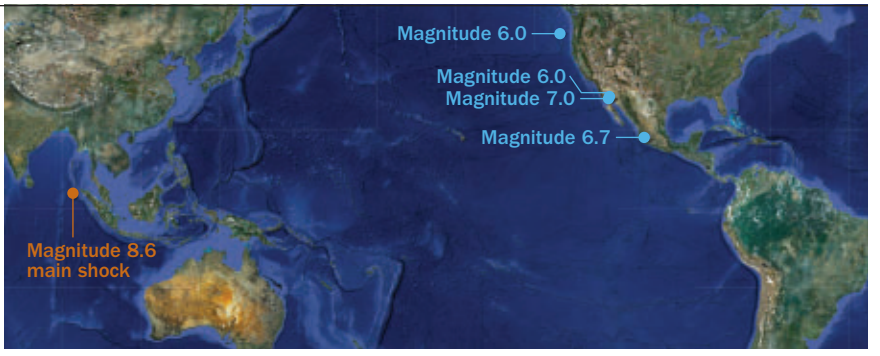


The magnitude 8.6 earthquake that struck off Sumatra on April 11, the largest ever seen on a strike-slip fault, triggered aftershocks worldwide. Within 24 hours it had spawned four temblors of magnitude 6.0 or more at the boundary of the Pacific and North American plates, including a magnitude 7.0 event in Mexico.

how the monster 2004 and 2005 quakes changed stress patterns in the Earth's crust and found that releasing stress on the faults diving under Sumatra to the northeast actually raised stress in the strike-slip faults in the Indian Ocean.

In a second *Nature* paper, seismic records illuminate the complex way the seafloor ruptured in April. The first April 11 quake unzipped four perpendicular faults one after another in just over two minutes, the scientists found. Each fault ruptured with the equivalent energy of at least a magnitude 8.0 quake in that magnitude 8.6 event. Two hours later, the magnitude 8.2 aftershock struck just south of the main rupture. "This was a gee-whiz event for us," says team member Thorne Lay, a seismologist at the University of California, Santa Cruz.

But the story wasn't over once the two quakes were done. They continued to resonate around the globe, triggering big aftershocks as far away as Mexico, a third study finds.

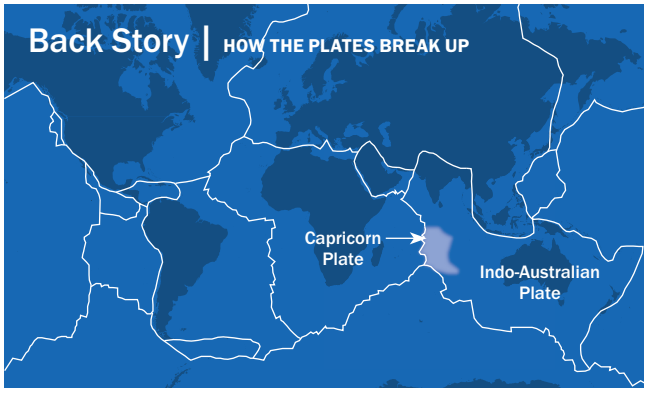
Fred Pollitz, a seismologist at the U.S. Geological Survey in Menlo Park, Calif., became interested in the quakes when his colleagues' pagers kept going off for days afterward with alerts of other big quakes. "That struck me as rather suspicious," Pollitz says. So he and his colleagues went through catalogs of global earthquakes, looking for changes in patterns of seismicity.

They found that the number of quakes of magnitude 5.5 or greater, located more than 1,500 kilometers from the April 11 quakes, went up nearly fivefold for six days afterward. The biggest such quake was a magnitude 7.0 in Baja California, Mexico, about 22 hours afterward.

Most giant quakes don't trigger major temblors so far away. The difference, Pollitz says, lay in the strike-slip nature of the April 11 quakes. This type of fault geometry allows the stress of a crustal movement to propagate much farther across the planet's surface, compared with deep-diving plates that transmit their energy into the bowels of the Earth.

Though the strike-slip geometry may have triggered other quakes, it also meant that few people died in the April 11 events. Horizontal ground movements don't push ocean water around in ways that generate tsunamis.

Still, the seismic risk around Sumatra remains high, because other parts of the plate diving beneath Indonesia have not broken for some time. The fact that big earthquakes can pop off where they're not expected, like along strike-slip faults in the eastern Indian Ocean, suggests that future surprises may lie in store. ■



As geologists' defining theory of the processes that shape the face of the planet, plate tectonics is rock solid. Yet there's no clear definition on exactly what constitutes a tectonic plate or how many plates there are. At its most basic, a tectonic plate is a chunk of Earth's outer surface (its crust and a portion of the upper mantle) that moves as a single entity. Where plates meet, they grind against or dive beneath one another.

Seven huge plates dominate the plate tectonic scene. At least eight smaller plates show up on most maps, mostly on the margins of oceans where Earth's crust is thinner and more prone to fracture. But some of these plates, big and small, are in the process of breaking up (see main story), and in a few cases may have already done so. Several scientists argue that the Indo-Australian plate, which is the third largest plate and is in the midst of a drawn-out breakup, has already shed one fragment, a smaller plate dubbed Capricorn, on its southwest edge. Global-positioning satellite data show that the southwest part of the larger plate is not moving in exactly the same direction as the northwest and east. That, some geologists argue, suggests that Capricorn has already broken away. —*Alexandra Witze*

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Genes & Cells

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E. coli caught in the act of evolving

Long-term lab experiment traces a trait's reappearance

By Tina Hesman Saey

Big leaps in evolution are the products of tiny genetic changes over thousands of generations, a new study shows.

E. coli bacteria growing in a lab for nearly 25 years have learned to do something no *E. coli* has done since the Miocene epoch: eat a chemical called citrate in the presence of oxygen. Evolutionary biologists Zachary Blount and Richard Lenski of Michigan State University in East Lansing and their colleagues describe the molecular steps leading to the feat in the Sept. 27 *Nature*.

Learning to eat citrate, a form of citric acid, is as big an innovation for *E. coli* as developing eyes or wings would be for multicellular creatures, says evolutionary geneticist Paul Rainey of Massey University in Auckland, New Zealand.

Ancestors of *E. coli* may once have been able to eat citrate when oxygen was around, but *E. coli* lost the ability at least 13 million years ago, Blount says. In fact, the inability to grow on citrate in oxygen-rich conditions is a defining characteristic of *E. coli* that helps distinguish them from other types of bacteria.

Twelve flasks, each containing an independently evolving population of *E. coli*, have been growing in Lenski's lab for more than 56,000 generations. A low concentration of *E. coli*'s favorite food, the sugar glucose, keeps most of the populations in check. But around generation 33,000, one flask, designated Ara–3, suddenly became cloudy as the bacteria within developed the ability to gobble citrate, an acid-controlling chemical that is abundant in the growth solution.

The ability of the Ara–3 *E. coli* to chow down on the alternative food source took at least three steps to develop, carried out over more than 13,000 generations. That's the equivalent of a quarter-million years worth of human evolution in just five to six years of growth time in the lab.

In step one, or potentiation, at least two mutations arose that set the stage for the citrate-eating ability. In step two, called actualization, a stretch of DNA containing a dormant gene for moving citrate into cells was copied, and the copy was inserted near the original gene. The copied-and-pasted version of the gene started producing the citrate-pumping protein again. Step three, refinement, took another 1,500 to 2,000 generations (about a year in the lab, or 30,000 to 40,000 years worth of human evolution) before the bacteria could make full use of the new food source.

Breast cancer gets gene profile

Data reveal tumor origins and may improve treatment

By Tina Hesman Saey

One of the most complete portraits of breast cancer yet painted may inspire some new treatment options.

Doctors and researchers have long classified breast cancer into four types based on which genes are most active. Now, an international consortium of researchers known as the Cancer Genome Atlas Network has combined many different types of data to fill in the picture, including the mutations that probably sparked tumor formation in the first place. The molecular portraits were published online September 23 in *Nature*.

Tumors with an overactive estrogen receptor gene are known as ER-positive and fall into two groups: the easier-to-treat luminal A group and a more aggressive luminal B group. Another category is based on the activity of the *HER2* gene.

The fourth category, basal-like tumors, sometimes called triple-negative tumors, is different from the rest. This type of breast cancer is aggressive, tends to strike younger women, African-Americans and women with a family history of the disease. It is also associated with mutations in the *BRCA1* gene that indicate a greatly increased risk of breast cancer.

Knowing a tumor's category has helped doctors advise patients about treatments but hasn't offered information about the underlying cause of the disease, says Matthew Ellis, an oncologist and molecular biologist at Washington University School of Medicine in St. Louis. Ellis was one of hundreds of coauthors of the paper.

Information from the new study shows that basal-like breast cancer strongly resembles a type of ovarian tumor called serous ovarian cancer.

"This is what we hoped to find," says Philip Bernard, a genomics researcher at Huntsman Cancer Institute at the University of Utah, who was not involved in the study. "It was expected ... but it still needed to be confirmed."

Women with these basal-like tumors may benefit from chemotherapy regimens like those given to patients with ovarian cancer, Ellis says. He expects fierce debate and probably some clinical trials to test that conclusion.

In the three other types of breast cancer, a series of biochemical reactions known as the PI3 kinase pathway is overstimulated because of mutations in genes involved at different steps of the process. Some drugs that target specific mutations in those genes are already being tested against other types of cancer and might be appropriate for some women with breast cancer, the study results suggest.

"It undermines simpler stories trying to pinpoint a single geographic origin of modern humans." —ADAM SIEPEL

No home for *Homo sapiens*

African DNA analysis fails to locate birthplace of species

By Erin Wayman

The origin story for *Homo sapiens* is a messy tale. Rather than emerging from one small population, the human species likely evolved from a dispersed, complex network of groups that mixed and mated with each other, scientists report online September 20 in *Science*.

The new research is one of the largest genetic studies of southern Africa's click-speaking hunter-gatherers, known as the Khoisan. Sometimes called Bushmen, the Khoisan are the world's most genetically diverse people and diverged from other populations very early in human history.

The new work dates the genetic split between the Khoisan and the rest of humankind to at least 100,000 years ago, which is in line with other estimates. That's 55,000 years older than the next branch on the human family tree, when Central African pygmies split off. The researchers also found that the Khoisan divided into a northern and a southern group approximately 35,000 years ago.

But when the scientists looked for genetic clues pointing to where in sub-Saharan Africa humankind began, they couldn't trace modern groups back to any one region. That suggests early humans came from a highly structured population with genetic exchange between subgroups.

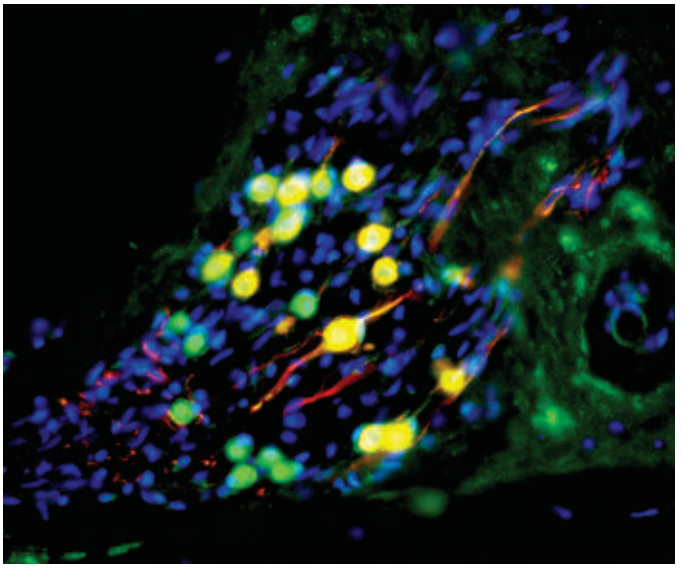
"The complexity of the south African population is the big story," says Adam Siepel, a computational biologist at Cornell University. "It undermines simpler stories trying to pinpoint a single geographic origin of modern humans." Previous fossil evidence had suggested eastern Africa while smaller genetic studies indicated southern Africa.

In the new study, Carina Schlebusch of Sweden's Uppsala University and colleagues looked at single nucleotide polymorphisms, or SNPs, which are locations in the genetic sequence where people commonly differ. The researchers surveyed 2.3 million SNPs in 220 individuals from 11 African populations, including seven Khoisan groups. After combining the new data with previously published data, the team assessed four measures of genetic variation to find where in Africa humans originated, but the results didn't converge on one location.

A paper set to appear in an upcoming issue of *Nature Communications* reaches similar conclusions. Joseph Pickrell of Harvard Medical School and colleagues analyzed a different set of more than 565,000 SNPs in 187 individuals from 22 African populations. Like Schlebusch's team, Pickrell's group identified a split within the Khoisan that occurred less than 30,000 years ago, breaking the population into a northwestern and a southeastern group. Their work also failed to find a single area where humans arose.

You wouldn't necessarily expect to find the cradle of humanity by looking at present-day Africans, says Sarah Tishkoff, a human geneticist at the University of Pennsylvania. "When you look at modern populations, you see where they live today," she says. "You don't know where they were 50,000 or 60,000 years ago."

Schlebusch's team also searched for genetic changes that might reveal the evolutionary forces that shaped early Africans. The researchers found hints that selection acting on a few genes related to skeletal and neurological development may have played a role in the emergence of anatomically modern humans.



