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BRIEFINGS

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change of e-mail addresses:

U.S. and Canada: 800-333-1199

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Postal address: *Scientific American Briefings*, Box
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EVOLUTION

Oldest ant lover
found entombed

INSECTS THAT embed themselves in ant colonies have existed for nearly as long as their hosts, and some have evolved rapidly, probably in response to ant diversification. Joseph Parker at Columbia University and David Grimaldi from the American Museum of Natural History, both in New York, conclude that a 52-million-year-old beetle found entombed in amber (pictured) is the earliest known example of a myrmecophile — species that depend on ants for their survival. The newly identified species, *Proto-claviger trichodens*, is an extinct ancestor of contemporary rove beetles and has features such as hairs to deliver tasty secretions to worker ants. It existed just as ant populations were starting to rise in tropical rainforests.

In another myrmecophile study, Wendy Moore and James Robertson at the University of Arizona in Tucson used DNA sequences to examine the evolutionary relationships of ant-nest beetles (*Paussus* spp). They found that the beetles are some of the fastest evolving animals on Earth. For example, the common ancestor of the 86 species that are native to Madagascar existed just 2.6 million years ago.

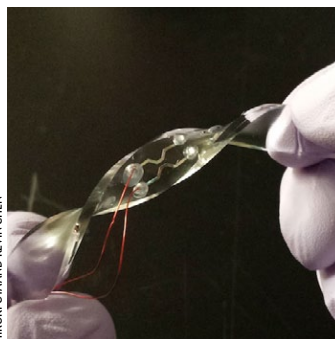
—Ewen Callaway, [Nature](#)

- [Curr Biol. doi:10.1016/j.cub.2014.08.068 \(2014\)](#)
- [Curr Biol. doi:10.1016/j.cub.2014.09.022 \(2014\)](#)

ELECTRONICS

Fluid-based
sensor bends
and twists

ELECTRONIC SENSORS made using liquids can outperform



The fluid-based electronic sensor.

other flexible devices that have solid components.

Most sensors rely on solid metals that form junctions. To render such devices flexible, Ali Javey of the University of California, Berkeley, and his colleagues developed a way to make a junction between two different fluids that does not allow them to mix.

For the junction, the team fabricated a series of microchannels, each about 30 micrometers wide, which are designed to let in only one of the fluids — an ionic liquid. The other fluid, the commercial liquid metal Galinstan, has too much surface tension to enter the channels.

The sensors could detect humidity, oxygen and temperature; the temperature sensor was 17–46 times more sensitive than flexible alternatives made with solid components. The device could be useful in prostheses, robotics and smart wallpapers, the authors say.

—Mark Zastrow, [Nature](#)

- [Nature Commun. doi:10.1038/ncomms6032 \(2014\)](#)

GENOMICS

Hundreds of
genes for height

ONE OF the largest-ever genome-wide association studies has identified 697 genetic variants for human height — several hundred more than a previous, smaller study.

Peter Visscher of the University of Queensland in Brisbane, Australia, and a team of hundreds of scientists analyzed the combined results of 79 genome-wide association studies, encompassing 253,288 people, and found that the common gene variants account for 16% of the genetic contribution to height. Many of the variants lie near genes in biochemical pathways associated with skeletal growth, and others were linked to genes that were not previously thought to be growth-related.



The authors suggest that tens of thousands of common genetic variants together influence height, and that bigger genome-wide association studies including hundreds of thousands of people will continue to provide useful biological information.

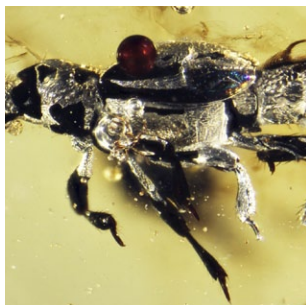
—Erika Check Hayden, [Nature](#)

- [Nature Genet. doi:10.1038/ng.3097 \(2014\)](#)

POLYMER CHAINS

The power of
two

THE MACHINERY of living organisms is founded on the ability of biomacromolecules to fold and coil. Recently, scientists have begun to explore the possibility of creating artificial systems from synthetic polymers that can fold in a predictable manner. Although nanoparticles have been created by folding linear polymers, it remains challenging to



ON THE COVER

A 52-million-year-old beetle found entombed in amber is the earliest known example of a species that depend on ants for its survival. See page 2.

