Nature News

周六, 02 9月 2017

Nature News

[周六, 02 9月 2017]

- **Nature News**

Nature News

Nature is a weekly international journal publishing the finest peer-reviewed research in all fields of science and technology on the basis of its originality, importance, interdisciplinary interest, timeliness, accessibility, elegance and surprising conclusions. Nature also provides rapid, authoritative, insightful and arresting news and interpretation of topical and coming trends affecting science, scientists and the wider public.

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Nature videos help to calm inmates in solitary confinement

Controversial experiment ignites debate over whether scientific work could be used to justify harsh prison tactics.

01 September 2017

Benj Drummond

An inmate watches nature videos in a designated room at Snake River Correctional Institution in Oregon.

A little bit of nature can calm even the most stressed populations of people, according to a study conducted on prisoners in solitary confinement.

In the experiment, researchers found that prisoners who watched videos with nature scenes felt less stressed and weren't as violent as those who didn't. The team, led by ecologist Nalini Nadkarni at the University of Utah in Salt Lake City, published their findings on 1 September in *Frontiers in Ecology and the Environment*[1].

Nadkarni first proposed the study in 2010 while visiting a prison that housed criminals who were considered to be the highest security risks. "Six guards in Kevlar vests and full riot gear had to go in and subdue an inmate in a restraining chair," she says. "I thought, wow, if we could just calm them with nature rather than with Kevlar vests and riot gear, that would be really great." But it took Nadkarni years to find a prison that was willing to let her test her hypothesis.

The experiment's results have now convinced some prison officials to offer inmates access to nature videos. However, critics of the study argue that it could be used to justify the continued use of solitary confinement — a practice that some consider too harsh.

Calming influence

Past research has shown that regularly seeing plants — even from a window — can improve hospital patients' and prison inmates' physical and mental health[2]. Nadkarni went further by studying people in solitary confinement, where inmates typically spend 23 hours a day alone in bare-walled cells.

Her team divided inmates at the Snake River Correctional Institution in Ontario, Oregon, into 2 groups of 24. Those in one group could choose to exercise or, up to five times per week, go to a 'blue room' to watch 45-minute-long videos showing natural scenes such as mountains, forests and oceans. Those in the other group were offered exercise, but no videos.

The researchers and prison staff measured inmates' moods and stress levels, and tracked violent incidents over a year. They found that inmates who had access to videos reported feeling calmer and were involved in 26% fewer violent incidents. The results suggest that nature imagery can help even

society's most nature-deprived populations, which includes prison inmates, but also residents of nursing homes and inner city areas, says Nadkarni.

The blue room has also helped Snake River to save thousands of dollars in medical costs resulting from altercations and self-harm, says Renee Smith, the institution's behavioral health systems manager. "We were pretty excited," she says. The programme is already being replicated in three other states.

Benj Drummond

Nalini Nadkarni interviews a prisoner who participated in the study.

A controversial idea

"It's certainly a pretty creative naturalistic experiment," says Lisa Nisbet, a psychologist at Trent University in Peterborough, Canada. "You couldn't get a much more deprived group of people."

But she and others caution that it is impossible to know whether exposure to nature had the beneficial effect because no group was shown videos with other content. Without this additional control group, “you can’t really draw any definitive conclusions,” says Marc Berman, a psychologist at the University of Chicago in Illinois.

The study authors acknowledge this limitation, which they say is due to there being an insufficient number of prison staff to implement the additional control condition. But they say that inmates specifically mentioned the videos’ nature content during interviews. One wrote: “The nature project help’s [*sic*] me think clearer to know there is so much more beauty in this world then [*sic*] this prison”.

Not everyone is embracing the study. Opponents of solitary confinement worry that the paper could provide cover for perpetuating a practice that many consider to be cruel and counterproductive. “I would hate to think that this study will be used to justify keeping solitary confinement prisoners in conditions where they are deprived of opportunities to actually experience nature,” says Craig Haney, a psychologist at the University of California, Santa Cruz.

Nadkarni says her collaboration has helped inmates even if it hasn’t dramatically reformed the prison system. “As an ecologist, it is not in my power to change the system of mass incarceration,” she says. “One thing I can do is think about ways that bring the therapeutic value of nature to people who are incarcerated.”

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Comments

Comments

There are currently no comments.

Volcanic views, stalking storks and the ephemeral eclipse

August's sharpest science shots, selected by *Nature*'s photo team.

01 September 2017

Souvenirs of travel

Image Slideshow

1. 

   There was plenty to interest the scientifically inclined in the latest National Geographic Travel Photographer of the Year contest. The

Grand Prize winner was this shot of the Colima Volcano in Mexico erupting in December 2015.

Sergio Tapiro Velasco/National Geographic Travel Photographer of the Year

2. 

This picture of Caribbean reef sharks (*Carcharhinus perezii*) was taken with a remote camera in the Gardens of the Queen, a marine protected area near Cuba. This image and the next two earned honourable mentions in the Nature category.

Shane Gross/National Geographic Travel Photographer of the Year

3.

This picture from the Tamba area of Japan shows fireflies signalling for mates above the stairs leading to a shrine.

Yutaka Takafuji/National Geographic Travel Photographer of the Year

4.

This shot of Mount Bromo erupting in 2016 in Indonesia was taken from the patio of a local hotel.

Reynold Riksa Dewantara/National Geographic Travel Photographer of the Year

Eclipse excitement

Jasman Mander

North Americans turned into literal lunatics on 21 August, as an eclipse sent thousands of obsessed sky-watchers scrambling to see the Moon block out the Sun. Here, a composite image shows the progression of the eclipse as seen from the Lowell Observatory in Madras, Oregon.

Go northwest!

Dan Goldman/AP/REX/Shutterstock

The Northwest Passage through the Arctic Ocean has become a much-examined signifier of climate change. As ice thins, more ships than ever before are attempting to push through this previously impassable sea route. On 29 July, the icebreaker MSV *Nordica* — pictured here — completed the route earlier in the year than ever before. Just a few weeks later, a reinforced Russian tanker made the journey successfully without an icebreaker escort.

Harvey's toll

Jonathan Bachman/Reuters

Storm Harvey is still bringing death and destruction to the United States, as record rainfall in Texas triggered flooding and evacuations. These people in Houston, Texas, were among many forced to take to the waters to escape.

Stork, stalking

Nicky Classen/Solent News/REX/Shutterstock

This yellow-billed stork (*Mycteria ibis*) began hunting for fish right alongside a photographer’s hide in Kwa-Zulu Natal, South Africa. Nicky Classen was inside the hide earlier this month to capture the shot.

Catching dinner

John Thys/AFP/Getty

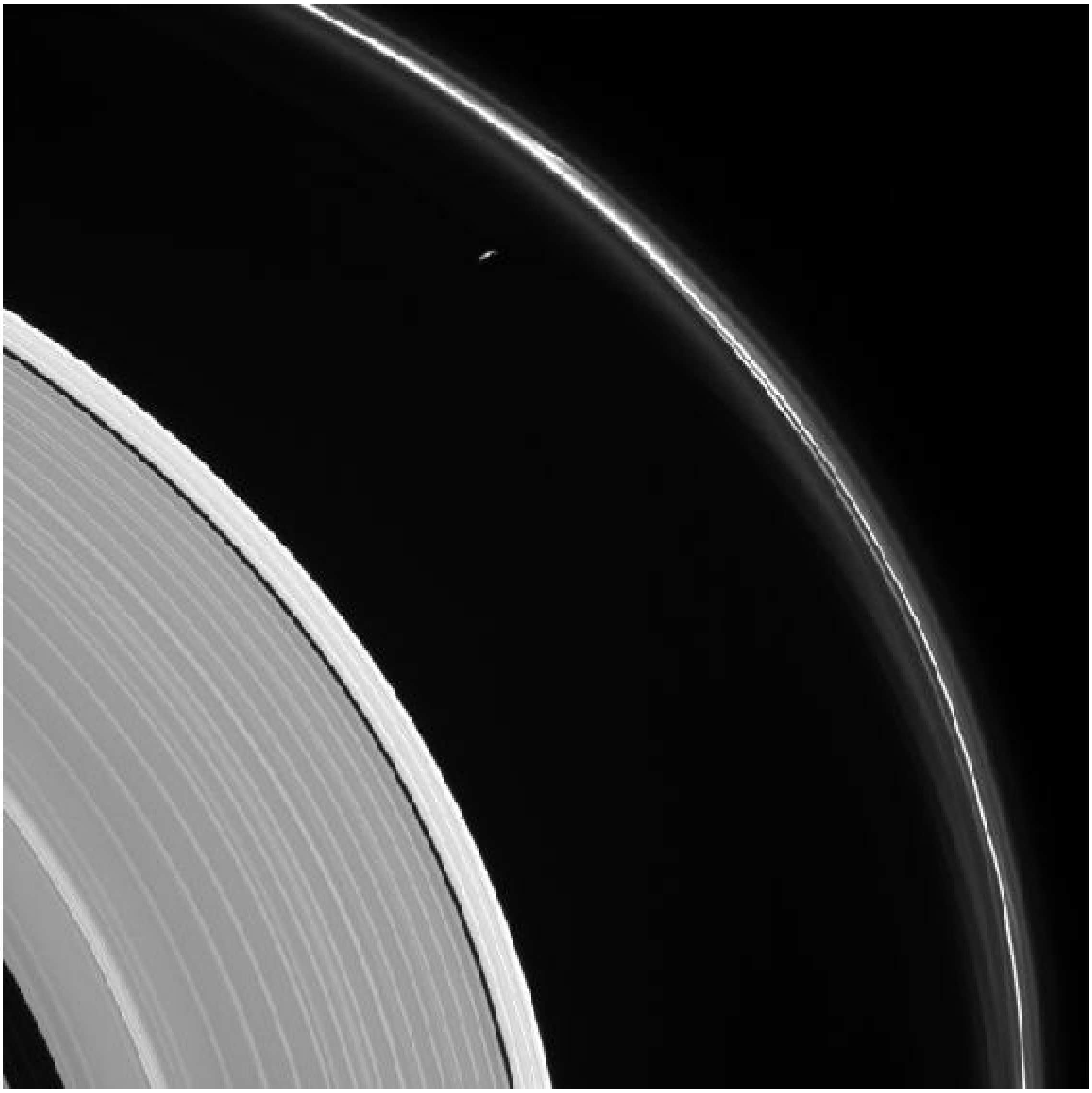
In the Netherlands, lions that were once trained to do tricks in circuses have been taught other skills. This lioness is catching a piece of meat during hunting training.

Do svidaniya!

Joel Kowsky/NASA

On 28 July, a Soyuz rocket shuttled three crew members of Expedition 52 to the International Space Station. The mission plans to test out flexible solar panels that roll out like blankets; explore the physics of neutron stars; and test in rats an experimental drug to deal with bone-mass loss caused by weightlessness.

Cassini’s legacy



NASA/JPL-Caltech/SSI

On 15 September, NASA’s Cassini spacecraft will begin a plunge into Saturn’s clouds that will lead to its destruction and the end of its 13 years of data collection. *Nature* looks back at some of the pictures the probe has captured, and what they have meant for science.

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Comments

Comments

There are currently no comments.

How labs are coping with Hurricane Harvey's devastating floods

Advance planning has kept some Texas facilities safe during the unprecedented storm.

31 August 2017 Clarified:

1. 01 September 2017

Win McNamee/Getty

Now that the rains have cleared over downtown Houston, the long road to recovery can begin.

Hurricane Harvey swept ashore on 25 August and dumped record-breaking amounts of rain on Houston, Texas, over the next several days. As the storm begins to dissipate, scientists in its wake are starting to take stock of the personal and professional toll.

Many institutions in Houston were relatively well prepared for Harvey, having put precautions in place after suffering major losses when Tropical Storm Allison flooded the city in 2001. Facilities in other parts of the state have not been so lucky, but researchers hit by Harvey — now downgraded to a tropical depression — are not being left to fend for themselves. As of 31 August, roughly 200 scientific laboratories across the country have offered computer time, lab space, animal care and spare rooms to researchers displaced by the storm, using the hashtag #SciHelpTX on Twitter.

When Harvey made landfall as a category 4 hurricane, it hit facilities at the University of Texas at Austin Marine Science Institute in Port Aransas particularly hard, ripping the roof off Brett Baker's microbial-ecology lab. Baker says that one of his graduate students has already arranged to transfer to a lab at the University of California, Berkeley, and a postdoc is heading to Uppsala University in Sweden. "Our institute is on a barrier island," Baker says, and it took a direct hit from the storm. Baker spent some time crying, he adds, but is now so busy with logistics that he hasn't fully processed his feelings.

Lessons learnt

Most of the biomedical-research facilities in Houston, including those at Rice University, MD Anderson Cancer Center and the University of Texas Health Science Center, had installed special doors and floodgates to hold back storm waters after Allison. Those precautions saved equipment and animals, says Anirban Maitra, a pathologist at MD Anderson. "I think they prevented a mega-catastrophe," he adds.

Baylor College of Medicine lost 60,000 breast-cancer specimens in the 2001 storm. But the lessons that it learnt have paid off, says spokesperson Lori Williams. "We built a wall around the entire campus," she says. "We've had

no animals lost, no research lost."

The University of Houston (UH), by contrast, does not have special flood infrastructure. So the institution has been dealing with flooded basement labs, and has struggled to keep animals dry and fed. Forty baby rhesus monkeys had their formula milk rationed, says Amr Elnashai, vice-president for research and technology transfer at UH. A few had to be weaned a week early. Supplies of liquid nitrogen and helium are also running low, endangering frozen samples if they cannot be restocked soon. "If the worst is over, then we are fine," says Elnashai. "If there is another hit, then we are in deep trouble."

Personal costs

Meanwhile, staff at the Johnson Space Center in Houston are camping out at mission control to keep the International Space Station and the James Webb Space Telescope (JWST) programmes going. "I came in for a shift Friday night and I've been here ever since," says flight director Courtenay McMillan. Staff have been sleeping on makeshift beds and air mattresses, and subsisting on provisions provided by co-workers and friends. "We have not run out of coffee, which is the most important thing," McMillan adds.

The JWST was in the middle of a 100-day test in a thermal vacuum chamber when Harvey struck, but is unharmed. And a Soyuz capsule landing scheduled for this weekend in Kazakhstan — which the space centre will help to coordinate — will go ahead with only minor modifications to the plan, says McMillan.

Although many institutions have fared relatively well despite the storm's ferocity, researchers and staff are still dealing with personal losses. Officials estimate that at least 38 people have died as a result of the storm. Maitra says that one administrator on his team has been evacuated to a hotel. "She had to leave in a hurry with her kids in the middle of the night. They were stuck on the third floor of her complex for three days. It is just heartbreaking."

Louise Prockter, director of the Lunar Planetary Institute in Houston, was

travelling when Harvey swept into town. She has been trying to support her staff remotely from Washington DC. “Some of our staff have lost all their property,” she says. “It is a mess. For some people, normal is a long, long way off.”

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Clarifications

Clarified:

Louise Prockter originally stated that a lot of the staff at the Lunar Planetary Institute lost all of their property. She misspoke and says it should be some of the staff that lost all of their property.

Comments

Comments

There are currently no comments.

Artificial warming trial reveals striking sea-floor changes

Researchers deliberately heated up a slice of the Antarctic sea bed to see how ecosystems responded.

31 August 2017

David Doubilet/NGC

Antarctic ecosystems will be affected by warming waters.

The future has come to a small patch of the Antarctic sea floor, courtesy of an experiment that placed electric heating pads on the ocean's bottom. The pioneering trial is one of the most realistic and technically challenging ocean-warming experiments yet performed, researchers say — and it opens up a

new avenue to explore how warming oceans affect marine ecosystems.

In the past 40 years, the surface waters of Earth's oceans have warmed by some 0.4 °C on average as a result of climate change. And if greenhouse-gas emissions continue at their current pace, models forecast that the warming could reach up to 2 °C by 2100.

But researchers know little about how ocean ecosystems will respond and adapt as a result — and uncertainties are largest in polar regions where there are few field data, says study co-author Gail Ashton, a marine ecologist with the Smithsonian Environmental Research Center in Tiburon, California.

That data gap spurred Ashton and her colleagues to carry out the artificial warming experiment in Antarctica. They began in 2014, when scuba divers dug trenches, laid cables and installed 12 panels 15 metres under water on flat sea bed near the Rothera Research Station of the British Antarctic Survey (BAS), which is on a small island off the west coast of the Antarctic Peninsula. Four panels were heated so that they were always 1 °C above the ambient temperature — which in the region varies from around –2 °C to +2 °C during the year — and four were heated to 2 °C above ambient temperature. The remaining four were left unheated, as controls.

Gail Ashton

A team of researchers laid heating pads on the Antarctic sea floor to investigate warming.

Using cameras, the divers then monitored how microorganisms — of the kind that encrust wet surfaces and biofoul underwater pipes — colonized the panels. The species, including microscopic invertebrates and sponges, represented typical sea-bed fauna in the region. The experiment was supposed to run for two years but ended after nine months, when icebergs damaged power-supply cables. Still, researchers saw significant and surprising differences between the panels, says Ashton. “I had hoped we might be able to see some subtle differences after careful image analysis,” she says. “But I would never have expected that the warming effects would be so easily discernible with the human eye.”

Metabolic theory predicts that biological growth rates increase by around 10% for every 1 °C of warming. But some species grew twice as fast on the heated panels as they did on the controls, Ashton and her colleagues report in *Current Biology*[1]. Distinctly different animal communities settled on the heated surfaces. On the 1 °C set, a species called *Fenestrulina rugula* — a kind of filter-feeding invertebrate called a bryozoan — so dominated the fauna that the diversity of all the species on the panel was reduced.

“The results are very exciting and provocative,” says Craig Smith, a marine ecologist at the University of Hawaii at Manoa. “They suggest that climate warming in the next 50 years in Antarctica could substantially alter the unique diversity of Antarctic ecosystems.”

Experimenters have struggled in the past to study the effects of ocean warming in a controlled experiment, in which one area of sea is deliberately and uniformly warmed relative to another over a long period of time. Previous ocean tests have compared coastal areas with nearby regions that receive extra heat from local power plants. And one effort in 2010 used electric panels to heat a small section of water in western Australia, but the animals being studied quickly grew big enough to leave the warmed water layer.

Danger to diversity

Researchers worry that Antarctic species — adapted to cold waters — may suffer as waters warm. The results suggest that species at the bottom of the marine food web are able to cope with one or two degrees of warming, Ashton says, particularly given that it happens over decades. However, species-richness or diversity might be affected, and some species might grow to dominate others. Ashton says she would also like to know what the knock-on effects will be for other creatures.

“We do need more reliable field data to validate and interpret lab experiments on how environmental change affects life in the seas,” says Hans-Otto Pörtner, an ecologist at the Alfred Wegener Institute of Polar and Marine Research in Bremerhaven, Germany. “As yet, we have only a sketchy knowledge of what controls the success of species.”

Others agree that carefully designed controlled-warming experiments such as Ashton’s are the way to go, although Smith says they should ideally be run for longer, with more replications.

One caveat, he cautions, is that the panels warmed only a roughly 2-millimetre-thick layer of water. The rest of the water column — which would have contained larvae and food on which the animals in the experiment depend — remained colder. So the results aren’t a perfect predictor of how sea-floor communities might change, he says.

Furthermore, the results can’t be generalized to suggest what will happen in other seas, says Simon Morley, a marine biologist with the BAS in Cambridge, who took part in the study.

Ashton and Morley plan to do more warming experiments in other polar environments. In September, Morley will look for a suitable test site near the Canadian High Arctic Research Station in Cambridge Bay. He says he will also apply for money to do similar experiments in tropical waters, and perhaps even freshwater environments.

“More of these experiments need to be done to be able to generalize, and

draw wider conclusions," says Boris Worm, an oceanographer at Dalhousie University in Halifax, Canada. "Each is necessary to challenge our simplistic assumptions about how climate change may alter the world we live in."

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Comments

Comments

There are currently no comments.

Doubts raised about CRISPR gene-editing study in human embryos

Alternative explanations challenge whether technique actually fixed a genetic mutation as claimed.

31 August 2017

Doubts have surfaced about a landmark paper claiming that human embryos were cleared of a deadly mutation using genome editing. In an article[1] posted to the bioRxiv preprint server on 28 August, a team of prominent stem-cell scientists and geneticists question whether the mutation was actually fixed.

The 2 August *Nature* paper[2], led by reproductive biologist Shoukhrat Mitalipov at the Oregon Health and Science University in Portland, described experiments in dozens of embryos to correct a mutation that causes a heart condition called hypertrophic cardiomyopathy.

In contrast to previous human-embryo editing studies, Mitalipov's team reported a high success rate at correcting a disease-causing mutation in a gene. The team claimed that the CRISPR–Cas9 genome editing tool was able to replace a mutant version of the *MYBPC3* gene carried by sperm with a normal copy from the egg cell, yielding an embryo with two normal copies. Mitalipov's team also introduced a healthy version of the gene along with the CRISPR machinery, but they found that the corrected embryos had shunned it for the maternal version.

But there is reason to doubt whether this really occurred, reports a team led by Dieter Egli, a stem-cell scientist at Columbia University in New York City, and Maria Jasin, a developmental biologist at Memorial Sloan Kettering Cancer Center in New York City. George Church, a geneticist at Harvard Medical School in Boston, Massachusetts, is another co-author.

In their bioRxiv paper, Egli and Jasin and their co-authors say that there is no plausible biological mechanism to explain how a genetic mutation in sperm could be corrected based on the egg's version of the gene. More likely, they say, Mitalipov's team failed to actually fix the mutation and were misled into thinking they had by using an inadequate genetics assay. Egli and Jasin declined to comment because they say they have submitted their article to *Nature*.

"The critique levelled by Egli *et al*. offers no new results but instead relies on alternative explanations of our results based on pure speculation," Mitalipov said in a statement.

Shared concerns

But other scientists contacted by *Nature*'s news team shared the Egli team's concerns. (*Nature*'s news team is editorially independent of its journal team.) Reproductive biologist Anthony Perry at the University of Bath, UK, says that after fertilization, the genomes of the egg and sperm reside at opposite ends of the egg cell, and each is enshrouded in a membrane for several hours. This fact, Perry says, would make it difficult for CRISPR-Cas9 to fix the sperm's mutation based on the egg's version of the gene, using a process called homologous recombination. "It's very difficult to conceive how recombination can occur between parental genomes across these huge cellular distances," he says.

Egli and Jasin raise that issue in their paper. They suggest that Mitalipov's team was misled into believing that they had corrected the mutation by relying on a genetic assay that was unable to detect a far likelier outcome of the genome-editing experiment: that CRISPR had instead introduced a large deletion in the paternal gene that was not picked up by their genetic assay. The Cas9 enzyme breaks DNA strands, and cells can attempt to repair the damage by haphazardly stitching the genome together, often resulting in missing or extra DNA letters.

That explanation makes sense, says Gaétan Burgio, a geneticist at the Australian National University in Canberra. "In my view Egli *et al*.

convincingly provided a series of compelling arguments explaining that the correction of the deleterious mutation by self repair is unlikely to have occurred."

Another possibility Egli's team raise is that the embryos were produced without a genetic contribution from sperm, a process known as parthenogenesis. Mitalipov's team showed that the paternal genome was present in only 2 out of the 6 embryonic stem cell lines they made from gene-edited embryos.

Robin Lovell-Badge, a developmental biologist at the Francis Crick Institute in London, says that it is possible that there is a "novel or unsuspected" biological mechanism at work in the very early human embryo that could explain how Mitalipov's team corrected the embryos' genomes in the manner claimed. He would first like to hear from Mitalipov before passing judgement. "It simply says that we need to know more, not that the work is unimportant," Lovell-Badge says of Egli and Jasin's paper.

In the statement, Mitalipov's said his team stands by their results. "We will respond to their critiques point by point in the form of a formal peer-reviewed response in a matter of weeks."

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Comments

Comments

There are currently no comments.

Skeleton plundered from Mexican cave was one of the Americas’ oldest

Rock-encased bone shard left behind by thieves allowed researchers to determine that the remains are probably more than 13,000 years old.

30 August 2017

Nick Poole/Liquid Jungle

A human skeleton — probably one of the Americas' oldest — was stolen from the Chan Hol Cave in Mexico soon after it was discovered in 2012.

A human skeleton that was stolen from an underwater cave in Mexico in 2012 may be one of the oldest ever found in the Americas. Scientists have now put the age of the skeleton at more than 13,000 years old after analysing a shard of hip bone — left behind by the thieves because it was embedded in a stalagmite.

Cave divers discovered the remains in February 2012 in a submerged cave called Chan Hol near Tulúm on Mexico's Yucatán peninsula, and posted photos of a nearly complete skull and other whole bones to social media. The posts caught the attention of archaeologists Arturo González González at the Desert Museum in Saltillo, Mexico, and Jerónimo Avilés Olguín at the Institute of American Prehistory in Cancún.

By the time researchers visited the cave in late March, the remains were gone — except for about 150 bone fragments and a pelvic bone that had been subsumed by a stalagmite growing up from the cave floor. On the basis of these bones, the researchers think that the skeleton belonged to a young man who died when sea levels were much lower and the cave was above ground.

Dating techniques

To determine the age of human remains, researchers often measure levels of a radioactive isotope of carbon in collagen protein within bones. But in this case, most of the collagen had been leached out by water while the bones were submerged, making this method unreliable, says Wolfgang Stinnesbeck, a palaeontologist and geoscientist at the University of Heidelberg, Germany, who led the efforts to date the remains.

Instead, Stinnesbeck's team collected a fleck of the pelvis bone and surrounding stalagmite, which contains a mineral called calcite. The team then dated the rock using the relative levels of uranium and thorium isotopes in the calcite. The deeper into the stalagmite the researchers sampled, the older the dates turned out to be; stone just 2 centimetres from the bone was 11,300 years old. Calcite closer to the bone gave conflicting results, Stinnesbeck says.

The team determined that the skeleton was older than 13,000 years by analysing the rate at which calcite had formed around the bone, and by matching the shifts in stalagmite isotope levels to those in other caves. The findings were published on 30 August in *PLoS ONE*[1].

Eugenio Acevez Nunez

A diver collects a portion of a cave stalagmite found in cave that contains ancient human bones.

Alistair Pike, an archaeological scientist at the University of Southampton, UK, notes that the stalagmite set over the bone during a time of profound climate change, which could have altered the stalagmite's rate of growth. He says he is therefore more comfortable considering the bones to be a minimum of 11,300 years old — still “very significant”, he notes.

Ancient company

Few other human remains from the Americas are older than 13,000 years. The skeleton of a teenage girl recovered from a different Yucatán cave was carbon-dated to more than 12,000 years old, and a skeleton found in another submerged cave near Tulúm was deemed to be around 13,500 years old, also using radiocarbon dating.

“They’ve done a really nice job determining the age of this thing,” says David Meltzer, an archaeologist at Southern Methodist University in Dallas, Texas. There is convincing archaeological proof that humans colonized the Americas before 14,000 years ago, but very old remains are precious. “These sites are rare as hen’s teeth,” Meltzer says.

Apart from the Yucatán finds, the next-oldest skeleton from the Americas is that of a 12,600-year-old boy found in Montana, whose sequenced genome places him on a lineage leading to present-day Native American groups. Researchers have sequenced only a few other human skeletons from the Americas that are older than 10,000 years, hindering efforts to unravel the region's ancient population history.

Getting DNA from what remains of the Chan Hol skeleton will be hard. A sample sent to one of the world’s leading ancient-DNA labs, the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, did not contain enough DNA, Stinnesbeck says. He hopes to find DNA in the few teeth not taken by the thieves.

The theft still boggles Stinnesbeck, whose team is continuing to study the cave and its remains. The researchers recently reported the discovery of

fossils in the cave that are of a new species of peccary[2] — a hoofed mammal related to pigs — as well as evidence that the cave's human inhabitants made fires.

“What would you want with a skeleton? Would you take it home?” Stinnesbeck asks. “If they had known it was very old, maybe just to have a souvenir, to have something special.”

“We went to the police and they did some inquiries,” he adds. “They never came up with anything substantial.”

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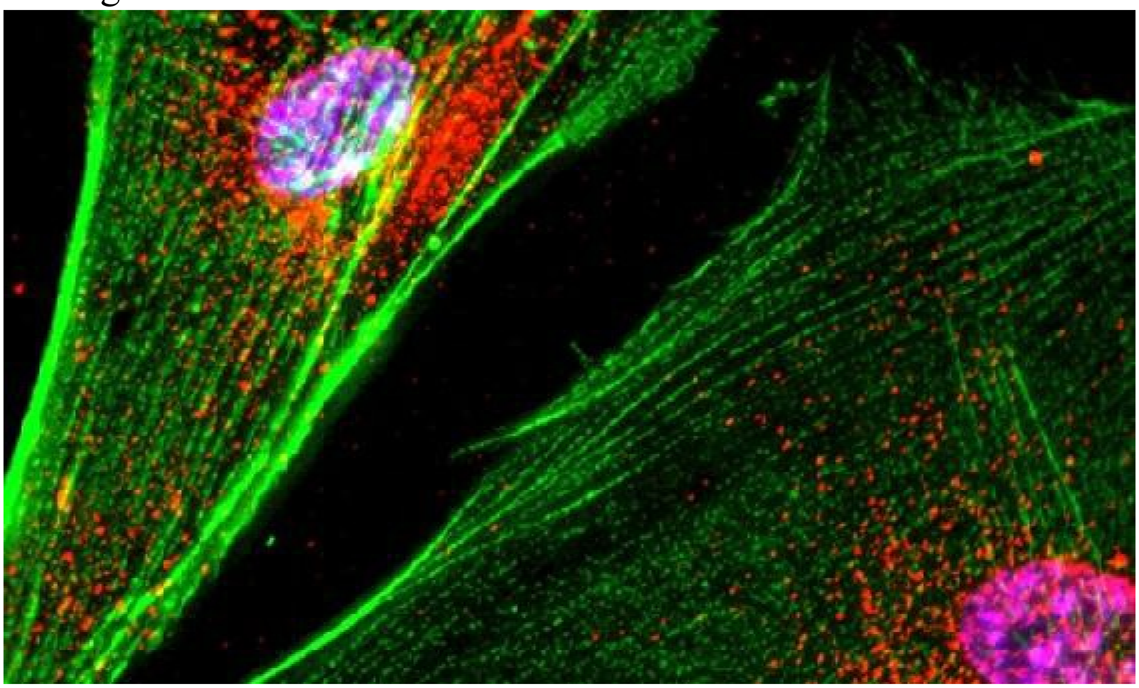
Comments

Commenting is currently unavailable.

Reprogrammed cells relieve Parkinson's symptoms in trials

Monkeys implanted with neurons derived from stem cells showed sustained improvement after two years.

30 August 2017



B. Bick, . Poindexter, UT Med. School/SPL

A depletion of brain cells that produce dopamine is responsible for the mobility problems seen in people with Parkinson's disease.

Japanese researchers report promising results from an experimental therapy for Parkinson's disease that involves implanting neurons made from 'reprogrammed' stem cells into the brain. A trial conducted in monkeys with a version of the disease showed that the treatment improved their symptoms

and seemed to be safe, according to a report published on 30 August in *Nature*[1].

The study's key finding — that the implanted cells survived in the brain for at least two years without causing any dangerous effects in the body — provides a major boost to researchers' hopes of testing stem-cell treatments for Parkinson's in humans, say scientists.

Jun Takahashi, a stem-cell scientist at Kyoto University in Japan who led the study, says that his team plans to begin transplanting neurons made from induced pluripotent stem (iPS) cells into people with Parkinson's in clinical trials soon.

The research is also likely to inform several other groups worldwide that are testing different approaches to treating Parkinson's using stem cells, with trials also slated to begin soon.

Nature breaks down the latest research — and what it means for the future of stem-cell treatments.

Why are stem cells a promising treatment for Parkinson's disease?

Parkinson's is a neurodegenerative condition caused by the death of cells called dopaminergic neurons, which make a neurotransmitter called dopamine in certain areas of the brain. Because dopamine-producing brain cells are involved in movement, people with the condition experience characteristic tremors and stiff muscles. Current treatments address symptoms of the disease but not the underlying cause.

Researchers have pursued the idea that pluripotent stem cells, which can form any cell type in the body, could replace dead dopamine-making neurons in people with Parkinson's, and thus potentially halt or even reverse disease progression. Embryonic stem cells, derived from human embryos, have this capacity, but they have been the subject of ethical debates. Induced pluripotent stem (iPS) cells, which are made by coaxing adult cells into an

embryonic-like state, have the same versatility without the associated ethical concerns.

What did the latest study find?

Takahashi’s team transformed iPS cells derived from both healthy people and those with Parkinson’s into dopamine-producing neurons. They then transplanted these cells into macaque monkeys with a form of the disease induced by a neuron-killing toxin.

The transplanted brain cells survived for at least two years and formed connections with the monkey’s brain cells, potentially explaining why the monkeys treated with cells began moving around their cages more frequently.

Why is the research important?

Crucially, Takahashi’s team found no sign that the transplanted cells had developed into tumours — a key concern with treatments that involve pluripotent cells — or that they evoked an immune response that couldn’t be controlled with immune-suppressing drugs.

“It’s addressing a set of critical issues that need to be investigated before one can, with confidence, move to using the cells in humans,” says Anders Bjorklund, a neuroscientist at Lund University in Sweden.

When will clinical trials begin and how will they work?

“I hope we can begin a clinical trial by the end of next year,” says Takahashi. Such a trial would be the first iPS cell trial for Parkinson's. In 2014, a Japanese woman in her 70s became the first person to receive cells derived from iPS cells, to treat her macular degeneration.

In theory, iPS cells could be tailor-made for individual patients, which would eliminate the need to use drugs that suppress a possible immune response to foreign tissues.

But customized iPS cells are expensive to make and can take a couple months to derive and grow, Takahashi notes. So his team instead plans to establish iPS cell lines from healthy people and then use immune cell biomarkers to match them to people with Parkinson's in the hope of minimizing the immune response (and therefore the need for drugs to blunt the attack).

In a study described in an accompanying paper in *Nature Communications*[2], Takahashi's team implanted into monkeys iPS-cell-derived neurons from different macaques. They found that transplants between monkeys carrying similar white blood cell markers triggered a muted immune reaction.

What other stem-cell approaches are being tested for Parkinson's?

Earlier this year, Chinese researchers began a Parkinson's trial that used a different approach: giving patients neural-precursor cells made from embryonic stem cells, which are intended to develop into mature dopamine-producing neurons. A year earlier, in a separate trial, patients in Australia received similar cells. But some researchers have expressed concerns that the immature transplanted cells could develop tumour-causing mutations.

Meanwhile, researchers who are part of a Parkinson's stem-cell therapy consortium called GForce-PD, of which Takahashi's team is a member, are set to bring still other approaches to the clinic. Teams in the United States, Sweden and the United Kingdom are all planning trials to transplant dopamine-producing neurons made from embryonic stem cells into humans. Previously established lines of embryonic stem cells have the benefit that they are well studied and can be grown in large quantities, and so all trial participants can receive a standardized treatment, notes Bjorklund, also a consortium member.

Jeanne Loring, a stem-cell scientist at the Scripps Research Institute in La

Jolla, California, favours transplanting iPS-derived neurons made from a patient's own cells. Although expensive, this approach avoids dangerous immunosuppressive drugs, she says. And because iPS cells are established anew for each patient, the lines go through relatively few cell divisions, minimizing the risk that they will develop tumour-causing mutations. Loring hopes to begin her team's trial in 2019. "This shouldn't be a race and we're cheering for success by all," she says.

Lorenz Studer, a stem-cell scientist at the Memorial Sloan Kettering Cancer Center in New York City who is working on a trial that will use neurons made from embryonic stem cells, says that there are still issues to work out, such as the number of cells needed in each transplant procedure. But he says that the latest study is "a sign that we are ready to move forward".

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Comments

There are currently no comments.

Closure of US coal study marks an alarming precedent

The Trump administration has stepped up its assault on environmental protections by halting a US$1-million study on the health risks of coal mining — casting a pall on academic freedom.

30 August 2017

Saul Loeb/AFP/Getty

US President Donald Trump makes his priorities clear during a rally in West Virginia.

When the US National Academies of Science, Engineering, and Medicine (NASEM) speaks, the government usually listens. Last year, US government

agencies spent US$216 million to commission NASEM expertise on issues from the scientific workforce to military implications of synthetic biology. Most NASEM reports are filled with caveats and make for dry reading. But occasionally, they pull no punches. A memorable 2009 report on the state of forensic science, for instance, concluded that almost every forensic method used in law enforcement is seriously flawed and that their use risks putting innocent people in jail. Given the academies' stature, it's hard for the government to brush off its hired commission when faced with such language.

Such concerns seem to weigh on the US Department of the Interior (DOI), which in 2016 commissioned a $1-million study of the potential health risks of surface coal mining on communities in West Virginia. Some evidence suggests that people who live near surface-mining operations — also known as mountaintop removal — have an unusually high rate of lung cancer and birth defects, which could be attributed to air and water pollution.

Launching the study — now halfway through its two-year term — was itself an achievement, given the political nature of the topic. Although much is known about the risks of coal mining to miners, little research has been done on its health impacts on local communities, not least because of attempts by the coal industry to hinder such work. Mining companies and trade organizations have sued for access to the e-mails of academics researching mountaintop removal, and have fought to keep peer-reviewed studies from being used in court. The National Mining Association questioned the value of the NASEM study when it was announced.

On 18 August, three days before the NASEM committee working on the study was due to meet in a Kentucky mining town, the DOI ordered a stop to the study, with immediate effect. The agency says it is reviewing spending on all projects that cost more than $100,000. "The Trump administration is dedicated to responsibly using taxpayer dollars in a way that advances the department's mission and fulfils the roles mandated by Congress," DOI spokeswoman Heather Swift said in a statement to *Nature*. She did not respond to questions about which other projects are under review.

This is the first time that the administration of President Donald Trump has cancelled a NASEM study that has already started — a move that has rarely

happened in the past, according to the academies.

In its statement about the cancellation, the NASEM said that its investigators "stand ready" to resume as soon as the DOI completes its review. But they're likely to be waiting a long time. The Trump administration has made no secret of its fondness for the US coal industry, which employs around 76,000 people. (By comparison, around 1.2 million people live in counties where mountaintop removal takes place.) The DOI's assertion that the decision is a budgetary one is suspect, especially given that the study has already spent a good amount of its budget.

It seems, instead, that the government would rather quash the review than risk it producing results that cast aspersions on the coal industry. This is par for the course for the DOI, whose head, Ryan Zinke, plans to downsize national parks in favour of resource extraction, and which has also suspended meetings with its independent advisory councils on issues concerning public lands.

With the near-daily news about the Trump administration weakening climate and environmental protections, it is easy to become fatigued. Yet the move to pre-empt the prestigious and independent NASEM is particularly concerning. It raises questions about what other studies could be cancelled if the government fears their results. It is another blow for science and for academic freedom.

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Cassini’s 13 years of stunning Saturn science — in pictures

As the mission speeds towards its conclusion, *Nature* takes a look at what researchers have learnt about the planet’s moons, rings and tempest-filled skies.

30 August 2017

NASA/JPL

In 2004, Cassini became the first spacecraft to orbit Saturn.

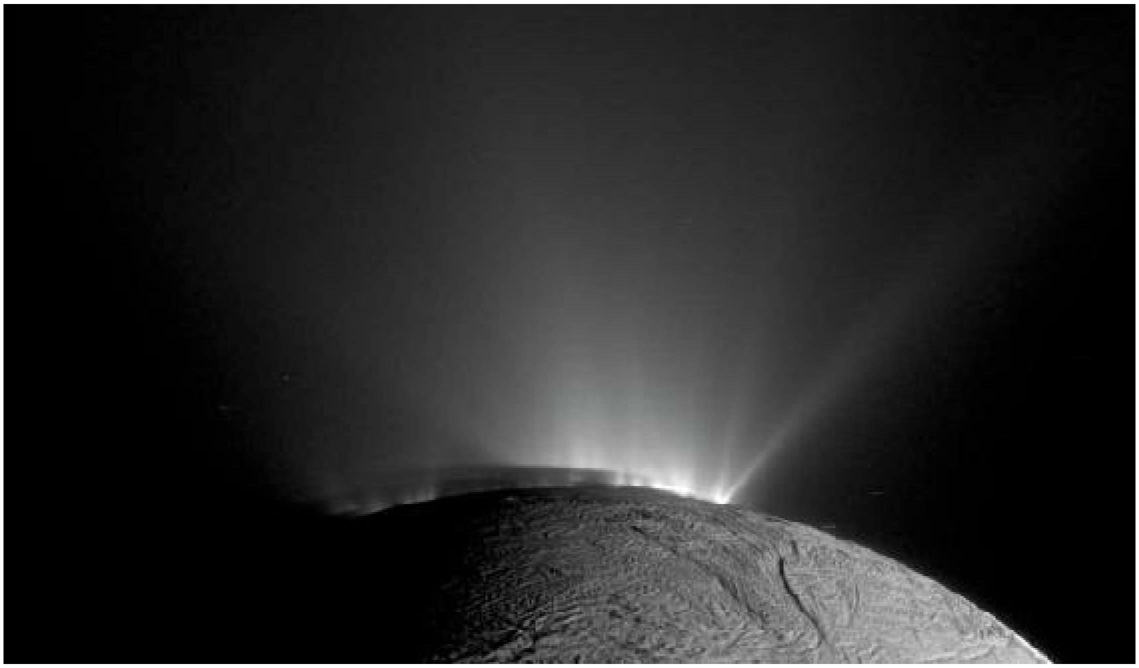
Twenty years ago, in the wee hours of a muggy Florida morning, the Cassini spacecraft lit up the skies as it blasted off from Cape Canaveral. Now, after a 3.5-billion-kilometre journey and 13 years spent circling Saturn, the orbiter is running low on fuel. On 15 September, Cassini's controllers on Earth will send the craft plunging into Saturn's cloudtops to prevent it from accidentally

crashing into and contaminating any moon that might be able to harbour life.

Cassini will send data back to Earth right up until that incandescent coda — a fitting end for one of history's most successful interplanetary missions. A joint venture between NASA, the European Space Agency and the Italian Space Agency, Cassini was the first spacecraft to orbit Saturn. And with much more time to gather science than the earlier fly-bys of Pioneer 11 in 1979, Voyager 1 in 1980 and Voyager 2 in 1981, the mission delivered discoveries in spades, racking up an impressive list of findings as it looped around the majestic planet, danced along its glorious rings and whizzed past many of its bizarre moons. “Cassini was a long wait, but it was definitely worth it,” says Linda Spilker, a planetary scientist at NASA's Jet Propulsion Laboratory in Pasadena, California, and the mission's project scientist. “It has so many incredible accomplishments we can be so proud of.”

Cassini: NASA/JPL; Orbital schematic: NASA/Jet Propulsion Laboratory-Caltech

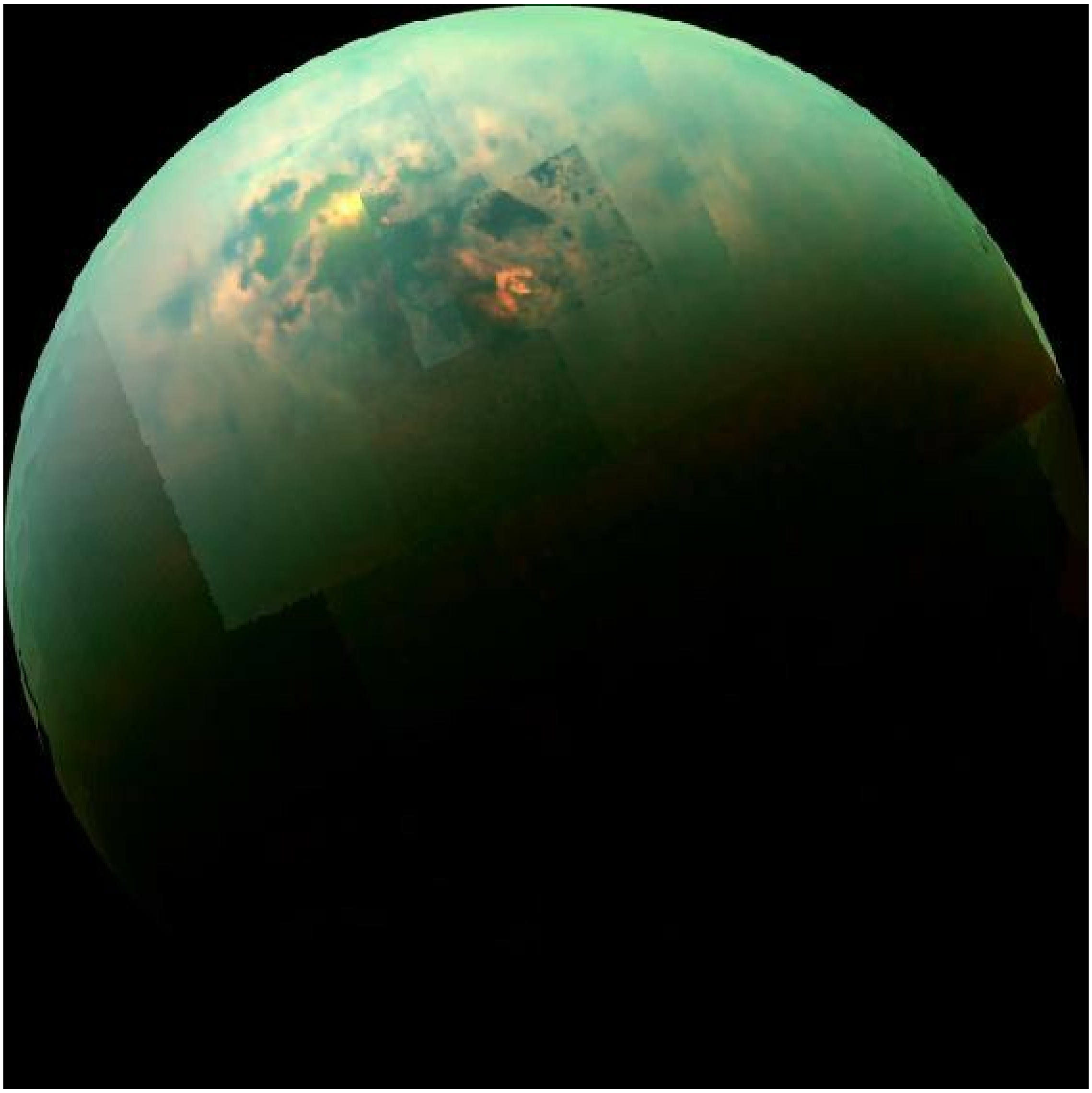
The spacecraft revealed the chaotic dynamics that shape Saturn's rings, found geysers spraying from the moon Enceladus and watched gigantic storms roil the planet's atmosphere. It observed seasons change for nearly half of a Saturn year, as first the equinox and then the solstice passed, transforming weather patterns. Over the life of Cassini's mission, Saturn has become less of a stranger and revealed itself to be a vibrant system churning with continual change. The spacecraft's observations became a touchstone for understanding the complexity of gas-giant planets, a legacy that NASA's Juno spacecraft is currently continuing at Jupiter.



NASA/JPL-Caltech/Univ. Arizona/Univ. Idaho

Geysers on Enceladus spray water vapour and ice mixed with organic molecules into space.

Cassini also made history when it released the Huygens probe, which became the first craft to touch down in the outer Solar System. After a daring two-and-a-half hour descent to the surface of the moon Titan in 2005, Huygens sent back snapshots of a frozen floodplain littered with rocks. Cassini's mapping later revealed Titan to be a world teeming with hydrocarbon lakes and rivers, replenished by methane and ethane rain.



NASA/JPL-Caltech/Univ. Arizona/Univ. Idaho

Sunlight glints off lakes of liquid hydrocarbons on Titan.

With no official plans to return to Saturn anytime soon, 15 September will mark the end of an era. “On Cassini's final day, we will be watching the signal as we go as deeply into the atmosphere as we can,” says Spilker. “That day to say goodbye will be a tough day.”

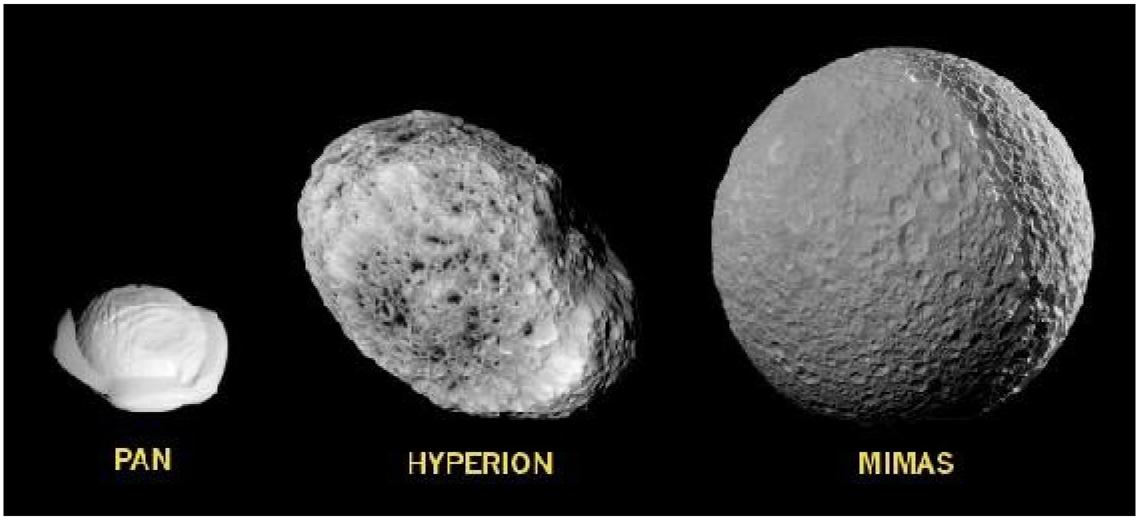
A menagerie of moons

Cassini's biggest surprises came as it studied some of Saturn's 60-plus moons, raising as many questions as it answered.

NASA/JPL/Space Science Institute

Three of Saturn's moons — Epimetheus, Janus and larger Dione — pass by one another in this set of images captured in 2005.

Researchers finally solved the mystery of Iapetus — which boasts one light-coloured side and one dark side — when they discovered an enormous ring of material streaming off another of Saturn's moons, Phoebe. Iapetus seems to get its two-faced look as its leading surface ploughs through Phoebe's debris. And in their study of how crater-pocked Mimas wobbles on its axis, Cassini scientists realized that the world may have either a buried ocean or a stretched-out core.



NASA/JPL-Caltech/SSI

Saturn’s moons come in a variety of shapes.

A look at the planet's littlest moons — never before seen up close — uncovered a panoply of strange shapes. Hyperion resembles a sponge, and Pan has been compared to a piece of space ravioli. Pandora features an enormous impact crater, a scar from some long-ago collision.

But the most astonishing observations were of Titan and Enceladus. On Titan, Saturn's largest moon, Cassini discovered a world with complex chemistry similar to Earth's before life arose. In the 72 minutes that Huygens survived on Titan's surface, the battery-powered lander snapped images of a landscape strewn with frozen rocks and cloaked in an orange haze. From above, Cassini mapped the moon using radar and other instruments, revealing enormous dunes of water ice coated with a hydrocarbon glaze, which wind for hundreds of kilometres in wavy bands near the equator. Liquid methane and ethane rain down, forming rivers and lakes of hydrocarbons. Cassini captured images of sunlight reflecting off these bodies of liquid — and even used radar to chart their bottoms, sketching out the depths through which a future mission's submersible might glide.

Even after all that, Enceladus stole the show. Thought to be inert before Cassini arrived, the moon actually spews ice and water vapour from enormous fractures that decorate its south-pole region like tiger stripes.

Powered by Saturn's gravitational pull, the geysers spurt out 200 kilograms of salty, organic-laced material every second.

Cassini scientists were surprised to find that this material contains small particles of silica, which may be formed by the interaction of water and rock at hydrothermal vents deep inside Enceladus. On Earth, similar deep-ocean vents are home to microbes that thrive off chemical energy, far from sunlight — and so Enceladus has vaulted to the top of the list of places to search for extraterrestrial microbes. Planetary scientists are already plotting return missions to fly through Enceladus's plumes and sniff for hints of life.

The ever-changing rings

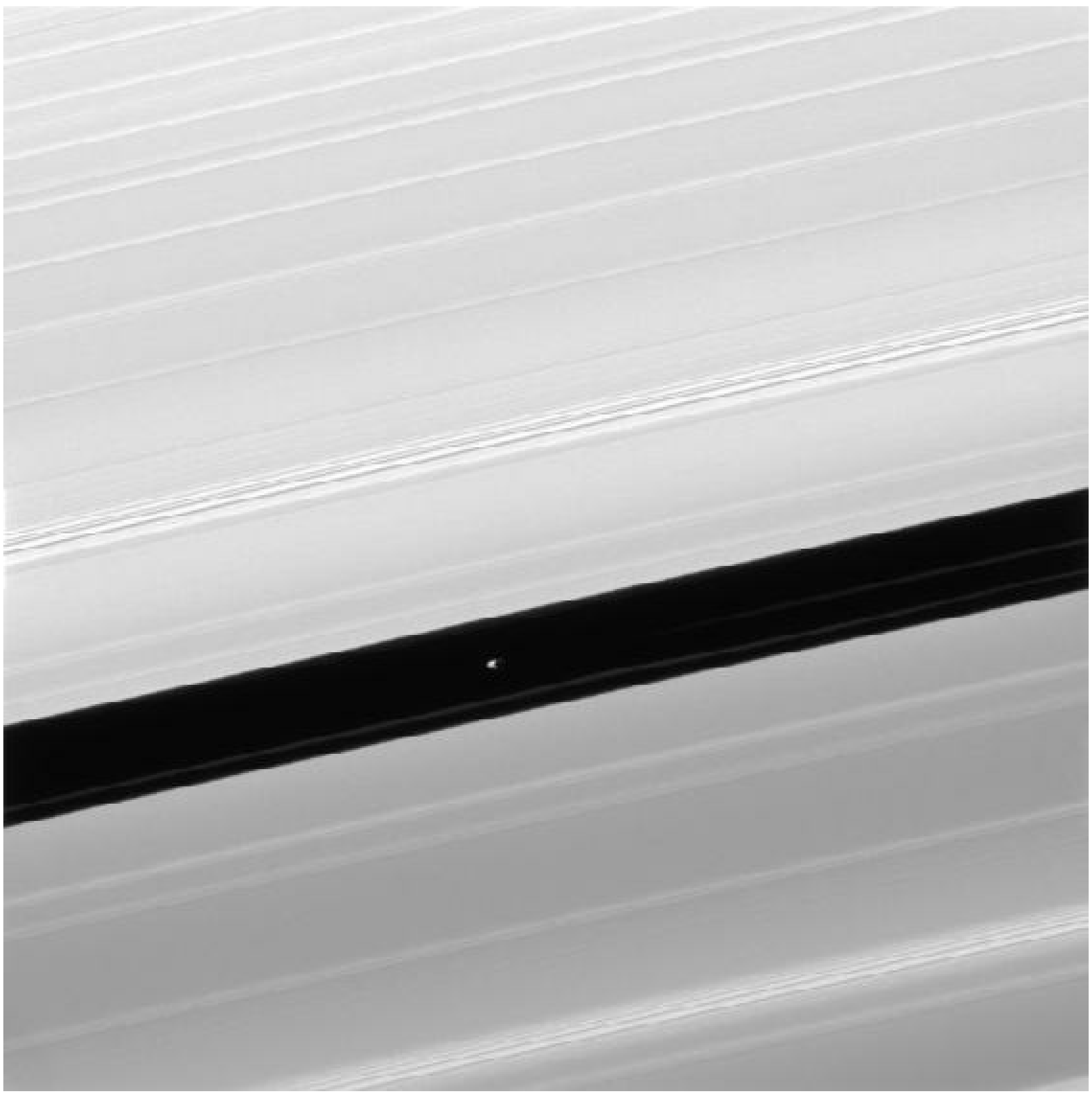
Saturn's rings — the planet's most iconic feature — are populated by billions of icy particles. From afar, the rings appear fixed and perfectly sculpted, but Cassini revealed some of the processes that shape them, and showed how dynamic they truly are. Ring features form, change shape and vanish — sometimes in a matter of hours.

NASA/JPL/SSI

Just 100 metres or so thick, Saturn’s rings are shaped by many moons and moonlets embedded within. In this view, the moon Pandora can be seen

beyond the planet’s main rings.

Cassini discovered how the gravitational forces of even the smallest of Saturn's moons can help to shepherd ring particles into beautifully manicured bands. For example, little Pan, just 28 kilometres across, has cleared a wide path through the rings. Dark and bright bands in the rings on either side of this gap reflect the pull of Pan's gravity. Images taken over the years revealed how some of Saturn's moons continuously shape and sculpt its rings — a phenomenon that was not fully apparent until Cassini was able to watch them over time.



NASA/JPL-Caltech/SSI

The moon Pan clears a pathway within the rings known as the Encke Gap.

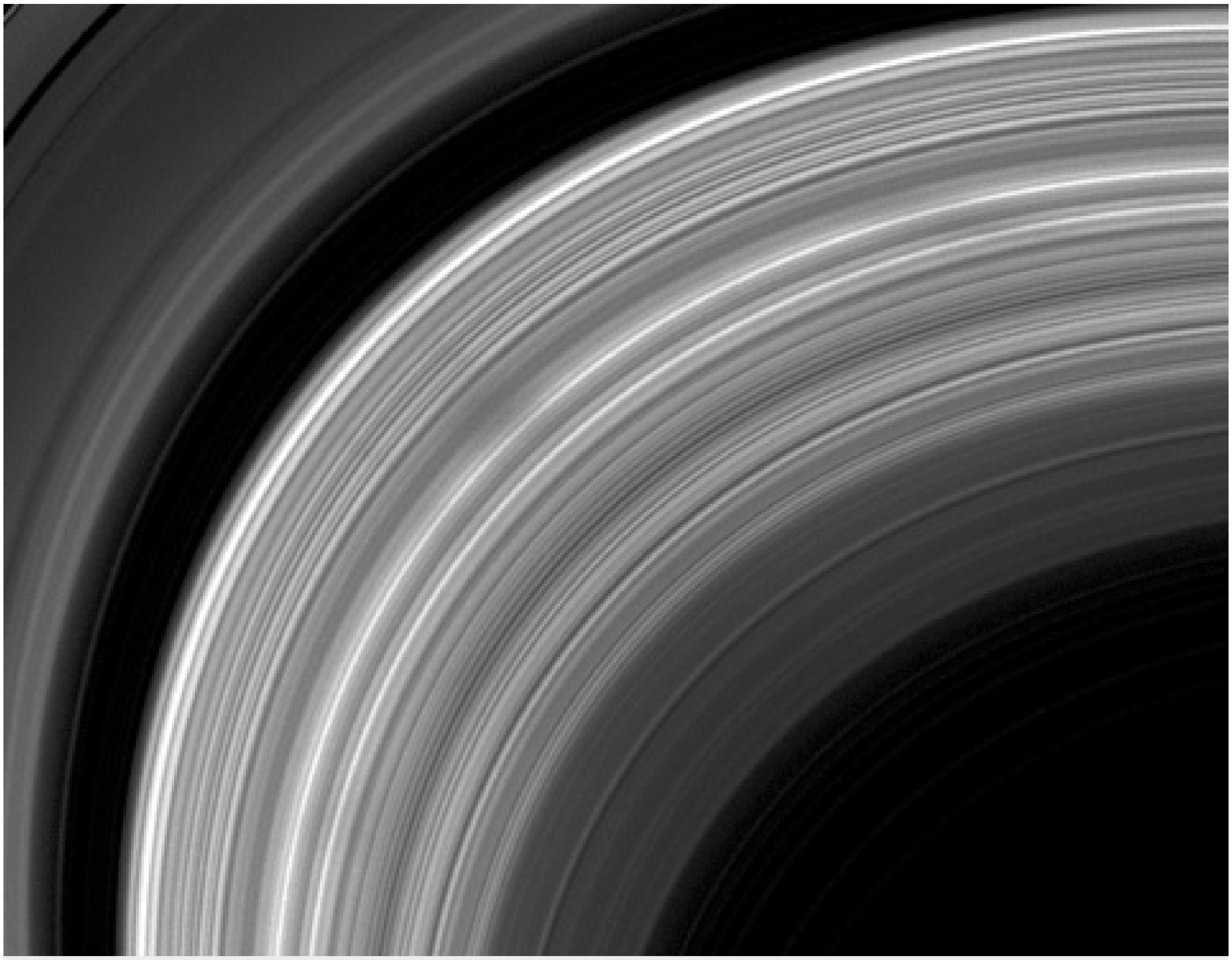
But the moons are not perfect shepherds. In Saturn's F ring, a narrow band along the outside edge of the main rings, Cassini found ephemeral sprays of material called mini-jets (image, below). The gravitational pull of the nearby moon Prometheus probably causes ice particles in the ring to clump together like snowballs.

NASA/JPL-Caltech/SSI

At Saturn’s F ring, gravitational disturbances have caused ring particles to clump together and kick out a dusty-looking ‘jet’ of material.

Those bigger objects then punch outwards, trailing particles behind them like a dusty veil that can stretch up to 180 kilometres long, marring the otherwise perfect rings. Out here on the fringes of the ring system, features such as these come and go.

Dramatic changes can also play out on large scales. Around the Saturnian equinox, as sunlight fell at a steep slant across the rings, Cassini observed spoke-like features that rotate with the rings much like the pattern in a bicycle wheel. These spokes, which may be huge stripes of electrostatically charged particles drifting just above and below the rings, can form and disappear over the course of a few hours.



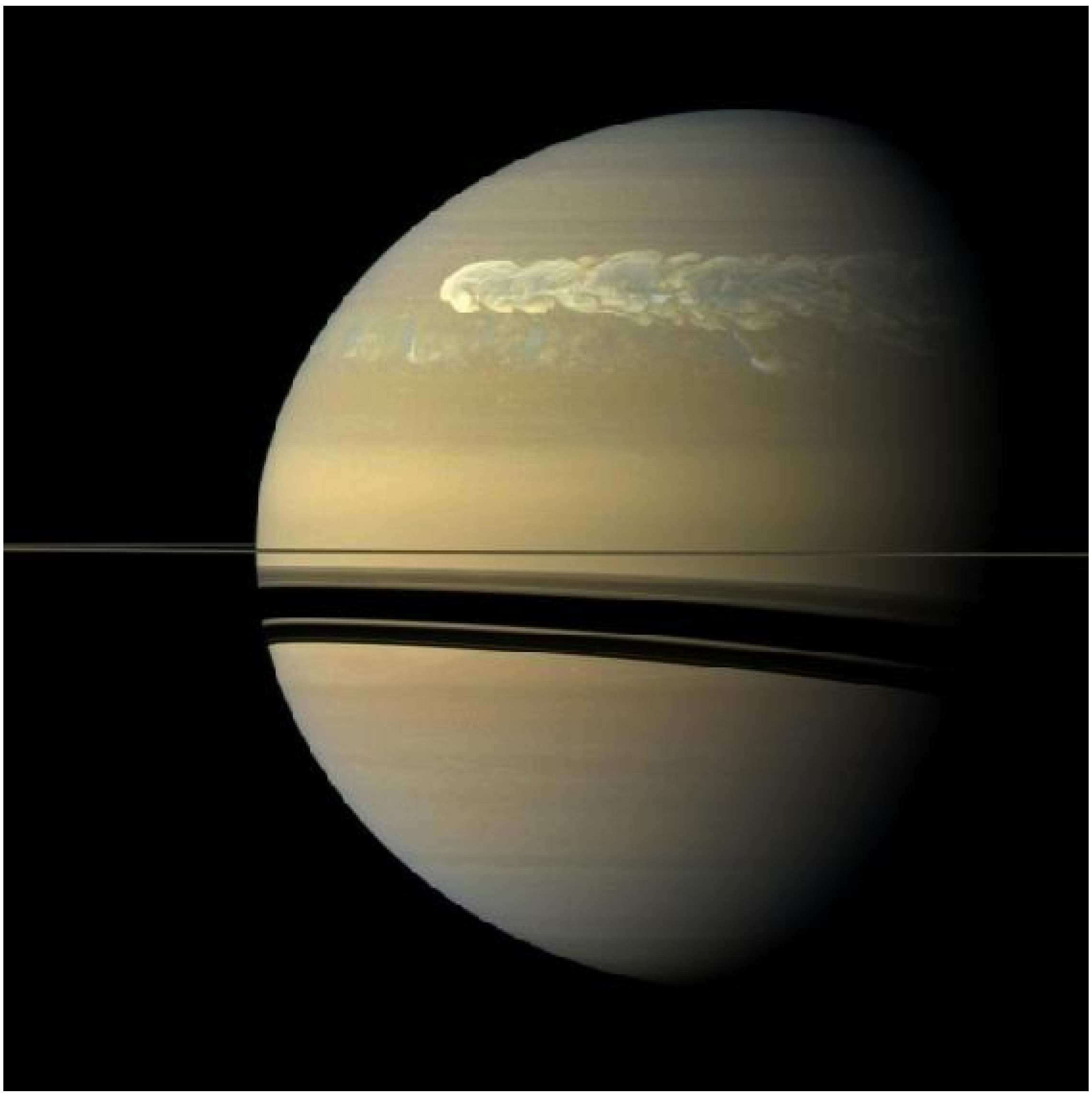
NASA/JPL/Space Science Institute

Spoke-like features that seem to be made of charged particles rotate around the planet.

Depths of the atmosphere

With Saturn's gorgeous ring system distracting the eye, the planet's swirling cloudtop patterns are sometimes underappreciated. Cassini changed that by observing how storms roiled Saturn's atmosphere over the course of many Earth years, providing deep insights into the currents that shape the planet's atmosphere.

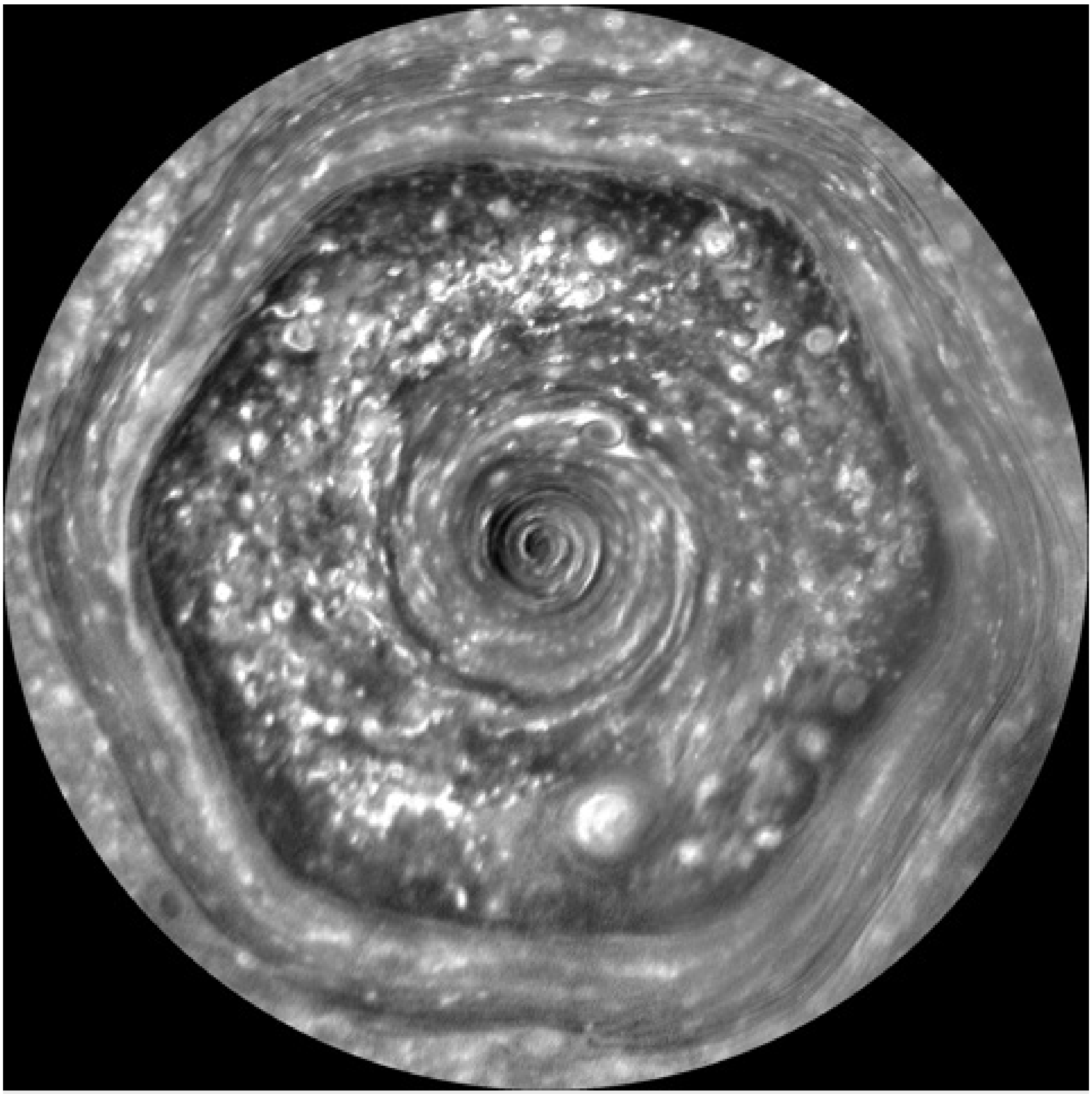
In late 2010, the spacecraft had a front-row seat as a thunderstorm developed into an enormous, swirling white cloud more than 10,000 kilometres across. The storm churned from deep inside the atmosphere all the way to the its upper layers, and in the ensuing months, wrapped entirely around the northern hemisphere until the 'head' of the storm crashed into the tail. Similar storms appear every two to three decades, a rate that is probably controlled by the amount of water vapour in the atmosphere. Other planets in the Solar System, such as Jupiter, have massive storms but do not see such planet-circling giants.



NASA/JPL-Caltech/SSI

Thunderclouds barrelled across Saturn’s northern hemisphere in 2010–11.

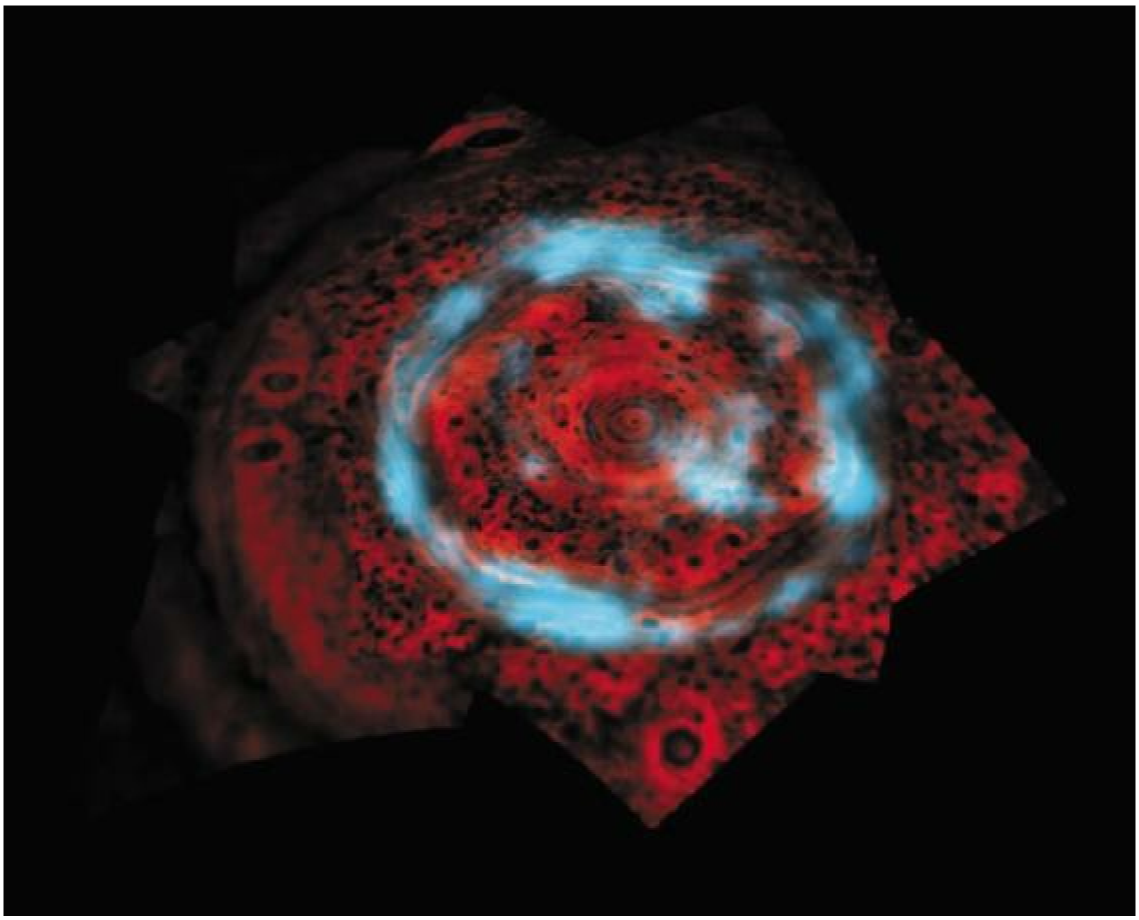
Cassini also probed a unique hexagon-shaped feature, some 30,000 kilometres across, at Saturn's north pole. Confined by winds flowing at more than 300 kilometres an hour, the hexagon is home to smaller hurricane-like vortices that rotate within it. Oddly, Saturn has no such feature at its south pole.



NASA/JPL-Caltech/SSI/Hampton University

A six-sided, jet-stream-like swirl churns around the planet’s north pole.

Even Saturn's interior came into better focus thanks to the mission. The planet has a strong and complex magnetic field, generated by liquid churning deep within it. The bright auroras that glow around Saturn's poles served as guide posts by helping to reveal the patterns and intensity of its polar magnetic fields.



NASA/JPL/University of Arizona

Glowing bands are created at the poles where the solar wind slams into Saturn’s magnetosphere.

Some fundamental mysteries remain. Mission scientists are still working to determine how long a Saturnian day is. Because the planet has no solid surface, researchers cannot track a fixed feature to measure its rotation rate.

Instead, they have tried to measure its true spinning speed by observing the planet's powerful rotating radio emissions, which should reflect the movement of the magnetic field stemming from deep within. But Cassini found that these emissions were more intricate than expected, which complicates efforts to use them to understand the rotation rate. More-detailed information about the magnetic field may come during this final phase of the mission, as Cassini loops between the planet and its rings.

Although the mission will come to a close soon, it will leave behind a wealth of information for future studies. “Cassini's treasure of data is 100 times as broad and deep as Voyager's, and it will take decades to get to the bottom of it,” says Jeff Cuzzi, a planetary scientist at NASA's Ames Research Center in Moffett Field, California. “The end of Cassini's active operations may be only the beginning of real advances in our understanding of what it has discovered.”

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Stop blocking postdocs' paths to success

30 August 2017

Lab heads should let junior researchers take their projects with them when they start their own labs — it drives innovation and discovery, argues Ben A. Barres.

Illustration by David Parkins

Postdocs are the engines of scientific progress. Typically poorly paid despite their three to seven years of doctoral training, they might labour in a postdoc lab for another four to nine years before moving to a more independent and remunerative career. What are they owed in return?

One type of postdoc maltreatment is rarely discussed, despite its prevalence and importance — should a postdoc be able to take their research project with them when they set up their own lab? And if so, should that new principal investigator (PI) be free from direct competition on that project with his or her former mentor? In my view, the answer to both questions is yes. Such 'project porting' is crucial for the success of young scientists and should be a fundamental right for postdocs.

This is such a touchy topic that it is only now that I feel comfortable writing about it. I am at the end of a long academic career and dying of stage four pancreatic cancer. I think it's time for the academic community to start openly discussing the issue of research freedom for postdocs (or lack of it).

Opinions will vary, but different strategies could enable PIs and postdocs to handle the issue more constructively. At the very least, trainees looking for a postdoc job need to find out about the policies of potential mentors before selecting a lab, and assess the implications that these policies could have for their independent success.

Who owns what?

Most mentors at the PI level have policies on research ownership. Unfortunately, many postdocs fail to ask what these policies are, either through lack of forethought or because they assume that it will not be an issue. Some mentors, if asked, warn prospective postdocs that they will not be free to take their projects with them to their own labs. (The meaning of 'project' may vary depending on the mentor, from the postdoc's specific research question to the entire subject area of the mentor's lab.) Others permit postdocs to retain their projects on moving, but then directly compete on the same work.

A postdoc is formally free to work on any project in his or her own lab. But those that spurn their advisers' wishes risk losing their support — something that is usually crucial for winning junior investigator awards and other types of funding, or when trying to obtain a promotion, say from assistant to associate professor.

So what is wrong with an adviser asking a postdoc to begin a different project on setting up their own lab?

Doing so assumes that a given topic is owned by the adviser and that the adviser can control who works on it. This is insulting to the postdoc, who in most cases has earned co-ownership by pushing a project forward with ideas and hard work.

Most importantly, when it comes to obtaining a faculty position or funding for a newly independent laboratory, having compelling preliminary data greatly increases the chances of success. Such data are most feasibly obtained from the final stage of a postdoc, or from research in the same area in a new lab. In addition, having to start work in an entirely different area makes it harder to achieve tenure because of the short tenure clock. Over time, the best faculty members will often launch projects in new areas, but this typically happens only after a lab is established.

Another strategy is to allow a postdoc to start a project in their final year that they can then take with them. In my experience, however, postdoc training periods are already so long and it takes so much effort to get papers published that there is rarely time for a postdoc to make headway before starting their own lab.

If a mentor lets a postdoc retain their project but continues to work on the same question, this doesn't solve the problem. In most cases, there is simply no way that a young person starting a lab can compete successfully with their former mentor. Established labs have an endless stream of excellent postdocs; new labs typically get started with graduate students, who take longer to train and to do meaningful experiments.

Competitor clash

I believe that not allowing postdocs to take projects with them, or competing with them when they do, harms science. It is well known among senior investigators that mentors who are ungenerous to their trainees have a lower rate of trainee success, and their area of research suffers as a result. By

contrast, generous mentors soon find that their trainees dominate a given field, and that together they can rapidly move it forward.

For instance, the neurobiology department at Stanford University — where I hold a professorship — has a long tradition of caring about mentorship. All faculty members allow their postdocs to take projects on to their own labs, free from competition. On analysing lists of trainees, I found that nearly 70% of our postdocs over the past 25 years have gone on to run their own academic labs and to achieve tenure. Anecdotal evidence suggests that the US national average is less than 10%. Indeed, in any given field, one can easily think of outstanding scientists who also manage to be generous mentors with no sacrifice to the quality of their science.

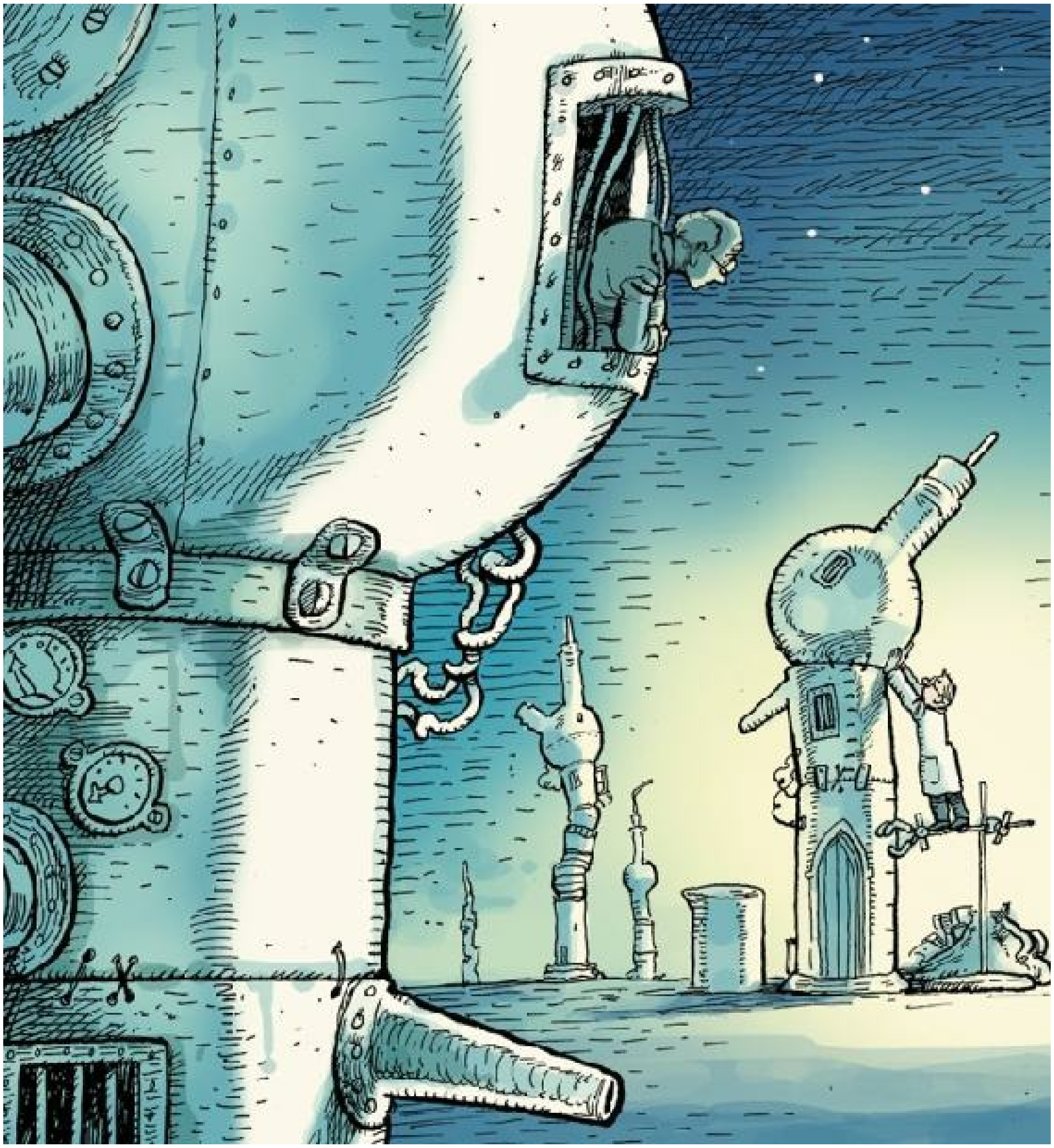

Illustration by David Parkins

If preventing postdocs from porting projects to their own labs is so detrimental to young researchers and to science, why do so many PIs do it? Highly competitive lab leaders wishing to become the best in their field can feel that they are working on a half-eaten pie if they focus on a research question to which others are contributing. They may imagine that their chances of winning a Nobel prize or other prestigious award are lessened if there are too many contributors to a field. Or they can understandably feel

they have invested their entire careers in developing a project area, whereas the postdoc has invested only a few years and relies on building on the PI's previous work.

Some may even be concerned that science could be harmed if PIs stop working on a project that has been taken to another lab by a postdoc. A young PI may be less likely to make advances than an accomplished, well-funded lab would be.

I am not persuaded by any of these arguments. In fact, I think that keeping the whole pie for oneself is sheer gluttony.

I don't believe that science is better off as a completely open competition. Pitting large, established research groups against the nascent labs of young scientists is not fair. And, as in business, monopolies act against the welfare of the whole by preventing innovation. Indeed, in my view, established labs can stifle creativity in their field even as they flourish. Young labs are much more likely to bring new ideas and to question dogmas. Worse, excessively competitive behaviour drives many talented young researchers out of science altogether.