MARCELO RIVOLTA/UNIV. OF SHEFFIELD

Hearing cells sprouted

Human embryonic stem cells (green) can be coaxed to form sound-detecting nerve cells (yellow) in the inner ears of deaf gerbils. Deafness often results from the loss of specialized nerve cells—called hair cells and spiral ganglion neurons—in the cochlea, the part of the inner ear that converts vibrations into signals that the brain understands as sounds. Until now, no one has been able to replace both types of nerve cells. Researchers at the University of Sheffield in England devised a way to make the human stem cells follow the same steps that sound-detecting nerves take during normal development. When transplanted into the cochleas of deaf adult gerbils, the human cells partially restored the animals' hearing, the researchers report online September 12 in *Nature*. Such cells may one day be used in combination with cochlear implants to treat deafness in people. —*Tina Hesman Saey*

Genes & Cells

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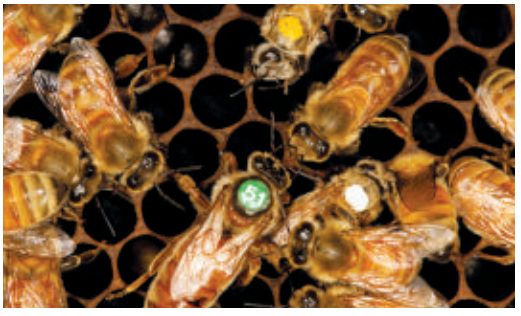
DNA tags may dictate bee behavior

Alterations affect genetic activity but not genes' content

By Tina Hesman Saey

Reversible changes that dictate how genes function may determine what jobs honeybees do in the hive.

Worker honeybees are literally born to be nurses that take care of larvae. After two to three weeks, the workers become foragers. That career change is accompanied by the addition or subtraction of chemical tags called methyl groups to some of the bees' genes, says a team of researchers led by epigeneticist Andrew Feinberg of Johns Hopkins University and biologist Gro Amdam of Arizona State University.



Worker bees surround a queen (numbered). Paint splotches distinguish forager bees from nurses. New research suggests chemical tags on DNA may be involved in training bees for new jobs.

Tacking on or removing chemical, or epigenetic, tags changes genes' activity but doesn't alter the genes themselves. In honeybees, these modifications are also reversible: Foragers that go back to being nurses also revert to nurses' epigenetic pattern, the researchers report in the October issue of *Nature Neuroscience*.

"This is an exciting paper because it implicates epigenetics in the establishment and stability of distinct behavioral predispositions," says Gene Robinson, who studies bees, genes and behavior at the University of Illinois at Urbana-Champaign. The study doesn't show that epigenetic changes cause bees to behave differently, but it does show that behavior and epigenetic modifications are both reversible and associated with each other.

Amdam and her colleagues set up bee colonies in which all the workers were the same age. The researchers continually removed larvae just before hatching so no relief workers could be added to the workforce. Dots of paint distinguished foragers from nurses. An analysis of the chemical tags in bee brains showed that the nurse-to-forager career transition was associated with dropped or added epigenetic tags on 155 different genes.

When all the foragers were out of the colony, Amdam and her colleagues snatched the remaining nurses. After a few days of confusion, some foragers returned to their old nursing jobs. That reversion was accompanied by epigenetic changes to 107 genes, including 57 involved in the original nurse-to-forager change, the team found.

Light moves lab-made muscle

Artificial tissue inspires dream of squirming robots

By Meghan Rosen

Artificial muscle tissue that recoils when hit with a burst of light could one day be used to build soft-bodied robots that can be guided by light.

The light-sensitive tissue could also be used to test new drugs that target muscle-wasting diseases, says Mahmut Selman Sakar of ETH Zurich. The findings are slated to appear in an upcoming issue of the journal *Lab on a Chip*.

The work is "a neat step forward," says bioengineer Hang Lu of the Georgia Institute of Technology in Atlanta, although Lu notes that making a light-controlled robot might still be a long way off.

Sakar and colleagues at MIT teamed up with scientists at the University of Pennsylvania to genetically engineer mouse muscle cells that twinge in response to light. The researchers loaded the cells with a light-activated protein, let the cells fuse into fibers and then mixed them with a special gel to form 3-D strips smaller than the width of a grain of rice. Then, they hit the strips with narrow beams of blue light.

Only the light-zapped fibers jumped; those in the dark stayed still. "I was hoping it would work, but the first time I saw it, it was amazing," Sakar says.

Sakar and colleagues even got the muscle fibers to show off a bit of brawn. Tissue strips stretched between two tiny elastic posts pulled the structures together when scientists switched on the light.

Burly tissues with controllable fibers could help researchers make muscle-bound robots that crawl along the ground like worms. The itty-bitty biological machines would have to carry a light source to turn on their muscles. But other research groups are working to merge LED lights onto elastic sheets that could ride atop a wormbot's muscles like skin, Sakar says.

The real challenge would be making the bots bigger: If the muscle strips got much thicker than the ones Sakar and his colleagues have created, oxygen and nutrients wouldn't be able to pass into the tissue to power its contractions. That means a beefed-up robot would need something like a blood vessel system to carry fuel through its body. Another problem, Sakar says, would be getting light to penetrate opaque chunks of tissue.

CHRISTOFER BANG

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Science & Society

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Facebook prompts people to vote

Those whose pals went to polls were more likely to go

By Rachel Ehrenberg

An experiment involving more than 61 million people reveals that Facebook users who received a message that a friend had voted were more likely to go to the polls themselves.

Facebook users who saw a call to vote that included pictures of friends who had voted were more likely to vote than those who got a plain message or none at all.

"This paper presents really nice large-scale evidence that political mobilization is a peer-to-peer activity," says information economist Sinan Aral of New York University.

During the 2010 congressional elections, researchers led by social scientist James Fowler of the University of California, San Diego worked with Facebook to conduct a massive social influence experiment. On November 2, election day, all U.S. Facebook users over 18 years old experienced one of three treatments: One group got a message that urged them to vote, encouraged them to click an "I voted" button and showed a counter indicating the number of Facebook users who had voted. A second group received the same message and also saw profile pictures of up to six friends who had reported voting and a tally of how many of their Facebook contacts had clicked on "I voted." A third group received no message.

People who saw pictures of their friends along with the message were 2.08 percent more likely to click the "I voted" button than people who saw the message alone, Fowler and his colleagues report in the Sept. 13 *Nature*. The researchers also examined publicly available voting records for a third of the Facebook users in the study and found that those who saw the friend message were 0.39 percent more likely to vote, while turnout among those who saw the generic message or no message was similar.

Those percentages are low compared with other get-out-the-vote tactics, such as door-to-door canvassing, says Fowler. But the researchers' conservative estimate suggests that the message with pictures translated directly into getting about 60,000 people to vote.

New homes lift only happiness

Housing vouchers did not bring families out of poverty

By Bruce Bower

Single mothers mired in extreme poverty feel better about their lives and are mentally healthier after moving out of public housing with the help of federal housing vouchers, a new study finds. But that type of helping hand isn't strong enough to break the cycle of poverty.

This two-sided trend, uncovered by economist Jens Ludwig of the University of Chicago and his colleagues, presents policy makers with a quandary. Designed as poverty-fighting tools, housing vouchers don't get poor adults off welfare and into decent-paying jobs, Ludwig's team reports in the Sept. 21 *Science*. Yet the same single mothers who received vouchers did cite big emotional benefits after moving from public housing to apartments in somewhat better parts of town.

"Moving to a less-distressed neighborhood matters a great deal for the well-being of low-income women who participated in this study, but it doesn't seem to be enough to boost their earnings," Ludwig says.

Ludwig's team examined data from the U.S. Department of Housing and Urban Development's Moving to Opportunity project, which, from 1994 to 1998, gave more than 4,600 poor, mostly black and Hispanic female-headed families either housing vouchers or no financial help. Over 10 to 15 years, women who moved their families to better, but still poor, neighborhoods reported better mental health and greater happiness than those in public housing who received no assistance. But the voucher group showed no advantage in being able to secure jobs or get off welfare.

People given vouchers to move out of public housing like the Cabrini-Green development in Chicago (shown) felt better about their lives, but their income level did not rise, a new study finds.

"This study reveals how hard it is to ameliorate poverty among those who have spent most of their lives in severely disadvantaged neighborhoods," says Harvard University sociologist Robert Sampson.

FROM TOP: R.M. BOND *ET AL*./*NATURE* 2012; TIM BOYLE/GETTY IMAGES

Car-crazy kid wins science competition

Thirty Broadcom MASTERS finalists visit nation's capital

By Laura Sanders

Raymond Gilmartin's research on how spoilers affect the drag on passenger vehicles won him the top prize at the second annual Broadcom MASTERS competition.

BROADCOM MASTERS, IML PHOTOGRAPHY

WASHINGTON — After cruising through days of engineering enigmas, science stumpers and mathematical mysteries, a 14-year-old car aficionado earned the top award at the second annual Broadcom Math, Applied Science, Technology and Engineering for Rising Stars, or MASTERS, competition. Eighth-grader Raymond Gilmartin from South Pasadena, Calif., was honored at an October 2 gala with an educational award of $25,000 provided by the Samueli Foundation, a nonprofit organization based in Corona del Mar, Calif., started by Broadcom cofounder Henry Samueli and his wife, Susan.

"Broadcom is a company about science and innovation," said Broadcom Corp. president and chief executive officer Scott McGregor, who is also president of the Broadcom Foundation, which funds the competition. "This is a way to encourage and inspire the innovators of the future."

A quarter of Gilmartin's score was based on his original research. In a project he called "Spare the Environment, Spoiler the Car: The Effect of Rear Spoilers on Drag and Lift," Gilmartin studied how different sizes and shapes of spoilers affect the drag that cars experience. He built a six-foot wind tunnel in his house and tested various combinations of model cars and hand-carved wooden spoilers, tests that ultimately told him that some kinds of rear spoilers on SUVs may ease drivers' pain at the pump.

Participating in the competition has been "the greatest thing that's happened to me," Gilmartin said. "I made a lot of friends and learned a lot."

The other portion of Gilmartin's winning score came from a gauntlet of science challenges in Washington, D.C. Over several days, teams made up of the 30 Broadcom MASTERS finalists designed and constructed a model house to withstand strong gusts of wind, tested various biofuels for their energy potential and engineered a passenger restraint system that simulated the forces involved in a car crash.

"Our finalists tonight exemplify what our students can do if given the right encouragement, direction and support," said Elizabeth Marincola, president of Society for Science and the Public, which administers the Broadcom MASTERS competition and publishes *Science News*.

For her ingenuity, 13-year-old Jessika Baral took home the Marconi/Samueli Award for Innovation and $10,000. Inspired by a family full of glasses-wearers, Baral designed a gadget that flashes LED lights in the periphery. After a few weeks of practice with the device, Baral's family, classmates and neighbors in Fremont, Calif., saw improvements in their peripheral vision.

First and second place awards of $3,500 and $2,500 were given in four areas of the competition — science, technology, engineering and mathematics. That award is to be spent toward attending a summer camp with a research focus. First prize in science went to Shixuan Justin Li of Lynn Haven, Fla., and second to Nicole Odzer of North Miami Beach, Fla. First prize in technology went to Daniel Lu of Carlisle, Mass., and second to Anirudh Jain of Portland, Ore. First in engineering was Chase Lewis of Chapel Hill, N.C., and second was Carolyn Jons of Eden Prairie, Minn. Maria Elena Grimmett of Jupiter, Fla., took first place in mathematics, with Maya Patel of The Woodlands, Texas, taking second.

This year's crop of finalists also included 13-year-old twin brothers — Shashank Dholakia and Shishir Dholakia of Santa Clara, Calif. — who tracked the movements of two stars in the sky; a 14-year-old surfer from Hebron, Conn. — Maura Clare Oei — who developed a way to capture energy from waves; and a 13-year-old Texas rancher — Paige Gentry of San Angelo — who had a run-in with a rabid skunk in her hen house. After tinkering around with various types of skunk bait that could eventually be spiked with a rabies vaccine, Gentry discovered that skunks like chicken best.

Cassie Drury of Louisville, Ky., and Mabel Wheeler of Orom, Utah, won Rising Stars Awards, which include a trip to the largest international precollege science competition, Intel ISEF, held in Phoenix in May. ■

Atom & Cosmos

14.9 billion kilometers | Distance to Voyager 2 spacecraft

18.3 billion kilometers | Distance to Voyager 1 spacecraft

Mars clays may have volcanic past

Chemistry suggests deposits didn't need flowing water

By Erin Wayman

Ancient clay deposits on Mars may not indicate that the Red Planet was originally a warm, wet place. Instead of needing liquid water to form, many of Mars' 4-billion-year-old clays could have originated from cooling lava, scientists report in the October *Nature Geoscience*.

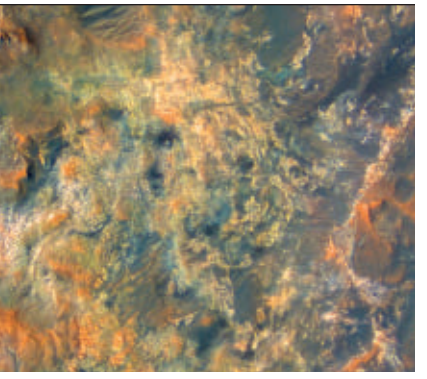
Clays are widely scattered across Mars' oldest terrain, dating to the Noachian period 4.1 billion to 3.7 billion years ago. The deposits were originally considered evidence of large bodies of water weathering and altering Mars' basalt surface. Then last year, some researchers suggested that underground hydrothermal activity provided the water that is necessary to form the clays (*SN: 12/3/11, p. 5*).