SOURCE: Joseph Parker and David A. Grimaldi

make polymer particles that are comprised of multiple, foldable domains. Raj Kumar Koy and Jean-François Lutz at the Institut Charles Sadron in Strasbourg have now synthesized polymer nanoparticles in which two polymer subdomains fold independently of each other.

The researchers start by devising a foldable single-chain polymeric sequence that contains two chemically distinct parts separated by a polystyrene spacer. Both chemically active sections contain variations of an *N*-substituted maleimide that can undergo intramolecular crosslinking, but in one of the two domains, the maleimide is initially protected by a triisopropylsilyl group. To synthesize the folded nanoparticle, the researchers first induce intramolecular crosslinking in one domain. They then deprotect the second domain, which allows it to undergo intramolecular crosslinking and form nanoparticles with two distinct subdomains.

—Alberto Moscatelli,
[Nature Nanotechnology](#)

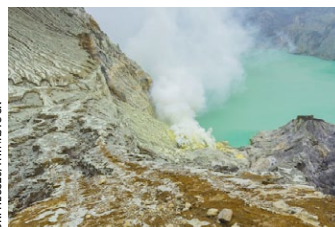
■ [J Am Chem Soc. doi: 10.1021/ja507889x \(2014\)](#)

GEOPHYSICS

Mid-depth
quakes are risky
too

EARTHQUAKES THAT originate at intermediate depths are an underappreciated seismic risk, according to a study of a June 2014 earthquake in the western Aleutian Islands off Alaska.

The epicenter of the magnitude-7.9 quake was approximately 100 kilometers deep, making the quake the largest in this depth range — between about 70 and 200 km down — in the past century. Thorne Lay of the University of California, Santa Cruz, and his colleagues



Kawah Ijen Volcano in East Java, Indonesia.

analyzed the earthquake and found that the energy release was weak at first but became strong during its final 25 seconds.

Other regions with a similar tectonic structure, such as Japan and Indonesia, should be aware of how big and powerful intermediate-depth quakes can be, the authors warn.

—Alexandra Witze, [Nature](#)

■ [Geophys Res Lett. doi: 10.1002/2014GL061153 \(2014\)](#)

CLIMATE CHANGE

Ocean warming
underestimated

RECENT ESTIMATES of global temperature rises in the upper ocean may have been too low.

Oceans absorb the majority of the heat resulting from global warming. Paul Durack of the Lawrence Livermore National Laboratory in California and his colleagues used a range of climate models and satellite obser-



Warming seas are rising seas.

vations to reassess observed changes in ocean warming between 1970 and 2004. They concluded that upper-ocean warming has been underestimated by as much as 58%, mainly because of sparse data from oceans in the Southern Hemisphere.

A separate study by William Llovel and his colleagues at NASA's Jet Propulsion Laboratory in Pasadena, California, showed that the ocean's upper 2,000 meters have strongly warmed since 2005. However, at depths below 2,000 meters, the ocean has absorbed negligible amounts of heat during this period.

These two studies have implications for accurately assessing the effects of climate change on sea-level rise.

—Emily Banham, [Nature](#)

■ [Nature Clim Change. doi: 10.1038/nclimate2389 \(2014\)](#)
[Nature Clim Change. doi: 10.1038/nclimate2387 \(2014\)](#)

NEUROSCIENCE

How curiosity
enhances
learning

CURIOSITY BOOSTS people's ability to learn and retain new information, thanks to key reward and memory centers in the brain.

Matthias Gruber and his colleagues at the University of California, Davis asked volunteers to rate their level of curiosity for a series of trivia questions, and then scanned their brains as they saw the questions and waited for the answers.

For questions that they were curious about, participants remembered answers better than for questions in which they were less interested. Brain scans showed increased activity during this learning in regions that respond to reward and regulate



CHRISTIAN NER/THINKSTOCK

memory formation, and revealed heightened connectivity between the two regions.