Allowing a postdoc to retain a project does not mean that the PI leaves the field; it just means that they don't assign the obvious next research step to their subsequent postdoc. As a PI myself, I will admit that this approach sometimes seems painful. Discoveries typically result from the years of effort my lab has put into a project and a postdoc's contributions. Often, the immediate next steps are exciting — it is tempting to keep going. Moreover, starting an entirely new project is always challenging, because you first need to obtain sufficient preliminary data to win funding. But with mentorship, there is a time when you must make the welfare of your trainee the highest priority. As with good parenting, I believe that one should give to one's trainees until it hurts to do so.

With every step forward in science, more questions are raised than have been answered. In my case, there is no end of interesting and unexplored avenues about glial cells and their roles in health and disease. In fact, one of my greatest frustrations is that there are questions in my field for which I will not discover the answer during my lifetime. It is a great consolation to know that

I have trained many terrific young scientists, who, in their own labs, will keep exploring these areas long after I am gone.

Good track record

For all of these reasons, graduate students who hope to one day have their own labs need to take great care in selecting their postdoctoral mentor (B. A. Barres *Neuron* **80,** 275–279; 2013). The best mentors serve as strong role models when it comes to doing creative and rigorous science. They are also highly generous people who are willing to give their postdocs academic freedom, the long hours needed to teach them how to design good experiments, and continued support long after their trainees have left, for instance by providing recommendation letters or advice.

Graduate students should investigate the training track records of labs of interest, and discuss these labs with their PhD advisers, programme directors and thesis committee members. All prospective postdocs would be wise to explicitly ask potential mentors (as well as the mentors' previous trainees) what their policies are. In fact, all should be aware that when hiring committees assess an individual postdoc's prospects for future success, they routinely consider whether the applicant is from a lab that allows postdocs to retain projects and, if so, whether that lab is known to directly compete with its former trainees.

Many ungenerous mentors are also highly accomplished scientists. They are often tenured and run successful labs that add stature to their universities and bring in large amounts of funding. So it is not surprising that university leaderships generally overlook poor mentoring. Instead, everyone in biomedical science should strive to reward high-quality mentorship and to protect young scientists.

I think that the topic of research ownership should be included in ethics courses, such as those now mandated by the US National Institutes of Health (NIH) graduate training grants.

Indeed, funding agencies worldwide should do more to ensure postdoc

welfare. In the United States, the NIH's Pathway to Independence (K99) Award is a step in the right direction. Postdocs must formulate specific aims for their own laboratories as part of their funding applications. This prompts them to begin early discussions with their mentors about what they will do on completing their training. Similarly, the K01 Postdoctoral Mentored Career Development Award from the US National Institute of Neurological Disorders and Stroke funds postdocs to work on a project that they can take with them when they start their own labs.

I believe that the major funders of postdoc fellowships, such as the European Molecular Biology Organization and elite funding foundations, should mandate that postdoc fellows be free to take their projects when they move on to their own laboratories. Given that competition for these fellowships is intense, why shouldn't funders and foundations support the postdocs who are most likely to be successful in their own labs?

For graduate students looking to select a postdoctoral mentor, a helpful step would be for the NIH and other funding organizations to make lists of all trainees from training-grant applications available through a public database. These lists would greatly assist prospective postdocs by allowing them to see the training track record of each lab they are considering. In the United States, the National Postdoctoral Association could assume this responsibility (information on funded grant applications is public information that the NIH must disclose on request).

Importantly, grant-review committees should consider training track records during evaluations of applications from established labs. It is encouraging that the Howard Hughes Medical Institute (a non-profit medical-research organization in Chevy Chase, Maryland) has started to put more emphasis on a mentor's training record as one criterion when making decisions about renewing funding. Similarly, I believe that an individual's training track record should be factored in when considering the award of prestigious science prizes. Why should we honour those who don't support science's next generation?

Right now, PIs wishing to take advantage of their postdocs can act with impunity. In this increasingly competitive world, where it is harder than ever for young scientists to get off to a good start in their own laboratories, it is

incumbent upon us as a community to ensure that those to whom we hand the baton are treated equitably.

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There are currently no comments.

Extreme weather events are the new normal

Hurricane Harvey highlights the struggle to apply climate science.

29 August 2017

Brendan Smialowski/AFP/Getty

Flooding from Hurricane Harvey underscores the need for more detailed predictions of climate impacts.

Hurricane Harvey is already being described as one of the ten costliest storms in US history, with the estimated financial damage put at between US$10 billion and $20 billion. Oil- and gas-industry infrastructure lies among the wreckage, and investors are eyeing the impact on the energy and

insurance markets.

Decisions on where to install, build and develop have always been weather dependent. But they are becoming increasingly so. Extreme weather events such as Harvey can be described as ‘unprecedented’ only so many times before companies and governments are forced to accept that such events are the new normal, and to plan accordingly.

Such plans are more difficult and complicated than the simple broad-brush narrative often cited about the need to adapt to global warming. As we explore in a News story this week, scientists cannot yet supply the kind of detailed, quantified information that companies and others require to best plan for changes coming in the next few years to decades.

This is partly a question of resources: the world is a big place, the future infinite and there isn’t enough computing power to go around. It is partly political, with the few late-adopters still offering a false flag around which to rally those who prefer inaction and obstruction. And it’s partly because the field of climate services — as the field of such detailed projections is known — is on the front line of a cultural switch that sees science listen to society’s questions, instead of simply offering answers. It is an imperfect storm, and scientists can’t meet the cost alone.

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Keep on marching for science education

Scientists might have made a difference, had they protested against laws that now threaten what can be taught in our classrooms, argues Brandon Haught[2].

29 August 2017

The new school year is beginning in the United States, and science education in Florida is at risk from laws that passed earlier this summer. It leaves me wondering: where have those who joined April's March for Science gone?

That global action was probably the most popular science-advocacy event of this generation. I took part in Titusville, Florida, and was impressed with the attendance, enthusiasm and creative slogans. In the speeches that followed, I warned against pending legislation that would allow any citizen to demand a hearing to challenge instructional materials. Both critics and advocates see this as a way to stifle teaching about evolution and climate change. We had the summer to make our case.

The science-advocacy group Florida Citizens for Science — for which I volunteer as a board member and communications officer — led the battle to kill, or least modify, those bills. We lost on all fronts. The bills are now law.

Where were those marchers when we needed them? I know several science cheerleaders who took some concrete steps to forestall the legislation (by

phoning elected representatives, for example), but I can count on one hand the number of working scientists who offered their expertise to our group. And I didn't hear of any who approached lawmakers on their own.

Having the scientific community more actively involved might have had an impact. The final vote in the state senate was tight. Advocates of the law were widely quoted as claiming that evolution is just a theory and that anthropogenic global warming is in doubt. It would have been invaluable if scientists at local universities had issued simple statements: yes, evolution is a fact; the word 'theory' is used differently in science from how it's used in casual conversation; and the basics of human-caused global warming need to be taught. Perhaps authoritative voices from the state's universities would have swayed a senator or two.

Since the laws were passed, dozens of articles about them have been published statewide and even nationally. Social media has been buzzing. But the scientific community is still woefully quiet.

Hey, scientists, beleaguered high-school science teachers could use your support.

Other US states have endured attacks on science education. Legislatures in Alabama and Indiana passed non-binding resolutions that encourage 'academic freedom' for science teachers who cover topics — including biological evolution and the chemical origins of life — that the lawmakers deem controversial.

In Iowa, state lawmakers proposed a law requiring teachers to balance instruction on evolution and global warming with opposing views. That effort dwindled without concrete action, but not because of pressure from the scientific community.

We have had some help in our efforts: Jiri Hulcr and Andrea Lucky, scientists at the University of Florida in Gainesville, spoke out with me against these bad educational bills in a newspaper opinion piece. We argued that the choice was stark: training students for careers in the twenty-first century, or plunging them into the Middle Ages.

And Paul D. Cottle at Florida State University in Tallahassee is unrelenting in pursuing his goal of preparing elementary and high-school students for their adult lives. He's an integral part of Future Physicists of Florida, a middle-school outreach programme that identifies students with mathematical ability and guides them into courses that will prepare them for university studies in science and engineering. More generally, he makes sure that students, parents and school administrators hear the message that the path to high-paying, satisfying careers using skills acquired in mathematics and science starts long before university, and depends on accurate instruction.

Plenty of issues need attention. The pool of qualified science and maths teachers is shrinking. Florida students' performance in state-mandated science exams has been poor and stagnant for nearly a decade. This year, the state's education department will begin to review and select science textbooks that will be used in classrooms across the state for at least the next five years.

We need scientists who are willing to take the time and effort to push back against the textbook challenges that these new laws will encourage. We need expert advisers eager to review and recommend quality science textbooks for our schools. We need bold scientists ready to state unapologetically that evolution, global warming — and, yes, even a round Earth — are facts of life.

You're busy. I know. And some of you are uncomfortable in the spotlight. But doing something, even on a small scale, is better than doing nothing. Sign up for action alerts from the National Center for Science Education and your state's science-advocacy group, if you have one. Be a voice within any organizations you belong to, urging them to make statements supporting science education as issues arise. Introduce yourself to teachers at local elementary and high schools.

Even if all you have to offer are ideas and emotional support, we'll take them. Politicians, school administrators, business leaders, parents and even children need to know that you support high-quality science education.

The March for Science was a beneficial, feel-good event. It's over. But we need you to keep on marching!

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Europe’s X-ray laser fires up

High-speed shooter will help scientists to make molecular movies.

29 August 2017

Heiner Müller-Elsner/European XFEL

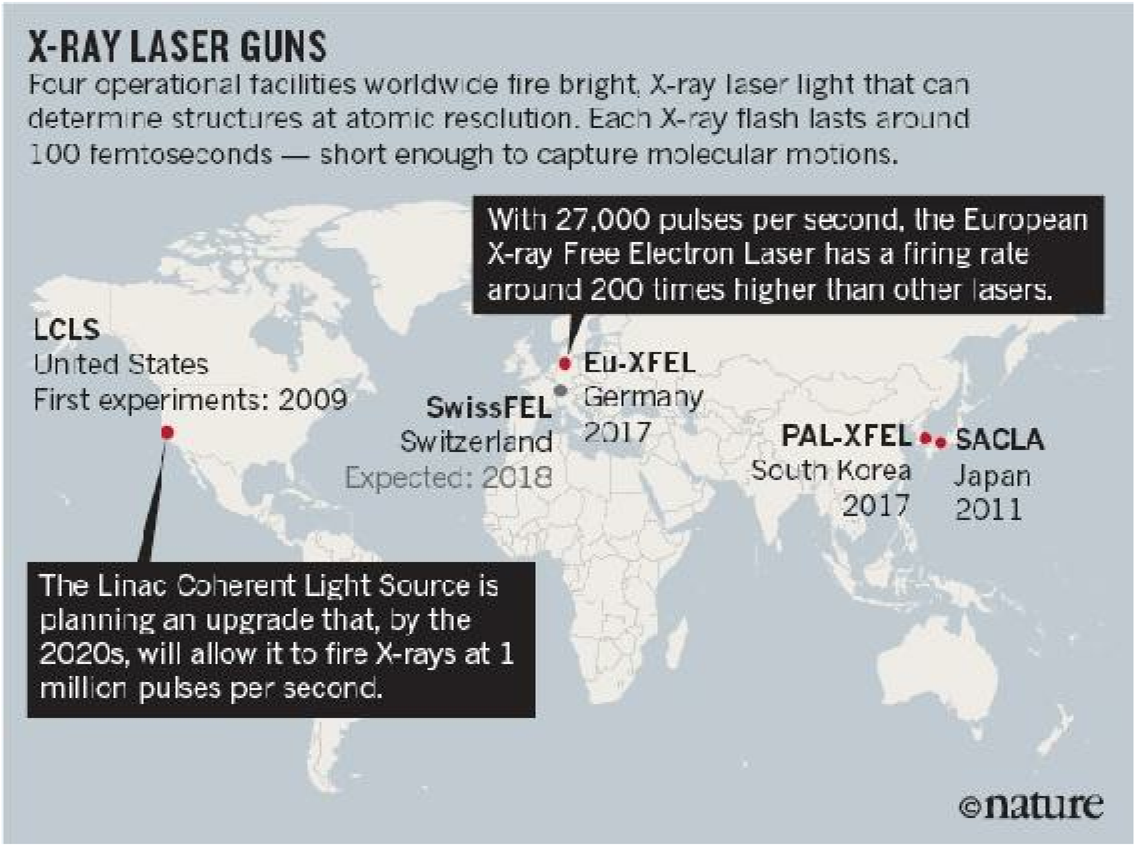
Researchers will soon be able to use the European X-ray Free Electron Laser near Hamburg, Germany, to watch molecules in action.

Scientists who make movies of molecules in motion have a new high-speed camera to shoot with. The €1.2-billion (US$1.4-billion) European X-ray Free Electron Laser (XFEL) will start running its first experiments in September near Hamburg, Germany.

The European XFEL fires powerful X-rays in bursts of a few hundred femtoseconds: so short that, like strobe lights, they can capture snapshots of jittery molecules frozen in time, and with a wavelength small enough to

provide pictures at atomic resolution. The Hamburg machine is one of a few such X-ray lasers worldwide, but boasts a unique rapid-fire feature: it can rattle off 27,000 pulses every second, a firing rate more than 200 times greater than the next-fastest facility, the $420-million Linac Coherent Light Source (LCLS) at the SLAC National Accelerator Laboratory in Menlo Park, California. “It’s such a different beast to anything else on the planet that it really feels like going into uncharted territory,” says Arwen Pearson, a biochemist at the Centre for Free-Electron Laser Science in Hamburg.

In a single second, scientists should be able to collect more than 3,000 good-quality X-ray pictures, compared with 100 or so at other facilities, says Adrian Mancuso, a project scientist at the European XFEL’s experimental stations in Schenefeld, near Hamburg. “Having lots of data matters, and the European XFEL will deliver it in truckloads,” says Abbas Ourmazd, a physicist at the University of Wisconsin–Milwaukee. The European machine — paid for by 12 countries — should relieve some of the pressure on older XFELs in the United States and Japan (see ‘X-ray laser guns’), which are heavily oversubscribed by scientists keen to capture atomic-scale images of their samples. Another XFEL opened to users in Pohang, South Korea, in June, and a machine in Villigen, Switzerland, is due to start experiments in 2018.



Source: European XFEL

At the Hamburg XFEL, bunches of electrons are first accelerated down a 1.7-kilometre-long tunnel. Magnets then bend the electrons' path into wiggling slalom tracks, causing them to emit bunches of high-energy X-rays as they curve. The bright X-ray pulses are so intense that they destroy the samples they hit — but not before enough photons have been scattered to reveal the sample's atomic structure.

X-ray movies

In structure-determination experiments using conventional X-ray sources, molecules must be packed into crystals to scatter enough photons to deduce their structure. But the X-rays from XFELs are so bright that researchers can gather diffraction patterns from crystals just a few nanometres in size, or even from non-crystalline clusters of molecules. This means that XFELs can study

proteins that are hard to crystallize. And researchers can create movies of enzymes, viruses or catalysts in action by building up thousands of different snapshots of the same system taken at different timepoints — often by passing a jet of molecules in solution past an X-ray beam.

In 2015, for example, scientists using the LCLS reported eight snapshots of myoglobin, a muscle protein that binds oxygen, at a resolution of 0.18 nanometres. The images were taken a few picoseconds after a flash of light dislodged a molecule of carbon monoxide from its binding position on the protein (T. R. M. Barends *et al. Science* **350,** 445–450; 2015). On 14 August, Ourmazd and his colleagues reported using X-ray scattering from single viruses at the LCLS to create a 3D movie at 9-nm resolution. It shows the motions of a virus as it reorganizes its genome so that the genetic material can squeeze through a tubular molecular structure — a process that occurs when the virus infects a cell (A. Hosseinizadeh *et al. Nature Methods* http://dx.doi.org/10.1038/nmeth.4395; 2017).

Work such as this depends on gathering many snapshots of identical particles in different conformational states to build up a composite picture of a particle's range of motion, explains physicist John Spence at Arizona State University in Tempe. He says that the European XFEL's high pulse rate will make this process much quicker — so structural data could be accumulated for much smaller individual particles. One of the European facility's most important milestones will be proving that diffraction patterns can indeed be collected from single particles at very high rates, says Mancuso. Because an intense X-ray burst obliterates each particle it hits in a passing spray or jet, it can be a challenge to ensure that the destroyed sample does not impede capture of the next shot. "We won't know that until we try," he says.

Hamburg's facility also has a larger capacity than its competitors: unlike other XFELs, it has three separate undulators to create simultaneous X-ray beams, with the 27,000 pulses per second distributed among them. But the European XFEL will reign for only a limited time: SLAC this year began construction of a $1-billion project to create an even brighter laser beam that, by the early 2020s, will fire up to 1 million pulses each second.

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Legal threat exposes gaps in climate-change planning

Australian lawsuit highlights how difficult it is to turn global warming data into useful advice.

29 August 2017

Daniel Munoz/Reuters

Climate forecasts indicate that Australia will face an increased risk of severe droughts and bush fires.

In a world-first case, an Australian court will next month begin hearing from shareholders who have sued a bank for failing to disclose its vulnerability to climate change.

The case highlights the fact that financial institutions around the world have been slow to acknowledge the risk that climate change poses to investments in infrastructure, agriculture and property. But researchers say the lawsuit also shows that Australia and many other countries are currently unable to forecast the financial risks of climate change.

Shareholders Guy and Kim Abrahams filed the lawsuit on 8 August against the Commonwealth Bank of Australia, saying that the institution's 2016 directors' report did not adequately inform investors of climate-change risks. Their suit also seeks an injunction to stop the bank from making the same omissions in future annual reports.

Climate scientist Andy Pitman at the Centre of Excellence for Climate System Science in Sydney, Australia, says that researchers have been warning companies and governments for years about the need to invest in climate modelling and the related field of climate services, which provides forecasts and other information to public and private users. He says that it would take substantial investment and five to ten years of work for his team to provide banks with the climate information they need.

To be useful, he says, the forecasts would need to be on a time scale that is specific to a business or government's climate vulnerabilities, such as a period of months to years, or on small spatial scales, such as the size of a farmer's field. "That's hugely challenging," he says. "It's the difference between building a car that travels around Sydney and building one that wins a Formula One Grand Prix."

In theory, it should be possible to make such forecasts, but "it's a huge undertaking to actually do it", says Pitman; and it would require high-performance supercomputers generating massive amounts of data.

A question of scale

No country can yet produce climate forecasts on the scales and with the accuracy needed for detailed planning, says Simon Mason, a climate scientist at Columbia University's International Research Institute for Climate and

Society in Palisades, New York. Even the best forecasts are highly uncertain, which makes it difficult to use them for planning, he says.

For instance, if a farmer's bank wants to know the probability that the farm might experience drought, a 10-year projection might suggest a 60% chance of more frequent droughts, says Mason. But that doesn't indicate how severe the droughts might be or whether they will lead to crop failures, he says. "These are exactly the types of questions that need a lot of research."

But Jacqueline Peel, who specializes in climate-change law at the University of Melbourne, Australia, says that companies are likely to face more lawsuits like the Australian one, meaning that they won't have time to wait for fine-scale, tailored models. She says that there is already sufficient information on future warming scenarios for a business to disclose its vulnerabilities.

In Australia, researchers say that budget cuts haven't helped. A report released earlier this month by the Australian Academy of Science identified major gaps in climate research and climate services. The report found that Australia needs an additional 77 climate scientists, including 33 in modelling and 12 in climate services. The academy commissioned the report after the Australian national science agency, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), axed about 30 climate-science positions in 2016. CSIRO says it later added back 31 posts.

"There is a pressing need to improve projections of extreme-weather events to meet the demand for adaptation planning and disaster risk management," the report said.

The situation is better in Germany, the Netherlands and the United Kingdom, which have well-established, government-funded systems that provide climate information. But in the United States, researchers say that climate services are fragmented and struggle to meet the needs of governments or private-sector decision-makers. The Obama administration tried to launch a climate services division, but the US Congress blocked that effort.

"We haven't invested as much in climate services in time scales from several weeks to decades in the US," says John Furlow, who works on climate change and development at Columbia.

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Dinosaurs' spiky armour may have been status symbol

Soft-tissue patterns on a well-preserved fossil suggest that elaborate spines helped dinosaurs to attract mates and communicate.

26 August 2017

Royal Tyrrell Museum of Palaeontology, Drumheller, Canada

Borealopelta's skull was covered with bony knobs.

The thick body armour on some dinosaurs seems perfectly engineered to foil hungry predators. But the remains of a newly discovered armoured dinosaur hint that its spiky suit had another role: showing off to potential mates and rivals.

The spikes on a well-preserved fossil of a 1,300-kilogram armoured dinosaur called *Borealopelta markmitchelli* exhibit the same growth pattern as antelope horns and other structures used for both defence and display, says vertebrate palaentologist Caleb Brown of the Royal Tyrrell Museum of Palaeontology in Drumheller, Canada. “They might have been billboards, basically, to advertise for the animal,” Brown says. He is scheduled to present his findings on 26 August at the Society of Vertebrate Paleontology annual meeting in Calgary, Canada[1].

Fossils generally don’t reveal much about the size of a dinosaur’s spines when it was alive. Armoured dinosaurs were sheathed in bone plates, but that bone was also crowned by more flexible tissue made partly of keratin. Such soft tissue is seldom preserved in the fossil record, leaving researchers uncertain of the size and variety of these keratin caps.

But researchers got a rare glimpse of this soft tissue with the 2011 discovery in Canada of the first specimen of *B. markmitchelli*, which lived 110 million years ago. The exquisitely preserved fossil allowed Brown to measure both the keratin caps and bone plates from the animal’s snout to its hips. He found that the flatter bone plates closer to its tail were covered with a thin crust of keratin. But the keratin on the tusk-like spines protruding from the animal’s shoulders was much thicker, making up one-third of the spines’ length. Chunky keratin ornaments also capped the bone spikes on the animal’s neck.

Up and down the animal’s body, the taller the bone plate, the thicker its cap of keratin. Brown says that pattern is common in horns and antlers, which today’s animals use to send signals to each other as well as to fend off attackers.

Royal Tyrrell Museum of Palaeontology

Borealopelta lived around 110 million years ago.

Armour attraction

It's also telling that *B. markmitchelli*'s most elaborate decorations are near the front of its body, as are modern-day horns and antlers. Two Borealopeltas facing off would each have gotten an eyeful of bristling armour.

The details add up to suggest that the evolution of *B. markmitchelli*'s flashy spikes was driven by the demands of social communication. The adornments might have provided a warning to potential foes, a lure to potential sexual partners —or both.

The argument that dinosaur armour had a role beyond protection makes sense, says vertebrate palaeontologist Thomas Holtz of the University of Maryland in College Park. "This is a nice indication that there is more to armour than absorbing damage," he says.

B. markmitchelli tells scientists "an incredible amount", agrees vertebrate palaeontologist Michael Burns of Jacksonville State University in Alabama. The animal helps to reveal how armour was patterned and how it evolved over time, he says, but saying that the spikes served a role in mating displays is speculation, given that there's data from only one specimen.

Brown agrees that his idea isn't definitive. Other exceptionally preserved fossils would help to confirm his thinking, he says, although it may be a long time before researchers are lucky enough to find anything to match Borealopelta.

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There are currently no comments.

Nature News

周日, 03 9月 2017

Nature News

[周日, 03 9月 2017]

- **Nature News**

Nature News

Nature is a weekly international journal publishing the finest peer-reviewed research in all fields of science and technology on the basis of its originality, importance, interdisciplinary interest, timeliness, accessibility, elegance and surprising conclusions. Nature also provides rapid, authoritative, insightful and arresting news and interpretation of topical and coming trends affecting science, scientists and the wider public.

- **Trump finally nominates new leader for NASA** [周六, 02 9月 08:00]
  James Bridenstine, a member of Congress, has long pushed for the United States to return to the Moon.
- **Nature videos help to calm inmates in solitary confinement** [周五, 01 9月 08:00]
  Controversial experiment ignites debate over whether scientific work could be used to justify harsh prison tactics.
- **Volcanic views, stalking storks and the ephemeral eclipse** [周五, 01 9月 08:00]
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  Researchers deliberately heated up a slice of the Antarctic sea bed to see how ecosystems responded.
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- **Reprogrammed cells relieve Parkinson's symptoms in trials** [周三, 30 8月 08:00]
  Monkeys implanted with neurons derived from stem cells showed sustained improvement after two years.
- **Closure of US coal study marks an alarming precedent** [周三, 30 8月 08:00]
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US$1-million study on the health risks of coal mining — casting a pall on academic freedom.

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- **Stop blocking postdocs’ paths to success** [周三, 30 8月 08:00]
  Lab heads should let junior researchers take their projects with them when they start their own labs — it drives innovation and discovery, argues Ben A. Barres.
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- **Books in brief** [周三, 30 8月 08:00]
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- **Keep on marching for science education** [周二, 29 8月 08:00]
  Scientists might have made a difference, had they protested against laws that now threaten what can be taught in our classrooms, argues Brandon Haught.
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  High-speed shooter will help scientists to make molecular movies.
- **Legal threat exposes gaps in climate-change planning** [周二, 29 8月 08:00]

Australian lawsuit highlights how difficult it is to turn global warming data into useful advice.

Trump finally nominates new leader for NASA

James Bridenstine, a member of Congress, has long pushed for the United States to return to the Moon.

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1. 02 September 2017

James Bridenstine, a Republican member of the US Congress from Oklahoma, has been tapped to be the next head of NASA. Bridenstine is a strong supporter of lunar exploration and commercial spaceflight.

If confirmed by the Senate, he will take the reins of an agency that is building a new heavy-lift rocket to fly astronauts to an unknown destination. Bridenstine has repeatedly argued that the United States should return to the Moon — among other things, to mine water ice to fuel a fleet of satellites with lunar hydrogen and oxygen.

“From the discovery of water ice on the Moon until this day, the American objective should have been a permanent outpost of rovers and machines at the poles with occasional manned missions for science and maintenance,” Bridenstine told a lunar exploration group last November. “This is our Sputnik moment.”

Bridenstine has also pushed to accelerate the government’s use of commercial space services. “The US government understands that in the future, and even today, it will be a customer of routine space services, not a provider of routine space services,” he said in the November speech. NASA currently pays for private companies to fly agency cargo to the International Space Station; US astronauts will fly aboard commercial rockets no earlier than next year.

“Representative Bridenstine is certainly a "different" choice for NASA Administrator, but to me the difference is mainly positive,” says John Logsdon, a space-policy expert at George Washington University in Washington DC. “He has been refining his ideas with diverse audiences over the past months, and would bring to the NASA position a clearer and better defined strategy for moving ahead than did most of his predecessors as they began their tenure.”

Space credentials

After studying economics, business and psychology at Rice University in Houston, Texas, Bridenstine served as a pilot in the US Navy. He flew combat missions in Iraq and Afghanistan, and in anti-drug operations in Central and South America. He also worked as executive director for an aerospace museum in Tulsa, Oklahoma. Since he was first elected to Congress in 2012, Bridenstine has slowly built up his space-policy credentials, serving on the House of Representatives’ science, space, and technology committee and speaking in front of groups such as the US Federal Aviation Administration’s space-transportation conference.

In 2016, Bridenstine introduced legislation in the House that would require NASA to make Mars its “main human spaceflight priority” — presumably after first establishing a Moon base — and bolster the already-growing role of commercial spaceflight. The legislation stalled at the subcommittee level.

Bridenstine has expressed scepticism about climate change. In a June 2013 speech on the House floor, he disparaged the role of humans in global warming and criticized President Barack Obama for spending more money on climate research than on weather forecasting. Bridenstine has argued to exclude greenhouse gases from federal regulation, and to expand oil and gas exploration on federal lands and offshore.

Major challenges facing the next NASA administrator include keeping the development of the Space Launch System heavy-lift rocket and its accompanying Orion crew capsule on track. The first flight of the paired system is meant to be in November 2018 but will likely be delayed, an April report from the US Government Accountability Office found.

“We hope the new Administrator embraces NASA's strong commitment to science and public engagement,” says Heidi Hammel, executive vice president of the Association of Universities for Research in Astronomy (AURA) in Washington DC. “AURA looks forward to working with the new NASA Administrator to ensure that the Agency maintains a robust science portfolio.”

Bridenstine would replace Charles Bolden, a former astronaut who flew four times aboard the space shuttle.

In June, the administration of President Donald Trump re-established the National Space Council, an on-again off-again entity meant to coordinate space activities among various government departments, including between civilian and military agencies. Vice-President Mike Pence is chair of the council.

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Updates

Updated:

This piece has been updated with comments from John Logsdon and Heidi Hammel.

Comments

Comments

There are currently no comments.

Nature videos help to calm inmates in solitary confinement

Controversial experiment ignites debate over whether scientific work could be used to justify harsh prison tactics.

01 September 2017

Benj Drummond

An inmate watches nature videos in a designated room at Snake River Correctional Institution in Oregon.

A little bit of nature can calm even the most stressed populations of people, according to a study conducted on prisoners in solitary confinement.

In the experiment, researchers found that prisoners who watched videos with nature scenes felt less stressed and weren't as violent as those who didn't. The team, led by ecologist Nalini Nadkarni at the University of Utah in Salt Lake City, published their findings on 1 September in *Frontiers in Ecology and the Environment*[1].

Nadkarni first proposed the study in 2010 while visiting a prison that housed criminals who were considered to be the highest security risks. "Six guards in Kevlar vests and full riot gear had to go in and subdue an inmate in a restraining chair," she says. "I thought, wow, if we could just calm them with nature rather than with Kevlar vests and riot gear, that would be really great." But it took Nadkarni years to find a prison that was willing to let her test her hypothesis.

The experiment's results have now convinced some prison officials to offer inmates access to nature videos. However, critics of the study argue that it could be used to justify the continued use of solitary confinement — a practice that some consider too harsh.

Calming influence

Past research has shown that regularly seeing plants — even from a window — can improve hospital patients' and prison inmates' physical and mental health[2]. Nadkarni went further by studying people in solitary confinement, where inmates typically spend 23 hours a day alone in bare-walled cells.

Her team divided inmates at the Snake River Correctional Institution in Ontario, Oregon, into 2 groups of 24. Those in one group could choose to exercise or, up to five times per week, go to a 'blue room' to watch 45-minute-long videos showing natural scenes such as mountains, forests and oceans. Those in the other group were offered exercise, but no videos.

The researchers and prison staff measured inmates' moods and stress levels, and tracked violent incidents over a year. They found that inmates who had access to videos reported feeling calmer and were involved in 26% fewer violent incidents. The results suggest that nature imagery can help even

society’s most nature-deprived populations, which includes prison inmates, but also residents of nursing homes and inner city areas, says Nadkarni.

The blue room has also helped Snake River to save thousands of dollars in medical costs resulting from altercations and self-harm, says Renee Smith, the institution’s behavioral health systems manager. “We were pretty excited,” she says. The programme is already being replicated in three other states.

Benj Drummond

Nalini Nadkarni interviews a prisoner who participated in the study.

A controversial idea

“It’s certainly a pretty creative naturalistic experiment,” says Lisa Nisbet, a psychologist at Trent University in Peterborough, Canada. “You couldn’t get a much more deprived group of people.”

But she and others caution that it is impossible to know whether exposure to nature had the beneficial effect because no group was shown videos with other content. Without this additional control group, “you can’t really draw any definitive conclusions,” says Marc Berman, a psychologist at the University of Chicago in Illinois.

The study authors acknowledge this limitation, which they say is due to there being an insufficient number of prison staff to implement the additional control condition. But they say that inmates specifically mentioned the videos’ nature content during interviews. One wrote: “The nature project help’s [*sic*] me think clearer to know there is so much more beauty in this world then [*sic*] this prison”.

Not everyone is embracing the study. Opponents of solitary confinement worry that the paper could provide cover for perpetuating a practice that many consider to be cruel and counterproductive. “I would hate to think that this study will be used to justify keeping solitary confinement prisoners in conditions where they are deprived of opportunities to actually experience nature,” says Craig Haney, a psychologist at the University of California, Santa Cruz.

Nadkarni says her collaboration has helped inmates even if it hasn’t dramatically reformed the prison system. “As an ecologist, it is not in my power to change the system of mass incarceration,” she says. “One thing I can do is think about ways that bring the therapeutic value of nature to people who are incarcerated.”

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Comments

Comments

There are currently no comments.

| Section menu | 主菜单 |

Volcanic views, stalking storks and the ephemeral eclipse

August’s sharpest science shots, selected by *Nature*’s photo team.

01 September 2017

Souvenirs of travel

Image Slideshow

1. 

There was plenty to interest the scientifically inclined in the latest National Geographic Travel Photographer of the Year contest. The

Grand Prize winner was this shot of the Colima Volcano in Mexico erupting in December 2015.

Sergio Tapiro Velasco/National Geographic Travel Photographer of the Year

2. 

This picture of Caribbean reef sharks (*Carcharhinus perezii*) was taken with a remote camera in the Gardens of the Queen, a marine protected area near Cuba. This image and the next two earned honourable mentions in the Nature category.

Shane Gross/National Geographic Travel Photographer of the Year

3. 

This picture from the Tamba area of Japan shows fireflies signalling for mates above the stairs leading to a shrine.

Yutaka Takafuji/National Geographic Travel Photographer of the Year

4. 

This shot of Mount Bromo erupting in 2016 in Indonesia was taken from the patio of a local hotel.

Reynold Riksa Dewantara/National Geographic Travel Photographer of the Year

Eclipse excitement

Jasman Mander

North Americans turned into literal lunatics on 21 August, as an eclipse sent thousands of obsessed sky-watchers scrambling to see the Moon block out the Sun. Here, a composite image shows the progression of the eclipse as seen from the Lowell Observatory in Madras, Oregon.

Go northwest!

Dan Goldman/AP/REX/Shutterstock

The Northwest Passage through the Arctic Ocean has become a much-examined signifier of climate change. As ice thins, more ships than ever before are attempting to push through this previously impassable sea route. On 29 July, the icebreaker MSV *Nordica* — pictured here — completed the route earlier in the year than ever before. Just a few weeks later, a reinforced Russian tanker made the journey successfully without an icebreaker escort.

Harvey's toll

Jonathan Bachman/Reuters

Storm Harvey is still bringing death and destruction to the United States, as record rainfall in Texas triggered flooding and evacuations. These people in Houston, Texas, were among many forced to take to the waters to escape.

Stork, stalking

Nicky Classen/Solent News/REX/Shutterstock

This yellow-billed stork (*Mycteria ibis*) began hunting for fish right alongside a photographer’s hide in Kwa-Zulu Natal, South Africa. Nicky Classen was inside the hide earlier this month to capture the shot.

Catching dinner

John Thys/AFP/Getty

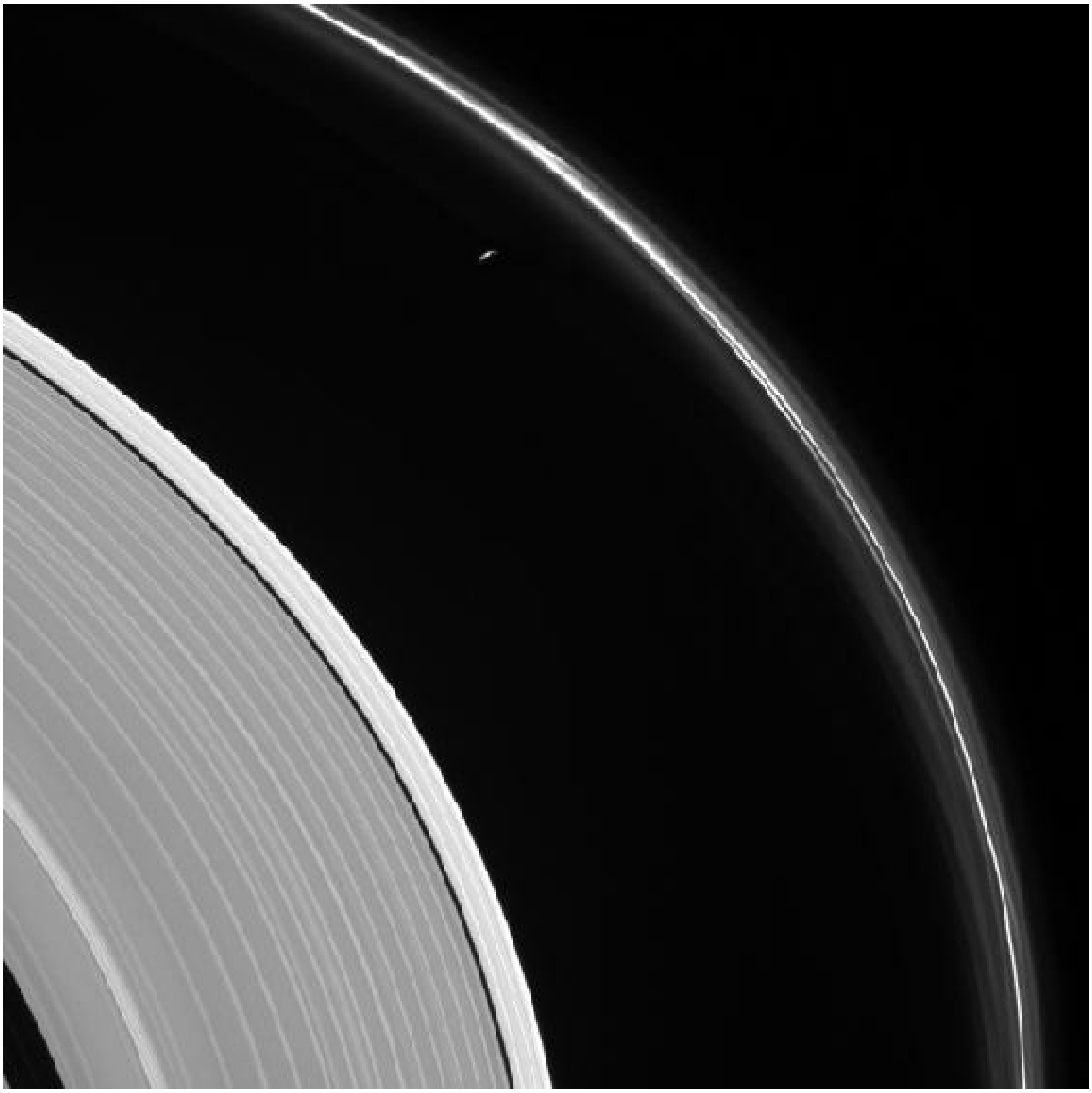
In the Netherlands, lions that were once trained to do tricks in circuses have been taught other skills. This lioness is catching a piece of meat during hunting training.

Do svidaniya!

Joel Kowsky/NASA

On 28 July, a Soyuz rocket shuttled three crew members of Expedition 52 to the International Space Station. The mission plans to test out flexible solar panels that roll out like blankets; explore the physics of neutron stars; and test in rats an experimental drug to deal with bone-mass loss caused by weightlessness.

Cassini’s legacy



NASA/JPL-Caltech/SSI

On 15 September, NASA's Cassini spacecraft will begin a plunge into Saturn's clouds that will lead to its destruction and the end of its 13 years of data collection. [*Nature* looks back at some of the pictures] the probe has captured, and what they have meant for science.

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Comments

There are currently no comments.

How labs are coping with Hurricane Harvey's devastating floods

Advance planning has kept some Texas facilities safe during the unprecedented storm.

31 August 2017 Clarified:

1. 01 September 2017

Win McNamee/Getty

Now that the rains have cleared over downtown Houston, the long road to recovery can begin.

Hurricane Harvey swept ashore on 25 August and dumped record-breaking amounts of rain on Houston, Texas, over the next several days. As the storm begins to dissipate, scientists in its wake are starting to take stock of the personal and professional toll.

Many institutions in Houston were relatively well prepared for Harvey, having put precautions in place after suffering major losses when Tropical Storm Allison flooded the city in 2001. Facilities in other parts of the state have not been so lucky, but researchers hit by Harvey — now downgraded to a tropical depression — are not being left to fend for themselves. As of 31 August, roughly 200 scientific laboratories across the country have offered computer time, lab space, animal care and spare rooms to researchers displaced by the storm, using the hashtag #SciHelpTX on Twitter.

When Harvey made landfall as a category 4 hurricane, it hit facilities at the University of Texas at Austin Marine Science Institute in Port Aransas particularly hard, ripping the roof off Brett Baker's microbial-ecology lab. Baker says that one of his graduate students has already arranged to transfer to a lab at the University of California, Berkeley, and a postdoc is heading to Uppsala University in Sweden. "Our institute is on a barrier island," Baker says, and it took a direct hit from the storm. Baker spent some time crying, he adds, but is now so busy with logistics that he hasn't fully processed his feelings.

Lessons learnt

Most of the biomedical-research facilities in Houston, including those at Rice University, MD Anderson Cancer Center and the University of Texas Health Science Center, had installed special doors and floodgates to hold back storm waters after Allison. Those precautions saved equipment and animals, says Anirban Maitra, a pathologist at MD Anderson. "I think they prevented a mega-catastrophe," he adds.

Baylor College of Medicine lost 60,000 breast-cancer specimens in the 2001 storm. But the lessons that it learnt have paid off, says spokesperson Lori Williams. "We built a wall around the entire campus," she says. "We've had

no animals lost, no research lost."

The University of Houston (UH), by contrast, does not have special flood infrastructure. So the institution has been dealing with flooded basement labs, and has struggled to keep animals dry and fed. Forty baby rhesus monkeys had their formula milk rationed, says Amr Elnashai, vice-president for research and technology transfer at UH. A few had to be weaned a week early. Supplies of liquid nitrogen and helium are also running low, endangering frozen samples if they cannot be restocked soon. "If the worst is over, then we are fine," says Elnashai. "If there is another hit, then we are in deep trouble."

Personal costs

Meanwhile, staff at the Johnson Space Center in Houston are camping out at mission control to keep the International Space Station and the James Webb Space Telescope (JWST) programmes going. "I came in for a shift Friday night and I've been here ever since," says flight director Courtenay McMillan. Staff have been sleeping on makeshift beds and air mattresses, and subsisting on provisions provided by co-workers and friends. "We have not run out of coffee, which is the most important thing," McMillan adds.

The JWST was in the middle of a 100-day test in a thermal vacuum chamber when Harvey struck, but is unharmed. And a Soyuz capsule landing scheduled for this weekend in Kazakhstan — which the space centre will help to coordinate — will go ahead with only minor modifications to the plan, says McMillan.

Although many institutions have fared relatively well despite the storm's ferocity, researchers and staff are still dealing with personal losses. Officials estimate that at least 38 people have died as a result of the storm. Maitra says that one administrator on his team has been evacuated to a hotel. "She had to leave in a hurry with her kids in the middle of the night. They were stuck on the third floor of her complex for three days. It is just heartbreaking."

Louise Prockter, director of the Lunar Planetary Institute in Houston, was

travelling when Harvey swept into town. She has been trying to support her staff remotely from Washington DC. “Some of our staff have lost all their property,” she says. “It is a mess. For some people, normal is a long, long way off.”

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Clarifications

Clarified:

Louise Prockter originally stated that a lot of the staff at the Lunar Planetary Institute lost all of their property. She misspoke and says it should be some of the staff that lost all of their property.

Comments

Comments

There are currently no comments.

Artificial warming trial reveals striking sea-floor changes

Researchers deliberately heated up a slice of the Antarctic sea bed to see how ecosystems responded.

31 August 2017

David Doubilet/NGC

Antarctic ecosystems will be affected by warming waters.

The future has come to a small patch of the Antarctic sea floor, courtesy of an experiment that placed electric heating pads on the ocean's bottom. The pioneering trial is one of the most realistic and technically challenging ocean-warming experiments yet performed, researchers say — and it opens up a

new avenue to explore how warming oceans affect marine ecosystems.

In the past 40 years, the surface waters of Earth's oceans have warmed by some 0.4 °C on average as a result of climate change. And if greenhouse-gas emissions continue at their current pace, models forecast that the warming could reach up to 2 °C by 2100.

But researchers know little about how ocean ecosystems will respond and adapt as a result — and uncertainties are largest in polar regions where there are few field data, says study co-author Gail Ashton, a marine ecologist with the Smithsonian Environmental Research Center in Tiburon, California.

That data gap spurred Ashton and her colleagues to carry out the artificial warming experiment in Antarctica. They began in 2014, when scuba divers dug trenches, laid cables and installed 12 panels 15 metres under water on flat sea bed near the Rothera Research Station of the British Antarctic Survey (BAS), which is on a small island off the west coast of the Antarctic Peninsula. Four panels were heated so that they were always 1 °C above the ambient temperature — which in the region varies from around –2 °C to +2 °C during the year — and four were heated to 2 °C above ambient temperature. The remaining four were left unheated, as controls.

Gail Ashton

A team of researchers laid heating pads on the Antarctic sea floor to investigate warming.

Using cameras, the divers then monitored how microorganisms — of the kind that encrust wet surfaces and biofoul underwater pipes — colonized the panels. The species, including microscopic invertebrates and sponges, represented typical sea-bed fauna in the region. The experiment was supposed to run for two years but ended after nine months, when icebergs damaged power-supply cables. Still, researchers saw significant and surprising differences between the panels, says Ashton. “I had hoped we might be able to see some subtle differences after careful image analysis,” she says. “But I would never have expected that the warming effects would be so easily discernible with the human eye.”

Metabolic theory predicts that biological growth rates increase by around 10% for every 1 °C of warming. But some species grew twice as fast on the heated panels as they did on the controls, Ashton and her colleagues report in *Current Biology*[1]. Distinctly different animal communities settled on the heated surfaces. On the 1 °C set, a species called *Fenestrulina rugula* — a kind of filter-feeding invertebrate called a bryozoan — so dominated the fauna that the diversity of all the species on the panel was reduced.

“The results are very exciting and provocative,” says Craig Smith, a marine ecologist at the University of Hawaii at Manoa. “They suggest that climate warming in the next 50 years in Antarctica could substantially alter the unique diversity of Antarctic ecosystems.”

Experimenters have struggled in the past to study the effects of ocean warming in a controlled experiment, in which one area of sea is deliberately and uniformly warmed relative to another over a long period of time. Previous ocean tests have compared coastal areas with nearby regions that receive extra heat from local power plants. And one effort in 2010 used electric panels to heat a small section of water in western Australia, but the animals being studied quickly grew big enough to leave the warmed water layer.

Danger to diversity

Researchers worry that Antarctic species — adapted to cold waters — may suffer as waters warm. The results suggest that species at the bottom of the marine food web are able to cope with one or two degrees of warming, Ashton says, particularly given that it happens over decades. However, species-richness or diversity might be affected, and some species might grow to dominate others. Ashton says she would also like to know what the knock-on effects will be for other creatures.

“We do need more reliable field data to validate and interpret lab experiments on how environmental change affects life in the seas,” says Hans-Otto Pörtner, an ecologist at the Alfred Wegener Institute of Polar and Marine Research in Bremerhaven, Germany. “As yet, we have only a sketchy knowledge of what controls the success of species.”

Others agree that carefully designed controlled-warming experiments such as Ashton’s are the way to go, although Smith says they should ideally be run for longer, with more replications.

One caveat, he cautions, is that the panels warmed only a roughly 2-millimetre-thick layer of water. The rest of the water column — which would have contained larvae and food on which the animals in the experiment depend — remained colder. So the results aren’t a perfect predictor of how sea-floor communities might change, he says.

Furthermore, the results can’t be generalized to suggest what will happen in other seas, says Simon Morley, a marine biologist with the BAS in Cambridge, who took part in the study.

Ashton and Morley plan to do more warming experiments in other polar environments. In September, Morley will look for a suitable test site near the Canadian High Arctic Research Station in Cambridge Bay. He says he will also apply for money to do similar experiments in tropical waters, and perhaps even freshwater environments.

“More of these experiments need to be done to be able to generalize, and

draw wider conclusions," says Boris Worm, an oceanographer at Dalhousie University in Halifax, Canada. "Each is necessary to challenge our simplistic assumptions about how climate change may alter the world we live in."

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Comments

Comments

There are currently no comments.

Doubts raised about CRISPR gene-editing study in human embryos

Alternative explanations challenge whether technique actually fixed a genetic mutation as claimed.

31 August 2017

Doubts have surfaced about a landmark paper claiming that human embryos were cleared of a deadly mutation using genome editing. In an article[1] posted to the bioRxiv preprint server on 28 August, a team of prominent stem-cell scientists and geneticists question whether the mutation was actually fixed.

The 2 August *Nature* paper[2], led by reproductive biologist Shoukhrat Mitalipov at the Oregon Health and Science University in Portland, described experiments in dozens of embryos to correct a mutation that causes a heart condition called hypertrophic cardiomyopathy.

In contrast to previous human-embryo editing studies, Mitalipov's team reported a high success rate at correcting a disease-causing mutation in a gene. The team claimed that the CRISPR–Cas9 genome editing tool was able to replace a mutant version of the *MYBPC3* gene carried by sperm with a normal copy from the egg cell, yielding an embryo with two normal copies. Mitalipov's team also introduced a healthy version of the gene along with the CRISPR machinery, but they found that the corrected embryos had shunned it for the maternal version.

But there is reason to doubt whether this really occurred, reports a team led by Dieter Egli, a stem-cell scientist at Columbia University in New York City, and Maria Jasin, a developmental biologist at Memorial Sloan Kettering Cancer Center in New York City. George Church, a geneticist at Harvard Medical School in Boston, Massachusetts, is another co-author.

In their bioRxiv paper, Egli and Jasin and their co-authors say that there is no plausible biological mechanism to explain how a genetic mutation in sperm could be corrected based on the egg's version of the gene. More likely, they say, Mitalipov's team failed to actually fix the mutation and were misled into thinking they had by using an inadequate genetics assay. Egli and Jasin declined to comment because they say they have submitted their article to *Nature*.

"The critique levelled by Egli *et al*. offers no new results but instead relies on alternative explanations of our results based on pure speculation," Mitalipov said in a statement.

Shared concerns

But other scientists contacted by *Nature*'s news team shared the Egli team's concerns. (*Nature*'s news team is editorially independent of its journal team.) Reproductive biologist Anthony Perry at the University of Bath, UK, says that after fertilization, the genomes of the egg and sperm reside at opposite ends of the egg cell, and each is enshrouded in a membrane for several hours. This fact, Perry says, would make it difficult for CRISPR-Cas9 to fix the sperm's mutation based on the egg's version of the gene, using a process called homologous recombination. "It's very difficult to conceive how recombination can occur between parental genomes across these huge cellular distances," he says.

Egli and Jasin raise that issue in their paper. They suggest that Mitalipov's team was misled into believing that they had corrected the mutation by relying on a genetic assay that was unable to detect a far likelier outcome of the genome-editing experiment: that CRISPR had instead introduced a large deletion in the paternal gene that was not picked up by their genetic assay. The Cas9 enzyme breaks DNA strands, and cells can attempt to repair the damage by haphazardly stitching the genome together, often resulting in missing or extra DNA letters.

That explanation makes sense, says Gaétan Burgio, a geneticist at the Australian National University in Canberra. "In my view Egli *et al*.

convincingly provided a series of compelling arguments explaining that the correction of the deleterious mutation by self repair is unlikely to have occurred."

Another possibility Egli's team raise is that the embryos were produced without a genetic contribution from sperm, a process known as parthenogenesis. Mitalipov's team showed that the paternal genome was present in only 2 out of the 6 embryonic stem cell lines they made from gene-edited embryos.

Robin Lovell-Badge, a developmental biologist at the Francis Crick Institute in London, says that it is possible that there is a "novel or unsuspected" biological mechanism at work in the very early human embryo that could explain how Mitalipov's team corrected the embryos' genomes in the manner claimed. He would first like to hear from Mitalipov before passing judgement. "It simply says that we need to know more, not that the work is unimportant," Lovell-Badge says of Egli and Jasin's paper.

In the statement, Mitalipov's said his team stands by their results. "We will respond to their critiques point by point in the form of a formal peer-reviewed response in a matter of weeks."

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Comments

Comments

There are currently no comments.

Skeleton plundered from Mexican cave was one of the Americas' oldest

Rock-encased bone shard left behind by thieves allowed researchers to determine that the remains are probably more than 13,000 years old.

30 August 2017

Nick Poole/Liquid Jungle

A human skeleton — probably one of the Americas' oldest — was stolen from the Chan Hol Cave in Mexico soon after it was discovered in 2012.

A human skeleton that was stolen from an underwater cave in Mexico in 2012 may be one of the oldest ever found in the Americas. Scientists have now put the age of the skeleton at more than 13,000 years old after analysing a shard of hip bone — left behind by the thieves because it was embedded in a stalagmite.

Cave divers discovered the remains in February 2012 in a submerged cave called Chan Hol near Tulúm on Mexico's Yucatán peninsula, and posted photos of a nearly complete skull and other whole bones to social media. The posts caught the attention of archaeologists Arturo González González at the Desert Museum in Saltillo, Mexico, and Jerónimo Avilés Olguín at the Institute of American Prehistory in Cancún.

By the time researchers visited the cave in late March, the remains were gone — except for about 150 bone fragments and a pelvic bone that had been subsumed by a stalagmite growing up from the cave floor. On the basis of these bones, the researchers think that the skeleton belonged to a young man who died when sea levels were much lower and the cave was above ground.

Dating techniques

To determine the age of human remains, researchers often measure levels of a radioactive isotope of carbon in collagen protein within bones. But in this case, most of the collagen had been leached out by water while the bones were submerged, making this method unreliable, says Wolfgang Stinnesbeck, a palaeontologist and geoscientist at the University of Heidelberg, Germany, who led the efforts to date the remains.

Instead, Stinnesbeck’s team collected a fleck of the pelvis bone and surrounding stalagmite, which contains a mineral called calcite. The team then dated the rock using the relative levels of uranium and thorium isotopes in the calcite. The deeper into the stalagmite the researchers sampled, the older the dates turned out to be; stone just 2 centimetres from the bone was 11,300 years old. Calcite closer to the bone gave conflicting results, Stinnesbeck says.

The team determined that the skeleton was older than 13,000 years by analysing the rate at which calcite had formed around the bone, and by matching the shifts in stalagmite isotope levels to those in other caves. The findings were published on 30 August in *PLoS ONE*[1].

Eugenio Acevez Nunez

A diver collects a portion of a cave stalagmite found in cave that contains ancient human bones.

Alistair Pike, an archaeological scientist at the University of Southampton, UK, notes that the stalagmite set over the bone during a time of profound climate change, which could have altered the stalagmite's rate of growth. He says he is therefore more comfortable considering the bones to be a minimum of 11,300 years old — still “very significant”, he notes.

Ancient company

Few other human remains from the Americas are older than 13,000 years. The skeleton of a teenage girl recovered from a different Yucatán cave was carbon-dated to more than 12,000 years old, and a skeleton found in another submerged cave near Tulúm was deemed to be around 13,500 years old, also using radiocarbon dating.

“They’ve done a really nice job determining the age of this thing,” says David Meltzer, an archaeologist at Southern Methodist University in Dallas, Texas. There is convincing archaeological proof that humans colonized the Americas before 14,000 years ago, but very old remains are precious. “These sites are rare as hen’s teeth,” Meltzer says.

Apart from the Yucatán finds, the next-oldest skeleton from the Americas is that of a 12,600-year-old boy found in Montana, whose sequenced genome places him on a lineage leading to present-day Native American groups. Researchers have sequenced only a few other human skeletons from the Americas that are older than 10,000 years, hindering efforts to unravel the region's ancient population history.

Getting DNA from what remains of the Chan Hol skeleton will be hard. A sample sent to one of the world’s leading ancient-DNA labs, the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, did not contain enough DNA, Stinnesbeck says. He hopes to find DNA in the few teeth not taken by the thieves.

The theft still boggles Stinnesbeck, whose team is continuing to study the cave and its remains. The researchers recently reported the discovery of

fossils in the cave that are of a new species of peccary[2] — a hoofed mammal related to pigs — as well as evidence that the cave's human inhabitants made fires.

“What would you want with a skeleton? Would you take it home?” Stinnesbeck asks. “If they had known it was very old, maybe just to have a souvenir, to have something special.”

“We went to the police and they did some inquiries,” he adds. “They never came up with anything substantial.”

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Comments

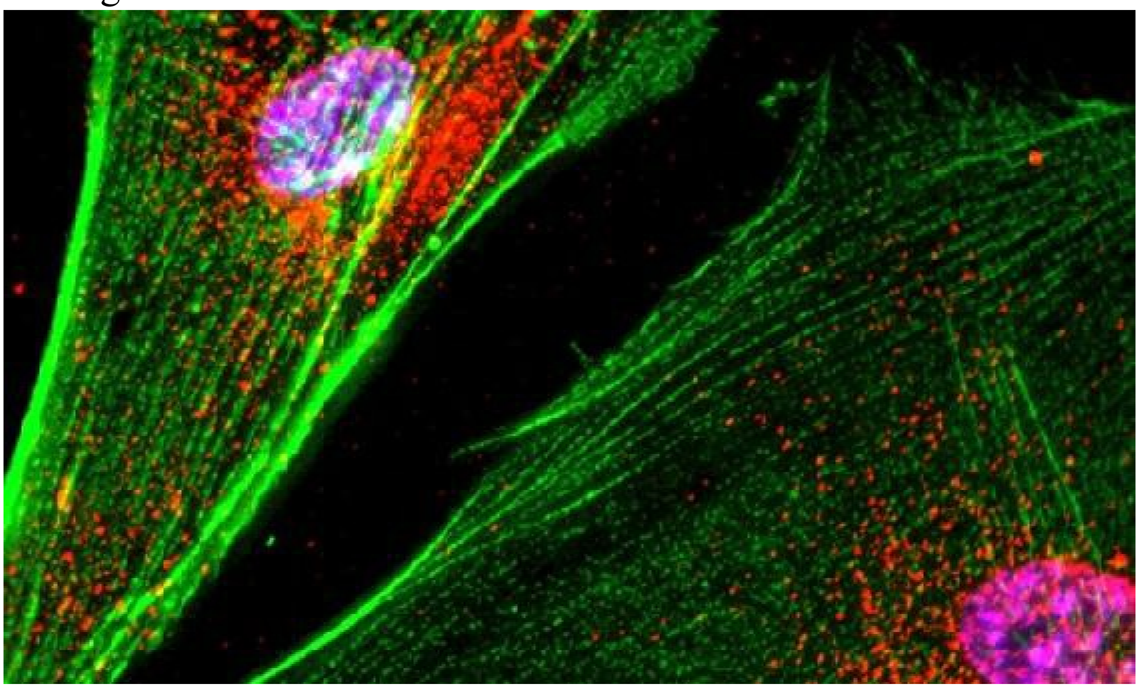
Commenting is currently unavailable.

| Section menu | 主菜单 |

Reprogrammed cells relieve Parkinson's symptoms in trials

Monkeys implanted with neurons derived from stem cells showed sustained improvement after two years.

30 August 2017



B. Bick, . Poindexter, UT Med. School/SPL

A depletion of brain cells that produce dopamine is responsible for the mobility problems seen in people with Parkinson’s disease.

Japanese researchers report promising results from an experimental therapy for Parkinson’s disease that involves implanting neurons made from ‘reprogrammed’ stem cells into the brain. A trial conducted in monkeys with a version of the disease showed that the treatment improved their symptoms

and seemed to be safe, according to a report published on 30 August in *Nature*[1].

The study's key finding — that the implanted cells survived in the brain for at least two years without causing any dangerous effects in the body — provides a major boost to researchers' hopes of testing stem-cell treatments for Parkinson's in humans, say scientists.

Jun Takahashi, a stem-cell scientist at Kyoto University in Japan who led the study, says that his team plans to begin transplanting neurons made from induced pluripotent stem (iPS) cells into people with Parkinson's in clinical trials soon.

The research is also likely to inform several other groups worldwide that are testing different approaches to treating Parkinson's using stem cells, with trials also slated to begin soon.

Nature breaks down the latest research — and what it means for the future of stem-cell treatments.

Why are stem cells a promising treatment for Parkinson's disease?

Parkinson's is a neurodegenerative condition caused by the death of cells called dopaminergic neurons, which make a neurotransmitter called dopamine in certain areas of the brain. Because dopamine-producing brain cells are involved in movement, people with the condition experience characteristic tremors and stiff muscles. Current treatments address symptoms of the disease but not the underlying cause.

Researchers have pursued the idea that pluripotent stem cells, which can form any cell type in the body, could replace dead dopamine-making neurons in people with Parkinson's, and thus potentially halt or even reverse disease progression. Embryonic stem cells, derived from human embryos, have this capacity, but they have been the subject of ethical debates. Induced pluripotent stem (iPS) cells, which are made by coaxing adult cells into an

embryonic-like state, have the same versatility without the associated ethical concerns.

What did the latest study find?

Takahashi's team transformed iPS cells derived from both healthy people and those with Parkinson's into dopamine-producing neurons. They then transplanted these cells into macaque monkeys with a form of the disease induced by a neuron-killing toxin.

The transplanted brain cells survived for at least two years and formed connections with the monkey's brain cells, potentially explaining why the monkeys treated with cells began moving around their cages more frequently.

Why is the research important?

Crucially, Takahashi's team found no sign that the transplanted cells had developed into tumours — a key concern with treatments that involve pluripotent cells — or that they evoked an immune response that couldn't be controlled with immune-suppressing drugs.

"It's addressing a set of critical issues that need to be investigated before one can, with confidence, move to using the cells in humans," says Anders Bjorklund, a neuroscientist at Lund University in Sweden.

When will clinical trials begin and how will they work?

"I hope we can begin a clinical trial by the end of next year," says Takahashi. Such a trial would be the first iPS cell trial for Parkinson's. In 2014, a Japanese woman in her 70s became the first person to receive cells derived from iPS cells, to treat her macular degeneration.

In theory, iPS cells could be tailor-made for individual patients, which would eliminate the need to use drugs that suppress a possible immune response to foreign tissues.

But customized iPS cells are expensive to make and can take a couple months to derive and grow, Takahashi notes. So his team instead plans to establish iPS cell lines from healthy people and then use immune cell biomarkers to match them to people with Parkinson's in the hope of minimizing the immune response (and therefore the need for drugs to blunt the attack).

In a study described in an accompanying paper in *Nature Communications*[2], Takahashi's team implanted into monkeys iPS-cell-derived neurons from different macaques. They found that transplants between monkeys carrying similar white blood cell markers triggered a muted immune reaction.

What other stem-cell approaches are being tested for Parkinson's?

Earlier this year, Chinese researchers began a Parkinson's trial that used a different approach: giving patients neural-precursor cells made from embryonic stem cells, which are intended to develop into mature dopamine-producing neurons. A year earlier, in a separate trial, patients in Australia received similar cells. But some researchers have expressed concerns that the immature transplanted cells could develop tumour-causing mutations.

Meanwhile, researchers who are part of a Parkinson's stem-cell therapy consortium called GForce-PD, of which Takahashi's team is a member, are set to bring still other approaches to the clinic. Teams in the United States, Sweden and the United Kingdom are all planning trials to transplant dopamine-producing neurons made from embryonic stem cells into humans. Previously established lines of embryonic stem cells have the benefit that they are well studied and can be grown in large quantities, and so all trial participants can receive a standardized treatment, notes Bjorklund, also a consortium member.

Jeanne Loring, a stem-cell scientist at the Scripps Research Institute in La

Jolla, California, favours transplanting iPS-derived neurons made from a patient's own cells. Although expensive, this approach avoids dangerous immunosuppressive drugs, she says. And because iPS cells are established anew for each patient, the lines go through relatively few cell divisions, minimizing the risk that they will develop tumour-causing mutations. Loring hopes to begin her team's trial in 2019. "This shouldn't be a race and we're cheering for success by all," she says.

Lorenz Studer, a stem-cell scientist at the Memorial Sloan Kettering Cancer Center in New York City who is working on a trial that will use neurons made from embryonic stem cells, says that there are still issues to work out, such as the number of cells needed in each transplant procedure. But he says that the latest study is "a sign that we are ready to move forward".

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Comments

Comments

There are currently no comments.

Closure of US coal study marks an alarming precedent

The Trump administration has stepped up its assault on environmental protections by halting a US$1-million study on the health risks of coal mining — casting a pall on academic freedom.

30 August 2017

Saul Loeb/AFP/Getty

US President Donald Trump makes his priorities clear during a rally in West Virginia.

When the US National Academies of Science, Engineering, and Medicine (NASEM) speaks, the government usually listens. Last year, US government

agencies spent US$216 million to commission NASEM expertise on issues from the scientific workforce to military implications of synthetic biology. Most NASEM reports are filled with caveats and make for dry reading. But occasionally, they pull no punches. A memorable 2009 report on the state of forensic science, for instance, concluded that almost every forensic method used in law enforcement is seriously flawed and that their use risks putting innocent people in jail. Given the academies' stature, it's hard for the government to brush off its hired commission when faced with such language.

Such concerns seem to weigh on the US Department of the Interior (DOI), which in 2016 commissioned a $1-million study of the potential health risks of surface coal mining on communities in West Virginia. Some evidence suggests that people who live near surface-mining operations — also known as mountaintop removal — have an unusually high rate of lung cancer and birth defects, which could be attributed to air and water pollution.

Launching the study — now halfway through its two-year term — was itself an achievement, given the political nature of the topic. Although much is known about the risks of coal mining to miners, little research has been done on its health impacts on local communities, not least because of attempts by the coal industry to hinder such work. Mining companies and trade organizations have sued for access to the e-mails of academics researching mountaintop removal, and have fought to keep peer-reviewed studies from being used in court. The National Mining Association questioned the value of the NASEM study when it was announced.

On 18 August, three days before the NASEM committee working on the study was due to meet in a Kentucky mining town, the DOI ordered a stop to the study, with immediate effect. The agency says it is reviewing spending on all projects that cost more than $100,000. "The Trump administration is dedicated to responsibly using taxpayer dollars in a way that advances the department's mission and fulfils the roles mandated by Congress," DOI spokeswoman Heather Swift said in a statement to *Nature*. She did not respond to questions about which other projects are under review.

This is the first time that the administration of President Donald Trump has cancelled a NASEM study that has already started — a move that has rarely

happened in the past, according to the academies.

In its statement about the cancellation, the NASEM said that its investigators "stand ready" to resume as soon as the DOI completes its review. But they're likely to be waiting a long time. The Trump administration has made no secret of its fondness for the US coal industry, which employs around 76,000 people. (By comparison, around 1.2 million people live in counties where mountaintop removal takes place.) The DOI's assertion that the decision is a budgetary one is suspect, especially given that the study has already spent a good amount of its budget.

It seems, instead, that the government would rather quash the review than risk it producing results that cast aspersions on the coal industry. This is par for the course for the DOI, whose head, Ryan Zinke, plans to downsize national parks in favour of resource extraction, and which has also suspended meetings with its independent advisory councils on issues concerning public lands.

With the near-daily news about the Trump administration weakening climate and environmental protections, it is easy to become fatigued. Yet the move to pre-empt the prestigious and independent NASEM is particularly concerning. It raises questions about what other studies could be cancelled if the government fears their results. It is another blow for science and for academic freedom.

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Alan Turing's notes, runaway salmon and illegal gold-mining

The week in science 25–31 August 2017.

30 August 2017

Research | Facilities | Publishing | People | Environment | Business | Trend watch

RESEARCH

Science results emerge from US eclipse A total solar eclipse swept across the continental United States on 21 August, delighting skygazers and scientists. The path of totality crossed more than a dozen states, making it one of the most observed eclipses ever (composite image shown). A citizen-science project collected data from more than 55 telescopes to produce a high-resolution movie of the solar corona — the part of the Sun's atmosphere seen during totality. Among the professional scientific studies, a pair of NASA jets that chased the eclipse gathered high-resolution video of the corona, while ground-based expeditions collected information about ionized elements in the solar atmosphere.

Stan Honda/AFP/Getty

Gravitational waves Many of the world's best telescopes were turned to a little-known galaxy called NGC 4993 from 17 August, after an alert about a potential gravitational-wave detection in the region. Rumours abounded that the US-based Laser Interferometer Gravitational-wave Observatory (LIGO), possibly aided for the first time by the Virgo interferometer in Pisa, Italy, had picked up the signature of two neutron stars colliding in the galaxy. NASA's Fermi Gamma-ray Space Telescope detected a burst of γ-rays in roughly the same region of the sky as NGC 4993, which may indicate the aftermath of a neutron-star collision there, but which could instead come from an unrelated event. It would be a historic first for astronomy if telescopes saw signatures of the collision at the same time as interferometers 'heard' the event through vibrations in space-time. See go.nature.com/2w46ja8 for more.

FACILITIES

Big NASA missions NASA should continue its tradition of building

spacecraft for large strategic space-science missions such as the Hubble Space Telescope and the Mars Curiosity rover, says a 24 August panel report from the US National Academies of Sciences, Engineering, and Medicine. Like other agencies, NASA is struggling with a limited budget, and the panel examined whether big missions should remain a part of its portfolio. But the scientific return is worth it, the report found, as long as missions are managed well. Developing a range of cost options for large projects could help the agency to avoid problems such as those plaguing the James Webb Space Telescope, which has run billions of dollars over budget and is currently set to launch in 2018.

PUBLISHING

Preprint sites Six new preprint sites were rolled out on 29 August. The services, which host research papers before formal publication, include paleorXiv for palaeontology and INA-rXiv, a preprint server for Indonesian research. The other sites cover research on nutrition, library sciences, sports and exercise, and mind and contemplative practices. The servers are supported by software developed by the Center for Open Science in Charlottesville, Virginia, which already hosts eight other preprint services.

PEOPLE

Surprise Turing find Documents belonging to mathematician Alan Turing have been unearthed at the University of Manchester, UK, and made available to researchers, the university announced on 25 August. The 148 items include a letter to Turing from British intelligence agency GCHQ and a draft BBC radio programme on artificial intelligence. Discovered in a storeroom filing cabinet in May, the collection does not include much personal correspondence. But it offers a glimpse of the code-breaker's working life between 1949 and his death in 1954 — a period for which archive material is scarce, according to the university library's archivist. Some documents also give insight into his rather forthright personal opinions; his response to an invitation to a US conference in April 1953 was simply: "I would not like the journey, and I detest America."

Science envoy quits An energy researcher at the University of California, Berkeley, resigned from his post as a science envoy for the US Department of State on 21 August, citing US President Donald Trump's "attacks on the core values of the United States". In a resignation letter addressed to Trump, Daniel Kammen criticized the president's equivocal response to violent demonstrations by white supremacists in Charlottesville, Virginia, on 12 August. Kammen also condemned the Trump administration's "destructive" policies on energy and the environment, which he said have affected his work as a science envoy.

ENVIRONMENT

Mind the penguins Chile has blocked plans for an iron mine that would have posed a threat to thousands of penguins. On 21 August, a Chilean government committee announced that Andes Iron, the local firm in charge of the US$2.5-billion project, failed to put into place effective environmental protections to compensate for how mining activities might disturb wildlife. The project aimed to extract millions of tonnes of iron from a site in the northern Coquimbo region of Chile. But the site lies near the 888-hectare National Humboldt Penguin Reserve — a set of islands that are home to one of the world's largest breeding populations of Humboldt penguins (*Spheniscus humboldti*; pictured). The species is listed as 'vulnerable' by the IUCN Red List. Andes Iron says that it will appeal against the decision.

Joel Sartore/NGC

Runaway salmon Thousands of Atlantic salmon have made a break for the Pacific Ocean after fish-farm nets in Washington state’s San Juan Islands succumbed to “exceptionally high tides” on 19 August, according to the aquaculture company that owned the fish. The Washington Department of Fish & Wildlife estimates that about 4,000–5,000 fish escaped from the pens, which contain more than 1.3 million kilograms of farmed fish. The incident has raised concern that the Atlantic species could threaten wild fish populations native to the region. Officials are temporarily suspending fishing regulations and encouraging recreational and commercial fishers to capture and sell any Atlantic salmon that they find.

Australia land laws Contentious laws that allow landowners in New South Wales, Australia, to clear native vegetation on their properties came into effect on 25 August. Landowners in the country’s most populous state can now remove more of certain types of vegetation, a loosening of the state’s previous regulations. The decision has angered scientists and conservationists, who say that the laws put biodiversity and threatened species at risk. But some farmers aren’t satisfied either, saying that the

amended rules are still too restrictive.

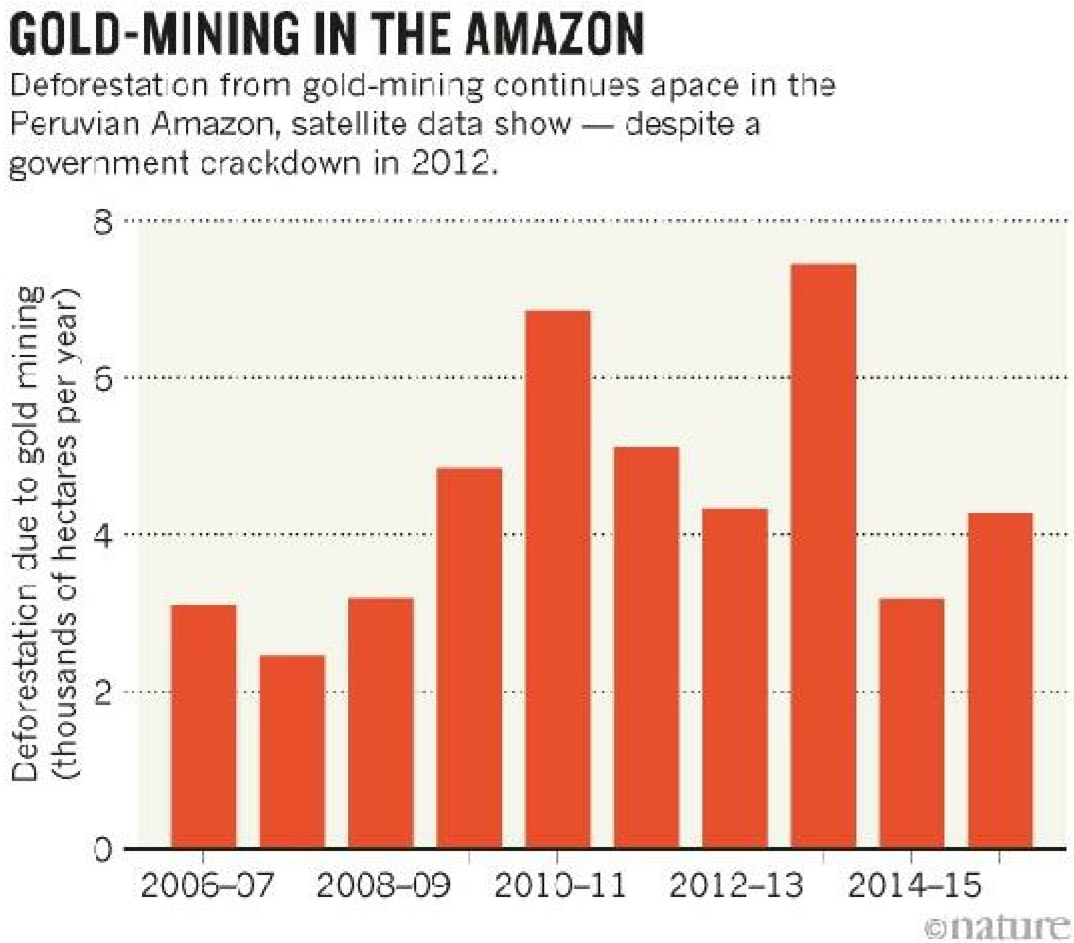
BUSINESS

Quantum quest Australia's first quantum-computing hardware company started up on 23 August. Silicon Quantum Computing is a partnership between government, industry and the University of New South Wales in Sydney. It aims to develop and commercialize a prototype of a 10-quantum-bit circuit made from silicon within five years — a stepping stone towards the creation of a silicon-based quantum computer. The company enters an increasingly crowded marketplace in quantum computing, with competition from technology giants such as Google and Microsoft.

Drug costs cut Millions of people with hepatitis C may soon be able to afford the life-saving antiviral drug sofosbuvir. On 23 August, Gilead Sciences of Foster City, California, which sells the daily pills, said that it would license manufacturers of generic drugs to supply its antivirals in four middle-income countries — Malaysia, Thailand, Belarus and Ukraine. That should slash prices: a 3-month course of the pills ranges from US$84,000 in the United States to $12,000 in Malaysia, but costs as little as $300 in the 101 developing countries where generic versions are already permitted. Pressure had been mounting for the change: the Malaysian government has been considering a licence that would allow generics to be made or used in government facilities, overriding Gilead's patent, and Ukraine has already revoked a key patent on sofosbuvir that shortened Gilead's monopoly.

TREND WATCH

Illegal gold-mining in the Peruvian Amazon is on the rise again, according to a study published on 22 August (G. Asner and R. Tupayachi *Environ. Res. Lett.* **12,** 094004; 2017). Mining-related deforestation abated after a government crackdown in 2012, the authors found in their analysis of land-cover images. But since then, the mined area has increased by more than 40% in the Madre de Dios region, to 68,228 hectares. The region has some of the world's highest levels of animal diversity.



Source: G. P. Asner & R. Tupayachi Environ. Res. Lett. 12, 094004 (2017).

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Cassini’s 13 years of stunning Saturn science — in pictures

As the mission speeds towards its conclusion, *Nature* takes a look at what researchers have learnt about the planet’s moons, rings and tempest-filled skies.

30 August 2017

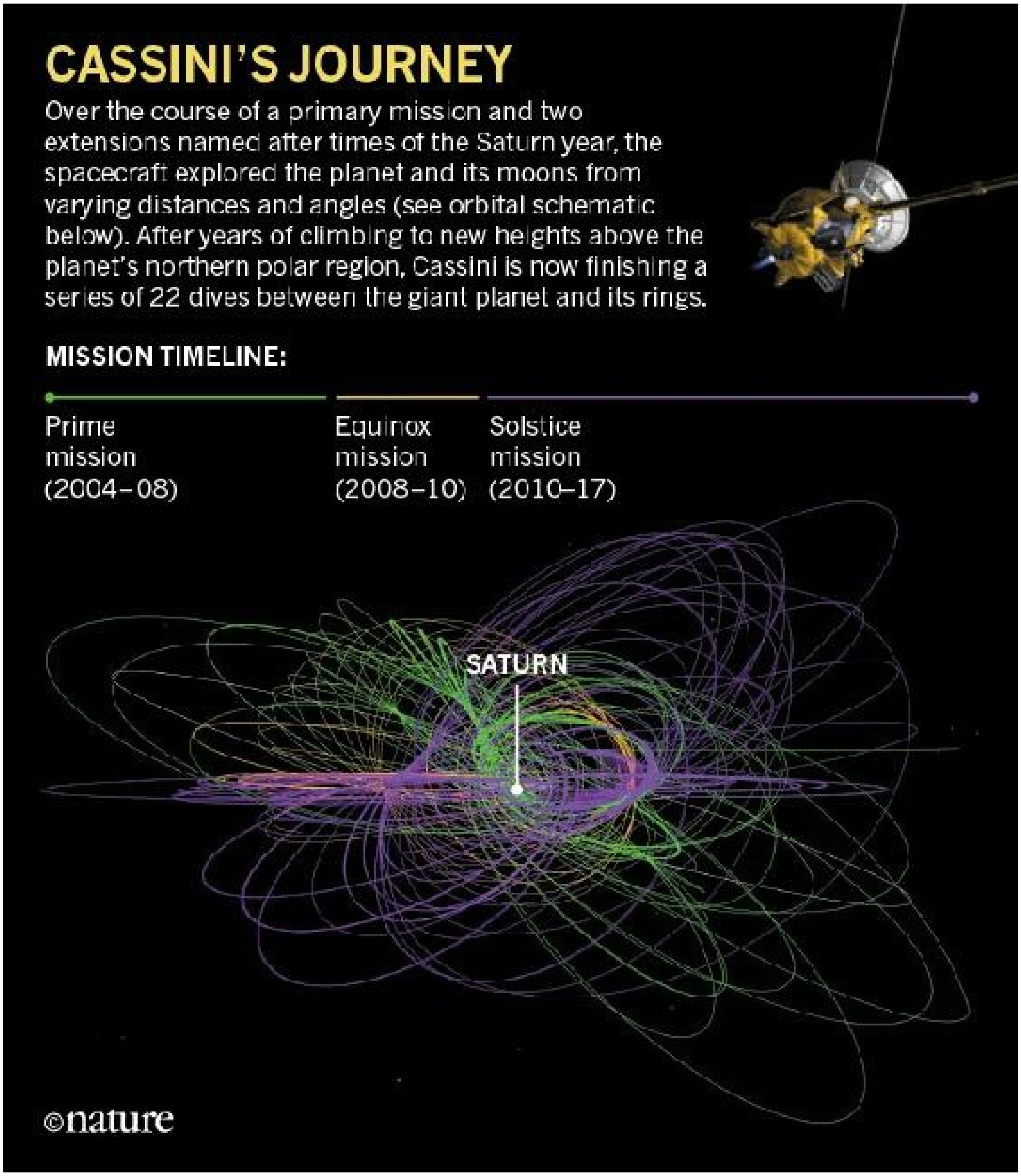
NASA/JPL

In 2004, Cassini became the first spacecraft to orbit Saturn.

Twenty years ago, in the wee hours of a muggy Florida morning, the Cassini spacecraft lit up the skies as it blasted off from Cape Canaveral. Now, after a 3.5-billion-kilometre journey and 13 years spent circling Saturn, the orbiter is running low on fuel. On 15 September, Cassini's controllers on Earth will send the craft plunging into Saturn's cloudtops to prevent it from accidentally

crashing into and contaminating any moon that might be able to harbour life.

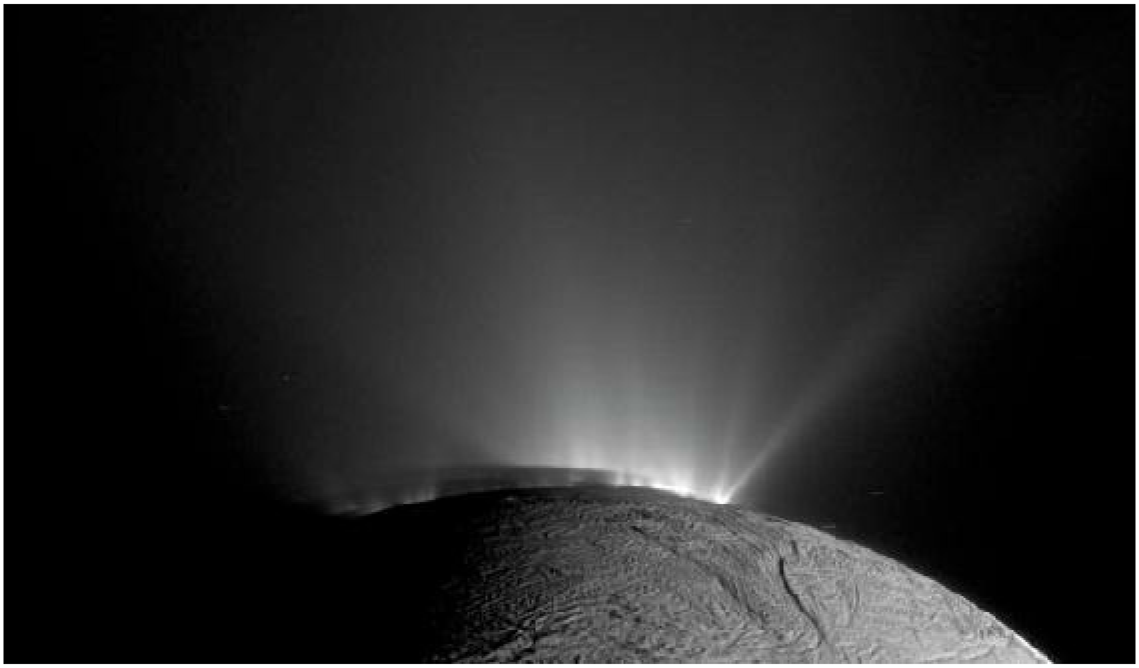
Cassini will send data back to Earth right up until that incandescent coda — a fitting end for one of history's most successful interplanetary missions. A joint venture between NASA, the European Space Agency and the Italian Space Agency, Cassini was the first spacecraft to orbit Saturn. And with much more time to gather science than the earlier fly-bys of Pioneer 11 in 1979, Voyager 1 in 1980 and Voyager 2 in 1981, the mission delivered discoveries in spades, racking up an impressive list of findings as it looped around the majestic planet, danced along its glorious rings and whizzed past many of its bizarre moons. “Cassini was a long wait, but it was definitely worth it,” says Linda Spilker, a planetary scientist at NASA's Jet Propulsion Laboratory in Pasadena, California, and the mission's project scientist. “It has so many incredible accomplishments we can be so proud of.”