Now there's another suggestion: Crystallizing lava may have contained tiny pockets where water could react with other chemicals to make small amounts of iron- and magnesium-rich clay. No additional water flowing on the surface or belowground would be needed.

"We're not saying all clays on Mars formed by this process," says coauthor Bethany Ehlmann, a planetary geologist at Caltech. But "if most clays formed by a magmatic process, it says maybe water wasn't so available on early Mars."

It's too soon to know how pervasive this process might have been. "There is a lot more work to be done before this should be accepted as the prevailing paradigm for clays on Mars," says Laszlo Kestay, director of the U.S. Geological Survey's Astrogeology Science Center in Flagstaff, Ariz.

Ehlmann's team investigated the cooling-lava scenario because some Martian clays don't appear to fit with previous explanations. Unable to test the idea directly, the researchers looked for clues on Earth in Martian meteorites. Some of these meteorites contain clay minerals with a mix of hydrogen and its heavier form, deuterium, that is characteristic of water coming from Mars' mantle — not from the atmosphere or surface — and carried in lava. That suggests water-rich lava has produced some Martian clay.



A warm, wet climate may not have been necessary to form Mars' ancient clays (bright areas in this enhanced-color image). Instead, the minerals might have been the product of cooling lava, researchers suggest.

The researchers also looked at clay deposits that formed from cooling lava in French Polynesia's Mururoa Atoll in the Pacific Ocean. This clay reflects the same wavelengths of infrared light as Martian deposits, suggesting that both have similar mineralogical properties and thus probably formed in the same way.

Maybe water flowed on the Martian surface only during brief episodes, as evidenced by the planet's ancient river valleys, says coauthor Alain Meunier of the University of Poitiers in France.

Voyager 1 still in solar system

Scientists wait for craft to reach interstellar space

By Nadia Drake

NASA's Voyager 1 spacecraft, launched 35 years ago on September 5, 1977, is ready to plunge into interstellar space. Soon the craft will leave the solar system behind, bursting through the windy bubble blown by the sun.

The question is: How soon? That boundary may be a bit farther away than expected, a team from Johns Hopkins University suggests in the Sept. 6 *Nature*.

NASA reported earlier this year that Voyager 1, the most distant spacecraft from Earth at more than 18 billion kilometers away, had detected two major signs heralding its impending exit from the solar system. But after analyzing data from an earlier series of rolling maneuvers, scientists didn't detect the expected stream of charged particles thought to signify the solar system's edge.

At that edge, such particles should reroute to flow in the direction of the sun's poles, forming a stream that coats the inner surface of the bubble-shaped boundary. That Voyager 1 didn't observe that change suggests that either the spacecraft is not snuggled up against the boundary, or that the edge behaves differently than predicted.

"The idea that there is some sort of distinct boundary, like crossing from New Jersey to Pennsylvania — it isn't shaping up that way," says study coauthor and space physicist Edmond Roelof.

It's clear that Voyager 1 is in a region called the heliosheath, a transition area between the point where the solar wind slows down and the heliopause, the very edge of the bubble blown by the sun.

"We've been seeing that the wind has more or less come to a stop. It's in a stagnation region," Voyager chief scientist Edward Stone of Caltech said in May. "That means we're close to the heliopause."

JPL-CALTECH/NASA, UNIV. OF ARIZONA

Matter & Energy

Adding precision to uncertainty

Heisenberg's famous physics principle gets refinements

By Alexandra Witze

Measuring light particles doesn't push them as far into the realm of quantum fuzziness as once thought, new research suggests. The work doesn't invalidate Werner Heisenberg's uncertainty principle, the foundation of modern quantum theory. But it may have implications for supersecure cryptography and other quantum applications.

"The real Heisenberg uncertainty principle is alive and well," says Lee Rozema, a physicist at the University of Toronto whose team reports the finding in the Sept. 7 *Physical Review Letters*. "It's really just [one aspect] that needs to be updated."

In its most famous articulation, Heisenberg's principle states that it's possible at a given moment to know either the position or momentum of a particle, but not both. This relationship can be written out mathematically. But Heisenberg first came up with the idea in a slightly different fashion using slightly different mathematics. That version says the more you disturb a particle, the less precisely you can measure a particular property of it, and vice versa.

Heisenberg imagined shining particles of light on an electron and, by watching how the light bounced off it, deducing the position of the electron. But with each bounce, a light particle would impart a little of its momentum to the electron, thus blurring how well scientists can measure the system. "This is how Heisenberg thought, but it wasn't what was rigorously proven later," says Rozema. "Physicists quite often confuse the two."

In 2003, Japanese physicist Masanao Ozawa showed mathematically that Heisenberg's first version couldn't be right. Earlier this year, he and a research team at the University of Vienna reported lab experiments confirming this.

Now, the Toronto physicists have weighed in with what they call a more direct measurement. They took single light particles, or photons, and measured two directions in which the light waves oscillated. The first measurement was a "weak" probe, gently inquiring about oscillations in one direction and then the other. Then the scientists made a "strong" measurement, directly probing whether that first, weak measurement had disturbed the system.

By combining the weak and strong measurements, Rozema's team showed that the measured oscillations did not fit the mathematics of Heisenberg's first formulation of the uncertainty idea. In other words, shrinking the inaccuracy of a particle measurement (making it more precise) doesn't disturb the particle quite as much as scientists had thought.

> "The real Heisenberg uncertainty principle is alive and well. It's really just this [one aspect] that needs to be updated."
>
> LEE ROZEMA

"It is possible for both the inaccuracy and the disturbance to be small, although not both strictly zero," says Howard Wiseman, a physicist at Griffith University in Brisbane, Australia.

The discovery is important for anyone trying to build an unbreakable quantum code. Quantum cryptography relies on the fact that eavesdroppers would be spotted by the disturbance they make. If the disturbance is smaller than expected, then eavesdroppers might be harder to detect.

"The new relation will open up new science and technology in the field of quantum information," says Ozawa, now of Nagoya University. "It also presents a profound philosophical problem."

Life

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A postreproductive killer whale and her son (shown) may have a special bond that extends his life and thus her chances of having grandchildren.

Killer whale mama's boys live longer

Females' long postmenopause years may benefit their sons

By Susan Milius

Male killer whale thirtysomethings appear to live longer when mom is nearby, especially if mom has stopped reproducing. This survival bonus could be the first evidence from nonhuman animals for an evolutionary advantage to living long after reproduction stops.

In the Pacific Northwest, a male killer whale's risk of disappearing, presumably from dying, seems to jump almost 14-fold in the first year after his post-reproductive mom dies if he's older than 30, says marine biologist Emma Foster of the University of Exeter in England. Daughters get a more modest fivefold boost, Foster and her colleagues report in the Sept. 14 *Science*.

Keeping her son alive as long as possible would maximize a mom's chances of passing her genes into further generations. That may help explain how female killer whales have evolved the longest postreproductive life span known among nonhuman animals. Even though a female killer whale may stop having babies in her 30s or 40s, she can live into her 90s.

"Menopause is still one of the great mysteries of biology," Foster says. What drives the evolution of a no-babies phase of adulthood has been a puzzle. Some biologists argue that this postreproductive life span is just a side effect of other survival-boosting traits, but others have searched for some benefit in staying alive after child-bearing years.

Foster and her colleagues analyzed whale-spotting censuses that have been running since 1974 off Washington state and British Columbia. Each year, teams photograph the resident killer whales there and identify individuals known from the quirks of their fins and markings. By 2010, these data included records of 589 individuals, including 297 that had disappeared and were presumed dead.

Foster and colleagues then calculated how a mom's presence affected her offspring's likelihood of death. Losing a mother had the biggest effect on adult sons older than 30.

"The results of this study, if interpreted correctly, are quite surprising," says Craig Packer of the University of Minnesota, Twin Cities. A big benefit to sons would be remarkable, he says, but a much simpler explanation would be that sons had disappeared because they swam off somewhere else after their mothers died.

Wild no-sex reproduction

Free-slithering snakes sometimes give birth without first having sex, researchers have confirmed with genetic testing. Occasional no-sex reproduction has been seen in captivity among snakes, Komodo dragons and sharks. But until now there has been no conclusive evidence for wild virgin birth in species that normally reproduce sexually, says Warren Booth of the University of Tulsa in Oklahoma. Booth and his colleagues examined dozens of litters of wild-caught copperheads and cottonmouths. The team found one case in each species of a male baby born without littermates (such as the baby copperhead shown at left with his mother). Genetic testing found that these babies' maternal and what would be paternal DNA was identical at multiple locations, making the chances that a daddy snake actually was involved in the blessed event vanishingly small. The researchers report their findings online September 12 in *Biology Letters*. —*Susan Milius*

FROM TOP: DAVID ELLIFRIT/CENTER FOR WHALE RESEARCH; © CHARLES SMITH & PAM ESKRIDGE

122 years Age at death of oldest human with verified age

86 years Age at death of oldest captive elephant

90 years Typical life span of wild female killer whale

Too young for sex but not its scent

Larvae follow pheromones

By Susan Milius

Caterpillars way too immature for actual sex turn out to detect and take an interest in adult sex pheromones.

Caterpillars of the cotton leafworm moth (*Spodoptera littoralis*) don't have working sex organs. They're just long, black-green larvae eating as much as they can before transforming into the completely different body shape and lifestyle of an adult moth. Yet these caterpillars can sense, and appear to like, the adult sex pheromone of their species, an international team reports September 4 in *Nature Communications*.

"This is a funny fact because sex pheromones are supposed to be for sex," says coauthor Emmanuelle Jacquin-Joly of the French agricultural research agency INRA in Versailles. Adult female moths release puffs of these chemicals, and males catching a whiff — sometimes from considerable distances — sniff their way through the night to the female.

What means "come hither" to adult moths may indicate something different, perhaps "here's food," to a youngster, Jacquin-Joly and her colleagues propose.

She began looking for a cotton leafworm caterpillar pheromone response after another lab found that larval silkworms make the adult-style proteins required to capture molecules of adult sex pheromones from the air. Young silkworms didn't seem to use the information, but Jacquin-Joly wondered if young cotton leafworms might.

It turns out that cotton leafworm caterpillars also carry proteins that can latch on to adult sex pheromones of their species, Jacquin-Joly and her colleagues found. Also, caterpillars tended to crawl toward a whiff of pheromone and were more likely to investigate food if it smelled like sex pheromone.

Jacquin-Joly hypothesizes that adult females may scent their eggs or the plants where the eggs are laid with the pheromone. A newly hatched caterpillar thus might get a clue that the plant makes fine food.

One of the most exciting parts of this work, says insect molecular biologist Kevin Wanner of Montana State University, is its potential to lead to new tools in pest control. Sex pheromones have been helpful for luring adults to traps or baits, so he wonders if there will be ways to trick pesty youngsters, too. ■

Bees fast to find shortest route

Foragers solve traveling salesman problem by trial and error

By Rachel Ehrenberg

Bumblebees are anything but bumbling: The insects quickly figure out the optimal route for visiting five far-flung flowers, a computational task that even human brains find challenging.

That result suggests that an elaborate mental map isn't necessary to travel efficiently in unknown territory. Finding a way to mimic the bumblebee's navigation system may allow programmers to develop robots that adeptly maneuver through unfamiliar places.

The new study, published online September 20 in *PLOS Biology*, pulls together several lines of previous research into one grand experiment. After training bumblebees to associate artificial flowers with a reward, scientists from England and Australia arranged five fake blooms in a pentagon with sides 50 meters long. One at a time, bumblebees outfitted with a little radar antenna were released from the nest. The bumblebees' movements were tracked by radar, and motion-sensing cameras on the flowers recorded each visiting bee.

There are 120 possible routes that hit each flower once, but some are far more efficient than others. This presents a puzzle known as the traveling salesman problem: Given a set number of cities, determine the shortest travel route that takes the salesman to every city once. The bumblebees, without even knowing at the outset where the flowers were located, found an optimum path after trying only about 20 of the 120 different routes, cutting their flight distance from the first attempt to the last by about 80 percent.

ANDREW MARTIN

An experiment that outfitted bumblebees with radar antennas (shown) found that the insects quickly figure out the optimal route among five flowers.

A computer analysis of the bees' movements suggested that the insects were doing some quick comparing, says team member Mathieu Lihoreau, a behavioral ecologist at the University of Sydney. If a bee went from flower A to B and later went from flower A to C, it would compare those routes, adding the one that was shorter to its itinerary and abandoning longer paths.

"It's amazing that these little creatures are as flexible as they are and have evolved these solutions that make maximum use of these little brains they are carrying around," says behavioral biologist Fred Dyer of Michigan State University in East Lansing.

Body & Brain

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White matter withers with neglect

Mouse experiments illuminate plight of Romanian orphans

By Laura Sanders

Changes in the brains of mice isolated as young pups may help explain the profound behavioral problems of severely neglected children. The experiments suggest that neglect during a specific developmental period irreversibly stunts brain development, researchers report in the Sept. 14 *Science*.

Studies of Romanian orphans raised in bare-bones environments have found that many of these children display emotional and social problems. By studying mice isolated early in life, researchers led by Gabriel Corfas of Children's Hospital Boston and Harvard Medical School hoped to uncover how social deprivation can affect the developing brain.