The volunteers were shown unrelated faces while they waited for the trivia answers, and were better at learning those faces when their curiosity was aroused. This suggests that curiosity also helps with the learning of incidental information.

—Corie Lok, [Nature](#)

■ [Neuron](#). doi: 10.1016/j.neuron.2014.08.060 (2014)

CLIMATE SCIENCE

Plant growth leads to Arctic warming

INCREASED CARBON dioxide in the atmosphere is known to boost vegetation cover at high latitudes — and this could accelerate Arctic warming year-round.

Grasses and shrubs have a warming effect because plant-covered areas reflect less sunlight than barren surfaces do. Baek-Min Kim at the Korea Polar Research Institute in Incheon,

South Korea, Sang-Yoon Jun at the Korea Institute of Atmospheric Prediction Systems in Seoul and their colleagues used a climate model to study the impact of doubled CO₂ concentrations and increased high-latitude plant growth on Arctic temperatures.

They found that increased vegetation in summer warms the surface and this heat moves to the Arctic, where it causes additional ocean warming and sea-ice melting in winter and spring. The exposed ocean then releases more heat, leading to a further boost in Arctic warming and promoting even more plant growth the following season, the team says.

—Quirin Schiermeier, [Nature](#)

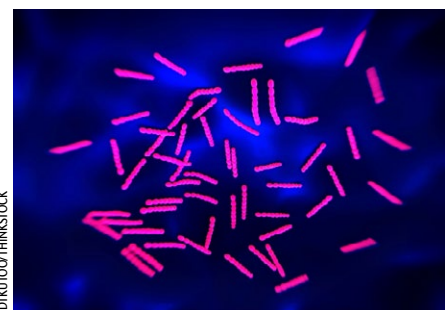
■ [Environ Res Lett](#). doi: 10.1088/1748-9326/9/9/094007 (2014)

MICROBIAL GENETICS

Gene switch helps bacteria invade

A BACTERIUM that causes pneumonia and other ailments can switch between six different forms by rearranging key genes, allowing the microbe to alter its ability to infect.

Streptococcus pneumoniae lives harmlessly in the nose but can cause serious infections in some people. Michael Jennings at Griffith University in Southport, Australia, Marco Oggioni at the University of Leicester, UK, and their co-workers focused on a specific set of genes comprising a system called SpnD39III in a strain of *S. pneumoniae*. They found that rearrangements of these genes result in six distinct bacterial subpopulations, each with its own pattern of methyl groups on DNA, which modify gene expression.



DTKUTOOTH/THINKSTOCK

S. pneumoniae.

The subpopulations caused infections of varying severity in mice.

The finding suggests how this pathogen can quickly adapt to changing environments, such as when it shifts from harmless colonization to invasive disease.

—Corie Lok, [Nature](#)

■ [Nature Commun](#). doi: 10.1038/ncomms6055 (2014)

SCIENCE COMMUNICATION

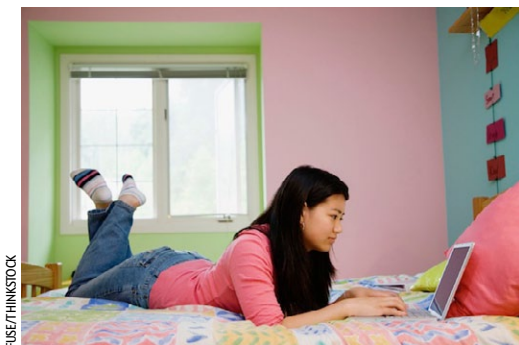
Blogging benefits students

SUCCESSFUL SCIENCE careers are based on more than just a foundation in the subject — they require effective communication, leadership and teamwork skills. To improve the ability of graduates to communicate complex topics to technical and non-technical audiences, writing and presentation courses, as well as workshops on communication skills, have been implemented in graduate and undergraduate programs. In line with such efforts, Robert Hamers and colleagues now show that blogging can increase students' confidence in writing and improve their ability to communicate technical topics effectively to general audiences.