Cassini: NASA/JPL; Orbital schematic: NASA/Jet Propulsion Laboratory-Caltech

The spacecraft revealed the chaotic dynamics that shape Saturn's rings, found geysers spraying from the moon Enceladus and watched gigantic storms roil the planet's atmosphere. It observed seasons change for nearly half of a Saturn year, as first the equinox and then the solstice passed, transforming

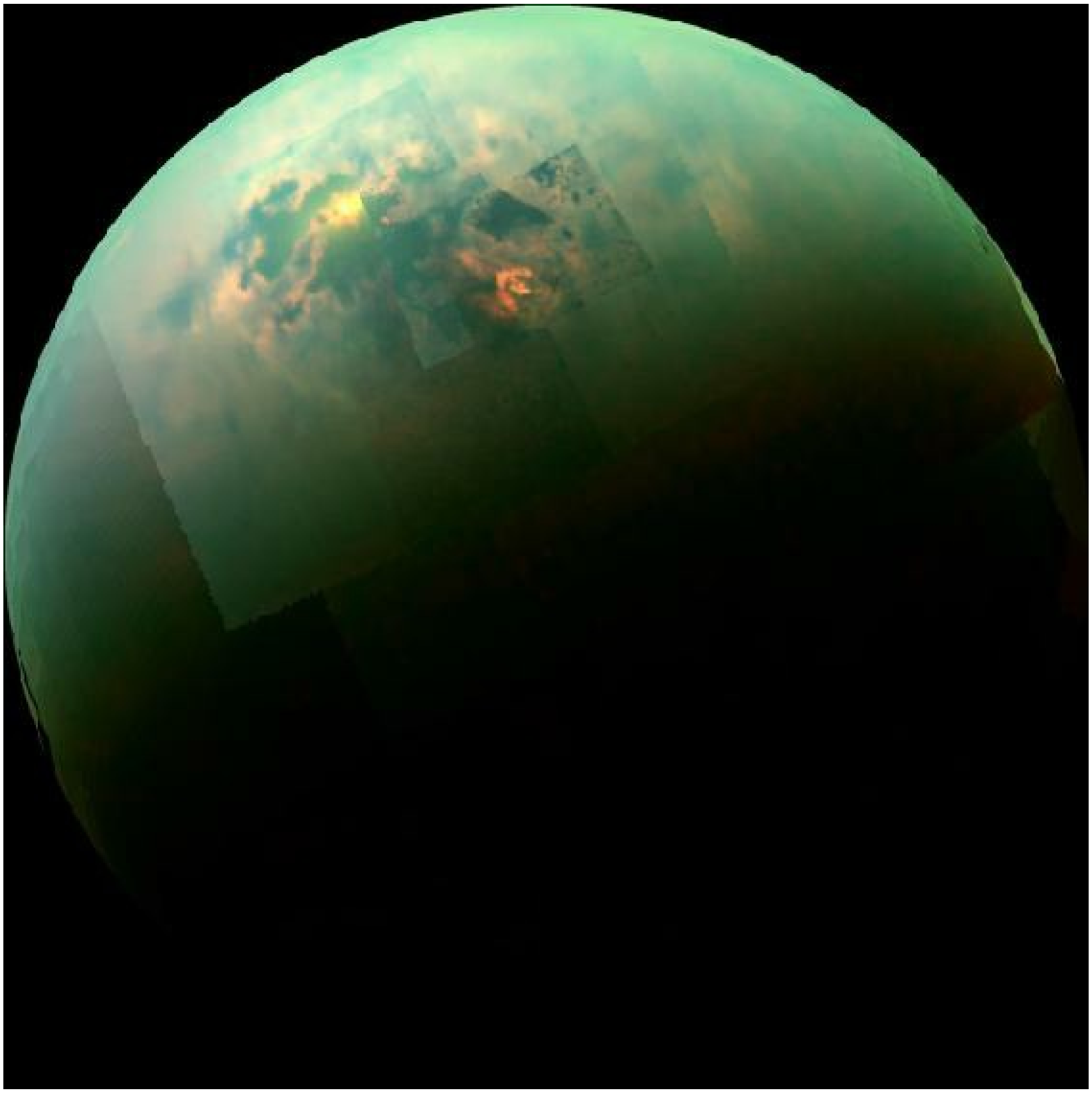
weather patterns. Over the life of Cassini's mission, Saturn has become less of a stranger and revealed itself to be a vibrant system churning with continual change. The spacecraft's observations became a touchstone for understanding the complexity of gas-giant planets, a legacy that NASA's Juno spacecraft is currently continuing at Jupiter.



NASA/JPL-Caltech/Univ. Arizona/Univ. Idaho

Geysers on Enceladus spray water vapour and ice mixed with organic molecules into space.

Cassini also made history when it released the Huygens probe, which became the first craft to touch down in the outer Solar System. After a daring two-and-a-half hour descent to the surface of the moon Titan in 2005, Huygens sent back snapshots of a frozen floodplain littered with rocks. Cassini's mapping later revealed Titan to be a world teeming with hydrocarbon lakes and rivers, replenished by methane and ethane rain.



NASA/JPL-Caltech/Univ. Arizona/Univ. Idaho

Sunlight glints off lakes of liquid hydrocarbons on Titan.

With no official plans to return to Saturn anytime soon, 15 September will mark the end of an era. “On Cassini's final day, we will be watching the signal as we go as deeply into the atmosphere as we can,” says Spilker. “That day to say goodbye will be a tough day.”

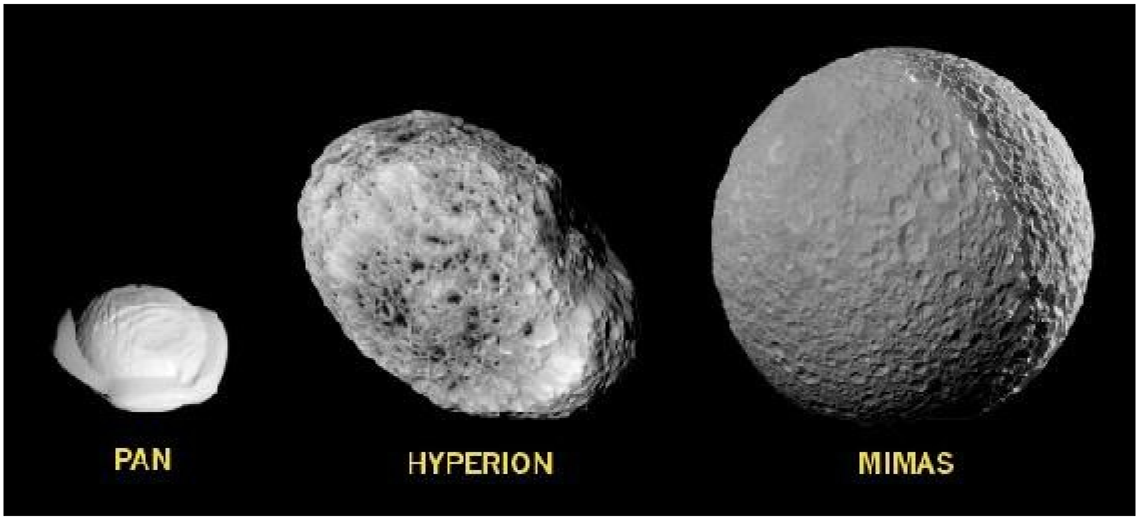
A menagerie of moons

Cassini's biggest surprises came as it studied some of Saturn's 60-plus moons, raising as many questions as it answered.

NASA/JPL/Space Science Institute

Three of Saturn’s moons — Epimetheus, Janus and larger Dione — pass by one another in this set of images captured in 2005.

Researchers finally solved the mystery of Iapetus — which boasts one light-coloured side and one dark side — when they discovered an enormous ring of material streaming off another of Saturn's moons, Phoebe. Iapetus seems to get its two-faced look as its leading surface ploughs through Phoebe's debris. And in their study of how crater-pocked Mimas wobbles on its axis, Cassini scientists realized that the world may have either a buried ocean or a stretched-out core.



NASA/JPL-Caltech/SSI

Saturn’s moons come in a variety of shapes.

A look at the planet's littlest moons — never before seen up close — uncovered a panoply of strange shapes. Hyperion resembles a sponge, and Pan has been compared to a piece of space ravioli. Pandora features an enormous impact crater, a scar from some long-ago collision.

But the most astonishing observations were of Titan and Enceladus. On Titan, Saturn's largest moon, Cassini discovered a world with complex chemistry similar to Earth's before life arose. In the 72 minutes that Huygens survived on Titan's surface, the battery-powered lander snapped images of a landscape strewn with frozen rocks and cloaked in an orange haze. From above, Cassini mapped the moon using radar and other instruments, revealing enormous dunes of water ice coated with a hydrocarbon glaze, which wind for hundreds of kilometres in wavy bands near the equator. Liquid methane and ethane rain down, forming rivers and lakes of hydrocarbons. Cassini captured images of sunlight reflecting off these bodies of liquid — and even used radar to chart their bottoms, sketching out the depths through which a future mission's submersible might glide.

Even after all that, Enceladus stole the show. Thought to be inert before Cassini arrived, the moon actually spews ice and water vapour from enormous fractures that decorate its south-pole region like tiger stripes.

Powered by Saturn's gravitational pull, the geysers spurt out 200 kilograms of salty, organic-laced material every second.

Cassini scientists were surprised to find that this material contains small particles of silica, which may be formed by the interaction of water and rock at hydrothermal vents deep inside Enceladus. On Earth, similar deep-ocean vents are home to microbes that thrive off chemical energy, far from sunlight — and so Enceladus has vaulted to the top of the list of places to search for extraterrestrial microbes. Planetary scientists are already plotting return missions to fly through Enceladus's plumes and sniff for hints of life.

The ever-changing rings

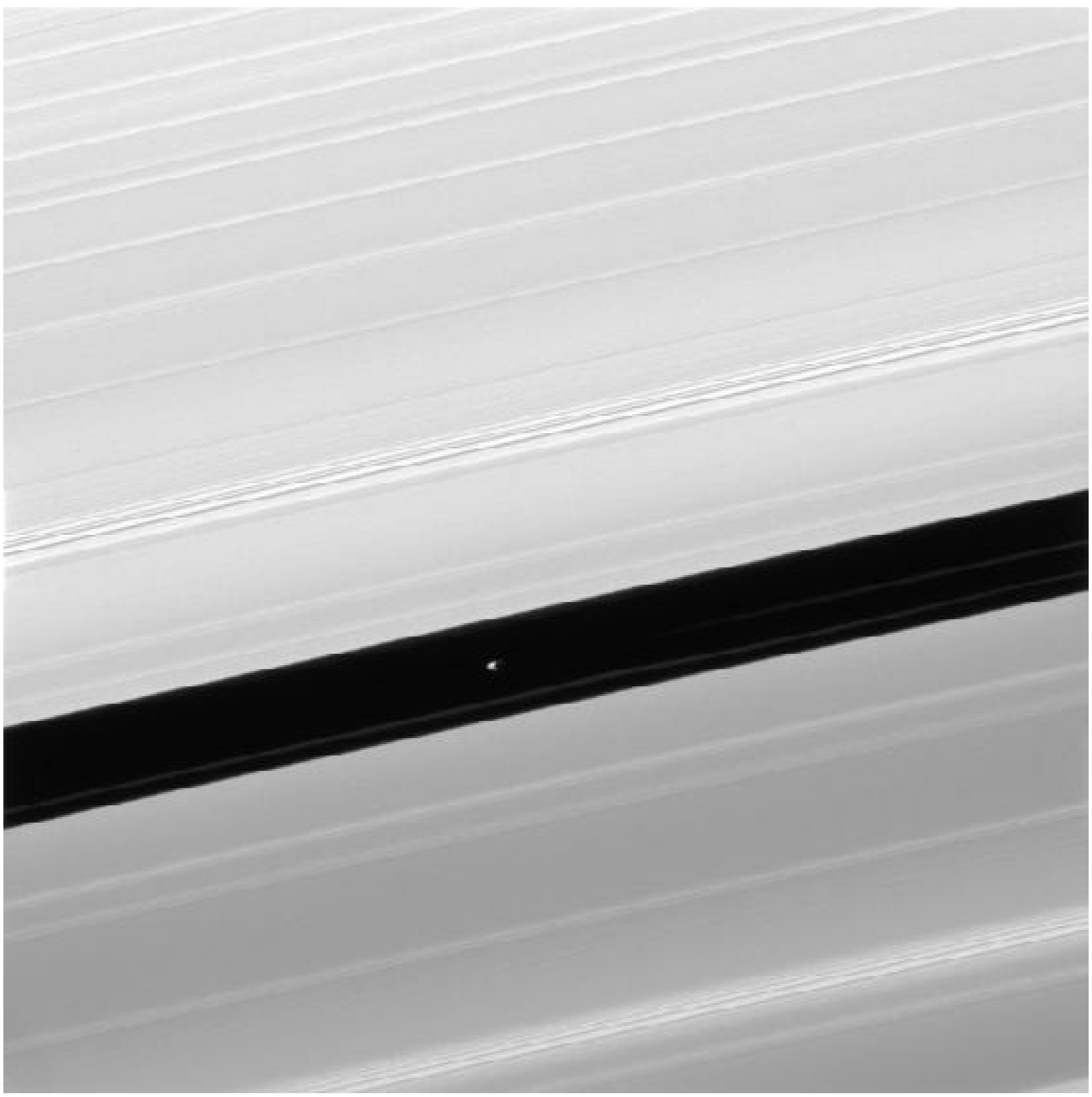
Saturn's rings — the planet's most iconic feature — are populated by billions of icy particles. From afar, the rings appear fixed and perfectly sculpted, but Cassini revealed some of the processes that shape them, and showed how dynamic they truly are. Ring features form, change shape and vanish — sometimes in a matter of hours.

NASA/JPL/SSI

Just 100 metres or so thick, Saturn's rings are shaped by many moons and moonlets embedded within. In this view, the moon Pandora can be seen

beyond the planet’s main rings.

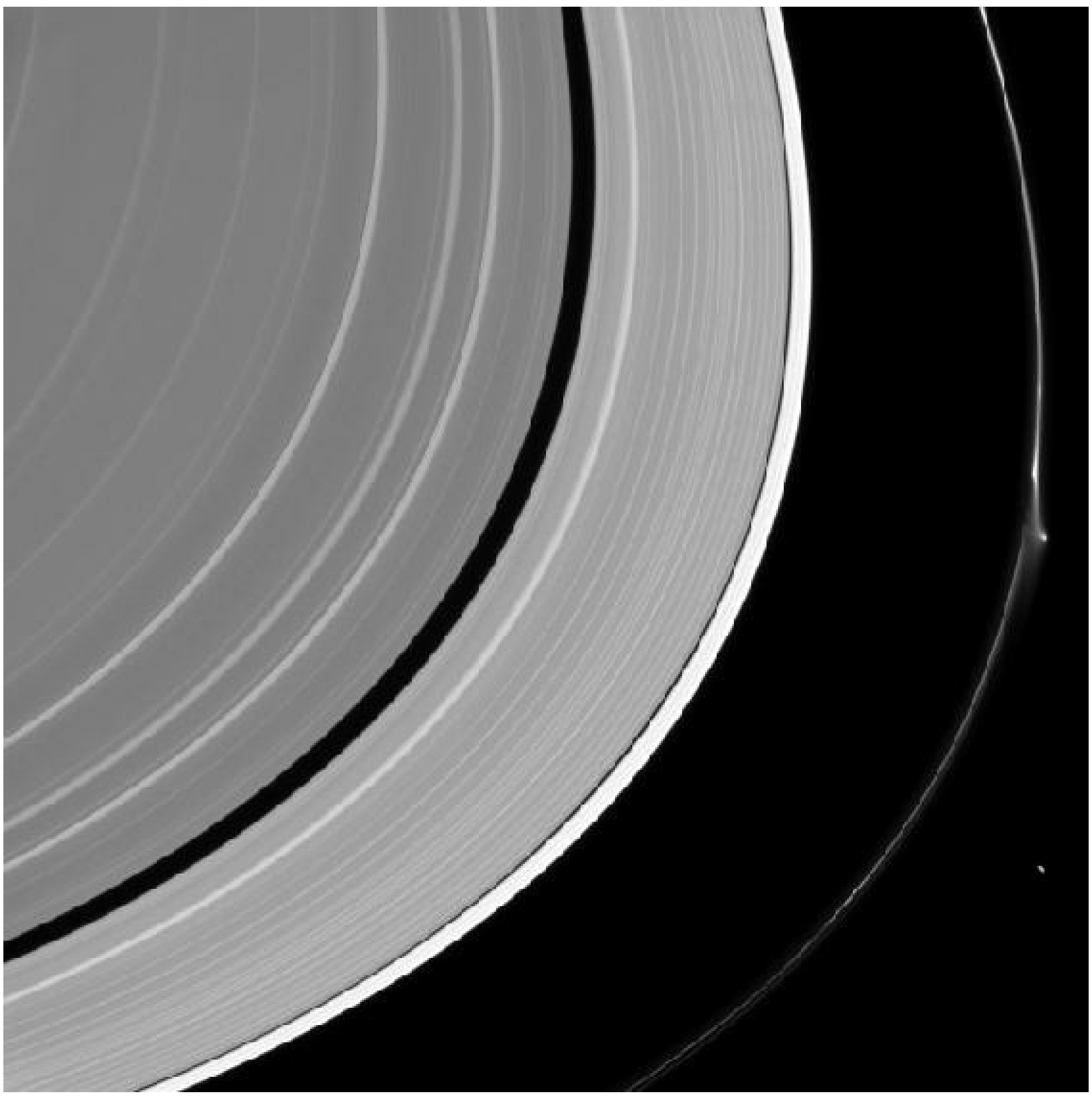
Cassini discovered how the gravitational forces of even the smallest of Saturn's moons can help to shepherd ring particles into beautifully manicured bands. For example, little Pan, just 28 kilometres across, has cleared a wide path through the rings. Dark and bright bands in the rings on either side of this gap reflect the pull of Pan's gravity. Images taken over the years revealed how some of Saturn's moons continuously shape and sculpt its rings — a phenomenon that was not fully apparent until Cassini was able to watch them over time.



NASA/JPL-Caltech/SSI

The moon Pan clears a pathway within the rings known as the Encke Gap.

But the moons are not perfect shepherds. In Saturn's F ring, a narrow band along the outside edge of the main rings, Cassini found ephemeral sprays of material called mini-jets (image, below). The gravitational pull of the nearby moon Prometheus probably causes ice particles in the ring to clump together like snowballs.

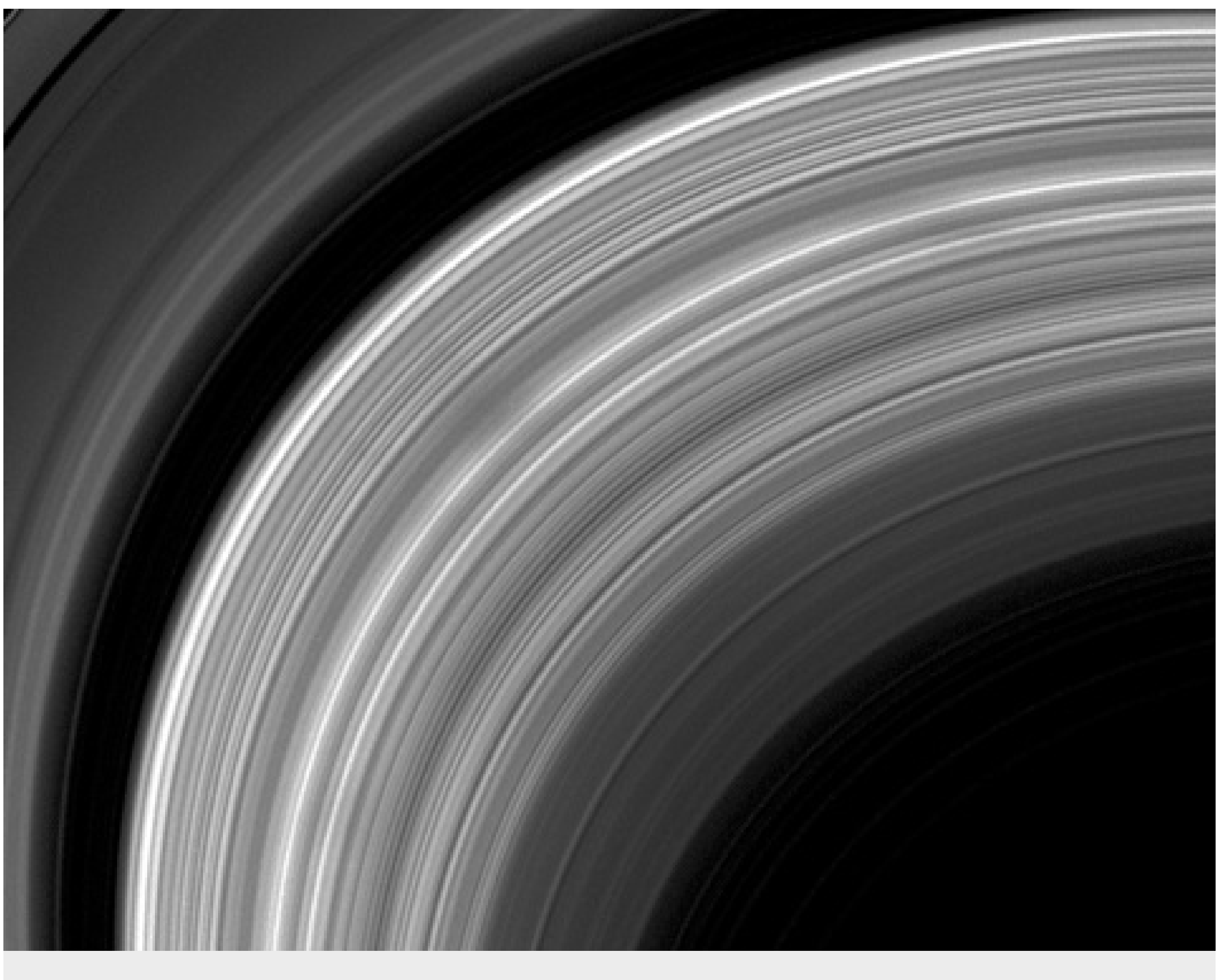


NASA/JPL-Caltech/SSI

At Saturn’s F ring, gravitational disturbances have caused ring particles to clump together and kick out a dusty-looking ‘jet’ of material.

Those bigger objects then punch outwards, trailing particles behind them like a dusty veil that can stretch up to 180 kilometres long, marring the otherwise perfect rings. Out here on the fringes of the ring system, features such as these come and go.

Dramatic changes can also play out on large scales. Around the Saturnian equinox, as sunlight fell at a steep slant across the rings, Cassini observed spoke-like features that rotate with the rings much like the pattern in a bicycle wheel. These spokes, which may be huge stripes of electrostatically charged particles drifting just above and below the rings, can form and disappear over the course of a few hours.



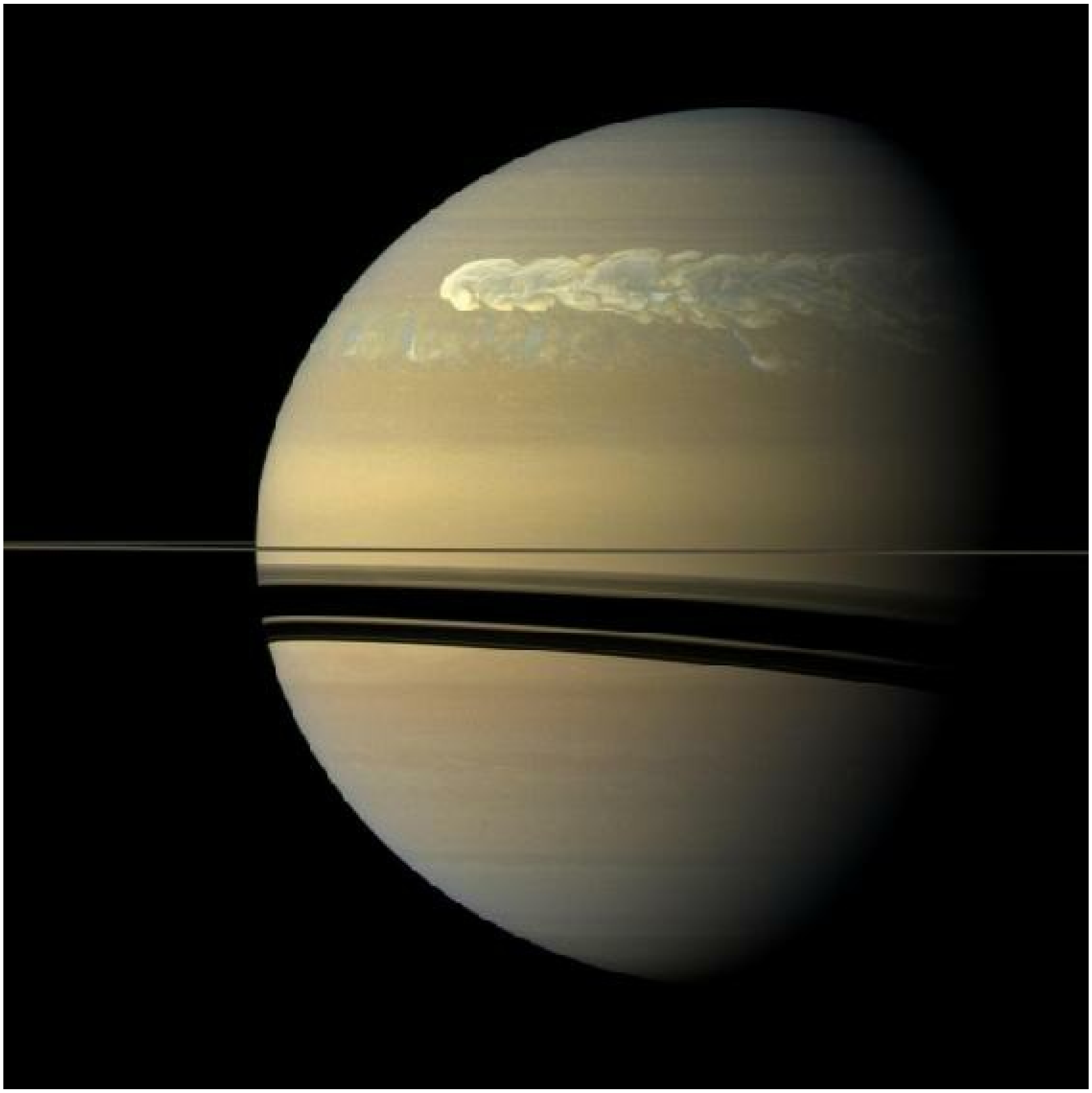
NASA/JPL/Space Science Institute

Spoke-like features that seem to be made of charged particles rotate around the planet.

Depths of the atmosphere

With Saturn's gorgeous ring system distracting the eye, the planet's swirling cloudtop patterns are sometimes underappreciated. Cassini changed that by observing how storms roiled Saturn's atmosphere over the course of many Earth years, providing deep insights into the currents that shape the planet's atmosphere.

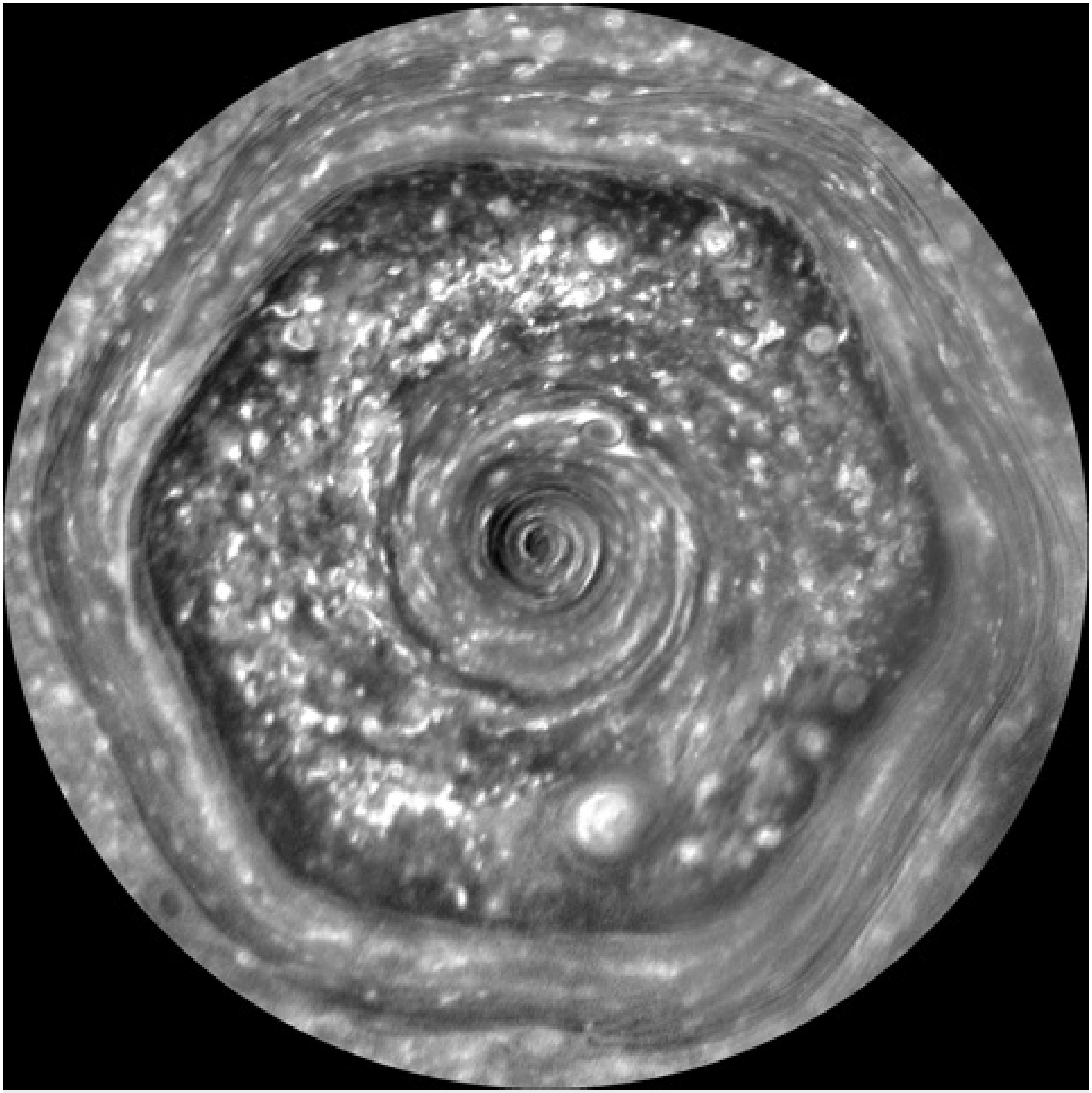
In late 2010, the spacecraft had a front-row seat as a thunderstorm developed into an enormous, swirling white cloud more than 10,000 kilometres across. The storm churned from deep inside the atmosphere all the way to the its upper layers, and in the ensuing months, wrapped entirely around the northern hemisphere until the 'head' of the storm crashed into the tail. Similar storms appear every two to three decades, a rate that is probably controlled by the amount of water vapour in the atmosphere. Other planets in the Solar System, such as Jupiter, have massive storms but do not see such planet-circling giants.



NASA/JPL-Caltech/SSI

Thunderclouds barrelled across Saturn’s northern hemisphere in 2010–11.

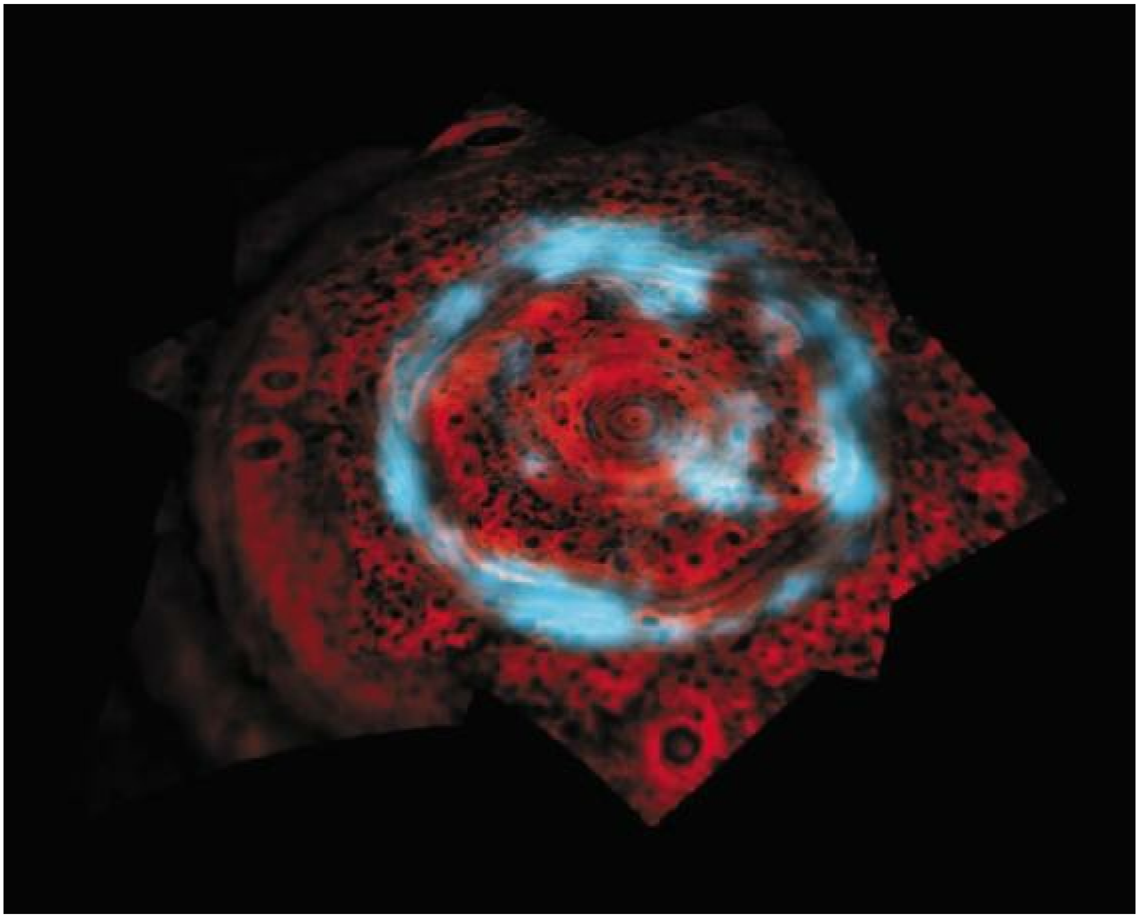
Cassini also probed a unique hexagon-shaped feature, some 30,000 kilometres across, at Saturn's north pole. Confined by winds flowing at more than 300 kilometres an hour, the hexagon is home to smaller hurricane-like vortices that rotate within it. Oddly, Saturn has no such feature at its south pole.



NASA/JPL-Caltech/SSI/Hampton University

A six-sided, jet-stream-like swirl churns around the planet’s north pole.

Even Saturn's interior came into better focus thanks to the mission. The planet has a strong and complex magnetic field, generated by liquid churning deep within it. The bright auroras that glow around Saturn's poles served as guide posts by helping to reveal the patterns and intensity of its polar magnetic fields.



NASA/JPL/University of Arizona

Glowing bands are created at the poles where the solar wind slams into Saturn's magnetosphere.

Some fundamental mysteries remain. Mission scientists are still working to determine how long a Saturnian day is. Because the planet has no solid surface, researchers cannot track a fixed feature to measure its rotation rate. Instead, they have tried to measure its true spinning speed by observing the planet's powerful rotating radio emissions, which should reflect the movement of the magnetic field stemming from deep within. But Cassini found that these emissions were more intricate than expected, which complicates efforts to use them to understand the rotation rate. More-detailed information about the magnetic field may come during this final phase of the mission, as Cassini loops between the planet and its rings.

Although the mission will come to a close soon, it will leave behind a wealth of information for future studies. “Cassini's treasure of data is 100 times as broad and deep as Voyager's, and it will take decades to get to the bottom of it,” says Jeff Cuzzi, a planetary scientist at NASA's Ames Research Center in Moffett Field, California. “The end of Cassini's active operations may be only the beginning of real advances in our understanding of what it has discovered.”

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Stop blocking postdocs' paths to success

30 August 2017

Lab heads should let junior researchers take their projects with them when they start their own labs — it drives innovation and discovery, argues Ben A. Barres.

Illustration by David Parkins

Postdocs are the engines of scientific progress. Typically poorly paid despite their three to seven years of doctoral training, they might labour in a postdoc lab for another four to nine years before moving to a more independent and remunerative career. What are they owed in return?

One type of postdoc maltreatment is rarely discussed, despite its prevalence and importance — should a postdoc be able to take their research project with them when they set up their own lab? And if so, should that new principal investigator (PI) be free from direct competition on that project with his or her former mentor? In my view, the answer to both questions is yes. Such 'project porting' is crucial for the success of young scientists and should be a fundamental right for postdocs.

This is such a touchy topic that it is only now that I feel comfortable writing about it. I am at the end of a long academic career and dying of stage four pancreatic cancer. I think it's time for the academic community to start openly discussing the issue of research freedom for postdocs (or lack of it).

Opinions will vary, but different strategies could enable PIs and postdocs to handle the issue more constructively. At the very least, trainees looking for a postdoc job need to find out about the policies of potential mentors before selecting a lab, and assess the implications that these policies could have for their independent success.

Who owns what?

Most mentors at the PI level have policies on research ownership. Unfortunately, many postdocs fail to ask what these policies are, either through lack of forethought or because they assume that it will not be an issue. Some mentors, if asked, warn prospective postdocs that they will not be free to take their projects with them to their own labs. (The meaning of 'project' may vary depending on the mentor, from the postdoc's specific research question to the entire subject area of the mentor's lab.) Others permit postdocs to retain their projects on moving, but then directly compete on the same work.

A postdoc is formally free to work on any project in his or her own lab. But those that spurn their advisers' wishes risk losing their support — something that is usually crucial for winning junior investigator awards and other types of funding, or when trying to obtain a promotion, say from assistant to associate professor.

So what is wrong with an adviser asking a postdoc to begin a different project on setting up their own lab?

Doing so assumes that a given topic is owned by the adviser and that the adviser can control who works on it. This is insulting to the postdoc, who in most cases has earned co-ownership by pushing a project forward with ideas and hard work.

Most importantly, when it comes to obtaining a faculty position or funding for a newly independent laboratory, having compelling preliminary data greatly increases the chances of success. Such data are most feasibly obtained from the final stage of a postdoc, or from research in the same area in a new lab. In addition, having to start work in an entirely different area makes it harder to achieve tenure because of the short tenure clock. Over time, the best faculty members will often launch projects in new areas, but this typically happens only after a lab is established.

Another strategy is to allow a postdoc to start a project in their final year that they can then take with them. In my experience, however, postdoc training periods are already so long and it takes so much effort to get papers published that there is rarely time for a postdoc to make headway before starting their own lab.

If a mentor lets a postdoc retain their project but continues to work on the same question, this doesn't solve the problem. In most cases, there is simply no way that a young person starting a lab can compete successfully with their former mentor. Established labs have an endless stream of excellent postdocs; new labs typically get started with graduate students, who take longer to train and to do meaningful experiments.

Competitor clash

I believe that not allowing postdocs to take projects with them, or competing with them when they do, harms science. It is well known among senior investigators that mentors who are ungenerous to their trainees have a lower rate of trainee success, and their area of research suffers as a result. By

contrast, generous mentors soon find that their trainees dominate a given field, and that together they can rapidly move it forward.

For instance, the neurobiology department at Stanford University — where I hold a professorship — has a long tradition of caring about mentorship. All faculty members allow their postdocs to take projects on to their own labs, free from competition. On analysing lists of trainees, I found that nearly 70% of our postdocs over the past 25 years have gone on to run their own academic labs and to achieve tenure. Anecdotal evidence suggests that the US national average is less than 10%. Indeed, in any given field, one can easily think of outstanding scientists who also manage to be generous mentors with no sacrifice to the quality of their science.

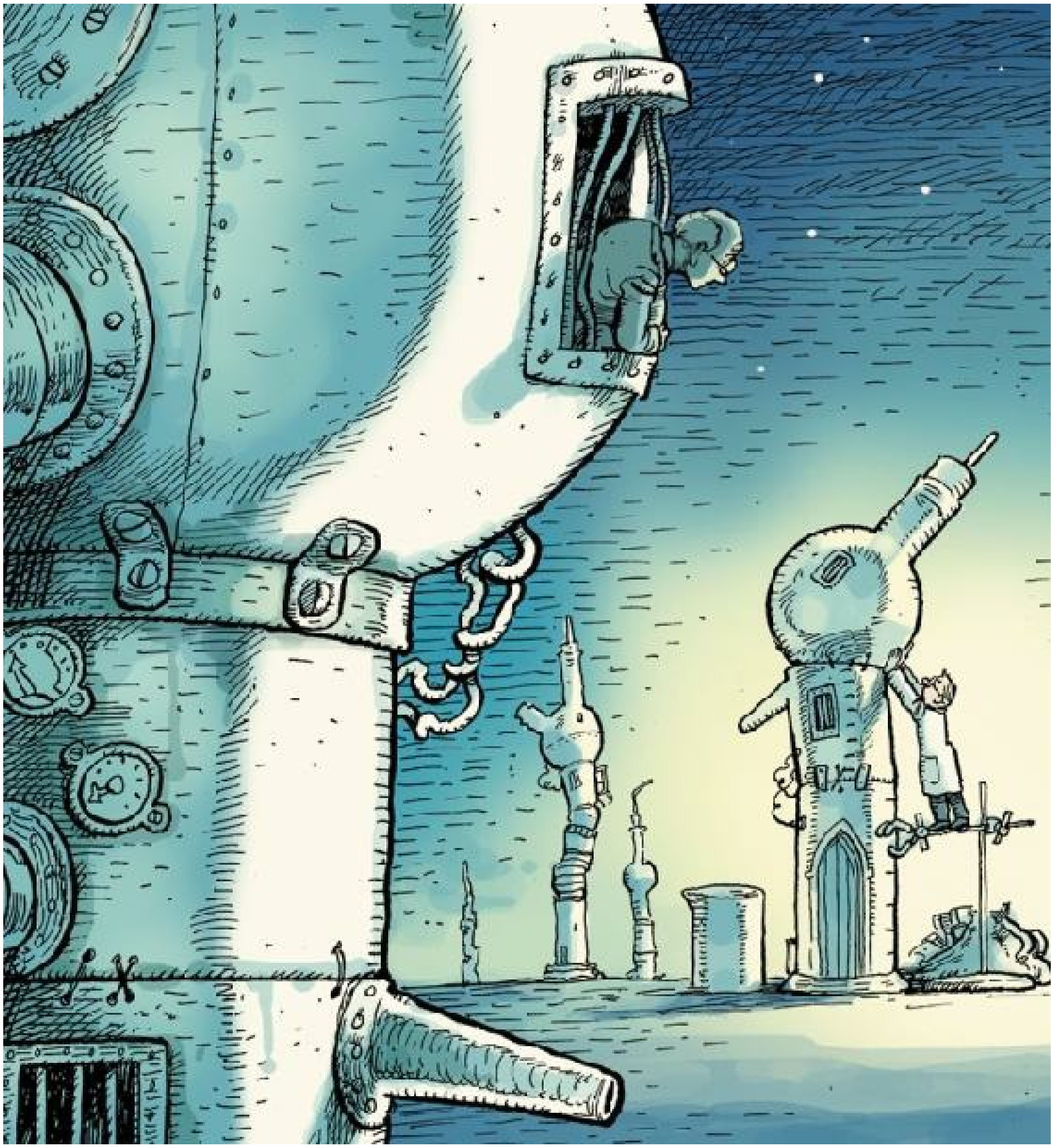

Illustration by David Parkins

If preventing postdocs from porting projects to their own labs is so detrimental to young researchers and to science, why do so many PIs do it? Highly competitive lab leaders wishing to become the best in their field can feel that they are working on a half-eaten pie if they focus on a research question to which others are contributing. They may imagine that their chances of winning a Nobel prize or other prestigious award are lessened if there are too many contributors to a field. Or they can understandably feel

they have invested their entire careers in developing a project area, whereas the postdoc has invested only a few years and relies on building on the PI's previous work.

Some may even be concerned that science could be harmed if PIs stop working on a project that has been taken to another lab by a postdoc. A young PI may be less likely to make advances than an accomplished, well-funded lab would be.

I am not persuaded by any of these arguments. In fact, I think that keeping the whole pie for oneself is sheer gluttony.

I don't believe that science is better off as a completely open competition. Pitting large, established research groups against the nascent labs of young scientists is not fair. And, as in business, monopolies act against the welfare of the whole by preventing innovation. Indeed, in my view, established labs can stifle creativity in their field even as they flourish. Young labs are much more likely to bring new ideas and to question dogmas. Worse, excessively competitive behaviour drives many talented young researchers out of science altogether.

Allowing a postdoc to retain a project does not mean that the PI leaves the field; it just means that they don't assign the obvious next research step to their subsequent postdoc. As a PI myself, I will admit that this approach sometimes seems painful. Discoveries typically result from the years of effort my lab has put into a project and a postdoc's contributions. Often, the immediate next steps are exciting — it is tempting to keep going. Moreover, starting an entirely new project is always challenging, because you first need to obtain sufficient preliminary data to win funding. But with mentorship, there is a time when you must make the welfare of your trainee the highest priority. As with good parenting, I believe that one should give to one's trainees until it hurts to do so.

With every step forward in science, more questions are raised than have been answered. In my case, there is no end of interesting and unexplored avenues about glial cells and their roles in health and disease. In fact, one of my greatest frustrations is that there are questions in my field for which I will not discover the answer during my lifetime. It is a great consolation to know that

I have trained many terrific young scientists, who, in their own labs, will keep exploring these areas long after I am gone.

Good track record

For all of these reasons, graduate students who hope to one day have their own labs need to take great care in selecting their postdoctoral mentor (B. A. Barres *Neuron* **80,** 275–279; 2013). The best mentors serve as strong role models when it comes to doing creative and rigorous science. They are also highly generous people who are willing to give their postdocs academic freedom, the long hours needed to teach them how to design good experiments, and continued support long after their trainees have left, for instance by providing recommendation letters or advice.

Graduate students should investigate the training track records of labs of interest, and discuss these labs with their PhD advisers, programme directors and thesis committee members. All prospective postdocs would be wise to explicitly ask potential mentors (as well as the mentors' previous trainees) what their policies are. In fact, all should be aware that when hiring committees assess an individual postdoc's prospects for future success, they routinely consider whether the applicant is from a lab that allows postdocs to retain projects and, if so, whether that lab is known to directly compete with its former trainees.

Many ungenerous mentors are also highly accomplished scientists. They are often tenured and run successful labs that add stature to their universities and bring in large amounts of funding. So it is not surprising that university leaderships generally overlook poor mentoring. Instead, everyone in biomedical science should strive to reward high-quality mentorship and to protect young scientists.

I think that the topic of research ownership should be included in ethics courses, such as those now mandated by the US National Institutes of Health (NIH) graduate training grants.

Indeed, funding agencies worldwide should do more to ensure postdoc

welfare. In the United States, the NIH's Pathway to Independence (K99) Award is a step in the right direction. Postdocs must formulate specific aims for their own laboratories as part of their funding applications. This prompts them to begin early discussions with their mentors about what they will do on completing their training. Similarly, the K01 Postdoctoral Mentored Career Development Award from the US National Institute of Neurological Disorders and Stroke funds postdocs to work on a project that they can take with them when they start their own labs.

I believe that the major funders of postdoc fellowships, such as the European Molecular Biology Organization and elite funding foundations, should mandate that postdoc fellows be free to take their projects when they move on to their own laboratories. Given that competition for these fellowships is intense, why shouldn't funders and foundations support the postdocs who are most likely to be successful in their own labs?

For graduate students looking to select a postdoctoral mentor, a helpful step would be for the NIH and other funding organizations to make lists of all trainees from training-grant applications available through a public database. These lists would greatly assist prospective postdocs by allowing them to see the training track record of each lab they are considering. In the United States, the National Postdoctoral Association could assume this responsibility (information on funded grant applications is public information that the NIH must disclose on request).

Importantly, grant-review committees should consider training track records during evaluations of applications from established labs. It is encouraging that the Howard Hughes Medical Institute (a non-profit medical-research organization in Chevy Chase, Maryland) has started to put more emphasis on a mentor's training record as one criterion when making decisions about renewing funding. Similarly, I believe that an individual's training track record should be factored in when considering the award of prestigious science prizes. Why should we honour those who don't support science's next generation?

Right now, PIs wishing to take advantage of their postdocs can act with impunity. In this increasingly competitive world, where it is harder than ever for young scientists to get off to a good start in their own laboratories, it is

incumbent upon us as a community to ensure that those to whom we hand the baton are treated equitably.

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There are currently no comments.

Extreme weather events are the new normal

Hurricane Harvey highlights the struggle to apply climate science.

29 August 2017

Brendan Smialowski/AFP/Getty

Flooding from Hurricane Harvey underscores the need for more detailed predictions of climate impacts.

Hurricane Harvey is already being described as one of the ten costliest storms in US history, with the estimated financial damage put at between US$10 billion and $20 billion. Oil- and gas-industry infrastructure lies among the wreckage, and investors are eyeing the impact on the energy and

insurance markets.

Decisions on where to install, build and develop have always been weather dependent. But they are becoming increasingly so. Extreme weather events such as Harvey can be described as 'unprecedented' only so many times before companies and governments are forced to accept that such events are the new normal, and to plan accordingly.

Such plans are more difficult and complicated than the simple broad-brush narrative often cited about the need to adapt to global warming. As we explore in a News story this week, scientists cannot yet supply the kind of detailed, quantified information that companies and others require to best plan for changes coming in the next few years to decades.

This is partly a question of resources: the world is a big place, the future infinite and there isn't enough computing power to go around. It is partly political, with the few late-adopters still offering a false flag around which to rally those who prefer inaction and obstruction. And it's partly because the field of climate services — as the field of such detailed projections is known — is on the front line of a cultural switch that sees science listen to society's questions, instead of simply offering answers. It is an imperfect storm, and scientists can't meet the cost alone.

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Keep on marching for science education

Scientists might have made a difference, had they protested against laws that now threaten what can be taught in our classrooms, argues Brandon Haught[2].

29 August 2017

The new school year is beginning in the United States, and science education in Florida is at risk from laws that passed earlier this summer. It leaves me wondering: where have those who joined April's March for Science gone?

That global action was probably the most popular science-advocacy event of this generation. I took part in Titusville, Florida, and was impressed with the attendance, enthusiasm and creative slogans. In the speeches that followed, I warned against pending legislation that would allow any citizen to demand a hearing to challenge instructional materials. Both critics and advocates see this as a way to stifle teaching about evolution and climate change. We had the summer to make our case.

The science-advocacy group Florida Citizens for Science — for which I volunteer as a board member and communications officer — led the battle to kill, or least modify, those bills. We lost on all fronts. The bills are now law.

Where were those marchers when we needed them? I know several science cheerleaders who took some concrete steps to forestall the legislation (by

phoning elected representatives, for example), but I can count on one hand the number of working scientists who offered their expertise to our group. And I didn't hear of any who approached lawmakers on their own.

Having the scientific community more actively involved might have had an impact. The final vote in the state senate was tight. Advocates of the law were widely quoted as claiming that evolution is just a theory and that anthropogenic global warming is in doubt. It would have been invaluable if scientists at local universities had issued simple statements: yes, evolution is a fact; the word 'theory' is used differently in science from how it's used in casual conversation; and the basics of human-caused global warming need to be taught. Perhaps authoritative voices from the state's universities would have swayed a senator or two.

Since the laws were passed, dozens of articles about them have been published statewide and even nationally. Social media has been buzzing. But the scientific community is still woefully quiet.

Hey, scientists, beleaguered high-school science teachers could use your support.

Other US states have endured attacks on science education. Legislatures in Alabama and Indiana passed non-binding resolutions that encourage 'academic freedom' for science teachers who cover topics — including biological evolution and the chemical origins of life — that the lawmakers deem controversial.

In Iowa, state lawmakers proposed a law requiring teachers to balance instruction on evolution and global warming with opposing views. That effort dwindled without concrete action, but not because of pressure from the scientific community.

We have had some help in our efforts: Jiri Hulcr and Andrea Lucky, scientists at the University of Florida in Gainesville, spoke out with me against these bad educational bills in a newspaper opinion piece. We argued that the choice was stark: training students for careers in the twenty-first century, or plunging them into the Middle Ages.

And Paul D. Cottle at Florida State University in Tallahassee is unrelenting in pursuing his goal of preparing elementary and high-school students for their adult lives. He's an integral part of Future Physicists of Florida, a middle-school outreach programme that identifies students with mathematical ability and guides them into courses that will prepare them for university studies in science and engineering. More generally, he makes sure that students, parents and school administrators hear the message that the path to high-paying, satisfying careers using skills acquired in mathematics and science starts long before university, and depends on accurate instruction.

Plenty of issues need attention. The pool of qualified science and maths teachers is shrinking. Florida students' performance in state-mandated science exams has been poor and stagnant for nearly a decade. This year, the state's education department will begin to review and select science textbooks that will be used in classrooms across the state for at least the next five years.

We need scientists who are willing to take the time and effort to push back against the textbook challenges that these new laws will encourage. We need expert advisers eager to review and recommend quality science textbooks for our schools. We need bold scientists ready to state unapologetically that evolution, global warming — and, yes, even a round Earth — are facts of life.

You're busy. I know. And some of you are uncomfortable in the spotlight. But doing something, even on a small scale, is better than doing nothing. Sign up for action alerts from the National Center for Science Education and your state's science-advocacy group, if you have one. Be a voice within any organizations you belong to, urging them to make statements supporting science education as issues arise. Introduce yourself to teachers at local elementary and high schools.

Even if all you have to offer are ideas and emotional support, we'll take them. Politicians, school administrators, business leaders, parents and even children need to know that you support high-quality science education.

The March for Science was a beneficial, feel-good event. It's over. But we need you to keep on marching!

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Europe’s X-ray laser fires up

High-speed shooter will help scientists to make molecular movies.

29 August 2017

Heiner Müller-Elsner/European XFEL

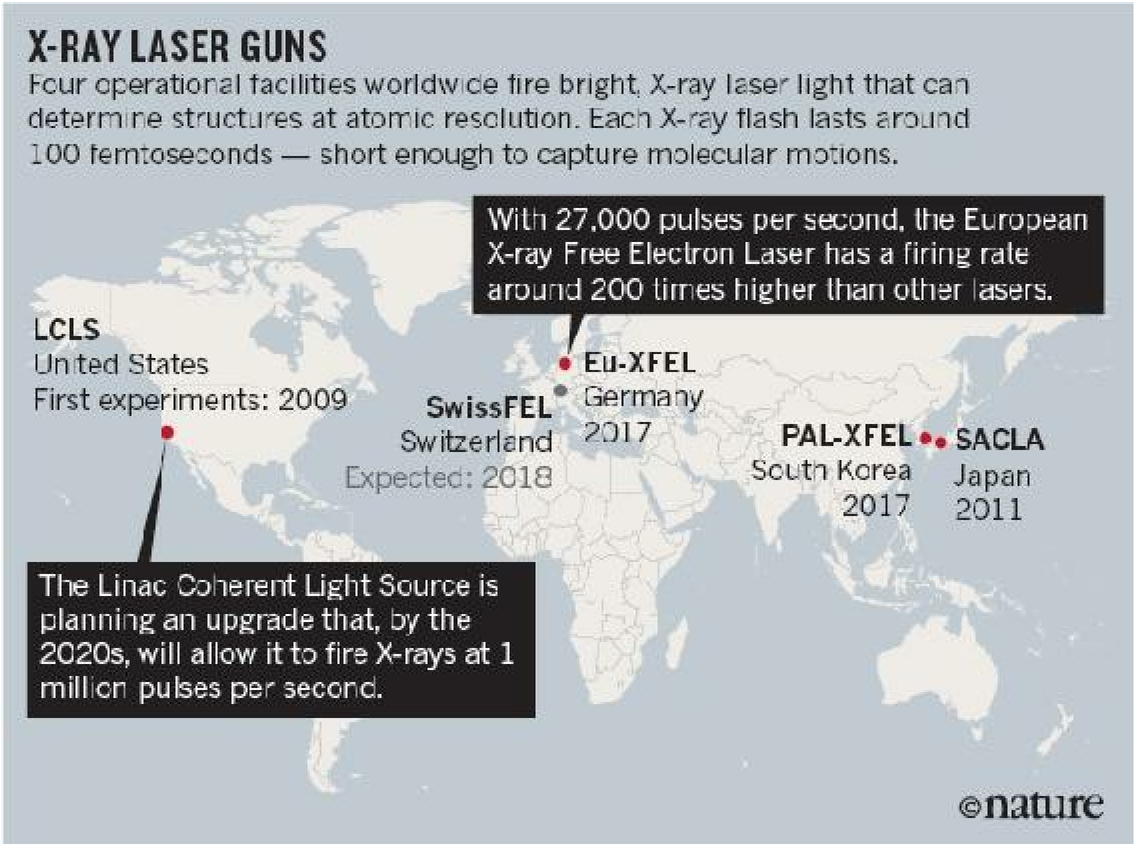
Researchers will soon be able to use the European X-ray Free Electron Laser near Hamburg, Germany, to watch molecules in action.

Scientists who make movies of molecules in motion have a new high-speed camera to shoot with. The €1.2-billion (US$1.4-billion) European X-ray Free Electron Laser (XFEL) will start running its first experiments in September near Hamburg, Germany.

The European XFEL fires powerful X-rays in bursts of a few hundred femtoseconds: so short that, like strobe lights, they can capture snapshots of jittery molecules frozen in time, and with a wavelength small enough to

provide pictures at atomic resolution. The Hamburg machine is one of a few such X-ray lasers worldwide, but boasts a unique rapid-fire feature: it can rattle off 27,000 pulses every second, a firing rate more than 200 times greater than the next-fastest facility, the $420-million Linac Coherent Light Source (LCLS) at the SLAC National Accelerator Laboratory in Menlo Park, California. “It’s such a different beast to anything else on the planet that it really feels like going into uncharted territory,” says Arwen Pearson, a biochemist at the Centre for Free-Electron Laser Science in Hamburg.

In a single second, scientists should be able to collect more than 3,000 good-quality X-ray pictures, compared with 100 or so at other facilities, says Adrian Mancuso, a project scientist at the European XFEL’s experimental stations in Schenefeld, near Hamburg. “Having lots of data matters, and the European XFEL will deliver it in truckloads,” says Abbas Ourmazd, a physicist at the University of Wisconsin–Milwaukee. The European machine — paid for by 12 countries — should relieve some of the pressure on older XFELs in the United States and Japan (see ‘X-ray laser guns’), which are heavily oversubscribed by scientists keen to capture atomic-scale images of their samples. Another XFEL opened to users in Pohang, South Korea, in June, and a machine in Villigen, Switzerland, is due to start experiments in 2018.



Source: European XFEL

At the Hamburg XFEL, bunches of electrons are first accelerated down a 1.7-kilometre-long tunnel. Magnets then bend the electrons' path into wiggling slalom tracks, causing them to emit bunches of high-energy X-rays as they curve. The bright X-ray pulses are so intense that they destroy the samples they hit — but not before enough photons have been scattered to reveal the sample's atomic structure.

X-ray movies

In structure-determination experiments using conventional X-ray sources, molecules must be packed into crystals to scatter enough photons to deduce their structure. But the X-rays from XFELs are so bright that researchers can gather diffraction patterns from crystals just a few nanometres in size, or even from non-crystalline clusters of molecules. This means that XFELs can study

proteins that are hard to crystallize. And researchers can create movies of enzymes, viruses or catalysts in action by building up thousands of different snapshots of the same system taken at different timepoints — often by passing a jet of molecules in solution past an X-ray beam.

In 2015, for example, scientists using the LCLS reported eight snapshots of myoglobin, a muscle protein that binds oxygen, at a resolution of 0.18 nanometres. The images were taken a few picoseconds after a flash of light dislodged a molecule of carbon monoxide from its binding position on the protein (T. R. M. Barends *et al. Science* **350,** 445–450; 2015). On 14 August, Ourmazd and his colleagues reported using X-ray scattering from single viruses at the LCLS to create a 3D movie at 9-nm resolution. It shows the motions of a virus as it reorganizes its genome so that the genetic material can squeeze through a tubular molecular structure — a process that occurs when the virus infects a cell (A. Hosseinizadeh *et al. Nature Methods* http://dx.doi.org/10.1038/nmeth.4395; 2017).

Work such as this depends on gathering many snapshots of identical particles in different conformational states to build up a composite picture of a particle's range of motion, explains physicist John Spence at Arizona State University in Tempe. He says that the European XFEL's high pulse rate will make this process much quicker — so structural data could be accumulated for much smaller individual particles. One of the European facility's most important milestones will be proving that diffraction patterns can indeed be collected from single particles at very high rates, says Mancuso. Because an intense X-ray burst obliterates each particle it hits in a passing spray or jet, it can be a challenge to ensure that the destroyed sample does not impede capture of the next shot. "We won't know that until we try," he says.

Hamburg's facility also has a larger capacity than its competitors: unlike other XFELs, it has three separate undulators to create simultaneous X-ray beams, with the 27,000 pulses per second distributed among them. But the European XFEL will reign for only a limited time: SLAC this year began construction of a $1-billion project to create an even brighter laser beam that, by the early 2020s, will fire up to 1 million pulses each second.

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There are currently no comments.

Legal threat exposes gaps in climate-change planning

Australian lawsuit highlights how difficult it is to turn global warming data into useful advice.

29 August 2017

Daniel Munoz/Reuters

Climate forecasts indicate that Australia will face an increased risk of severe droughts and bush fires.

In a world-first case, an Australian court will next month begin hearing from shareholders who have sued a bank for failing to disclose its vulnerability to climate change.

The case highlights the fact that financial institutions around the world have been slow to acknowledge the risk that climate change poses to investments in infrastructure, agriculture and property. But researchers say the lawsuit also shows that Australia and many other countries are currently unable to forecast the financial risks of climate change.

Shareholders Guy and Kim Abrahams filed the lawsuit on 8 August against the Commonwealth Bank of Australia, saying that the institution's 2016 directors' report did not adequately inform investors of climate-change risks. Their suit also seeks an injunction to stop the bank from making the same omissions in future annual reports.

Climate scientist Andy Pitman at the Centre of Excellence for Climate System Science in Sydney, Australia, says that researchers have been warning companies and governments for years about the need to invest in climate modelling and the related field of climate services, which provides forecasts and other information to public and private users. He says that it would take substantial investment and five to ten years of work for his team to provide banks with the climate information they need.

To be useful, he says, the forecasts would need to be on a time scale that is specific to a business or government's climate vulnerabilities, such as a period of months to years, or on small spatial scales, such as the size of a farmer's field. "That's hugely challenging," he says. "It's the difference between building a car that travels around Sydney and building one that wins a Formula One Grand Prix."

In theory, it should be possible to make such forecasts, but "it's a huge undertaking to actually do it", says Pitman; and it would require high-performance supercomputers generating massive amounts of data.

A question of scale

No country can yet produce climate forecasts on the scales and with the accuracy needed for detailed planning, says Simon Mason, a climate scientist at Columbia University's International Research Institute for Climate and

Society in Palisades, New York. Even the best forecasts are highly uncertain, which makes it difficult to use them for planning, he says.

For instance, if a farmer's bank wants to know the probability that the farm might experience drought, a 10-year projection might suggest a 60% chance of more frequent droughts, says Mason. But that doesn't indicate how severe the droughts might be or whether they will lead to crop failures, he says. "These are exactly the types of questions that need a lot of research."

But Jacqueline Peel, who specializes in climate-change law at the University of Melbourne, Australia, says that companies are likely to face more lawsuits like the Australian one, meaning that they won't have time to wait for fine-scale, tailored models. She says that there is already sufficient information on future warming scenarios for a business to disclose its vulnerabilities.

In Australia, researchers say that budget cuts haven't helped. A report released earlier this month by the Australian Academy of Science identified major gaps in climate research and climate services. The report found that Australia needs an additional 77 climate scientists, including 33 in modelling and 12 in climate services. The academy commissioned the report after the Australian national science agency, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), axed about 30 climate-science positions in 2016. CSIRO says it later added back 31 posts.

"There is a pressing need to improve projections of extreme-weather events to meet the demand for adaptation planning and disaster risk management," the report said.

The situation is better in Germany, the Netherlands and the United Kingdom, which have well-established, government-funded systems that provide climate information. But in the United States, researchers say that climate services are fragmented and struggle to meet the needs of governments or private-sector decision-makers. The Obama administration tried to launch a climate services division, but the US Congress blocked that effort.

"We haven't invested as much in climate services in time scales from several weeks to decades in the US," says John Furlow, who works on climate change and development at Columbia.

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Nature News

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Nature News

[周一, 04 9月 2017]

- **Nature News**

Nature News

Nature is a weekly international journal publishing the finest peer-reviewed research in all fields of science and technology on the basis of its originality, importance, interdisciplinary interest, timeliness, accessibility, elegance and surprising conclusions. Nature also provides rapid, authoritative, insightful and arresting news and interpretation of topical and coming trends affecting science, scientists and the wider public.

- **Trump finally nominates new leader for NASA** [周六, 02 9月 08:00]
  James Bridenstine, a member of Congress, has long pushed for the United States to return to the Moon.
- **Nature videos help to calm inmates in solitary confinement** [周五, 01 9月 08:00]
  Controversial experiment ignites debate over whether scientific work could be used to justify harsh prison tactics.
- **Volcanic views, stalking storks and the ephemeral eclipse** [周五, 01 9月 08:00]
  August’s sharpest science shots, selected by Nature ’s photo team.
- **How labs are coping with Hurricane Harvey's devastating floods** [周四, 31 8月 08:00]
  Advance planning has kept some Texas facilities safe during the unprecedented storm.
- **Doubts raised about CRISPR gene-editing study in human embryos** [周四, 31 8月 08:00]
  Alternative explanations challenge whether technique actually fixed a genetic mutation as claimed.
- **Skeleton plundered from Mexican cave was one of the Americas’ oldest** [周三, 30 8月 08:00]
  Rock-encased bone shard left behind by thieves allowed researchers to determine that the remains are probably more than 13,000 years old.
- **Reprogrammed cells relieve Parkinson's symptoms in trials** [周三, 30 8月 08:00]
  Monkeys implanted with neurons derived from stem cells showed sustained improvement after two years.
- **Closure of US coal study marks an alarming precedent** [周三, 30 8月 08:00]
  The Trump administration has stepped up its assault on environmental protections by halting a US$1-million study on the health risks of coal mining — casting a pall on academic freedom.
- **Alan Turing's notes, runaway salmon and illegal gold-mining** [周三, 30 8月 08:00]

The week in science 25–31 August 2017.

- **[Artificial intelligence: The future is superintelligent]** [周三, 30 8月 08:00]
  Stuart Russell weighs up a book on the risks and rewards of the AI revolution.
- **[Economics: Messy genesis of the welfare state]** [周三, 30 8月 08:00]
  Paul Cairney examines the tangled history of one nation's drive for social equity.
- **[Computational materials: Open data settled in materials theory]** [周三, 30 8月 08:00]
- **[Brain surgery: Most lobotomies were done on women]** [周三, 30 8月 08:00]
- **[Keep on marching for science education]** [周二, 29 8月 08:00]
  Scientists might have made a difference, had they protested against laws that now threaten what can be taught in our classrooms, argues Brandon Haught.

Trump finally nominates new leader for NASA

James Bridenstine, a member of Congress, has long pushed for the United States to return to the Moon.

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1. 02 September 2017

James Bridenstine, a Republican member of the US Congress from Oklahoma, has been tapped to be the next head of NASA. Bridenstine is a strong supporter of lunar exploration and commercial spaceflight.

If confirmed by the Senate, he will take the reins of an agency that is building a new heavy-lift rocket to fly astronauts to an unknown destination. Bridenstine has repeatedly argued that the United States should return to the Moon — among other things, to mine water ice to fuel a fleet of satellites with lunar hydrogen and oxygen.

“From the discovery of water ice on the Moon until this day, the American objective should have been a permanent outpost of rovers and machines at the poles with occasional manned missions for science and maintenance,” Bridenstine told a lunar exploration group last November. “This is our Sputnik moment.”

Bridenstine has also pushed to accelerate the government’s use of commercial space services. “The US government understands that in the future, and even today, it will be a customer of routine space services, not a provider of routine space services,” he said in the November speech. NASA currently pays for private companies to fly agency cargo to the International Space Station; US astronauts will fly aboard commercial rockets no earlier than next year.

“Representative Bridenstine is certainly a "different" choice for NASA Administrator, but to me the difference is mainly positive,” says John Logsdon, a space-policy expert at George Washington University in Washington DC. “He has been refining his ideas with diverse audiences over the past months, and would bring to the NASA position a clearer and better defined strategy for moving ahead than did most of his predecessors as they began their tenure.”

Space credentials

After studying economics, business and psychology at Rice University in Houston, Texas, Bridenstine served as a pilot in the US Navy. He flew combat missions in Iraq and Afghanistan, and in anti-drug operations in Central and South America. He also worked as executive director for an aerospace museum in Tulsa, Oklahoma. Since he was first elected to Congress in 2012, Bridenstine has slowly built up his space-policy credentials, serving on the House of Representatives’ science, space, and technology committee and speaking in front of groups such as the US Federal Aviation Administration’s space-transportation conference.

In 2016, Bridenstine introduced legislation in the House that would require NASA to make Mars its “main human spaceflight priority” — presumably after first establishing a Moon base — and bolster the already-growing role of commercial spaceflight. The legislation stalled at the subcommittee level.

Bridenstine has expressed scepticism about climate change. In a June 2013 speech on the House floor, he disparaged the role of humans in global warming and criticized President Barack Obama for spending more money on climate research than on weather forecasting. Bridenstine has argued to exclude greenhouse gases from federal regulation, and to expand oil and gas exploration on federal lands and offshore.

Major challenges facing the next NASA administrator include keeping the development of the Space Launch System heavy-lift rocket and its accompanying Orion crew capsule on track. The first flight of the paired system is meant to be in November 2018 but will likely be delayed, an April report from the US Government Accountability Office found.

"We hope the new Administrator embraces NASA's strong commitment to science and public engagement," says Heidi Hammel, executive vice president of the Association of Universities for Research in Astronomy (AURA) in Washington DC. "AURA looks forward to working with the new NASA Administrator to ensure that the Agency maintains a robust science portfolio."

Bridenstine would replace Charles Bolden, a former astronaut who flew four times aboard the space shuttle.

In June, the administration of President Donald Trump re-established the National Space Council, an on-again off-again entity meant to coordinate space activities among various government departments, including between civilian and military agencies. Vice-President Mike Pence is chair of the council.

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Updates

Updated:

This piece has been updated with comments from John Logsdon and Heidi Hammel.

Comments

Comments

There are currently no comments.

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Nature videos help to calm inmates in solitary confinement

Controversial experiment ignites debate over whether scientific work could be used to justify harsh prison tactics.

01 September 2017

Benj Drummond

An inmate watches nature videos in a designated room at Snake River Correctional Institution in Oregon.

A little bit of nature can calm even the most stressed populations of people, according to a study conducted on prisoners in solitary confinement.

In the experiment, researchers found that prisoners who watched videos with nature scenes felt less stressed and weren't as violent as those who didn't. The team, led by ecologist Nalini Nadkarni at the University of Utah in Salt Lake City, published their findings on 1 September in *Frontiers in Ecology and the Environment*[1].

Nadkarni first proposed the study in 2010 while visiting a prison that housed criminals who were considered to be the highest security risks. "Six guards in Kevlar vests and full riot gear had to go in and subdue an inmate in a restraining chair," she says. "I thought, wow, if we could just calm them with nature rather than with Kevlar vests and riot gear, that would be really great." But it took Nadkarni years to find a prison that was willing to let her test her hypothesis.

The experiment's results have now convinced some prison officials to offer inmates access to nature videos. However, critics of the study argue that it could be used to justify the continued use of solitary confinement — a practice that some consider too harsh.

Calming influence

Past research has shown that regularly seeing plants — even from a window — can improve hospital patients' and prison inmates' physical and mental health[2]. Nadkarni went further by studying people in solitary confinement, where inmates typically spend 23 hours a day alone in bare-walled cells.

Her team divided inmates at the Snake River Correctional Institution in Ontario, Oregon, into 2 groups of 24. Those in one group could choose to exercise or, up to five times per week, go to a 'blue room' to watch 45-minute-long videos showing natural scenes such as mountains, forests and oceans. Those in the other group were offered exercise, but no videos.

The researchers and prison staff measured inmates' moods and stress levels, and tracked violent incidents over a year. They found that inmates who had access to videos reported feeling calmer and were involved in 26% fewer violent incidents. The results suggest that nature imagery can help even

society's most nature-deprived populations, which includes prison inmates, but also residents of nursing homes and inner city areas, says Nadkarni.

The blue room has also helped Snake River to save thousands of dollars in medical costs resulting from altercations and self-harm, says Renee Smith, the institution's behavioral health systems manager. "We were pretty excited," she says. The programme is already being replicated in three other states.

Benj Drummond

Nalini Nadkarni interviews a prisoner who participated in the study.

A controversial idea

"It's certainly a pretty creative naturalistic experiment," says Lisa Nisbet, a psychologist at Trent University in Peterborough, Canada. "You couldn't get a much more deprived group of people."

But she and others caution that it is impossible to know whether exposure to nature had the beneficial effect because no group was shown videos with other content. Without this additional control group, “you can’t really draw any definitive conclusions,” says Marc Berman, a psychologist at the University of Chicago in Illinois.

The study authors acknowledge this limitation, which they say is due to there being an insufficient number of prison staff to implement the additional control condition. But they say that inmates specifically mentioned the videos’ nature content during interviews. One wrote: “The nature project help’s [*sic*] me think clearer to know there is so much more beauty in this world then [*sic*] this prison”.

Not everyone is embracing the study. Opponents of solitary confinement worry that the paper could provide cover for perpetuating a practice that many consider to be cruel and counterproductive. “I would hate to think that this study will be used to justify keeping solitary confinement prisoners in conditions where they are deprived of opportunities to actually experience nature,” says Craig Haney, a psychologist at the University of California, Santa Cruz.

Nadkarni says her collaboration has helped inmates even if it hasn’t dramatically reformed the prison system. “As an ecologist, it is not in my power to change the system of mass incarceration,” she says. “One thing I can do is think about ways that bring the therapeutic value of nature to people who are incarcerated.”

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Comments

Comments

There are currently no comments.

| Section menu | 主菜单 |

Volcanic views, stalking storks and the ephemeral eclipse

August’s sharpest science shots, selected by *Nature*’s photo team.

01 September 2017

Souvenirs of travel

Image Slideshow

1. 

There was plenty to interest the scientifically inclined in the latest National Geographic Travel Photographer of the Year contest. The

Grand Prize winner was this shot of the Colima Volcano in Mexico erupting in December 2015.

Sergio Tapiro Velasco/National Geographic Travel Photographer of the Year

2. 

This picture of Caribbean reef sharks (*Carcharhinus perezii*) was taken with a remote camera in the Gardens of the Queen, a marine protected area near Cuba. This image and the next two earned honourable mentions in the Nature category.

Shane Gross/National Geographic Travel Photographer of the Year

3. 

This picture from the Tamba area of Japan shows fireflies signalling for mates above the stairs leading to a shrine.

Yutaka Takafuji/National Geographic Travel Photographer of the Year

4. 

This shot of Mount Bromo erupting in 2016 in Indonesia was taken from the patio of a local hotel.

Reynold Riksa Dewantara/National Geographic Travel Photographer of the Year

Eclipse excitement

Jasman Mander

North Americans turned into literal lunatics on 21 August, as an eclipse sent thousands of obsessed sky-watchers scrambling to see the Moon block out the Sun. Here, a composite image shows the progression of the eclipse as seen from the Lowell Observatory in Madras, Oregon.

Go northwest!

Dan Goldman/AP/REX/Shutterstock

The Northwest Passage through the Arctic Ocean has become a much-examined signifier of climate change. As ice thins, more ships than ever before are attempting to push through this previously impassable sea route. On 29 July, the icebreaker MSV *Nordica* — pictured here — completed the route earlier in the year than ever before. Just a few weeks later, a reinforced Russian tanker made the journey successfully without an icebreaker escort.

Harvey's toll

Jonathan Bachman/Reuters

Storm Harvey is still bringing death and destruction to the United States, as record rainfall in Texas triggered flooding and evacuations. These people in Houston, Texas, were among many forced to take to the waters to escape.

Stork, stalking

Nicky Classen/Solent News/REX/Shutterstock

This yellow-billed stork (*Mycteria ibis*) began hunting for fish right alongside a photographer's hide in Kwa-Zulu Natal, South Africa. Nicky Classen was inside the hide earlier this month to capture the shot.

Catching dinner

John Thys/AFP/Getty

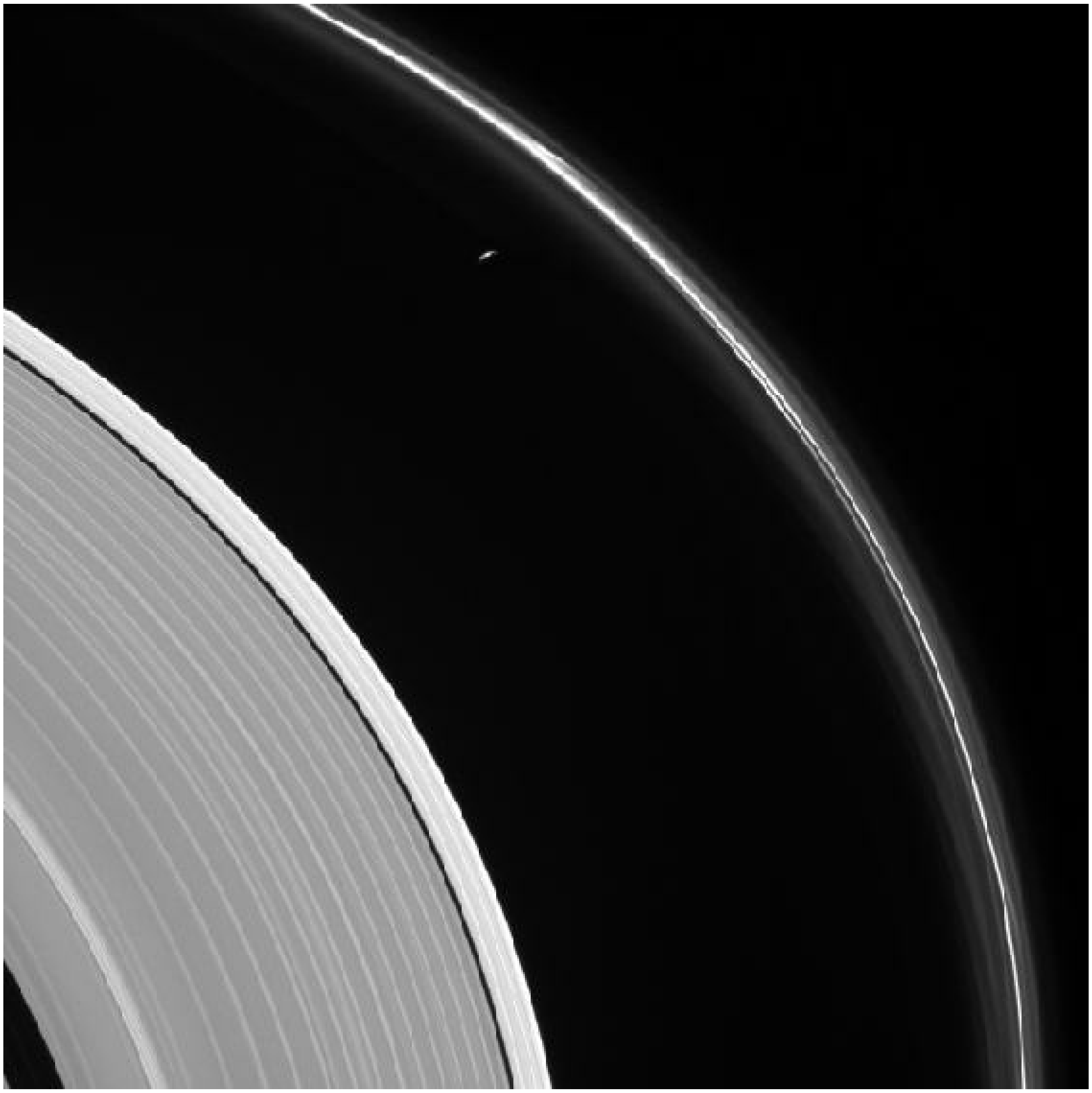
In the Netherlands, lions that were once trained to do tricks in circuses have been taught other skills. This lioness is catching a piece of meat during hunting training.

Do svidaniya!

Joel Kowsky/NASA

On 28 July, a Soyuz rocket shuttled three crew members of Expedition 52 to the International Space Station. The mission plans to test out flexible solar panels that roll out like blankets; explore the physics of neutron stars; and test in rats an experimental drug to deal with bone-mass loss caused by weightlessness.

Cassini’s legacy



NASA/JPL-Caltech/SSI

On 15 September, NASA's Cassini spacecraft will begin a plunge into Saturn's clouds that will lead to its destruction and the end of its 13 years of data collection. *Nature* looks back at some of the pictures the probe has captured, and what they have meant for science.

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Comments

There are currently no comments.

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How labs are coping with Hurricane Harvey's devastating floods

Advance planning has kept some Texas facilities safe during the unprecedented storm.

31 August 2017 Clarified:

1. 01 September 2017

Win McNamee/Getty

Now that the rains have cleared over downtown Houston, the long road to recovery can begin.

Hurricane Harvey swept ashore on 25 August and dumped record-breaking amounts of rain on Houston, Texas, over the next several days. As the storm begins to dissipate, scientists in its wake are starting to take stock of the personal and professional toll.

Many institutions in Houston were relatively well prepared for Harvey, having put precautions in place after suffering major losses when Tropical Storm Allison flooded the city in 2001. Facilities in other parts of the state have not been so lucky, but researchers hit by Harvey — now downgraded to a tropical depression — are not being left to fend for themselves. As of 31 August, roughly 200 scientific laboratories across the country have offered computer time, lab space, animal care and spare rooms to researchers displaced by the storm, using the hashtag #SciHelpTX on Twitter.

When Harvey made landfall as a category 4 hurricane, it hit facilities at the University of Texas at Austin Marine Science Institute in Port Aransas particularly hard, ripping the roof off Brett Baker's microbial-ecology lab. Baker says that one of his graduate students has already arranged to transfer to a lab at the University of California, Berkeley, and a postdoc is heading to Uppsala University in Sweden. "Our institute is on a barrier island," Baker says, and it took a direct hit from the storm. Baker spent some time crying, he adds, but is now so busy with logistics that he hasn't fully processed his feelings.