After weaning, the mice were put into one of three environments: a deluxe suite enriched with fresh toys every other day and populated by familiar mice of similar ages, a standard cage holding four mice or a solitary cell.

After two weeks, mice in the deluxe suite and the regular cage showed no abnormalities. But isolated mice showed fewer signs of exploratory behavior and diminished working memory. The researchers also uncovered abnormal development in the brain's white matter, which helps nerve cells communicate.

In a brain region called the prefrontal cortex, isolated mice had less of a fatty insulating substance called myelin that wraps around nerve cells and helps carry their messages. The prefrontal cortex is thought to be crucial for high-level tasks like social interactions.

The two-week period after weaning was critical. If isolation happened three weeks after weaning, the mice didn't show these deficits. Nor could the isolation effects be reversed later by moving the isolated mice into a better situation.

"What I find fascinating is that this is the neurobiological counterpart of the behavioral changes," says pediatric neurologist Harry Chugani of Wayne State University in Detroit and Children's Hospital of Michigan.

Dengue vaccine trial disappoints

Shots protect against three virus subtypes, not fourth

By Nathan Seppa

The first large-scale test of a dengue fever vaccine has failed to consistently prevent the disease in children, researchers report online September 11 in the *Lancet*. The results leave scientists wondering how one form of the virus dodged what looked like a potent immunization regimen.

The vaccine made by Sanofi Pasteur provided respectable defense overall, protecting against three of four viral subtypes of dengue in 61 to 90 percent of vaccinated children. But the vaccine failed to fend off one subtype of dengue, serotype 2, which is common in the part of Thailand where the trial was conducted.

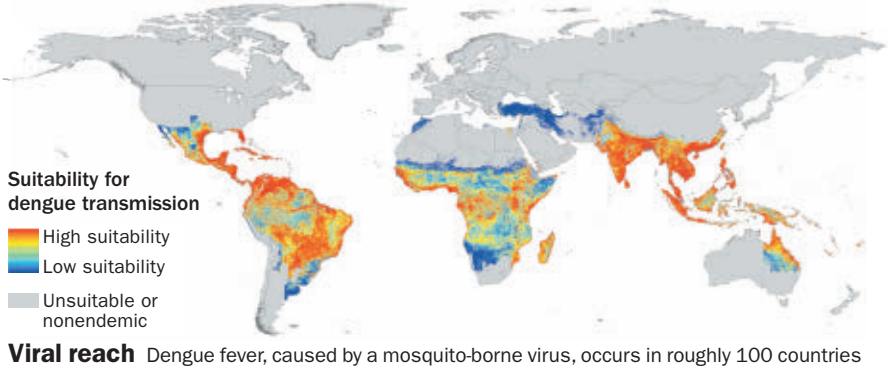
"This trial is a cautionary tale for investigators designing future dengue vaccine trials," Scott Halstead, a physician with the International Vaccine Institute in Seoul, Korea, wrote in a commentary in the same issue of the *Lancet*.

The vaccine had previously generated ample neutralizing antibodies in people, Halstead says. The version of dengue serotype 2 virus circulating in Thailand might have evaded these antibodies, he suggests, or the vaccine might have failed to generate balanced immune responses to all four subtypes of dengue.

The researchers enrolled 4,002 children ages 4 to 11 in the study. The kids were randomly assigned to get three shots spaced over one year — either three doses of the dengue vaccine or placebo shots. In all, 2,452 children got three shots and full follow-up tests, while 1,221 got the control shots.

The researchers diagnosed 134 dengue infections in all children in the study over two years. Dengue serotype 2 caused three-fifths of these infections.

Overall, 2.8 percent of the vaccinated children and 4.4 percent of the controls came down with dengue fever, a difference too small to establish a benefit. Five children contracted severe dengue — three who got the vaccine and two controls — but all recovered fully.



Viral reach Dengue fever, caused by a mosquito-borne virus, occurs in roughly 100 countries and is expanding its territory. This map shows regions that are potentially susceptible to dengue, based on 18 climatic and environmental variables such as temperature and available moisture.

C.P. SIMMONS *ET AL./NEJM* 2012

"This trial is a cautionary tale for investigators designing future dengue vaccine trials." — SCOTT HALSTEAD

Oral MS drug performs well

Medication similar to one now used against psoriasis

By Nathan Seppa

People with multiple sclerosis might soon have a new option for controlling their disease with pills instead of shots. Two studies in the Sept. 20 *New England Journal of Medicine* demonstrate that a variation on a drug used against psoriasis in Germany holds off MS relapses and has minimal side effects.

"Both studies show a reduction in relapses with really pretty robust effects," says Clyde Markowitz, a neurologist at the University of Pennsylvania who wasn't involved with the trials.

The drug, called BG-12, has been submitted to the U.S. Food and Drug Administration for approval by the biotech company Biogen Idec. If approved, BG-12 would be the third oral drug available to treat MS.

The disease results when the immune system attacks the fatty myelin sheaths coating nerves in the central nervous system, leading to impaired muscle control, balance, vision and speech. BG-12, or dimethyl fumarate, has anti-inflammatory, cell-protective and antioxidant effects, which earlier work suggested could suppress the aberrant immune reactions in people with MS.

Scientists in both studies recruited MS patients and randomly assigned them to BG-12 or placebo tablets. In one study, an additional group was randomly assigned to get an injectable MS drug called glatiramer acetate (Copaxone). In other respects the studies were nearly identical, each enrolling more than 1,000 patients, ages 18 to 55, in 28 countries apiece, for two years of treatment.

On average, patients getting BG-12 went between 72 weeks and more than 90 weeks before experiencing a relapse, compared with 30 and 38 weeks among those assigned a placebo in the two studies. Magnetic resonance imaging also revealed strikingly fewer lesions in the brains of patients who took BG-12 for two years than in those on placebos.

The results come at a heady time in MS research, with several drugs in testing and some others newly approved in the last decade. The most recent was the oral drug teriflunomide (Aubagio), which the FDA cleared on September 12. It joins another oral drug, fingolimod (Gilenya), which was approved in 2010. Two injectable cancer drugs have also shown promise against MS, and these or similar versions are awaiting FDA approval as MS drugs. For years, the standard treatment has been injectable anti-inflammatory interferon beta.

2.5 million

Estimated number of people worldwide living with MS

The oral drugs are more convenient to use than interferon and the other injectables, boosting patient compliance, says Robert Fox, a neurologist at the Cleveland Clinic who coauthored one of the new studies. The oral drugs also seem more effective at preventing relapses than the injected drugs, with the exception of a potent injectable called natalizumab (Tysabri). First approved in 2004, natalizumab stumbled on early reports of side effects and was pulled off shelves temporarily. It's been back on the market for six years, with warning labels.

"It is not clear at the moment how to advise patients about the new oral drugs, but the overall benefit-to-risk assessment, as of this month, may favor [BG-12]," says physician Allan Ropper of Brigham and Women's Hospital in Boston, writing in the same *New England Journal of Medicine* issue. "The two-decade safety record of fumarate in psoriasis lessens concern about long-term risk," he says.

NSAIDs tied to cardiac risk

Heart attack survivors on painkillers more likely to die

By Nathan Seppa

People who have survived a heart attack seem to increase their risk of having another one, or of dying, by taking common painkillers called NSAIDs, a popular class of drugs that includes ibuprofen.

The unsettling link between nonsteroidal anti-inflammatory drugs and heart attack risk is not new. The American Heart Association released guidelines in 2007 discouraging the use of any NSAIDs among people with a history of cardiovascular disease. Researchers in Denmark now bolster that link with the largest study to date of NSAID use in heart patients. The findings appeared online September 10 in *Circulation*.

The scientists mined a huge database to identify every first-time heart attack in people 30 years old or older that occurred in the country between 1997 and 2009, nearly 100,000 people in all. The researchers then cross-checked this information with death records, subsequent heart attacks and NSAID prescriptions. (Most NSAIDs in Denmark are prescribed.) About 44 percent of people were prescribed an NSAID during the five years following a first heart attack.

Compared with people who didn't get NSAIDs via prescription, those who did were 63 percent more likely to die over the next five years and 41 percent more likely to die specifically of a heart problem or to have another heart attack.

"This is the biggest study, no question, in terms of numbers and completeness," to address the NSAID/heart risk question, says Vibeke Strand, a rheumatologist at Stanford University School of Medicine.

Body & Brain

18,449 Lab-confirmed deaths from 2009 swine flu pandemic

575,400 Upper-bound estimate of all deaths from 2009 swine flu pandemic

Gamblers go all-in on Ritalin

Risk taking may rise when using stimulant for focus

By Laura Sanders

A dose of Ritalin makes healthy women more reckless in a gambling game. After taking the stimulant, participants in an experiment shifted their betting strategy and kept playing even when faced with stakes too high for most folks.

Though solid numbers are scarce, evidence suggests that many healthy people use methylphenidate (Ritalin) and other stimulants to boost mental capacity.

The new results, published in the Sept. 19 *Journal of Neuroscience*, suggest that the drugs might have unanticipated consequences for these people, says study coauthor Daniel Campbell-Meiklejohn of New York University.

Scientists have known that the very same drug has an opposite effect in people with attention-deficit/hyperactivity disorder and a kind of dementia, normalizing these people's risky behavior. Scientists can't yet explain Ritalin's divergent effects, but they suspect that variations in how the brain handles the chemical messenger dopamine may be involved.

Researchers in Denmark enlisted 40 healthy women to take either Ritalin or a placebo, and later play a gambling game. The game was rigged so players would quickly rack up a loss and then have to choose whether to double-down in the hopes of recovering their money.

The game was rigged so players would quickly rack up a loss and then have to choose whether to double-down.

When the stakes get too high, most people bow out and accept their loss. Women on the placebo behaved this way in the gambling game, which used fake money and awarded a real cash prize to the overall winner. But women who got Ritalin kept betting, even when the stakes reached 1,600 kroner, or about $280. These women seemed inured to the fear of losing a big pot of money.

More studies are needed to know exactly how Ritalin, which boosts levels of dopamine and another chemical called noradrenaline in the brain, influences risky behavior. Ritalin and similar drugs might shift people to be more focused on the potential reward at the expense of thinking about consequences. Or the drugs might impair a person's ability to recognize a risky situation or learn from a loss.

Other drugs, such as amphetamines and cocaine, that behave similarly to Ritalin in the brain might also increase aspects of risky behavior, says cognitive neuroscientist Trevor Robbins of the University of Cambridge in England. And these changed behaviors, which might include drug seeking and using, could promote addiction.

New swine flu could infect humans

Strain in Korean pigs potentially transmissible to people

By Tina Hesman Saey

Just a few genetic tweaks could turn an influenza virus found in pigs into the next pandemic threat in people.

At least one virus isolated from pigs in Korea may already have potential to cause disease in people, researchers report online September 10 in the *Proceedings of the National Academy of Sciences*. The virus caused severe flu in ferrets, a favored proxy for humans in flu research, and grew in human lung tissue.

Pigs are known to be genetic mixing vessels in which influenza viruses from birds, humans and pigs can swap genes. The resulting viruses, called triple reassortants, are a concern because adaptations arising in pigs may help the viruses spread in humans. A triple reassortant virus that originated in pigs caused the 2009 H1N1 pandemic (*SN Online: 4/27/09*).

Similar triple reassortant viruses have been found among Korean pig herds, so Robert Webster, a virologist at St. Jude Children's Research Hospital in Memphis, and his colleagues studied several strains for their pandemic potential. Only one, known as Sw/1204 (H1N2), made ferrets seriously ill. That virus picked up mutations in genes that help flu viruses break into and slip out of host cells.

Neither mutation has previously been associated with virulence, but both appear necessary for the virus to spread among ferrets. Flu viruses need to strike a balance between clinging tightly to host cells and cutting themselves free to infect other cells, Webster says.

Although the virus made ferrets sick in the new experiments and easily passed from ferret to ferret, there's no guarantee the virus would behave the same way in people, says biochemist James Paulson of the Scripps Research Institute in La Jolla, Calif. People don't seem to pass H1N2 flu viruses to one another, perhaps because human immune systems are accustomed to fighting flu viruses that contain similar components, Paulson says.

Still, spotting these flu virus mutations in pigs may be cause for concern, says Daniel Perez, a virologist at the University of Maryland, College Park. Researchers cannot predict how a flu virus will behave just by looking at its genetics, Perez says. So studies of flu virus transmission in ferrets could become early warning systems for potential pandemics.

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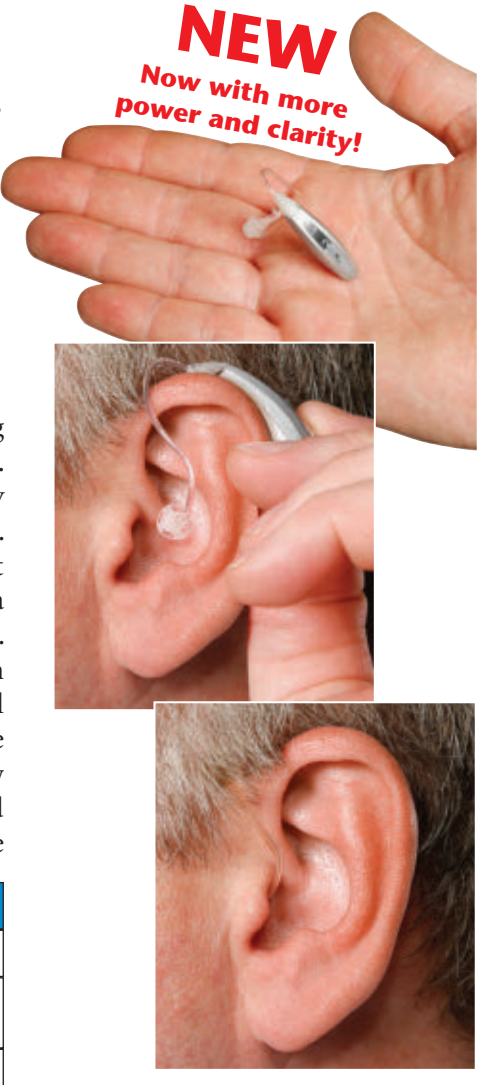

Over the years, technology has made the way we live easier, safer and more convenient. In many cases, it's even made many products more affordable… (remember how much the first VCR used to cost?). Unfortunately, the cost of hearing aids never seemed to come down. Now, a new alternative has been invented… it's called Perfect Choice HD™.