The researchers — who are based at the Center for Sustainable Nanotechnology, a National Science Foundation Center for Chemical Innovation that involves five universities and a national lab — created a



TOLKONOV/THINKSTOCK



ROSE/THINKSTOCK

multi-author blog to enhance the communication skills of its students, and to increase the interest and improve the knowledge of the public on the science related to sustainability and nanotechnology. Students were free to write on sustainability or nanotechnology topics based on their own work or that of a collaborator. At the start of the project, students were given a seminar on content guidelines, editorial workflow and social networking promotion strategies. To address the students' concerns over the lack of ideas, experience and time, a Center staff member acted as a blog editor. Students proposed ideas to the editor, who then coached them and edited drafts of the blog posts before publication.

After nine months, surveys from focus groups found that students felt that the editorial and peer editing process was useful and that the experience boosted their confidence in writing.

—*Ai Lin Chun,*
[Nature Nanotechnology](#)

■ [J Chem Educ. doi: 10.1021/ed500050d \(2014\)](#)

ORGANIC SEMICONDUCTORS

Solving the nuclear issue

CONDENSED-MATTER PHYSICISTS often perform experiments at low temperatures to minimize the undesired effects

of thermal excitation. Yet, if the phenomenon being studied has potential practical applications, it can also be important to know what happens at high temperatures. Hans Malissa and colleagues at the University of Utah, the University of Queensland and the University of Regensburg have now studied the effect of nuclear spin excitations in organic light-emitting diodes (OLEDs) at room temperature; these experiments are particularly challenging because at room temperature the nuclear spin excitation is one million times smaller than the thermal energy.

The effects of external magnetic fields on the conductivity of organic semiconductors have previously been attributed to the hyperfine interaction between the nuclear and the electron spins. Malissa and colleagues confirmed this prediction with two types of experiment. In the first, they used a technique known as electron spin-echo envelope modulation to study OLEDs made of the polymer MEH-PPV, and monitored the way in which the current evolves after the electron spin has been excited by a microwave pulse. In particular, they measured a signal modulated by a frequency typical of the hydrogen nuclear spin in the polymer. By replacing hydrogen with deuterium in the polymer the modulation frequency changed accordingly, illustrating that the interaction of the electron spin and the nuclear spin affects the current in these materials.

A more direct confirmation of the effect of the hyperfine interaction came from the second experiment. Here, the researchers used a technique known as electron–nuclear double resonance, in which the current is measured after excitation of the hydrogen nuclear



LEE J. SIEGEL, UNIVERSITY OF UTAH

University of Utah physicist Christoph Boehme works in his laboratory on an apparatus used in a new study that brings physics a step closer to spintronic devices.

spin with a radiofrequency pulse. Again, a clear modulation of the current was observed.

—*Fabio Pulizzi,*
[Nature Nanotechnology](#)

■ [Science. doi: 10.1126/science.1255624 \(2014\)](#)

ACUTE KIDNEY INJURY

Kidney injury and burnt sugarcane harvesting

AN ENDEMIC of chronic kidney disease—termed ‘Mesoamerican nephropathy’—has been identified among young and previously healthy plantation workers in Central America. The etiology of Mesoamerican nephropathy is unknown, but is thought to involve repeated episodes of daily dehydration and hypovolemia associated with rhabdomyolysis. A new study of renal function among harvesters of burnt sugarcane in Brazil shows that acute changes in markers of kidney function occur over the course of a harvesting day. “Our findings support the hypothesis that repeated episodes of dehydration is a possible causative factor in Mesoamerican nephropathy,” says lead author Ubiratan Paula Santos.

To evaluate the acute effects of a typical harvesting day, Paula Santos and colleagues from the University of São Paulo Medical

School, Brazil, collected blood and urine samples before and after a daily work shift in the last month of the harvesting season. “The typical harvesting day is carried out under insalubrious conditions, with extremely physical work, high temperatures and exposure to pollutants,” explains Paula Santos.