Lessons learnt

Most of the biomedical-research facilities in Houston, including those at Rice University, MD Anderson Cancer Center and the University of Texas Health Science Center, had installed special doors and floodgates to hold back storm waters after Allison. Those precautions saved equipment and animals, says Anirban Maitra, a pathologist at MD Anderson. "I think they prevented a mega-catastrophe," he adds.

Baylor College of Medicine lost 60,000 breast-cancer specimens in the 2001 storm. But the lessons that it learnt have paid off, says spokesperson Lori Williams. "We built a wall around the entire campus," she says. "We've had

no animals lost, no research lost."

The University of Houston (UH), by contrast, does not have special flood infrastructure. So the institution has been dealing with flooded basement labs, and has struggled to keep animals dry and fed. Forty baby rhesus monkeys had their formula milk rationed, says Amr Elnashai, vice-president for research and technology transfer at UH. A few had to be weaned a week early. Supplies of liquid nitrogen and helium are also running low, endangering frozen samples if they cannot be restocked soon. "If the worst is over, then we are fine," says Elnashai. "If there is another hit, then we are in deep trouble."

Personal costs

Meanwhile, staff at the Johnson Space Center in Houston are camping out at mission control to keep the International Space Station and the James Webb Space Telescope (JWST) programmes going. "I came in for a shift Friday night and I've been here ever since," says flight director Courtenay McMillan. Staff have been sleeping on makeshift beds and air mattresses, and subsisting on provisions provided by co-workers and friends. "We have not run out of coffee, which is the most important thing," McMillan adds.

The JWST was in the middle of a 100-day test in a thermal vacuum chamber when Harvey struck, but is unharmed. And a Soyuz capsule landing scheduled for this weekend in Kazakhstan — which the space centre will help to coordinate — will go ahead with only minor modifications to the plan, says McMillan.

Although many institutions have fared relatively well despite the storm's ferocity, researchers and staff are still dealing with personal losses. Officials estimate that at least 38 people have died as a result of the storm. Maitra says that one administrator on his team has been evacuated to a hotel. "She had to leave in a hurry with her kids in the middle of the night. They were stuck on the third floor of her complex for three days. It is just heartbreaking."

Louise Prockter, director of the Lunar Planetary Institute in Houston, was

travelling when Harvey swept into town. She has been trying to support her staff remotely from Washington DC. “Some of our staff have lost all their property,” she says. “It is a mess. For some people, normal is a long, long way off.”

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Clarifications

Clarified:

Louise Prockter originally stated that a lot of the staff at the Lunar Planetary Institute lost all of their property. She misspoke and says it should be some of the staff that lost all of their property.

Comments

Comments

There are currently no comments.

Doubts raised about CRISPR gene-editing study in human embryos

Alternative explanations challenge whether technique actually fixed a genetic mutation as claimed.

31 August 2017

Doubts have surfaced about a landmark paper claiming that human embryos were cleared of a deadly mutation using genome editing. In an article[1] posted to the bioRxiv preprint server on 28 August, a team of prominent stem-cell scientists and geneticists question whether the mutation was actually fixed.

The 2 August *Nature* paper[2], led by reproductive biologist Shoukhrat Mitalipov at the Oregon Health and Science University in Portland, described experiments in dozens of embryos to correct a mutation that causes a heart condition called hypertrophic cardiomyopathy.

In contrast to previous human-embryo editing studies, Mitalipov's team reported a high success rate at correcting a disease-causing mutation in a gene. The team claimed that the CRISPR–Cas9 genome editing tool was able to replace a mutant version of the *MYBPC3* gene carried by sperm with a normal copy from the egg cell, yielding an embryo with two normal copies. Mitalipov's team also introduced a healthy version of the gene along with the CRISPR machinery, but they found that the corrected embryos had shunned it for the maternal version.

But there is reason to doubt whether this really occurred, reports a team led by Dieter Egli, a stem-cell scientist at Columbia University in New York City, and Maria Jasin, a developmental biologist at Memorial Sloan Kettering Cancer Center in New York City. George Church, a geneticist at Harvard Medical School in Boston, Massachusetts, is another co-author.

In their bioRxiv paper, Egli and Jasin and their co-authors say that there is no plausible biological mechanism to explain how a genetic mutation in sperm could be corrected based on the egg's version of the gene. More likely, they say, Mitalipov's team failed to actually fix the mutation and were misled into thinking they had by using an inadequate genetics assay. Egli and Jasin declined to comment because they say they have submitted their article to *Nature*.

"The critique levelled by Egli *et al*. offers no new results but instead relies on alternative explanations of our results based on pure speculation," Mitalipov said in a statement.

Shared concerns

But other scientists contacted by *Nature*'s news team shared the Egli team's concerns. (*Nature*'s news team is editorially independent of its journal team.) Reproductive biologist Anthony Perry at the University of Bath, UK, says that after fertilization, the genomes of the egg and sperm reside at opposite ends of the egg cell, and each is enshrouded in a membrane for several hours. This fact, Perry says, would make it difficult for CRISPR-Cas9 to fix the sperm's mutation based on the egg's version of the gene, using a process called homologous recombination. "It's very difficult to conceive how recombination can occur between parental genomes across these huge cellular distances," he says.

Egli and Jasin raise that issue in their paper. They suggest that Mitalipov's team was misled into believing that they had corrected the mutation by relying on a genetic assay that was unable to detect a far likelier outcome of the genome-editing experiment: that CRISPR had instead introduced a large deletion in the paternal gene that was not picked up by their genetic assay. The Cas9 enzyme breaks DNA strands, and cells can attempt to repair the damage by haphazardly stitching the genome together, often resulting in missing or extra DNA letters.

That explanation makes sense, says Gaétan Burgio, a geneticist at the Australian National University in Canberra. "In my view Egli *et al*.

convincingly provided a series of compelling arguments explaining that the correction of the deleterious mutation by self repair is unlikely to have occurred."

Another possibility Egli's team raise is that the embryos were produced without a genetic contribution from sperm, a process known as parthenogenesis. Mitalipov's team showed that the paternal genome was present in only 2 out of the 6 embryonic stem cell lines they made from gene-edited embryos.

Robin Lovell-Badge, a developmental biologist at the Francis Crick Institute in London, says that it is possible that there is a "novel or unsuspected" biological mechanism at work in the very early human embryo that could explain how Mitalipov's team corrected the embryos' genomes in the manner claimed. He would first like to hear from Mitalipov before passing judgement. "It simply says that we need to know more, not that the work is unimportant," Lovell-Badge says of Egli and Jasin's paper.

In the statement, Mitalipov's said his team stands by their results. "We will respond to their critiques point by point in the form of a formal peer-reviewed response in a matter of weeks."

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Comments

Comments

There are currently no comments.

Skeleton plundered from Mexican cave was one of the Americas’ oldest

Rock-encased bone shard left behind by thieves allowed researchers to determine that the remains are probably more than 13,000 years old.

30 August 2017

Nick Poole/Liquid Jungle

A human skeleton — probably one of the Americas' oldest — was stolen fron the Chan Hol Cave in Mexico soon after it was discovered in 2012.

A human skeleton that was stolen from an underwater cave in Mexico in 2012 may be one of the oldest ever found in the Americas. Scientists have now put the age of the skeleton at more than 13,000 years old after analysing a shard of hip bone — left behind by the thieves because it was embedded in a stalagmite.

Cave divers discovered the remains in February 2012 in a submerged cave called Chan Hol near Tulúm on Mexico's Yucatán peninsula, and posted photos of a nearly complete skull and other whole bones to social media. The posts caught the attention of archaeologists Arturo González González at the Desert Museum in Saltillo, Mexico, and Jerónimo Avilés Olguín at the Institute of American Prehistory in Cancún.

By the time researchers visited the cave in late March, the remains were gone — except for about 150 bone fragments and a pelvic bone that had been subsumed by a stalagmite growing up from the cave floor. On the basis of these bones, the researchers think that the skeleton belonged to a young man who died when sea levels were much lower and the cave was above ground.

Dating techniques

To determine the age of human remains, researchers often measure levels of a radioactive isotope of carbon in collagen protein within bones. But in this case, most of the collagen had been leached out by water while the bones were submerged, making this method unreliable, says Wolfgang Stinnesbeck, a palaeontologist and geoscientist at the University of Heidelberg, Germany, who led the efforts to date the remains.

Instead, Stinnesbeck's team collected a fleck of the pelvis bone and surrounding stalagmite, which contains a mineral called calcite. The team then dated the rock using the relative levels of uranium and thorium isotopes in the calcite. The deeper into the stalagmite the researchers sampled, the older the dates turned out to be; stone just 2 centimetres from the bone was 11,300 years old. Calcite closer to the bone gave conflicting results, Stinnesbeck says.

The team determined that the skeleton was older than 13,000 years by analysing the rate at which calcite had formed around the bone, and by matching the shifts in stalagmite isotope levels to those in other caves. The findings were published on 30 August in *PLoS ONE*[1].

Eugenio Acevez Nunez

A diver collects a portion of a cave stalagmite found in cave that contains ancient human bones.

Alistair Pike, an archaeological scientist at the University of Southampton, UK, notes that the stalagmite set over the bone during a time of profound climate change, which could have altered the stalagmite's rate of growth. He says he is therefore more comfortable considering the bones to be a minimum of 11,300 years old — still “very significant”, he notes.

Ancient company

Few other human remains from the Americas are older than 13,000 years. The skeleton of a teenage girl recovered from a different Yucatán cave was carbon-dated to more than 12,000 years old, and a skeleton found in another submerged cave near Tulúm was deemed to be around 13,500 years old, also using radiocarbon dating.

“They’ve done a really nice job determining the age of this thing,” says David Meltzer, an archaeologist at Southern Methodist University in Dallas, Texas. There is convincing archaeological proof that humans colonized the Americas before 14,000 years ago, but very old remains are precious. “These sites are rare as hen’s teeth,” Meltzer says.

Apart from the Yucatán finds, the next-oldest skeleton from the Americas is that of a 12,600-year-old boy found in Montana, whose sequenced genome places him on a lineage leading to present-day Native American groups. Researchers have sequenced only a few other human skeletons from the Americas that are older than 10,000 years, hindering efforts to unravel the region's ancient population history.

Getting DNA from what remains of the Chan Hol skeleton will be hard. A sample sent to one of the world’s leading ancient-DNA labs, the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, did not contain enough DNA, Stinnesbeck says. He hopes to find DNA in the few teeth not taken by the thieves.

The theft still boggles Stinnesbeck, whose team is continuing to study the cave and its remains. The researchers recently reported the discovery of

fossils in the cave that are of a new species of peccary[2] — a hoofed mammal related to pigs — as well as evidence that the cave's human inhabitants made fires.

“What would you want with a skeleton? Would you take it home?” Stinnesbeck asks. “If they had known it was very old, maybe just to have a souvenir, to have something special.”

“We went to the police and they did some inquiries,” he adds. “They never came up with anything substantial.”

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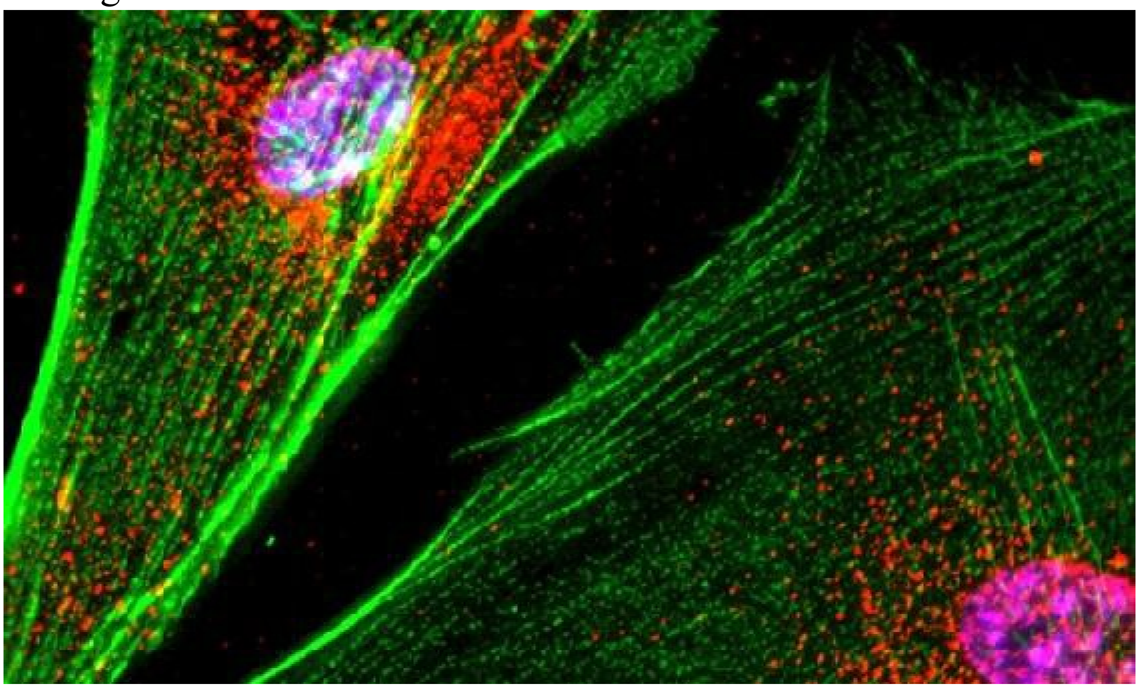
Comments

Commenting is currently unavailable.

Reprogrammed cells relieve Parkinson's symptoms in trials

Monkeys implanted with neurons derived from stem cells showed sustained improvement after two years.

30 August 2017



B. Bick, . Poindexter, UT Med. School/SPL

A depletion of brain cells that produce dopamine is responsible for the mobility problems seen in people with Parkinson’s disease.

Japanese researchers report promising results from an experimental therapy for Parkinson’s disease that involves implanting neurons made from ‘reprogrammed’ stem cells into the brain. A trial conducted in monkeys with a version of the disease showed that the treatment improved their symptoms

and seemed to be safe, according to a report published on 30 August in *Nature*[1].

The study's key finding — that the implanted cells survived in the brain for at least two years without causing any dangerous effects in the body — provides a major boost to researchers' hopes of testing stem-cell treatments for Parkinson's in humans, say scientists.

Jun Takahashi, a stem-cell scientist at Kyoto University in Japan who led the study, says that his team plans to begin transplanting neurons made from induced pluripotent stem (iPS) cells into people with Parkinson's in clinical trials soon.

The research is also likely to inform several other groups worldwide that are testing different approaches to treating Parkinson's using stem cells, with trials also slated to begin soon.

Nature breaks down the latest research — and what it means for the future of stem-cell treatments.

Why are stem cells a promising treatment for Parkinson's disease?

Parkinson's is a neurodegenerative condition caused by the death of cells called dopaminergic neurons, which make a neurotransmitter called dopamine in certain areas of the brain. Because dopamine-producing brain cells are involved in movement, people with the condition experience characteristic tremors and stiff muscles. Current treatments address symptoms of the disease but not the underlying cause.

Researchers have pursued the idea that pluripotent stem cells, which can form any cell type in the body, could replace dead dopamine-making neurons in people with Parkinson's, and thus potentially halt or even reverse disease progression. Embryonic stem cells, derived from human embryos, have this capacity, but they have been the subject of ethical debates. Induced pluripotent stem (iPS) cells, which are made by coaxing adult cells into an

embryonic-like state, have the same versatility without the associated ethical concerns.

What did the latest study find?

Takahashi's team transformed iPS cells derived from both healthy people and those with Parkinson's into dopamine-producing neurons. They then transplanted these cells into macaque monkeys with a form of the disease induced by a neuron-killing toxin.

The transplanted brain cells survived for at least two years and formed connections with the monkey's brain cells, potentially explaining why the monkeys treated with cells began moving around their cages more frequently.

Why is the research important?

Crucially, Takahashi's team found no sign that the transplanted cells had developed into tumours — a key concern with treatments that involve pluripotent cells — or that they evoked an immune response that couldn't be controlled with immune-suppressing drugs.

"It's addressing a set of critical issues that need to be investigated before one can, with confidence, move to using the cells in humans," says Anders Bjorklund, a neuroscientist at Lund University in Sweden.

When will clinical trials begin and how will they work?

"I hope we can begin a clinical trial by the end of next year," says Takahashi. Such a trial would be the first iPS cell trial for Parkinson's. In 2014, a Japanese woman in her 70s became the first person to receive cells derived from iPS cells, to treat her macular degeneration.

In theory, iPS cells could be tailor-made for individual patients, which would eliminate the need to use drugs that suppress a possible immune response to foreign tissues.

But customized iPS cells are expensive to make and can take a couple months to derive and grow, Takahashi notes. So his team instead plans to establish iPS cell lines from healthy people and then use immune cell biomarkers to match them to people with Parkinson's in the hope of minimizing the immune response (and therefore the need for drugs to blunt the attack).

In a study described in an accompanying paper in *Nature Communications*[2], Takahashi's team implanted into monkeys iPS-cell-derived neurons from different macaques. They found that transplants between monkeys carrying similar white blood cell markers triggered a muted immune reaction.

What other stem-cell approaches are being tested for Parkinson's?

Earlier this year, Chinese researchers began a Parkinson's trial that used a different approach: giving patients neural-precursor cells made from embryonic stem cells, which are intended to develop into mature dopamine-producing neurons. A year earlier, in a separate trial, patients in Australia received similar cells. But some researchers have expressed concerns that the immature transplanted cells could develop tumour-causing mutations.

Meanwhile, researchers who are part of a Parkinson's stem-cell therapy consortium called GForce-PD, of which Takahashi's team is a member, are set to bring still other approaches to the clinic. Teams in the United States, Sweden and the United Kingdom are all planning trials to transplant dopamine-producing neurons made from embryonic stem cells into humans. Previously established lines of embryonic stem cells have the benefit that they are well studied and can be grown in large quantities, and so all trial participants can receive a standardized treatment, notes Bjorklund, also a consortium member.

Jeanne Loring, a stem-cell scientist at the Scripps Research Institute in La

Jolla, California, favours transplanting iPS-derived neurons made from a patient's own cells. Although expensive, this approach avoids dangerous immunosuppressive drugs, she says. And because iPS cells are established anew for each patient, the lines go through relatively few cell divisions, minimizing the risk that they will develop tumour-causing mutations. Loring hopes to begin her team's trial in 2019. "This shouldn't be a race and we're cheering for success by all," she says.

Lorenz Studer, a stem-cell scientist at the Memorial Sloan Kettering Cancer Center in New York City who is working on a trial that will use neurons made from embryonic stem cells, says that there are still issues to work out, such as the number of cells needed in each transplant procedure. But he says that the latest study is "a sign that we are ready to move forward".

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Comments

Comments

There are currently no comments.

Closure of US coal study marks an alarming precedent

The Trump administration has stepped up its assault on environmental protections by halting a US$1-million study on the health risks of coal mining — casting a pall on academic freedom.

30 August 2017

Saul Loeb/AFP/Getty

US President Donald Trump makes his priorities clear during a rally in West Virginia.

When the US National Academies of Science, Engineering, and Medicine (NASEM) speaks, the government usually listens. Last year, US government

agencies spent US$216 million to commission NASEM expertise on issues from the scientific workforce to military implications of synthetic biology. Most NASEM reports are filled with caveats and make for dry reading. But occasionally, they pull no punches. A memorable 2009 report on the state of forensic science, for instance, concluded that almost every forensic method used in law enforcement is seriously flawed and that their use risks putting innocent people in jail. Given the academies' stature, it's hard for the government to brush off its hired commission when faced with such language.

Such concerns seem to weigh on the US Department of the Interior (DOI), which in 2016 commissioned a $1-million study of the potential health risks of surface coal mining on communities in West Virginia. Some evidence suggests that people who live near surface-mining operations — also known as mountaintop removal — have an unusually high rate of lung cancer and birth defects, which could be attributed to air and water pollution.

Launching the study — now halfway through its two-year term — was itself an achievement, given the political nature of the topic. Although much is known about the risks of coal mining to miners, little research has been done on its health impacts on local communities, not least because of attempts by the coal industry to hinder such work. Mining companies and trade organizations have sued for access to the e-mails of academics researching mountaintop removal, and have fought to keep peer-reviewed studies from being used in court. The National Mining Association questioned the value of the NASEM study when it was announced.

On 18 August, three days before the NASEM committee working on the study was due to meet in a Kentucky mining town, the DOI ordered a stop to the study, with immediate effect. The agency says it is reviewing spending on all projects that cost more than $100,000. "The Trump administration is dedicated to responsibly using taxpayer dollars in a way that advances the department's mission and fulfils the roles mandated by Congress," DOI spokeswoman Heather Swift said in a statement to *Nature*. She did not respond to questions about which other projects are under review.

This is the first time that the administration of President Donald Trump has cancelled a NASEM study that has already started — a move that has rarely

happened in the past, according to the academies.

In its statement about the cancellation, the NASEM said that its investigators "stand ready" to resume as soon as the DOI completes its review. But they're likely to be waiting a long time. The Trump administration has made no secret of its fondness for the US coal industry, which employs around 76,000 people. (By comparison, around 1.2 million people live in counties where mountaintop removal takes place.) The DOI's assertion that the decision is a budgetary one is suspect, especially given that the study has already spent a good amount of its budget.

It seems, instead, that the government would rather quash the review than risk it producing results that cast aspersions on the coal industry. This is par for the course for the DOI, whose head, Ryan Zinke, plans to downsize national parks in favour of resource extraction, and which has also suspended meetings with its independent advisory councils on issues concerning public lands.

With the near-daily news about the Trump administration weakening climate and environmental protections, it is easy to become fatigued. Yet the move to pre-empt the prestigious and independent NASEM is particularly concerning. It raises questions about what other studies could be cancelled if the government fears their results. It is another blow for science and for academic freedom.

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Alan Turing's notes, runaway salmon and illegal gold-mining

The week in science 25–31 August 2017.

30 August 2017

Research | Facilities | Publishing | People | Environment | Business | Trend watch

RESEARCH

Science results emerge from US eclipse A total solar eclipse swept across the continental United States on 21 August, delighting skygazers and scientists. The path of totality crossed more than a dozen states, making it one of the most observed eclipses ever (composite image shown). A citizen-science project collected data from more than 55 telescopes to produce a high-resolution movie of the solar corona — the part of the Sun's atmosphere seen during totality. Among the professional scientific studies, a pair of NASA jets that chased the eclipse gathered high-resolution video of the corona, while ground-based expeditions collected information about ionized elements in the solar atmosphere.

Stan Honda/AFP/Getty

Gravitational waves Many of the world's best telescopes were turned to a little-known galaxy called NGC 4993 from 17 August, after an alert about a potential gravitational-wave detection in the region. Rumours abounded that the US-based Laser Interferometer Gravitational-wave Observatory (LIGO), possibly aided for the first time by the Virgo interferometer in Pisa, Italy, had picked up the signature of two neutron stars colliding in the galaxy. NASA's Fermi Gamma-ray Space Telescope detected a burst of γ-rays in roughly the same region of the sky as NGC 4993, which may indicate the aftermath of a neutron-star collision there, but which could instead come from an unrelated event. It would be a historic first for astronomy if telescopes saw signatures of the collision at the same time as interferometers 'heard' the event through vibrations in space-time. See go.nature.com/2w46ja8 for more.

FACILITIES

Big NASA missions NASA should continue its tradition of building

spacecraft for large strategic space-science missions such as the Hubble Space Telescope and the Mars Curiosity rover, says a 24 August panel report from the US National Academies of Sciences, Engineering, and Medicine. Like other agencies, NASA is struggling with a limited budget, and the panel examined whether big missions should remain a part of its portfolio. But the scientific return is worth it, the report found, as long as missions are managed well. Developing a range of cost options for large projects could help the agency to avoid problems such as those plaguing the James Webb Space Telescope, which has run billions of dollars over budget and is currently set to launch in 2018.

PUBLISHING

Preprint sites Six new preprint sites were rolled out on 29 August. The services, which host research papers before formal publication, include paleorXiv for palaeontology and INA-rXiv, a preprint server for Indonesian research. The other sites cover research on nutrition, library sciences, sports and exercise, and mind and contemplative practices. The servers are supported by software developed by the Center for Open Science in Charlottesville, Virginia, which already hosts eight other preprint services.

PEOPLE

Surprise Turing find Documents belonging to mathematician Alan Turing have been unearthed at the University of Manchester, UK, and made available to researchers, the university announced on 25 August. The 148 items include a letter to Turing from British intelligence agency GCHQ and a draft BBC radio programme on artificial intelligence. Discovered in a storeroom filing cabinet in May, the collection does not include much personal correspondence. But it offers a glimpse of the code-breaker's working life between 1949 and his death in 1954 — a period for which archive material is scarce, according to the university library's archivist. Some documents also give insight into his rather forthright personal opinions; his response to an invitation to a US conference in April 1953 was simply: "I would not like the journey, and I detest America."

Science envoy quits An energy researcher at the University of California, Berkeley, resigned from his post as a science envoy for the US Department of State on 21 August, citing US President Donald Trump's "attacks on the core values of the United States". In a resignation letter addressed to Trump, Daniel Kammen criticized the president's equivocal response to violent demonstrations by white supremacists in Charlottesville, Virginia, on 12 August. Kammen also condemned the Trump administration's "destructive" policies on energy and the environment, which he said have affected his work as a science envoy.

ENVIRONMENT

Mind the penguins Chile has blocked plans for an iron mine that would have posed a threat to thousands of penguins. On 21 August, a Chilean government committee announced that Andes Iron, the local firm in charge of the US$2.5-billion project, failed to put into place effective environmental protections to compensate for how mining activities might disturb wildlife. The project aimed to extract millions of tonnes of iron from a site in the northern Coquimbo region of Chile. But the site lies near the 888-hectare National Humboldt Penguin Reserve — a set of islands that are home to one of the world's largest breeding populations of Humboldt penguins (*Spheniscus humboldti*; pictured). The species is listed as 'vulnerable' by the IUCN Red List. Andes Iron says that it will appeal against the decision.

Joel Sartore/NGC

Runaway salmon Thousands of Atlantic salmon have made a break for the Pacific Ocean after fish-farm nets in Washington state's San Juan Islands succumbed to "exceptionally high tides" on 19 August, according to the aquaculture company that owned the fish. The Washington Department of Fish & Wildlife estimates that about 4,000–5,000 fish escaped from the pens, which contain more than 1.3 million kilograms of farmed fish. The incident has raised concern that the Atlantic species could threaten wild fish populations native to the region. Officials are temporarily suspending fishing regulations and encouraging recreational and commercial fishers to capture and sell any Atlantic salmon that they find.

Australia land laws Contentious laws that allow landowners in New South Wales, Australia, to clear native vegetation on their properties came into effect on 25 August. Landowners in the country's most populous state can now remove more of certain types of vegetation, a loosening of the state's previous regulations. The decision has angered scientists and conservationists, who say that the laws put biodiversity and threatened species at risk. But some farmers aren't satisfied either, saying that the

amended rules are still too restrictive.

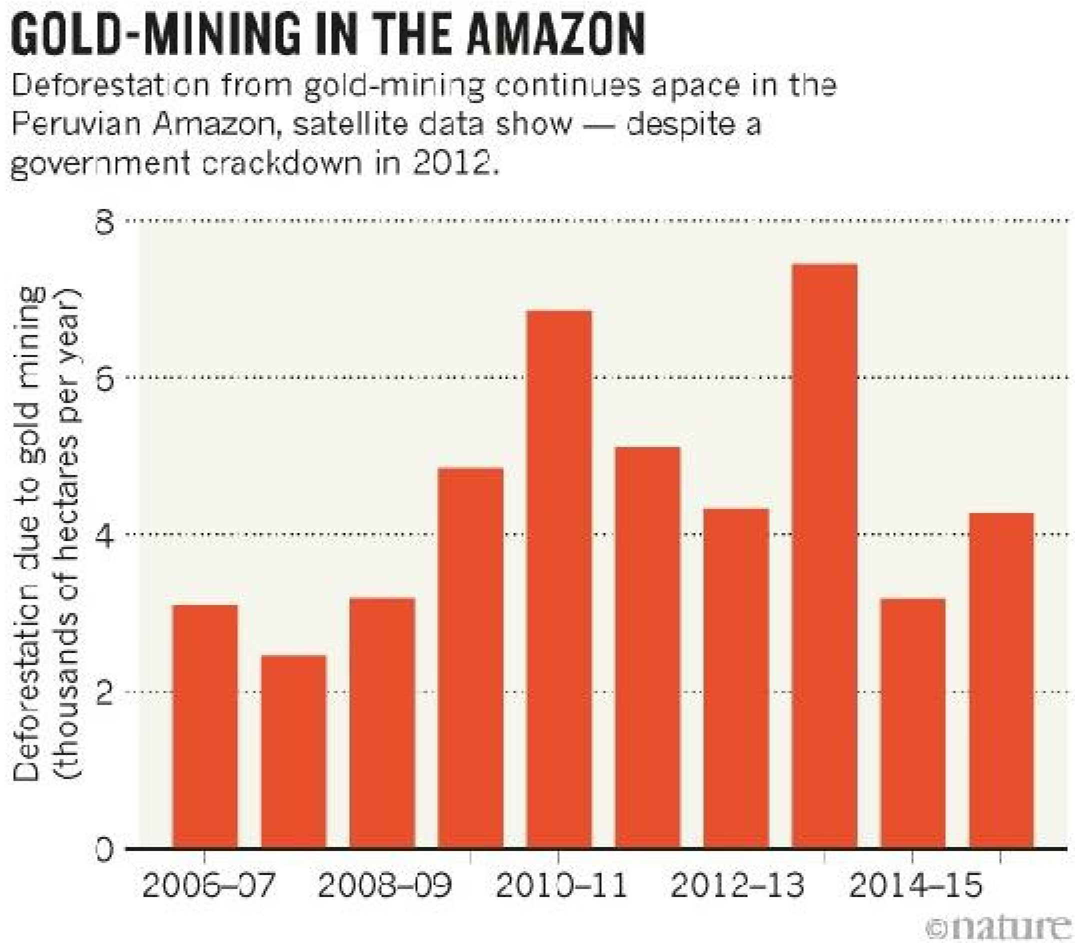
BUSINESS

Quantum quest Australia’s first quantum-computing hardware company started up on 23 August. Silicon Quantum Computing is a partnership between government, industry and the University of New South Wales in Sydney. It aims to develop and commercialize a prototype of a 10-quantum-bit circuit made from silicon within five years — a stepping stone towards the creation of a silicon-based quantum computer. The company enters an increasingly crowded marketplace in quantum computing, with competition from technology giants such as Google and Microsoft.

Drug costs cut Millions of people with hepatitis C may soon be able to afford the life-saving antiviral drug sofosbuvir. On 23 August, Gilead Sciences of Foster City, California, which sells the daily pills, said that it would license manufacturers of generic drugs to supply its antivirals in four middle-income countries — Malaysia, Thailand, Belarus and Ukraine. That should slash prices: a 3-month course of the pills ranges from US$84,000 in the United States to $12,000 in Malaysia, but costs as little as $300 in the 101 developing countries where generic versions are already permitted. Pressure had been mounting for the change: the Malaysian government has been considering a licence that would allow generics to be made or used in government facilities, overriding Gilead’s patent, and Ukraine has already revoked a key patent on sofosbuvir that shortened Gilead’s monopoly.

TREND WATCH

Illegal gold-mining in the Peruvian Amazon is on the rise again, according to a study published on 22 August (G. Asner and R. Tupayachi *Environ. Res. Lett.* **12,** 094004; 2017). Mining-related deforestation abated after a government crackdown in 2012, the authors found in their analysis of land-cover images. But since then, the mined area has increased by more than 40% in the Madre de Dios region, to 68,228 hectares. The region has some of the world’s highest levels of animal diversity.



Source: G. P. Asner & R. Tupayachi Environ. Res. Lett. 12, 094004 (2017).

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Comments

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Keep on marching for science education

Scientists might have made a difference, had they protested against laws that now threaten what can be taught in our classrooms, argues Brandon Haught[2].

29 August 2017

The new school year is beginning in the United States, and science education in Florida is at risk from laws that passed earlier this summer. It leaves me wondering: where have those who joined April's March for Science gone?

That global action was probably the most popular science-advocacy event of this generation. I took part in Titusville, Florida, and was impressed with the attendance, enthusiasm and creative slogans. In the speeches that followed, I warned against pending legislation that would allow any citizen to demand a hearing to challenge instructional materials. Both critics and advocates see this as a way to stifle teaching about evolution and climate change. We had the summer to make our case.

The science-advocacy group Florida Citizens for Science — for which I volunteer as a board member and communications officer — led the battle to kill, or least modify, those bills. We lost on all fronts. The bills are now law.

Where were those marchers when we needed them? I know several science cheerleaders who took some concrete steps to forestall the legislation (by

phoning elected representatives, for example), but I can count on one hand the number of working scientists who offered their expertise to our group. And I didn't hear of any who approached lawmakers on their own.

Having the scientific community more actively involved might have had an impact. The final vote in the state senate was tight. Advocates of the law were widely quoted as claiming that evolution is just a theory and that anthropogenic global warming is in doubt. It would have been invaluable if scientists at local universities had issued simple statements: yes, evolution is a fact; the word 'theory' is used differently in science from how it's used in casual conversation; and the basics of human-caused global warming need to be taught. Perhaps authoritative voices from the state's universities would have swayed a senator or two.

Since the laws were passed, dozens of articles about them have been published statewide and even nationally. Social media has been buzzing. But the scientific community is still woefully quiet.

Hey, scientists, beleaguered high-school science teachers could use your support.

Other US states have endured attacks on science education. Legislatures in Alabama and Indiana passed non-binding resolutions that encourage 'academic freedom' for science teachers who cover topics — including biological evolution and the chemical origins of life — that the lawmakers deem controversial.

In Iowa, state lawmakers proposed a law requiring teachers to balance instruction on evolution and global warming with opposing views. That effort dwindled without concrete action, but not because of pressure from the scientific community.

We have had some help in our efforts: Jiri Hulcr and Andrea Lucky, scientists at the University of Florida in Gainesville, spoke out with me against these bad educational bills in a newspaper opinion piece. We argued that the choice was stark: training students for careers in the twenty-first century, or plunging them into the Middle Ages.

And Paul D. Cottle at Florida State University in Tallahassee is unrelenting in pursuing his goal of preparing elementary and high-school students for their adult lives. He's an integral part of Future Physicists of Florida, a middle-school outreach programme that identifies students with mathematical ability and guides them into courses that will prepare them for university studies in science and engineering. More generally, he makes sure that students, parents and school administrators hear the message that the path to high-paying, satisfying careers using skills acquired in mathematics and science starts long before university, and depends on accurate instruction.

Plenty of issues need attention. The pool of qualified science and maths teachers is shrinking. Florida students' performance in state-mandated science exams has been poor and stagnant for nearly a decade. This year, the state's education department will begin to review and select science textbooks that will be used in classrooms across the state for at least the next five years.

We need scientists who are willing to take the time and effort to push back against the textbook challenges that these new laws will encourage. We need expert advisers eager to review and recommend quality science textbooks for our schools. We need bold scientists ready to state unapologetically that evolution, global warming — and, yes, even a round Earth — are facts of life.

You're busy. I know. And some of you are uncomfortable in the spotlight. But doing something, even on a small scale, is better than doing nothing. Sign up for action alerts from the National Center for Science Education and your state's science-advocacy group, if you have one. Be a voice within any organizations you belong to, urging them to make statements supporting science education as issues arise. Introduce yourself to teachers at local elementary and high schools.

Even if all you have to offer are ideas and emotional support, we'll take them. Politicians, school administrators, business leaders, parents and even children need to know that you support high-quality science education.

The March for Science was a beneficial, feel-good event. It's over. But we need you to keep on marching!

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Nature News

周二, 05 9月 2017

Nature News

[周二, 05 9月 2017]

- **Nature News**

Nature News

Nature is a weekly international journal publishing the finest peer-reviewed research in all fields of science and technology on the basis of its originality, importance, interdisciplinary interest, timeliness, accessibility, elegance and surprising conclusions. Nature also provides rapid, authoritative, insightful and arresting news and interpretation of topical and coming trends affecting science, scientists and the wider public.

- **Massive Ebola data site planned to combat outbreaks** [周一, 04 9月 08:00]
  An international partnership seeks African leadership to organize information about the disease.
- **Removing statues of historical figures risks whitewashing history** [周一, 04 9月 08:00]
  Science must acknowledge mistakes as it marks its past.
- **Trump finally nominates new leader for NASA** [周六, 02 9月 08:00]
  James Bridenstine, a member of Congress, has long pushed for the United States to return to the Moon.
- **Nature videos help to calm inmates in solitary confinement** [周五, 01 9月 08:00]
  Controversial experiment ignites debate over whether scientific work could be used to justify harsh prison tactics.
- **Volcanic views, stalking storks and the ephemeral eclipse** [周五, 01 9月 08:00]
  August’s sharpest science shots, selected by Nature ’s photo team.
- **Brain researchers in uproar over NIH clinical-trials policy** [周五, 01 9月 08:00]
  An open letter to the US National Institutes of Health says that classifying human-behaviour studies as clinical trials creates unnecessary red tape.
- **How labs are coping with Hurricane Harvey's devastating floods** [周四, 31 8月 08:00]
  Advance planning has kept some Texas facilities safe during the unprecedented storm.
- **Artificial warming trial reveals striking sea-floor changes** [周四, 31 8月 08:00]
  Researchers deliberately heated up a slice of the Antarctic sea bed to see how ecosystems responded.
- **Doubts raised about CRISPR gene-editing study in human embryos** [周四, 31 8月 08:00]
  Alternative explanations challenge whether technique actually fixed a genetic mutation as claimed.

- **[Skeleton plundered from Mexican cave was one of the Americas’ oldest]** [周三, 30 8月 08:00]
  Rock-encased bone shard left behind by thieves allowed researchers to determine that the remains are probably more than 13,000 years old.
- **[Reprogrammed cells relieve Parkinson's symptoms in trials]** [周三, 30 8月 08:00]
  Monkeys implanted with neurons derived from stem cells showed sustained improvement after two years.
- **[Closure of US coal study marks an alarming precedent]** [周三, 30 8月 08:00]
  The Trump administration has stepped up its assault on environmental protections by halting a US$1-million study on the health risks of coal mining — casting a pall on academic freedom.
- **[Alan Turing's notes, runaway salmon and illegal gold-mining]** [周三, 30 8月 08:00]
  The week in science 25–31 August 2017.
- **[Cassini’s 13 years of stunning Saturn science — in pictures]** [周三, 30 8月 08:00]
  As the mission speeds towards its conclusion, Nature takes a look at what researchers have learnt about the planet’s moons, rings and tempest-filled skies.
- **[Stop blocking postdocs’ paths to success]** [周三, 30 8月 08:00]
  Lab heads should let junior researchers take their projects with them when they start their own labs — it drives innovation and discovery, argues Ben A. Barres.
- **[Artificial intelligence: The future is superintelligent]** [周三, 30 8月 08:00]
  Stuart Russell weighs up a book on the risks and rewards of the AI revolution.
- **[Books in brief]** [周三, 30 8月 08:00]
  Barbara Kiser reviews five of the week's best science picks.
- **[Economics: Messy genesis of the welfare state]** [周三, 30 8月 08:00]
  Paul Cairney examines the tangled history of one nation's drive for social equity.
- **[Pollution: US coal plans flout mercury convention]** [周三, 30 8月 08:00]
- **[Multidisciplinarity: Philanthropy research is thriving]** [周三, 30 8月 08:00]
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- **[Geode]** [周三, 30 8月 08:00]

Breaking new ground.

- **Extreme weather events are the new normal** [周二, 29 8月 08:00]
  Hurricane Harvey highlights the struggle to apply climate science.
- **Keep on marching for science education** [周二, 29 8月 08:00]
  Scientists might have made a difference, had they protested against laws that now threaten what can be taught in our classrooms, argues Brandon Haught.
- **Europe’s X-ray laser fires up** [周二, 29 8月 08:00]
  High-speed shooter will help scientists to make molecular movies.
- **Legal threat exposes gaps in climate-change planning** [周二, 29 8月 08:00]
  Australian lawsuit highlights how difficult it is to turn global warming data into useful advice.

Massive Ebola data site planned to combat outbreaks

An international partnership seeks African leadership to organize information about the disease.

04 September 2017

John Moore/Getty

An Ebola awareness mural in Monrovia, Liberia — one of the three West African countries that was hit by a devastating outbreak of the disease starting in 2014.

More than 11,000 people died when Ebola tore through West Africa between 2014 and 2016, and yet clinicians still lack data that would enable them to reliably identify the disease when a person first walks into a clinic. To fill that gap and others before the next outbreak hits, researchers are developing a platform to organize and share Ebola data that have so far been scattered beyond reach.

The information system is coordinated by the Infectious Diseases Data Observatory (IDDO), an international research network based at the University of Oxford, UK, and is expected to launch by the end of the year. At a meeting to discuss Ebola on 7–9 September in Conakry, Guinea, the team heading the platform will seek input from West African scientists, health officials and advocacy groups.

“We are looking for West African leadership in this initiative,” says Laura Merson, associate director of the IDDO.

Local leaders

Africans must be involved in the platform’s creation so that they can not only use the existing data, but also improve their capacity to conduct research during future outbreaks, says John Amuasi, an infectious-diseases researcher at the Kumasi Centre for Collaborative Research in Tropical Medicine in Ghana and a member of the platform’s steering committee. A true partnership would also lessen the general public’s mistrust of scientists, he adds.

During the outbreak, for example, a widespread rumour claimed that the plague was an experiment conducted by the West, which led some people to resist going to clinics and helped Ebola to spread.

Merson and her collaborators want to avoid the kind of data fragmentation that hindered efforts to stop the outbreak in Liberia, Guinea and Sierra Leone. As the Ebola crisis was escalating in October 2014, she visited treatment units in the three countries to advise on research. Merson found tremendous variation in practices, which complicated attempts to merge and analyse the information. For instance, some record books listed lethargy and hiccups as symptoms, whereas others recorded fatigue but not hiccups.

"People were just collecting what they could," she recalls. Non-governmental organizations "were keeping their data private; academics take a year to get it out; and West Africa had set up surveillance but they were siloed from the international systems", she says.

Questions of control

In July 2015, the IDDO received pilot funds from the UK charity the Wellcome Trust to pool anonymized data from the medical records of people who contracted Ebola — and those who survived it — as well as data from clinical trials and public health projects during outbreaks in West Africa, Uganda and the Democratic Republic of Congo. The hope is that a researcher could search for data to help in diagnosing, treating and understanding the disease. The platform would also provide a home for new data as they emerge. A draft research agenda lists questions that the information might answer, such as how long the virus can survive outside the human body, and what factors are associated with psychological issues in those who survive Ebola.

One sensitive issue is deciding who will control the data. Amuasi says that he would have liked the database to be hosted and curated in Africa, rather than in Oxford, because training and paying African researchers to manage the platform would teach them how to use the information and improve their ability to respond to future outbreaks in the region. But he adds that this seems unlikely, because it would raise the cost of the project, and the infrastructure already exists at Oxford.

Merson says that a copy of the database will be maintained in West Africa, although its exact location has yet to be determined. She adds that an African committee may be in charge of deciding who gets access to the data. And she says that fellowships are likely to be made available for West African students who want to work on the database.

It's vital that these discussions happen now, in a period of relative calm, says

Jeremy Farrar, director of the Wellcome Trust in London. When the virus emerges again, clinicians, scientists, and regulatory boards will need fast access to data so as not to repeat mistakes made last time. “We need to sit down and make sure we have a data platform in place so that we can respond to a new case of Ebola in hours and days, and not in months and years,” he says. “A great danger is that the world will move on and forget the horror of Ebola in West Africa.”

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Comments

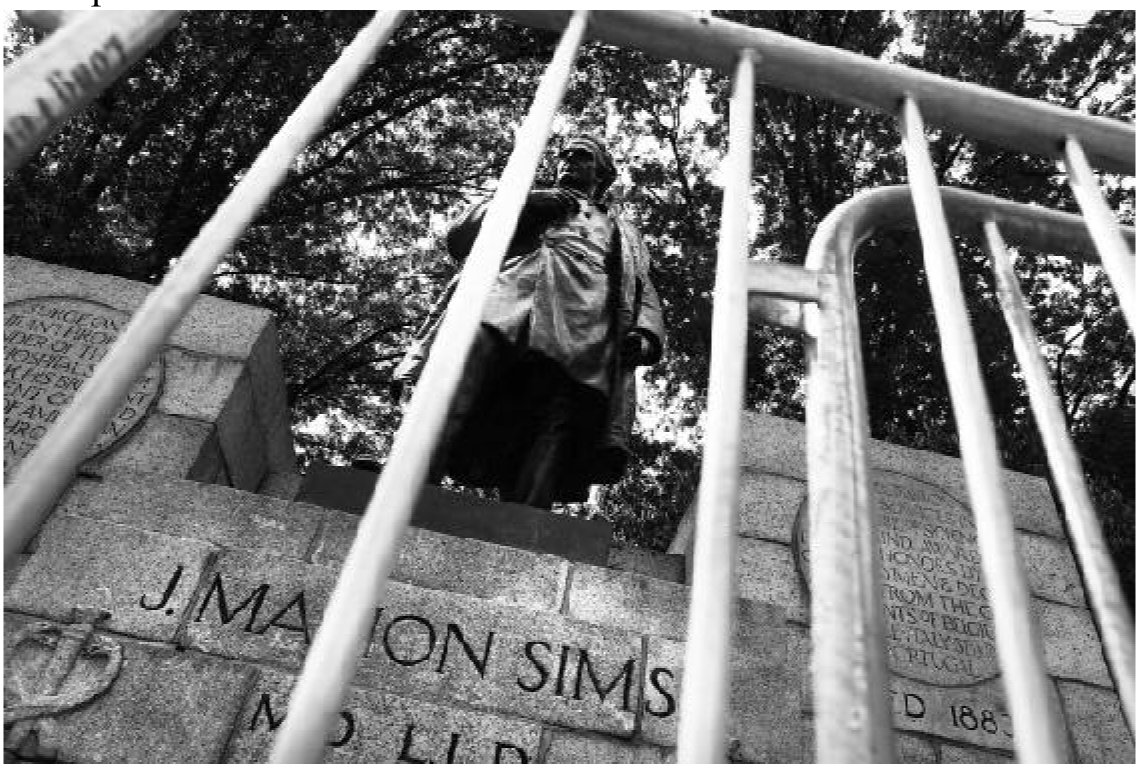
Comments

There are currently no comments.

Removing statues of historical figures risks whitewashing history

Science must acknowledge mistakes as it marks its past.

04 September 2017



Spencer Platt/Getty

The New York City statue of gynaeocologist J. Marion Sims has drawn protests.

The statues of explorer Christopher Columbus and gynaecologist J. Marion Sims stand at nearly opposite corners of New York City's Central Park, but for how much longer? Both monuments have been dragged into a nationwide debate about memorials to historical figures who have questionable records on human rights. The arguments are long-standing, but were thrown onto the world’s front pages last month when protests against the removal of a statue of Confederate General Robert E. Lee in Charlottesville, Virginia, produced racially charged violence.

Last week, the Central Park Sims statue — one of many that stand in numerous US cities — was vandalized. The word ‘racist’ was spray-painted alongside his list of achievements, which include life-saving techniques he developed to help women recover from traumatic births. Yet many protest about the lionization of this ‘father of modern gynaecology’ because he performed his experiments on female slaves.

Sims is not the only scientist whose long-dead head is on the block and whose achievements, and the circumstances around them, are being revisited from the twenty-first century. Institutions in the United States have struggled with the case of Thomas Parran, the US surgeon general who oversaw the infamous Tuskegee study that ran between 1932 and 1972. The researchers enrolled hundreds of African American men who had syphilis, but did not inform them that they had the infection and withheld treatment in an effort to monitor how the disease progressed.

A similar study on Parran’s watch happened between 1946 and 1948 in Guatemala, when more than 1,300 people were intentionally infected with diseases including syphilis. The study was not made public until historian Susan Reverby stumbled across research records in 2005. Both studies were performed surreptitiously, as though their perpetrators suspected that what they were doing could be perceived as immoral. The US government has formally apologized for the way in which both studies were conducted.

In 2013, after lengthy debate, the American Sexually Transmitted Diseases Association voted to rename its prestigious Thomas Parran award. “Many [members] were concerned that continuing to offer the Parran award may give the appearance of tacit approval of unethical research,” the society said in a statement. The University of Pittsburgh in Pennsylvania is similarly debating whether to rename its Parran Hall (Parran worked at the university after his stint as surgeon general).

Defenders of controversial historical figures argue that they should be judged by their achievements rather than by modern norms. Sims was far from the only doctor experimenting on slaves in 1849, despite the fact that the abolitionist movement was well under way in the United States. And his achievements saved the lives of black and white women alike. But some historians argue that his experiments could have been considered unethical even for his time.

Europe has struggled with these issues for even longer than the United States. After some debate, Oriel College at Britain's University of Oxford last year decided to keep a controversial statue of Cecil Rhodes, the nineteenth-century businessman and committed imperialist.

After the Second World War, cities and institutions were left with streets, buildings, statues and other memorials that were named after people who collaborated with the Nazis or were at least sympathetic to the regime. And in Canada earlier this month, Montreal decided to rename streets and parks named after French Nobel laureate Alexis Carrel, who supported enforced sterilization and eugenics. Other cities in France have already wiped his name from their maps.

Erasing names, however, runs the risk of whitewashing history. Germany's Max Planck Society — formerly the Kaiser Wilhelm Society — deserves credit for its public acknowledgement that many prominent members worked with the Nazi regime and that the society did not help to protect Jewish scientists.

Instead of removing painful reminders, perhaps these should be supplemented. Such notes are also standard in biomedical literature. The American Medical Association recommends that if unethically acquired data are essential to science, any use or citation of these data should describe the unethical behaviour and pay respect to the victims of the experimentation.

Institutions and cities could do something similar by installing a plaque noting the controversy, or an equally sized monument commemorating the victims. Such a historical marker stands for Carrie Buck, a young woman who was the first person to be sterilized under a 1924 eugenics programme in the United States, which was designed to eliminate 'genetically inferior' people with mental and physical disabilities. It stands in Charlottesville just a few blocks — but a million miles away — from the disputed statue of General Lee.

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There are currently no comments.

Trump finally nominates new leader for NASA

James Bridenstine, a member of Congress, has long pushed for the United States to return to the Moon.

02 September 2017 Updated:

1. 02 September 2017

James Bridenstine, a Republican member of the US Congress from Oklahoma, has been tapped to be the next head of NASA. Bridenstine is a strong supporter of lunar exploration and commercial space flight.

If confirmed by the Senate, he will take the reins of an agency that is building a new heavy-lift rocket to fly astronauts to unknown destinations. Bridenstine has repeatedly argued that the United States should return to the Moon — to, among other things, mine water ice to fuel a fleet of satellites with lunar hydrogen and oxygen.

“From the discovery of water ice on the Moon until this day, the American objective should have been a permanent outpost of rovers and machines at the poles with occasional manned missions for science and maintenance,” Bridenstine told a lunar-exploration group last November. “This is our Sputnik moment.”

Bridenstine has also pushed to accelerate the government’s use of commercial space services. “The US government understands that in the future, and even today, it will be a customer of routine space services, not a provider of routine space services,” he said in the November speech. NASA currently pays for private companies to fly agency cargo to the International Space Station; US astronauts will fly aboard commercial rockets no earlier than next year.

“Representative Bridenstine is certainly a “different” choice for NASA administrator, but to me the difference is mainly positive,” says John Logsdon, who specializes in space policy at George Washington University in Washington DC. “He has been refining his ideas with diverse audiences over the past months, and would bring to the NASA position a clearer and better-defined strategy for moving ahead than did most of his predecessors as they began their tenure.”

Space credentials

After studying economics, business and psychology at Rice University in Houston, Texas, Bridenstine served as a pilot in the US Navy. He flew combat missions in Iraq and Afghanistan, and in anti-drug operations in Central and South America. He also worked as executive director for an aerospace museum in Tulsa, Oklahoma. Since he was first elected to Congress in 2012, Bridenstine has slowly built up his space-policy credentials, serving on the House of Representatives’ science, space and technology committee and speaking in front of groups such as the US Federal Aviation Administration’s space-transportation conference.

In 2016, Bridenstine introduced legislation in the House that would require NASA to make Mars its “main human spaceflight priority” — presumably after first establishing a Moon base — and bolster the already-growing role of commercial space flight. The legislation stalled at the subcommittee level.

Bridenstine has expressed scepticism about climate change. In a June 2013 speech on the House floor, he disparaged the role of humans in global warming and criticized then-President Barack Obama for spending more money on climate research than on weather forecasting. Bridenstine has argued to exclude greenhouse gases from federal regulation, and to expand oil and gas exploration on federal lands and offshore.

Major challenges facing the next NASA administrator include keeping the development of the Space Launch System heavy-lift rocket and its accompanying Orion crew capsule on track. The first flight of the paired system is meant to be in November 2018 but will probably be delayed, an

April report from the US Government Accountability Office found.

“We hope the new administrator embraces NASA’s strong commitment to science and public engagement,” says Heidi Hammel, executive vice-president of the Association of Universities for Research in Astronomy (AURA) in Washington DC. “AURA looks forward to working with the new NASA administrator to ensure that the agency maintains a robust science portfolio.”

Bridenstine would replace Charles Bolden, a former astronaut who flew four times aboard the space shuttle.

In June, the administration of President Donald Trump re-established the National Space Council, an on-again, off-again entity meant to coordinate space activities between various government departments, including civilian and military agencies. Vice-President Mike Pence is chair of the council.

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Updates

Updated:

This piece has been updated with comments from John Logsdon and Heidi Hammel.

Comments

Comments

There are currently no comments.

Nature videos help to calm inmates in solitary confinement

Controversial experiment ignites debate over whether scientific work could be used to justify harsh prison tactics.

01 September 2017

Benj Drummond

An inmate watches nature videos in a designated room at Snake River Correctional Institution in Oregon.

A little bit of nature can calm even the most stressed populations of people, according to a study conducted on prisoners in solitary confinement.

In the experiment, researchers found that prisoners who watched videos with nature scenes felt less stressed and weren't as violent as those who didn't. The team, led by ecologist Nalini Nadkarni at the University of Utah in Salt Lake City, published their findings on 1 September in *Frontiers in Ecology and the Environment*[1].

Nadkarni first proposed the study in 2010 while visiting a prison that housed criminals who were considered to be the highest security risks. "Six guards in Kevlar vests and full riot gear had to go in and subdue an inmate in a restraining chair," she says. "I thought, wow, if we could just calm them with nature rather than with Kevlar vests and riot gear, that would be really great." But it took Nadkarni years to find a prison that was willing to let her test her hypothesis.

The experiment's results have now convinced some prison officials to offer inmates access to nature videos. However, critics of the study argue that it could be used to justify the continued use of solitary confinement — a practice that some consider too harsh.

Calming influence

Past research has shown that regularly seeing plants — even from a window — can improve hospital patients' and prison inmates' physical and mental health[2]. Nadkarni went further by studying people in solitary confinement, where inmates typically spend 23 hours a day alone in bare-walled cells.

Her team divided inmates at the Snake River Correctional Institution in Ontario, Oregon, into 2 groups of 24. Those in one group could choose to exercise or, up to five times per week, go to a 'blue room' to watch 45-minute-long videos showing natural scenes such as mountains, forests and oceans. Those in the other group were offered exercise, but no videos.

The researchers and prison staff measured inmates' moods and stress levels, and tracked violent incidents over a year. They found that inmates who had access to videos reported feeling calmer and were involved in 26% fewer violent incidents. The results suggest that nature imagery can help even

society's most nature-deprived populations, which includes prison inmates, but also residents of nursing homes and inner city areas, says Nadkarni.

The blue room has also helped Snake River to save thousands of dollars in medical costs resulting from altercations and self-harm, says Renee Smith, the institution's behavioral health systems manager. "We were pretty excited," she says. The programme is already being replicated in three other states.

Benj Drummond

Nalini Nadkarni interviews a prisoner who participated in the study.

A controversial idea

"It's certainly a pretty creative naturalistic experiment," says Lisa Nisbet, a psychologist at Trent University in Peterborough, Canada. "You couldn't get a much more deprived group of people."

But she and others caution that it is impossible to know whether exposure to nature had the beneficial effect because no group was shown videos with other content. Without this additional control group, “you can’t really draw any definitive conclusions,” says Marc Berman, a psychologist at the University of Chicago in Illinois.

The study authors acknowledge this limitation, which they say is due to there being an insufficient number of prison staff to implement the additional control condition. But they say that inmates specifically mentioned the videos’ nature content during interviews. One wrote: “The nature project help’s [*sic*] me think clearer to know there is so much more beauty in this world then [*sic*] this prison”.

Not everyone is embracing the study. Opponents of solitary confinement worry that the paper could provide cover for perpetuating a practice that many consider to be cruel and counterproductive. “I would hate to think that this study will be used to justify keeping solitary confinement prisoners in conditions where they are deprived of opportunities to actually experience nature,” says Craig Haney, a psychologist at the University of California, Santa Cruz.

Nadkarni says her collaboration has helped inmates even if it hasn’t dramatically reformed the prison system. “As an ecologist, it is not in my power to change the system of mass incarceration,” she says. “One thing I can do is think about ways that bring the therapeutic value of nature to people who are incarcerated.”

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Comments

Comments

There are currently no comments.

| Section menu | 主菜单 |

Volcanic views, stalking storks and the ephemeral eclipse

August's sharpest science shots, selected by *Nature*'s photo team.

01 September 2017

Souvenirs of travel

Image Slideshow

1. 

There was plenty to interest the scientifically inclined in the latest National Geographic Travel Photographer of the Year contest. The

Grand Prize winner was this shot of the Colima Volcano in Mexico erupting in December 2015.

Sergio Tapiro Velasco/National Geographic Travel Photographer of the Year

2. 

This picture of Caribbean reef sharks (*Carcharhinus perezii*) was taken with a remote camera in the Gardens of the Queen, a marine protected area near Cuba. This image and the next two earned honourable mentions in the Nature category.

Shane Gross/National Geographic Travel Photographer of the Year

3. 

This picture from the Tamba area of Japan shows fireflies signalling for mates above the stairs leading to a shrine.

Yutaka Takafuji/National Geographic Travel Photographer of the Year

4. 

This shot of Mount Bromo erupting in 2016 in Indonesia was taken from the patio of a local hotel.

Reynold Riksa Dewantara/National Geographic Travel Photographer of the Year

Eclipse excitement

Jasman Mander

North Americans turned into literal lunatics on 21 August, as an eclipse sent thousands of obsessed sky-watchers scrambling to see the Moon block out the Sun. Here, a composite image shows the progression of the eclipse as seen from the Lowell Observatory in Madras, Oregon.

Go northwest!

Dan Goldman/AP/REX/Shutterstock

The Northwest Passage through the Arctic Ocean has become a much-examined signifier of climate change. As ice thins, more ships than ever before are attempting to push through this previously impassable sea route. On 29 July, the icebreaker MSV *Nordica* — pictured here — completed the route earlier in the year than ever before. Just a few weeks later, a reinforced Russian tanker made the journey successfully without an icebreaker escort.

Harvey's toll

Jonathan Bachman/Reuters

Storm Harvey is still bringing death and destruction to the United States, as record rainfall in Texas triggered flooding and evacuations. These people in Houston, Texas, were among many forced to take to the waters to escape.

Stork, stalking

Nicky Classen/Solent News/REX/Shutterstock

This yellow-billed stork (*Mycteria ibis*) began hunting for fish right alongside a photographer’s hide in Kwa-Zulu Natal, South Africa. Nicky Classen was inside the hide earlier this month to capture the shot.

Catching dinner

John Thys/AFP/Getty

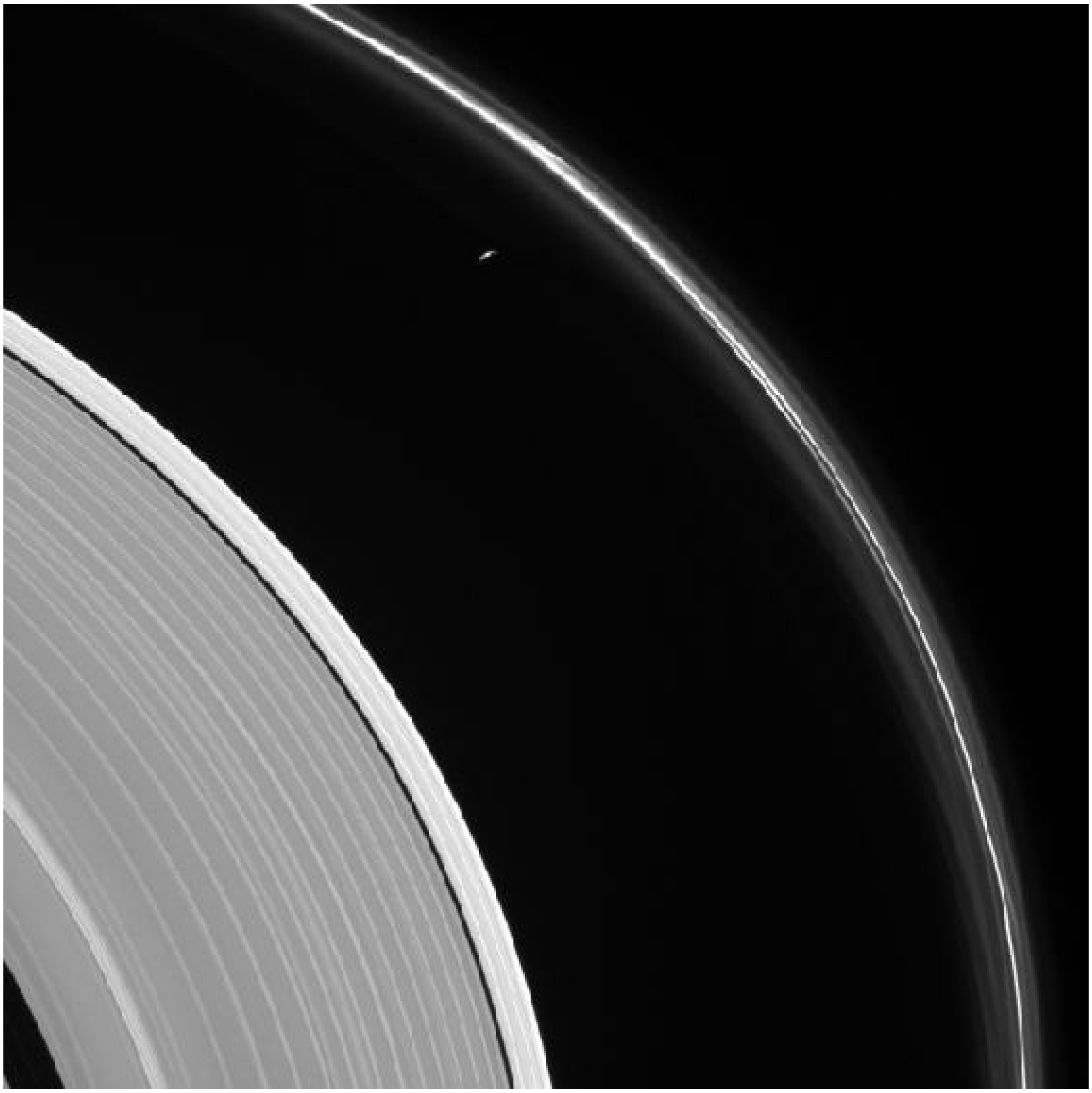
In the Netherlands, lions that were once trained to do tricks in circuses have been taught other skills. This lioness is catching a piece of meat during hunting training.

***Do svidaniya*!**

Joel Kowsky/NASA

On 28 July, a Soyuz rocket shuttled three crew members of Expedition 52 to the International Space Station. The mission plans to test out flexible solar panels that roll out like blankets; explore the physics of neutron stars; and test in rats an experimental drug to deal with bone-mass loss caused by weightlessness.

Cassini’s legacy



NASA/JPL-Caltech/SSI

On 15 September, NASA's Cassini spacecraft will begin a plunge into Saturn's clouds that will lead to its destruction and the end of its 13 years of data collection. *Nature* looks back at some of the pictures the probe has captured, and what they have meant for science.

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Comments

There are currently no comments.

| Section menu | 主菜单 |

Brain researchers in uproar over NIH clinical-trials policy

An open letter to the US National Institutes of Health says that classifying human-behaviour studies as clinical trials creates unnecessary red tape.

01 September 2017

Scientists studying human behaviour and cognitive brain function are up in arms over a plan by the US National Institutes of Health (NIH) to classify most studies involving human participants as clinical trials.

An open letter posted to an online petition site on 31 August and addressed to NIH director Francis Collins on says that the policy could “unnecessarily increase the administrative burden on investigators”, slowing the pace of discovery in basic research. It asked the NIH to delay implementation of the policy until it has consulted with the behavioural-science and neuroscience communities. The letter has so far garnered more than 2,700 signatures.

“Every scientist I have talked to who is doing basic research on the human mind and brain has been shocked by this policy, which makes no sense,” says Nancy Kanwisher, a cognitive neuroscientist at the Massachusetts Institute of Technology in Cambridge, who co-wrote the letter with four other researchers.

The policy is part of an NIH reform effort started in 2014, which aims to ensure that all clinical results are publicly reported. The policy is scheduled to go into effect in January 2018; it defines a clinical trial as anything involving biomedical behavioural ‘interventions’, such as asking participants to perform a memory task or monitor their food intake. Under the policy, such studies would need special evaluation by NIH committees and institutional ethics-review boards. The experiments would also need to be registered in the ClinicalTrials.gov database.

Waiting for clarification

But many researchers think that studies of normal human behaviour — intended to discover phenomena rather than alter them — should not be classified in this way. Among other concerns, small institutions that do not normally perform clinical trials may not have the resources or knowledge to comply fully with the policy.

These concerns are overblown, said Michael Lauer, NIH deputy director for extramural research, at meeting of the agency's advisory council on 1 September in Bethesda, Maryland. "The only regulation we're talking about is reporting that the trial exists and telling the world about the results. It is as simple as this and as profound as this." He said that his office would work with behavioural scientists to ensure that their studies were getting the proper review and that their research could be registered properly.

But council member Terry Jernigan, a cognitive scientist at the University of California, San Diego, told Lauer that it was "not as simple as that". She said the policy has already caused problems for a study she is leading that tracks normal brain development in adolescents. When her group asked participants' parents to sign the required clinical-trial consent form, some expressed concerns that the form's language indicated that something was being done to their children, rather than that researchers were simply observing them.

Next week, in response to some of those concerns, the NIH will release a list of examples of studies that qualify as clinical trials under the policy. "The NIH definition of a clinical trial may be broader than other clinical-trial definitions because it reflects NIH's mission, encompassing biomedical and behavioural outcomes as they pertain to human health," said the agency in a statement to *Nature*'s news team. "This definition does not encompass all psychological and cognitive research that is funded by NIH."

Jeremy Wolfe, a vision researcher at Brigham and Women's Hospital in Boston, Massachusetts, says it is encouraging that the NIH plans to work with researchers in his field, but he adds that the details of the policy will be key. "We're worried about whether those details can be worked out by the

January deadline," he says.

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Comments

Comments

There are currently no comments.

How labs are coping with Hurricane Harvey's devastating floods

Advance planning has kept some Texas facilities safe during the unprecedented storm.

31 August 2017 Clarified:

1. 01 September 2017

Win McNamee/Getty

Now that the rains have cleared over downtown Houston, the long road to recovery can begin.

Hurricane Harvey swept ashore on 25 August and dumped record-breaking amounts of rain on Houston, Texas, over the next several days. As the storm begins to dissipate, scientists in its wake are starting to take stock of the personal and professional toll.

Many institutions in Houston were relatively well prepared for Harvey, having put precautions in place after suffering major losses when Tropical Storm Allison flooded the city in 2001. Facilities in other parts of the state have not been so lucky, but researchers hit by Harvey — now downgraded to a tropical depression — are not being left to fend for themselves. As of 31 August, roughly 200 scientific laboratories across the country have offered computer time, lab space, animal care and spare rooms to researchers displaced by the storm, using the hashtag #SciHelpTX on Twitter.

When Harvey made landfall as a category 4 hurricane, it hit facilities at the University of Texas at Austin Marine Science Institute in Port Aransas particularly hard, ripping the roof off Brett Baker's microbial-ecology lab. Baker says that one of his graduate students has already arranged to transfer to a lab at the University of California, Berkeley, and a postdoc is heading to Uppsala University in Sweden. "Our institute is on a barrier island," Baker says, and it took a direct hit from the storm. Baker spent some time crying, he adds, but is now so busy with logistics that he hasn't fully processed his feelings.

Lessons learnt

Most of the biomedical-research facilities in Houston, including those at Rice University, MD Anderson Cancer Center and the University of Texas Health Science Center, had installed special doors and floodgates to hold back storm waters after Allison. Those precautions saved equipment and animals, says Anirban Maitra, a pathologist at MD Anderson. "I think they prevented a mega-catastrophe," he adds.

Baylor College of Medicine lost 60,000 breast-cancer specimens in the 2001 storm. But the lessons that it learnt have paid off, says spokesperson Lori Williams. "We built a wall around the entire campus," she says. "We've had

no animals lost, no research lost."

The University of Houston (UH), by contrast, does not have special flood infrastructure. So the institution has been dealing with flooded basement labs, and has struggled to keep animals dry and fed. Forty baby rhesus monkeys had their formula milk rationed, says Amr Elnashai, vice-president for research and technology transfer at UH. A few had to be weaned a week early. Supplies of liquid nitrogen and helium are also running low, endangering frozen samples if they cannot be restocked soon. "If the worst is over, then we are fine," says Elnashai. "If there is another hit, then we are in deep trouble."

Personal costs

Meanwhile, staff at the Johnson Space Center in Houston are camping out at mission control to keep the International Space Station and the James Webb Space Telescope (JWST) programmes going. "I came in for a shift Friday night and I've been here ever since," says flight director Courtenay McMillan. Staff have been sleeping on makeshift beds and air mattresses, and subsisting on provisions provided by co-workers and friends. "We have not run out of coffee, which is the most important thing," McMillan adds.

The JWST was in the middle of a 100-day test in a thermal vacuum chamber when Harvey struck, but is unharmed. And a Soyuz capsule landing scheduled for this weekend in Kazakhstan — which the space centre will help to coordinate — will go ahead with only minor modifications to the plan, says McMillan.

Although many institutions have fared relatively well despite the storm's ferocity, researchers and staff are still dealing with personal losses. Officials estimate that at least 38 people have died as a result of the storm. Maitra says that one administrator on his team has been evacuated to a hotel. "She had to leave in a hurry with her kids in the middle of the night. They were stuck on the third floor of her complex for three days. It is just heartbreaking."

Louise Prockter, director of the Lunar Planetary Institute in Houston, was

travelling when Harvey swept into town. She has been trying to support her staff remotely from Washington DC. “Some of our staff have lost all their property,” she says. “It is a mess. For some people, normal is a long, long way off.”

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Clarifications

Clarified:

Louise Prockter originally stated that a lot of the staff at the Lunar Planetary Institute lost all of their property. She misspoke and says it should be some of the staff that lost all of their property.

Comments

Comments

There are currently no comments.

Artificial warming trial reveals striking sea-floor changes

Researchers deliberately heated up a slice of the Antarctic sea bed to see how ecosystems responded.

31 August 2017

David Doubilet/NGC

Antarctic ecosystems will be affected by warming waters.

The future has come to a small patch of the Antarctic sea floor, courtesy of an experiment that placed electric heating pads on the ocean's bottom. The pioneering trial is one of the most realistic and technically challenging ocean-warming experiments yet performed, researchers say — and it opens up a

new avenue to explore how warming oceans affect marine ecosystems.

In the past 40 years, the surface waters of Earth's oceans have warmed by some 0.4 °C on average as a result of climate change. And if greenhouse-gas emissions continue at their current pace, models forecast that the warming could reach up to 2 °C by 2100.

But researchers know little about how ocean ecosystems will respond and adapt as a result — and uncertainties are largest in polar regions where there are few field data, says study co-author Gail Ashton, a marine ecologist with the Smithsonian Environmental Research Center in Tiburon, California.

That data gap spurred Ashton and her colleagues to carry out the artificial warming experiment in Antarctica. They began in 2014, when scuba divers dug trenches, laid cables and installed 12 panels 15 metres under water on flat sea bed near the Rothera Research Station of the British Antarctic Survey (BAS), which is on a small island off the west coast of the Antarctic Peninsula. Four panels were heated so that they were always 1 °C above the ambient temperature — which in the region varies from around –2 °C to +2 °C during the year — and four were heated to 2 °C above ambient temperature. The remaining four were left unheated, as controls.

Gail Ashton

A team of researchers laid heating pads on the Antarctic sea floor to investigate warming.

Using cameras, the divers then monitored how microorganisms — of the kind that encrust wet surfaces and biofoul underwater pipes — colonized the panels. The species, including microscopic invertebrates and sponges, represented typical sea-bed fauna in the region. The experiment was supposed to run for two years but ended after nine months, when icebergs damaged power-supply cables. Still, researchers saw significant and surprising differences between the panels, says Ashton. “I had hoped we might be able to see some subtle differences after careful image analysis,” she says. “But I would never have expected that the warming effects would be so easily discernible with the human eye.”

Metabolic theory predicts that biological growth rates increase by around 10% for every 1 °C of warming. But some species grew twice as fast on the heated panels as they did on the controls, Ashton and her colleagues report in *Current Biology*[1]. Distinctly different animal communities settled on the heated surfaces. On the 1 °C set, a species called *Fenestrulina rugula* — a kind of filter-feeding invertebrate called a bryozoan — so dominated the fauna that the diversity of all the species on the panel was reduced.

“The results are very exciting and provocative,” says Craig Smith, a marine ecologist at the University of Hawaii at Manoa. “They suggest that climate warming in the next 50 years in Antarctica could substantially alter the unique diversity of Antarctic ecosystems.”

Experimenters have struggled in the past to study the effects of ocean warming in a controlled experiment, in which one area of sea is deliberately and uniformly warmed relative to another over a long period of time. Previous ocean tests have compared coastal areas with nearby regions that receive extra heat from local power plants. And one effort in 2010 used electric panels to heat a small section of water in western Australia, but the animals being studied quickly grew big enough to leave the warmed water layer.

Danger to diversity

Researchers worry that Antarctic species — adapted to cold waters — may suffer as waters warm. The results suggest that species at the bottom of the marine food web are able to cope with one or two degrees of warming, Ashton says, particularly given that it happens over decades. However, species-richness or diversity might be affected, and some species might grow to dominate others. Ashton says she would also like to know what the knock-on effects will be for other creatures.

“We do need more reliable field data to validate and interpret lab experiments on how environmental change affects life in the seas,” says Hans-Otto Pörtner, an ecologist at the Alfred Wegener Institute of Polar and Marine Research in Bremerhaven, Germany. “As yet, we have only a sketchy knowledge of what controls the success of species.”

Others agree that carefully designed controlled-warming experiments such as Ashton’s are the way to go, although Smith says they should ideally be run for longer, with more replications.

One caveat, he cautions, is that the panels warmed only a roughly 2-millimetre-thick layer of water. The rest of the water column — which would have contained larvae and food on which the animals in the experiment depend — remained colder. So the results aren’t a perfect predictor of how sea-floor communities might change, he says.

Furthermore, the results can’t be generalized to suggest what will happen in other seas, says Simon Morley, a marine biologist with the BAS in Cambridge, who took part in the study.

Ashton and Morley plan to do more warming experiments in other polar environments. In September, Morley will look for a suitable test site near the Canadian High Arctic Research Station in Cambridge Bay. He says he will also apply for money to do similar experiments in tropical waters, and perhaps even freshwater environments.

“More of these experiments need to be done to be able to generalize, and

draw wider conclusions," says Boris Worm, an oceanographer at Dalhousie University in Halifax, Canada. "Each is necessary to challenge our simplistic assumptions about how climate change may alter the world we live in."

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Comments

Comments

There are currently no comments.

Doubts raised about CRISPR gene-editing study in human embryos

Alternative explanations challenge whether technique actually fixed a genetic mutation as claimed.

31 August 2017

H. Ma et al./Nature

Eight-cell human embryos from an August study that reported success in using CRISPR to remove a deadly mutation.

Doubts have surfaced about a landmark paper claiming that human embryos were cleared of a deadly mutation using genome editing. In an article[1] posted to the bioRxiv preprint server on 28 August, a team of prominent stem-cell scientists and geneticists question whether the mutation was actually fixed.

The 2 August *Nature* paper[2], led by reproductive biologist Shoukhrat Mitalipov at the Oregon Health and Science University in Portland, described experiments in dozens of embryos to correct a mutation that causes a heart condition called hypertrophic cardiomyopathy.

In contrast to previous human-embryo editing studies, Mitalipov's team reported a high success rate at correcting a disease-causing mutation in a gene. The team claimed that the CRISPR–Cas9 genome editing tool was able to replace a mutant version of the *MYBPC3* gene carried by sperm with a normal copy from the egg cell, yielding an embryo with two normal copies. Mitalipov's team also introduced a healthy version of the gene along with the CRISPR machinery, but they found that the corrected embryos had shunned it for the maternal version.

But there is reason to doubt whether this really occurred, reports a team led by Dieter Egli, a stem-cell scientist at Columbia University in New York City, and Maria Jasin, a developmental biologist at Memorial Sloan Kettering Cancer Center in New York City. George Church, a geneticist at Harvard Medical School in Boston, Massachusetts, is another co-author.

In their bioRxiv paper, Egli and Jasin and their co-authors say that there is no plausible biological mechanism to explain how a genetic mutation in sperm could be corrected based on the egg's version of the gene. More likely, they say, Mitalipov's team failed to actually fix the mutation and were misled into thinking they had by using an inadequate genetics assay. Egli and Jasin declined to comment because they say they have submitted their article to *Nature*.

"The critique levelled by Egli *et al*. offers no new results but instead relies on alternative explanations of our results based on pure speculation," Mitalipov said in a statement.

Shared concerns

But other scientists contacted by *Nature*'s news team shared the Egli team's concerns. (*Nature*'s news team is editorially independent of its journal team.) Reproductive biologist Anthony Perry at the University of Bath, UK, says that after fertilization, the genomes of the egg and sperm reside at opposite ends of the egg cell, and each is enshrouded in a membrane for several hours. This fact, Perry says, would make it difficult for CRISPR-Cas9 to fix the sperm's mutation based on the egg's version of the gene, using a process called homologous recombination. "It's very difficult to conceive how recombination can occur between parental genomes across these huge cellular distances," he says.

Egli and Jasin raise that issue in their paper. They suggest that Mitalipov's team was misled into believing that they had corrected the mutation by relying on a genetic assay that was unable to detect a far likelier outcome of the genome-editing experiment: that CRISPR had instead introduced a large deletion in the paternal gene that was not picked up by their genetic assay. The Cas9 enzyme breaks DNA strands, and cells can attempt to repair the damage by haphazardly stitching the genome together, often resulting in missing or extra DNA letters.

That explanation makes sense, says Gaétan Burgio, a geneticist at the Australian National University in Canberra. "In my view Egli *et al*. convincingly provided a series of compelling arguments explaining that the correction of the deleterious mutation by self repair is unlikely to have occurred."

Another possibility Egli's team raise is that the embryos were produced without a genetic contribution from sperm, a process known as parthenogenesis. Mitalipov's team showed that the paternal genome was present in only 2 out of the 6 embryonic stem cell lines they made from gene-edited embryos.

Robin Lovell-Badge, a developmental biologist at the Francis Crick Institute in London, says that it is possible that there is a "novel or unsuspected" biological mechanism at work in the very early human embryo that could explain how Mitalipov's team corrected the embryos' genomes in the manner claimed. He would first like to hear from Mitalipov before passing judgement. "It simply says that we need to know more, not that the work is unimportant," Lovell-Badge says of Egli and Jasin's paper.

In the statement, Mitalipov's said his team stands by their results. "We will respond to their critiques point by point in the form of a formal peer-reviewed response in a matter of weeks."

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Comments

Comments

There are currently no comments.

Skeleton plundered from Mexican cave was one of the Americas' oldest

Rock-encased bone shard left behind by thieves allowed researchers to determine that the remains are probably more than 13,000 years old.

30 August 2017

Nick Poole/Liquid Jungle

A human skeleton — probably one of the Americas' oldest — was stolen from the Chan Hol Cave in Mexico soon after it was discovered in 2012.

A human skeleton that was stolen from an underwater cave in Mexico in 2012 may be one of the oldest ever found in the Americas. Scientists have now put the age of the skeleton at more than 13,000 years old after analysing a shard of hip bone — left behind by the thieves because it was embedded in a stalagmite.

Cave divers discovered the remains in February 2012 in a submerged cave called Chan Hol near Tulúm on Mexico's Yucatán peninsula, and posted photos of a nearly complete skull and other whole bones to social media. The posts caught the attention of archaeologists Arturo González González at the Desert Museum in Saltillo, Mexico, and Jerónimo Avilés Olguín at the Institute of American Prehistory in Cancún.

By the time researchers visited the cave in late March, the remains were gone — except for about 150 bone fragments and a pelvic bone that had been subsumed by a stalagmite growing up from the cave floor. On the basis of these bones, the researchers think that the skeleton belonged to a young man who died when sea levels were much lower and the cave was above ground.

Dating techniques

To determine the age of human remains, researchers often measure levels of a radioactive isotope of carbon in collagen protein within bones. But in this case, most of the collagen had been leached out by water while the bones were submerged, making this method unreliable, says Wolfgang Stinnesbeck, a palaeontologist and geoscientist at the University of Heidelberg, Germany, who led the efforts to date the remains.

Instead, Stinnesbeck's team collected a fleck of the pelvis bone and surrounding stalagmite, which contains a mineral called calcite. The team then dated the rock using the relative levels of uranium and thorium isotopes in the calcite. The deeper into the stalagmite the researchers sampled, the older the dates turned out to be; stone just 2 centimetres from the bone was 11,300 years old. Calcite closer to the bone gave conflicting results, Stinnesbeck says.

The team determined that the skeleton was older than 13,000 years by analysing the rate at which calcite had formed around the bone, and by matching the shifts in stalagmite isotope levels to those in other caves. The findings were published on 30 August in *PLoS ONE*[1].

Eugenio Acevez Nunez

A diver collects a portion of a cave stalagmite found in cave that contains ancient human bones.

Alistair Pike, an archaeological scientist at the University of Southampton, UK, notes that the stalagmite set over the bone during a time of profound climate change, which could have altered the stalagmite's rate of growth. He says he is therefore more comfortable considering the bones to be a minimum of 11,300 years old — still “very significant”, he notes.

Ancient company

Few other human remains from the Americas are older than 13,000 years. The skeleton of a teenage girl recovered from a different Yucatán cave was carbon-dated to more than 12,000 years old, and a skeleton found in another submerged cave near Tulúm was deemed to be around 13,500 years old, also using radiocarbon dating.

“They’ve done a really nice job determining the age of this thing,” says David Meltzer, an archaeologist at Southern Methodist University in Dallas, Texas. There is convincing archaeological proof that humans colonized the Americas before 14,000 years ago, but very old remains are precious. “These sites are rare as hen’s teeth,” Meltzer says.

Apart from the Yucatán finds, the next-oldest skeleton from the Americas is that of a 12,600-year-old boy found in Montana, whose sequenced genome places him on a lineage leading to present-day Native American groups. Researchers have sequenced only a few other human skeletons from the Americas that are older than 10,000 years, hindering efforts to unravel the region's ancient population history.

Getting DNA from what remains of the Chan Hol skeleton will be hard. A sample sent to one of the world’s leading ancient-DNA labs, the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, did not contain enough DNA, Stinnesbeck says. He hopes to find DNA in the few teeth not taken by the thieves.