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Perfect Choice HD feature comparison

	Perfect Choice HD	Others
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Tests and Fittings Required	NO	Most
Affordable	YES	as much as $5000
Friendly Return Policy	**YES**	**Rarely**

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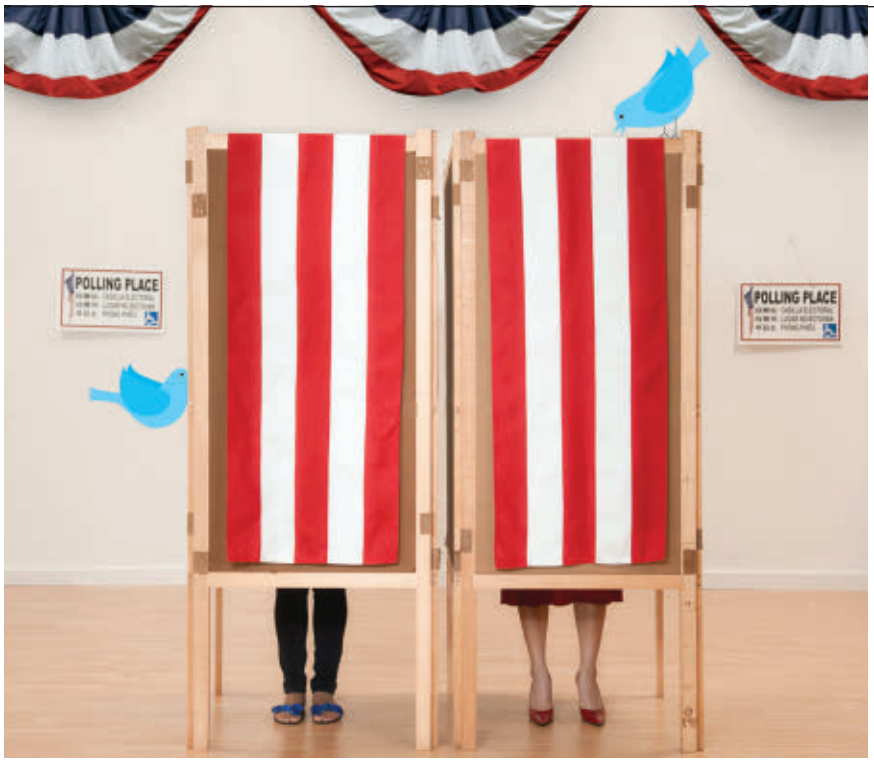


Social media sway

Worries over political misinformation on Twitter attract scientists' attention

By Rachel Ehrenberg

Four days before the 2010 special election in Massachusetts to fill the Senate seat formerly held by Ted Kennedy, an anonymous source delivered a blast of political spam. The smear campaign launched against Democratic candidate Martha Coakley quickly infiltrated the rest of the election-related chatter on the social networking service Twitter. Detonating over just 138 minutes, the "Twitter bomb" and the rancorous claims it brought with it eventually reached tens of thousands of people.

It's impossible to say whether the bomb left shrapnel that influenced the outcome of the heated race (Republican candidate Scott Brown overtook Coakley in the campaign's final days). But the bomb did signal an end to the political left's dominance of social media. Twitter, which allows people to broadcast short online messages called "tweets," has become a prominent player in the digital toolbox employed on both sides of the aisle. Campaigns and their supporters use the platform to spread messages, connect with like-minded people and garner votes. But along with shared news and engaging discussions come lies, propaganda and spin.

Though the strategic spread of misinformation is as old as elections themselves, the Internet Age has changed the game. Back before social media, the origins of political messages were less muddied. A man yelling on a soapbox looked like a man on a soapbox. Ads were ads. Most other material intended for wide consumption was vetted by journalists before it reached the masses. There were rumors and slander, of course, but those messages didn't get around so quickly.

Today venues such as Twitter offer a direct route for delivering a message to a large target audience, often with little context for evaluating the message's veracity.

"Social media are a very effective and efficient way to spread false beliefs," says political scientist Brendan Nyhan of Dartmouth College.

As pundits, journalists and citizens traverse the still-evolving social media landscape, scientists are doing the same. Using tools from linguistics, computer science and network science, these researchers are uncovering the digital calling cards of spin. Amid all the genuine discourse, teams are turning up speech dressed in truthful clothing squawked by impersonators, whether a single citizen with an agenda or a well-oiled political machine. While some may dismiss online misinformation as political graffiti that has no serious effect, others are concerned that it could change behavior at the voting booth.

Enough people are certainly paying attention. About 90 million Americans use Twitter in a typical month. Other social media sites are also well-populated: Estimates suggest that half of all Americans are on Facebook. And more than 5 million people in the United States spend part of their day on the blogging platform Tumblr.

While a hefty number of voters are on these platforms, no outlet is so mainstream that everybody uses it. The splintered nature of the social media landscape means misinformation often flies under the radar of the fact-checking apparatus employed by the traditional mass media, says Kathleen Hall Jamieson, director of the Annenberg Public Policy Center at the University of Pennsylvania.

"The danger is, correction channels aren't sitting inside that universe," Jamieson says. "And people may vote for, or elect someone — or not vote — based on misinformation."

Dirty digital tricks

The Coakley bomb, uncovered by computer scientists Eni Mustafaraj and Panagiotis Metaxas in the weeks after the 2010 special election, was cutting edge for its day.

PHOTO: HILL STREET STUDIOS; BIRDS: E. FELICIANO; BUNTING: DNY59/ISTOCKPHOTO

Back in 2006, the year Twitter was born, the going dirty digital political trick was to game Web search engines, says Mustafaraj, of Wellesley College in Massachusetts. During the 2006 midterm congressional elections, for example, the left-leaning group My Direct Democracy tried to manipulate search results to boost the prominence of negative stories about Republican incumbents. Through 2006, searching "miserable failure" on Google brought up President George W. Bush's website.

By the 2008 congressional elections, such tactics became largely ineffective thanks to Google tweaking its search algorithms. An analysis by Mustafaraj and Metaxas found that during those elections, the top five Google results for queries about candidates consistently yielded the candidates' official websites, their campaign websites and their Wikipedia entries. (Today, the first result of a Google search for "miserable failure" yields the Wikipedia entry defining "Google bomb.")

There were a few exceptions. For the Republican 2008 senatorial candidate for Louisiana, some search results were still negative. A later analysis by Mustafaraj and Metaxas, presented at an MIT workshop last June, pinned the prominence of one of the pages on manipulation by liberal bloggers. But for the most part gaming search engines is a thing of the past.

Today, political noisemakers can direct an audience to websites through social media platforms. Such was the case with the Coakley Twitter bomb.

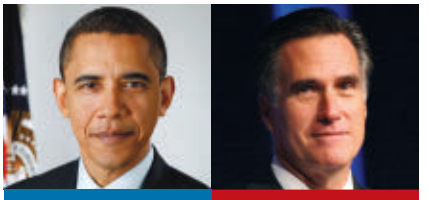
Using Twitter's application programming interface, which allows researchers to collect and examine tweets, Mustafaraj and Metaxas hunted for news about the special election. In the days surrounding the election, they collected more than 234,697 tweets that contained the words "Coakley" or "Scott Brown." Among tweets containing links to websites, a disproportionate number directed readers to "coakleysaidit.com." This website, which appeared in 1,112 tweets, urged people to sign an online petition protesting Coakley's "discrimination" against various groups.

Then the team discovered that the tweets containing the coakleysaidit.com link came from nine similarly named Twitter accounts created in a 13-minute interval on January 15, four days before the election (account names included @CoakleySaidWhat, @CoakleySaidThat, @CoakleyAgainstU, @CoakleyAndU). Further research revealed that the coakleysaidit.com site was also created on January 15. On that day, over the course of 138 minutes, the nine Twitter accounts sent 929 tweets to 573 individuals. Those individuals passed along the messages ("retweeted") to others, potentially reaching more than 60,000 people.

Twitter data doesn't necessarily reveal a tweeter's location or actual name, and the Wellesley scientists couldn't pin the bomb on any single person. But well after the election, they discovered that the website was registered to the American Future Fund. This Iowa-based Republican-leaning group is known for its connection to the campaign against 2004 presidential nominee John Kerry that led to the term "swift boating," now synonymous with smearing a politician with an untrue or unfair claim.

The Coakley Twitter bomb was an early case of what Filippo Menczer, a specialist in complex networks and Web data mining, calls "astroturfing." To the untrained eye, a surge in vitriol against a candidate can appear to be a grassroots outcry, growing naturally from constituent concern or discontent. But in actuality, it's machine-made artificial grass, or AstroTurf. Astroturfing campaigns (which are prohibited by Twitter policies) can give the impression that a discussion is truly representative of what a lot of people are thinking, Menczer says. This could prompt people to change their minds at the polls, he says, or to not vote.

Following the candidates Social media has quickly become a staple in election campaigns. Below are some definitions and a comparison of how the 2012 presidential candidates stack up on Twitter.

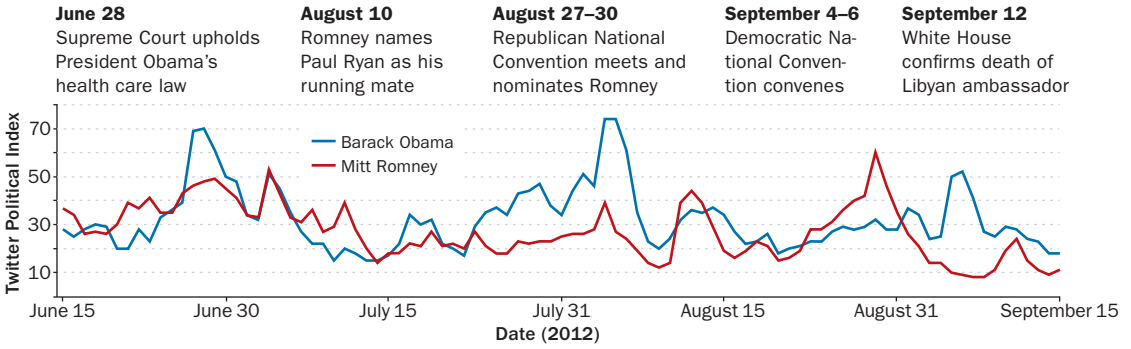


Barack Obama	Mitt Romney	
@BarackObama	@MittRomney	Username, or Twitter handle
6,455 tweets	1,193 tweets	Number of 140-character messages broadcast on Twitter
20,377,790 followers	1,216,137 followers	Number of people who subscribe to candidate's tweets
672,285 following	269 following	Number of people whose updates the candidates are subscribed to

SOURCE: TWITTER.COM, DATA TAKEN 10/2/12

Next-gen polling A website called the Twitter Political Index, or Twindex, offers a daily appraisal of the sentiment surrounding each candidate on Twitter. The site's algorithm analyzes the content of three days' worth of tweets and then compares results with that day's tweets about the candidates.

SOURCE: ELECTION.TWITTER.COM



CLOCKWISE FROM TOP LEFT: © 2008 PETE SOUZA; GAGE SKIDMORE/WIKIMEDIA COMMONS; E. FELICIANO

Truthy tracks deceit

Menczer, of Indiana University Bloomington, heard about the Twitter bomb research at the 2010 Web Science Conference in Raleigh, N.C. He figured there were probably many more instances of such social media skullduggery, so he began a project to track the spread of ideas and phrases on Twitter.

Called "Truthy," the project captures thousands of tweets per hour and searches for tweets associated with particular topics by looking for hashtags (the # symbol) embedded in the 140-character-or-less messages. When placed in front of a word or phrase on Twitter, the # sign tags the tweet as having a particular relevance. For example, #tcot identifies tweets referencing "top conservatives on Twitter." The researchers (and anyone who goes to the Truthy site) can also search for a particular phrase or tweets sent by, sent to or sent about a particular tweeter, as indicated by the @ that appears as part of an account's username, as in @BarackObama.

With network analysis techniques that diagram relationships among tweeters, those who follow them (that is, receive their tweets) and those who choose to retweet messages, Menczer and his colleagues can trace where messages originate and how they travel. Tools from linguistics that evaluate words and phrases also allow a rough gauge of the political partisanship and the positive or negative sentiment surrounding a topic or tweeter.

Via the Truthy system, the researchers have uncovered several examples of astroturfing. Leading up to the 2010 midterm elections, for example, two suspicious accounts were created within 10 minutes of each other. @PeaceKaren_25 generated more than 10,000 tweets in a few months, almost all of which included positive messages about Republican candidates. The other, @HopeMarie_25, retweeted all the tweets generated by @PeaceKaren_25 but never created any original tweets. Neither account revealed its creator's identity, and both have since been shut down, says Menczer, who presented an update on the Truthy system in Vancouver at a February meeting of the American Association for the Advancement of Science.