HYWIT DINAADI/THINKSTOCK

At the beginning of the harvesting season, all 28 participants were considered to be healthy, with no sign of systemic or renal disease. In the last month of the harvesting season, however, all participants experienced an increase in serum creatinine level and a decrease in estimated glomerular filtration rate (eGFR) over the course of the working day (pre-shift versus post-shift values: 70.7 ± 8.8 $\mu\text{mol/l}$ versus 93.70 ± 1.68 $\mu\text{mol/l}$ [$P < 0.001$] for serum creatinine and 120 ± 9.0 ml/min/1.73 m^2 versus 100 ± 15.0 ml/min/1.73 m^2 [$P < 0.001$] for eGFR as measured by CKD-EPI). “In 19% of workers, the increase in serum creatinine level was consistent with a diagnosis of acute kidney injury,” notes Paula Santos. The researchers also recorded evidence of muscle injury and bursts of systemic inflammation.

Paula Santos and colleagues have already started a new project, with a greater number of participants, to assess urinary

biomarkers for kidney injury. “Future results may help us understand the mechanisms of this type of kidney injury and help to establish preventative interventions,” he concludes.

—Susan J. Allison, [Nature Reviews Nephrology](#)

■ [Kidney Int. doi: 10.1038/ki.2014.306 \(2014\)](#)

ECOLOGY

Marine brown algae may inhibit HIV infection

AQUEOUS EXTRACTS of marine brown algae (*Lobophora variegata*) can inhibit the replication of human immunodeficiency virus type 1 (HIV-1) by preventing its entry into host cells, a research team has revealed.

The algae extracts inhibit various HIV-1 strains – including a multi-drug resistant strain – that cause infection by binding to different cell-surface proteins of host cells. This could mean the brown algae is a potential natural source for developing a broad-spectrum anti-HIV-1 drug, suggests the research published in *PLOS ONE*.

L. variegata is a common brown alga that thrives in the coral reefs of the Caribbean, the Indian Ocean and the Red Sea. It contains high concentrations of phenolic compounds, mainly bromophenols, and no previous studies had identified its antiviral effects.

“Our study is the first to demonstrate the anti-viral effects of *L. variegata* and thus contributes to the extraordinary bioactive spectrum of this abundant marine brown alga,” says Stephan Kremb, one of the authors of the study, a marine biologist from the King Abdullah University of Science and Technology (KAUST), Saudi Arabia, and Institute of Virology,

Helmholtz Zentrum Muenchen, Germany.

The scientists exposed aqueous extracts of the brown algae to various patient-derived HIV-1 strains grown in peripheral blood mononuclear cells prepared from the whole blood of healthy donors. The algae extracts were non-toxic and inhibited the replication of the HIV-1 strains in the cells.

To understand how the algae extracts inhibit the virus, the researchers added fluorescent-protein-labelled HIV-1 particles and specific indicator cells to the algae extracts. They found that the algae extracts prevented the attachment of the HIV-1 particles to the cells, suggesting it inhibits HIV-1 entry into the cells.

Current HIV drugs work by preventing the binding of HIV-1 viruses to cell-surface proteins of host cells. “In contrast, the algae extracts seem to directly interact with the viral particles by targeting their membranes,” says Kremb.

Kremb says that this anti-HIV-1 action of the brown algae extracts is different from the inhibitory effects of the experimental anti-HIV-1 drug Griffithsin, which has been isolated from the marine red alga *Griffithsia*.

Kanji Hori from the Laboratory of Marine Bio-resource Chemistry of Hiroshima University, Japan, says marine algae such as the *L. variegata* are rich in polyphenols which may have non-specifically attached to viral proteins, contributing to the anti-HIV-1 activities of the algae extracts. However, with current analytical techniques, it is difficult to pin down specific algae polyphenols with anti-HIV activities, suggesting that further innovative structural analyses are needed to identify any potential lead compounds with anti-HIV-1 activity, he adds.

—Biplab Das, [Nature Middle East](#)

■ [PLOS ONE. doi: 10.1371/journal.pone.0103895 \(2014\)](#)

AGRICULTURE

Drought destroyed ancient civilizations

ARCHAEOLOGICAL EVIDENCE

suggests prolonged droughts may have caused the fall of civilizations in the Fertile Crescent region thousands of years ago.