The theft still boggles Stinnesbeck, whose team is continuing to study the cave and its remains. The researchers recently reported the discovery of

fossils in the cave that are of a new species of peccary[2] — a hoofed mammal related to pigs — as well as evidence that the cave's human inhabitants made fires.

“What would you want with a skeleton? Would you take it home?” Stinnesbeck asks. “If they had known it was very old, maybe just to have a souvenir, to have something special.”

“We went to the police and they did some inquiries,” he adds. “They never came up with anything substantial.”

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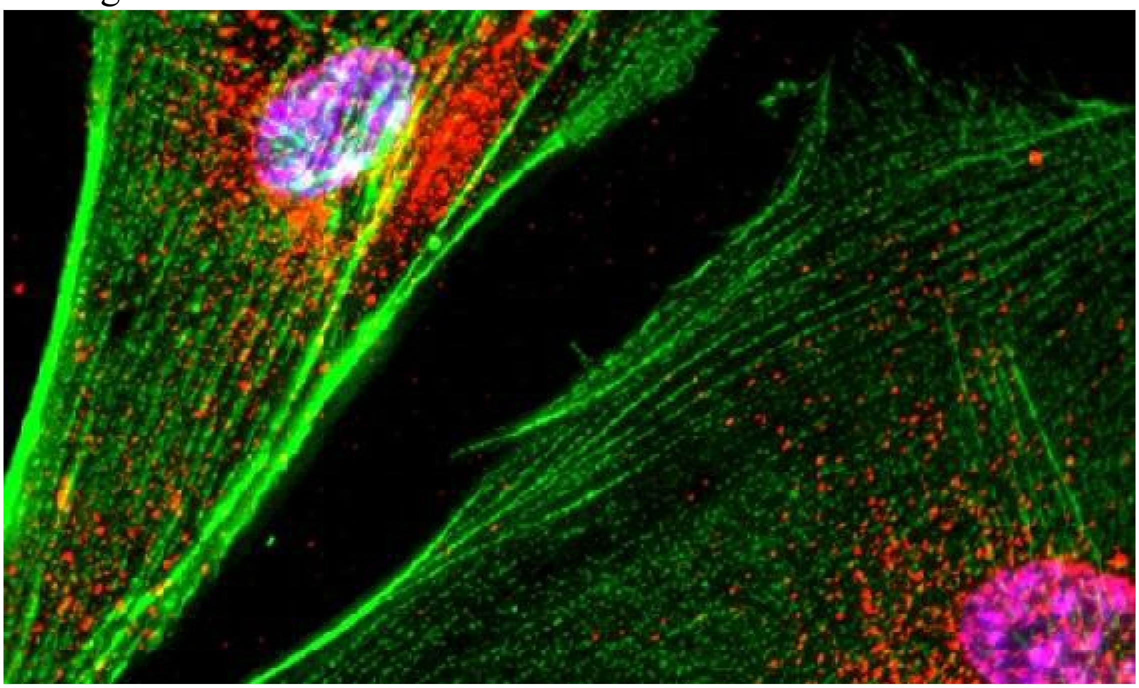
Comments

Commenting is currently unavailable.

Reprogrammed cells relieve Parkinson's symptoms in trials

Monkeys implanted with neurons derived from stem cells showed sustained improvement after two years.

30 August 2017



B. Bick, . Poindexter, UT Med. School/SPL

A depletion of brain cells that produce dopamine is responsible for the mobility problems seen in people with Parkinson's disease.

Japanese researchers report promising results from an experimental therapy for Parkinson's disease that involves implanting neurons made from 'reprogrammed' stem cells into the brain. A trial conducted in monkeys with a version of the disease showed that the treatment improved their symptoms

and seemed to be safe, according to a report published on 30 August in *Nature*[1].

The study's key finding — that the implanted cells survived in the brain for at least two years without causing any dangerous effects in the body — provides a major boost to researchers' hopes of testing stem-cell treatments for Parkinson's in humans, say scientists.

Jun Takahashi, a stem-cell scientist at Kyoto University in Japan who led the study, says that his team plans to begin transplanting neurons made from induced pluripotent stem (iPS) cells into people with Parkinson's in clinical trials soon.

The research is also likely to inform several other groups worldwide that are testing different approaches to treating Parkinson's using stem cells, with trials also slated to begin soon.

Nature breaks down the latest research — and what it means for the future of stem-cell treatments.

Why are stem cells a promising treatment for Parkinson's disease?

Parkinson's is a neurodegenerative condition caused by the death of cells called dopaminergic neurons, which make a neurotransmitter called dopamine in certain areas of the brain. Because dopamine-producing brain cells are involved in movement, people with the condition experience characteristic tremors and stiff muscles. Current treatments address symptoms of the disease but not the underlying cause.

Researchers have pursued the idea that pluripotent stem cells, which can form any cell type in the body, could replace dead dopamine-making neurons in people with Parkinson's, and thus potentially halt or even reverse disease progression. Embryonic stem cells, derived from human embryos, have this capacity, but they have been the subject of ethical debates. Induced pluripotent stem (iPS) cells, which are made by coaxing adult cells into an

embryonic-like state, have the same versatility without the associated ethical concerns.

What did the latest study find?

Takahashi's team transformed iPS cells derived from both healthy people and those with Parkinson's into dopamine-producing neurons. They then transplanted these cells into macaque monkeys with a form of the disease induced by a neuron-killing toxin.

The transplanted brain cells survived for at least two years and formed connections with the monkey's brain cells, potentially explaining why the monkeys treated with cells began moving around their cages more frequently.

Why is the research important?

Crucially, Takahashi's team found no sign that the transplanted cells had developed into tumours — a key concern with treatments that involve pluripotent cells — or that they evoked an immune response that couldn't be controlled with immune-suppressing drugs.

"It's addressing a set of critical issues that need to be investigated before one can, with confidence, move to using the cells in humans," says Anders Bjorklund, a neuroscientist at Lund University in Sweden.

When will clinical trials begin and how will they work?

"I hope we can begin a clinical trial by the end of next year," says Takahashi. Such a trial would be the first iPS cell trial for Parkinson's. In 2014, a Japanese woman in her 70s became the first person to receive cells derived from iPS cells, to treat her macular degeneration.

In theory, iPS cells could be tailor-made for individual patients, which would eliminate the need to use drugs that suppress a possible immune response to foreign tissues.

But customized iPS cells are expensive to make and can take a couple months to derive and grow, Takahashi notes. So his team instead plans to establish iPS cell lines from healthy people and then use immune cell biomarkers to match them to people with Parkinson's in the hope of minimizing the immune response (and therefore the need for drugs to blunt the attack).

In a study described in an accompanying paper in *Nature Communications*[2], Takahashi's team implanted into monkeys iPS-cell-derived neurons from different macaques. They found that transplants between monkeys carrying similar white blood cell markers triggered a muted immune reaction.

What other stem-cell approaches are being tested for Parkinson's?

Earlier this year, Chinese researchers began a Parkinson's trial that used a different approach: giving patients neural-precursor cells made from embryonic stem cells, which are intended to develop into mature dopamine-producing neurons. A year earlier, in a separate trial, patients in Australia received similar cells. But some researchers have expressed concerns that the immature transplanted cells could develop tumour-causing mutations.

Meanwhile, researchers who are part of a Parkinson's stem-cell therapy consortium called GForce-PD, of which Takahashi's team is a member, are set to bring still other approaches to the clinic. Teams in the United States, Sweden and the United Kingdom are all planning trials to transplant dopamine-producing neurons made from embryonic stem cells into humans. Previously established lines of embryonic stem cells have the benefit that they are well studied and can be grown in large quantities, and so all trial participants can receive a standardized treatment, notes Bjorklund, also a consortium member.

Jeanne Loring, a stem-cell scientist at the Scripps Research Institute in La

Jolla, California, favours transplanting iPS-derived neurons made from a patient's own cells. Although expensive, this approach avoids dangerous immunosuppressive drugs, she says. And because iPS cells are established anew for each patient, the lines go through relatively few cell divisions, minimizing the risk that they will develop tumour-causing mutations. Loring hopes to begin her team's trial in 2019. “This shouldn't be a race and we're cheering for success by all,” she says.

Lorenz Studer, a stem-cell scientist at the Memorial Sloan Kettering Cancer Center in New York City who is working on a trial that will use neurons made from embryonic stem cells, says that there are still issues to work out, such as the number of cells needed in each transplant procedure. But he says that the latest study is “a sign that we are ready to move forward”.

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Comments

Comments

There are currently no comments.

Closure of US coal study marks an alarming precedent

The Trump administration has stepped up its assault on environmental protections by halting a US$1-million study on the health risks of coal mining — casting a pall on academic freedom.

30 August 2017

Saul Loeb/AFP/Getty

US President Donald Trump makes his priorities clear during a rally in West Virginia.

When the US National Academies of Science, Engineering, and Medicine (NASEM) speaks, the government usually listens. Last year, US government

agencies spent US$216 million to commission NASEM expertise on issues from the scientific workforce to military implications of synthetic biology. Most NASEM reports are filled with caveats and make for dry reading. But occasionally, they pull no punches. A memorable 2009 report on the state of forensic science, for instance, concluded that almost every forensic method used in law enforcement is seriously flawed and that their use risks putting innocent people in jail. Given the academies' stature, it's hard for the government to brush off its hired commission when faced with such language.

Such concerns seem to weigh on the US Department of the Interior (DOI), which in 2016 commissioned a $1-million study of the potential health risks of surface coal mining on communities in West Virginia. Some evidence suggests that people who live near surface-mining operations — also known as mountaintop removal — have an unusually high rate of lung cancer and birth defects, which could be attributed to air and water pollution.

Launching the study — now halfway through its two-year term — was itself an achievement, given the political nature of the topic. Although much is known about the risks of coal mining to miners, little research has been done on its health impacts on local communities, not least because of attempts by the coal industry to hinder such work. Mining companies and trade organizations have sued for access to the e-mails of academics researching mountaintop removal, and have fought to keep peer-reviewed studies from being used in court. The National Mining Association questioned the value of the NASEM study when it was announced.

On 18 August, three days before the NASEM committee working on the study was due to meet in a Kentucky mining town, the DOI ordered a stop to the study, with immediate effect. The agency says it is reviewing spending on all projects that cost more than $100,000. "The Trump administration is dedicated to responsibly using taxpayer dollars in a way that advances the department's mission and fulfils the roles mandated by Congress," DOI spokeswoman Heather Swift said in a statement to *Nature*. She did not respond to questions about which other projects are under review.

This is the first time that the administration of President Donald Trump has cancelled a NASEM study that has already started — a move that has rarely

happened in the past, according to the academies.

In its statement about the cancellation, the NASEM said that its investigators "stand ready" to resume as soon as the DOI completes its review. But they're likely to be waiting a long time. The Trump administration has made no secret of its fondness for the US coal industry, which employs around 76,000 people. (By comparison, around 1.2 million people live in counties where mountaintop removal takes place.) The DOI's assertion that the decision is a budgetary one is suspect, especially given that the study has already spent a good amount of its budget.

It seems, instead, that the government would rather quash the review than risk it producing results that cast aspersions on the coal industry. This is par for the course for the DOI, whose head, Ryan Zinke, plans to downsize national parks in favour of resource extraction, and which has also suspended meetings with its independent advisory councils on issues concerning public lands.

With the near-daily news about the Trump administration weakening climate and environmental protections, it is easy to become fatigued. Yet the move to pre-empt the prestigious and independent NASEM is particularly concerning. It raises questions about what other studies could be cancelled if the government fears their results. It is another blow for science and for academic freedom.

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Alan Turing's notes, runaway salmon and illegal gold-mining

The week in science 25–31 August 2017.

30 August 2017

Research | Facilities | Publishing | People | Environment | Business | Trend watch

RESEARCH

Science results emerge from US eclipse A total solar eclipse swept across the continental United States on 21 August, delighting skygazers and scientists. The path of totality crossed more than a dozen states, making it one of the most observed eclipses ever (composite image shown). A citizen-science project collected data from more than 55 telescopes to produce a high-resolution movie of the solar corona — the part of the Sun's atmosphere seen during totality. Among the professional scientific studies, a pair of NASA jets that chased the eclipse gathered high-resolution video of the corona, while ground-based expeditions collected information about ionized elements in the solar atmosphere.

Stan Honda/AFP/Getty

Gravitational waves Many of the world's best telescopes were turned to a little-known galaxy called NGC 4993 from 17 August, after an alert about a potential gravitational-wave detection in the region. Rumours abounded that the US-based Laser Interferometer Gravitational-wave Observatory (LIGO), possibly aided for the first time by the Virgo interferometer in Pisa, Italy, had picked up the signature of two neutron stars colliding in the galaxy. NASA's Fermi Gamma-ray Space Telescope detected a burst of γ-rays in roughly the same region of the sky as NGC 4993, which may indicate the aftermath of a neutron-star collision there, but which could instead come from an unrelated event. It would be a historic first for astronomy if telescopes saw signatures of the collision at the same time as interferometers 'heard' the event through vibrations in space-time. See go.nature.com/2w46ja8 for more.

FACILITIES

Big NASA missions NASA should continue its tradition of building

spacecraft for large strategic space-science missions such as the Hubble Space Telescope and the Mars Curiosity rover, says a 24 August panel report from the US National Academies of Sciences, Engineering, and Medicine. Like other agencies, NASA is struggling with a limited budget, and the panel examined whether big missions should remain a part of its portfolio. But the scientific return is worth it, the report found, as long as missions are managed well. Developing a range of cost options for large projects could help the agency to avoid problems such as those plaguing the James Webb Space Telescope, which has run billions of dollars over budget and is currently set to launch in 2018.

PUBLISHING

Preprint sites Six new preprint sites were rolled out on 29 August. The services, which host research papers before formal publication, include paleorXiv for palaeontology and INA-rXiv, a preprint server for Indonesian research. The other sites cover research on nutrition, library sciences, sports and exercise, and mind and contemplative practices. The servers are supported by software developed by the Center for Open Science in Charlottesville, Virginia, which already hosts eight other preprint services.

PEOPLE

Surprise Turing find Documents belonging to mathematician Alan Turing have been unearthed at the University of Manchester, UK, and made available to researchers, the university announced on 25 August. The 148 items include a letter to Turing from British intelligence agency GCHQ and a draft BBC radio programme on artificial intelligence. Discovered in a storeroom filing cabinet in May, the collection does not include much personal correspondence. But it offers a glimpse of the code-breaker's working life between 1949 and his death in 1954 — a period for which archive material is scarce, according to the university library's archivist. Some documents also give insight into his rather forthright personal opinions; his response to an invitation to a US conference in April 1953 was simply: "I would not like the journey, and I detest America."

Science envoy quits An energy researcher at the University of California, Berkeley, resigned from his post as a science envoy for the US Department of State on 21 August, citing US President Donald Trump's "attacks on the core values of the United States". In a resignation letter addressed to Trump, Daniel Kammen criticized the president's equivocal response to violent demonstrations by white supremacists in Charlottesville, Virginia, on 12 August. Kammen also condemned the Trump administration's "destructive" policies on energy and the environment, which he said have affected his work as a science envoy.

ENVIRONMENT

Mind the penguins Chile has blocked plans for an iron mine that would have posed a threat to thousands of penguins. On 21 August, a Chilean government committee announced that Andes Iron, the local firm in charge of the US$2.5-billion project, failed to put into place effective environmental protections to compensate for how mining activities might disturb wildlife. The project aimed to extract millions of tonnes of iron from a site in the northern Coquimbo region of Chile. But the site lies near the 888-hectare National Humboldt Penguin Reserve — a set of islands that are home to one of the world's largest breeding populations of Humboldt penguins (*Spheniscus humboldti*; pictured). The species is listed as 'vulnerable' by the IUCN Red List. Andes Iron says that it will appeal against the decision.

Joel Sartore/NGC

Runaway salmon Thousands of Atlantic salmon have made a break for the Pacific Ocean after fish-farm nets in Washington state's San Juan Islands succumbed to "exceptionally high tides" on 19 August, according to the aquaculture company that owned the fish. The Washington Department of Fish & Wildlife estimates that about 4,000–5,000 fish escaped from the pens, which contain more than 1.3 million kilograms of farmed fish. The incident has raised concern that the Atlantic species could threaten wild fish populations native to the region. Officials are temporarily suspending fishing regulations and encouraging recreational and commercial fishers to capture and sell any Atlantic salmon that they find.

Australia land laws Contentious laws that allow landowners in New South Wales, Australia, to clear native vegetation on their properties came into effect on 25 August. Landowners in the country's most populous state can now remove more of certain types of vegetation, a loosening of the state's previous regulations. The decision has angered scientists and conservationists, who say that the laws put biodiversity and threatened species at risk. But some farmers aren't satisfied either, saying that the

amended rules are still too restrictive.

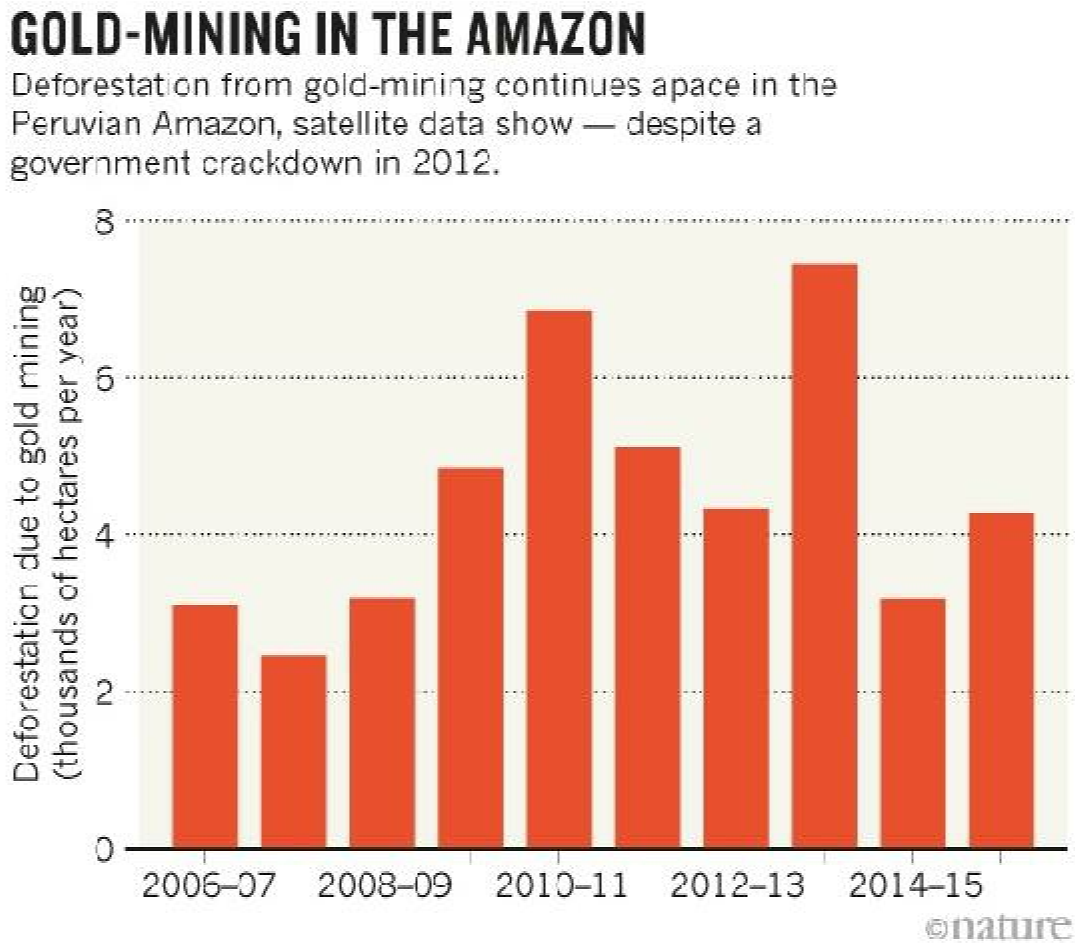
BUSINESS

Quantum quest Australia's first quantum-computing hardware company started up on 23 August. Silicon Quantum Computing is a partnership between government, industry and the University of New South Wales in Sydney. It aims to develop and commercialize a prototype of a 10-quantum-bit circuit made from silicon within five years — a stepping stone towards the creation of a silicon-based quantum computer. The company enters an increasingly crowded marketplace in quantum computing, with competition from technology giants such as Google and Microsoft.

Drug costs cut Millions of people with hepatitis C may soon be able to afford the life-saving antiviral drug sofosbuvir. On 23 August, Gilead Sciences of Foster City, California, which sells the daily pills, said that it would license manufacturers of generic drugs to supply its antivirals in four middle-income countries — Malaysia, Thailand, Belarus and Ukraine. That should slash prices: a 3-month course of the pills ranges from US$84,000 in the United States to $12,000 in Malaysia, but costs as little as $300 in the 101 developing countries where generic versions are already permitted. Pressure had been mounting for the change: the Malaysian government has been considering a licence that would allow generics to be made or used in government facilities, overriding Gilead's patent, and Ukraine has already revoked a key patent on sofosbuvir that shortened Gilead's monopoly.

TREND WATCH

Illegal gold-mining in the Peruvian Amazon is on the rise again, according to a study published on 22 August (G. Asner and R. Tupayachi *Environ. Res. Lett.* **12,** 094004; 2017). Mining-related deforestation abated after a government crackdown in 2012, the authors found in their analysis of land-cover images. But since then, the mined area has increased by more than 40% in the Madre de Dios region, to 68,228 hectares. The region has some of the world's highest levels of animal diversity.



Source: G. P. Asner & R. Tupayachi Environ. Res. Lett. 12, 094004 (2017).

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Cassini’s 13 years of stunning Saturn science — in pictures

As the mission speeds towards its conclusion, *Nature* takes a look at what researchers have learnt about the planet’s moons, rings and tempest-filled skies.

30 August 2017

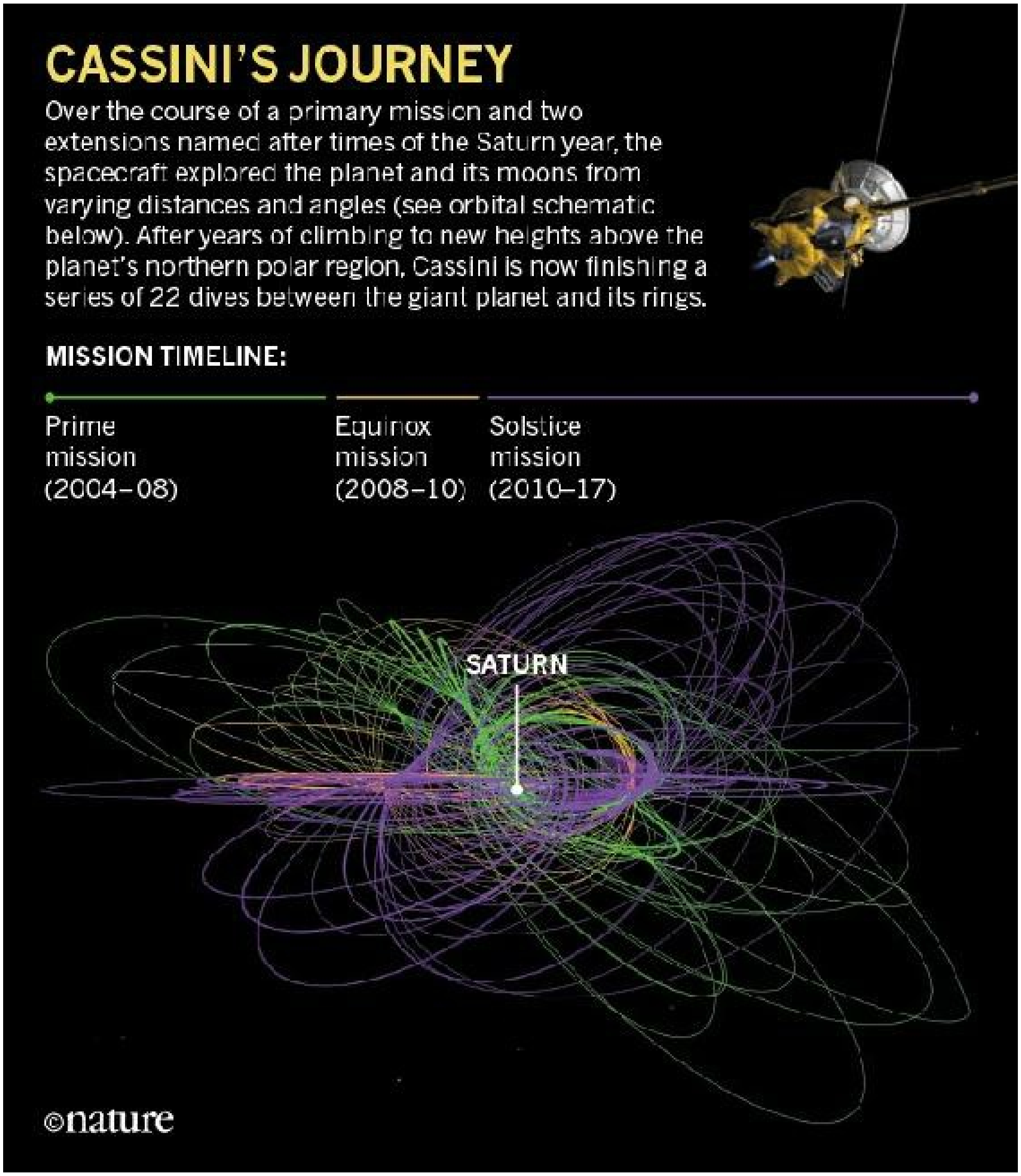
NASA/JPL

In 2004, Cassini became the first spacecraft to orbit Saturn.

Twenty years ago, in the wee hours of a muggy Florida morning, the Cassini spacecraft lit up the skies as it blasted off from Cape Canaveral. Now, after a 3.5-billion-kilometre journey and 13 years spent circling Saturn, the orbiter is running low on fuel. On 15 September, Cassini's controllers on Earth will send the craft plunging into Saturn's cloudtops to prevent it from accidentally

crashing into and contaminating any moon that might be able to harbour life.

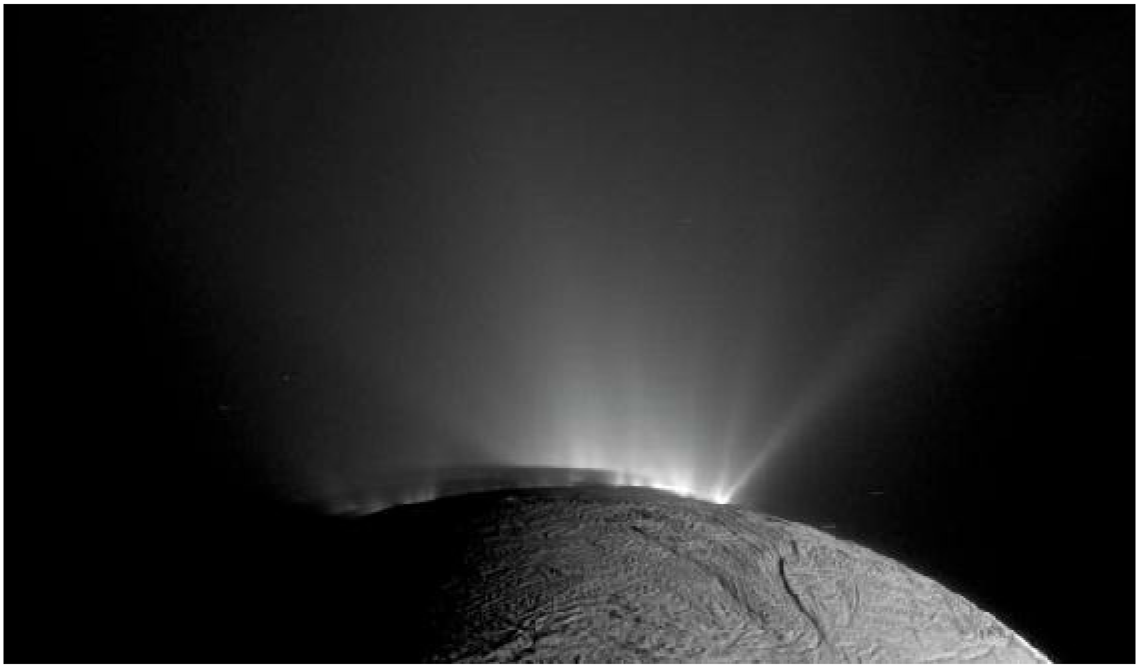
Cassini will send data back to Earth right up until that incandescent coda — a fitting end for one of history's most successful interplanetary missions. A joint venture between NASA, the European Space Agency and the Italian Space Agency, Cassini was the first spacecraft to orbit Saturn. And with much more time to gather science than the earlier fly-bys of Pioneer 11 in 1979, Voyager 1 in 1980 and Voyager 2 in 1981, the mission delivered discoveries in spades, racking up an impressive list of findings as it looped around the majestic planet, danced along its glorious rings and whizzed past many of its bizarre moons. “Cassini was a long wait, but it was definitely worth it,” says Linda Spilker, a planetary scientist at NASA's Jet Propulsion Laboratory in Pasadena, California, and the mission's project scientist. “It has so many incredible accomplishments we can be so proud of.”



Cassini: NASA/JPL; Orbital schematic: NASA/Jet Propulsion Laboratory-Caltech

The spacecraft revealed the chaotic dynamics that shape Saturn's rings, found geysers spraying from the moon Enceladus and watched gigantic storms roil the planet's atmosphere. It observed seasons change for nearly half of a Saturn year, as first the equinox and then the solstice passed, transforming

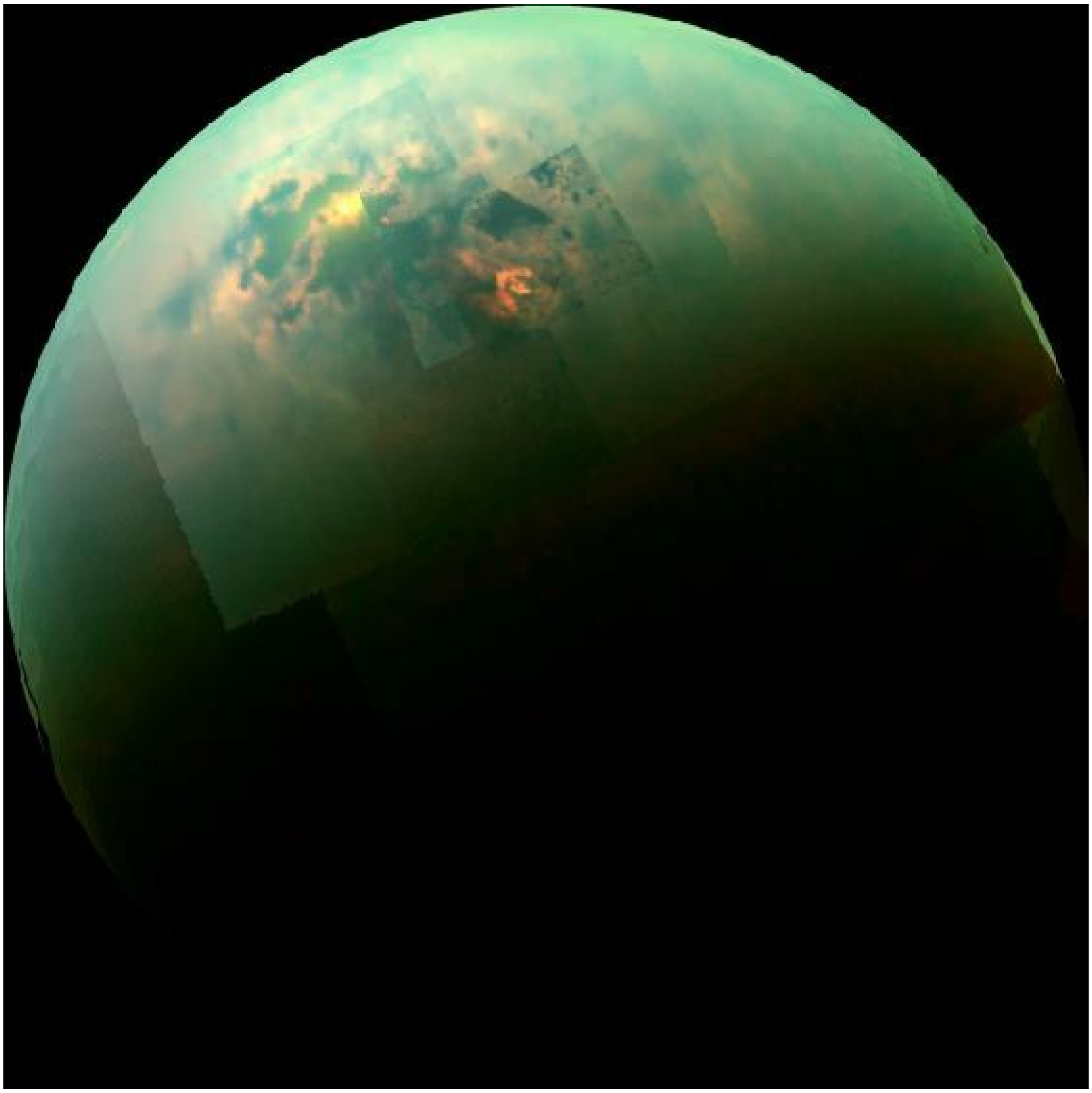
weather patterns. Over the life of Cassini's mission, Saturn has become less of a stranger and revealed itself to be a vibrant system churning with continual change. The spacecraft's observations became a touchstone for understanding the complexity of gas-giant planets, a legacy that NASA's Juno spacecraft is currently continuing at Jupiter.



NASA/JPL-Caltech/Univ. Arizona/Univ. Idaho

Geysers on Enceladus spray water vapour and ice mixed with organic molecules into space.

Cassini also made history when it released the Huygens probe, which became the first craft to touch down in the outer Solar System. After a daring two-and-a-half hour descent to the surface of the moon Titan in 2005, Huygens sent back snapshots of a frozen floodplain littered with rocks. Cassini's mapping later revealed Titan to be a world teeming with hydrocarbon lakes and rivers, replenished by methane and ethane rain.



NASA/JPL-Caltech/Univ. Arizona/Univ. Idaho

Sunlight glints off lakes of liquid hydrocarbons on Titan.

With no official plans to return to Saturn anytime soon, 15 September will mark the end of an era. “On Cassini's final day, we will be watching the signal as we go as deeply into the atmosphere as we can,” says Spilker. “That day to say goodbye will be a tough day.”

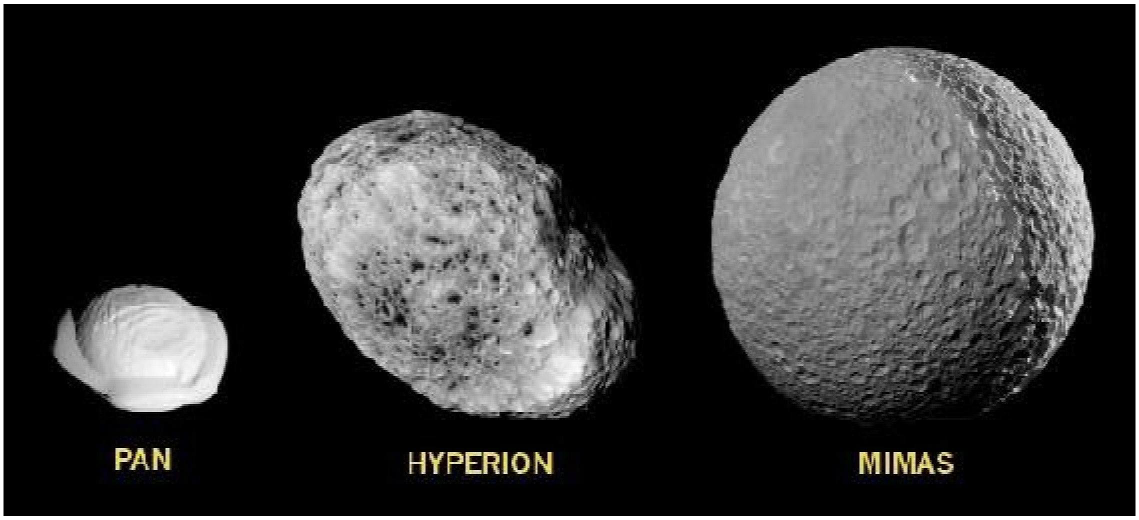
A menagerie of moons

Cassini's biggest surprises came as it studied some of Saturn's 60-plus moons, raising as many questions as it answered.

NASA/JPL/Space Science Institute

Three of Saturn's moons — Epimetheus, Janus and larger Dione — pass by one another in this set of images captured in 2005.

Researchers finally solved the mystery of Iapetus — which boasts one light-coloured side and one dark side — when they discovered an enormous ring of material streaming off another of Saturn's moons, Phoebe. Iapetus seems to get its two-faced look as its leading surface ploughs through Phoebe's debris. And in their study of how crater-pocked Mimas wobbles on its axis, Cassini scientists realized that the world may have either a buried ocean or a stretched-out core.



NASA/JPL-Caltech/SSI

Saturn’s moons come in a variety of shapes.

A look at the planet's littlest moons — never before seen up close — uncovered a panoply of strange shapes. Hyperion resembles a sponge, and Pan has been compared to a piece of space ravioli. Pandora features an enormous impact crater, a scar from some long-ago collision.

But the most astonishing observations were of Titan and Enceladus. On Titan, Saturn's largest moon, Cassini discovered a world with complex chemistry similar to Earth's before life arose. In the 72 minutes that Huygens survived on Titan's surface, the battery-powered lander snapped images of a landscape strewn with frozen rocks and cloaked in an orange haze. From above, Cassini mapped the moon using radar and other instruments, revealing enormous dunes of water ice coated with a hydrocarbon glaze, which wind for hundreds of kilometres in wavy bands near the equator. Liquid methane and ethane rain down, forming rivers and lakes of hydrocarbons. Cassini captured images of sunlight reflecting off these bodies of liquid — and even used radar to chart their bottoms, sketching out the depths through which a future mission's submersible might glide.

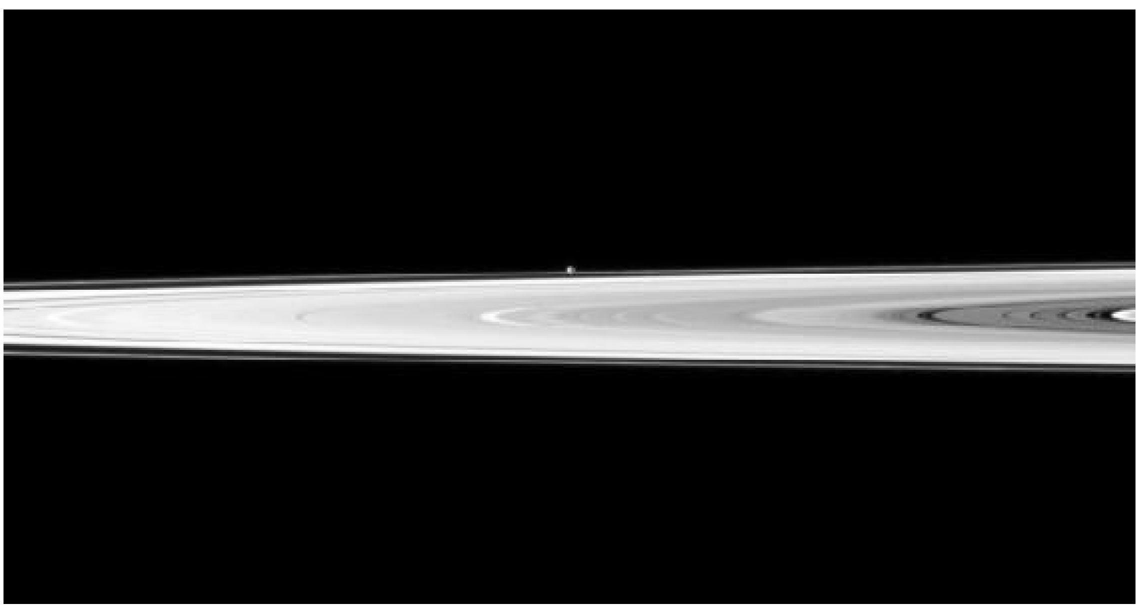
Even after all that, Enceladus stole the show. Thought to be inert before Cassini arrived, the moon actually spews ice and water vapour from enormous fractures that decorate its south-pole region like tiger stripes.

Powered by Saturn's gravitational pull, the geysers spurt out 200 kilograms of salty, organic-laced material every second.

Cassini scientists were surprised to find that this material contains small particles of silica, which may be formed by the interaction of water and rock at hydrothermal vents deep inside Enceladus. On Earth, similar deep-ocean vents are home to microbes that thrive off chemical energy, far from sunlight — and so Enceladus has vaulted to the top of the list of places to search for extraterrestrial microbes. Planetary scientists are already plotting return missions to fly through Enceladus's plumes and sniff for hints of life.

The ever-changing rings

Saturn's rings — the planet's most iconic feature — are populated by billions of icy particles. From afar, the rings appear fixed and perfectly sculpted, but Cassini revealed some of the processes that shape them, and showed how dynamic they truly are. Ring features form, change shape and vanish — sometimes in a matter of hours.

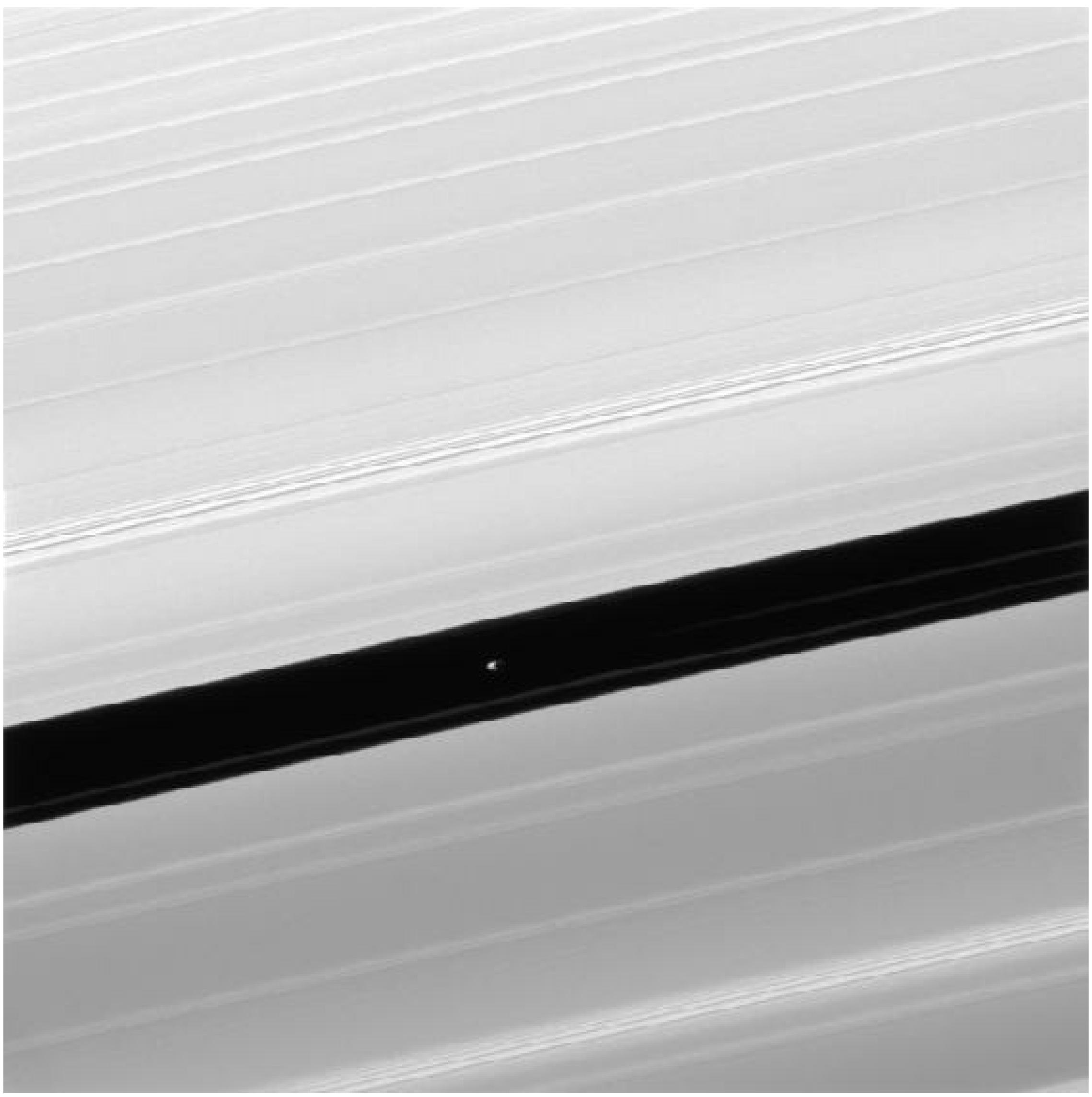


NASA/JPL/SSI

Just 100 metres or so thick, Saturn's rings are shaped by many moons and moonlets embedded within. In this view, the moon Pandora can be seen

beyond the planet’s main rings.

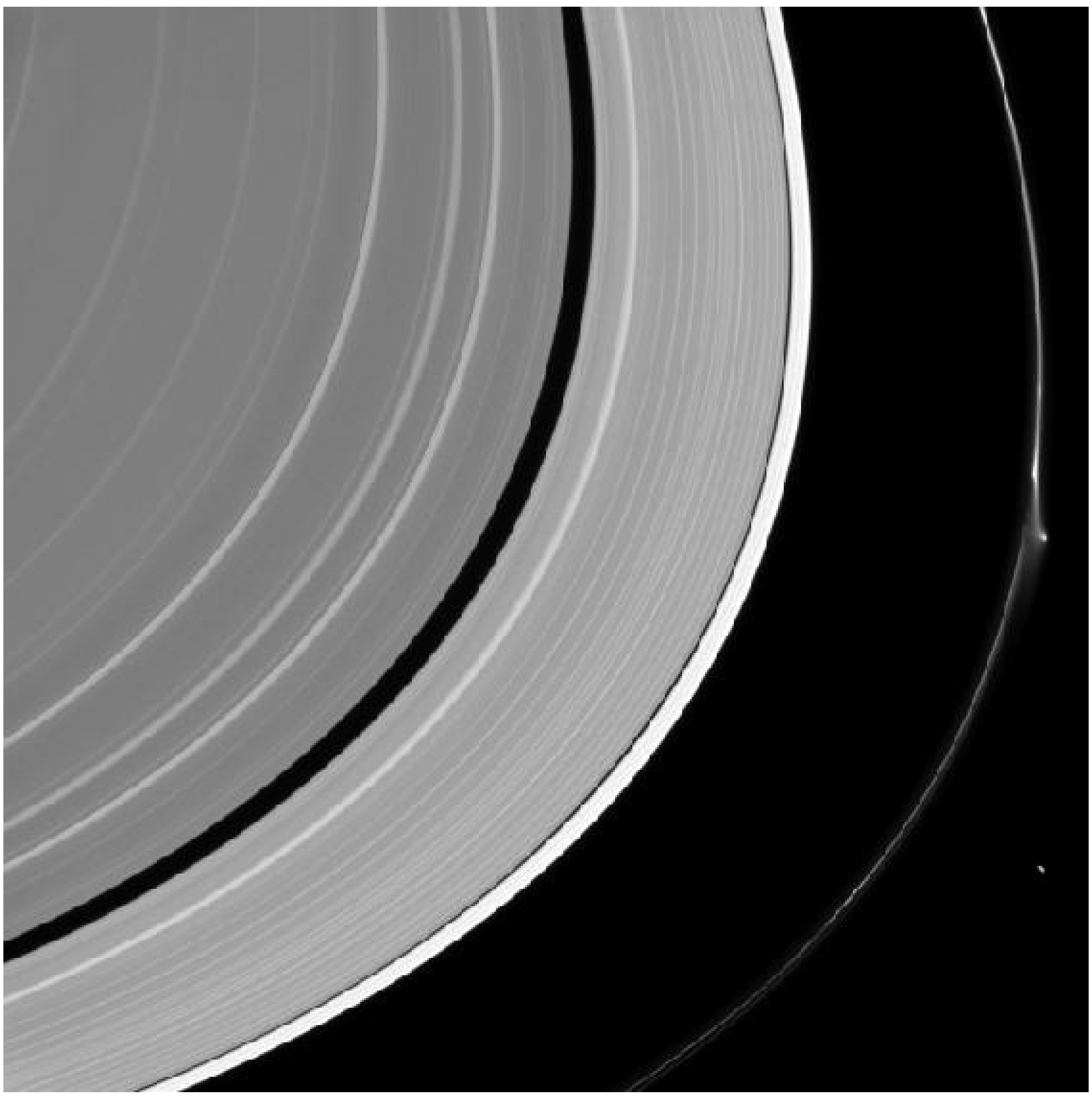
Cassini discovered how the gravitational forces of even the smallest of Saturn's moons can help to shepherd ring particles into beautifully manicured bands. For example, little Pan, just 28 kilometres across, has cleared a wide path through the rings. Dark and bright bands in the rings on either side of this gap reflect the pull of Pan's gravity. Images taken over the years revealed how some of Saturn's moons continuously shape and sculpt its rings — a phenomenon that was not fully apparent until Cassini was able to watch them over time.



NASA/JPL-Caltech/SSI

The moon Pan clears a pathway within the rings known as the Encke Gap.

But the moons are not perfect shepherds. In Saturn's F ring, a narrow band along the outside edge of the main rings, Cassini found ephemeral sprays of material called mini-jets (image, below). The gravitational pull of the nearby moon Prometheus probably causes ice particles in the ring to clump together like snowballs.

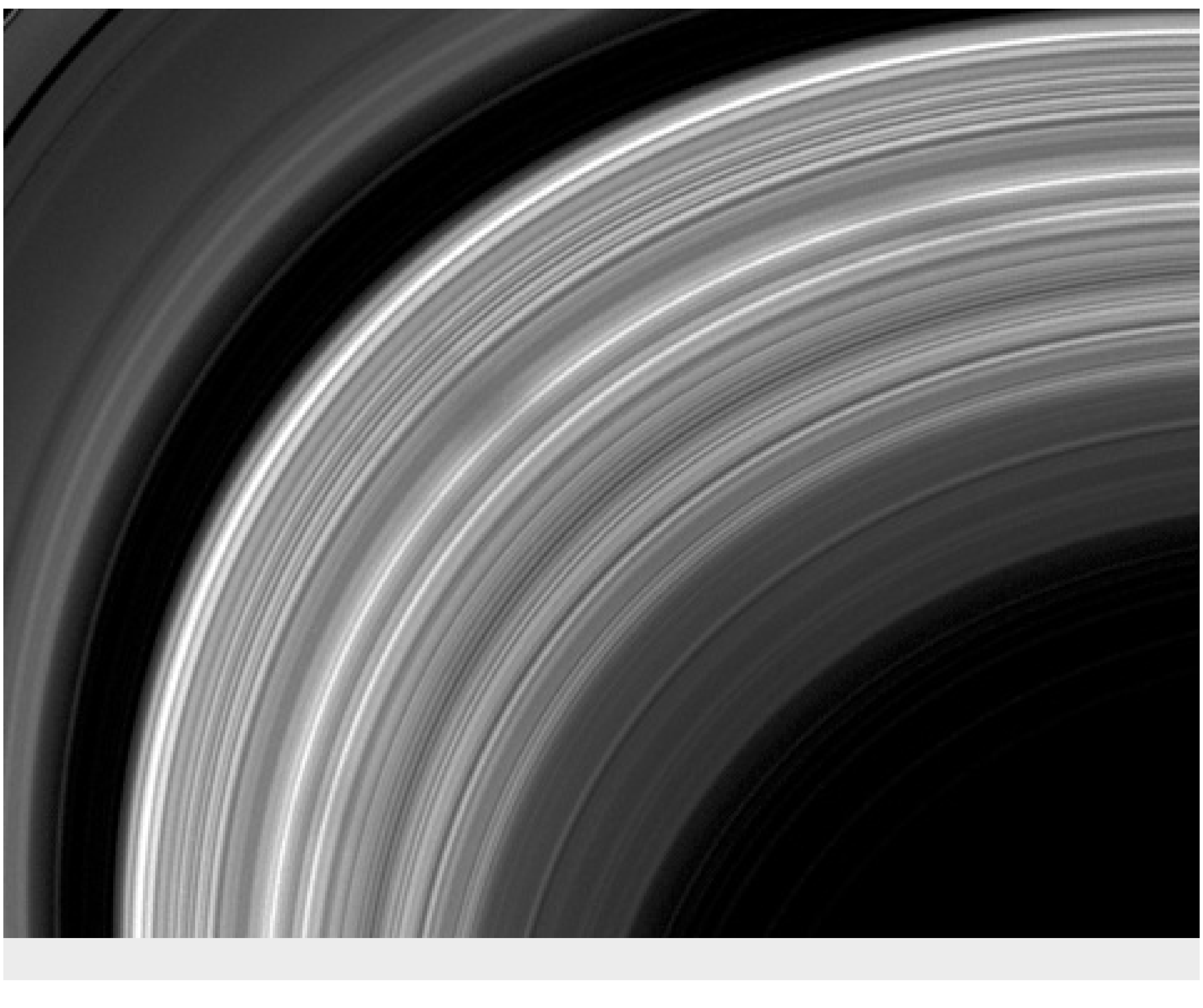


NASA/JPL-Caltech/SSI

At Saturn's F ring, gravitational disturbances have caused ring particles to clump together and kick out a dusty-looking 'jet' of material.

Those bigger objects then punch outwards, trailing particles behind them like a dusty veil that can stretch up to 180 kilometres long, marring the otherwise perfect rings. Out here on the fringes of the ring system, features such as these come and go.

Dramatic changes can also play out on large scales. Around the Saturnian equinox, as sunlight fell at a steep slant across the rings, Cassini observed spoke-like features that rotate with the rings much like the pattern in a bicycle wheel. These spokes, which may be huge stripes of electrostatically charged particles drifting just above and below the rings, can form and disappear over the course of a few hours.



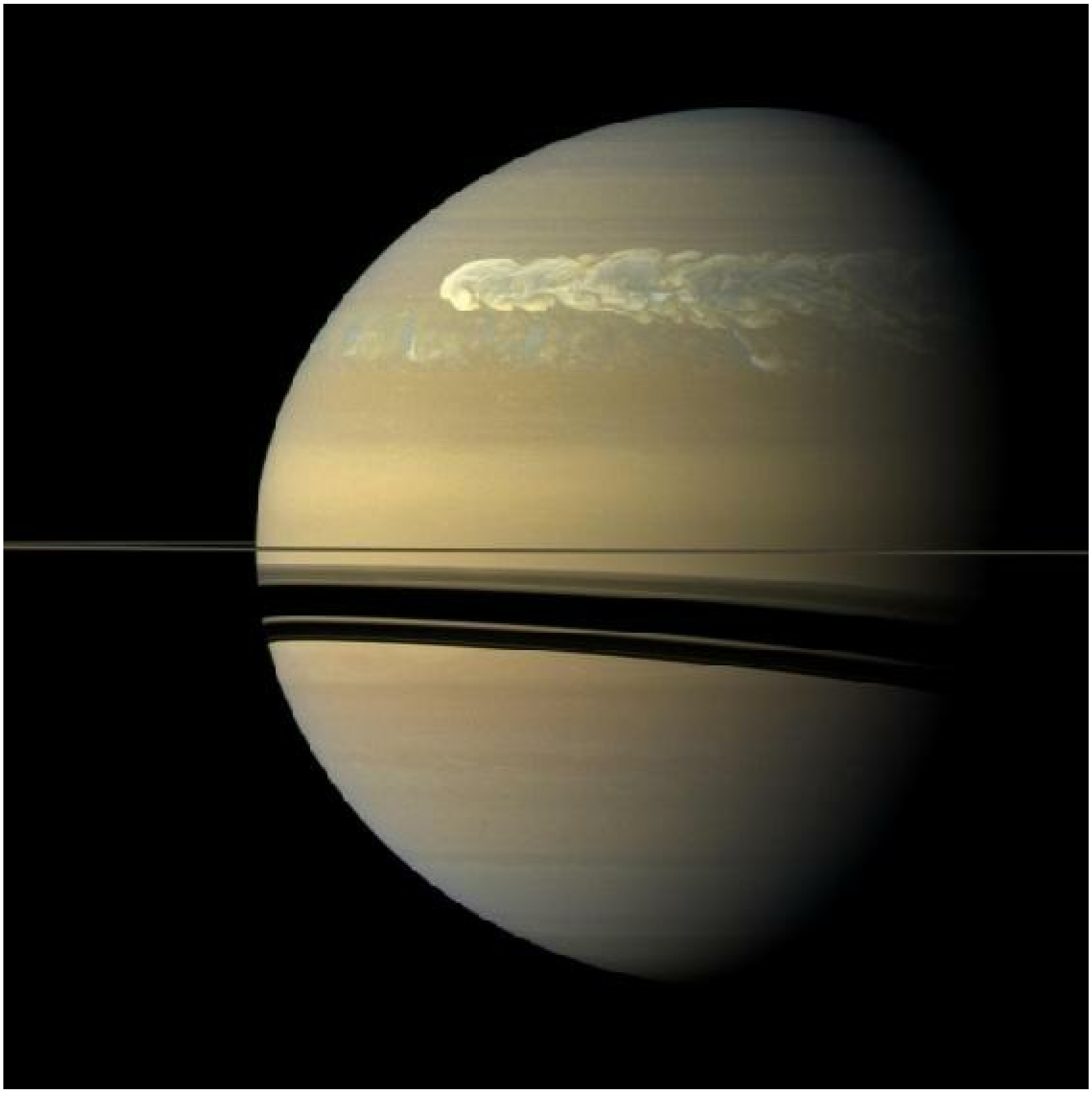
NASA/JPL/Space Science Institute

Spoke-like features that seem to be made of charged particles rotate around the planet.

Depths of the atmosphere

With Saturn's gorgeous ring system distracting the eye, the planet's swirling cloudtop patterns are sometimes underappreciated. Cassini changed that by observing how storms roiled Saturn's atmosphere over the course of many Earth years, providing deep insights into the currents that shape the planet's atmosphere.

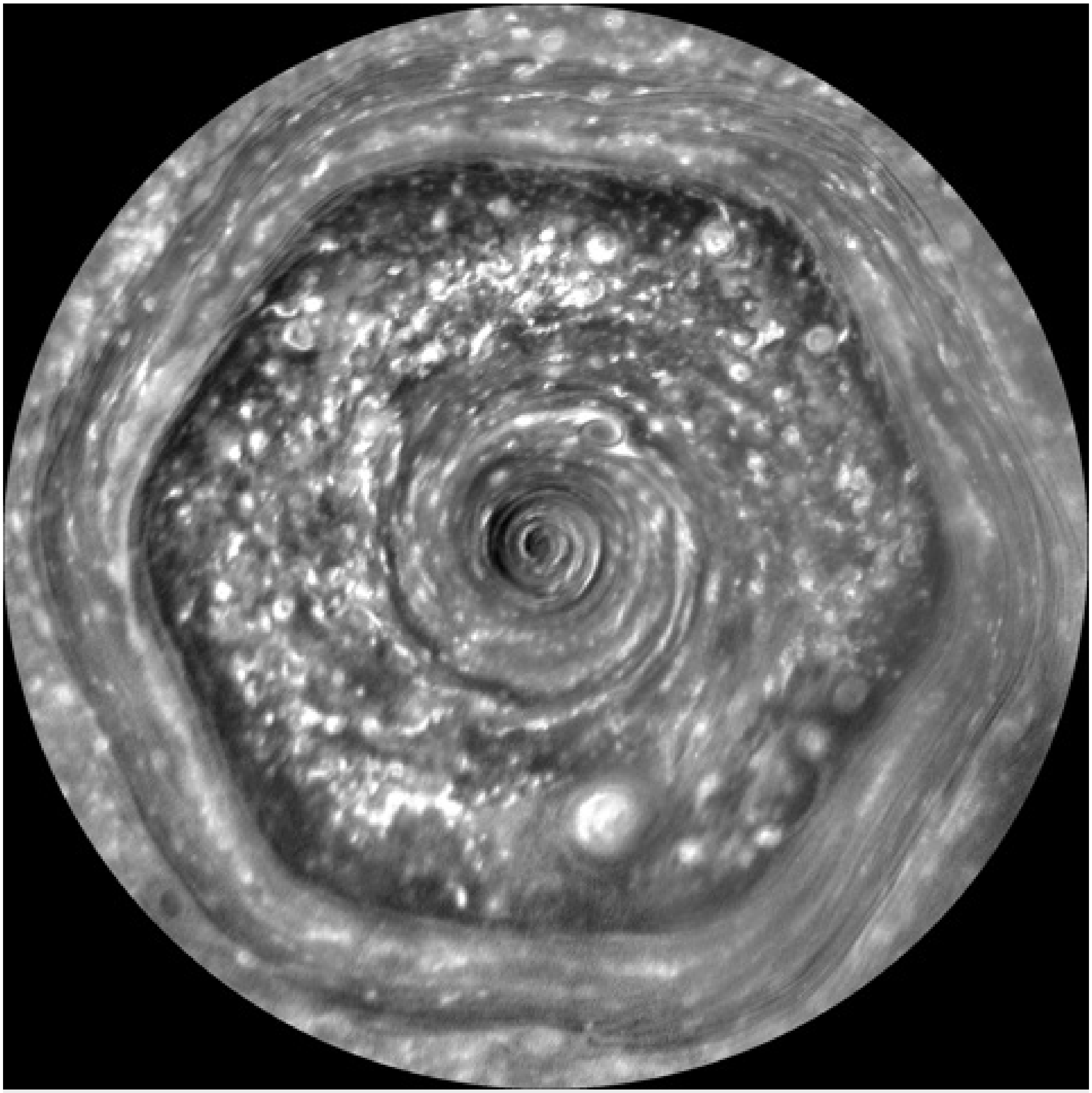
In late 2010, the spacecraft had a front-row seat as a thunderstorm developed into an enormous, swirling white cloud more than 10,000 kilometres across. The storm churned from deep inside the atmosphere all the way to the its upper layers, and in the ensuing months, wrapped entirely around the northern hemisphere until the 'head' of the storm crashed into the tail. Similar storms appear every two to three decades, a rate that is probably controlled by the amount of water vapour in the atmosphere. Other planets in the Solar System, such as Jupiter, have massive storms but do not see such planet-circling giants.



NASA/JPL-Caltech/SSI

Thunderclouds barrelled across Saturn’s northern hemisphere in 2010–11.

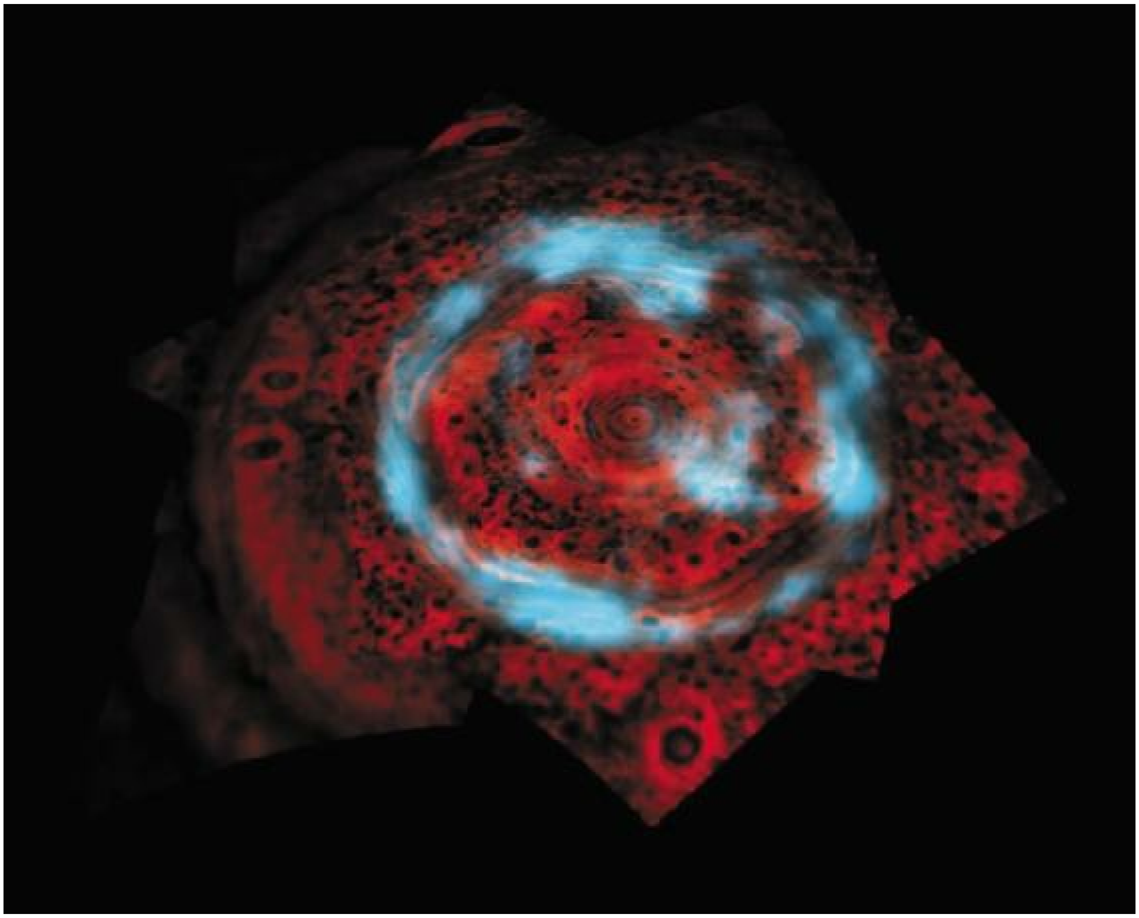
Cassini also probed a unique hexagon-shaped feature, some 30,000 kilometres across, at Saturn's north pole. Confined by winds flowing at more than 300 kilometres an hour, the hexagon is home to smaller hurricane-like vortices that rotate within it. Oddly, Saturn has no such feature at its south pole.



NASA/JPL-Caltech/SSI/Hampton University

A six-sided, jet-stream-like swirl churns around the planet’s north pole.

Even Saturn's interior came into better focus thanks to the mission. The planet has a strong and complex magnetic field, generated by liquid churning deep within it. The bright auroras that glow around Saturn's poles served as guide posts by helping to reveal the patterns and intensity of its polar magnetic fields.



NASA/JPL/University of Arizona

Glowing bands are created at the poles where the solar wind slams into Saturn’s magnetosphere.

Some fundamental mysteries remain. Mission scientists are still working to determine how long a Saturnian day is. Because the planet has no solid surface, researchers cannot track a fixed feature to measure its rotation rate. Instead, they have tried to measure its true spinning speed by observing the planet's powerful rotating radio emissions, which should reflect the movement of the magnetic field stemming from deep within. But Cassini found that these emissions were more intricate than expected, which complicates efforts to use them to understand the rotation rate. More-detailed information about the magnetic field may come during this final phase of the mission, as Cassini loops between the planet and its rings.

Although the mission will come to a close soon, it will leave behind a wealth of information for future studies. “Cassini's treasure of data is 100 times as broad and deep as Voyager's, and it will take decades to get to the bottom of it,” says Jeff Cuzzi, a planetary scientist at NASA's Ames Research Center in Moffett Field, California. “The end of Cassini's active operations may be only the beginning of real advances in our understanding of what it has discovered.”

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Stop blocking postdocs' paths to success

30 August 2017

Lab heads should let junior researchers take their projects with them when they start their own labs — it drives innovation and discovery, argues Ben A. Barres.

Illustration by David Parkins

Postdocs are the engines of scientific progress. Typically poorly paid despite their three to seven years of doctoral training, they might labour in a postdoc lab for another four to nine years before moving to a more independent and remunerative career. What are they owed in return?

One type of postdoc maltreatment is rarely discussed, despite its prevalence and importance — should a postdoc be able to take their research project with them when they set up their own lab? And if so, should that new principal investigator (PI) be free from direct competition on that project with his or her former mentor? In my view, the answer to both questions is yes. Such 'project porting' is crucial for the success of young scientists and should be a fundamental right for postdocs.

This is such a touchy topic that it is only now that I feel comfortable writing about it. I am at the end of a long academic career and dying of stage four pancreatic cancer. I think it's time for the academic community to start openly discussing the issue of research freedom for postdocs (or lack of it).

Opinions will vary, but different strategies could enable PIs and postdocs to handle the issue more constructively. At the very least, trainees looking for a postdoc job need to find out about the policies of potential mentors before selecting a lab, and assess the implications that these policies could have for their independent success.

Who owns what?

Most mentors at the PI level have policies on research ownership. Unfortunately, many postdocs fail to ask what these policies are, either through lack of forethought or because they assume that it will not be an issue. Some mentors, if asked, warn prospective postdocs that they will not be free to take their projects with them to their own labs. (The meaning of 'project' may vary depending on the mentor, from the postdoc's specific research question to the entire subject area of the mentor's lab.) Others permit postdocs to retain their projects on moving, but then directly compete on the same work.

A postdoc is formally free to work on any project in his or her own lab. But those that spurn their advisers' wishes risk losing their support — something that is usually crucial for winning junior investigator awards and other types of funding, or when trying to obtain a promotion, say from assistant to associate professor.

So what is wrong with an adviser asking a postdoc to begin a different project on setting up their own lab?

Doing so assumes that a given topic is owned by the adviser and that the adviser can control who works on it. This is insulting to the postdoc, who in most cases has earned co-ownership by pushing a project forward with ideas and hard work.

Most importantly, when it comes to obtaining a faculty position or funding for a newly independent laboratory, having compelling preliminary data greatly increases the chances of success. Such data are most feasibly obtained from the final stage of a postdoc, or from research in the same area in a new lab. In addition, having to start work in an entirely different area makes it harder to achieve tenure because of the short tenure clock. Over time, the best faculty members will often launch projects in new areas, but this typically happens only after a lab is established.

Another strategy is to allow a postdoc to start a project in their final year that they can then take with them. In my experience, however, postdoc training periods are already so long and it takes so much effort to get papers published that there is rarely time for a postdoc to make headway before starting their own lab.

If a mentor lets a postdoc retain their project but continues to work on the same question, this doesn't solve the problem. In most cases, there is simply no way that a young person starting a lab can compete successfully with their former mentor. Established labs have an endless stream of excellent postdocs; new labs typically get started with graduate students, who take longer to train and to do meaningful experiments.

Competitor clash

I believe that not allowing postdocs to take projects with them, or competing with them when they do, harms science. It is well known among senior investigators that mentors who are ungenerous to their trainees have a lower rate of trainee success, and their area of research suffers as a result. By

contrast, generous mentors soon find that their trainees dominate a given field, and that together they can rapidly move it forward.

For instance, the neurobiology department at Stanford University — where I hold a professorship — has a long tradition of caring about mentorship. All faculty members allow their postdocs to take projects on to their own labs, free from competition. On analysing lists of trainees, I found that nearly 70% of our postdocs over the past 25 years have gone on to run their own academic labs and to achieve tenure. Anecdotal evidence suggests that the US national average is less than 10%. Indeed, in any given field, one can easily think of outstanding scientists who also manage to be generous mentors with no sacrifice to the quality of their science.

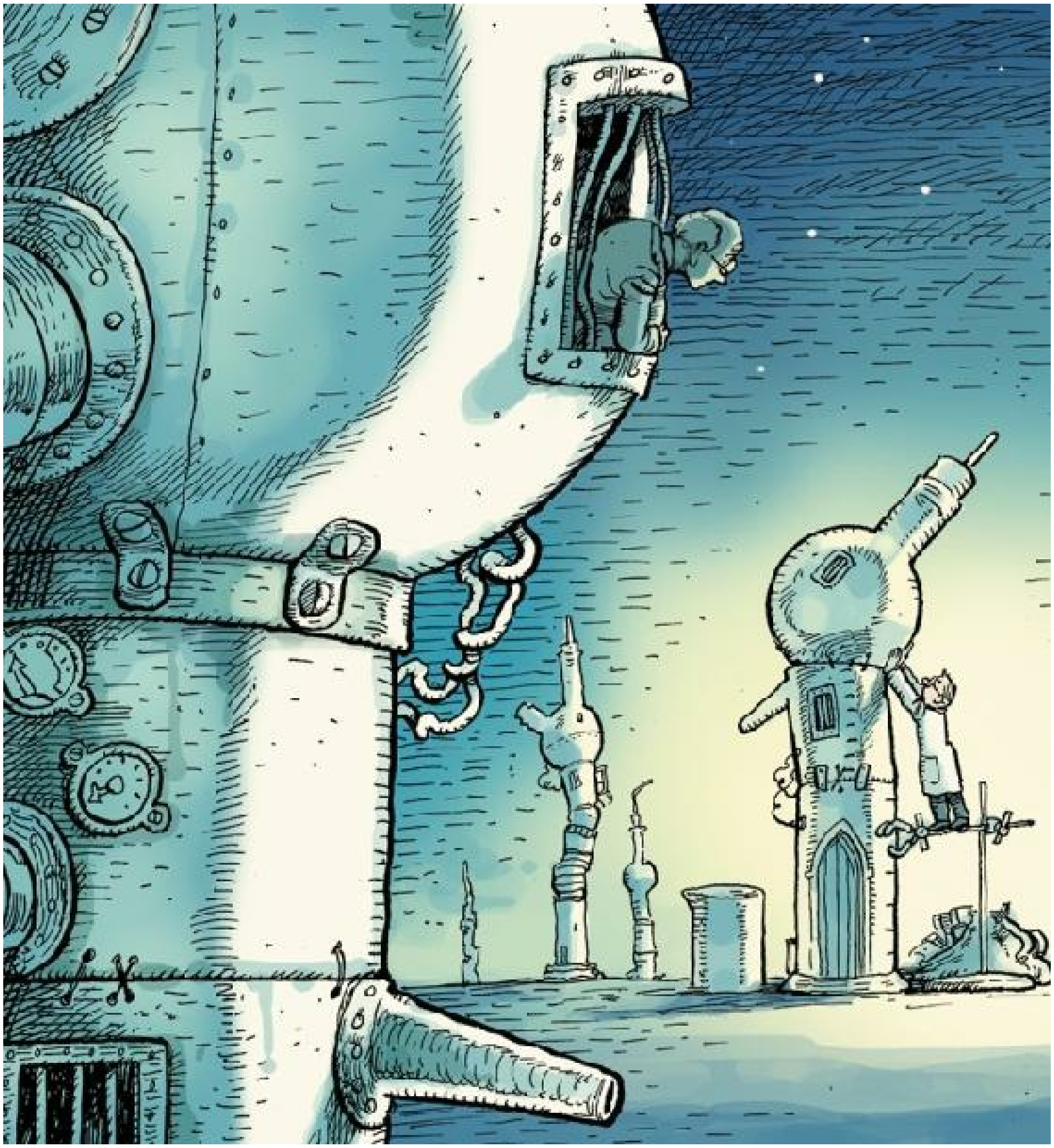

Illustration by David Parkins

If preventing postdocs from porting projects to their own labs is so detrimental to young researchers and to science, why do so many PIs do it? Highly competitive lab leaders wishing to become the best in their field can feel that they are working on a half-eaten pie if they focus on a research question to which others are contributing. They may imagine that their chances of winning a Nobel prize or other prestigious award are lessened if there are too many contributors to a field. Or they can understandably feel

they have invested their entire careers in developing a project area, whereas the postdoc has invested only a few years and relies on building on the PI's previous work.

Some may even be concerned that science could be harmed if PIs stop working on a project that has been taken to another lab by a postdoc. A young PI may be less likely to make advances than an accomplished, well-funded lab would be.

I am not persuaded by any of these arguments. In fact, I think that keeping the whole pie for oneself is sheer gluttony.

I don't believe that science is better off as a completely open competition. Pitting large, established research groups against the nascent labs of young scientists is not fair. And, as in business, monopolies act against the welfare of the whole by preventing innovation. Indeed, in my view, established labs can stifle creativity in their field even as they flourish. Young labs are much more likely to bring new ideas and to question dogmas. Worse, excessively competitive behaviour drives many talented young researchers out of science altogether.

Allowing a postdoc to retain a project does not mean that the PI leaves the field; it just means that they don't assign the obvious next research step to their subsequent postdoc. As a PI myself, I will admit that this approach sometimes seems painful. Discoveries typically result from the years of effort my lab has put into a project and a postdoc's contributions. Often, the immediate next steps are exciting — it is tempting to keep going. Moreover, starting an entirely new project is always challenging, because you first need to obtain sufficient preliminary data to win funding. But with mentorship, there is a time when you must make the welfare of your trainee the highest priority. As with good parenting, I believe that one should give to one's trainees until it hurts to do so.

With every step forward in science, more questions are raised than have been answered. In my case, there is no end of interesting and unexplored avenues about glial cells and their roles in health and disease. In fact, one of my greatest frustrations is that there are questions in my field for which I will not discover the answer during my lifetime. It is a great consolation to know that

I have trained many terrific young scientists, who, in their own labs, will keep exploring these areas long after I am gone.

Good track record

For all of these reasons, graduate students who hope to one day have their own labs need to take great care in selecting their postdoctoral mentor (B. A. Barres *Neuron* **80,** 275–279; 2013). The best mentors serve as strong role models when it comes to doing creative and rigorous science. They are also highly generous people who are willing to give their postdocs academic freedom, the long hours needed to teach them how to design good experiments, and continued support long after their trainees have left, for instance by providing recommendation letters or advice.

Graduate students should investigate the training track records of labs of interest, and discuss these labs with their PhD advisers, programme directors and thesis committee members. All prospective postdocs would be wise to explicitly ask potential mentors (as well as the mentors' previous trainees) what their policies are. In fact, all should be aware that when hiring committees assess an individual postdoc's prospects for future success, they routinely consider whether the applicant is from a lab that allows postdocs to retain projects and, if so, whether that lab is known to directly compete with its former trainees.

Many ungenerous mentors are also highly accomplished scientists. They are often tenured and run successful labs that add stature to their universities and bring in large amounts of funding. So it is not surprising that university leaderships generally overlook poor mentoring. Instead, everyone in biomedical science should strive to reward high-quality mentorship and to protect young scientists.

I think that the topic of research ownership should be included in ethics courses, such as those now mandated by the US National Institutes of Health (NIH) graduate training grants.

Indeed, funding agencies worldwide should do more to ensure postdoc

welfare. In the United States, the NIH's Pathway to Independence (K99) Award is a step in the right direction. Postdocs must formulate specific aims for their own laboratories as part of their funding applications. This prompts them to begin early discussions with their mentors about what they will do on completing their training. Similarly, the K01 Postdoctoral Mentored Career Development Award from the US National Institute of Neurological Disorders and Stroke funds postdocs to work on a project that they can take with them when they start their own labs.

I believe that the major funders of postdoc fellowships, such as the European Molecular Biology Organization and elite funding foundations, should mandate that postdoc fellows be free to take their projects when they move on to their own laboratories. Given that competition for these fellowships is intense, why shouldn't funders and foundations support the postdocs who are most likely to be successful in their own labs?

For graduate students looking to select a postdoctoral mentor, a helpful step would be for the NIH and other funding organizations to make lists of all trainees from training-grant applications available through a public database. These lists would greatly assist prospective postdocs by allowing them to see the training track record of each lab they are considering. In the United States, the National Postdoctoral Association could assume this responsibility (information on funded grant applications is public information that the NIH must disclose on request).

Importantly, grant-review committees should consider training track records during evaluations of applications from established labs. It is encouraging that the Howard Hughes Medical Institute (a non-profit medical-research organization in Chevy Chase, Maryland) has started to put more emphasis on a mentor's training record as one criterion when making decisions about renewing funding. Similarly, I believe that an individual's training track record should be factored in when considering the award of prestigious science prizes. Why should we honour those who don't support science's next generation?

Right now, PIs wishing to take advantage of their postdocs can act with impunity. In this increasingly competitive world, where it is harder than ever for young scientists to get off to a good start in their own laboratories, it is

incumbent upon us as a community to ensure that those to whom we hand the baton are treated equitably.

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Extreme weather events are the new normal

Hurricane Harvey highlights the struggle to apply climate science.

29 August 2017

Brendan Smialowski/AFP/Getty

Flooding from Hurricane Harvey underscores the need for more detailed predictions of climate impacts.

Hurricane Harvey is already being described as one of the ten costliest storms in US history, with the estimated financial damage put at between US$10 billion and $20 billion. Oil- and gas-industry infrastructure lies among the wreckage, and investors are eyeing the impact on the energy and

insurance markets.

Decisions on where to install, build and develop have always been weather dependent. But they are becoming increasingly so. Extreme weather events such as Harvey can be described as ‘unprecedented’ only so many times before companies and governments are forced to accept that such events are the new normal, and to plan accordingly.

Such plans are more difficult and complicated than the simple broad-brush narrative often cited about the need to adapt to global warming. As we explore in a News story this week, scientists cannot yet supply the kind of detailed, quantified information that companies and others require to best plan for changes coming in the next few years to decades.

This is partly a question of resources: the world is a big place, the future infinite and there isn’t enough computing power to go around. It is partly political, with the few late-adopters still offering a false flag around which to rally those who prefer inaction and obstruction. And it’s partly because the field of climate services — as the field of such detailed projections is known — is on the front line of a cultural switch that sees science listen to society’s questions, instead of simply offering answers. It is an imperfect storm, and scientists can’t meet the cost alone.

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Keep on marching for science education

Scientists might have made a difference, had they protested against laws that now threaten what can be taught in our classrooms, argues Brandon Haught[2].

29 August 2017

The new school year is beginning in the United States, and science education in Florida is at risk from laws that passed earlier this summer. It leaves me wondering: where have those who joined April's March for Science gone?

That global action was probably the most popular science-advocacy event of this generation. I took part in Titusville, Florida, and was impressed with the attendance, enthusiasm and creative slogans. In the speeches that followed, I warned against pending legislation that would allow any citizen to demand a hearing to challenge instructional materials. Both critics and advocates see this as a way to stifle teaching about evolution and climate change. We had the summer to make our case.

The science-advocacy group Florida Citizens for Science — for which I volunteer as a board member and communications officer — led the battle to kill, or least modify, those bills. We lost on all fronts. The bills are now law.

Where were those marchers when we needed them? I know several science cheerleaders who took some concrete steps to forestall the legislation (by

phoning elected representatives, for example), but I can count on one hand the number of working scientists who offered their expertise to our group. And I didn't hear of any who approached lawmakers on their own.

Having the scientific community more actively involved might have had an impact. The final vote in the state senate was tight. Advocates of the law were widely quoted as claiming that evolution is just a theory and that anthropogenic global warming is in doubt. It would have been invaluable if scientists at local universities had issued simple statements: yes, evolution is a fact; the word 'theory' is used differently in science from how it's used in casual conversation; and the basics of human-caused global warming need to be taught. Perhaps authoritative voices from the state's universities would have swayed a senator or two.

Since the laws were passed, dozens of articles about them have been published statewide and even nationally. Social media has been buzzing. But the scientific community is still woefully quiet.

Hey, scientists, beleaguered high-school science teachers could use your support.

Other US states have endured attacks on science education. Legislatures in Alabama and Indiana passed non-binding resolutions that encourage 'academic freedom' for science teachers who cover topics — including biological evolution and the chemical origins of life — that the lawmakers deem controversial.

In Iowa, state lawmakers proposed a law requiring teachers to balance instruction on evolution and global warming with opposing views. That effort dwindled without concrete action, but not because of pressure from the scientific community.

We have had some help in our efforts: Jiri Hulcr and Andrea Lucky, scientists at the University of Florida in Gainesville, spoke out with me against these bad educational bills in a newspaper opinion piece. We argued that the choice was stark: training students for careers in the twenty-first century, or plunging them into the Middle Ages.