Menczer argues that generating Web traffic about a candidate or political platform lends credibility to the message, whether it is true or not. Tweets by prolific and influential tweeters may come up in search engine results, further suggesting that the messages are part of a widespread discussion.

And efforts to correct misinformation frequently fail. Evidence suggests that corrections on Twitter don't always have the same wings as an original false claim.

"Misinformation can win out, even with a correction," says Jamieson of the Annenberg Public Policy Center, which runs a nonpartisan website called FactCheck.org that aims to call out inaccurate, misleading or false claims by politicians. "It depends on the frequency of the correction compared to the frequency of the misinformation."

Menczer suspects that the accounts @PeaceKaren_25 and @HopeMarie_25 were "bots" designed to send out spam. These spam spreaders may be automated accounts, or duplicate accounts run by the same person or, by some definitions, any account that is intended to mislead. Spam bots, political or otherwise, are prohibited by Twitter, which has its own algorithms that monitor for such deceit. This type of monitoring includes looking for accounts that tweet misleading links. Other efforts focus on how people react to the account — how many people have blocked it, for example.

After Republican presidential candidate Mitt Romney's Twitter account acquired 141,000 followers in two days in July, many suspected the new followers were fake. Devin Gaffney and Alexander Furnas, then at the University of Oxford's Internet Institute in England, decided to investigate the followers by looking at the followers' followers.

"A lot of the existing ways to detect cheaters focus on the actors themselves," Gaffney says. "We're asking, how do people react to this account?"

The approach leveraged a version of Alan Turing's famous test for artificial intelligence: Do other people find Romney's followers believable as human beings? After comparing a random sample of accounts that follow Romney's followers with those of similarly sized Twitter accounts, Romney's followers looked especially fishy. Of the followers of the randomly sampled accounts, about 10 percent had fewer than two followers. Yet nearly 27 percent of Romney's newly acquired followers had just one or zero followers.

"No one follows them," says Gaffney, who with Furnas describes the analysis in a piece in *The Atlantic*. "Clearly, they don't pass the Turing test."

Political bomb After the 2010 special election in Massachusetts, scientists discovered nine similarly named Twitter accounts created within minutes of each other on January 15 (below), four days before the election. In a little over two hours, the suspicious accounts sent out 929 tweets.

Accounts created for spam attack

Account Name	Time created (1/15/10)	No. of tweets
@CoakleySaidWhat	18:43:46	28
@CoakleyWhat	18:44:55	127
@CoakleySaidThat	18:46:12	125
@CoakleyAgainstU	18:48:21	127
@CoakleyCatholic	18:50:22	127
@CoakleyER	18:52:05	127
@CoakleyAG	18:53:17	32
@CoakleyMass	18:54:31	109
@CoakleyAndU	18:56:02	127

Tweets from spamming accounts
Links in the suspicious tweets (examples below) sent readers to an online petition against Democratic candidate Martha Coakley, created the same day as the suspicious Twitter accounts.

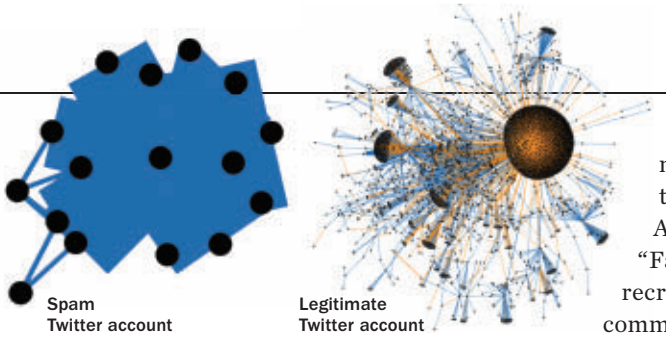
AG Coakley thinks Catholics shouldn't be in the ER, take action now! bit.ly/8gDSp5

Tell AG Coakley not to discriminate against Catholics in medicine! bit.ly/8gDSp5

Catholics can practice medicine too! Tell AG Coakley today. bit.ly/7yXbTd

Sign the petition to AG Coakley today. We won't tolerate discrimination of any kind! bit.ly/8gDSp5

SOURCE: P.T. METAXAS AND E. MUSTAFARAJ/2010



Moving messages
A diagram reveals a classic spam network (left), in which one account (center dot) promotes a website and other spam accounts collude in its spread. The pattern differs for mentions and tweets by a legitimate account, @sarahpalinusa (right).

While some speculate the Romney followers were created to make him appear more popular, others suggest that they were designed to make him look like a buffoon who has to buy Twitter followers — which is also against Twitter's rules.

Bots in charge

Going forward, fake accounts may become harder to detect. There are new levels of sophistication, says Tim Hwang of the San Francisco–based Pacific Social Architecting Corp.

Hwang should know; he's been developing virtual robots that are so real that they can change the shape of a social network, creating ties between people who weren't previously connected.

Last year, Hwang and his colleagues at the Web Ecology Project organized a competition to see who could build the best network-influencing social robots. Three teams had two weeks to write the code — the "brains" behind the bots — and then the bots had to infiltrate a network of 500 Twitter users. Each bot received one point for each target user that ended up following it and three points for each tweet sent by a target user that mentioned the bot. A team lost 15 points if its bot was recognized and shut down. By the end of the two-week competition, the creators of "James M. Titus" had won, with 107 followers and 198 mentions, for a total of 701 points.

Research suggests that by 2015, about 10 percent of a given person's social online network will be masquerading bots, presumably not obvious spam bots, but the social kind. Hwang and colleagues Ian Pearce and Max Nanis now create bots for clients they will not name. Instead of just having fake accounts pepper people with tweets, the PacSocial bots have sleep-wake cycles so they appear more real. Some bots have built-in databases of current events, so they can piece together phrases that seem relevant.

Marketing products with these bots is an obvious task: Nanis describes a social bot that might post a Twitter picture of the African savanna with the tweet "this Nikon camera really was the best choice! Loving my trip."

Bots that create chatter to try to sway elections are another obvious choice. Whether such bots will be detectable — by Twitter or by researchers monitoring the service — remains to be seen.

Because of the difficulty in correcting misinformation once it is out there, researchers are now trying to track rumors as they develop, rather than after they've fully infiltrated the Twittersphere. With the help of a $2 million grant from DARPA, Menczer and others are building the machinery and algorithms to do real-time detection on large-scale datasets.

Dartmouth's Nyhan is also working with colleagues including information scientist Paul Resnick of the University of Michigan in Ann Arbor on a project called "Fact Spreaders" that aims to recruit people in social networking communities to help spread accurate information to counter false claims.

It's hard to estimate the effect that ongoing digital discussions — true or false — could have on elections. In a recent study, Facebook users were more likely to go to the polls when they saw a message including pictures and names of friends who had voted (see Page 12).

Figuring out what type of information from whom wields the most power and when may help scientists beat misinformation to the punch. Swaying power could be most effective in influencing smaller elections, for which people don't necessarily have a lot of exposure to candidates' platforms.

"I don't expect a given rumor about a presidential candidate to dramatically influence the outcome of an election," Nyhan says. "But false claims crowd out the more informed and fact-based debate we could be having," he says. "It pollutes the political debate of our democracy."

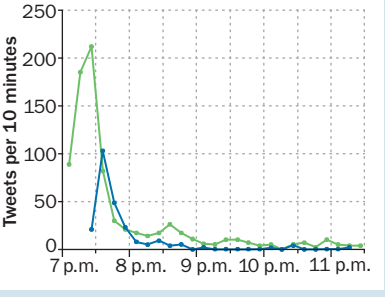
Explore more

- Truthy research at Indiana University: truthy.indiana.edu

False news travels fast

Misinformation can spread quickly through social media, but corrections may not travel as far or fast. Last November, two days after Occupy Wall Street protesters were evicted from Zucotti Park in New York City, the local NBC station sent out a tweet that the New York Police Department was closing air space above the protests, a message quickly retweeted by others. A few minutes later, NYPD tweeted that the information was incorrect. While NBC immediately sent out corrections, an analysis by Gilad Lotan of the social analytics company SocialFlow reveals that the correction (blue) wasn't tweeted as much as the incorrect claim (green).

Spread of @NBCNews/@NBCNewYork tweets, November 17, 2011



FROM TOP: TRUTHY PROJECT/INDIANA UNIV.; G. LOTAN/SOCIALFLOW

SCENT into action

Rodent responses to a whiff of predator may offer clues to instinct in the brain

By Meghan Rosen

David Ferrero wasn't expecting the jaguar to pounce. When he approached the holding pens at Massachusetts' Stone Zoo, the big cat watched but looked relaxed, lounging on her cage's concrete floor. Two other jaguars rested in separate cages nearby.

The jaguars usually prowled outside, in the grassy grounds of the zoo's enclosure. But this afternoon, zookeepers kept the animals inside so that Ferrero and a colleague could grab a behind-the-scenes peek. Here, the jaguars slept at night — and fed. Here, only metal bars stood between the humans and the cats.

As Ferrero stepped closer to the cages, the watchful female sprang up, twisting her body toward him, front paws thumping the bars. Fully extended, she

SASCHA BURKARD/SHUTTERSTOCK

In mice, a sniff of certain odors can trigger instinctual responses related to defense and mating.

was as tall as Ferrero.

"I think she wanted to eat me," he says. The zookeepers weren't afraid, but Ferrero flinched. He wasn't familiar with the lean, black-spotted feline. He was just there to pick up some pee.

Ferrero, a neurobiologist from Harvard, was visiting the zoo to gather urine specimens for a study linking odors to instinctual behavior in rodents. Early lab results had hinted that a whiff of a chemical in carnivore pee flashed a sort of billboard message, blinking "DANGER" in neon lights — enough to make animals automatically shrink away in fear.

Ferrero and Harvard neurobiologist Stephen Liberles are among a cadre of researchers trying to understand the basis of instinctual animal behaviors. In the last few years, scientists have made progress by studying smell — unmasking the molecular identities of behavior-triggering odors and charting these odors' routes to the brain. One early stop, a sensory structure known to spur mice into action when they encounter odors from other mice, can actually rev the rodents up when they run into cats or rats, too.

In fact, studies have shown that odors from different species can spark varying patterns of neural activity in mice. And new evidence from researchers including Ferrero and Liberles suggests behavior-triggering odors don't always travel to the brain in the way scientists once thought.

Recent research has even revived interest in the once-ridiculed idea that humans also respond instinctually to odors from other humans — though some scientists still think the idea is kooky. No matter who has it right, the new work may hold clues to the brain areas responsible for complex behavior in people.

"We used to think it was beyond the reach of what we could study," says neurobiologist Lisa Stowers of the Scripps Research Institute in La Jolla, Calif. "There was just too much going on in the brain."

Human heads are big, complicated and tricky to access, so researchers are zeroing in on rodent brains instead.

Slaves to scent

The world is a dark place for rodents. The skittish animals wait till night to scavenge for food, and hide out in shadows during the day. A life spent evading light means little use for vision. Mice are nearsighted and nearly color-blind. Their beady eyes glimpse only a barebones version of the rainbow: a dishwater copy of what humans see, tinted mostly gray and yellow.

> "The fear response is one of these ancient things...so important to survival."
> LISA STOWERS

To survive, rodents depend almost entirely on their sense of smell. A mouse can gather almost everything it needs to know about the world from odors. Even clues about a potential girlfriend.

A quick sniff of a new love interest is better than stalking her on Facebook. In an instant, the snooper can find out if his crush is sick, pregnant or if she's had a stressful day. Mice use this information to make decisions about potential partners. But this decision making isn't exactly a well-thought-out process. Some smells trigger behaviors that are automatic.

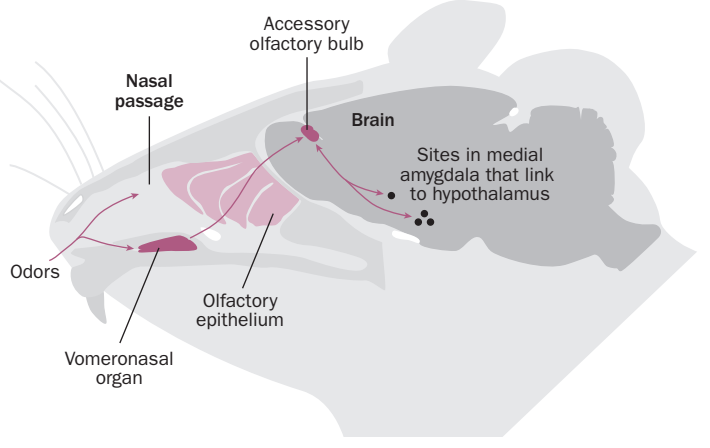
That mice are slaves to scents is good news for researchers. "They're the perfect animal for us to study," Stowers says. Their olfactory systems tap into areas of the brain that jump-start behavior.

Researchers have found, for example, a compound in tears that fast-forwards the dating process in mice. When a female nuzzles up against a teary male, something in her brain just clicks — she relaxes into a mating position, allowing the male to mount.

And odors don't just spark attraction; they can trigger aggression, too. In mouse urine, Stowers' team has found ingredients that spur male-on-male violence. The molecules identified are enough to send male mice into kicking, biting, tail-rattling bouts of rage.