Researchers analyzed stable carbon isotopes in ancient barley grains from archaeological sites spanning between 10,000 and 500 BC in the region and found signs of several droughts that may have afflicted agricultural settlements there.

“There may be some textual evidence saying the inhabitants of these sites were involved in a war with another city-state. But with the data on their agricultural background, we can more precisely define the parameters that led to either collapse or resilience of societies,” says Simone Riehl from the University of Tübingen, Germany, who led the research.

Riehl and her colleagues analyzed the ratio values of stable carbon isotopes in barley grains from 33 archaeological and 13 modern sites that humans occupied at various periods. The ratio values of the carbon isotopes reflect times of reduced water availability and signal evidence of drought stress.

The researchers found severe drought stress signals in barley grains extracted from the archaeological sites lying along the banks

of Euphrates and Khabur rivers in addition to sites in northwestern and western Syria between 2,500 and 1,600 years ago.

Faced with drought, local people grew grains using river-derived irrigation or cultivating grains that grew without irrigation.

The results provide clues to how agricultural societies performed under fluctuating climatic conditions, which has implications for risk assessment in regions of endangered food security today, he adds.

The study, according to Ellery Frahm from the University of Minnesota, US, provides “a new, millennia-spanning foundation for research that explores links between environment and society.”

The drought stress, around 4,000 years ago, at Tell Mozan and other human settlements in Syria may have forced humans to abandon urban centers, eventually leading to the fall of the Akkadian empire, adds Frahm.

The findings by Riehl and her colleagues published in *PNAS* suggest that the historic climatic changes in the region forced people to invent new strategies to maintain agriculture and their economies. This may help better understand the ongoing crisis in war-torn Syria that was hit by a severe drought between 2007 and 2010.

—Biplab Das,

[Nature Middle East](#)

■ [Proc Natl Acad Sci USA. doi: 10.1073/pnas.1409516111 \(2014\)](#)

MIGRAINE

Midlife migraines could lead to late-life parkinsonism

PEOPLE WHO have migraine in middle age could be at increased risk of developing Parkinson dis-



CHRISTOPHER ROBBINS/THINKSTOCK

ease (PD) or parkinsonian symptoms later in life, according to a longitudinal study comprising 5,620 adults from Reykjavik, Iceland.

“Because previous studies have linked migraine with aura to increased risk of stroke, there has been growing interest in whether migraine might be linked with other neurological symptoms,” explains Ann Scher, the lead author of the study. “To our knowledge, this is the first study to link migraine with parkinsonism or PD in the general population.”

Study participants were interviewed about migraine symptoms in middle age (mean 51 years). About 25 years later, the same participants were interviewed about whether they had been diagnosed with PD, experienced symptoms of parkinsonism or restless leg syndrome, or had a family history of PD. The investigators also examined inpatient medical records and administrative records of medication use. “People who were experiencing migraine attacks—particularly migraine with aura—at the time of the first interview were more likely to be diagnosed with PD or to have parkinsonian symptoms in later life than people who did not have headache in midlife,” summarizes Scher.

Migraine with aura in middle age was associated with a two-fold increase in risk of PD, but Scher points out that the risk of PD in people with migraine is still very low (<2.5%). About 20%



TOBIAS HELBIG/THINKSTOCK

of the people who had migraine with aura—but only 8% of those without migraine—reported having four or more parkinsonian symptoms.

Scher emphasizes that the researchers controlled for use of migraine medications, some of which are dopamine antagonists. Therefore, a causal link between migraine pharmacotherapy and development of PD seems unlikely.

A mechanism that increases vulnerability to both migraine and parkinsonism, such as a shared genetic risk factor or dys-

function of the dopaminergic system, might explain the observed association. Another potential predisposing factor could be a history of head injury, which was reported more often in people with migraine with aura than in those without. In the future, understanding the shared risk factors might aid the identification of individuals at risk of PD.

—Hemi Malkki, [Nature Reviews Neurology](#)

■ [Neurology](#). doi:10.1212/
WNL.000000000000084 (2014)