And Paul D. Cottle at Florida State University in Tallahassee is unrelenting in pursuing his goal of preparing elementary and high-school students for their adult lives. He's an integral part of Future Physicists of Florida, a middle-school outreach programme that identifies students with mathematical ability and guides them into courses that will prepare them for university studies in science and engineering. More generally, he makes sure that students, parents and school administrators hear the message that the path to high-paying, satisfying careers using skills acquired in mathematics and science starts long before university, and depends on accurate instruction.

Plenty of issues need attention. The pool of qualified science and maths teachers is shrinking. Florida students' performance in state-mandated science exams has been poor and stagnant for nearly a decade. This year, the state's education department will begin to review and select science textbooks that will be used in classrooms across the state for at least the next five years.

We need scientists who are willing to take the time and effort to push back against the textbook challenges that these new laws will encourage. We need expert advisers eager to review and recommend quality science textbooks for our schools. We need bold scientists ready to state unapologetically that evolution, global warming — and, yes, even a round Earth — are facts of life.

You're busy. I know. And some of you are uncomfortable in the spotlight. But doing something, even on a small scale, is better than doing nothing. Sign up for action alerts from the National Center for Science Education and your state's science-advocacy group, if you have one. Be a voice within any organizations you belong to, urging them to make statements supporting science education as issues arise. Introduce yourself to teachers at local elementary and high schools.

Even if all you have to offer are ideas and emotional support, we'll take them. Politicians, school administrators, business leaders, parents and even children need to know that you support high-quality science education.

The March for Science was a beneficial, feel-good event. It's over. But we need you to keep on marching!

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Europe’s X-ray laser fires up

High-speed shooter will help scientists to make molecular movies.

29 August 2017

Heiner Müller-Elsner/European XFEL

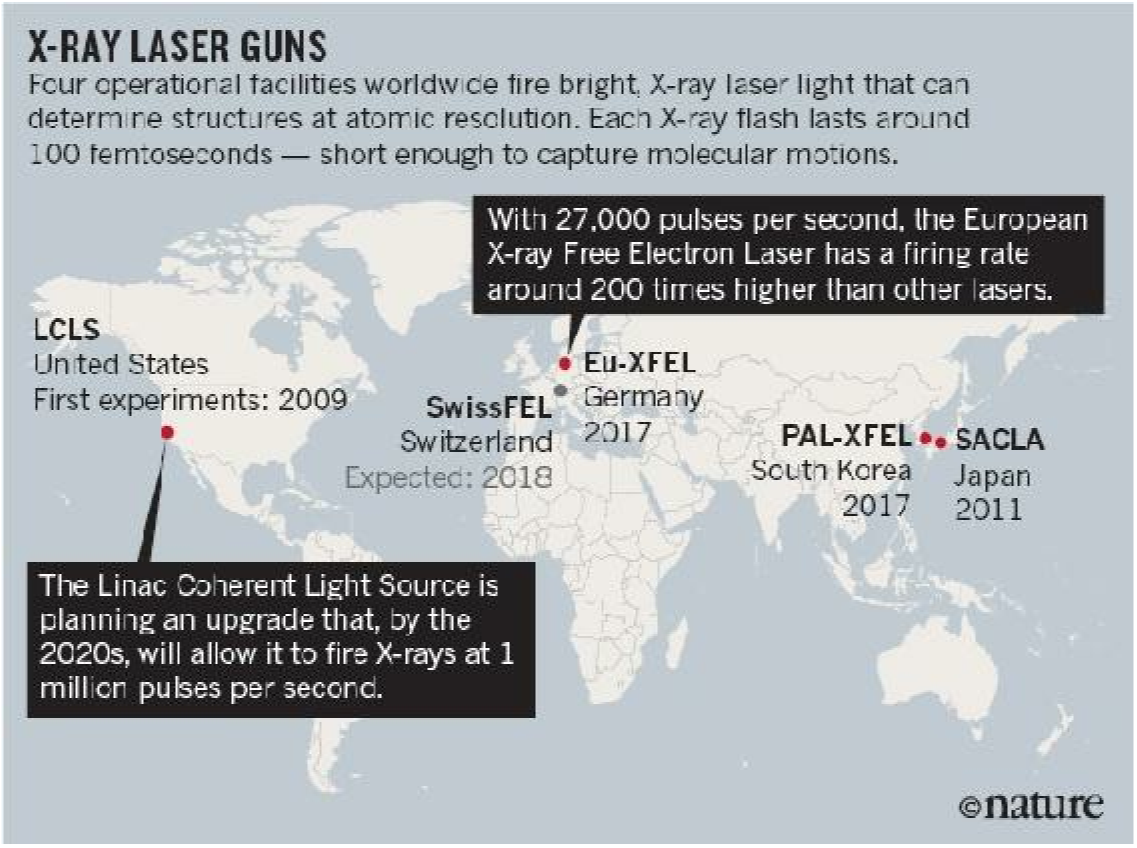
Researchers will soon be able to use the European X-ray Free Electron Laser near Hamburg, Germany, to watch molecules in action.

Scientists who make movies of molecules in motion have a new high-speed camera to shoot with. The €1.2-billion (US$1.4-billion) European X-ray Free Electron Laser (XFEL) will start running its first experiments in September near Hamburg, Germany.

The European XFEL fires powerful X-rays in bursts of a few hundred femtoseconds: so short that, like strobe lights, they can capture snapshots of jittery molecules frozen in time, and with a wavelength small enough to

provide pictures at atomic resolution. The Hamburg machine is one of a few such X-ray lasers worldwide, but boasts a unique rapid-fire feature: it can rattle off 27,000 pulses every second, a firing rate more than 200 times greater than the next-fastest facility, the $420-million Linac Coherent Light Source (LCLS) at the SLAC National Accelerator Laboratory in Menlo Park, California. “It’s such a different beast to anything else on the planet that it really feels like going into uncharted territory,” says Arwen Pearson, a biochemist at the Centre for Free-Electron Laser Science in Hamburg.

In a single second, scientists should be able to collect more than 3,000 good-quality X-ray pictures, compared with 100 or so at other facilities, says Adrian Mancuso, a project scientist at the European XFEL’s experimental stations in Schenefeld, near Hamburg. “Having lots of data matters, and the European XFEL will deliver it in truckloads,” says Abbas Ourmazd, a physicist at the University of Wisconsin–Milwaukee. The European machine — paid for by 12 countries — should relieve some of the pressure on older XFELs in the United States and Japan (see ‘X-ray laser guns’), which are heavily oversubscribed by scientists keen to capture atomic-scale images of their samples. Another XFEL opened to users in Pohang, South Korea, in June, and a machine in Villigen, Switzerland, is due to start experiments in 2018.



Source: European XFEL

At the Hamburg XFEL, bunches of electrons are first accelerated down a 1.7-kilometre-long tunnel. Magnets then bend the electrons' path into wiggling slalom tracks, causing them to emit bunches of high-energy X-rays as they curve. The bright X-ray pulses are so intense that they destroy the samples they hit — but not before enough photons have been scattered to reveal the sample's atomic structure.

X-ray movies

In structure-determination experiments using conventional X-ray sources, molecules must be packed into crystals to scatter enough photons to deduce their structure. But the X-rays from XFELs are so bright that researchers can gather diffraction patterns from crystals just a few nanometres in size, or even from non-crystalline clusters of molecules. This means that XFELs can study

proteins that are hard to crystallize. And researchers can create movies of enzymes, viruses or catalysts in action by building up thousands of different snapshots of the same system taken at different timepoints — often by passing a jet of molecules in solution past an X-ray beam.

In 2015, for example, scientists using the LCLS reported eight snapshots of myoglobin, a muscle protein that binds oxygen, at a resolution of 0.18 nanometres. The images were taken a few picoseconds after a flash of light dislodged a molecule of carbon monoxide from its binding position on the protein (T. R. M. Barends *et al. Science* **350,** 445–450; 2015). On 14 August, Ourmazd and his colleagues reported using X-ray scattering from single viruses at the LCLS to create a 3D movie at 9-nm resolution. It shows the motions of a virus as it reorganizes its genome so that the genetic material can squeeze through a tubular molecular structure — a process that occurs when the virus infects a cell (A. Hosseinizadeh *et al. Nature Methods* http://dx.doi.org/10.1038/nmeth.4395; 2017).

Work such as this depends on gathering many snapshots of identical particles in different conformational states to build up a composite picture of a particle's range of motion, explains physicist John Spence at Arizona State University in Tempe. He says that the European XFEL's high pulse rate will make this process much quicker — so structural data could be accumulated for much smaller individual particles. One of the European facility's most important milestones will be proving that diffraction patterns can indeed be collected from single particles at very high rates, says Mancuso. Because an intense X-ray burst obliterates each particle it hits in a passing spray or jet, it can be a challenge to ensure that the destroyed sample does not impede capture of the next shot. "We won't know that until we try," he says.

Hamburg's facility also has a larger capacity than its competitors: unlike other XFELs, it has three separate undulators to create simultaneous X-ray beams, with the 27,000 pulses per second distributed among them. But the European XFEL will reign for only a limited time: SLAC this year began construction of a $1-billion project to create an even brighter laser beam that, by the early 2020s, will fire up to 1 million pulses each second.

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Legal threat exposes gaps in climate-change planning

Australian lawsuit highlights how difficult it is to turn global warming data into useful advice.

29 August 2017

Daniel Munoz/Reuters

Climate forecasts indicate that Australia will face an increased risk of severe droughts and bush fires.

In a world-first case, an Australian court will next month begin hearing from shareholders who have sued a bank for failing to disclose its vulnerability to climate change.

The case highlights the fact that financial institutions around the world have been slow to acknowledge the risk that climate change poses to investments in infrastructure, agriculture and property. But researchers say the lawsuit also shows that Australia and many other countries are currently unable to forecast the financial risks of climate change.

Shareholders Guy and Kim Abrahams filed the lawsuit on 8 August against the Commonwealth Bank of Australia, saying that the institution’s 2016 directors’ report did not adequately inform investors of climate-change risks. Their suit also seeks an injunction to stop the bank from making the same omissions in future annual reports.

Climate scientist Andy Pitman at the Centre of Excellence for Climate System Science in Sydney, Australia, says that researchers have been warning companies and governments for years about the need to invest in climate modelling and the related field of climate services, which provides forecasts and other information to public and private users. He says that it would take substantial investment and five to ten years of work for his team to provide banks with the climate information they need.

To be useful, he says, the forecasts would need to be on a time scale that is specific to a business or government’s climate vulnerabilities, such as a period of months to years, or on small spatial scales, such as the size of a farmer’s field. “That’s hugely challenging,” he says. “It’s the difference between building a car that travels around Sydney and building one that wins a Formula One Grand Prix.”

In theory, it should be possible to make such forecasts, but “it’s a huge undertaking to actually do it”, says Pitman; and it would require high-performance supercomputers generating massive amounts of data.

A question of scale

No country can yet produce climate forecasts on the scales and with the accuracy needed for detailed planning, says Simon Mason, a climate scientist at Columbia University’s International Research Institute for Climate and

Society in Palisades, New York. Even the best forecasts are highly uncertain, which makes it difficult to use them for planning, he says.

For instance, if a farmer's bank wants to know the probability that the farm might experience drought, a 10-year projection might suggest a 60% chance of more frequent droughts, says Mason. But that doesn't indicate how severe the droughts might be or whether they will lead to crop failures, he says. "These are exactly the types of questions that need a lot of research."

But Jacqueline Peel, who specializes in climate-change law at the University of Melbourne, Australia, says that companies are likely to face more lawsuits like the Australian one, meaning that they won't have time to wait for fine-scale, tailored models. She says that there is already sufficient information on future warming scenarios for a business to disclose its vulnerabilities.

In Australia, researchers say that budget cuts haven't helped. A report released earlier this month by the Australian Academy of Science identified major gaps in climate research and climate services. The report found that Australia needs an additional 77 climate scientists, including 33 in modelling and 12 in climate services. The academy commissioned the report after the Australian national science agency, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), axed about 30 climate-science positions in 2016. CSIRO says it later added back 31 posts.

"There is a pressing need to improve projections of extreme-weather events to meet the demand for adaptation planning and disaster risk management," the report said.

The situation is better in Germany, the Netherlands and the United Kingdom, which have well-established, government-funded systems that provide climate information. But in the United States, researchers say that climate services are fragmented and struggle to meet the needs of governments or private-sector decision-makers. The Obama administration tried to launch a climate services division, but the US Congress blocked that effort.

"We haven't invested as much in climate services in time scales from several weeks to decades in the US," says John Furlow, who works on climate change and development at Columbia.

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Nature News

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Nature News

[周三, 06 9月 2017]

- **Nature News**

Nature News

Nature is a weekly international journal publishing the finest peer-reviewed research in all fields of science and technology on the basis of its originality, importance, interdisciplinary interest, timeliness, accessibility, elegance and surprising conclusions. Nature also provides rapid, authoritative, insightful and arresting news and interpretation of topical and coming trends affecting science, scientists and the wider public.

- **Cuckoo call adds another layer of deception** [周二, 05 9月 08:00]
  The female bird makes a different and much sneakier sound than the male.
- **Budget battle looms for US science programmes** [周二, 05 9月 08:00]
  Competing spending priorities in the House of Representative and Senate could push funding negotiations into December.
- **Plot a course through the genome** [周二, 05 9月 08:00]
  Inspired by Google Maps, a suite of tools is allowing researchers to chart the complex conformations of chromosomes.
- **Removing statues of historical figures risks whitewashing history** [周一, 04 9月 08:00]
  Science must acknowledge mistakes as it marks its past.
- **Massive Ebola data site planned to combat outbreaks** [周一, 04 9月 08:00]
  An international partnership seeks African leadership to organize information about the disease.
- **Trump finally nominates new leader for NASA** [周六, 02 9月 08:00]
  James Bridenstine, a member of Congress, has long pushed for the United States to return to the Moon.
- **Nature videos help to calm inmates in solitary confinement** [周五, 01 9月 08:00]
  Controversial experiment ignites debate over whether scientific work could be used to justify harsh prison tactics.
- **Volcanic views, stalking storks and the ephemeral eclipse** [周五, 01 9月 08:00]
  August's sharpest science shots, selected by Nature 's photo team.
- **Brain researchers in uproar over NIH clinical-trials policy** [周五, 01 9月 08:00]
  An open letter to the US National Institutes of Health says that classifying human-behaviour studies as clinical trials creates unnecessary red tape.
- **Doubts raised about CRISPR gene-editing study in human embryos** [周四, 31 8月 08:00]
  Alternative explanations challenge whether technique actually fixed a genetic mutation as

claimed.

- **[How labs are coping with Hurricane Harvey's devastating floods]** [周四, 31 8月 08:00]
Advance planning has kept some Texas facilities safe during the unprecedented storm.
- **[Artificial warming trial reveals striking sea-floor changes]** [周四, 31 8月 08:00]
Researchers deliberately heated up a slice of the Antarctic sea bed to see how ecosystems responded.
- **[Reprogrammed cells relieve Parkinson's symptoms in trials]** [周三, 30 8月 08:00]
Monkeys implanted with neurons derived from stem cells showed sustained improvement after two years.
- **[Skeleton plundered from Mexican cave was one of the Americas' oldest]** [周三, 30 8月 08:00]
Rock-encased bone shard left behind by thieves allowed researchers to determine that the remains are probably more than 13,000 years old.
- **[Closure of US coal study marks an alarming precedent]** [周三, 30 8月 08:00]
The Trump administration has stepped up its assault on environmental protections by halting a US$1-million study on the health risks of coal mining — casting a pall on academic freedom.
- **[Alan Turing's notes, runaway salmon and illegal gold-mining]** [周三, 30 8月 08:00]
The week in science 25–31 August 2017.
- **[Cassini's 13 years of stunning Saturn science — in pictures]** [周三, 30 8月 08:00]
As the mission speeds towards its conclusion, Nature takes a look at what researchers have learnt about the planet's moons, rings and tempest-filled skies.
- **[Stop blocking postdocs' paths to success]** [周三, 30 8月 08:00]
Lab heads should let junior researchers take their projects with them when they start their own labs — it drives innovation and discovery, argues Ben A. Barres.
- **[Artificial intelligence: The future is superintelligent]** [周三, 30 8月 08:00]
Stuart Russell weighs up a book on the risks and rewards of the AI revolution.
- **[Books in brief]** [周三, 30 8月 08:00]
Barbara Kiser reviews five of the week's best science picks.
- **[Economics: Messy genesis of the welfare state]** [周三, 30 8月 08:00]
Paul Cairney examines the tangled history of one nation's drive for social equity.
- **[Pollution: US coal plans flout mercury convention]** [周三, 30 8月 08:00]
- **[Multidisciplinarity: Philanthropy research is thriving]** [周三, 30 8月 08:00]

- **[Computational materials: Open data settled in materials theory]** [周三, 30 8月 08:00]
- **[Brain surgery: Most lobotomies were done on women]** [周三, 30 8月 08:00]
- **[Geode]** [周三, 30 8月 08:00]
  Breaking new ground.
- **[Extreme weather events are the new normal]** [周二, 29 8月 08:00]
  Hurricane Harvey highlights the struggle to apply climate science.
- **[Keep on marching for science education]** [周二, 29 8月 08:00]
  Scientists might have made a difference, had they protested against laws that now threaten what can be taught in our classrooms, argues Brandon Haught.
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  High-speed shooter will help scientists to make molecular movies.
- **[Legal threat exposes gaps in climate-change planning]** [周二, 29 8月 08:00]
  Australian lawsuit highlights how difficult it is to turn global warming data into useful advice.

Cuckoo call adds another layer of deception

The female bird makes a different and much sneakier sound than the male.

05 September 2017

blickwinkel/Alamy

The female cuckoo mimics the call of a hawk to distract nest-owners.

The BBC has just screened an adaptation of Harry Potter author J. K. Rowling’s detective story *The Cuckoo’s Calling*, and many viewers have been left confused. No spoilers here: but for many watching, the twist ending was a little hard to follow, the misdirection a little too effective. But then the book itself was famously published with some considerable misdirection:

Rowling wrote it under the pen name Robert Galbraith because she wanted to see how the public would respond to her passing off her own work as someone else's.

The reverse is more usually true: rather than conceal genuine achievements, fakers employ deception to take undeserved credit for work they themselves didn't carry out. That's a sensible strategy in the animal kingdom, too. More reward for less effort is a recipe for success in the ongoing natural struggle for resources and survival. Parasites get a bad press, but they keep getting away with it. All of which brings us neatly from *The Cuckoo's Calling* to a cuckoo calling.

The common cuckoo (*Cuculus canorus*) is a parasite with good PR. Despite deceiving other birds into hatching its eggs and raising its young — often at the expense of the cuckolded dupe's legitimate offspring — the cuckoo seems to have emerged with its reputation not only intact but enhanced. William Shakespeare may have labelled the cuckoo call a "word of fear unpleasing to a married ear", but people far and wide still willingly invite the sound into their homes to mark the hourly passing of time.

The female of the species is sneakier than the male. Whereas the proud and visible male cuckoo is responsible for that famous two-note call, it's the female that does the actual dirty work of leaving usurpers in the homes of others. And her call is very different and rarely heard. But, as it turns out, it too is part of the parasitical package.

In a paper published this week (J. E. York and N. B. Davies *Nature Ecol. Evol.* http://dx.doi.org/10.1038/s41559-017-0279-3; 2017), scientists at the University of Cambridge, UK, reveal a dark twist behind the (female) cuckoo's calling. The researchers studied the behaviour and impact of the sounds of the birds in a series of field experiments at nearby Wicken Fen. After the female has visited a target nest, she deliberately mimics the frightening calls of a hawk, which puts the parent birds on high alert and distracts them from spotting, say, a new, unusually large and differently coloured egg in their happy home. Instead of discovering the cuckoo's deception, the parent birds — in this case, reed warblers — then spent their time stretching their necks to peer over the rim of the nest, scanning the sky for incoming hungry hawks.

It’s another example, the researchers say, of how parasites can manipulate and redirect the behaviour of their host species to their own advantage. And this particular cuckoo’s calling sounds — spoiler alert — like a little chuckle.

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Budget battle looms for US science programmes

Competing spending priorities in the House of Representative and Senate could push funding negotiations into December.

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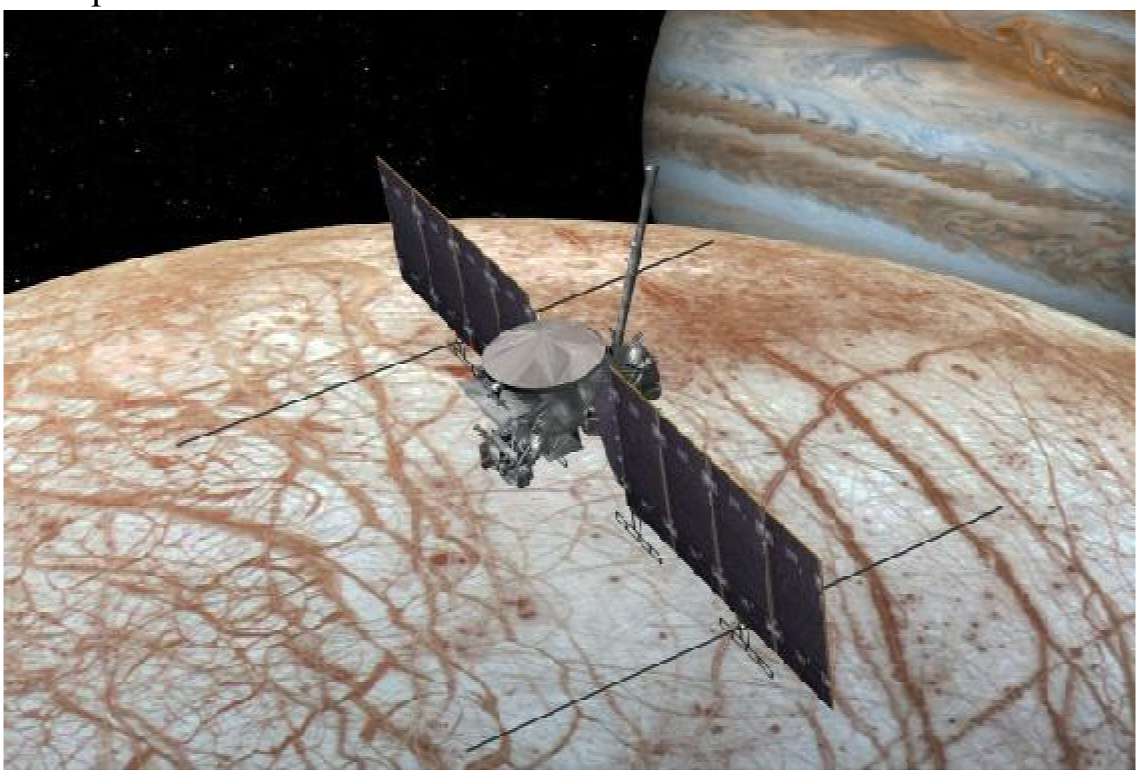

NASA/JPL-Caltech

NASA's planned Europa missions are among government-funded research for which budgets are up in the air.

Scientists in the United States are nervously watching from the sidelines as the annual budget skirmish heats up in Congress this week. Legislators are back in Washington DC from their August recess with an urgent list of tasks to complete before the country's fiscal year closes at the end of September. In addition to passing a budget to fund the government, they must also raise the debt ceiling so that the country does not default on its loans, and discuss providing emergency-relief funding for victims of Hurricane Harvey.

But legislators are well behind on drafting their 2018 spending plans, which creates uncertainty about how much money science agencies including the National Science Foundation (NSF) and NASA can expect.

Experts say Congress will probably pass a stopgap funding measure to keep the lights on. Government agencies would remain on 2017 funding levels until lawmakers eventually passed a new budget. In the meantime, they would be unable to start new programmes or end old ones without permission from Congress. “We're in for a wait,” says Matthew Hourihan, director of the research and development budget and policy programme at the American Association for the Advancement of Science in Washington DC.

Hashing out the differences between spending bills from the House of Representatives and the Senate for the 2018 fiscal year could take until December, says Amy Scott, a science-funding and policy specialist at the Association of American Universities (AAU) in Washington DC.

Bridging differences

At this current stage of the budget process, the House and Senate diverge on several key scientific priorities. This is reflected in the appropriations bills that have passed through the committees that oversee scientific agencies.

There is a large gulf in the plans for NASA. The House bill would boost the agency’s science programme by US$94 million over the 2017 level of $5.8 billion, whereas the Senate would cut it by $193 million.

Lawmakers in the House have allocated $2.1 billion for NASA’s planetary-science budget — up from the $1.8 billion it received in 2017. The Senate bill, by contrast, would cut $234 million from current spending levels. Support from the House and Senate is reversed for Earth-sciences research. The Senate would maintain 2017 spending levels at $1.9 billion, but the

House would cut it by $217 million for 2018. Despite these differences, negotiations to reconcile NASA's budget tend to go smoothly, says Scott.

A bigger sticking point is funding for the Advanced Research Projects Agency—Energy (ARPA-E), a Department of Energy (DOE) programme focused on incubating innovations in clean energy. The House bill guts ARPA-E and instructs that any remaining money from the $306 million the project received in 2017 be used to "conduct an orderly shutdown" of the programme. The Senate, however, gives ARPA-E $330 million for 2018.

Criticism for the 8-year-old programme often stems from a perceived lack of output, says Julia Smith, a DOE funding and policy specialist at the AAU. "But ARPA-E is young, so we can't say how it has changed your life because we don't know yet."

Another bone of contention is support for the multibillion-euro nuclear-fusion collaboration ITER, which is funded by an international consortium that includes the DOE. The planned facility, under construction at a site in St-Paul-lez-Durance, France, is over budget and suffering continual delays. Congress eventually allocated $50 million for the project in 2017, even though the Senate proposed eliminating its monetary support. For 2018, the Senate is again trying to cut out ITER's US funding completely, whereas the House has proposed an allocation of $63 million.

Polarizing programme

The National Oceanic and Atmospheric Administration (NOAA) may also face funding difficulties. The House slashes its 2018 budget to $5 billion, down from the $5.7 billion the agency received in 2017. The Senate has proposed $5.6 billion for 2018.

The divisions come to a head on an especially contentious item: NOAA's Polar Follow-On programme, which operates satellites that collect data used to predict the weather, including hurricanes. The House has proposed only $50 million for this programme, a huge cut from the $329 million it received in 2017. The Senate, however, would give the programme $419 million.

Money for designing and building three new research vessels for the NSF could also be problematic. Congress gave the agency $122 million for this purpose in 2017. For 2018, the House bill cut out all funding for the ships, whereas the Senate provides the $105 million requested by the NSF. Despite these differences, “this is something that does usually end up getting funded”, Scott says.

It is unclear whether or how items such as the funding aid package for Hurricane Harvey will affect negotiations over the budget and the debt limit, says Scott. Adding to the uncertainty is the fact that the Senate has yet to send half of its appropriations bills — including one that funds the National Institutes of Health (NIH) — through the relevant spending committees.

Judging by deliberations amongst lawmakers so far, experts say that the NIH will probably get a boost from both the House and the Senate. The two chambers “seem to be remarkably in agreement” on NIH funding, says Jennifer Zeitzer, director of legislative relations at the Federation of American Societies for Experimental Biology in Bethesda, Maryland.

But, until Congress starts working on the hurricane funding, “I don’t think we will know how federal science programmes will be affected”, Scott says.

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Plot a course through the genome

Inspired by Google Maps, a suite of tools is allowing researchers to chart the complex conformations of chromosomes.

05 September 2017

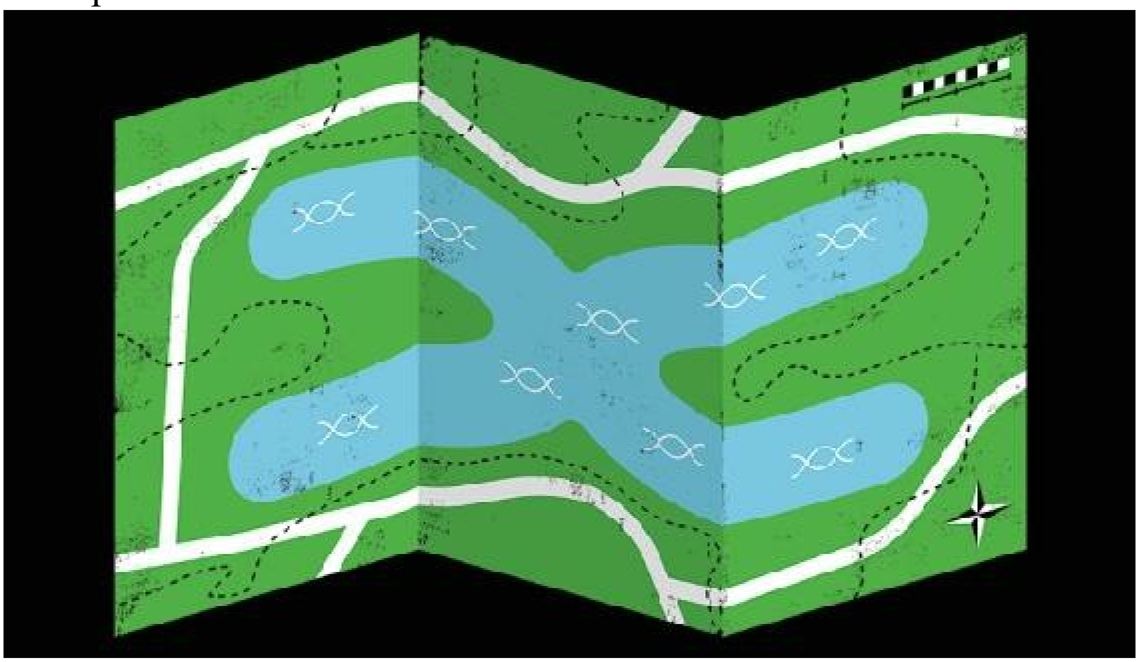

Illustration by the Project Twins

Chromatin does much more than just keep DNA neat and tidy. This complex of genomic DNA and protein assumes many different structures and conformations, which can affect the expression of the genes wrapped around it. In certain conformations, two sequences that are far apart in the linear DNA might actually be located next to each other and influence each other's activity; in other conformations, they might be far apart.

Erez Aiden was a graduate student at the Massachusetts Institute of Technology in Cambridge when he co-developed a technology that, for the first time, revealed the landscape of chromosome folding on a genomic scale.

Hi-C details the DNA loops and structural domains that influence gene expression, and can even help to piece together complex genomes. The data take the form of 2D matrices detailing chromatin contacts, but in 2009, Aiden had no easy way to explore them. So, he improvised.

“I would simply print out Hi-C matrices at multiple resolutions and I would use up hundreds of pages of paper,” he recalls. “I would find the biggest conference table I could and I'd just array printed pieces of paper in front of me in order to be able to see a big chunk of the matrix.”

“It was a great interface,” Aiden says. Still, he concedes, a more environmentally sustainable — and sharable — approach was required.

The result was Juicebox, a Java-based desktop application that provides Google Maps-style exploration of chromatin-interaction data. It allows researchers to zoom from the genome level down to small structural features.

Released in 2014, Juicebox has been downloaded some 14,000 times, Aiden says, and a browser-based version launched this year. Juicebox is just one of a range of freely available programs for exploring 2D interaction data: some focus on relatively narrow chromosomal loci, whereas others enable genome exploration. A growing subset infers 3D structures from 2D matrices. But all reflect the growing richness of chromatin-interaction data sets, not to mention the influence of funding initiatives such as the 4D Nucleome Project.

“Because [the data] have become so complex, visualization just became a lot more important,” says Peter Park, a bioinformatician at Harvard Medical School in Boston, Massachusetts.

The University of California, Santa Cruz (UCSC) Genome Browser is one of the most popular portals for exploring genomic data. Like most genome browsers, it renders sequence data as a linear array of letters decorated with epigenetic features, such as histone modifications and methylation sites, displayed in 1D 'tracks'.

Hi-C, however, generates 2D matrices. The technology identifies sequences that are far apart in the linear DNA sequence but close neighbours in 3D space. “You look at a pair of positions in the genome, and it tells you often they bump into one another," Aiden explains. Typically, those data are rendered as heat maps, with colour intensity reflecting the interaction frequency between two points.

Aiden and his co-developers, including James Robinson of the University of California, San Diego (UCSD), took inspiration from Google Maps, in which users can seamlessly zoom from the global to the street level. The entire data set is massive, but Google doesn't deliver it all at once. Instead, the software "divides the world into tiles at different resolution", says Robinson. At any one time, users view just a handful of tiles, which are organized to make adjacent tiles easy to fetch. "As long as you can always get to the four you're looking at quickly, you can support an interactive map," he says.

Similarly, Juicebox 'hic' files store precomputed tile sets for each possible chromosomal pair at multiple resolutions. A look-up table speeds access by allowing the software to retrieve data without having to search. As a result, Juicebox users can seamlessly explore an entire genome's worth of interactions, and then zoom in to view fine-scaled features.

Users can access any of several hundred precomputed contact maps that the Aiden lab has made publicly available, or view their own. They can overlay those data with standard browser tracks, such as gene locations or histone marks, either from their own studies or from public repositories. Binding sites for the DNA-binding protein CTCF, for instance, highly correlate with chromosomal loops. And they can flag and record features of interest.

Genomes in sync

HiGlass, a web-based tool launched in March by biomedical informatician Nils Gehlenborg at Harvard Medical School, also provides a Google Maps-like experience. As with Juicebox, researchers can import genomic tracks to help make sense of what they're seeing, but HiGlass also allows them to open multiple HiGlass views in one browser window and synchronize them so that they always display the same region. That way, Gehlenborg says, researchers can compare chromatin conformations across different conditions or experiments. "We are enabling the investigators and the analysts to generate new hypotheses," he says. (The browser-based version of Juicebox also allows multiple synchronized views per window, Aiden says; users of the desktop Juicebox app can synchronize maps across different windows, but not in a single display.)

Gehlenborg's team has established a HiGlass server for exploring publicly available data. Researchers who need to analyse custom data sets must install the software locally; a Docker container is available for that purpose.

Both Juicebox's web version and HiGlass allow users to create sharable URLs that point to specific views of the data — a feature that Aiden calls his software's "killer app". Suppose a user notices that a genomic structure overlaps perfectly with particular 1D track, he says. "You just take that URL, copy it, and you can tweet it. And all the people who receive the tweet can just click on it and boom! They get the exact same configuration that you had now on their computers as well."

Two other visualization options, the 3D Genome Browser and the WashU EpiGenome Browser, provide more localized views. Users select a locus of interest and the browsers display contacts in the area.

Whereas Juicebox and HiGlass render heat maps as squares divided diagonally into two mirror images, these browsers show heat maps as triangles — that is, half of the square, without its mirror image. "We cut down the half that is redundant information," says genome biologist Bing Ren at UCSD. (The WashU browser can also display contact data as arcs connecting linked regions.)

That change may sound trivial, but according to Feng Yue of Pennsylvania State University in Hershey, who developed his first 3D Genome Browser prototype as a postdoctoral researcher with Ren, it makes it easier to identify functional regions. The 3D Genome Browser, for instance, allows its users to align heat maps from two species, one atop the other, to assess the evolutionary conservation of folding architecture. A 'virtual-4C' mode allows users to query Hi-C data sets for sequences interacting with a specific genomic locus, providing a window into interactions between gene-regulatory regions.

Another option is GIVE, released by bioengineer Sheng Zhong and his colleagues at UCSD. This allows researchers to incorporate a fully functional genome browser, including a 2D contact data viewer, into their personal or lab web pages with just a few lines of HTML code. Researchers can thus share data with colleagues, publish it alongside their manuscripts, or explore it themselves — all with about 20 minutes' work, says Zhong.

Francesco Ferrari, a computational biologist at the FIRC Institute of Molecular Oncology in Milan, Italy, visualizes his Hi-C data using the R programming language and the Bioconductor software library. These text-based programs lack the interactivity of other software, but because the team already runs data analysis using R and Bioconductor, Ferrari explains, “it's just more convenient” to use them for visualization as well. The Bioconductor package HiTC provides Hi-C visualization tools, as does the Python library HiCPlotter.

Going 3D

Ultimately, 2D contact matrices imply 3D structure. After all, if two regions interact, they are probably in close physical proximity. Increasingly, some researchers are using their 2D data to compute and visualize 3D structures directly.

Csilla Várnai, a postdoc at the Babraham Institute in Cambridge, UK, helped to produce the 3D models for a single-cell Hi-C study earlier this year (T. Nagano *et al. Nature* **547,** 61–67; 2017). She used a generic molecular modelling package called Gromacs to model a chromosome as a string of beads — each representing about 100 kilobases — and then asked it to fold, using the Hi-C contacts as 'constraints' on that process.

Other packages have been designed specifically to model chromatin structure. Chrom3D, developed by bioinformatician Jonas Paulsen at the University of Oslo blends Hi-C data with information on proximity to the nuclear envelope to model the position of chromosomes in the nucleus. “That matters a lot for gene regulation,” Paulsen explains. Genes near the nuclear periphery tend to be repressed, whereas more centrally located genes are usually active.

Another tool, TADkit, from Marc Martí-Renom and Mike Goodstadt at the National Center for Genomic Analysis–Center for Genomic Regulation in Barcelona, Spain, allows users to view 3D chromosome models alongside the corresponding 2D heat map and 1D tracks. Selecting a feature in one representation highlights overlapping features in the others.

It remains to be seen what insights such 3D representations can provide that 2D heat maps cannot, especially as most Hi-C data sets represent millions of cells, rather than a single structure. Leonid Mirny, a bioinformatician at the Massachusetts Institute of Technology, likens the resulting data to averaging a batch of photographs to determine what a typical person looks like. “It's not going to be actually representative of anyone whom you take pictures of,” he says. Also unclear is which tool, if any, will emerge as the de facto standard for genome visualization. Debate on that front is ongoing, says Zhong.

When it comes to genome biology, says Ren, visualization is key. Analytical tools are based on statistics, he explains; sometimes they miss things, and sometimes they detect features that aren't there. “At the end of the day, nothing replaces looking at the data yourself.”

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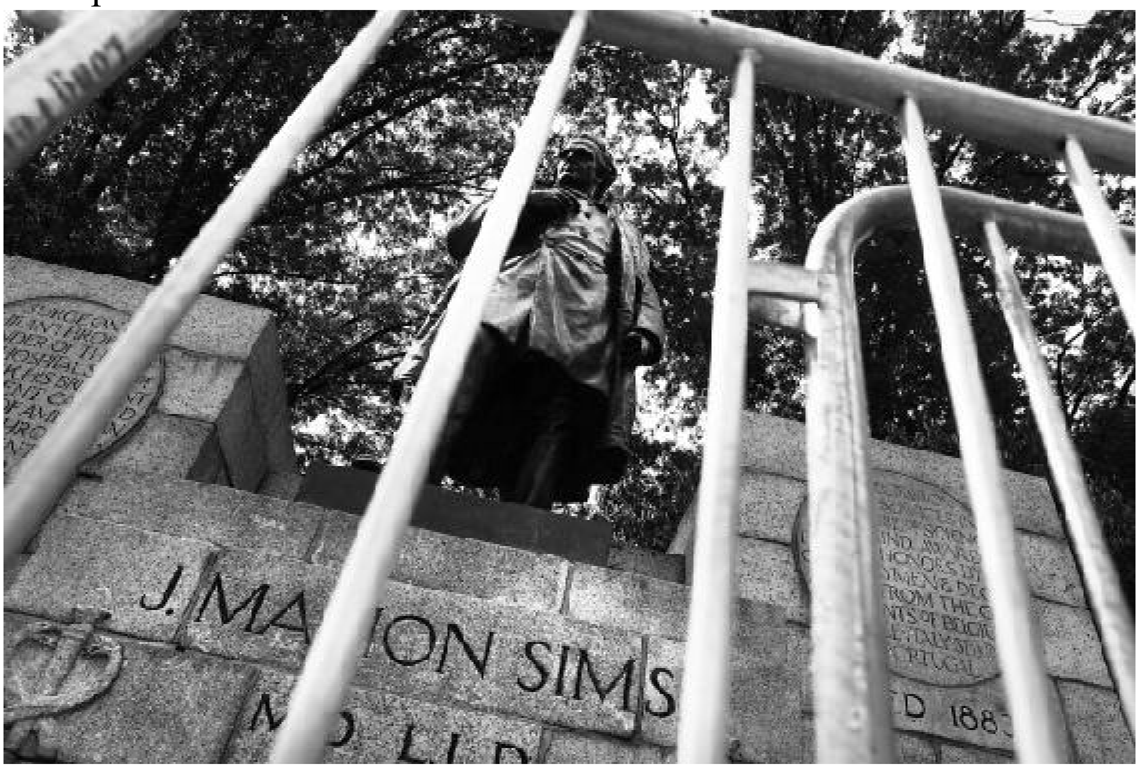
Removing statues of historical figures risks whitewashing history

Science must acknowledge mistakes as it marks its past.

04 September 2017



Spencer Platt/Getty

The New York City statue of gynaeocologist J. Marion Sims has drawn protests.

The statues of explorer Christopher Columbus and gynaecologist J. Marion Sims stand at nearly opposite corners of New York City's Central Park, but for how much longer? Both monuments have been dragged into a nationwide debate about memorials to historical figures who have questionable records on human rights. The arguments are long-standing, but were thrown onto the world's front pages last month when protests against the removal of a statue of Confederate General Robert E. Lee in Charlottesville, Virginia, produced racially charged violence.

Last week, the Central Park Sims statue — one of many that stand in numerous US cities — was vandalized. The word 'racist' was spray-painted alongside his list of achievements, which include life-saving techniques he developed to help women recover from traumatic births. Yet many protest about the lionization of this 'father of modern gynaecology' because he performed his experiments on female slaves.

Sims is not the only scientist whose long-dead head is on the block and whose achievements, and the circumstances around them, are being revisited from the twenty-first century. Institutions in the United States have struggled with the case of Thomas Parran, the US surgeon general who oversaw the infamous Tuskegee study that ran between 1932 and 1972. The researchers enrolled hundreds of African American men who had syphilis, but did not inform them that they had the infection and withheld treatment in an effort to monitor how the disease progressed.

A similar study on Parran's watch happened between 1946 and 1948 in Guatemala, when more than 1,300 people were intentionally infected with diseases including syphilis. The study was not made public until historian Susan Reverby stumbled across research records in 2005. Both studies were performed surreptitiously, as though their perpetrators suspected that what they were doing could be perceived as immoral. The US government has formally apologized for the way in which both studies were conducted.

In 2013, after lengthy debate, the American Sexually Transmitted Diseases Association voted to rename its prestigious Thomas Parran award. "Many [members] were concerned that continuing to offer the Parran award may give the appearance of tacit approval of unethical research," the society said in a statement. The University of Pittsburgh in Pennsylvania is similarly debating whether to rename its Parran Hall (Parran worked at the university after his stint as surgeon general).

Defenders of controversial historical figures argue that they should be judged by their achievements rather than by modern norms. Sims was far from the only doctor experimenting on slaves in 1849, despite the fact that the abolitionist movement was well under way in the United States. And his achievements saved the lives of black and white women alike. But some historians argue that his experiments could have been considered unethical even for his time.

Europe has struggled with these issues for even longer than the United States. After some debate, Oriel College at Britain's University of Oxford last year decided to keep a controversial statue of Cecil Rhodes, the nineteenth-century businessman and committed imperialist.

After the Second World War, cities and institutions were left with streets, buildings, statues and other memorials that were named after people who collaborated with the Nazis or were at least sympathetic to the regime. And in Canada earlier this month, Montreal decided to rename streets and parks named after French Nobel laureate Alexis Carrel, who supported enforced sterilization and eugenics. Other cities in France have already wiped his name from their maps.

Erasing names, however, runs the risk of whitewashing history. Germany's Max Planck Society — formerly the Kaiser Wilhelm Society — deserves credit for its public acknowledgement that many prominent members worked with the Nazi regime and that the society did not help to protect Jewish scientists.

Instead of removing painful reminders, perhaps these should be supplemented. Such notes are also standard in biomedical literature. The American Medical Association recommends that if unethically acquired data are essential to science, any use or citation of these data should describe the unethical behaviour and pay respect to the victims of the experimentation.

Institutions and cities could do something similar by installing a plaque noting the controversy, or an equally sized monument commemorating the victims. Such a historical marker stands for Carrie Buck, a young woman who was the first person to be sterilized under a 1924 eugenics programme in the United States, which was designed to eliminate 'genetically inferior' people with mental and physical disabilities. It stands in Charlottesville just a few blocks — but a million miles away — from the disputed statue of General Lee.

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Massive Ebola data site planned to combat outbreaks

An international partnership seeks African leadership to organize information about the disease.

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John Moore/Getty

An Ebola awareness mural in Monrovia, Liberia — one of the three West African countries that was hit by a devastating outbreak of the disease starting in 2014.

More than 11,000 people died when Ebola tore through West Africa between 2014 and 2016, and yet clinicians still lack data that would enable them to reliably identify the disease when a person first walks into a clinic. To fill that gap and others before the next outbreak hits, researchers are developing a platform to organize and share Ebola data that have so far been scattered beyond reach.

The information system is coordinated by the Infectious Diseases Data Observatory (IDDO), an international research network based at the University of Oxford, UK, and is expected to launch by the end of the year. At a meeting to discuss Ebola on 7–9 September in Conakry, Guinea, the team heading the platform will seek input from West African scientists, health officials and advocacy groups.

“We are looking for West African leadership in this initiative,” says Laura Merson, associate director of the IDDO.

Local leaders

Africans must be involved in the platform’s creation so that they can not only use the existing data, but also improve their capacity to conduct research during future outbreaks, says John Amuasi, an infectious-diseases researcher at the Kumasi Centre for Collaborative Research in Tropical Medicine in Ghana and a member of the platform’s steering committee. A true partnership would also lessen the general public’s mistrust of scientists, he adds.

During the outbreak, for example, a widespread rumour claimed that the plague was an experiment conducted by the West, which led some people to resist going to clinics and helped Ebola to spread.

Merson and her collaborators want to avoid the kind of data fragmentation that hindered efforts to stop the outbreak in Liberia, Guinea and Sierra Leone. As the Ebola crisis was escalating in October 2014, she visited treatment units in the three countries to advise on research. Merson found tremendous variation in practices, which complicated attempts to merge and analyse the information. For instance, some record books listed lethargy and hiccups as symptoms, whereas others recorded fatigue but not hiccups.

“People were just collecting what they could,” she recalls. Non-governmental organizations “were keeping their data private; academics take a year to get it out; and West Africa had set up surveillance but they were siloed from the international systems”, she says.

Questions of control

In July 2015, the IDDO received pilot funds from the UK charity the Wellcome Trust to pool anonymized data from the medical records of people who contracted Ebola — and those who survived it — as well as data from clinical trials and public health projects during outbreaks in West Africa, Uganda and the Democratic Republic of Congo. The hope is that a researcher could search for data to help in diagnosing, treating and understanding the disease. The platform would also provide a home for new data as they emerge. A draft research agenda lists questions that the information might answer, such as how long the virus can survive outside the human body, and what factors are associated with psychological issues in those who survive Ebola.

One sensitive issue is deciding who will control the data. Amuasi says that he would have liked the database to be hosted and curated in Africa, rather than in Oxford, because training and paying African researchers to manage the platform would teach them how to use the information and improve their ability to respond to future outbreaks in the region. But he adds that this seems unlikely, because it would raise the cost of the project, and the infrastructure already exists at Oxford.

Merson says that a copy of the database will be maintained in West Africa, although its exact location has yet to be determined. She adds that an African committee may be in charge of deciding who gets access to the data. And she says that fellowships are likely to be made available for West African students who want to work on the database.

It’s vital that these discussions happen now, in a period of relative calm, says

Jeremy Farrar, director of the Wellcome Trust in London. When the virus emerges again, clinicians, scientists, and regulatory boards will need fast access to data so as not to repeat mistakes made last time. “We need to sit down and make sure we have a data platform in place so that we can respond to a new case of Ebola in hours and days, and not in months and years,” he says. “A great danger is that the world will move on and forget the horror of Ebola in West Africa.”

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Trump finally nominates new leader for NASA

James Bridenstine, a member of Congress, has long pushed for the United States to return to the Moon.

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1. 02 September 2017

James Bridenstine, a Republican member of the US Congress from Oklahoma, has been tapped to be the next head of NASA. Bridenstine is a strong supporter of lunar exploration and commercial space flight.

If confirmed by the Senate, he will take the reins of an agency that is building a new heavy-lift rocket to fly astronauts to an as-yet-undecided destination. Bridenstine has repeatedly argued that the United States should return to the Moon — to, among other things, mine water ice to fuel a fleet of satellites with lunar hydrogen and oxygen.

“From the discovery of water ice on the Moon until this day, the American objective should have been a permanent outpost of rovers and machines at the poles with occasional manned missions for science and maintenance,” Bridenstine told a lunar-exploration group last November. “This is our Sputnik moment.”

Bridenstine has also pushed to accelerate the government’s use of commercial space services. “The US government understands that in the future, and even today, it will be a customer of routine space services, not a provider of routine space services,” he said in the November speech. NASA currently pays for private companies to fly agency cargo to the International Space Station; US astronauts will fly aboard commercial rockets no earlier than next year.

“Representative Bridenstine is certainly a “different” choice for NASA administrator, but to me the difference is mainly positive,” says John Logsdon, who specializes in space policy at George Washington University in Washington DC. “He has been refining his ideas with diverse audiences over the past months, and would bring to the NASA position a clearer and better-defined strategy for moving ahead than did most of his predecessors as they began their tenure.”

Space credentials

After studying economics, business and psychology at Rice University in Houston, Texas, Bridenstine served as a pilot in the US Navy. He flew combat missions in Iraq and Afghanistan, and in anti-drug operations in Central and South America. He also worked as executive director for an aerospace museum in Tulsa, Oklahoma. Since he was first elected to Congress in 2012, Bridenstine has slowly built up his space-policy credentials, serving on the House of Representatives’ science, space and technology committee and speaking in front of groups such as the US Federal Aviation Administration’s space-transportation conference.

In 2016, Bridenstine introduced legislation in the House that would require NASA to make Mars its “main human spaceflight priority” — presumably after first establishing a Moon base — and bolster the already-growing role of commercial space flight. The legislation stalled at the subcommittee level.

Bridenstine has expressed scepticism about climate change. In a June 2013 speech on the House floor, he disparaged the role of humans in global warming and criticized then-President Barack Obama for spending more money on climate research than on weather forecasting. Bridenstine has argued to exclude greenhouse gases from federal regulation, and to expand oil and gas exploration on federal lands and offshore.

Major challenges facing the next NASA administrator include keeping the development of the Space Launch System heavy-lift rocket and its accompanying Orion crew capsule on track. The first flight of the paired system is meant to be in November 2018 but will probably be delayed, an

April report from the US Government Accountability Office found.

“We hope the new administrator embraces NASA’s strong commitment to science and public engagement,” says Heidi Hammel, executive vice-president of the Association of Universities for Research in Astronomy (AURA) in Washington DC. “AURA looks forward to working with the new NASA administrator to ensure that the agency maintains a robust science portfolio.”

Bridenstine would replace Charles Bolden, a former astronaut who flew four times aboard the space shuttle.

In June, the administration of President Donald Trump re-established the National Space Council, an on-again, off-again entity meant to coordinate space activities between various government departments, including civilian and military agencies. Vice-President Mike Pence is chair of the council.

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Updates

Updated:

This piece has been updated with comments from John Logsdon and Heidi Hammel.

Comments

Commenting is currently unavailable.

Nature videos help to calm inmates in solitary confinement

Controversial experiment ignites debate over whether scientific work could be used to justify harsh prison tactics.

01 September 2017

Benj Drummond

An inmate watches nature videos in a designated room at Snake River Correctional Institution in Oregon.

A little bit of nature can calm even the most stressed populations of people, according to a study conducted on prisoners in solitary confinement.

In the experiment, researchers found that prisoners who watched videos with nature scenes felt less stressed and weren't as violent as those who didn't. The team, led by ecologist Nalini Nadkarni at the University of Utah in Salt Lake City, published their findings on 1 September in *Frontiers in Ecology and the Environment*[1].

Nadkarni first proposed the study in 2010 while visiting a prison that housed criminals who were considered to be the highest security risks. "Six guards in Kevlar vests and full riot gear had to go in and subdue an inmate in a restraining chair," she says. "I thought, wow, if we could just calm them with nature rather than with Kevlar vests and riot gear, that would be really great." But it took Nadkarni years to find a prison that was willing to let her test her hypothesis.

The experiment's results have now convinced some prison officials to offer inmates access to nature videos. However, critics of the study argue that it could be used to justify the continued use of solitary confinement — a practice that some consider too harsh.

Calming influence

Past research has shown that regularly seeing plants — even from a window — can improve hospital patients' and prison inmates' physical and mental health[2]. Nadkarni went further by studying people in solitary confinement, where inmates typically spend 23 hours a day alone in bare-walled cells.

Her team divided inmates at the Snake River Correctional Institution in Ontario, Oregon, into 2 groups of 24. Those in one group could choose to exercise or, up to five times per week, go to a 'blue room' to watch 45-minute-long videos showing natural scenes such as mountains, forests and oceans. Those in the other group were offered exercise, but no videos.

The researchers and prison staff measured inmates' moods and stress levels, and tracked violent incidents over a year. They found that inmates who had access to videos reported feeling calmer and were involved in 26% fewer violent incidents. The results suggest that nature imagery can help even

society’s most nature-deprived populations, which includes prison inmates, but also residents of nursing homes and inner city areas, says Nadkarni.

The blue room has also helped Snake River to save thousands of dollars in medical costs resulting from altercations and self-harm, says Renee Smith, the institution’s behavioral health systems manager. “We were pretty excited,” she says. The programme is already being replicated in three other states.

Benj Drummond

Nalini Nadkarni interviews a prisoner who participated in the study.

A controversial idea

“It’s certainly a pretty creative naturalistic experiment,” says Lisa Nisbet, a psychologist at Trent University in Peterborough, Canada. “You couldn’t get a much more deprived group of people.”

But she and others caution that it is impossible to know whether exposure to nature had the beneficial effect because no group was shown videos with other content. Without this additional control group, "you can't really draw any definitive conclusions," says Marc Berman, a psychologist at the University of Chicago in Illinois.

The study authors acknowledge this limitation, which they say is due to there being an insufficient number of prison staff to implement the additional control condition. But they say that inmates specifically mentioned the videos' nature content during interviews. One wrote: "The nature project help's [*sic*] me think clearer to know there is so much more beauty in this world then [*sic*] this prison".

Not everyone is embracing the study. Opponents of solitary confinement worry that the paper could provide cover for perpetuating a practice that many consider to be cruel and counterproductive. "I would hate to think that this study will be used to justify keeping solitary confinement prisoners in conditions where they are deprived of opportunities to actually experience nature," says Craig Haney, a psychologist at the University of California, Santa Cruz.

Nadkarni says her collaboration has helped inmates even if it hasn't dramatically reformed the prison system. "As an ecologist, it is not in my power to change the system of mass incarceration," she says. "One thing I can do is think about ways that bring the therapeutic value of nature to people who are incarcerated."

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Comments

Comments

There are currently no comments.

| Section menu | 主菜单 |

Volcanic views, stalking storks and the ephemeral eclipse

August’s sharpest science shots, selected by *Nature*’s photo team.

01 September 2017

Souvenirs of travel

Image Slideshow

1. 

There was plenty to interest the scientifically inclined in the latest National Geographic Travel Photographer of the Year contest. The

Grand Prize winner was this shot of the Colima Volcano in Mexico erupting in December 2015.

Sergio Tapiro Velasco/National Geographic Travel Photographer of the Year

2. 

This picture of Caribbean reef sharks (*Carcharhinus perezii*) was taken with a remote camera in the Gardens of the Queen, a marine protected area near Cuba. This image and the next two earned honourable mentions in the Nature category.

Shane Gross/National Geographic Travel Photographer of the Year

3. 

This picture from the Tamba area of Japan shows fireflies signalling for mates above the stairs leading to a shrine.

Yutaka Takafuji/National Geographic Travel Photographer of the Year

4. 

This shot of Mount Bromo erupting in 2016 in Indonesia was taken from the patio of a local hotel.

Reynold Riksa Dewantara/National Geographic Travel Photographer of the Year

Eclipse excitement

Jasman Mander

North Americans turned into literal lunatics on 21 August, as an eclipse sent thousands of obsessed sky-watchers scrambling to see the Moon block out the Sun. Here, a composite image shows the progression of the eclipse as seen from the Lowell Observatory in Madras, Oregon.

Go northwest!

Dan Goldman/AP/REX/Shutterstock

The Northwest Passage through the Arctic Ocean has become a much-examined signifier of climate change. As ice thins, more ships than ever before are attempting to push through this previously impassable sea route. On 29 July, the icebreaker MSV *Nordica* — pictured here — completed the route earlier in the year than ever before. Just a few weeks later, a reinforced Russian tanker made the journey successfully without an icebreaker escort.

Harvey's toll

Jonathan Bachman/Reuters

Storm Harvey is still bringing death and destruction to the United States, as record rainfall in Texas triggered flooding and evacuations. These people in Houston, Texas, were among many forced to take to the waters to escape.

Stork, stalking

Nicky Classen/Solent News/REX/Shutterstock

This yellow-billed stork (*Mycteria ibis*) began hunting for fish right alongside a photographer’s hide in Kwa-Zulu Natal, South Africa. Nicky Classen was inside the hide earlier this month to capture the shot.

Catching dinner

John Thys/AFP/Getty

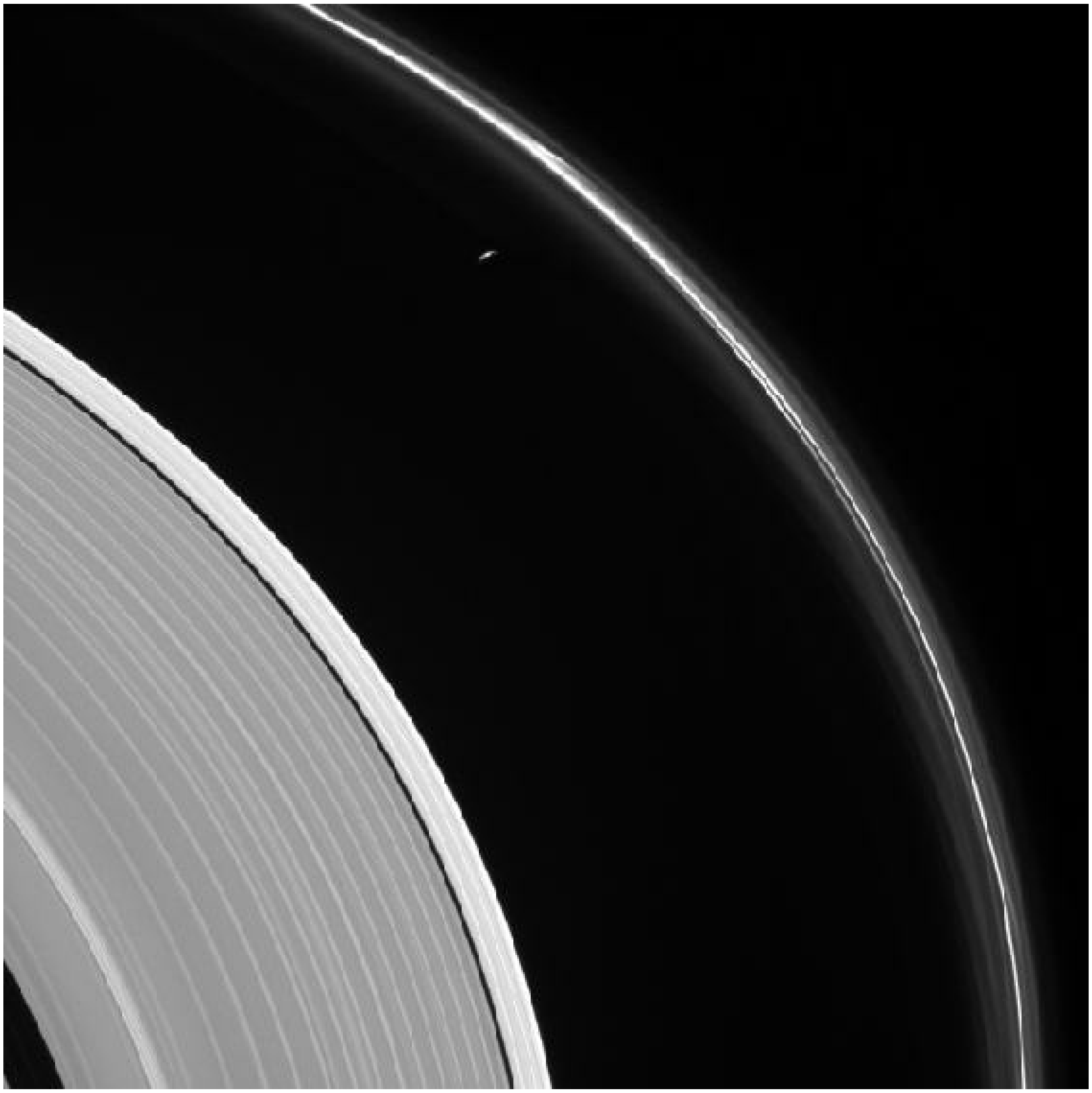
In the Netherlands, lions that were once trained to do tricks in circuses have been taught other skills. This lioness is catching a piece of meat during hunting training.

Do svidaniya!

Joel Kowsky/NASA

On 28 July, a Soyuz rocket shuttled three crew members of Expedition 52 to the International Space Station. The mission plans to test out flexible solar panels that roll out like blankets; explore the physics of neutron stars; and test in rats an experimental drug to deal with bone-mass loss caused by weightlessness.

Cassini’s legacy



NASA/JPL-Caltech/SSI

On 15 September, NASA's Cassini spacecraft will begin a plunge into Saturn's clouds that will lead to its destruction and the end of its 13 years of data collection. *Nature* looks back at some of the pictures the probe has captured, and what they have meant for science.

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Comments

There are currently no comments.

Brain researchers in uproar over NIH clinical-trials policy

An open letter to the US National Institutes of Health says that classifying human-behaviour studies as clinical trials creates unnecessary red tape.

01 September 2017

Scientists studying human behaviour and cognitive brain function are up in arms over a plan by the US National Institutes of Health (NIH) to classify most studies involving human participants as clinical trials.

An open letter posted to an online petition site on 31 August and addressed to NIH director Francis Collins on says that the policy could “unnecessarily increase the administrative burden on investigators”, slowing the pace of discovery in basic research. It asked the NIH to delay implementation of the policy until it has consulted with the behavioural-science and neuroscience communities. The letter has so far garnered more than 2,700 signatures.

“Every scientist I have talked to who is doing basic research on the human mind and brain has been shocked by this policy, which makes no sense,” says Nancy Kanwisher, a cognitive neuroscientist at the Massachusetts Institute of Technology in Cambridge, who co-wrote the letter with four other researchers.

The policy is part of an NIH reform effort started in 2014, which aims to ensure that all clinical results are publicly reported. The policy is scheduled to go into effect in January 2018; it defines a clinical trial as anything involving behavioural ‘interventions’, such as asking participants to perform a memory task or monitor their food intake. Under the policy, such studies would need special evaluation by NIH committees and institutional ethics-review boards. The experiments would also need to be registered in the ClinicalTrials.gov database.

Waiting for clarification

But many researchers think that studies of normal human behaviour — intended to discover phenomena rather than alter them — should not be classified in this way. Among other concerns, small institutions that do not normally perform clinical trials may not have the resources or knowledge to comply fully with the policy.

These concerns are overblown, said Michael Lauer, NIH deputy director for extramural research, at a meeting of the agency's advisory council on 1 September in Bethesda, Maryland. "The only regulation we're talking about is reporting that the trial exists and telling the world about the results. It is as simple as this and as profound as this." He said that his office would work with behavioural scientists to ensure that their studies were getting the proper review and that their research could be registered properly.

But council member Terry Jernigan, a cognitive scientist at the University of California, San Diego, told Lauer that it was "not as simple as that". She said the policy has already caused problems for a study she is leading that tracks normal brain development in adolescents. When her group asked participants' parents to sign the required clinical-trial consent form, some expressed concerns that the form's language indicated that something was being done to their children, rather than that researchers were simply observing them.

In response to some of those concerns, the NIH will update a list of examples of studies that qualify as clinical trials under the policy this week. "The NIH definition of a clinical trial may be broader than other clinical-trial definitions because it reflects NIH's mission, encompassing biomedical and behavioural outcomes as they pertain to human health," said the agency in a statement to *Nature*'s news team. "This definition does not encompass all psychological and cognitive research that is funded by NIH."

Jeremy Wolfe, a vision researcher at Brigham and Women's Hospital in Boston, Massachusetts, says it is encouraging that the NIH plans to work with researchers in his field, but he adds that the details of the policy will be key. "We're worried about whether those details can be worked out by the

January deadline,” he says.

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Comments

Comments

There are currently no comments.

Doubts raised about CRISPR gene-editing study in human embryos

Alternative explanations challenge whether technique actually fixed a genetic mutation as claimed.

31 August 2017

H. Ma et al./Nature

Eight-cell human embryos from an August study that reported success in using CRISPR to remove a deadly mutation.

Doubts have surfaced about a landmark paper claiming that human embryos were cleared of a deadly mutation using genome editing. In an article[1] posted to the bioRxiv preprint server on 28 August, a team of prominent stem-cell scientists and geneticists question whether the mutation was actually fixed.

The 2 August *Nature* paper[2], led by reproductive biologist Shoukhrat Mitalipov at the Oregon Health and Science University in Portland, described experiments in dozens of embryos to correct a mutation that causes a heart condition called hypertrophic cardiomyopathy.

In contrast to previous human-embryo editing studies, Mitalipov's team reported a high success rate at correcting a disease-causing mutation in a gene. The team claimed that the CRISPR–Cas9 genome editing tool was able to replace a mutant version of the *MYBPC3* gene carried by sperm with a normal copy from the egg cell, yielding an embryo with two normal copies. Mitalipov's team also introduced a healthy version of the gene along with the CRISPR machinery, but they found that the corrected embryos had shunned it for the maternal version.

But there is reason to doubt whether this really occurred, reports a team led by Dieter Egli, a stem-cell scientist at Columbia University in New York City, and Maria Jasin, a developmental biologist at Memorial Sloan Kettering Cancer Center in New York City. George Church, a geneticist at Harvard Medical School in Boston, Massachusetts, is another co-author.

In their bioRxiv paper, Egli and Jasin and their co-authors say that there is no plausible biological mechanism to explain how a genetic mutation in sperm could be corrected based on the egg's version of the gene. More likely, they say, Mitalipov's team failed to actually fix the mutation and were misled into thinking they had by using an inadequate genetics assay. Egli and Jasin declined to comment because they say they have submitted their article to *Nature*.

"The critique levelled by Egli *et al*. offers no new results but instead relies on alternative explanations of our results based on pure speculation," Mitalipov said in a statement.

Shared concerns

But other scientists contacted by *Nature*'s news team shared the Egli team's concerns. (*Nature*'s news team is editorially independent of its journal team.) Reproductive biologist Anthony Perry at the University of Bath, UK, says that after fertilization, the genomes of the egg and sperm reside at opposite ends of the egg cell, and each is enshrouded in a membrane for several hours. This fact, Perry says, would make it difficult for CRISPR-Cas9 to fix the sperm's mutation based on the egg's version of the gene, using a process called homologous recombination. "It's very difficult to conceive how recombination can occur between parental genomes across these huge cellular distances," he says.

Egli and Jasin raise that issue in their paper. They suggest that Mitalipov's team was misled into believing that they had corrected the mutation by relying on a genetic assay that was unable to detect a far likelier outcome of the genome-editing experiment: that CRISPR had instead introduced a large deletion in the paternal gene that was not picked up by their genetic assay. The Cas9 enzyme breaks DNA strands, and cells can attempt to repair the damage by haphazardly stitching the genome together, often resulting in missing or extra DNA letters.

That explanation makes sense, says Gaétan Burgio, a geneticist at the Australian National University in Canberra. "In my view Egli *et al*. convincingly provided a series of compelling arguments explaining that the correction of the deleterious mutation by self repair is unlikely to have occurred."

Another possibility Egli's team raise is that the embryos were produced without a genetic contribution from sperm, a process known as parthenogenesis. Mitalipov's team showed that the paternal genome was present in only 2 out of the 6 embryonic stem cell lines they made from gene-edited embryos.

Robin Lovell-Badge, a developmental biologist at the Francis Crick Institute in London, says that it is possible that there is a "novel or unsuspected" biological mechanism at work in the very early human embryo that could explain how Mitalipov's team corrected the embryos' genomes in the manner claimed. He would first like to hear from Mitalipov before passing judgement. "It simply says that we need to know more, not that the work is unimportant," Lovell-Badge says of Egli and Jasin's paper.

In the statement, Mitalipov's said his team stands by their results. "We will respond to their critiques point by point in the form of a formal peer-reviewed response in a matter of weeks."

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Comments

Comments

There are currently no comments.

How labs are coping with Hurricane Harvey's devastating floods

Advance planning has kept some Texas facilities safe during the unprecedented storm.

31 August 2017 Clarified:

1. 01 September 2017

Win McNamee/Getty

Now that the rains have cleared over downtown Houston, the long road to recovery can begin.

Hurricane Harvey swept ashore on 25 August and dumped record-breaking amounts of rain on Houston, Texas, over the next several days. As the storm begins to dissipate, scientists in its wake are starting to take stock of the personal and professional toll.

Many institutions in Houston were relatively well prepared for Harvey, having put precautions in place after suffering major losses when Tropical Storm Allison flooded the city in 2001. Facilities in other parts of the state have not been so lucky, but researchers hit by Harvey — now downgraded to a tropical depression — are not being left to fend for themselves. As of 31 August, roughly 200 scientific laboratories across the country have offered computer time, lab space, animal care and spare rooms to researchers displaced by the storm, using the hashtag #SciHelpTX on Twitter.

When Harvey made landfall as a category 4 hurricane, it hit facilities at the University of Texas at Austin Marine Science Institute in Port Aransas particularly hard, ripping the roof off Brett Baker's microbial-ecology lab. Baker says that one of his graduate students has already arranged to transfer to a lab at the University of California, Berkeley, and a postdoc is heading to Uppsala University in Sweden. "Our institute is on a barrier island," Baker says, and it took a direct hit from the storm. Baker spent some time crying, he adds, but is now so busy with logistics that he hasn't fully processed his feelings.

Lessons learnt

Most of the biomedical-research facilities in Houston, including those at Rice University, MD Anderson Cancer Center and the University of Texas Health Science Center, had installed special doors and floodgates to hold back storm waters after Allison. Those precautions saved equipment and animals, says Anirban Maitra, a pathologist at MD Anderson. "I think they prevented a mega-catastrophe," he adds.

Baylor College of Medicine lost 60,000 breast-cancer specimens in the 2001 storm. But the lessons that it learnt have paid off, says spokesperson Lori Williams. "We built a wall around the entire campus," she says. "We've had

no animals lost, no research lost."

The University of Houston (UH), by contrast, does not have special flood infrastructure. So the institution has been dealing with flooded basement labs, and has struggled to keep animals dry and fed. Forty baby rhesus monkeys had their formula milk rationed, says Amr Elnashai, vice-president for research and technology transfer at UH. A few had to be weaned a week early. Supplies of liquid nitrogen and helium are also running low, endangering frozen samples if they cannot be restocked soon. "If the worst is over, then we are fine," says Elnashai. "If there is another hit, then we are in deep trouble."

Personal costs

Meanwhile, staff at the Johnson Space Center in Houston are camping out at mission control to keep the International Space Station and the James Webb Space Telescope (JWST) programmes going. "I came in for a shift Friday night and I've been here ever since," says flight director Courtenay McMillan. Staff have been sleeping on makeshift beds and air mattresses, and subsisting on provisions provided by co-workers and friends. "We have not run out of coffee, which is the most important thing," McMillan adds.

The JWST was in the middle of a 100-day test in a thermal vacuum chamber when Harvey struck, but is unharmed. And a Soyuz capsule landing scheduled for this weekend in Kazakhstan — which the space centre will help to coordinate — will go ahead with only minor modifications to the plan, says McMillan.

Although many institutions have fared relatively well despite the storm's ferocity, researchers and staff are still dealing with personal losses. Officials estimate that at least 38 people have died as a result of the storm. Maitra says that one administrator on his team has been evacuated to a hotel. "She had to leave in a hurry with her kids in the middle of the night. They were stuck on the third floor of her complex for three days. It is just heartbreaking."

Louise Prockter, director of the Lunar Planetary Institute in Houston, was

travelling when Harvey swept into town. She has been trying to support her staff remotely from Washington DC. “Some of our staff have lost all their property,” she says. “It is a mess. For some people, normal is a long, long way off.”

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Clarifications

Clarified:

Louise Prockter originally stated that a lot of the staff at the Lunar Planetary Institute lost all of their property. She misspoke and says it should be some of the staff that lost all of their property.

Comments

Comments

There are currently no comments.

Artificial warming trial reveals striking sea-floor changes

Researchers deliberately heated up a slice of the Antarctic sea bed to see how ecosystems responded.

31 August 2017

David Doubilet/NGC

Antarctic ecosystems will be affected by warming waters.

The future has come to a small patch of the Antarctic sea floor, courtesy of an experiment that placed electric heating pads on the ocean's bottom. The pioneering trial is one of the most realistic and technically challenging ocean-warming experiments yet performed, researchers say — and it opens up a

new avenue to explore how warming oceans affect marine ecosystems.

In the past 40 years, the surface waters of Earth's oceans have warmed by some 0.4 °C on average as a result of climate change. And if greenhouse-gas emissions continue at their current pace, models forecast that the warming could reach up to 2 °C by 2100.

But researchers know little about how ocean ecosystems will respond and adapt as a result — and uncertainties are largest in polar regions where there are few field data, says study co-author Gail Ashton, a marine ecologist with the Smithsonian Environmental Research Center in Tiburon, California.

That data gap spurred Ashton and her colleagues to carry out the artificial warming experiment in Antarctica. They began in 2014, when scuba divers dug trenches, laid cables and installed 12 panels 15 metres under water on flat sea bed near the Rothera Research Station of the British Antarctic Survey (BAS), which is on a small island off the west coast of the Antarctic Peninsula. Four panels were heated so that they were always 1 °C above the ambient temperature — which in the region varies from around –2 °C to +2 °C during the year — and four were heated to 2 °C above ambient temperature. The remaining four were left unheated, as controls.

Gail Ashton

A team of researchers laid heating pads on the Antarctic sea floor to investigate warming.

Using cameras, the divers then monitored how microorganisms — of the kind that encrust wet surfaces and biofoul underwater pipes — colonized the panels. The species, including microscopic invertebrates and sponges, represented typical sea-bed fauna in the region. The experiment was supposed to run for two years but ended after nine months, when icebergs damaged power-supply cables. Still, researchers saw significant and surprising differences between the panels, says Ashton. “I had hoped we might be able to see some subtle differences after careful image analysis,” she says. “But I would never have expected that the warming effects would be so easily discernible with the human eye.”

Metabolic theory predicts that biological growth rates increase by around 10% for every 1 °C of warming. But some species grew twice as fast on the heated panels as they did on the controls, Ashton and her colleagues report in *Current Biology*[1]. Distinctly different animal communities settled on the heated surfaces. On the 1 °C set, a species called *Fenestrulina rugula* — a kind of filter-feeding invertebrate called a bryozoan — so dominated the fauna that the diversity of all the species on the panel was reduced.

“The results are very exciting and provocative,” says Craig Smith, a marine ecologist at the University of Hawaii at Manoa. “They suggest that climate warming in the next 50 years in Antarctica could substantially alter the unique diversity of Antarctic ecosystems.”

Experimenters have struggled in the past to study the effects of ocean warming in a controlled experiment, in which one area of sea is deliberately and uniformly warmed relative to another over a long period of time. Previous ocean tests have compared coastal areas with nearby regions that receive extra heat from local power plants. And one effort in 2010 used electric panels to heat a small section of water in western Australia, but the animals being studied quickly grew big enough to leave the warmed water layer.

Danger to diversity

Researchers worry that Antarctic species — adapted to cold waters — may suffer as waters warm. The results suggest that species at the bottom of the marine food web are able to cope with one or two degrees of warming, Ashton says, particularly given that it happens over decades. However, species-richness or diversity might be affected, and some species might grow to dominate others. Ashton says she would also like to know what the knock-on effects will be for other creatures.

“We do need more reliable field data to validate and interpret lab experiments on how environmental change affects life in the seas,” says Hans-Otto Pörtner, an ecologist at the Alfred Wegener Institute of Polar and Marine Research in Bremerhaven, Germany. “As yet, we have only a sketchy knowledge of what controls the success of species.”

Others agree that carefully designed controlled-warming experiments such as Ashton’s are the way to go, although Smith says they should ideally be run for longer, with more replications.

One caveat, he cautions, is that the panels warmed only a roughly 2-millimetre-thick layer of water. The rest of the water column — which would have contained larvae and food on which the animals in the experiment depend — remained colder. So the results aren’t a perfect predictor of how sea-floor communities might change, he says.

Furthermore, the results can’t be generalized to suggest what will happen in other seas, says Simon Morley, a marine biologist with the BAS in Cambridge, who took part in the study.

Ashton and Morley plan to do more warming experiments in other polar environments. In September, Morley will look for a suitable test site near the Canadian High Arctic Research Station in Cambridge Bay. He says he will also apply for money to do similar experiments in tropical waters, and perhaps even freshwater environments.

“More of these experiments need to be done to be able to generalize, and

draw wider conclusions," says Boris Worm, an oceanographer at Dalhousie University in Halifax, Canada. "Each is necessary to challenge our simplistic assumptions about how climate change may alter the world we live in."

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Comments

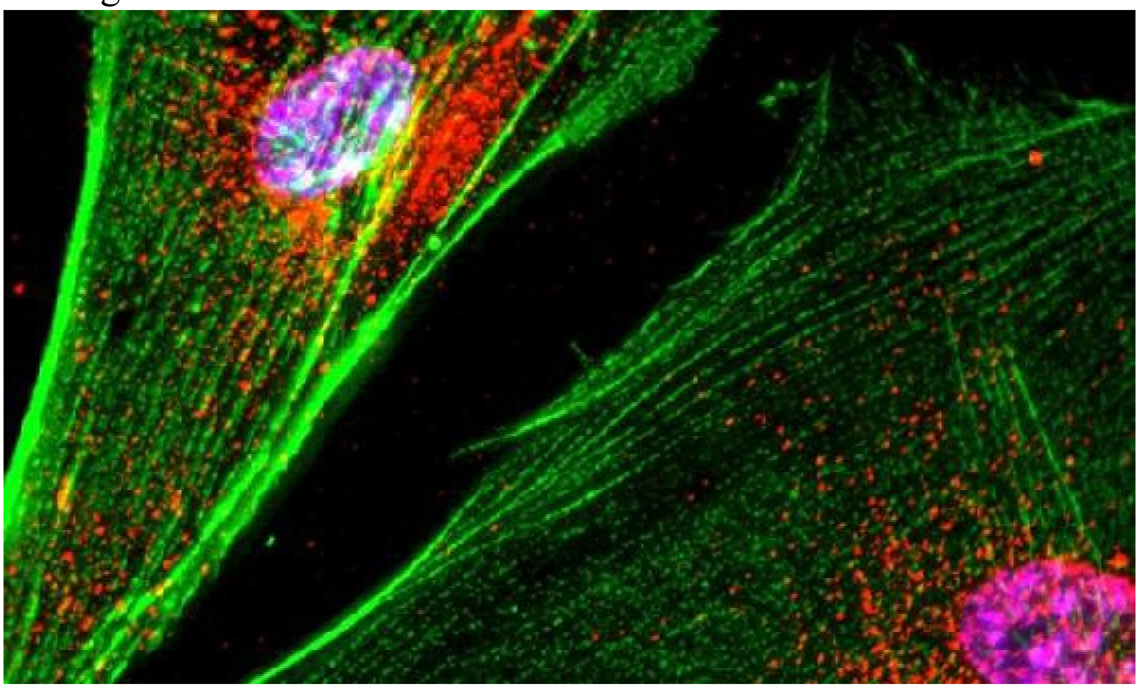
Comments

There are currently no comments.

Reprogrammed cells relieve Parkinson's symptoms in trials

Monkeys implanted with neurons derived from stem cells showed sustained improvement after two years.

30 August 2017



B. Bick, . Poindexter, UT Med. School/SPL

A depletion of brain cells that produce dopamine is responsible for the mobility problems seen in people with Parkinson’s disease.

Japanese researchers report promising results from an experimental therapy for Parkinson’s disease that involves implanting neurons made from ‘reprogrammed’ stem cells into the brain. A trial conducted in monkeys with a version of the disease showed that the treatment improved their symptoms

and seemed to be safe, according to a report published on 30 August in *Nature*[1].

The study's key finding — that the implanted cells survived in the brain for at least two years without causing any dangerous effects in the body — provides a major boost to researchers' hopes of testing stem-cell treatments for Parkinson's in humans, say scientists.

Jun Takahashi, a stem-cell scientist at Kyoto University in Japan who led the study, says that his team plans to begin transplanting neurons made from induced pluripotent stem (iPS) cells into people with Parkinson's in clinical trials soon.

The research is also likely to inform several other groups worldwide that are testing different approaches to treating Parkinson's using stem cells, with trials also slated to begin soon.

Nature breaks down the latest research — and what it means for the future of stem-cell treatments.

Why are stem cells a promising treatment for Parkinson's disease?

Parkinson's is a neurodegenerative condition caused by the death of cells called dopaminergic neurons, which make a neurotransmitter called dopamine in certain areas of the brain. Because dopamine-producing brain cells are involved in movement, people with the condition experience characteristic tremors and stiff muscles. Current treatments address symptoms of the disease but not the underlying cause.

Researchers have pursued the idea that pluripotent stem cells, which can form any cell type in the body, could replace dead dopamine-making neurons in people with Parkinson's, and thus potentially halt or even reverse disease progression. Embryonic stem cells, derived from human embryos, have this capacity, but they have been the subject of ethical debates. Induced pluripotent stem (iPS) cells, which are made by coaxing adult cells into an

embryonic-like state, have the same versatility without the associated ethical concerns.

What did the latest study find?

Takahashi's team transformed iPS cells derived from both healthy people and those with Parkinson's into dopamine-producing neurons. They then transplanted these cells into macaque monkeys with a form of the disease induced by a neuron-killing toxin.

The transplanted brain cells survived for at least two years and formed connections with the monkey's brain cells, potentially explaining why the monkeys treated with cells began moving around their cages more frequently.

Why is the research important?

Crucially, Takahashi's team found no sign that the transplanted cells had developed into tumours — a key concern with treatments that involve pluripotent cells — or that they evoked an immune response that couldn't be controlled with immune-suppressing drugs.

"It's addressing a set of critical issues that need to be investigated before one can, with confidence, move to using the cells in humans," says Anders Bjorklund, a neuroscientist at Lund University in Sweden.

When will clinical trials begin and how will they work?

"I hope we can begin a clinical trial by the end of next year," says Takahashi. Such a trial would be the first iPS cell trial for Parkinson's. In 2014, a Japanese woman in her 70s became the first person to receive cells derived from iPS cells, to treat her macular degeneration.

In theory, iPS cells could be tailor-made for individual patients, which would eliminate the need to use drugs that suppress a possible immune response to foreign tissues.

But customized iPS cells are expensive to make and can take a couple months to derive and grow, Takahashi notes. So his team instead plans to establish iPS cell lines from healthy people and then use immune cell biomarkers to match them to people with Parkinson's in the hope of minimizing the immune response (and therefore the need for drugs to blunt the attack).