Many of these instinctual behaviors are launched when an odor hits a clump of sensory tissue called the vomeronasal organ, or VNO. The clump — which fits in a bony pocket above the roof of a mouse's mouth — is smaller than a grain of rice and filled with sticky mucus. When mice bury their noses in fur, tears or pee, the mucus picks up odor particles and the VNO delivers neon-lit messages — SEX or FIGHT — to brain regions that guide behavior. Traditionally, scientists labeled mammalian VNOs as control centers for pheromones, odors that spark preprogrammed behaviors among members of the same species.

Building on behavioral studies performed long ago in reptiles, Stowers wanted to find out if mouse VNOs also sensed messages traded between differ-



Sniff driven When inhaled molecules activate nerve cells in the mouse's vomeronasal organ, the signals travel to the accessory olfactory bulb in the brain, then on to sites that connect to the hypothalamus and mediate fear, attraction and aggression. Recent studies also implicate the olfactory epithelium in smell-triggered behaviors.

SOURCE: P. CHAMERO *ET AL*/ *TRENDS IN NEUROSCIENCES* 2012

T. DUBÉ

ent species — and if so, how. In particular, she was interested in odor signals from predators that switch on fear behaviors.

"The fear response is one of these ancient things. If you look in any animal, you can recognize it," Stowers says. Pulses quicken, stress hormones soar and either muscles freeze or animals flee. "These behaviors are so important to survival."

Hunters and gardeners have long known that prey animals steer clear of predator odors. (Outdoor enthusiasts can even order such rodent repellents online: Predatorpee.com sells bobcat, coyote and fox urine.) What scientists didn't know was how the scents responsible for these instinctual interspecies responses tip off the brain.

To find out, Stowers and her colleagues delved into the bodily secretions of cats and rats.

The smell of fear

If you're looking for large volumes of cat saliva, the best place to go is the dentist. The cat dentist, that is.

"It turns out that when vets clean cat teeth, they suction off the saliva," Stowers says. She and her team already had a hint that cat saliva turned mice into trembling balls of fur. To find the spit molecule that prompted the fear reaction, the researchers had to get their hands on spoonfuls of drool from vets. "We would just show up, and they'd hand us milliliters," she says.

Sniffing a noseful of the saliva sent mice sprinting in the opposite direction and set off a behavior known as "stretch-attend." Mice get up on their tiptoes, point noses toward the odor, stretch tails back straight behind them and cautiously sniff to see if the scary scent is still around.

"A relaxed mouse doesn't do that," Stowers says.

Spit from cats and pee from rats drove mouse stress levels up and switched on neural activity. The chemical culprits — major urinary proteins, or MUPs — are similar to an aggression-sparking urine ingredient that mice make themselves, Stowers and colleagues reported in *Cell* in 2010. Mice without a working VNO were fearless in the face of cat and rat MUPs. The VNO, Stowers' team concluded, must be what's letting mice cue into the scents other species.

"What's really remarkable is that our mice haven't been around a predator since the 1930s," Stowers says. "They've never experienced these olfactory cues before; their grandmothers and great-grandmothers didn't even experience them." Because the mice have been bred in labs for hundreds of generations, any odor-triggered behavior has to be hardwired in the brain's circuitry.

Stowers' molecule should help pry open the door to how the brain converts scent into action. "It allows us to know a little something about how these behaviors work," she says, "and to hope that we can learn something more."

Scientists already have a rough sketch of an odor's path from nose to brain. They know that the hardware of a mouse's sense of smell includes more than 1,000 kinds of scent receptors, of which about 300 reside in the VNO. Like molecular antennas, the receptors sit at the surface of the nose's nerve cells and tune in to smelly signals. The VNO's neurons stretch up inside the mouse's head and hook up with cells deep in regions of the brain that ignite aggression, attraction or fear. By singling out specific instinct-triggering compounds, such as MUPs, scientists can start to paint a more intricate picture.

Last year, researchers filled in some new details by tackling the problem a little differently. Instead of teasing apart individual odor ingredients, a team at Harvard tapped the entire odor package. Ferret bedding, alligator droppings, insect larvae: Molecular neuroscientists Catherine Dulac, Yoh Isogai and colleagues wanted a species's whole scent caboodle.

Foul patterns

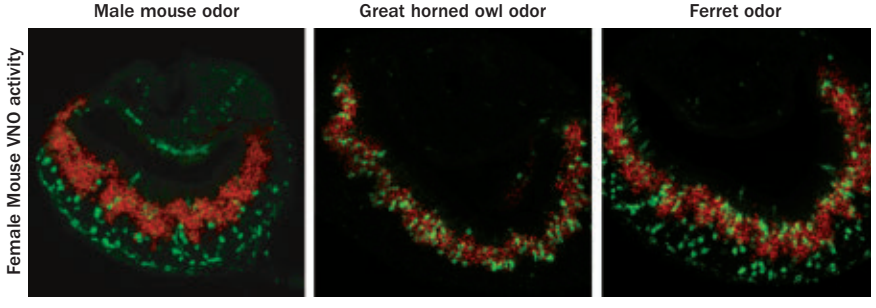
The ferrets smelled the worst, Isogai says. He remembers one afternoon on the subway, riding back from a lab at Tufts University with a backpack full of ferret bedding. The paper liner held all sorts of smelly leftovers: urine and feces and fur. And though he had wrapped the bedding well — in three layers of Ziploc bags — the foul odor still seeped from his pack. "Bedding's great because it's got lots of scents," he says, "but I was scared people would ask why I was so stinky!"

Isogai and Dulac, a Howard Hughes Medical Institute investigator, suspected mice might use their scent receptors to discern predators.

The researchers let mice sniff 29 different odor cues. Then, the team immediately sliced up the mouse VNOs and used colored tags to pinpoint scent receptors that had been hit. Depending on the odor mice sniffed, different scent receptors switched on. The patterns matched up with different organisms, and the combinations overlapped for odors from similar species — as if mice could specifically tune in to snakes or birds or mammals.

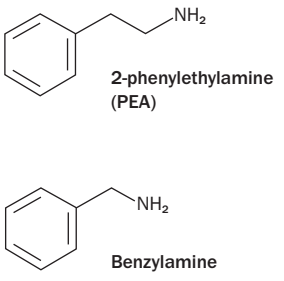
Of the 88 scent receptors identified in

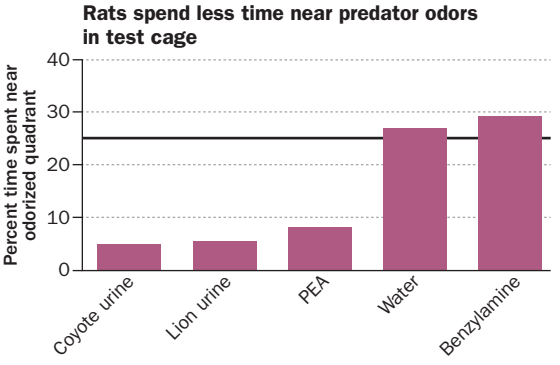
Distinguishing odor On a molecular level, mice respond to chemical cues from other mice differently than they do to cues from other species, especially potential predators. In the vomeronasal organ, cells with specific sensor molecules (red) detect an odor molecule and switch on (green) in response. The pattern of a female mouse reacting to a male mouse (left) looks distinct from a female mouse responding to an owl or a ferret, suggesting a way to distinguish between threats.



Y. ISOGAI *ET AL*./*NATURE* 2011

Carnivore stench The molecule 2-phenylethylamine, or PEA, has proved potent in eliciting defensive behaviors in rodents. The molecule is detected by the olfactory epithelium, which also mediates smell-triggered behaviors. PEA is more common in the urine of predators than herbivores (right) and is structurally similar to another molecule, benzylamine, that triggers no response in rats. In an avoidance test, PEA was almost as repellant to rats as lion urine (middle).





SOURCE: D. FERRERO *ET AL*/*PNAS* 2011

PEA levels in carnivores (pink), herbivores and omnivores

Animal	Amount of PEA in urine (micromolar)
Lion	340.1
Serval	306.7
Coyote	10.0
Cat	3.0
Mouse	1.2
Rat	0.9
Deer	0.4
Ferret	0.3
Human	0.1
Rabbit	<0.1
Pig	<0.1
Zebra	<0.1

the study, 71 responded to odors from animals other than mice, Dulac's team reported in *Nature* last year. "The sheer number of these receptors was surprising," she says.

In retrospect, Dulac says, the mouse's receptor collection seems pretty logical. "You probably don't need a lot of receptors to detect a mouse, but you might need a lot to detect and identify as many predators as possible." Now, the researchers can track scents' signals as they move from the VNO on through the brain's circuitry, and can ask questions about different behaviors. "What brain areas are involved? What do they make out of the different signals?" she says.

A human route

Though the VNO has been the olfactory celebrity of pheromone research, scent studies by Ferrero and Liberles suggest this special clump of sensory tissue isn't the only part of the mouse's equipment that triggers hard-wired behaviors in response to scents. In the last few years, scientists have shown that rodents' main olfactory epithelium — a folded sheet of cells that lines the nasal cavity — can provoke instinctual responses as well.

The folded sheet picks up a fear-triggering chemical from fox scent glands, for example, that the VNO misses. And when Ferrero, Liberles and colleagues tested pee from jaguars and other predators, the team found a new rodent-repelling odor ingredient, 2-phenylethylamine, that probably also hits the nasal cell sheet rather than the VNO.

Liberles and Ferrero's team found the odor ingredient at high levels in 18 out of 19 carnivore species tested, including African wildcats such as lions and servals. In fact, the stuff was more than 3,000 times stronger in these meat-eating predators than in pee from plant-eating animals such as zebras and elk, Liberles and colleagues reported last year in the *Proceedings of the National Academy of Sciences*.

The findings suggest that rodents may respond instinctually to predators like cats via the nasal cell sheet, as well as the VNO. Having a few built-in ways to detect smells from dangerous predators is kind of like having multiple smoke detectors: If one fails, the clamor from the others still jolts muscles into action.

Unlike most animals, humans don't have a working VNO. Humans do, however, have an able olfactory epithelium, a sensory-rich sheet covering about 3 percent of the nasal cavity. Though that's not much compared with 50 percent in rats, it's still enough for a decent sense of smell.

Recent data supporting the idea that the nasal sheet might drive odor-triggered behaviors "has sort of rejuvenated the idea" that humans respond instinctually to other humans' odors, Liberles says. And there are interesting hints: Last year, for example, researchers from Israel reported that sniffing women's tears curbed men's sexual desire. Overall, however, evidence for pheromone signaling in humans is weak. "But," Liberles jokes, "I don't know what Axe body spray has in their personal chemical collection."

Some evidence does exist, however, for other human instincts. Though people don't "stretch-attend" when they sniff a big cat at the zoo, they do tend to wrinkle their noses at the sulfurous odor of a rotten egg. And certain scary sights, like a slithering snake, can spark fear behaviors. What's more, because humans and mice have similar centers in the brain controlling aggression, attraction and fear, scientists think they may be able to apply what they've learned in mice to better understand human actions. The neural circuitry and the ultimate outcomes — FREEZE or RUN — are alike.

How sensory cues intertwine with people's everyday conscious decisions can help shape more complex behaviors. And, for now, rodents might be the best route to understanding these behaviors. After all, it's hard to find graduate students willing to get close with jaguars. ■

Explore more

- Pablo Chamero *et al*. "From genes to social communication: molecular sensing by the vomeronasal organ." *Trends in Neurosciences*. October 2012.
- To hear Catherine Dulac talk about pheromones, visit: www.mcb.harvard.edu/mcb/video/listing/

Spillover: Animal Infections and the Next Human Pandemic

David Quammen

Quammen's book has a touch of the big, sweeping suspense novel about it. The next scary new microbe (think the SARS or Ebola viruses) most likely lurks in some animal, waiting to spill over to people. And human behavior, explosively populating the planet and pushing into remote landscapes, is speeding the arrival of the next outbreak. Serious stuff, but writer Quammen mixes gentle explications of disease ecology with deft storytelling.

There's drama: An accidental needle prick lands a researcher in the U.S. Army's Fort Detrick quarantine "slammer" for weeks as her husband and three-year-old son wait to see if she'll die of Ebola. A tourist returning from Africa self-diagnoses via the Internet.

And there are characters. A former chef-trainee and furniture restorer switches to the academic study of bat diseases. A field biologist surveys the wildlife in forests in Central Africa by hiking through them for 2,000 miles.

Some of the diseases Quammen discusses have already gotten a lot of press, but he digs up lesser-known details. When he talks to Ebola researchers, they rail against sensationalized public expectations of liquefying organs and tears of blood.

As he worked on the book, Quammen writes, people would ask him, "Are we all gonna die?" Yes, he answers, but probably from something more mundane than a new virus.

There are doomsday scenarios, though. An ecologist studying nucleopolyhedrovirus in gypsy moths (which really does liquefy organs) shows that although the virus isn't likely to jump to people, its outbreaks show how particular disease dynamics can exterminate a population. Predicting such a catastrophe nevertheless remains a matter of much suspense. —*Susan Milius*

W.W. Norton & Co., 2012, 587 p., $28.95

Are We Getting Smarter? Rising IQ in the Twenty-First Century

James R. Flynn

IQ scores have risen dramatically over the last few generations. Flynn, a psychologist who discovered this trend 25 years ago, takes a provocative look at what escalating scores mean for the death penalty, racial differences in IQ and other controversial social issues.