In a study described in an accompanying paper in *Nature Communications*[2], Takahashi's team implanted into monkeys iPS-cell-derived neurons from different macaques. They found that transplants between monkeys carrying similar white blood cell markers triggered a muted immune reaction.

What other stem-cell approaches are being tested for Parkinson's?

Earlier this year, Chinese researchers began a Parkinson's trial that used a different approach: giving patients neural-precursor cells made from embryonic stem cells, which are intended to develop into mature dopamine-producing neurons. A year earlier, in a separate trial, patients in Australia received similar cells. But some researchers have expressed concerns that the immature transplanted cells could develop tumour-causing mutations.

Meanwhile, researchers who are part of a Parkinson's stem-cell therapy consortium called GForce-PD, of which Takahashi's team is a member, are set to bring still other approaches to the clinic. Teams in the United States, Sweden and the United Kingdom are all planning trials to transplant dopamine-producing neurons made from embryonic stem cells into humans. Previously established lines of embryonic stem cells have the benefit that they are well studied and can be grown in large quantities, and so all trial participants can receive a standardized treatment, notes Bjorklund, also a consortium member.

Jeanne Loring, a stem-cell scientist at the Scripps Research Institute in La

Jolla, California, favours transplanting iPS-derived neurons made from a patient's own cells. Although expensive, this approach avoids dangerous immunosuppressive drugs, she says. And because iPS cells are established anew for each patient, the lines go through relatively few cell divisions, minimizing the risk that they will develop tumour-causing mutations. Loring hopes to begin her team's trial in 2019. "This shouldn't be a race and we're cheering for success by all," she says.

Lorenz Studer, a stem-cell scientist at the Memorial Sloan Kettering Cancer Center in New York City who is working on a trial that will use neurons made from embryonic stem cells, says that there are still issues to work out, such as the number of cells needed in each transplant procedure. But he says that the latest study is "a sign that we are ready to move forward".

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Comments

Comments

There are currently no comments.

Skeleton plundered from Mexican cave was one of the Americas’ oldest

Rock-encased bone shard left behind by thieves allowed researchers to determine that the remains are probably more than 13,000 years old.

30 August 2017

Nick Poole/Liquid Jungle

A human skeleton — probably one of the Americas' oldest — was stolen from the Chan Hol Cave in Mexico soon after it was discovered in 2012.

A human skeleton that was stolen from an underwater cave in Mexico in 2012 may be one of the oldest ever found in the Americas. Scientists have now put the age of the skeleton at more than 13,000 years old after analysing a shard of hip bone — left behind by the thieves because it was embedded in a stalagmite.

Cave divers discovered the remains in February 2012 in a submerged cave called Chan Hol near Tulúm on Mexico's Yucatán peninsula, and posted photos of a nearly complete skull and other whole bones to social media. The posts caught the attention of archaeologists Arturo González González at the Desert Museum in Saltillo, Mexico, and Jerónimo Avilés Olguín at the Institute of American Prehistory in Cancún.

By the time researchers visited the cave in late March, the remains were gone — except for about 150 bone fragments and a pelvic bone that had been subsumed by a stalagmite growing up from the cave floor. On the basis of these bones, the researchers think that the skeleton belonged to a young man who died when sea levels were much lower and the cave was above ground.

Dating techniques

To determine the age of human remains, researchers often measure levels of a radioactive isotope of carbon in collagen protein within bones. But in this case, most of the collagen had been leached out by water while the bones were submerged, making this method unreliable, says Wolfgang Stinnesbeck, a palaeontologist and geoscientist at the University of Heidelberg, Germany, who led the efforts to date the remains.

Instead, Stinnesbeck’s team collected a fleck of the pelvis bone and surrounding stalagmite, which contains a mineral called calcite. The team then dated the rock using the relative levels of uranium and thorium isotopes in the calcite. The deeper into the stalagmite the researchers sampled, the older the dates turned out to be; stone just 2 centimetres from the bone was 11,300 years old. Calcite closer to the bone gave conflicting results, Stinnesbeck says.

The team determined that the skeleton was older than 13,000 years by analysing the rate at which calcite had formed around the bone, and by matching the shifts in stalagmite isotope levels to those in other caves. The findings were published on 30 August in *PLoS ONE*[1].

Eugenio Acevez Nunez

A diver collects a portion of a cave stalagmite found in cave that contains ancient human bones.

Alistair Pike, an archaeological scientist at the University of Southampton, UK, notes that the stalagmite set over the bone during a time of profound climate change, which could have altered the stalagmite's rate of growth. He says he is therefore more comfortable considering the bones to be a minimum of 11,300 years old — still “very significant”, he notes.

Ancient company

Few other human remains from the Americas are older than 13,000 years. The skeleton of a teenage girl recovered from a different Yucatán cave was carbon-dated to more than 12,000 years old, and a skeleton found in another submerged cave near Tulúm was deemed to be around 13,500 years old, also using radiocarbon dating.

“They’ve done a really nice job determining the age of this thing,” says David Meltzer, an archaeologist at Southern Methodist University in Dallas, Texas. There is convincing archaeological proof that humans colonized the Americas before 14,000 years ago, but very old remains are precious. “These sites are rare as hen’s teeth,” Meltzer says.

Apart from the Yucatán finds, the next-oldest skeleton from the Americas is that of a 12,600-year-old boy found in Montana, whose sequenced genome places him on a lineage leading to present-day Native American groups. Researchers have sequenced only a few other human skeletons from the Americas that are older than 10,000 years, hindering efforts to unravel the region's ancient population history.

Getting DNA from what remains of the Chan Hol skeleton will be hard. A sample sent to one of the world’s leading ancient-DNA labs, the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, did not contain enough DNA, Stinnesbeck says. He hopes to find DNA in the few teeth not taken by the thieves.

The theft still boggles Stinnesbeck, whose team is continuing to study the cave and its remains. The researchers recently reported the discovery of

fossils in the cave that are of a new species of peccary[2] — a hoofed mammal related to pigs — as well as evidence that the cave's human inhabitants made fires.

“What would you want with a skeleton? Would you take it home?” Stinnesbeck asks. “If they had known it was very old, maybe just to have a souvenir, to have something special.”

“We went to the police and they did some inquiries,” he adds. “They never came up with anything substantial.”

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Comments

Commenting is currently unavailable.

Closure of US coal study marks an alarming precedent

The Trump administration has stepped up its assault on environmental protections by halting a US$1-million study on the health risks of coal mining — casting a pall on academic freedom.

30 August 2017

Saul Loeb/AFP/Getty

US President Donald Trump makes his priorities clear during a rally in West Virginia.

When the US National Academies of Science, Engineering, and Medicine (NASEM) speaks, the government usually listens. Last year, US government

agencies spent US$216 million to commission NASEM expertise on issues from the scientific workforce to military implications of synthetic biology. Most NASEM reports are filled with caveats and make for dry reading. But occasionally, they pull no punches. A memorable 2009 report on the state of forensic science, for instance, concluded that almost every forensic method used in law enforcement is seriously flawed and that their use risks putting innocent people in jail. Given the academies' stature, it's hard for the government to brush off its hired commission when faced with such language.

Such concerns seem to weigh on the US Department of the Interior (DOI), which in 2016 commissioned a $1-million study of the potential health risks of surface coal mining on communities in West Virginia. Some evidence suggests that people who live near surface-mining operations — also known as mountaintop removal — have an unusually high rate of lung cancer and birth defects, which could be attributed to air and water pollution.

Launching the study — now halfway through its two-year term — was itself an achievement, given the political nature of the topic. Although much is known about the risks of coal mining to miners, little research has been done on its health impacts on local communities, not least because of attempts by the coal industry to hinder such work. Mining companies and trade organizations have sued for access to the e-mails of academics researching mountaintop removal, and have fought to keep peer-reviewed studies from being used in court. The National Mining Association questioned the value of the NASEM study when it was announced.

On 18 August, three days before the NASEM committee working on the study was due to meet in a Kentucky mining town, the DOI ordered a stop to the study, with immediate effect. The agency says it is reviewing spending on all projects that cost more than $100,000. "The Trump administration is dedicated to responsibly using taxpayer dollars in a way that advances the department's mission and fulfils the roles mandated by Congress," DOI spokeswoman Heather Swift said in a statement to *Nature*. She did not respond to questions about which other projects are under review.

This is the first time that the administration of President Donald Trump has cancelled a NASEM study that has already started — a move that has rarely

happened in the past, according to the academies.

In its statement about the cancellation, the NASEM said that its investigators “stand ready” to resume as soon as the DOI completes its review. But they’re likely to be waiting a long time. The Trump administration has made no secret of its fondness for the US coal industry, which employs around 76,000 people. (By comparison, around 1.2 million people live in counties where mountaintop removal takes place.) The DOI’s assertion that the decision is a budgetary one is suspect, especially given that the study has already spent a good amount of its budget.

It seems, instead, that the government would rather quash the review than risk it producing results that cast aspersions on the coal industry. This is par for the course for the DOI, whose head, Ryan Zinke, plans to downsize national parks in favour of resource extraction, and which has also suspended meetings with its independent advisory councils on issues concerning public lands.

With the near-daily news about the Trump administration weakening climate and environmental protections, it is easy to become fatigued. Yet the move to pre-empt the prestigious and independent NASEM is particularly concerning. It raises questions about what other studies could be cancelled if the government fears their results. It is another blow for science and for academic freedom.

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Alan Turing's notes, runaway salmon and illegal gold-mining

The week in science 25–31 August 2017.

30 August 2017

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RESEARCH

Science results emerge from US eclipse A total solar eclipse swept across the continental United States on 21 August, delighting skygazers and scientists. The path of totality crossed more than a dozen states, making it one of the most observed eclipses ever (composite image shown). A citizen-science project collected data from more than 55 telescopes to produce a high-resolution movie of the solar corona — the part of the Sun's atmosphere seen during totality. Among the professional scientific studies, a pair of NASA jets that chased the eclipse gathered high-resolution video of the corona, while ground-based expeditions collected information about ionized elements in the solar atmosphere.

Stan Honda/AFP/Getty

Gravitational waves Many of the world's best telescopes were turned to a little-known galaxy called NGC 4993 from 17 August, after an alert about a potential gravitational-wave detection in the region. Rumours abounded that the US-based Laser Interferometer Gravitational-wave Observatory (LIGO), possibly aided for the first time by the Virgo interferometer in Pisa, Italy, had picked up the signature of two neutron stars colliding in the galaxy. NASA's Fermi Gamma-ray Space Telescope detected a burst of γ-rays in roughly the same region of the sky as NGC 4993, which may indicate the aftermath of a neutron-star collision there, but which could instead come from an unrelated event. It would be a historic first for astronomy if telescopes saw signatures of the collision at the same time as interferometers 'heard' the event through vibrations in space-time. See go.nature.com/2w46ja8 for more.

FACILITIES

Big NASA missions NASA should continue its tradition of building

spacecraft for large strategic space-science missions such as the Hubble Space Telescope and the Mars Curiosity rover, says a 24 August panel report from the US National Academies of Sciences, Engineering, and Medicine. Like other agencies, NASA is struggling with a limited budget, and the panel examined whether big missions should remain a part of its portfolio. But the scientific return is worth it, the report found, as long as missions are managed well. Developing a range of cost options for large projects could help the agency to avoid problems such as those plaguing the James Webb Space Telescope, which has run billions of dollars over budget and is currently set to launch in 2018.

PUBLISHING

Preprint sites Six new preprint sites were rolled out on 29 August. The services, which host research papers before formal publication, include paleorXiv for palaeontology and INA-rXiv, a preprint server for Indonesian research. The other sites cover research on nutrition, library sciences, sports and exercise, and mind and contemplative practices. The servers are supported by software developed by the Center for Open Science in Charlottesville, Virginia, which already hosts eight other preprint services.

PEOPLE

Surprise Turing find Documents belonging to mathematician Alan Turing have been unearthed at the University of Manchester, UK, and made available to researchers, the university announced on 25 August. The 148 items include a letter to Turing from British intelligence agency GCHQ and a draft BBC radio programme on artificial intelligence. Discovered in a storeroom filing cabinet in May, the collection does not include much personal correspondence. But it offers a glimpse of the code-breaker's working life between 1949 and his death in 1954 — a period for which archive material is scarce, according to the university library's archivist. Some documents also give insight into his rather forthright personal opinions; his response to an invitation to a US conference in April 1953 was simply: "I would not like the journey, and I detest America."

Science envoy quits An energy researcher at the University of California, Berkeley, resigned from his post as a science envoy for the US Department of State on 21 August, citing US President Donald Trump's "attacks on the core values of the United States". In a resignation letter addressed to Trump, Daniel Kammen criticized the president's equivocal response to violent demonstrations by white supremacists in Charlottesville, Virginia, on 12 August. Kammen also condemned the Trump administration's "destructive" policies on energy and the environment, which he said have affected his work as a science envoy.

ENVIRONMENT

Mind the penguins Chile has blocked plans for an iron mine that would have posed a threat to thousands of penguins. On 21 August, a Chilean government committee announced that Andes Iron, the local firm in charge of the US$2.5-billion project, failed to put into place effective environmental protections to compensate for how mining activities might disturb wildlife. The project aimed to extract millions of tonnes of iron from a site in the northern Coquimbo region of Chile. But the site lies near the 888-hectare National Humboldt Penguin Reserve — a set of islands that are home to one of the world's largest breeding populations of Humboldt penguins (*Spheniscus humboldti*; pictured). The species is listed as 'vulnerable' by the IUCN Red List. Andes Iron says that it will appeal against the decision.

Joel Sartore/NGC

Runaway salmon Thousands of Atlantic salmon have made a break for the Pacific Ocean after fish-farm nets in Washington state's San Juan Islands succumbed to "exceptionally high tides" on 19 August, according to the aquaculture company that owned the fish. The Washington Department of Fish & Wildlife estimates that about 4,000–5,000 fish escaped from the pens, which contain more than 1.3 million kilograms of farmed fish. The incident has raised concern that the Atlantic species could threaten wild fish populations native to the region. Officials are temporarily suspending fishing regulations and encouraging recreational and commercial fishers to capture and sell any Atlantic salmon that they find.

Australia land laws Contentious laws that allow landowners in New South Wales, Australia, to clear native vegetation on their properties came into effect on 25 August. Landowners in the country's most populous state can now remove more of certain types of vegetation, a loosening of the state's previous regulations. The decision has angered scientists and conservationists, who say that the laws put biodiversity and threatened species at risk. But some farmers aren't satisfied either, saying that the

amended rules are still too restrictive.

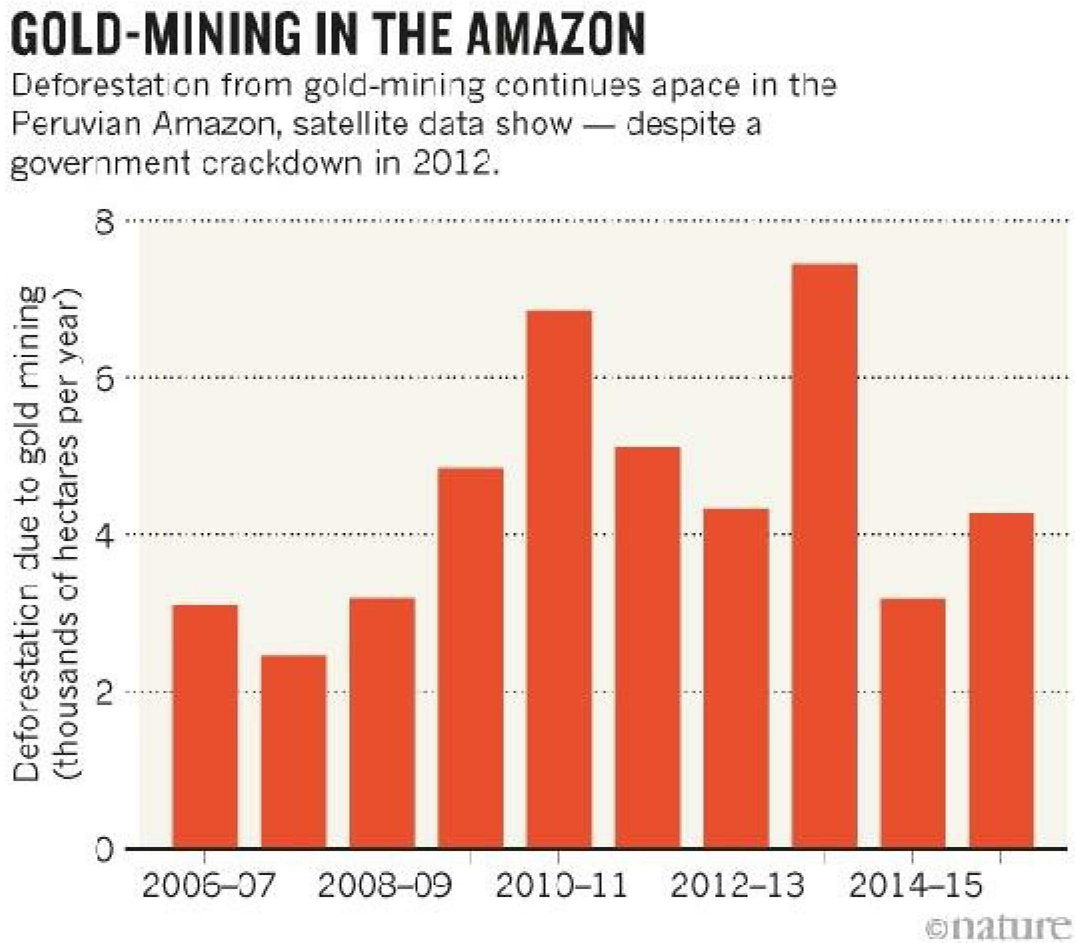
BUSINESS

Quantum quest Australia's first quantum-computing hardware company started up on 23 August. Silicon Quantum Computing is a partnership between government, industry and the University of New South Wales in Sydney. It aims to develop and commercialize a prototype of a 10-quantum-bit circuit made from silicon within five years — a stepping stone towards the creation of a silicon-based quantum computer. The company enters an increasingly crowded marketplace in quantum computing, with competition from technology giants such as Google and Microsoft.

Drug costs cut Millions of people with hepatitis C may soon be able to afford the life-saving antiviral drug sofosbuvir. On 23 August, Gilead Sciences of Foster City, California, which sells the daily pills, said that it would license manufacturers of generic drugs to supply its antivirals in four middle-income countries — Malaysia, Thailand, Belarus and Ukraine. That should slash prices: a 3-month course of the pills ranges from US$84,000 in the United States to $12,000 in Malaysia, but costs as little as $300 in the 101 developing countries where generic versions are already permitted. Pressure had been mounting for the change: the Malaysian government has been considering a licence that would allow generics to be made or used in government facilities, overriding Gilead's patent, and Ukraine has already revoked a key patent on sofosbuvir that shortened Gilead's monopoly.

TREND WATCH

Illegal gold-mining in the Peruvian Amazon is on the rise again, according to a study published on 22 August (G. Asner and R. Tupayachi *Environ. Res. Lett.* **12,** 094004; 2017). Mining-related deforestation abated after a government crackdown in 2012, the authors found in their analysis of land-cover images. But since then, the mined area has increased by more than 40% in the Madre de Dios region, to 68,228 hectares. The region has some of the world's highest levels of animal diversity.



Source: G. P. Asner & R. Tupayachi Environ. Res. Lett. 12, 094004 (2017).

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Cassini’s 13 years of stunning Saturn science — in pictures

As the mission speeds towards its conclusion, *Nature* takes a look at what researchers have learnt about the planet’s moons, rings and tempest-filled skies.

30 August 2017

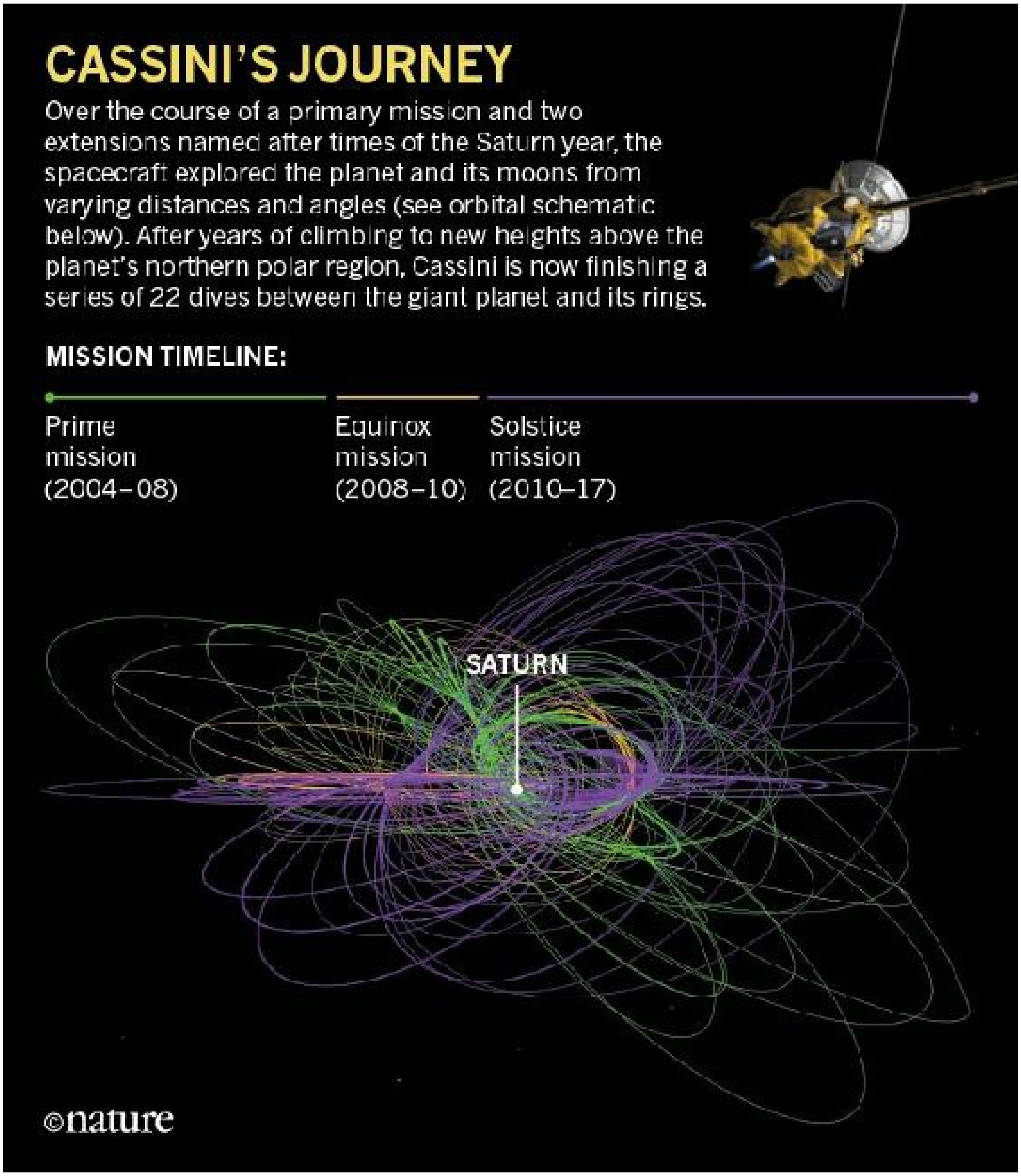
NASA/JPL

In 2004, Cassini became the first spacecraft to orbit Saturn.

Twenty years ago, in the wee hours of a muggy Florida morning, the Cassini spacecraft lit up the skies as it blasted off from Cape Canaveral. Now, after a 3.5-billion-kilometre journey and 13 years spent circling Saturn, the orbiter is running low on fuel. On 15 September, Cassini's controllers on Earth will send the craft plunging into Saturn's cloudtops to prevent it from accidentally

crashing into and contaminating any moon that might be able to harbour life.

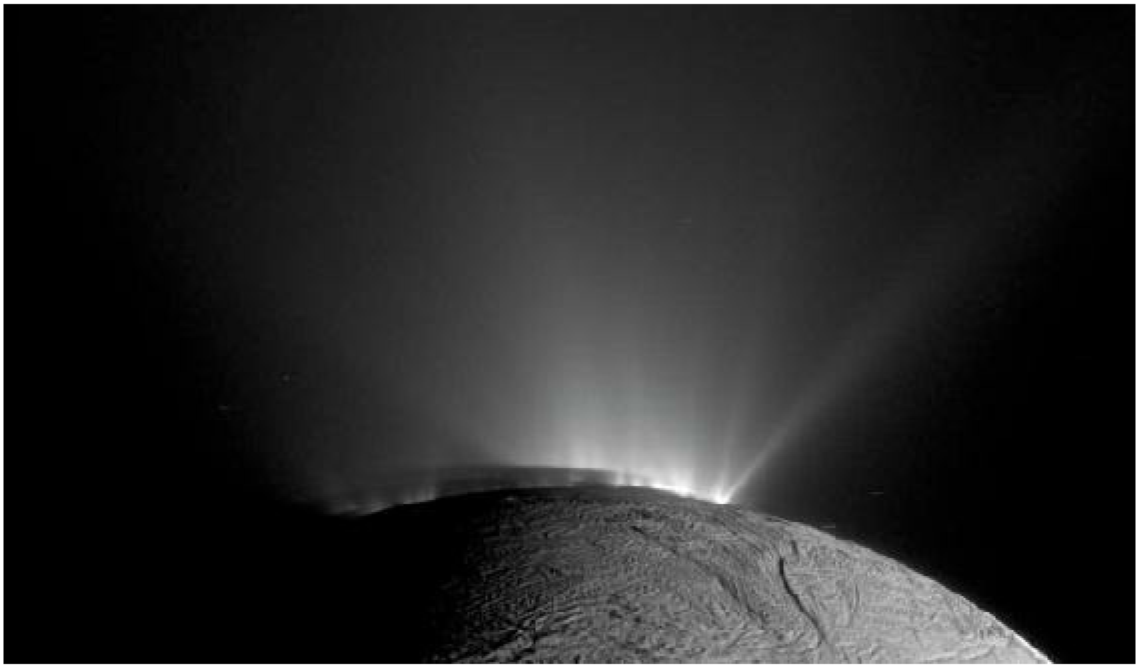
Cassini will send data back to Earth right up until that incandescent coda — a fitting end for one of history's most successful interplanetary missions. A joint venture between NASA, the European Space Agency and the Italian Space Agency, Cassini was the first spacecraft to orbit Saturn. And with much more time to gather science than the earlier fly-bys of Pioneer 11 in 1979, Voyager 1 in 1980 and Voyager 2 in 1981, the mission delivered discoveries in spades, racking up an impressive list of findings as it looped around the majestic planet, danced along its glorious rings and whizzed past many of its bizarre moons. “Cassini was a long wait, but it was definitely worth it,” says Linda Spilker, a planetary scientist at NASA's Jet Propulsion Laboratory in Pasadena, California, and the mission's project scientist. “It has so many incredible accomplishments we can be so proud of.”



Cassini: NASA/JPL; Orbital schematic: NASA/Jet Propulsion Laboratory-Caltech

The spacecraft revealed the chaotic dynamics that shape Saturn's rings, found geysers spraying from the moon Enceladus and watched gigantic storms roil the planet's atmosphere. It observed seasons change for nearly half of a Saturn year, as first the equinox and then the solstice passed, transforming

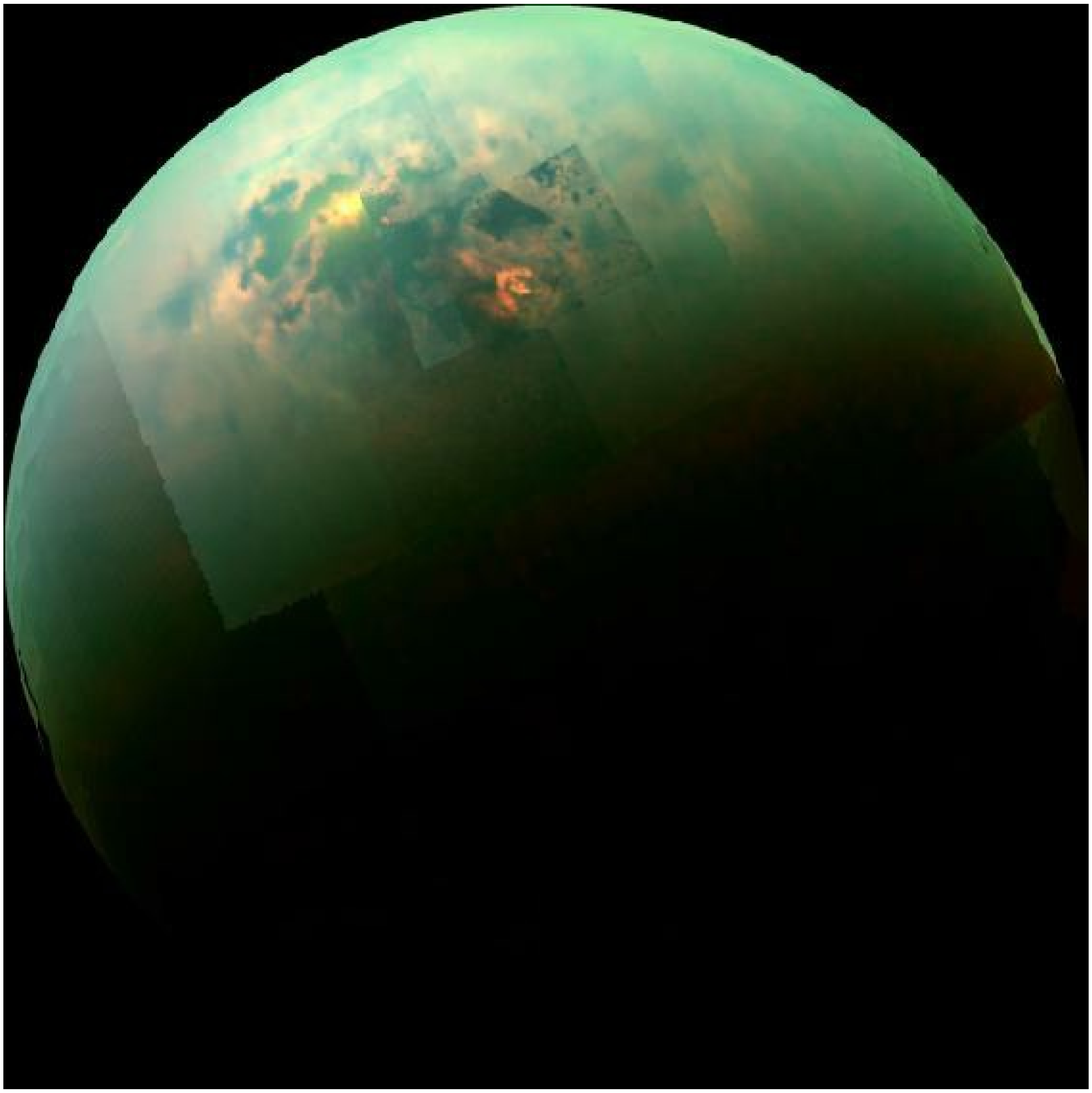
weather patterns. Over the life of Cassini's mission, Saturn has become less of a stranger and revealed itself to be a vibrant system churning with continual change. The spacecraft's observations became a touchstone for understanding the complexity of gas-giant planets, a legacy that NASA's Juno spacecraft is currently continuing at Jupiter.



NASA/JPL-Caltech/Univ. Arizona/Univ. Idaho

Geysers on Enceladus spray water vapour and ice mixed with organic molecules into space.

Cassini also made history when it released the Huygens probe, which became the first craft to touch down in the outer Solar System. After a daring two-and-a-half hour descent to the surface of the moon Titan in 2005, Huygens sent back snapshots of a frozen floodplain littered with rocks. Cassini's mapping later revealed Titan to be a world teeming with hydrocarbon lakes and rivers, replenished by methane and ethane rain.



NASA/JPL-Caltech/Univ. Arizona/Univ. Idaho

Sunlight glints off lakes of liquid hydrocarbons on Titan.

With no official plans to return to Saturn anytime soon, 15 September will mark the end of an era. “On Cassini's final day, we will be watching the signal as we go as deeply into the atmosphere as we can,” says Spilker. “That day to say goodbye will be a tough day.”

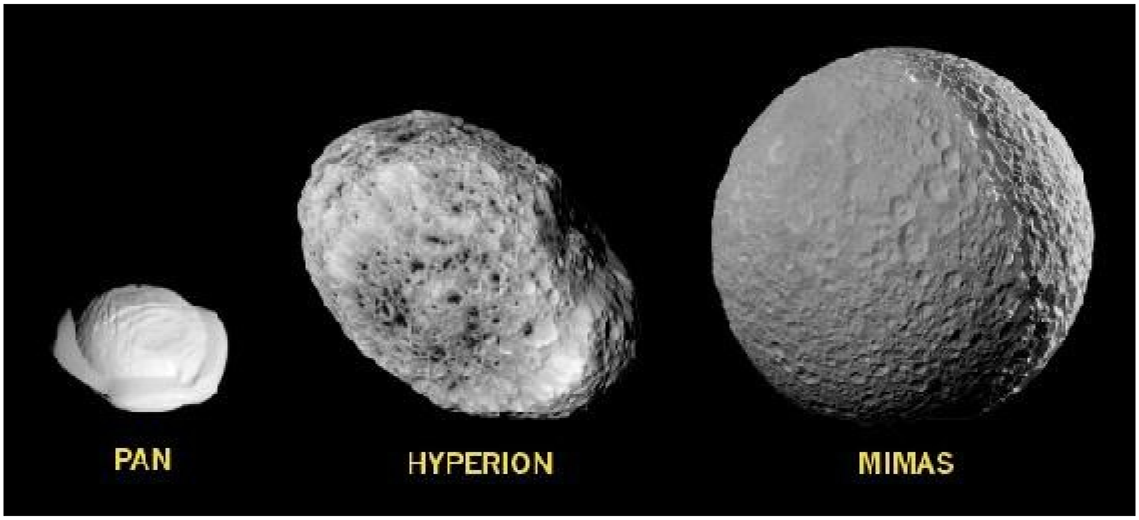
A menagerie of moons

Cassini's biggest surprises came as it studied some of Saturn's 60-plus moons, raising as many questions as it answered.

NASA/JPL/Space Science Institute

Three of Saturn’s moons — Epimetheus, Janus and larger Dione — pass by one another in this set of images captured in 2005.

Researchers finally solved the mystery of Iapetus — which boasts one light-coloured side and one dark side — when they discovered an enormous ring of material streaming off another of Saturn's moons, Phoebe. Iapetus seems to get its two-faced look as its leading surface ploughs through Phoebe's debris. And in their study of how crater-pocked Mimas wobbles on its axis, Cassini scientists realized that the world may have either a buried ocean or a stretched-out core.



NASA/JPL-Caltech/SSI

Saturn’s moons come in a variety of shapes.

A look at the planet's littlest moons — never before seen up close — uncovered a panoply of strange shapes. Hyperion resembles a sponge, and Pan has been compared to a piece of space ravioli. Pandora features an enormous impact crater, a scar from some long-ago collision.

But the most astonishing observations were of Titan and Enceladus. On Titan, Saturn's largest moon, Cassini discovered a world with complex chemistry similar to Earth's before life arose. In the 72 minutes that Huygens survived on Titan's surface, the battery-powered lander snapped images of a landscape strewn with frozen rocks and cloaked in an orange haze. From above, Cassini mapped the moon using radar and other instruments, revealing enormous dunes of water ice coated with a hydrocarbon glaze, which wind for hundreds of kilometres in wavy bands near the equator. Liquid methane and ethane rain down, forming rivers and lakes of hydrocarbons. Cassini captured images of sunlight reflecting off these bodies of liquid — and even used radar to chart their bottoms, sketching out the depths through which a future mission's submersible might glide.

Even after all that, Enceladus stole the show. Thought to be inert before Cassini arrived, the moon actually spews ice and water vapour from enormous fractures that decorate its south-pole region like tiger stripes.

Powered by Saturn's gravitational pull, the geysers spurt out 200 kilograms of salty, organic-laced material every second.

Cassini scientists were surprised to find that this material contains small particles of silica, which may be formed by the interaction of water and rock at hydrothermal vents deep inside Enceladus. On Earth, similar deep-ocean vents are home to microbes that thrive off chemical energy, far from sunlight — and so Enceladus has vaulted to the top of the list of places to search for extraterrestrial microbes. Planetary scientists are already plotting return missions to fly through Enceladus's plumes and sniff for hints of life.

The ever-changing rings

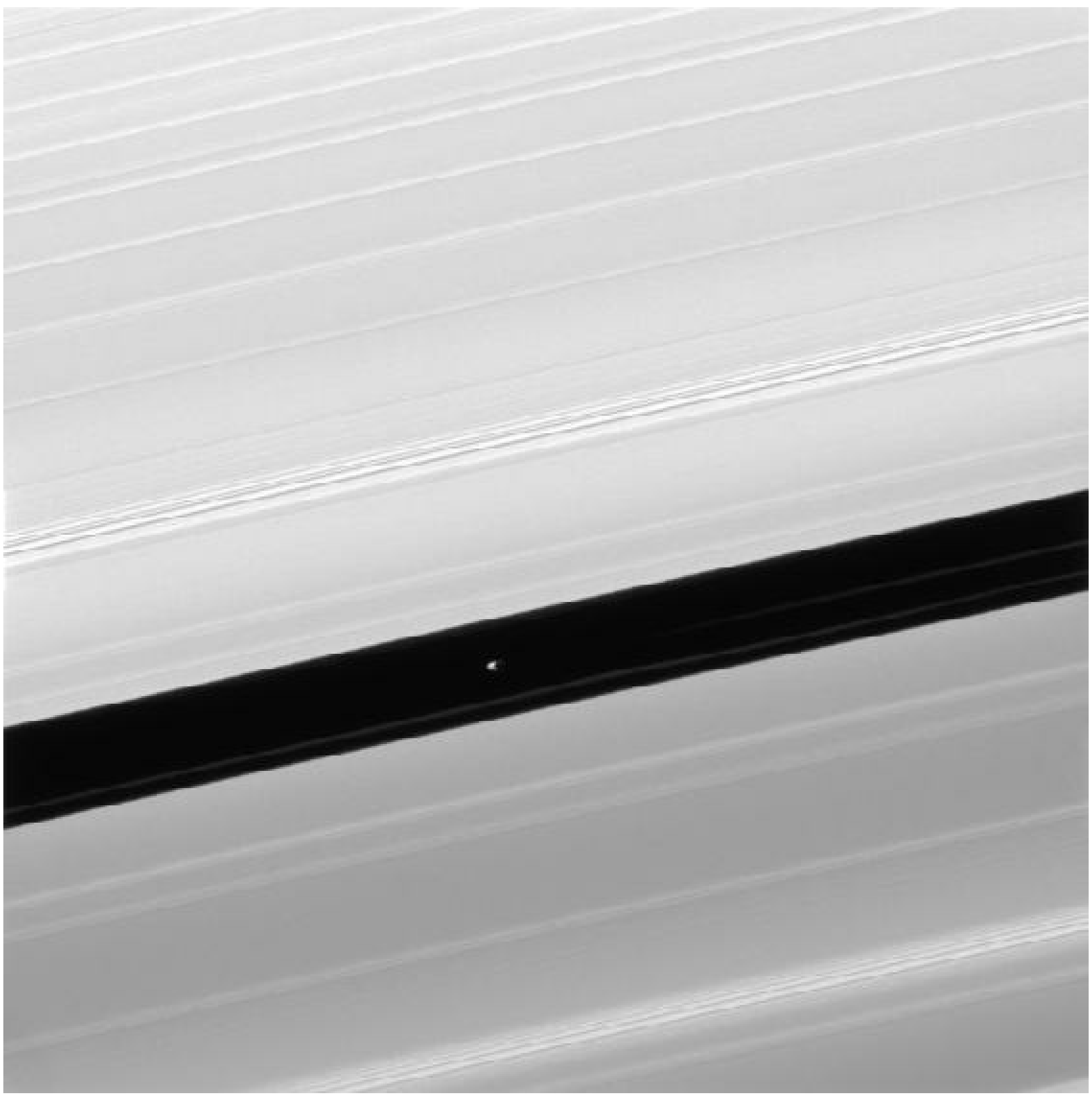
Saturn's rings — the planet's most iconic feature — are populated by billions of icy particles. From afar, the rings appear fixed and perfectly sculpted, but Cassini revealed some of the processes that shape them, and showed how dynamic they truly are. Ring features form, change shape and vanish — sometimes in a matter of hours.

NASA/JPL/SSI

Just 100 metres or so thick, Saturn’s rings are shaped by many moons and moonlets embedded within. In this view, the moon Pandora can be seen

beyond the planet’s main rings.

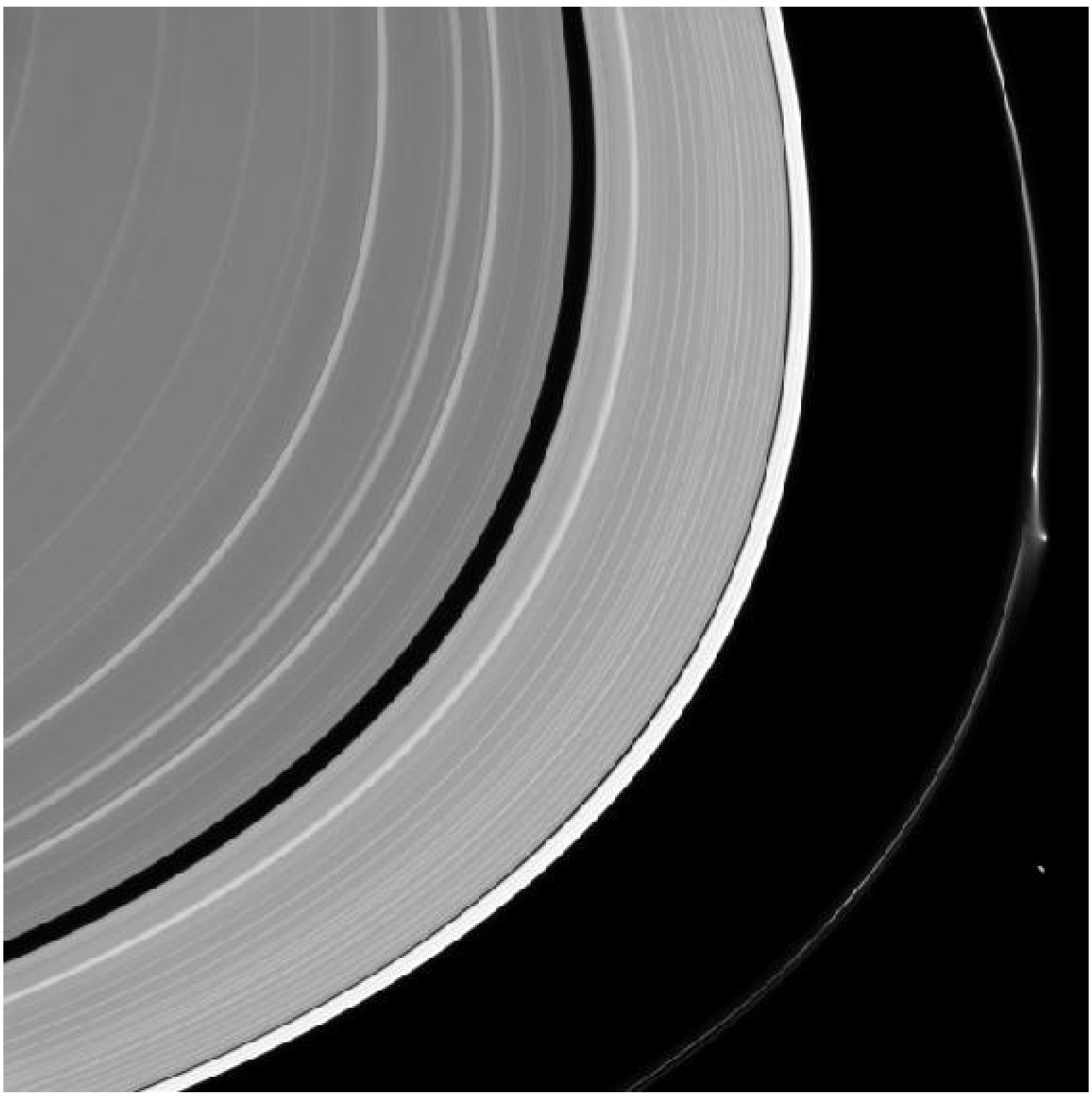
Cassini discovered how the gravitational forces of even the smallest of Saturn's moons can help to shepherd ring particles into beautifully manicured bands. For example, little Pan, just 28 kilometres across, has cleared a wide path through the rings. Dark and bright bands in the rings on either side of this gap reflect the pull of Pan's gravity. Images taken over the years revealed how some of Saturn's moons continuously shape and sculpt its rings — a phenomenon that was not fully apparent until Cassini was able to watch them over time.



NASA/JPL-Caltech/SSI

The moon Pan clears a pathway within the rings known as the Encke Gap.

But the moons are not perfect shepherds. In Saturn's F ring, a narrow band along the outside edge of the main rings, Cassini found ephemeral sprays of material called mini-jets (image, below). The gravitational pull of the nearby moon Prometheus probably causes ice particles in the ring to clump together like snowballs.

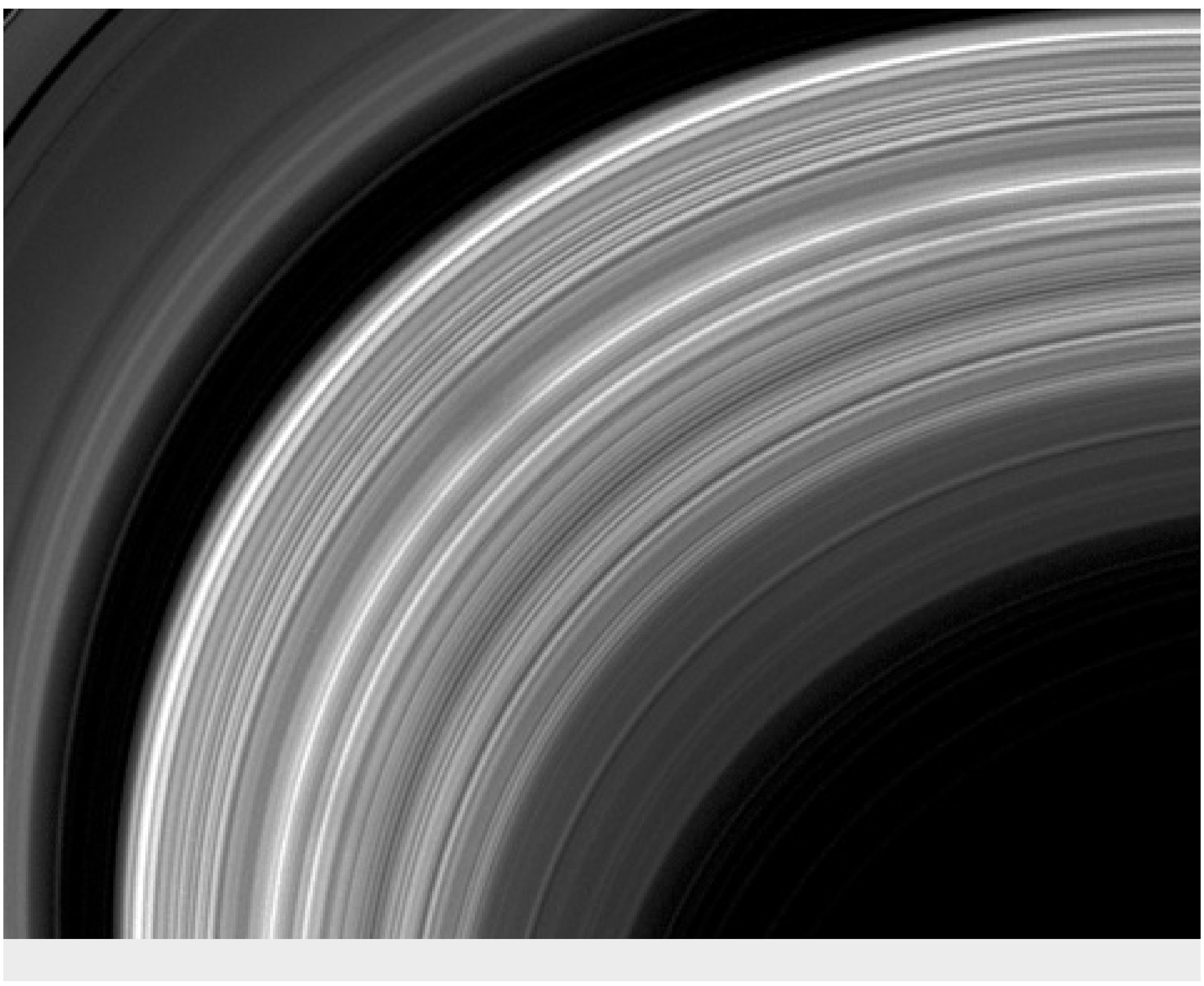


NASA/JPL-Caltech/SSI

At Saturn’s F ring, gravitational disturbances have caused ring particles to clump together and kick out a dusty-looking ‘jet’ of material.

Those bigger objects then punch outwards, trailing particles behind them like a dusty veil that can stretch up to 180 kilometres long, marring the otherwise perfect rings. Out here on the fringes of the ring system, features such as these come and go.

Dramatic changes can also play out on large scales. Around the Saturnian equinox, as sunlight fell at a steep slant across the rings, Cassini observed spoke-like features that rotate with the rings much like the pattern in a bicycle wheel. These spokes, which may be huge stripes of electrostatically charged particles drifting just above and below the rings, can form and disappear over the course of a few hours.



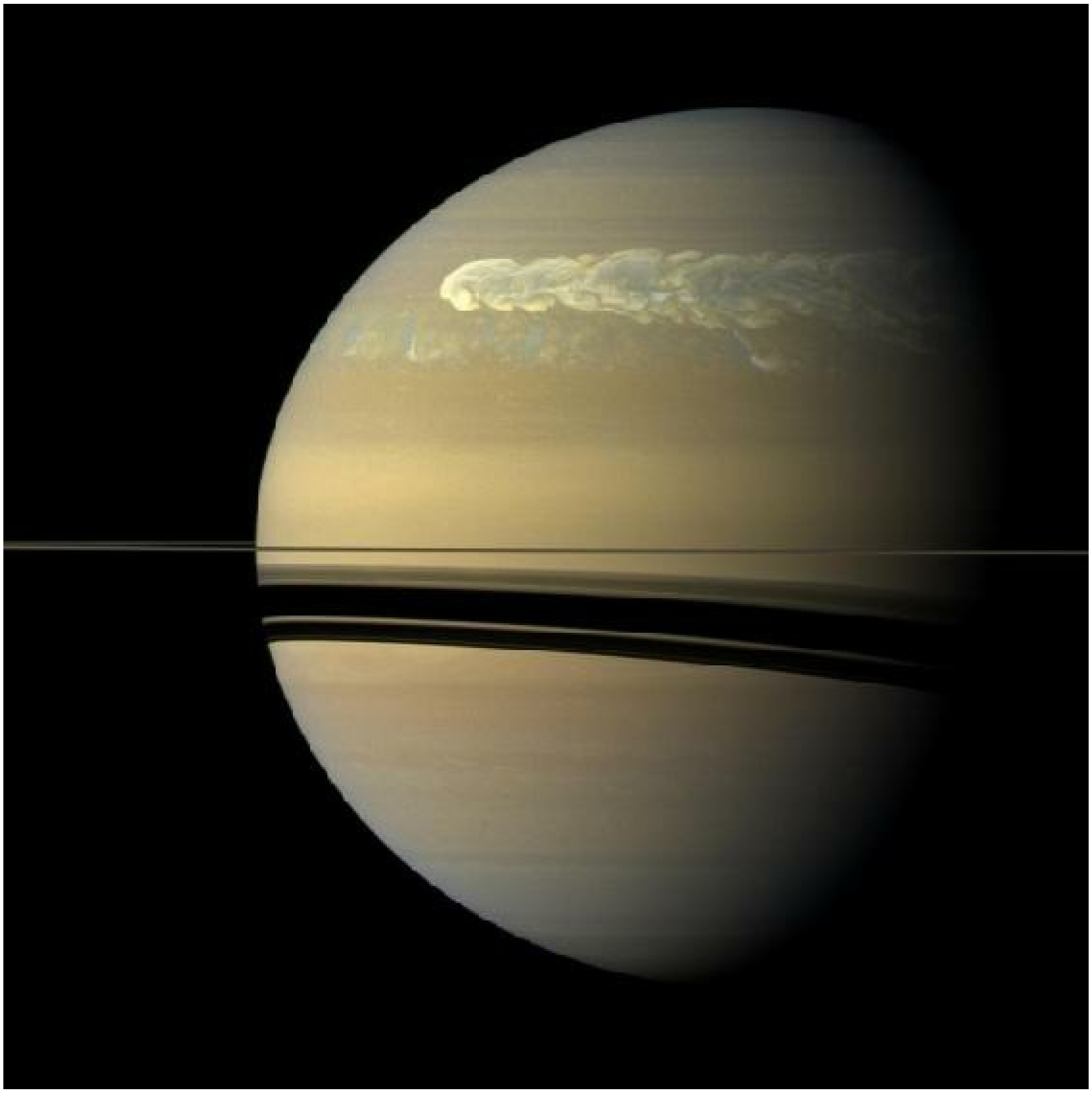
NASA/JPL/Space Science Institute

Spoke-like features that seem to be made of charged particles rotate around the planet.

Depths of the atmosphere

With Saturn's gorgeous ring system distracting the eye, the planet's swirling cloudtop patterns are sometimes underappreciated. Cassini changed that by observing how storms roiled Saturn's atmosphere over the course of many Earth years, providing deep insights into the currents that shape the planet's atmosphere.

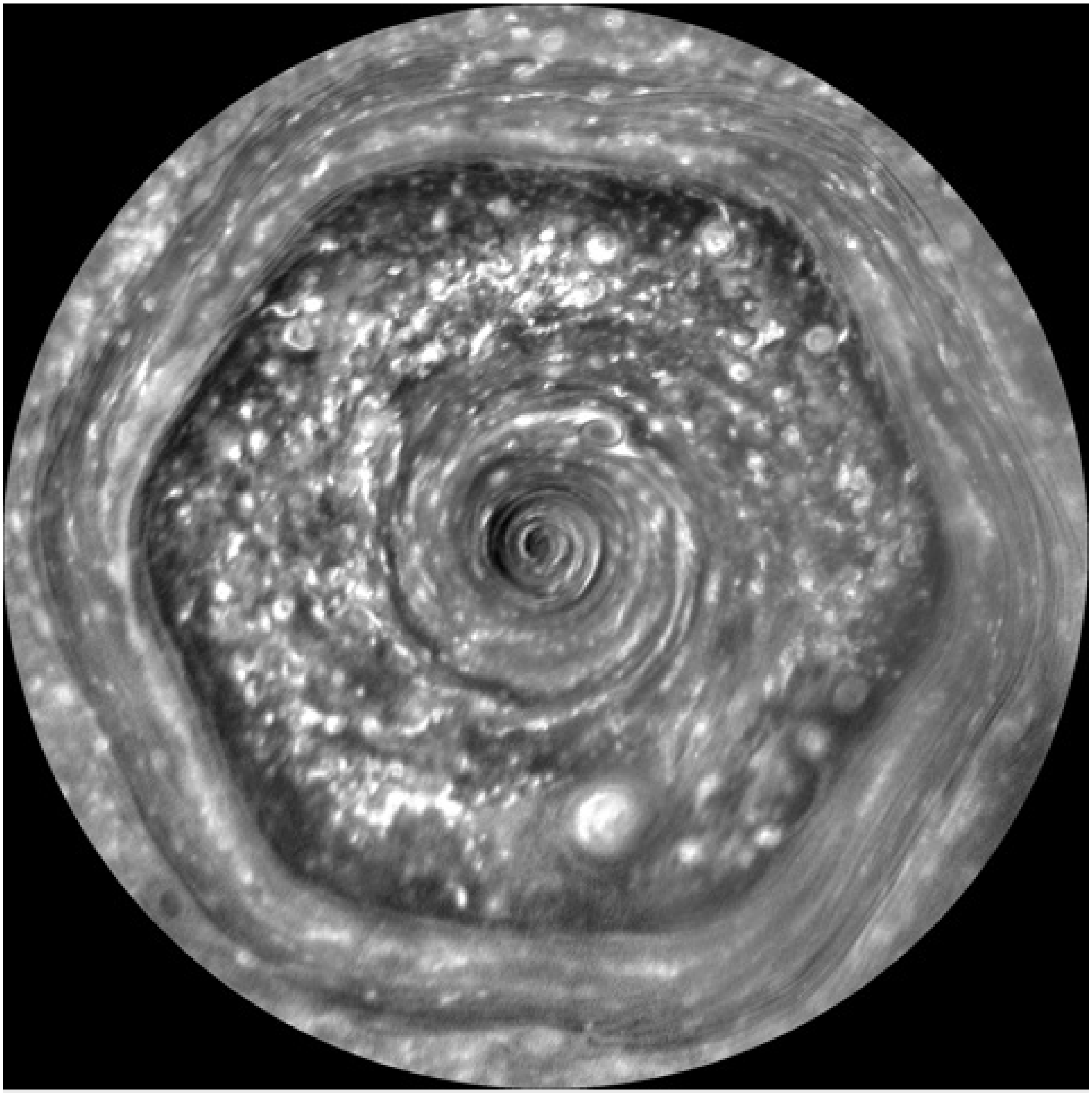
In late 2010, the spacecraft had a front-row seat as a thunderstorm developed into an enormous, swirling white cloud more than 10,000 kilometres across. The storm churned from deep inside the atmosphere all the way to the its upper layers, and in the ensuing months, wrapped entirely around the northern hemisphere until the 'head' of the storm crashed into the tail. Similar storms appear every two to three decades, a rate that is probably controlled by the amount of water vapour in the atmosphere. Other planets in the Solar System, such as Jupiter, have massive storms but do not see such planet-circling giants.



NASA/JPL-Caltech/SSI

Thunderclouds barrelled across Saturn’s northern hemisphere in 2010–11.

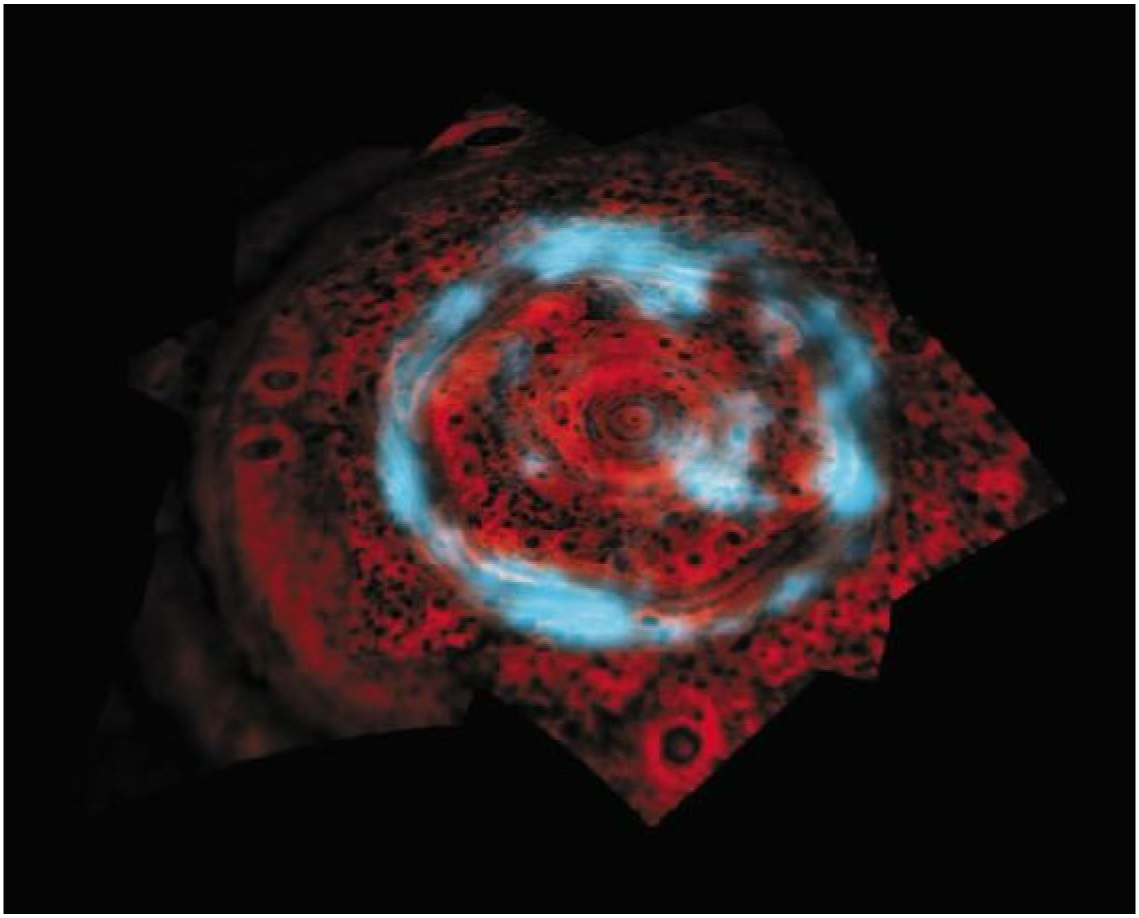
Cassini also probed a unique hexagon-shaped feature, some 30,000 kilometres across, at Saturn's north pole. Confined by winds flowing at more than 300 kilometres an hour, the hexagon is home to smaller hurricane-like vortices that rotate within it. Oddly, Saturn has no such feature at its south pole.



NASA/JPL-Caltech/SSI/Hampton University

A six-sided, jet-stream-like swirl churns around the planet’s north pole.

Even Saturn's interior came into better focus thanks to the mission. The planet has a strong and complex magnetic field, generated by liquid churning deep within it. The bright auroras that glow around Saturn's poles served as guide posts by helping to reveal the patterns and intensity of its polar magnetic fields.



NASA/JPL/University of Arizona

Glowing bands are created at the poles where the solar wind slams into Saturn’s magnetosphere.

Some fundamental mysteries remain. Mission scientists are still working to determine how long a Saturnian day is. Because the planet has no solid surface, researchers cannot track a fixed feature to measure its rotation rate. Instead, they have tried to measure its true spinning speed by observing the planet's powerful rotating radio emissions, which should reflect the movement of the magnetic field stemming from deep within. But Cassini found that these emissions were more intricate than expected, which complicates efforts to use them to understand the rotation rate. More-detailed information about the magnetic field may come during this final phase of the mission, as Cassini loops between the planet and its rings.

Although the mission will come to a close soon, it will leave behind a wealth of information for future studies. “Cassini's treasure of data is 100 times as broad and deep as Voyager's, and it will take decades to get to the bottom of it,” says Jeff Cuzzi, a planetary scientist at NASA's Ames Research Center in Moffett Field, California. “The end of Cassini's active operations may be only the beginning of real advances in our understanding of what it has discovered.”

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Stop blocking postdocs' paths to success

30 August 2017

Lab heads should let junior researchers take their projects with them when they start their own labs — it drives innovation and discovery, argues Ben A. Barres.

Illustration by David Parkins

Postdocs are the engines of scientific progress. Typically poorly paid despite their three to seven years of doctoral training, they might labour in a postdoc lab for another four to nine years before moving to a more independent and remunerative career. What are they owed in return?

One type of postdoc maltreatment is rarely discussed, despite its prevalence and importance — should a postdoc be able to take their research project with them when they set up their own lab? And if so, should that new principal investigator (PI) be free from direct competition on that project with his or her former mentor? In my view, the answer to both questions is yes. Such 'project porting' is crucial for the success of young scientists and should be a fundamental right for postdocs.

This is such a touchy topic that it is only now that I feel comfortable writing about it. I am at the end of a long academic career and dying of stage four pancreatic cancer. I think it's time for the academic community to start openly discussing the issue of research freedom for postdocs (or lack of it).

Opinions will vary, but different strategies could enable PIs and postdocs to handle the issue more constructively. At the very least, trainees looking for a postdoc job need to find out about the policies of potential mentors before selecting a lab, and assess the implications that these policies could have for their independent success.

Who owns what?

Most mentors at the PI level have policies on research ownership. Unfortunately, many postdocs fail to ask what these policies are, either through lack of forethought or because they assume that it will not be an issue. Some mentors, if asked, warn prospective postdocs that they will not be free to take their projects with them to their own labs. (The meaning of 'project' may vary depending on the mentor, from the postdoc's specific research question to the entire subject area of the mentor's lab.) Others permit postdocs to retain their projects on moving, but then directly compete on the same work.

A postdoc is formally free to work on any project in his or her own lab. But those that spurn their advisers' wishes risk losing their support — something that is usually crucial for winning junior investigator awards and other types of funding, or when trying to obtain a promotion, say from assistant to associate professor.

So what is wrong with an adviser asking a postdoc to begin a different project on setting up their own lab?

Doing so assumes that a given topic is owned by the adviser and that the adviser can control who works on it. This is insulting to the postdoc, who in most cases has earned co-ownership by pushing a project forward with ideas and hard work.

Most importantly, when it comes to obtaining a faculty position or funding for a newly independent laboratory, having compelling preliminary data greatly increases the chances of success. Such data are most feasibly obtained from the final stage of a postdoc, or from research in the same area in a new lab. In addition, having to start work in an entirely different area makes it harder to achieve tenure because of the short tenure clock. Over time, the best faculty members will often launch projects in new areas, but this typically happens only after a lab is established.

Another strategy is to allow a postdoc to start a project in their final year that they can then take with them. In my experience, however, postdoc training periods are already so long and it takes so much effort to get papers published that there is rarely time for a postdoc to make headway before starting their own lab.

If a mentor lets a postdoc retain their project but continues to work on the same question, this doesn't solve the problem. In most cases, there is simply no way that a young person starting a lab can compete successfully with their former mentor. Established labs have an endless stream of excellent postdocs; new labs typically get started with graduate students, who take longer to train and to do meaningful experiments.

Competitor clash

I believe that not allowing postdocs to take projects with them, or competing with them when they do, harms science. It is well known among senior investigators that mentors who are ungenerous to their trainees have a lower rate of trainee success, and their area of research suffers as a result. By

contrast, generous mentors soon find that their trainees dominate a given field, and that together they can rapidly move it forward.

For instance, the neurobiology department at Stanford University — where I hold a professorship — has a long tradition of caring about mentorship. All faculty members allow their postdocs to take projects on to their own labs, free from competition. On analysing lists of trainees, I found that nearly 70% of our postdocs over the past 25 years have gone on to run their own academic labs and to achieve tenure. Anecdotal evidence suggests that the US national average is less than 10%. Indeed, in any given field, one can easily think of outstanding scientists who also manage to be generous mentors with no sacrifice to the quality of their science.

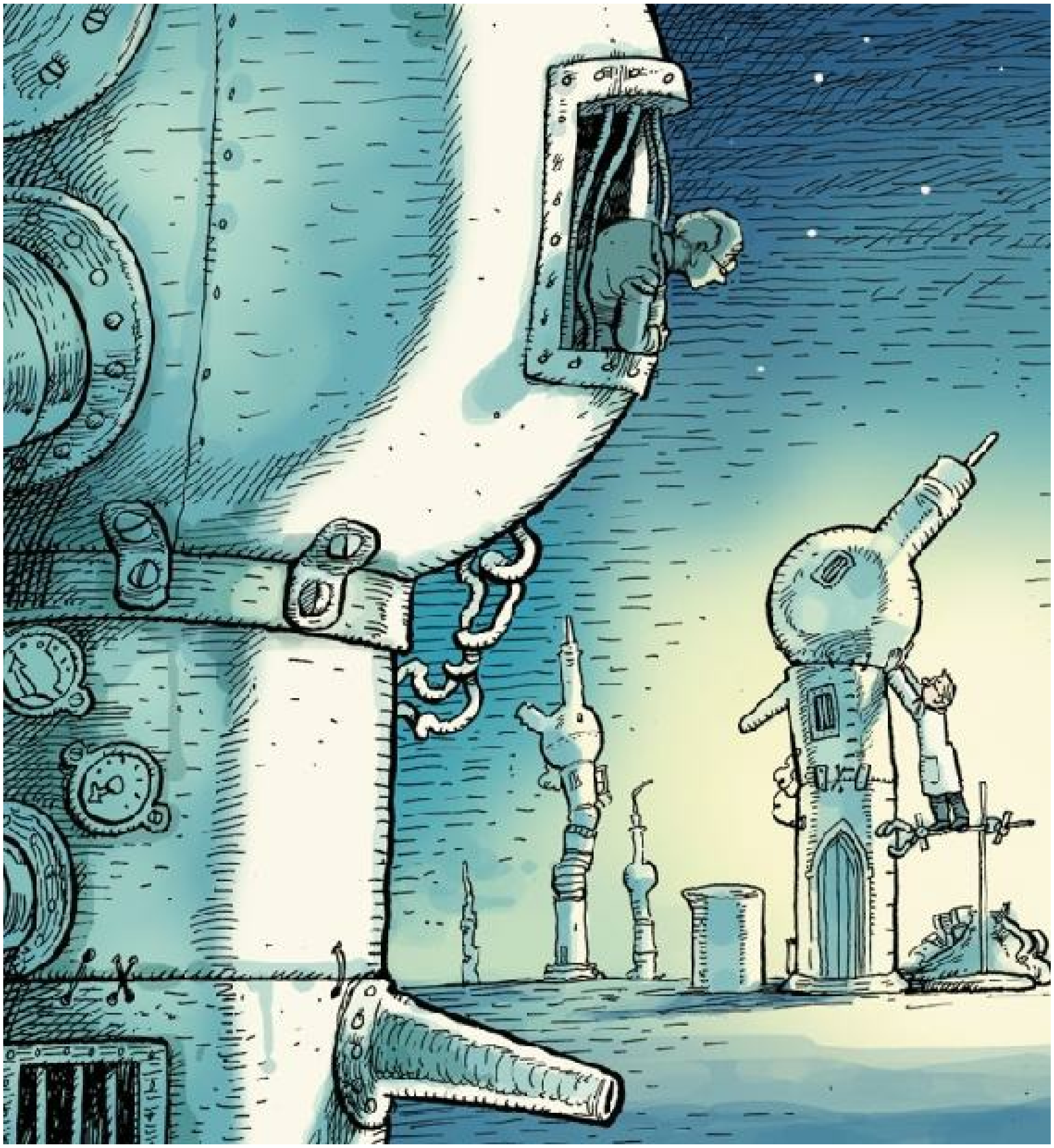

Illustration by David Parkins

If preventing postdocs from porting projects to their own labs is so detrimental to young researchers and to science, why do so many PIs do it? Highly competitive lab leaders wishing to become the best in their field can feel that they are working on a half-eaten pie if they focus on a research question to which others are contributing. They may imagine that their chances of winning a Nobel prize or other prestigious award are lessened if there are too many contributors to a field. Or they can understandably feel

they have invested their entire careers in developing a project area, whereas the postdoc has invested only a few years and relies on building on the PI's previous work.

Some may even be concerned that science could be harmed if PIs stop working on a project that has been taken to another lab by a postdoc. A young PI may be less likely to make advances than an accomplished, well-funded lab would be.

I am not persuaded by any of these arguments. In fact, I think that keeping the whole pie for oneself is sheer gluttony.

I don't believe that science is better off as a completely open competition. Pitting large, established research groups against the nascent labs of young scientists is not fair. And, as in business, monopolies act against the welfare of the whole by preventing innovation. Indeed, in my view, established labs can stifle creativity in their field even as they flourish. Young labs are much more likely to bring new ideas and to question dogmas. Worse, excessively competitive behaviour drives many talented young researchers out of science altogether.

Allowing a postdoc to retain a project does not mean that the PI leaves the field; it just means that they don't assign the obvious next research step to their subsequent postdoc. As a PI myself, I will admit that this approach sometimes seems painful. Discoveries typically result from the years of effort my lab has put into a project and a postdoc's contributions. Often, the immediate next steps are exciting — it is tempting to keep going. Moreover, starting an entirely new project is always challenging, because you first need to obtain sufficient preliminary data to win funding. But with mentorship, there is a time when you must make the welfare of your trainee the highest priority. As with good parenting, I believe that one should give to one's trainees until it hurts to do so.

With every step forward in science, more questions are raised than have been answered. In my case, there is no end of interesting and unexplored avenues about glial cells and their roles in health and disease. In fact, one of my greatest frustrations is that there are questions in my field for which I will not discover the answer during my lifetime. It is a great consolation to know that

I have trained many terrific young scientists, who, in their own labs, will keep exploring these areas long after I am gone.

Good track record

For all of these reasons, graduate students who hope to one day have their own labs need to take great care in selecting their postdoctoral mentor (B. A. Barres *Neuron* **80,** 275–279; 2013). The best mentors serve as strong role models when it comes to doing creative and rigorous science. They are also highly generous people who are willing to give their postdocs academic freedom, the long hours needed to teach them how to design good experiments, and continued support long after their trainees have left, for instance by providing recommendation letters or advice.

Graduate students should investigate the training track records of labs of interest, and discuss these labs with their PhD advisers, programme directors and thesis committee members. All prospective postdocs would be wise to explicitly ask potential mentors (as well as the mentors' previous trainees) what their policies are. In fact, all should be aware that when hiring committees assess an individual postdoc's prospects for future success, they routinely consider whether the applicant is from a lab that allows postdocs to retain projects and, if so, whether that lab is known to directly compete with its former trainees.

Many ungenerous mentors are also highly accomplished scientists. They are often tenured and run successful labs that add stature to their universities and bring in large amounts of funding. So it is not surprising that university leaderships generally overlook poor mentoring. Instead, everyone in biomedical science should strive to reward high-quality mentorship and to protect young scientists.

I think that the topic of research ownership should be included in ethics courses, such as those now mandated by the US National Institutes of Health (NIH) graduate training grants.

Indeed, funding agencies worldwide should do more to ensure postdoc

welfare. In the United States, the NIH's Pathway to Independence (K99) Award is a step in the right direction. Postdocs must formulate specific aims for their own laboratories as part of their funding applications. This prompts them to begin early discussions with their mentors about what they will do on completing their training. Similarly, the K01 Postdoctoral Mentored Career Development Award from the US National Institute of Neurological Disorders and Stroke funds postdocs to work on a project that they can take with them when they start their own labs.

I believe that the major funders of postdoc fellowships, such as the European Molecular Biology Organization and elite funding foundations, should mandate that postdoc fellows be free to take their projects when they move on to their own laboratories. Given that competition for these fellowships is intense, why shouldn't funders and foundations support the postdocs who are most likely to be successful in their own labs?

For graduate students looking to select a postdoctoral mentor, a helpful step would be for the NIH and other funding organizations to make lists of all trainees from training-grant applications available through a public database. These lists would greatly assist prospective postdocs by allowing them to see the training track record of each lab they are considering. In the United States, the National Postdoctoral Association could assume this responsibility (information on funded grant applications is public information that the NIH must disclose on request).

Importantly, grant-review committees should consider training track records during evaluations of applications from established labs. It is encouraging that the Howard Hughes Medical Institute (a non-profit medical-research organization in Chevy Chase, Maryland) has started to put more emphasis on a mentor's training record as one criterion when making decisions about renewing funding. Similarly, I believe that an individual's training track record should be factored in when considering the award of prestigious science prizes. Why should we honour those who don't support science's next generation?

Right now, PIs wishing to take advantage of their postdocs can act with impunity. In this increasingly competitive world, where it is harder than ever for young scientists to get off to a good start in their own laboratories, it is

incumbent upon us as a community to ensure that those to whom we hand the baton are treated equitably.

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Extreme weather events are the new normal

Hurricane Harvey highlights the struggle to apply climate science.

29 August 2017

Brendan Smialowski/AFP/Getty

Flooding from Hurricane Harvey underscores the need for more detailed predictions of climate impacts.

Hurricane Harvey is already being described as one of the ten costliest storms in US history, with the estimated financial damage put at between US$10 billion and $20 billion. Oil- and gas-industry infrastructure lies among the wreckage, and investors are eyeing the impact on the energy and

insurance markets.

Decisions on where to install, build and develop have always been weather dependent. But they are becoming increasingly so. Extreme weather events such as Harvey can be described as ‘unprecedented’ only so many times before companies and governments are forced to accept that such events are the new normal, and to plan accordingly.

Such plans are more difficult and complicated than the simple broad-brush narrative often cited about the need to adapt to global warming. As we explore in a News story this week, scientists cannot yet supply the kind of detailed, quantified information that companies and others require to best plan for changes coming in the next few years to decades.

This is partly a question of resources: the world is a big place, the future infinite and there isn’t enough computing power to go around. It is partly political, with the few late-adopters still offering a false flag around which to rally those who prefer inaction and obstruction. And it’s partly because the field of climate services — as the field of such detailed projections is known — is on the front line of a cultural switch that sees science listen to society’s questions, instead of simply offering answers. It is an imperfect storm, and scientists can’t meet the cost alone.

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Keep on marching for science education

Scientists might have made a difference, had they protested against laws that now threaten what can be taught in our classrooms, argues Brandon Haught[2].

29 August 2017

The new school year is beginning in the United States, and science education in Florida is at risk from laws that passed earlier this summer. It leaves me wondering: where have those who joined April's March for Science gone?

That global action was probably the most popular science-advocacy event of this generation. I took part in Titusville, Florida, and was impressed with the attendance, enthusiasm and creative slogans. In the speeches that followed, I warned against pending legislation that would allow any citizen to demand a hearing to challenge instructional materials. Both critics and advocates see this as a way to stifle teaching about evolution and climate change. We had the summer to make our case.

The science-advocacy group Florida Citizens for Science — for which I volunteer as a board member and communications officer — led the battle to kill, or least modify, those bills. We lost on all fronts. The bills are now law.

Where were those marchers when we needed them? I know several science cheerleaders who took some concrete steps to forestall the legislation (by

phoning elected representatives, for example), but I can count on one hand the number of working scientists who offered their expertise to our group. And I didn't hear of any who approached lawmakers on their own.

Having the scientific community more actively involved might have had an impact. The final vote in the state senate was tight. Advocates of the law were widely quoted as claiming that evolution is just a theory and that anthropogenic global warming is in doubt. It would have been invaluable if scientists at local universities had issued simple statements: yes, evolution is a fact; the word 'theory' is used differently in science from how it's used in casual conversation; and the basics of human-caused global warming need to be taught. Perhaps authoritative voices from the state's universities would have swayed a senator or two.

Since the laws were passed, dozens of articles about them have been published statewide and even nationally. Social media has been buzzing. But the scientific community is still woefully quiet.

Hey, scientists, beleaguered high-school science teachers could use your support.

Other US states have endured attacks on science education. Legislatures in Alabama and Indiana passed non-binding resolutions that encourage 'academic freedom' for science teachers who cover topics — including biological evolution and the chemical origins of life — that the lawmakers deem controversial.

In Iowa, state lawmakers proposed a law requiring teachers to balance instruction on evolution and global warming with opposing views. That effort dwindled without concrete action, but not because of pressure from the scientific community.

We have had some help in our efforts: Jiri Hulcr and Andrea Lucky, scientists at the University of Florida in Gainesville, spoke out with me against these bad educational bills in a newspaper opinion piece. We argued that the choice was stark: training students for careers in the twenty-first century, or plunging them into the Middle Ages.

And Paul D. Cottle at Florida State University in Tallahassee is unrelenting in pursuing his goal of preparing elementary and high-school students for their adult lives. He's an integral part of Future Physicists of Florida, a middle-school outreach programme that identifies students with mathematical ability and guides them into courses that will prepare them for university studies in science and engineering. More generally, he makes sure that students, parents and school administrators hear the message that the path to high-paying, satisfying careers using skills acquired in mathematics and science starts long before university, and depends on accurate instruction.

Plenty of issues need attention. The pool of qualified science and maths teachers is shrinking. Florida students' performance in state-mandated science exams has been poor and stagnant for nearly a decade. This year, the state's education department will begin to review and select science textbooks that will be used in classrooms across the state for at least the next five years.

We need scientists who are willing to take the time and effort to push back against the textbook challenges that these new laws will encourage. We need expert advisers eager to review and recommend quality science textbooks for our schools. We need bold scientists ready to state unapologetically that evolution, global warming — and, yes, even a round Earth — are facts of life.

You're busy. I know. And some of you are uncomfortable in the spotlight. But doing something, even on a small scale, is better than doing nothing. Sign up for action alerts from the National Center for Science Education and your state's science-advocacy group, if you have one. Be a voice within any organizations you belong to, urging them to make statements supporting science education as issues arise. Introduce yourself to teachers at local elementary and high schools.

Even if all you have to offer are ideas and emotional support, we'll take them. Politicians, school administrators, business leaders, parents and even children need to know that you support high-quality science education.

The March for Science was a beneficial, feel-good event. It's over. But we need you to keep on marching!

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Europe’s X-ray laser fires up

High-speed shooter will help scientists to make molecular movies.

29 August 2017

Heiner Müller-Elsner/European XFEL

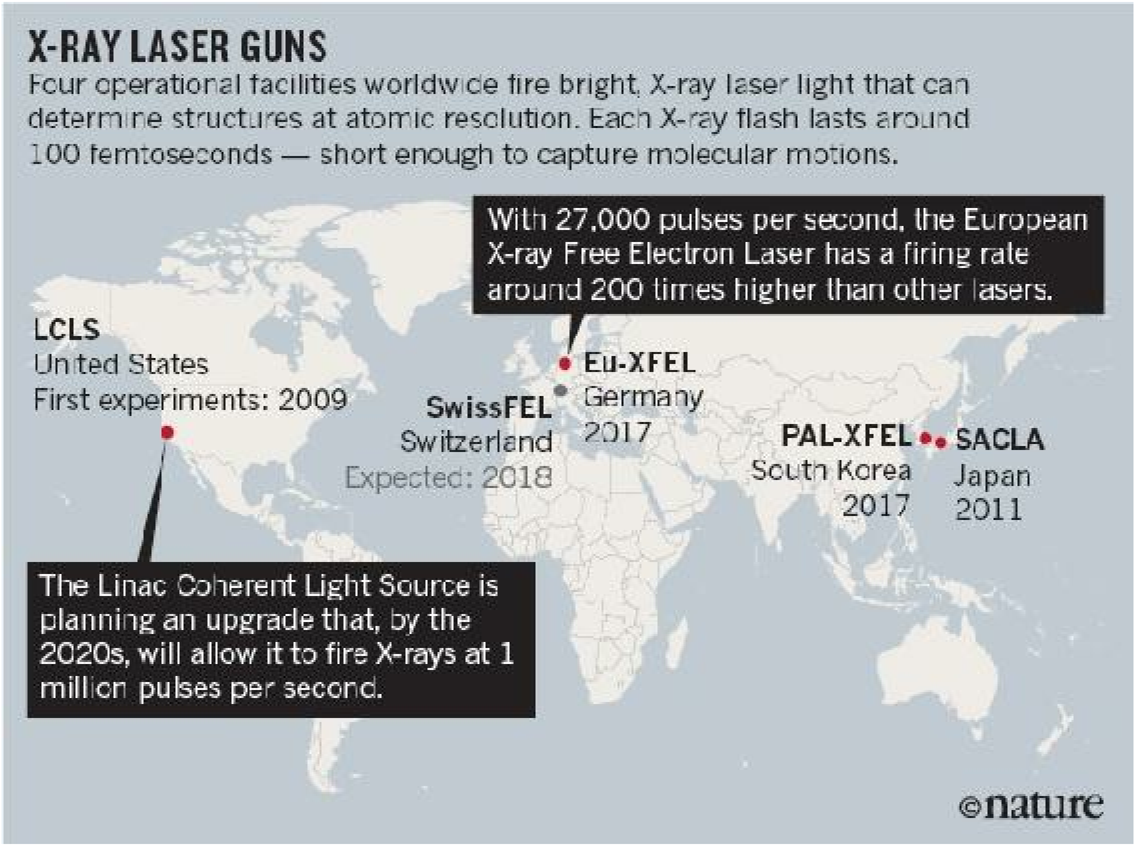
Researchers will soon be able to use the European X-ray Free Electron Laser near Hamburg, Germany, to watch molecules in action.