Flynn begins by reviewing IQ rises in developed countries. An average Dutch person in 1982, for instance, scored as a near genius relative to the Dutch of 1952. Formal schooling and more complex cultures sparked IQ inflation, Flynn says. Gains occurred largely on test items that gauge the ability to classify things using scientific terms, such as listing dogs and rabbits as mammals, and to use logic to solve hypothetical problems, such as determining how a sequence of abstract shapes will play out.

So people today are smarter than those in the past at dealing with complex, abstract problems, Flynn says. Perhaps modern societies have nurtured an analytical intelligence that contrasts with a past emphasis on practical smarts, he suggests.

As for IQ differences, Flynn criticizes psychologists for ignoring social forces as a shaper of intelligence along with genes and brains. For example, the role of some childhood exposures in observed racial differences in IQ scores has attracted almost no research.

Flynn's book sometimes gets bogged down in details and cross-national data crunching. But he remains one of the most original thinkers in IQ testing. —*Bruce Bower*

Cambridge Univ., 2012, 310 p., $22

Ordering Life

Kristin Johnson

Karl Jordan's innovative methods of classifying insect species are highlighted in this biography of the early 20th century entomologist. *Johns Hopkins Univ., 2012, 376 p., $39.95*

The Secrets of Triangles

Alfred Posamentier and Ingmar Lehmann

This guide to the surprising properties of a fundamental shape sheds light on geometric principles. *Prometheus Books, 2012, 387 p., $26*

Dreamland

David K. Randall

A journalist with unusual sleep habits seeks to learn why we slumber and how sleeping — or not — affects thoughts, behavior and health. *W.W. Norton & Co., 2012, 290 p., $25.95*

Overpotential

Matthew N. Eisler

This history of fuel cell research considers why engineers keep trying, and failing, to produce a commercially viable technology. *Rutgers Univ., 2012, 260 p., $49.95*

This Is Improbable

Marc Abrahams

The founder of the Ig Nobel Prizes rounds up strange studies, such as one on the best way to slice a ham sandwich. *Oneworld Publications, 2012, 320 p., $15.95*

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Consider numbers

I have been a faithful subscriber to *Science News* for a long time, since I subscribed for my kids in the 1960s. I don't have a degree but was a naval aviator for 32 years. I just cannot get used to converting kilometers per hour to miles per hour each time I encounter astronomical rates of speed in your articles. My flight career in the U.S. Navy began from helicopters, through patrol planes, then F-4B Phantom jets. Everything was in knots, nautical miles and Mach number. During combat tours in Vietnam we got used to kilometers, but miles and miles per hour never left us. Your use of kilometers per hour causes me to stop and convert.
Joe R. Brewer, Pensacola, Fla.

Please excuse me for being pedantic, but ponder what information is conveyed by "observed lithium levels are three or four times lower than Big Bang physics predicts" ("Lithium mystery could get deeper," *SN: 9/8/12, p. 14*). One time lower means zero. Three or four times lower mean negative quantities of lithium, which are nonsense. Fractions are best conveyed by terms indicating division, such as *one-third*. If all else fails, *percent of* works. Please join this old crank in efforts to run goofy number rendition out of fashion.
Brent G. Boving, Northville, Mich.

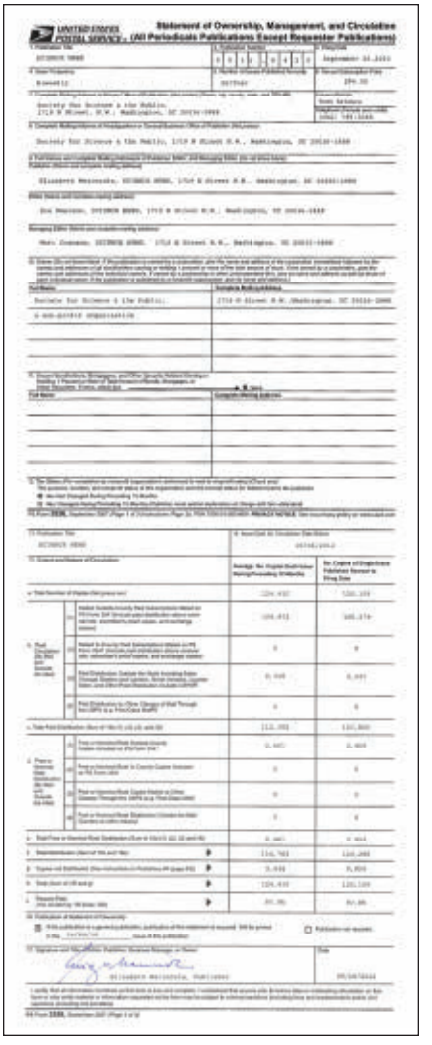
The reader is correct. Former Editor in Chief Tom Siegfried was known to stomp into a writer's or editor's office and demand a mathematical explanation (which of course could not be produced) upon catching a "times lower than" error. We regret letting one slip through. —Eds.

Peaceful prehistory

In "Mideast violence goes way back" (*SN: 8/25/12, p. 16*), archaeologist Augusta McMahon is quoted as saying "Prehistory was not peaceful." When looking back only 6,000 years she is clearly correct, but human history goes back a bit more than that. My reading is that human history prior to 14,000 years or so was quite peaceful. The question is what happened to make us so aggressive, competitive and violent?
Jim Tierney, Auburn, Maine

There's little evidence regarding ancient rates of violence one way or the other. New research on modern hunter-gatherers in Papua New Guinea suggests that historically, violence decreased with the transition from small-scale groups to state societies ("In New Guinea, peace comes with a price," SN Online 9/27/12). —Bruce Bower

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



The Science Life

To watch a video of Wayne Maddison hunting new spider species, visit **www.sciencenews.org/lorax**

The recently named *Lapsias lorax* spider got its name from the Dr. Seuss character with a yellow mustache.

Spider man fell for jumpers

At age 13, Wayne Maddison spied the metallic-green jaws of a spider marooned on a raft of vegetation floating on Lake Ontario. He rescued the young creature, and ultimately made a pet of her and one of her young. Along the way, he fell in love with their family — jumping spiders. That intense affection has never waned. Forty years later, Maddison, now scientific codirector of the Beaty Biodiversity Museum in Vancouver, is among the foremost authorities on these stealthy pouncers of the arachnid world.

Last year, Maddison tallied some 175 distinct jumping spider species as he trekked through rainforests in Borneo's state of Sarawak. The year before he collected a unique individual in the cloud forests west of Quito, Ecuador, and recently he asked Canadians to submit potential names for this new species of the genus *Lapsias*. The winning entry: lorax, for the Dr. Seuss character that not only speaks for the trees but also sports a yellow mustache, just like the face of the 5-millimeter-long male spider that can leap an astounding 7.6 centimeters (about three inches).

Maddison made videos of the critter before preserving it in alcohol for DNA analysis.

"It walked strangely," he says, "although you have to be a jumping spider geek to appreciate this." Spiders perambulate using a combination of muscles and hydraulics: They straighten their legs by pumping blood into them, allowing the spiders to take jerky steps. But a few species are able to pump blood so efficiently that they exhibit a slow, fluid motion. The newfound *L. lorax* is one of these exceptions. "So when you watch it walk, it's as if he's a little bit drunk," Maddison observes.

Maddison says he studies spiders primarily to probe their evolutionary history, but he considers it equally important to archive species for colleagues to view centuries from now. "It's like we're constructing a time machine so that we can send specimens into the future — to a time when such species no longer exist."

— Janet Raloff

Wayne Maddison examines a tiny but venomous snake caught along with spiders shaken from tree branches. Snakes are one hazard Maddison faces in the tropics, along with leeches, wasps and more.

COURTESY W. MADDISON/BEATY MUSEUM

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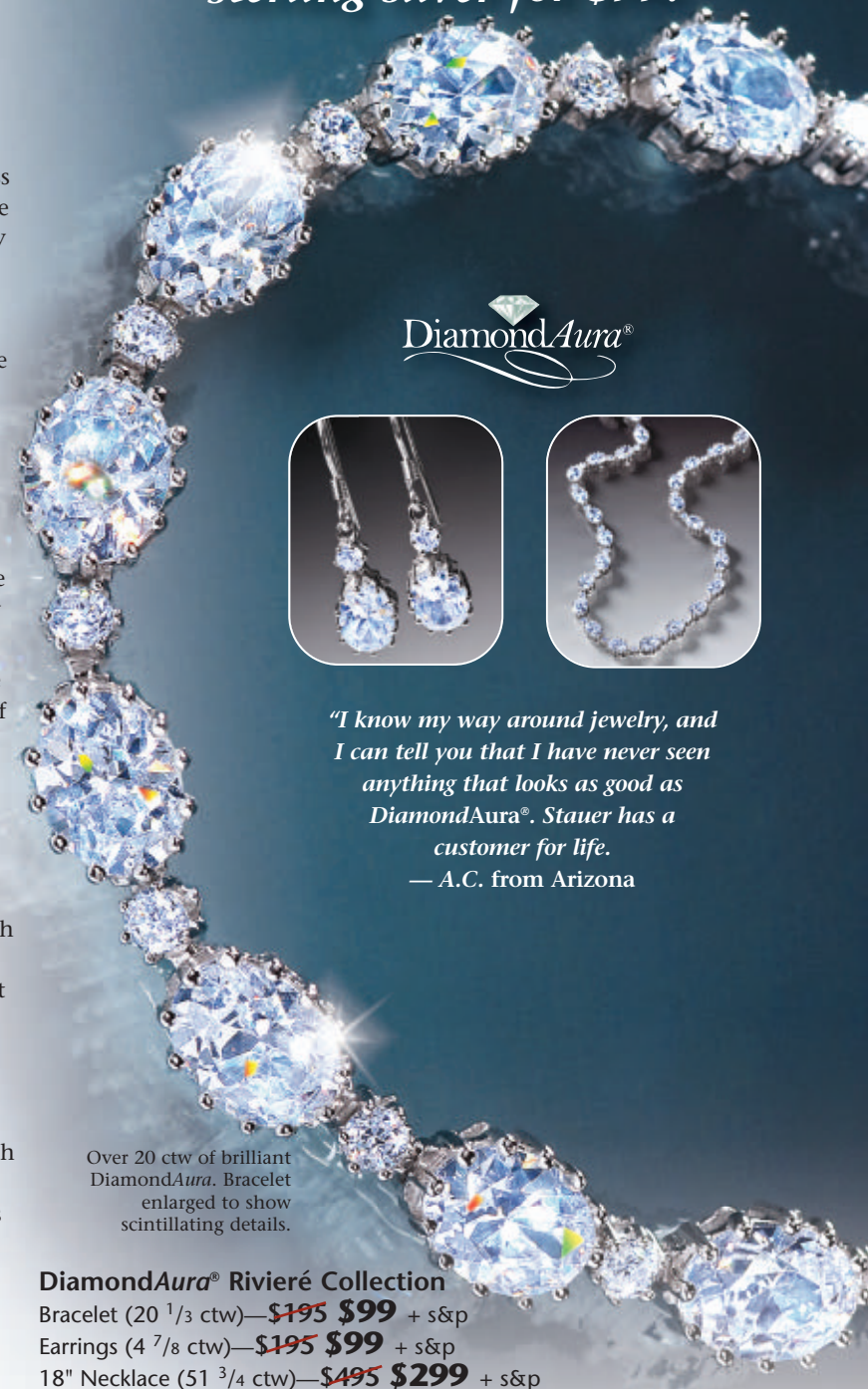

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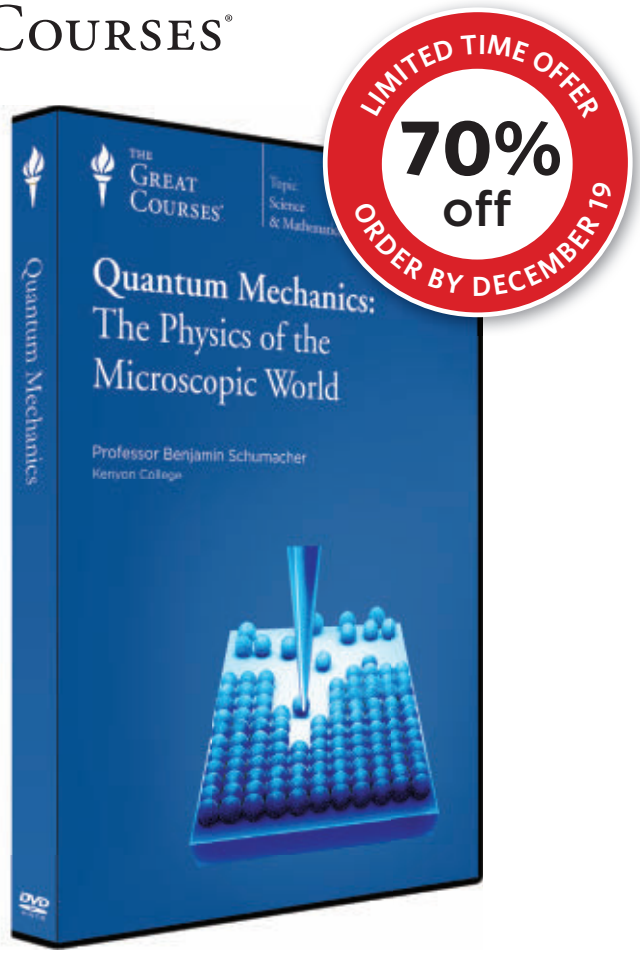

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