Scientists who make movies of molecules in motion have a new high-speed camera to shoot with. The €1.2-billion (US$1.4-billion) European X-ray Free Electron Laser (XFEL) will start running its first experiments in September near Hamburg, Germany.

The European XFEL fires powerful X-rays in bursts of a few hundred femtoseconds: so short that, like strobe lights, they can capture snapshots of jittery molecules frozen in time, and with a wavelength small enough to

provide pictures at atomic resolution. The Hamburg machine is one of a few such X-ray lasers worldwide, but boasts a unique rapid-fire feature: it can rattle off 27,000 pulses every second, a firing rate more than 200 times greater than the next-fastest facility, the $420-million Linac Coherent Light Source (LCLS) at the SLAC National Accelerator Laboratory in Menlo Park, California. “It’s such a different beast to anything else on the planet that it really feels like going into uncharted territory,” says Arwen Pearson, a biochemist at the Centre for Free-Electron Laser Science in Hamburg.

In a single second, scientists should be able to collect more than 3,000 good-quality X-ray pictures, compared with 100 or so at other facilities, says Adrian Mancuso, a project scientist at the European XFEL’s experimental stations in Schenefeld, near Hamburg. “Having lots of data matters, and the European XFEL will deliver it in truckloads,” says Abbas Ourmazd, a physicist at the University of Wisconsin–Milwaukee. The European machine — paid for by 12 countries — should relieve some of the pressure on older XFELs in the United States and Japan (see ‘X-ray laser guns’), which are heavily oversubscribed by scientists keen to capture atomic-scale images of their samples. Another XFEL opened to users in Pohang, South Korea, in June, and a machine in Villigen, Switzerland, is due to start experiments in 2018.



Source: European XFEL

At the Hamburg XFEL, bunches of electrons are first accelerated down a 1.7-kilometre-long tunnel. Magnets then bend the electrons' path into wiggling slalom tracks, causing them to emit bunches of high-energy X-rays as they curve. The bright X-ray pulses are so intense that they destroy the samples they hit — but not before enough photons have been scattered to reveal the sample's atomic structure.

X-ray movies

In structure-determination experiments using conventional X-ray sources, molecules must be packed into crystals to scatter enough photons to deduce their structure. But the X-rays from XFELs are so bright that researchers can gather diffraction patterns from crystals just a few nanometres in size, or even from non-crystalline clusters of molecules. This means that XFELs can study

proteins that are hard to crystallize. And researchers can create movies of enzymes, viruses or catalysts in action by building up thousands of different snapshots of the same system taken at different timepoints — often by passing a jet of molecules in solution past an X-ray beam.

In 2015, for example, scientists using the LCLS reported eight snapshots of myoglobin, a muscle protein that binds oxygen, at a resolution of 0.18 nanometres. The images were taken a few picoseconds after a flash of light dislodged a molecule of carbon monoxide from its binding position on the protein (T. R. M. Barends *et al. Science* **350,** 445–450; 2015). On 14 August, Ourmazd and his colleagues reported using X-ray scattering from single viruses at the LCLS to create a 3D movie at 9-nm resolution. It shows the motions of a virus as it reorganizes its genome so that the genetic material can squeeze through a tubular molecular structure — a process that occurs when the virus infects a cell (A. Hosseinizadeh *et al. Nature Methods* http://dx.doi.org/10.1038/nmeth.4395; 2017).

Work such as this depends on gathering many snapshots of identical particles in different conformational states to build up a composite picture of a particle's range of motion, explains physicist John Spence at Arizona State University in Tempe. He says that the European XFEL's high pulse rate will make this process much quicker — so structural data could be accumulated for much smaller individual particles. One of the European facility's most important milestones will be proving that diffraction patterns can indeed be collected from single particles at very high rates, says Mancuso. Because an intense X-ray burst obliterates each particle it hits in a passing spray or jet, it can be a challenge to ensure that the destroyed sample does not impede capture of the next shot. "We won't know that until we try," he says.

Hamburg's facility also has a larger capacity than its competitors: unlike other XFELs, it has three separate undulators to create simultaneous X-ray beams, with the 27,000 pulses per second distributed among them. But the European XFEL will reign for only a limited time: SLAC this year began construction of a $1-billion project to create an even brighter laser beam that, by the early 2020s, will fire up to 1 million pulses each second.

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Legal threat exposes gaps in climate-change planning

Australian lawsuit highlights how difficult it is to turn global warming data into useful advice.

29 August 2017

Daniel Munoz/Reuters

Climate forecasts indicate that Australia will face an increased risk of severe droughts and bush fires.

In a world-first case, an Australian court will next month begin hearing from shareholders who have sued a bank for failing to disclose its vulnerability to climate change.

The case highlights the fact that financial institutions around the world have been slow to acknowledge the risk that climate change poses to investments in infrastructure, agriculture and property. But researchers say the lawsuit also shows that Australia and many other countries are currently unable to forecast the financial risks of climate change.

Shareholders Guy and Kim Abrahams filed the lawsuit on 8 August against the Commonwealth Bank of Australia, saying that the institution's 2016 directors' report did not adequately inform investors of climate-change risks. Their suit also seeks an injunction to stop the bank from making the same omissions in future annual reports.

Climate scientist Andy Pitman at the Centre of Excellence for Climate System Science in Sydney, Australia, says that researchers have been warning companies and governments for years about the need to invest in climate modelling and the related field of climate services, which provides forecasts and other information to public and private users. He says that it would take substantial investment and five to ten years of work for his team to provide banks with the climate information they need.

To be useful, he says, the forecasts would need to be on a time scale that is specific to a business or government's climate vulnerabilities, such as a period of months to years, or on small spatial scales, such as the size of a farmer's field. "That's hugely challenging," he says. "It's the difference between building a car that travels around Sydney and building one that wins a Formula One Grand Prix."

In theory, it should be possible to make such forecasts, but "it's a huge undertaking to actually do it", says Pitman; and it would require high-performance supercomputers generating massive amounts of data.

A question of scale

No country can yet produce climate forecasts on the scales and with the accuracy needed for detailed planning, says Simon Mason, a climate scientist at Columbia University's International Research Institute for Climate and

Society in Palisades, New York. Even the best forecasts are highly uncertain, which makes it difficult to use them for planning, he says.

For instance, if a farmer's bank wants to know the probability that the farm might experience drought, a 10-year projection might suggest a 60% chance of more frequent droughts, says Mason. But that doesn't indicate how severe the droughts might be or whether they will lead to crop failures, he says. "These are exactly the types of questions that need a lot of research."

But Jacqueline Peel, who specializes in climate-change law at the University of Melbourne, Australia, says that companies are likely to face more lawsuits like the Australian one, meaning that they won't have time to wait for fine-scale, tailored models. She says that there is already sufficient information on future warming scenarios for a business to disclose its vulnerabilities.

In Australia, researchers say that budget cuts haven't helped. A report released earlier this month by the Australian Academy of Science identified major gaps in climate research and climate services. The report found that Australia needs an additional 77 climate scientists, including 33 in modelling and 12 in climate services. The academy commissioned the report after the Australian national science agency, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), axed about 30 climate-science positions in 2016. CSIRO says it later added back 31 posts.

"There is a pressing need to improve projections of extreme-weather events to meet the demand for adaptation planning and disaster risk management," the report said.

The situation is better in Germany, the Netherlands and the United Kingdom, which have well-established, government-funded systems that provide climate information. But in the United States, researchers say that climate services are fragmented and struggle to meet the needs of governments or private-sector decision-makers. The Obama administration tried to launch a climate services division, but the US Congress blocked that effort.

"We haven't invested as much in climate services in time scales from several weeks to decades in the US," says John Furlow, who works on climate change and development at Columbia.

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Nature News

[周四, 07 9月 2017]

- **Nature News**

Nature News

Nature is a weekly international journal publishing the finest peer-reviewed research in all fields of science and technology on the basis of its originality, importance, interdisciplinary interest, timeliness, accessibility, elegance and surprising conclusions. Nature also provides rapid, authoritative, insightful and arresting news and interpretation of topical and coming trends affecting science, scientists and the wider public.

- ## Bacterial 'aphrodisiac' sends single-celled organism into mating frenzy [周三, 06 9月 08:00]
  Researchers surprised to observe bacterial protein triggering a switch from asexual to sexual behaviour.
- ## Researchers riled by lack of detail in Brexit science plans [周三, 06 9月 08:00]
  UK government document fails to extinguish concerns over funding and migration.
- ## Merkel deserves another term as German chancellor [周三, 06 9月 08:00]
  The former physicist shows a welcome immunity to the mood of anti-science resentment that has infected some democracies.
- ## Illegitimate journals scam even senior scientists [周三, 06 9月 08:00]
  Kelly Cobey has seen a litany of researchers preyed on by predatory journals — and has ideas on how to stop it.
- ## North Korea's nuclear test, cash for Italy's scientists and Zika-vaccine pause [周三, 06 9月 08:00]
  The week in science: 1–7 September 2017.
- ## The secret to Germany’s scientific excellence [周三, 06 9月 08:00]
  With a national election this month, Germany proves that foresight and stability can power research.
- ## Books in brief [周三, 06 9月 08:00]
  Barbara Kiser reviews five of the week's best science picks.
- ## Quantum gravity: Quantum effects in the gravitational field [周三, 06 9月 08:00]
- ## Biomedical literature: Testers wanted for article search tool [周三, 06 9月 08:00]
- ## Tribute to Daedalus: Fertile mind that led to unexpected places [周三, 06 9月 08:00]

- **[Maryam Mirzakhani (1977–2017)]** [周三, 06 9月 08:00]
  Pioneering mathematician and winner of the Fields Medal.
- **[Alice in Peaceland]** [周三, 06 9月 08:00]
  One more nightmare.
- **[Cuckoo call adds another layer of deception]** [周二, 05 9月 08:00]
  The female bird makes a different and much sneakier sound than the male.
- **[Budget battle looms for US science programmes]** [周二, 05 9月 08:00]
  Competing spending priorities in the House of Representative and Senate could push funding negotiations into December.
- **[Science must acknowledge its past mistakes and crimes]** [周一, 04 9月 08:00]
  Injustice in the name of research should not be forgotten — nor should those injured by scientists.
- **[Massive Ebola data site planned to combat outbreaks]** [周一, 04 9月 08:00]
  An international partnership seeks African leadership to organize information about the disease.
- **[Nature videos help to calm inmates in solitary confinement]** [周五, 01 9月 08:00]
  Controversial experiment ignites debate over whether scientific work could be used to justify harsh prison tactics.
- **[Volcanic views, stalking storks and the ephemeral eclipse]** [周五, 01 9月 08:00]
  August’s sharpest science shots, selected by Nature ’s photo team.
- **[How labs are coping with Hurricane Harvey's devastating floods]** [周四, 31 8月 08:00]
  Advance planning has kept some Texas facilities safe during the unprecedented storm.

Bacterial 'aphrodisiac' sends single-celled organism into mating frenzy

Researchers surprised to observe bacterial protein triggering a switch from asexual to sexual behaviour.

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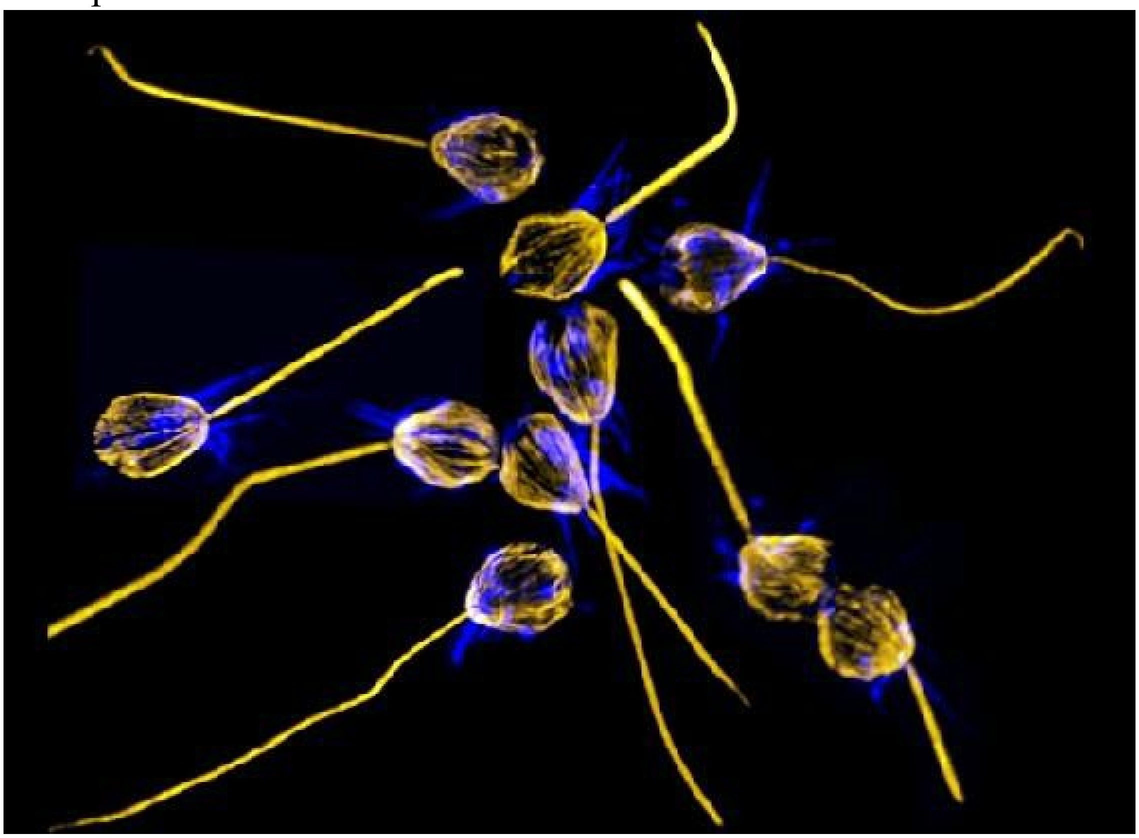

Arielle Woznica

The single-celled choanoflagellate *Salpingoeca rosetta* swarms and mates in response to a protein secreted by *Vibrio fischeri* bacteria. (This image is an edited 3D reconstruction of the original culture.)

Researchers have stumbled on a surprising aphrodisiac for a single-celled organism: a protein secreted by a bacterium. They suggest it's the first time that bacteria have been found to have a hand in controlling the sexual behaviour of eukaryotes — the domain of life that includes fungi, plants and animals.

The organism involved belongs to the choanoflagellates: sperm-like creatures that are among the closest living single-celled relatives of animals. Biologists study them to understand how unicellular organisms evolved to become the earliest multicellular animals.

Choanoflagellates usually divide asexually. Until now, scientists had only managed to coax them into mating by withholding their food.

A team led by microbiologist Nicole King of the University of California, Berkeley, was studying how certain bacterial signals induce asexual division in the choanoflagellate *Salpingoeca rosetta* when they discovered something surprising: adding a marine bacterium called *Vibrio fischeri* to the culture caused *S. rosetta* to swarm into a mating frenzy and reproduce sexually.

"It was completely unexpected," says Jon Clardy, a biochemist and study co-author at Harvard Medical School in Boston, Massachusetts. "To be honest, we were using *V. fischeri* as a control, because we knew that it wouldn't induce multicellularity." The work was published on 31 August in *Cell*[1].

Protein perk up

Further experiments revealed that the bacteria secreted a protein — which the researchers dubbed EroS, after the Greek god of sex — that caused the swarming behaviour. The choanoflagellates clustered in groups of up to 35 and fused head-on before duplicating and recombining their DNA and then dividing into genetically distinct offspring.

"It's the first time that I see bacteria inducing mating in a eukaryotic cell," says Vanessa Sperandio, a microbiologist at the University of Texas Southwestern Medical Center in Dallas. Sperandio points out that bacteria could be influencing the behaviour of multicellular animals more than we know. When a new signalling pathway is discovered, she says, chances are that similar discoveries will follow in other groups of organisms.

“It’s odd to rely on bacteria to induce your mating,” agrees Nick Brown, a cell biologist at the University of Cambridge, UK. He says that in further work, he’d like to know whether and, if so, how choanoflagellates are able to trigger their own sexual behaviour.

The researchers now think that the mechanism they observed might be how *S. rosetta* usually reproduces in the wild. It lives in the same coastal habitats as *V. fisheri*, and natural concentrations of the bacterial aphrodisiac could cause the choanoflagellates to gather in large numbers, making it more likely that two cells will come together for sexual reproduction.

Study author Arielle Woznica of the University of California, Berkeley, suggests that choanoflagellates may have adapted to use *V. fisheri* as an indicator that environmental conditions call for sexual reproduction.

Mating mechanics

Why bacteria would control sex in choanoflagellates is not yet clear. But the researchers have a few theories as to how the protein induces mating. EroS is an enzyme that cuts up a compound found in *S. rosetta*’s extracellular matrix, a collection of structural molecules surrounding the cell. The compound that it targets, called chondroitin sulfate, is made from sugar molecules — so it’s likely that *V. fisheri* secrete EroS to feed on this molecule, the authors say.

Clardy suggests that chewing up the extracellular matrix may physically ‘soften up’ the cells, so that two choanoflagellates can fuse. King is investigating a different lead: she thinks that chondroitin sulfate may be a signalling molecule that becomes active only when cleaved by EroS.

The finding is one of a growing number of examples of ‘cross-kingdom signalling’ — a process in which one group of organisms picks up cues from another. It has implications for the richness of chemical ecology that remains to be discovered, says Rosie Alegado, a microbiologist from the University of Hawaii at Manoa. Other microbes thought to be asexual might be convinced to give sex a try — if they're exposed to the right conditions.

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Comments

1 comment

1. *Fem Tom* • 2017-09-06 11:41 PM
   Very helpfull I used to buy here https://www.nutribluesaude.com.br/

Researchers riled by lack of detail in Brexit science plans

UK government document fails to extinguish concerns over funding and migration.

06 September 2017

Francois Lenoir/Reuters

David Davis (left) is negotiating Britain's exit from the European Union.

More than one year after UK citizens voted to leave the European Union and just over two months into ‘Brexit’ negotiations, the British government has finally laid out how it would like to handle scientific relationships with the EU after it leaves the bloc next year. Many scientists are less than impressed.

In a policy document published on 6 September, the UK government pledges to “seek an ambitious science and innovation agreement” in Brexit negotiations with the EU. But it only sets out areas where agreement will be sought, rather than making any specific proposals.

John Womersley, director-general of the European Spallation Source, a research facility in Lund, Sweden, says that although the aspirations in the document were welcome, the lack of detail means would probably disappoint the scientific community more than reassure it. “I downloaded the document and I thought, hoped, expected, it would be too big for me to digest in ten minutes. It was trivially easy to digest in ten minutes,” he says.

Mike Galsworthy, of the Scientists for EU pressure group, says that the document makes “generally warm and happy noises” but contains nothing really new. “My anxiety is specifically we could have told you all of this two years ago,” he says of its contents. “We have now wasted a quarter of the negotiation time and the government hasn’t really put forward anything that really addresses the hard challenges.”

Money matters

In January the government listed science as one of its 12 priorities for Brexit negotiations, but it has said little about what this would mean in practice. UK institutions currently receive around €1 billion in funding per year from EU programmes, mainly from the huge EU Horizon 2020 funding programme. Freedom-of-movement rules have allowed academic staff from EU countries other than the UK — currently more than 30,000 — to move to UK universities and live and work without visas.

Today’s document — one of a series outlining the government’s position in continuing negotiations with the EU — confirms that the United Kingdom would like to stay a member of Horizon 2020, the latest of the EU's research-funding 'Framework Programmes', and any successor schemes. It would “welcome discussions” about continued UK participation in these, as well as in space, nuclear and defence research-and-development programmes.

But it warns that any payments that the United Kingdom would have to make to remain part of such projects would be weighed “against other spending priorities”. It also says that, although EU citizens will lose the automatic right to come and work in the United Kingdom, the country “will continue to welcome the brightest and best”.

In a statement, David Davis, the minister in charge of the Department for Exiting the European Union, said: “This paper sends a clear message to the research and innovation community that we value their work and we feel it is crucial that we maintain collaboration with our European partners after we exit.”

Over the horizon

Ministers have previously declined to say whether they would seek to keep the United Kingdom in EU schemes such as Horizon 2020. Reports circulating in the media earlier this week indicated that the UK would be willing to pay €1.3 billion per year to stay in. However, this figure doesn't appear in the document, and no other specific financial contribution is mooted.

How much Britain might have to pay if it were to join a successor to Horizon 2020 would have to be negotiated. Several non-EU countries have joined the Framework Programme as ‘associated countries’. That allows their researchers to apply for grants, but also involves the nations paying a proportion of the programme’s budget. How much countries pay is based on a ratio of their gross domestic product to the EU's. On the basis of those rules, the UK might expect to pay between £1.7 billion and £2 billion to rejoin the scheme.

Kurt Deketelaere, secretary-general of the League of European Research Universities in Leuven, Belgium, says it is “an absolute necessity” that the United Kingdom joins the planned successor to Horizon 2020, which begins in 2021. However, this may require some changes to current rules, which allow membership to categories of countries the United Kingdom is unlikely to fall into, he says. Changes to the Framework Programme to make it more open internationally could be one solution to this, he notes.

A key concern for some is the gap between the UK leaving the EU in 2019, and potentially joining the Horizon 2020 successor scheme in 2021. The United Kingdom has already promised to fund grants that are awarded under the current scheme before it leaves the EU. But whether Britain will continue to pay into Horizon 2020 after it leaves the EU is part of the negotiations — the EU argues that the UK has a legal commitment to do so.

Deketelaere agrees that Horizon 2020 should not present a problem. But Edward Whiting, director of policy at the Wellcome Trust, says “we are concerned about the continuing uncertainty for UK researchers” about the gap between 2019 and 2021.

'Brightest and best'

Whiting praises the plans for addressing the ability of researchers to move to the United Kingdom, but he says it will be important for the government to think beyond researchers with established careers when they look for the “brightest and best”. Younger researchers and support staff are also crucial to science, he points out, and these scientists may fall foul of immigration controls, such as the need to earn above a certain salary.

The government's science plan was not the only document attracting attention from policy watchers today. *The Guardian* newspaper released a leaked draft of what might be the United Kingdom's post-Brexit immigration policy, which included a rapid end to freedom of movement for EU citizens, and three-to-five year visas for highly skilled workers. It also included suggestions for salary caps and restrictions on the ability to bring family members to Britain. Deketelare thinks the document will make researchers think twice about moving to the country.

To attract “brightest and best”, the UK is touting a new £100-million ‘Rutherford Fund’ which will provide fellowships for researchers to move to the country. But James Wilsdon, who studies research policy at the University of Sheffield, notes that the current EU system allows, for example, an Italian scientist with a grant from the prestigious European Research Council to move to the Britain with her grant, her partner and her children. Only allowing a researcher to come to the United Kingdom is not enough, he says, if that person's family would have to be left behind.

"The upside of the European system in mobility terms is clearly that it's very flexible in terms of movement of you and your partner and your kids," says Wilsdon. "Scientists are not these people who only sit there doing science. This is real life."

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Comments

Comments

There are currently no comments.

Merkel deserves another term as German chancellor

The former physicist shows a welcome immunity to the mood of anti-science resentment that has infected some democracies.

06 September 2017

Clemens Bilan/EPA-EFE/REX/Shutterstock

Germany under Angela Merkel has made steady progress on science.

“We can do it!” was Angela Merkel’s famously laconic response in 2015 to the refugee crisis. The phrase serves just as well as a motto for her country’s pragmatic approach to science. Like most modern nations, Germany owes its affluence to a powerful composite of liberal democracy, education and curiosity-driven advances in knowledge and technology. But unlike some democracies — the United Kingdom and the United States among them — Germany has wisely chosen not to weaken its scientific base through neglect, isolation or arrogance on the part of the powers that be.

That is likely to continue. Merkel, a physicist by background, shows welcome immunity to the strengthening political mood of anti-science resentment and post-factual phantasm. Polls suggest she is likely to continue her 12-year chancellorship after the federal elections on 24 September. But whatever government coalition might result from the vote (in Germany's political landscape, one single political party rarely gets enough votes to rule alone) scientists can trust that the next government will keep up the level of support that has made twenty-first century Germany a prime destination for research.

There is agreement across the political spectrum, for example, on the need for increased federal support for science and higher education, to lessen the burden on Germany's *Länder* (states) and particularly to strengthen university education and research, which is mostly funded by the *Länder*. Indeed, as we discuss in one of a series of articles that highlight Germany, some €35 billion (US$42 billion) might be needed over the next decade to maintain and modernize university research infrastructure. The next government must signal early on that it is prepared to shoulder the task.

Nature asked each party for its views on a number of pressing issues relating to science. Notable political differences emerged. The Social Democrats — the junior partner in Merkel's current grand coalition government — oppose the release of genetically modified organisms (GMOs) and favour strict regulations on genome editing using CRISPR technologies. Merkel's Christian Democrats say they want considerably more-liberal regulations in these areas. Both of these two main parties are determined, however, that the use of human embryos for research purposes will remain banned in Germany.

Possible junior partners in a new coalition are the Greens and the liberal Free Democrats (FDP). Both are likely to easily gain the 5% share of votes necessary to win seats in parliament. The Greens, although also strictly opposed to deliberate GMO releases, are considerably less restrictive in their approach to 'risky' technologies and animal experiments than they were in their early days. The FDP favours decidedly liberal policies in all fields of science and technology.

The socialist Left Party (Die Linke) and the far-right Alternative for Germany (AfD) are also expected to meet the 5% threshold, but are unlikely to be asked to join any coalition. Scientists won't miss them. Die Linke is the only political force that says it wants to discontinue the successful Excellence Initiative for universities. The AfD didn't even respond to *Nature*'s science-policy questions. And of the dozens of splinter parties also standing for election — mostly single-issue groups ranging from animal-protection hardliners to downright esoteric groups — none is likely to clear the 5% threshold.

Of the research money spent in Germany — a relatively high 3% or so of gross domestic product — private industry accounts for about two-thirds. This is also comparatively high, and one priority of the next government must be to enable Germany's research-intensive companies, including a car industry stricken by scandals over diesel-engine emissions, to compete in the global technology market and maintain its value-adding research and development activities.

Despite record student numbers, many of these companies struggle to find talented researchers and engineers among German graduates. Keeping the country open to talent from around the world — by offering generous stipends, easing visa requirements for scientists and rewarding talented migrants — is crucial if Germany is to maintain its success in science.

The recipe for that success — trust in science, openness to necessary change and a habit of methodically doing the right thing — is a lesson for those charged with overseeing more tumultuous science and policy environments elsewhere. Science is a thoroughly international affair. And amid political tensions and the surge of international terrorism, science and science diplomacy assume a peace-keeping dimension that is not often appreciated. Germany has long been a reliable partner of academically and politically troubled countries including Russia, Turkey and Egypt. Angela Merkel — or her successor — should keep this in mind when forging her country's future. Merkel deserves the chance to continue her good work. Can she do it? Yes she can.

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Jenn
Ganton

Illegitimate journals scam even senior scientists

Kelly Cobey[1] has seen a litany of researchers preyed on by predatory journals — and has ideas on how to stop it.

06 September 2017

The e-mail's subject line read, “Trouble with a duplicate publication.” As soon as it landed in my inbox, I knew it was important: the sender, an accomplished senior scientist, had flagged it as urgent. His message described a troubling encounter with a predatory journal.

Earlier that year, he had received an e-mail invitation to submit an article to a journal with a title and remit matching his expertise. The journal described itself as new and in search of content for a forthcoming issue. Shortly before this, the scientist's research fellow had pulled together an oral presentation on that very topic, and so it seemed like a good opportunity for him to convert the work into a published article.

They drafted a manuscript and submitted it. Soon, along with receiving some modest feedback, they were informed that the article had been accepted. After resubmitting the paper with minor revisions, they were sent a bill — US$979 — to cover the costs of publishing. Alarm bells went off. The invitation had not indicated any fee. The authors were wary of the journal's integrity, and had no funding to pay the article-processing charge. They rescinded their submission and ignored a spate of follow-up invoices. They next submitted their work to a familiar, legitimate journal. It was accepted after peer review and revision, and the authors thought that their brush with a predatory journal had ended.

Months later, the fellow discovered the article 'published' on the predatory journal's website. Their question to me: what should they do now?

Unfortunately, I have received a number of similar e-mails. As publications officer at the Ottawa Hospital Research Institute in Canada, I spend a great deal of my time consulting about research and publication best practices. Problems with submissions to predatory journals are not unique to our institution. (In this issue of *Nature*, my colleagues and I report that even authors from prestigious institutions publish in them.) However, few research institutions have hired a staff member with a role such as mine, dedicated to educating researchers and guiding them in their journal submission.

I advised the senior scientist to write a letter to the editor whom he had corresponded with earlier to request immediate removal of his article, and to remind him that he had revoked his submission without paying the publishing charge. The journal responded that a $319 retraction fee was due. (Such fees are unheard of at legitimate journals.)

I next advised the scientist to contact two editorial board members listed on the predatory journal, personal acquaintances of his, to express concern. Both replied that they had had little to do with the journal — beyond having answered an initial invitation — and would withdraw as board members. The scientist also informed the legitimate journal of the situation. Although that journal ultimately decided that the unauthorized publication should not count against the authors, the process was burdensome for all involved. “I guess I felt 'taken',” the scientist wrote me — “like you would if you were scammed”.

As another example, a medical trainee who attended one of my outreach seminars approached me to vet a journal to which she and her adviser planned to submit. I noticed many characteristics associated with predatory journals (for guidelines, see L. Shamseer *et al. BMC Med.* **15,** 28; 2017), and advised against it. She then had to navigate a difficult discussion with her adviser, who had been pressuring her to get the paper out. It was her first time preparing a manuscript; she had no concept of what standards were typical at legitimate journals and was acutely aware that her adviser, who had suggested the journal, was more experienced. Ultimately, this story has a happy ending: when she reported her concerns to her adviser, he thanked her for avoiding submission.

Even those who recognize a potential problem can fall victim. A large research group contracted my services to review its publications over the past academic year, and sent me a list of more than 200 articles. I assessed each title and found that over 5% of their publications were in predatory or otherwise low-quality journals, and estimated that the group had sent nearly US$8,000 in total to 14 predatory journals that year — including work by one of the very people who commissioned me.

Publication ethics and integrity are at the core of scientific research, but the necessary skills are learnt informally on the job. Busy senior researchers may leave it to the first author to choose a journal, submit the work and move it through peer review. They end up with a predatory publication, without realizing it, or realizing it too late.

In my two years as publications officer, the role has mushroomed. Still, too much of my consulting occurs after a predatory journal has been selected and papers already submitted or published.

To reduce the supply of papers flowing to predatory journals, we need to do a better job of educating trainees and faculty members about how to assess a journal's integrity. We need incentives and resources that will prevent scientists from sending real work to places that will not identify flaws or truly contribute to the scholarly literature. Several global funders have mandated open-access publishing. However, without guidance in selecting journals responsibly, this problem of irresponsible publishing is likely to increase. Science and society would be better off if we stopped the waste by cutting off the supply.

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North Korea's nuclear test, cash for Italy's scientists and Zika-vaccine pause

The week in science: 1–7 September 2017.

06 September 2017

Events | Facilities | Policy | Research | People | Health | Funding | Trend watch

EVENTS

North Korean nuclear test is biggest yet North Korea carried out its sixth nuclear-bomb test on 3 September. The explosion at an underground site in Punggye-ri had a yield equivalent to around 120 kilotons of TNT — six times greater than the country's previous test in 2016 — said NORSAR, a geoscience research foundation in Kjeller, Norway. As with previous tests, North Korea claimed it had detonated a hydrogen bomb, which uses a conventional nuclear-fission device to trigger a secondary, more powerful fusion reaction (pictured, North Korean leader Kim Jong-un, second right, inspecting an alleged nuclear device). The event had an estimated seismic magnitude of 6.3 — bigger than previous tests — but the bomb type cannot be determined from seismic data alone. The larger blast makes North Korea's claim more credible, says NORSAR. Leakage of radioactive particles from the test site could reveal whether the blast was from a hydrogen bomb.

KCNA via REUTERS

Record rainfall Hurricane Harvey dumped more than 127 centimetres of rain on areas east of Houston, Texas, between 25 and 29 August, making it the most extreme rain event on record in the continental United States. The previous record also occurred in Texas, when tropical storm Amelia delivered 122 cm of rain in 1978, according to data from the US National Weather Service. Harvey was a category 4 hurricane when it made landfall in Texas on 25 August but has since dissipated. At least 60 people have died as a result of the storm. See 'How labs are coping with Hurricane Harvey's devastating floods' for more.

Indian satellite fails An Indian navigation satellite that launched on 31 August has failed to reach orbit. The craft, called IRNSS-1H, was meant to replace one of seven satellites in the country's navigation system after its three atomic clocks malfunctioned last year. The rocket carrying IRNSS-1H had launched from the Satish Dhawan Space Centre on the southeast coast. But shortly after take-off, the heat shield protecting the satellite failed to separate, rendering the launch a failure, said the Indian Space Research

Organisation's chief, A. S. Kiran Kumar. The satellite was built by a consortium led by Alpha Design Technologies in Bangalore.

FACILITIES

Europe's X-ray laser The world's most powerful X-ray laser formally began operation on 1 September. The €1.2-billion (US$1.4-billion) European X-ray Free Electron Laser (XFEL), near Hamburg in Germany, fires bright X-ray light in pulses a few hundred femtoseconds (10^{-15} seconds) long — brief enough to capture molecules frozen in time — and with wavelengths short enough to capture images at atomic resolution. The European XFEL fires at least 200 times more X-ray pulses per second than the world's four other operational XFELs, so researchers should be able to collect more data.

POLICY

UK life sciences The UK life-sciences sector should invest in high-risk 'moonshot' projects, says a government-commissioned strategy report published on 30 August. The report was written by John Bell, a medical researcher at the University of Oxford, in collaboration with industry, charities and academia. It proposes the creation of a Health Advanced Research Programme (HARP) that would pool public and private funding and emulate the approach of the US government's high-risk research arm, the Defense Advanced Research Projects Agency (DARPA). Bell also urges the government to review the terms under which companies are given access to valuable patient data — which could be used, for example, to develop artificial-intelligence health algorithms — from the National Health Service. The government will review the report's recommendations.

US research cuts The US National Center for Atmospheric Research (NCAR) in Boulder, Colorado, has announced plans to lay off 18 scientists and technical staff in response to budget pressures. NCAR's core funding — nearly US$100 million this year — comes from the US National Science Foundation and has been flat for several years. But salaries and other costs have continued to increase. NCAR director Jim Hurrell says that the institution has chosen to cut research in areas such as climate impacts so that it can maintain core programmes such as climate and weather modelling, and atmospheric research. The staff cuts, along with the elimination of other vacant and part-time positions, will free up around $9 million a year.

NIH trial policy row An open letter calling on the US National Institutes of Health (NIH) to delay the implementation of a policy that would broaden its definition of ‘clinical trial’ has garnered nearly 3,000 signatures. The policy, scheduled to come into effect in January 2018, is part of an NIH effort to ensure that all clinical results are publicly reported. But it would classify most studies involving human participants as clinical trials, including many that observe normal human behaviour. Such studies may need to go through extra review processes. In the letter, published on 31 August on ipetitions.com, scientists say that the policy would “unnecessarily increase the administrative burden on investigators”. See go.nature.com/2exwupb for more.

RESEARCH

Amazon species Researchers described 381 new plant and animal species in the Amazon between 2014 and 2015, finds a report by the conservation organization WWF. The list was compiled by reviewing scientific publications, and includes Milton’s titi monkey (*Callicebus miltoni*) and the western puffbird (*Nystalus obamai*; pictured). The report, released on 31 August, found that many of the organisms live in protected areas of the rainforest, but that the regions are threatened by deforestation, farm expansion and other human activities in Brazil.

Joao Quental (CC BY 2.0)

PEOPLE

NASA nominee James Bridenstine, a Republican member of the US Congress from Oklahoma, was nominated to be the next head of NASA on 1 September. Bridenstine, a former US Navy pilot, is a supporter of commercial spaceflight and has repeatedly argued that the United States should return to the Moon. But he has also expressed scepticism about climate change: he has disparaged the role of humans in global warming and argued to exclude greenhouse gases from federal regulation. If confirmed by the Senate, Bridenstine will lead an agency that is wrestling with developing a new heavy-lift rocket and its accompanying Orion crew capsule to fly astronauts to an as-yet undetermined destination.

HEALTH

CAR-T approval The US Food and Drug Administration (FDA) has approved the use of a personalized cancer therapy called CAR-T for the first time. Tisagenlecleucel, made by Novartis of Basel, Switzerland, is a treatment for acute B-cell lymphoblastic leukaemia that involves genetically modifying a patient's immune cells so that they recognize and attack cancerous cells. The therapy, approved on 30 August, can be offered to people under 25 whose cancer has returned after they have tried other treatments. CAR-T therapies have been hailed as game-changers but pose serious risks, including seizures and inflammatory reactions. On the same day, the FDA approved a drug by Genentech in South San Francisco, California, to treat the inflammatory effects.

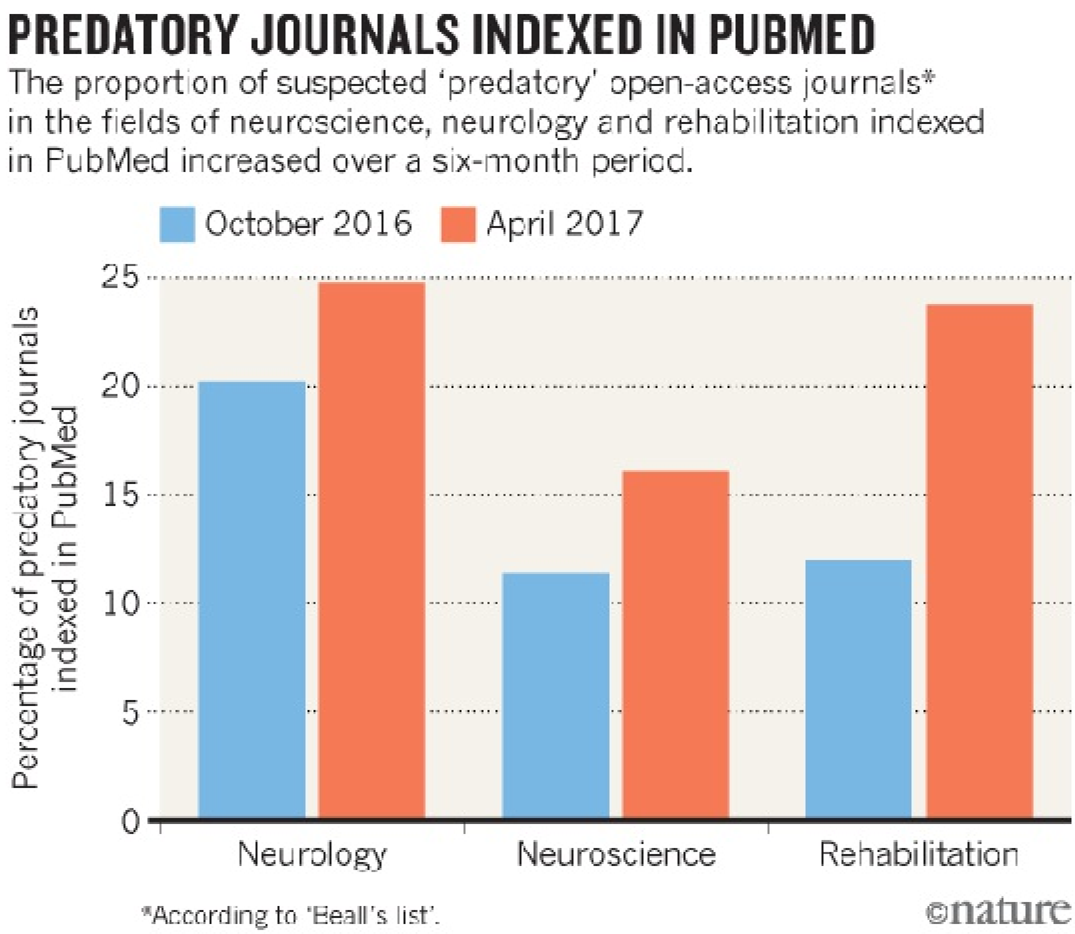
Zika vaccine pulled French drugmaker Sanofi is halting development of a vaccine against the Zika virus, it announced on 1 September. Last year, the firm signed a deal to trial and produce a candidate vaccine developed by the US government's Walter Reed Army Institute of Research. Sanofi received US$43 million for the project from the US Biomedical Advanced Research and Development Authority (BARDA), a government biodefence agency. But the drugmaker says that last month, BARDA decided to "de-scope" the contract and limit funding. As a result, Zika-vaccine development will be "indefinitely paused", Sanofi says. BARDA has partnered with other firms, including Japanese drugmaker Takeda and US start-up Moderna, to commercialize Zika vaccines, but a fall in cases of the virus worldwide is hampering field trials.

FUNDING

Italian science cash Cash-starved university researchers in Italy are celebrating a €400-million (US$480-million) windfall for competitive basic-research projects. Research minister Valeria Fedeli announced on 3 September that she will claw back €250 million from the coffers of the Italian Institute of Technology in Genoa. The money makes up nearly two-thirds of a cache of public funds that the national research centre had been given over a number of years but had controversially banked instead of spending. For more than a year, scientists have campaigned for the funds to be freed up for basic science. Fedeli said that she had cobbled together a further €150 million from other budget sources.

TREND WATCH

Increasing numbers of suspected ‘predatory’ journals in neurology, neuroscience and rehabilitation are having their articles indexed in PubMed, finds a survey (A. Manca *et al. Lancet* **390,** 734–735; 2017). Predatory journals do not provide standard services such as peer review but charge publication fees. The survey used a catalogue of questionable open-access journals called Beall’s list, which is now offline, and tracked how many had articles indexed in PubMed. The proportions for all fields grew from October 2016 to April 2017.



Source: A. Manca et al. Lancet 390, 734–735 (2017)

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The secret to Germany's scientific excellence

With a national election this month, Germany proves that foresight and stability can power research.

06 September 2017

Sean Gallup/Getty

Under the watch of Angela Merkel, Germany has invested heavily in energy innovation.

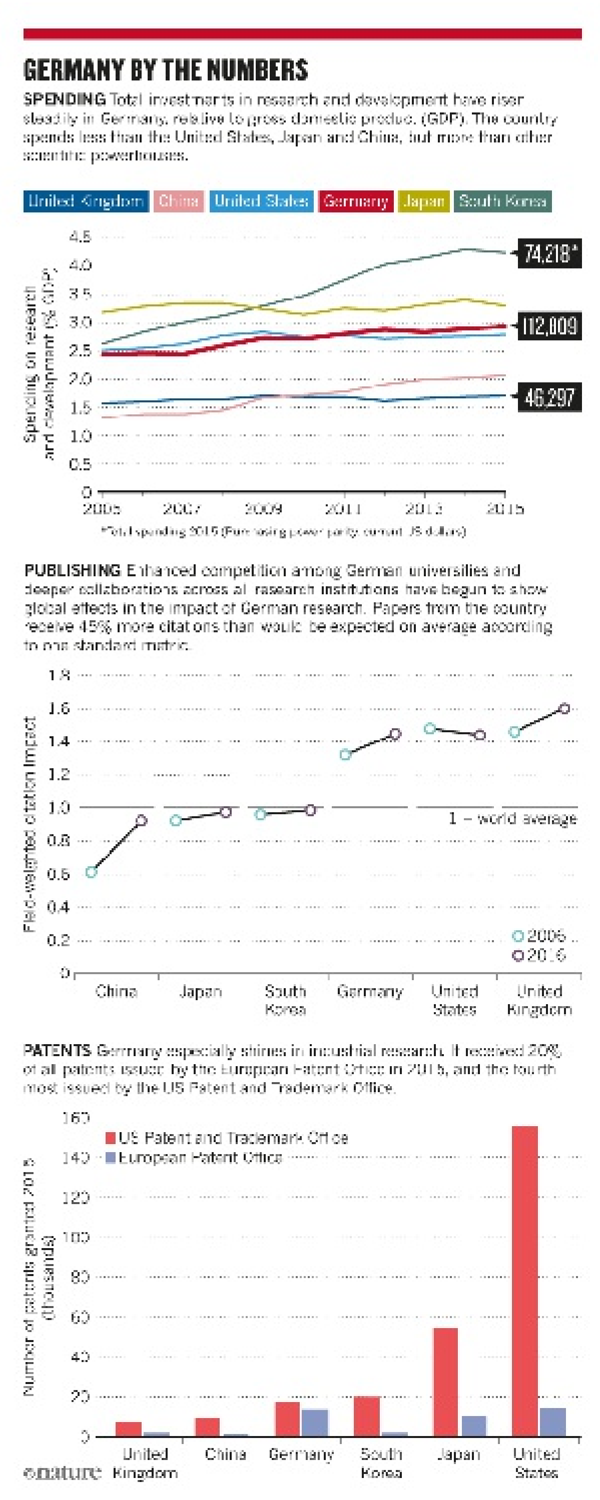
Ask any German researcher why the country's science base is blooming, and they are bound to mention Chancellor Angela Merkel. The world's most powerful woman, they say, has not forgotten her roots as an East German physicist.

During a decade of global financial turbulence, her government has increased annual science budgets in a stable, predictable, quintessentially German way. It has spurred competition among universities and improved collaboration with the country's unique publicly funded research institutions. Under Merkel's watch, Germany has maintained its position as a world leader in areas such as renewable energy and climate; and with the guarantee of strong support for basic research, its impact in other sectors has grown.

Foreign researchers are increasingly choosing to make their careers in Germany rather than opting for traditional brain magnets such as the United States or the United Kingdom. With its safe-but-dull reputation, Germany is starting to look like the tortoise to their hare. And as the country prepares for a national election on 24 September, most onlookers expect the trends to continue.

The reasons behind Germany’s success go beyond science budgets or some sort of ‘Merkel effect’, says Wolfgang Schön, a director of the Max Planck Institute for Tax Law and Public Finance in Munich and vice-president of the DFG, Germany’s main university-research funding agency. Like Merkel, the country has deep science roots, he says.

Germany was a world leader in science and technology before the turbulence of the twentieth century; it established traditions that many countries still follow. Although it struggles with the remnants of male-dominated hierarchies and pervasive, inflexible regulations, German research is looking as strong as ever, particularly on a global stage that seems increasingly indifferent to science. “I’d love it if our science-policy and budget decision-makers in the US were willing to take lessons from Germany again today,” says Kenneth Prewitt, a political scientist at Columbia University in New York City.



Source: Spending, OECD; Publishing, Scival/Scopus; Patents, USPTO/EPO

The structure of modern German science rests on concepts developed two centuries ago by Wilhelm von Humboldt, a Prussian educator who pioneered ideas that continue to hold sway around the world. It was he, for example, who suggested that university professors should do front-line research as well as teaching.

His philosophy that education should be both broad and deep, and that academic life should be free from politics and religion, remains engraved in the German psyche. “The Humboldtian system is in our DNA,” says Thorsten Wilhelmy, general secretary of the Berlin Institute for Advanced Study. “That’s why politicians are not so tempted to cut basic research when times get tough.” (See ‘Build, link and trust’.)

Build, link and trust

Staying strong will require huge investment and more international cooperation.

The German higher-education and research system seems to be in good shape. The country is near the top of global league tables in terms of output, publication quality, and numbers of students and faculty members from abroad (see ‘Germany by the numbers’). So why worry about the future? My reasons for concern relate to the political conditions under which universities and research organizations will have to operate in the 2020s. And, from my experience as director of Germany’s largest private funder of basic research, I feel that it is essential to establish more sustainable, long-term alliances with leading research institutions in other countries — in particular with universities from the Southern Hemisphere.

In 2020, a policy called *Schuldenbremse* or ‘debt brake’ is set to roll out in most German states. Agreed by the federal government and the 16 state governments in 2009, this will put a strict upper limit on budget deficits and prevent them from making new debts, especially at the state level. If implemented as planned, universities will struggle to maintain or refurbish their infrastructure, let alone acquire new buildings or facilities. Current estimates are that some €35 billion (US$41.2 billion) is needed until 2025 just to keep existing lecture halls and laboratories fit for purpose. Meeting these challenges will require the next federal government to make a strong financial commitment to the university sector.

Policymakers at every level must widen their objectives considerably in terms of what a resilient higher-education and research system should achieve. This was discussed earlier this year by the Hightech Forum, a government advisory body on which I sit. Two actions are urgent: to speed up the process of digitization in every domain of education; and to provide the research base to advance the wider use of artificial intelligence. The next government must also build on the considerable progress made in internationalizing the student and research communities. Germany will need to expand its foreign policies to integrate transnational innovation policies, including conceptual inputs to the European Union's next Framework programme.

Ultimately, the goal of all higher-education and research management must be to open up time and space for critical as well as creative thinking, to stimulate bold ideas and to aid movement beyond incremental achievements towards radical innovations. Policymakers, politicians, presidents, rectors and researchers must work together towards the high-trust culture of creativity that Germany and others are trying to achieve.

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  Contact Wilhelm Krull

  Search for this author in

  - NPG journals
  - PubMed
  - Google Scholar

These ideals have weathered dramatic political upheaval. Adolf Hitler's Third Reich perverted science and led to the country's devastation in the Second World War. In 1949, Germany was refounded as two countries, which rebuilt their scientific strengths under opposing political systems.

West Germany's democratic constitution, which remains in force, declared: "Arts and sciences, research and teaching shall be free." To ensure that centralization and abuse of power could never happen again, it created a highly federalized country in which responsibility for culture, science and education lies with the *Länder*, or states — a feature that was to have negative as well as positive effects on university development.

By contrast, the communist German Democratic Republic (DDR) centralized research and kept it under tight control. Scientists were isolated from their colleagues in the West and their system became impoverished as the DDR's economy gradually failed.

Merkel grew up in this system, graduating from the Karl Marx University in Leipzig in 1978 with a degree in physics and then moving to the Central Institute for Physical Chemistry in Berlin, one of the most prestigious research centres in the DDR. There, she met her second husband, quantum chemist Joachim Sauer, and earned her PhD with honours. Her zeal for physics did not extend to the required political education. In the DDR, no one got their PhD without an accompanying certificate in the study of Marxism–

Leninism; Merkel's dissertation for that subject, 'What is the socialist lifestyle?', was accepted with the lowest passing grade.

When the two Germanys were unified in 1990, special committees from the West evaluated the DDR scientists for competence. Many lost their jobs, but Sauer was accepted for transfer to Berlin's Humboldt University. Merkel, who had not been overtly political before, jumped into democratic politics and soon joined the centre-right Christian Democratic Union (CDU). Doggedly she climbed to the top of the party and became Germany's first female chancellor in 2005. She won federal elections in 2009 and 2013 and looks set to maintain her position. (In Germany, there is no time limit on serving as head of government.) In March, she opined: "I came from basic research myself and have always said, you can't predict things there — you just have to leave space."

Stable support

German publicly funded science is organized into five pillars: the universities and its four unique research organizations, each named after a scientific giant in German history.

The Max Planck Society, founded in 1948, now runs 81 basic-research institutes whose directors are given extraordinary budgets and free rein to tread their own paths. A director in life sciences typically gets a basic package of €2 million (US$2.4 million) a year to run their research programme, not including major equipment purchases. The Fraunhofer Society was founded a year later and is dedicated to applied research. It is named after the Bavarian physicist Joseph von Fraunhofer (1787–1826), a pioneer of precision optics. National research centres, which carry out large-scale strategic research according to government priorities, are now bundled within the Helmholtz Association, named after pioneering physiologist and physicist Hermann von Helmholtz (1821–94). A collection of other scientific institutes and facilities has been bundled into an association named after polymath Gottfried Wilhelm Leibniz (1646–1716).

In a deal that goes back to 1949, the federal government shares the costs of the research organizations with the *Länder*. But in general, the *Länder* have to finance the universities on their own. There are around 110 of these, and 230 *Fachhochschulen*, universities of applied sciences that can't offer PhDs but train the work force for industry.

"The clarity and transparency of this structure appeals to the German order-loving mentality," says Ferdi Schüth, a director at the Max Planck Institute for Coal Research in Mülheim. "It makes the system easier for outsiders, including politicians, to understand."

Support for research quickly built up during the years of West Germany's *Wirtschaftswunder*, or post-war economic miracle. Although the reunification of Germany exacted a heavy cost on the country, politicians have in most years maintained steady and strong support for science. Until 2015, the government increased support for all research organizations and the DFG by 5% per year; that annual increase has dropped in the current 'Pact for Research and Innovation' between the federal government and *Länder*, which runs until 2020, but remains enviable at 3%.

"This security about future funding allows us to really plan our research strategies in the long term," says chemist Martin Stratmann, president of the Max Planck Society. "It's a big advantage that few other countries share."

Funding flow

It was confidence in long-term funding that kept immunologist Dolores Schendel from returning to her native United States after what was meant to be a two-year postdoc placement at the Ludwig Maximilian University (LMU) in Munich in the late 1970s. She had intended only to help establish a mouse lab for the LMU's bone-marrow-transplant programme. But the facilities were seductive, and as her research became increasingly translational — and no longer lent itself to a regular flow of high-profile papers — she knew she could rely on secure local funding. She later moved to the Helmholtz Centre Munich to scale up her work. Then, when a start-up she had founded was bought out, she became chief executive and chief scientific officer of Medigene, an immunotherapy company in Munich. Now she is running clinical trials of candidate cancer vaccines. “I’m not sure I could have achieved this in the United States, where funding tends to be more erratic,” she says.

But Schendel is a rare case. Although Germany is an undisputed world leader in engineering (see ‘Get behind electric cars’), it has had few success stories in the practical application of work from emerging fields, such as biotechnology. Decisions and changes happen slowly, thanks to the layers of bureaucracy between the federal and *Länder* governments. What’s more, the abuse of science under the Third Reich, including eugenics and human experimentation, left Germans suspicious of genetics in any form and prone to moral outrage. All this has led to sluggish development on some fronts.

Get behind electric cars

Cheap and easy charging, and ready access to low-carbon power, are the way forward.

For Germany to retain its lead in climate policy and automotive technology, it must drive the switch to electric cars with coherent policies and investments in clean energy and infrastructure.

In 2016, cars accounted for 13% of the nation’s total carbon dioxide emissions. Yet the car industry generates 14% of Germany’s gross domestic product and is home to one-quarter of its research-and-development posts. The new government must align two major goals. The first is to cut CO_2 emissions by at least 80% of 1990 levels by 2050. The second is to maintain dominance as a producer of premium cars. Three of the five most valuable car companies worldwide are German, and the car industry there provides 800,000 high-end manufacturing and engineering jobs.

Cars account for almost three-quarters of the kilometres that people travel in Germany. But although registrations for electric cars this July were up by 131.8% on last year’s, only 0.06% of the nation’s cars run solely on electricity. So now what?

First, electric vehicles need access to low-carbon power (see page 26). Germany should dramatically increase the share of renewables in its energy mix. Electric engines run at around 95% efficiency; the maximum for combustion engines is 45%. Their CO_2 emissions are 20–50% lower than those of diesel cars, even if the energy mix is relatively carbon-intensive, as in Germany. Low or even carbon-neutral energy could reduce emissions by 80–100%. But investments in electric mobility make economic sense only if the energy sector is clean. Why? Because cutting one tonne of CO_2 by switching to electric cars costs 100 times more than doing so by changing agriculture practices and 10 times more than by installing wind power.

Second, electric vehicles must become cheaper and easier to charge. Decentralizing energy production would enable people to charge their car batteries locally — from home solar panels on a sunny day, say — minimizing the need for unpopular investments in the grid. Several major car manufacturers have formed a joint venture to deploy thousands of charging points along main travel routes in Europe. But cities need these charging stations too: in car parks, for example. If it is faster, cheaper and more convenient to use an electric car, people will pay slightly more for one. Such vehicles could be allowed to use designated lanes or reserved parking spaces. Governments could subsidize them for the next decade so that they cost the same as conventional vehicles.

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The disruption of reunification in 1990 forced the country to fix some systemic problems, such as a lack of collaboration across institutions. Politicians set about chipping away at the numerous obstacles to cooperation.

In 1999, the federal government that preceded Merkel's — a coalition between the Social Democratic Party and the Greens — amended a law that required *Länder* ministries to make all university decisions, from allocating budgets to making academic appointments. One by one, the *Länder* began allowing universities to run their own affairs.

The same government proposed a major shake up for universities, which had traditionally been considered all of equal status. As one of its last acts, it launched the 'Excellence Initiative' in 2005. Now well established, this encourages universities to compete for federal money to promote top-level research, graduate schools and, most importantly, 'clusters of excellence' — major collaborations with scientists in other research organizations. Universities that win in all categories also earn the title of 'elite', which comes with extra cash.

When Merkel became chancellor later that year, she appointed as education and research minister her like-minded colleague and friend Annette Schavan, who drove the Excellence Initiative through a series of rounds that fundamentally changed German universities. So far, the federal government has poured €4.6 billion into the scheme and a total of 14 universities have won elite status in various rounds. Those that have not yet earned that title have upped their game by trying for it, and by collaborating within clusters, which have opened up other streams of funding. The once-isolated pillars of German science are now working together.

Merkel and Schavan have championed laws that allow the federal government to fund university research directly and allow universities to offer high salaries to attract or keep the best scientists (as civil servants, German academics generally earn less than scientists in other countries or those in industry).

As a result of all these changes, German universities have climbed up the world rankings. In 2005, only 9 German universities appeared in the Times Higher Education top 200. Now, there are 22. The LMU, which tops the German list in most years and has won in each round of the Excellence Initiative, rose from 61st place in 2011 to 30th in 2017.

Physicist Axel Freimuth has been rector of the University of Cologne since 2005 and says the university has changed beyond recognition. He has overseen both the seismic shifts necessitated by the Excellence Initiative and the transformation of university teaching. Around the time he became rector, Germany began converting from its own idiosyncratic, drawn-out diploma system to the European standard of bachelor’s and master’s degrees, which process students more efficiently, in three to five years. With the arrival of university autonomy, Freimuth coordinated a new governance system for his institution. “We have learnt how to act strategically as a university,” he says. “There is a whole new spirit here.”

Cluster bugs

In the meantime, research-cluster fever has taken over Germany. Schavan launched several initiatives to get scientists from different pillars to work together and with industry. Most strikingly, she created a network of national institutes of health under the umbrella of the Helmholtz Association, which bundles nationwide competencies across institutions in health areas such as neurodegeneration or metabolic disease.

Berlin is experimenting with gathering together parts of its health-related research at the Charité teaching hospital and the Max Delbrück Centre for Molecular Medicine, a Helmholtz centre, into a translational-research structure called the Berlin Institute of Health. And the state of Baden-Württemberg has poured hundreds of millions of euros into the Cyber Valley initiative. Launched in December last year, this clusters all regional research in artificial intelligence and is heavily supported by big companies such as BMW, Daimler, Porsche, Bosch and Facebook.

“This clustering really does have a lot of advantages,” says neuroscientist Hannah Monyer, who has joint positions at the University of Heidelberg and the German Centre for Cancer Research, a Helmholtz centre in the same city. Although it requires researchers to spend more time talking and organizing, she says, “it’s the best thing we can do these days”. A cluster set up under one of the rounds of the Excellence Initiative saved her enormous work when her research led her briefly into the unfamiliar area of pain mechanisms, she says. Rather than having to learn everything from scratch, she enjoyed a seamless collaboration with a local behavioural lab, which provided advice, equipment and technical support.

The mega-collaborations are still in a test phase. Vascular biologist Holger Gerhardt left a permanent post at the Crick Institute in London to join the Berlin Institute of Health initiative in 2014. “I know it is all one big experiment,” he says. “But I feel I really might be able to build up something new here.”

The improvements that researchers now enjoy are sometimes challenged by the German cultural desire for administrative and moral order. Gerhardt says he often finds himself reminding cluster partners not to create unnecessary organizational structures. Primate research, although permitted, is very difficult to do. And use of human embryonic stem cells, aside from a few older cell lines, is forbidden — Merkel remains unshakeable on this point.

Germans' moral outrage can also be brutally swift. Merkel made a rare blunder in 2011, when she supported defence minister Karl-Theodor zu Guttenberg after he was proved to have plagiarized his PhD thesis. Merkel immediately argued that such accusations shouldn't matter to his current job; he was not acting as a scientific assistant. But within two weeks, he was forced to resign. Many prominent politicians in Germany have PhDs, and the affair unleashed a crusade to check each of them. Schavan herself faced accusations over her 1980 thesis. Although many scientists did not consider what she did to be plagiarism, she nevertheless had to resign in 2013.

Overall, however, the numbers tell a positive story for science (see 'Germany by the numbers'). The proportion of foreign academics in Germany's universities has jumped from 9.3% in 2005 to 12.9% in 2015. Germany now ranks above the United States for the percentage of papers it publishes among the top 10% most highly cited.

But German science still has some catching up to do, particularly in university infrastructure (see 'Adapt to stay ahead'). Compared with the pristine modernity of non-university research institutes, university facilities look positively shabby. The *Länder* have to bear the costs of increasing numbers of students — who attend for free — and cannot keep up with building repairs. The crumbling concrete of science labs and lecture theatres that shot up when the universities expanded in the 1960s and 1970s is embarrassing, says Wilhelm Krull, general secretary of the Volkswagen Foundation in Hanover, Germany's largest private research funder: "There is a contrast of *Glanz und Elend* — splendour and misery."

Adapt to stay ahead

German science should invest in professorships and cut bureaucracy.

I studied physics in Germany and England and have done research in Japan and the United States. I worked for ten years at a Max Planck institute and have spent another ten at a Leibniz institute. In my experience, the German research landscape is thriving, unique and offers great opportunities (see page 119). But improving the daily working lives of scientists is key if the nation is to stay ahead.

Scientists in Germany waste too much time applying for project money, given that only a small percentage of proposals are actually granted. Then there's the time spent on peer reviewing the exploding number of proposals and initiatives for excellence. All in all, scientists — hired to use their creative minds to come up with innovative ideas— lose thousands of hours in this way. Worse, big funding programmes and evaluation panels are in thrall to major research trends and shy away from radical approaches.

Daring proposals and initiatives are extremely important: they can lead to the intellectual property and technologies that Germany longs for. High-tech start-up firms have not made it into the list of Germany's top 100 companies for decades. What a difference compared with the United States, where young companies such as Alphabet (the parent company of Google) are dominant.

Every funder and institution wants to support promising young scientists, so time-limited programmes abound. But there are too few opportunities available to researchers after these. The best support for the best minds would be to create more professorships, with more resources — perhaps even by rebalancing some funds away from early-career research.

Administrative departments must serve academics, not the other way around. Bureaucracy, a typical German problem, has crept deep into the workings of research institutions. A time-recording scheme might make sense for someone in clerical work, but it doesn't help a scientist. And how can the country attract the best talent from around the world if proposals must be written in German, as several funding agencies demand?

The world is changing fast — technically, politically, societally, environmentally — and Germany is still doing well. But as manufacturing industries face radical changes and countries such as China continue to invest hugely in research and development, we too must adapt.

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Few scientists in Germany see the country leaping back to the very top of the scientific world. For one thing, the German language can be off-putting — even though English is generally spoken in the country's labs these days. The regulations and need for form-filling frustrate many. And, says Krull, "Germany is still somewhat risk-averse. Radical, disruptive innovation is less common here."

What’s more, the country has much to do to improve the representation of women in research. At research institutions, the proportion of women in top scientific positions has risen from a dismal 4.8% in 2005 to a still-meagre 13.7% in 2016. At universities, the share of women holding top-level academic positions has gone from 10% in 2005 to 17.9% in 2014. That still falls well below the average for the European Union. And things hardly look better in industry; Schendel is one of only 3 female board members out of 160 at the country’s top 30 technology companies.

But scientists are generally confident that things will continue to improve steadily. Merkel’s election platform pledges to continue supporting research and innovation, and to raise annual budget increases to 4%. Each day when not travelling, the chancellor goes home to her flat near the Humboldt University to spend what is left of the evening with her chemist husband. Schüth says that it simply comes down to her roots. “She knows what it is to be a scientist, the value of research,” he says. “That tone trickles down from the top.”

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There are currently no comments.

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Cuckoo call adds another layer of deception

The female bird makes a different and much sneakier sound than the male.

05 September 2017

blickwinkel/Alamy

The female cuckoo mimics the call of a hawk to distract nest-owners.

The BBC has just screened an adaptation of Harry Potter author J. K. Rowling's detective story *The Cuckoo's Calling*, and many viewers have been left confused. No spoilers here: but for many watching, the twist ending was a little hard to follow, the misdirection a little too effective. But then the book itself was famously published with some considerable misdirection: Rowling wrote it under the pen name Robert Galbraith because she wanted to see how the public would respond to her passing off her own work as someone else's.

The reverse is more usually true: rather than conceal genuine achievements, fakers employ deception to take undeserved credit for work they themselves didn't carry out. That's a sensible strategy in the animal kingdom, too. More reward for less effort is a recipe for success in the ongoing natural struggle for resources and survival. Parasites get a bad press, but they keep getting away with it. All of which brings us neatly from *The Cuckoo's Calling* to a cuckoo calling.

The common cuckoo (*Cuculus canorus*) is a parasite with good PR. Despite deceiving other birds into hatching its eggs and raising its young — often at the expense of the cuckolded dupe's legitimate offspring — the cuckoo seems to have emerged with its reputation not only intact but enhanced. William Shakespeare may have labelled the cuckoo call a “word of fear unpleasing to a married ear”, but people far and wide still willingly invite the sound into their homes to mark the hourly passing of time.

The female of the species is sneakier than the male. Whereas the proud and visible male cuckoo is responsible for that famous two-note call, it’s the female that does the actual dirty work of leaving usurpers in the homes of others. And her call is very different and rarely heard. But, as it turns out, it too is part of the parasitical package.

In a paper published this week (J. E. York and N. B. Davies *Nature Ecol. Evol.* http://dx.doi.org/10.1038/s41559-017-0279-3; 2017), scientists at the University of Cambridge, UK, reveal a dark twist behind the (female) cuckoo’s calling. The researchers studied the behaviour and impact of the sounds of the birds in a series of field experiments at nearby Wicken Fen. After the female has visited a target nest, she deliberately mimics the frightening calls of a hawk, which puts the parent birds on high alert and distracts them from spotting, say, a new, unusually large and differently coloured egg in their happy home. Instead of discovering the cuckoo’s deception, the parent birds — in this case, reed warblers — then spent their time stretching their necks to peer over the rim of the nest, scanning the sky for incoming hungry hawks.

It’s another example, the researchers say, of how parasites can manipulate and redirect the behaviour of their host species to their own advantage. And this particular cuckoo’s calling sounds — spoiler alert — like a little chuckle.

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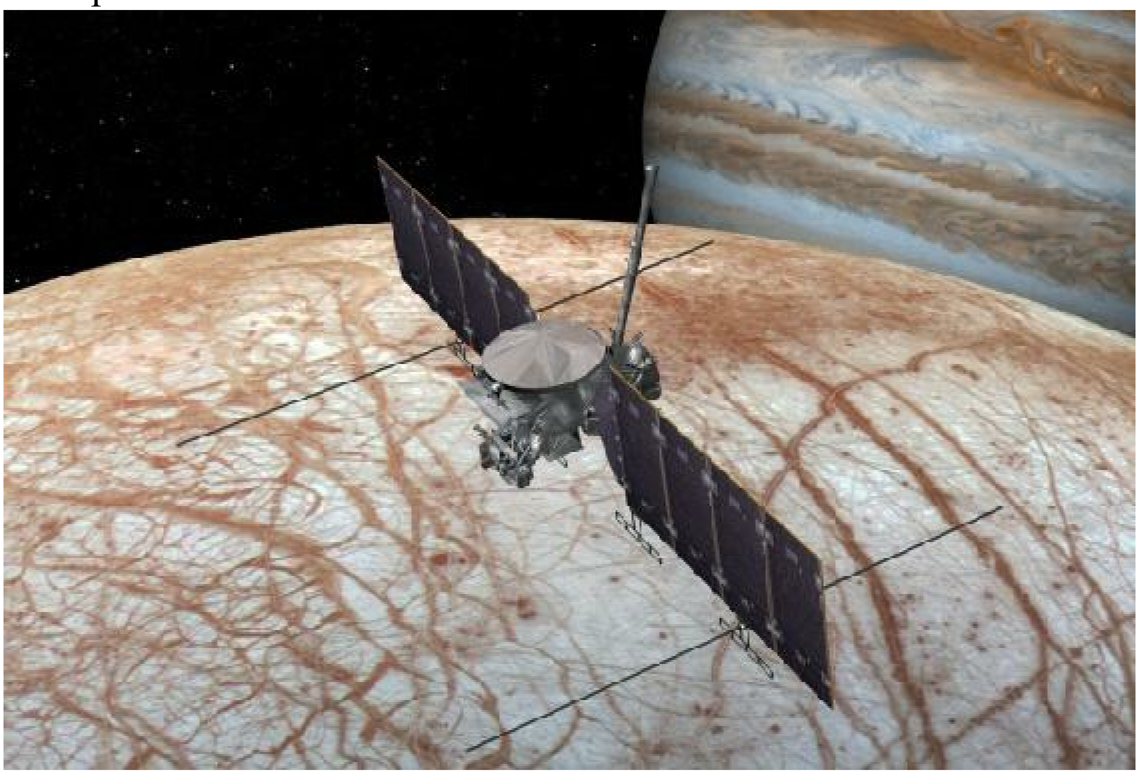
There are currently no comments.

Budget battle looms for US science programmes

Competing spending priorities in the House of Representative and Senate could push funding negotiations into December.

05 September 2017



NASA/JPL-Caltech

NASA's planned Europa missions are among government-funded research for which budgets are up in the air.

Scientists in the United States are nervously watching from the sidelines as the annual budget skirmish heats up in Congress this week. Legislators are back in Washington DC from their August recess with an urgent list of tasks to complete before the country's fiscal year closes at the end of September. In addition to passing a budget to fund the government, they must also raise the debt ceiling so that the country does not default on its loans, and discuss providing emergency-relief funding for victims of Hurricane Harvey.

But legislators are well behind on drafting their 2018 spending plans, which creates uncertainty about how much money science agencies including the National Science Foundation (NSF) and NASA can expect.

Experts say Congress will probably pass a stopgap funding measure to keep the lights on. Government agencies would remain on 2017 funding levels until lawmakers eventually passed a new budget. In the meantime, they would be unable to start new programmes or end old ones without permission from Congress. “We're in for a wait,” says Matthew Hourihan, director of the research and development budget and policy programme at the American Association for the Advancement of Science in Washington DC.

Hashing out the differences between spending bills from the House of Representatives and the Senate for the 2018 fiscal year could take until December, says Amy Scott, a science-funding and policy specialist at the Association of American Universities (AAU) in Washington DC.

Bridging differences

At this current stage of the budget process, the House and Senate diverge on several key scientific priorities. This is reflected in the appropriations bills that have passed through the committees that oversee scientific agencies.

There is a large gulf in the plans for NASA. The House bill would boost the agency’s science programme by US$94 million over the 2017 level of $5.8 billion, whereas the Senate would cut it by $193 million.

Lawmakers in the House have allocated $2.1 billion for NASA’s planetary-science budget — up from the $1.8 billion it received in 2017. The Senate bill, by contrast, would cut $234 million from current spending levels. Support from the House and Senate is reversed for Earth-sciences research. The Senate would maintain 2017 spending levels at $1.9 billion, but the

House would cut it by $217 million for 2018. Despite these differences, negotiations to reconcile NASA's budget tend to go smoothly, says Scott.

A bigger sticking point is funding for the Advanced Research Projects Agency—Energy (ARPA-E), a Department of Energy (DOE) programme focused on incubating innovations in clean energy. The House bill guts ARPA-E and instructs that any remaining money from the $306 million the project received in 2017 be used to "conduct an orderly shutdown" of the programme. The Senate, however, gives ARPA-E $330 million for 2018.

Criticism for the 8-year-old programme often stems from a perceived lack of output, says Julia Smith, a DOE funding and policy specialist at the AAU. "But ARPA-E is young, so we can't say how it has changed your life because we don't know yet."

Another bone of contention is support for the multibillion-euro nuclear-fusion collaboration ITER, which is funded by an international consortium that includes the DOE. The planned facility, under construction at a site in St-Paul-lez-Durance, France, is over budget and suffering continual delays. Congress eventually allocated $50 million for the project in 2017, even though the Senate proposed eliminating its monetary support. For 2018, the Senate is again trying to cut out ITER's US funding completely, whereas the House has proposed an allocation of $63 million.

Polarizing programme

The National Oceanic and Atmospheric Administration (NOAA) may also face funding difficulties. The House slashes its 2018 budget to $5 billion, down from the $5.7 billion the agency received in 2017. The Senate has proposed $5.6 billion for 2018.

The divisions come to a head on an especially contentious item: NOAA's Polar Follow-On programme, which operates satellites that collect data used to predict the weather, including hurricanes. The House has proposed only $50 million for this programme, a huge cut from the $329 million it received in 2017. The Senate, however, would give the programme $419 million.

Money for designing and building three new research vessels for the NSF could also be problematic. Congress gave the agency $122 million for this purpose in 2017. For 2018, the House bill cut out all funding for the ships, whereas the Senate provides the $105 million requested by the NSF. Despite these differences, “this is something that does usually end up getting funded”, Scott says.

It is unclear whether or how items such as the funding aid package for Hurricane Harvey will affect negotiations over the budget and the debt limit, says Scott. Adding to the uncertainty is the fact that the Senate has yet to send half of its appropriations bills — including one that funds the National Institutes of Health (NIH) — through the relevant spending committees.

Judging by deliberations amongst lawmakers so far, experts say that the NIH will probably get a boost from both the House and the Senate. The two chambers “seem to be remarkably in agreement” on NIH funding, says Jennifer Zeitzer, director of legislative relations at the Federation of American Societies for Experimental Biology in Bethesda, Maryland.

But, until Congress starts working on the hurricane funding, “I don’t think we will know how federal science programmes will be affected”, Scott says.

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Science must acknowledge its past mistakes and crimes

Injustice in the name of research should not be forgotten — nor should those injured by scientists.

04 September 2017 Corrected:

1. 07 September 2017

Spencer Platt/Getty

The New York City statue of gynaecologist J. Marion Sims has drawn protests.

Editor's note: *The original version of this article was offensive and poorly worded. It did not accurately convey our intended message and it suggested that* Nature *is defending statues of scientists who have done grave injustice to minorities and other people. We have corrected the headline, standfirst and a line in the text to make clear we do not support keeping those memorials; our position is that any such memorials that are allowed to stand should be accompanied by context that makes the injustice clear and acknowledges the victims.*

We apologise for the original article and are taking steps to ensure that we do not make similar mistakes in the future. We realise that many people disagree with the article more fundamentally; we will be publishing some of the strong criticisms that we have received and welcome further responses.

The statues of explorer Christopher Columbus and gynaecologist J. Marion Sims stand at nearly opposite corners of New York City's Central Park, but for how much longer? Both monuments have been dragged into a nationwide debate about memorials to historical figures who have questionable records on human rights. The arguments are long-standing, but were thrown onto the world's front pages last month when protests against the removal of a statue of Confederate General Robert E. Lee in Charlottesville, Virginia, produced racially charged violence.

Last week, the Central Park Sims statue — one of many that stand in numerous US cities — was vandalized. The word 'racist' was spray-painted alongside his list of achievements, which include life-saving techniques he developed to help women recover from traumatic births. Yet many protest about the lionization of this 'father of modern gynaecology' because he performed his experiments on female slaves.

Sims is not the only scientist whose long-dead head is on the block and whose achievements, and the circumstances around them, are being revisited from the twenty-first century. Institutions in the United States have struggled with the case of Thomas Parran, the US surgeon general who oversaw the infamous Tuskegee study that ran between 1932 and 1972. The researchers enrolled hundreds of African American men who had syphilis, but did not inform them that they had the infection and withheld treatment in an effort to monitor how the disease progressed.

A similar study on Parran's watch happened between 1946 and 1948 in Guatemala, when more than 1,300 people were intentionally infected with diseases including syphilis. The study was not made public until historian Susan Reverby stumbled across research records in 2005. Both studies were performed surreptitiously, as though their perpetrators suspected that what they were doing could be perceived as immoral. The US government has formally apologized for the way in which both studies were conducted.

In 2013, after lengthy debate, the American Sexually Transmitted Diseases Association voted to rename its prestigious Thomas Parran award. "Many [members] were concerned that continuing to offer the Parran award may give the appearance of tacit approval of unethical research," the society said in a statement. The University of Pittsburgh in Pennsylvania is similarly debating whether to rename its Parran Hall (Parran worked at the university after his stint as surgeon general).

Defenders of controversial historical figures argue that they should be judged by their achievements rather than by modern norms. Sims was far from the only doctor experimenting on slaves in 1849, despite the fact that the abolitionist movement was well under way in the United States. And his achievements saved the lives of black and white women alike. But some historians argue that his experiments could have been considered unethical even for his time.

Europe has struggled with these issues for even longer than the United States. After some debate, Oriel College at Britain's University of Oxford last year decided to keep a controversial statue of Cecil Rhodes, the nineteenth-century businessman and committed imperialist.

After the Second World War, cities and institutions were left with streets, buildings, statues and other memorials that were named after people who collaborated with the Nazis or were at least sympathetic to the regime. And in Canada earlier this month, Montreal decided to rename streets and parks named after French Nobel laureate Alexis Carrel, who supported enforced sterilization and eugenics. Other cities in France have already wiped his name from their maps.

Erasing names, however, runs the risk of whitewashing history. Germany's

Max Planck Society — formerly the Kaiser Wilhelm Society — deserves credit for its public acknowledgement that many prominent members worked with the Nazi regime and that the society did not help to protect Jewish scientists.

In cases where painful reminders are allowed to stand, they could be supplemented. Such notes are also standard in biomedical literature. The American Medical Association recommends that if unethically acquired data are essential to science, any use or citation of these data should describe the unethical behaviour and pay respect to the victims of the experimentation.

Institutions and cities could do something similar by installing a plaque noting the controversy, or an equally sized monument commemorating the victims. Such a historical marker stands for Carrie Buck, a young woman who was the first person to be sterilized under a 1924 eugenics programme in the United States, which was designed to eliminate 'genetically inferior' people with mental and physical disabilities. It stands in Charlottesville just a few blocks — but a million miles away — from the disputed statue of General Lee.

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Corrections

Corrected:

The headline, standfirst and the first line of the penultimate paragraph of this editorial implied that *Nature* supported retaining statues of historical figures whose work harmed others. This is not the case. The story has been corrected.

Comments

Commenting is currently unavailable.

Massive Ebola data site planned to combat outbreaks

An international partnership seeks African leadership to organize information about the disease.

04 September 2017

John Moore/Getty

An Ebola awareness mural in Monrovia, Liberia — one of the three West African countries that was hit by a devastating outbreak of the disease starting in 2014.

More than 11,000 people died when Ebola tore through West Africa between 2014 and 2016, and yet clinicians still lack data that would enable them to reliably identify the disease when a person first walks into a clinic. To fill that gap and others before the next outbreak hits, researchers are developing a platform to organize and share Ebola data that have so far been scattered beyond reach.

The information system is coordinated by the Infectious Diseases Data Observatory (IDDO), an international research network based at the University of Oxford, UK, and is expected to launch by the end of the year. At a meeting to discuss Ebola on 7–9 September in Conakry, Guinea, the team heading the platform will seek input from West African scientists, health officials and advocacy groups.

“We are looking for West African leadership in this initiative,” says Laura Merson, associate director of the IDDO.

Local leaders

Africans must be involved in the platform's creation so that they can not only use the existing data, but also improve their capacity to conduct research during future outbreaks, says John Amuasi, an infectious-diseases researcher at the Kumasi Centre for Collaborative Research in Tropical Medicine in Ghana and a member of the platform's steering committee. A true partnership would also lessen the general public's mistrust of scientists, he adds.

During the outbreak, for example, a widespread rumour claimed that the plague was an experiment conducted by the West, which led some people to resist going to clinics and helped Ebola to spread.

Merson and her collaborators want to avoid the kind of data fragmentation that hindered efforts to stop the outbreak in Liberia, Guinea and Sierra Leone. As the Ebola crisis was escalating in October 2014, she visited treatment units in the three countries to advise on research. Merson found tremendous variation in practices, which complicated attempts to merge and analyse the information. For instance, some record books listed lethargy and hiccups as symptoms, whereas others recorded fatigue but not hiccups.

"People were just collecting what they could," she recalls. Non-governmental organizations "were keeping their data private; academics take a year to get it out; and West Africa had set up surveillance but they were siloed from the international systems", she says.

Questions of control

In July 2015, the IDDO received pilot funds from the UK charity the Wellcome Trust to pool anonymized data from the medical records of people who contracted Ebola — and those who survived it — as well as data from clinical trials and public health projects during outbreaks in West Africa, Uganda and the Democratic Republic of Congo. The hope is that a researcher could search for data to help in diagnosing, treating and understanding the disease. The platform would also provide a home for new data as they emerge. A draft research agenda lists questions that the information might answer, such as how long the virus can survive outside the human body, and what factors are associated with psychological issues in those who survive Ebola.

One sensitive issue is deciding who will control the data. Amuasi says that he would have liked the database to be hosted and curated in Africa, rather than in Oxford, because training and paying African researchers to manage the platform would teach them how to use the information and improve their ability to respond to future outbreaks in the region. But he adds that this seems unlikely, because it would raise the cost of the project, and the infrastructure already exists at Oxford.

Merson says that a copy of the database will be maintained in West Africa, although its exact location has yet to be determined. She adds that an African committee may be in charge of deciding who gets access to the data. And she says that fellowships are likely to be made available for West African students who want to work on the database.

It's vital that these discussions happen now, in a period of relative calm, says Jeremy Farrar, director of the Wellcome Trust in London. When the virus emerges again, clinicians, scientists, and regulatory boards will need fast access to data so as not to repeat mistakes made last time. "We need to sit down and make sure we have a data platform in place so that we can respond to a new case of Ebola in hours and days, and not in months and years," he says. "A great danger is that the world will move on and forget the horror of Ebola in West Africa."

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Nature videos help to calm inmates in solitary confinement

Controversial experiment ignites debate over whether scientific work could be used to justify harsh prison tactics.

01 September 2017

Benj Drummond

An inmate watches nature videos in a designated room at Snake River Correctional Institution in Oregon.

A little bit of nature can calm even the most stressed populations of people, according to a study conducted on prisoners in solitary confinement.

In the experiment, researchers found that prisoners who watched videos with nature scenes felt less stressed and weren't as violent as those who didn't. The team, led by ecologist Nalini Nadkarni at the University of Utah in Salt Lake City, published their findings on 1 September in *Frontiers in Ecology and the Environment*[1].

Nadkarni first proposed the study in 2010 while visiting a prison that housed criminals who were considered to be the highest security risks. "Six guards in Kevlar vests and full riot gear had to go in and subdue an inmate in a restraining chair," she says. "I thought, wow, if we could just calm them with nature rather than with Kevlar vests and riot gear, that would be really great." But it took Nadkarni years to find a prison that was willing to let her test her hypothesis.

The experiment's results have now convinced some prison officials to offer inmates access to nature videos. However, critics of the study argue that it could be used to justify the continued use of solitary confinement — a practice that some consider too harsh.

Calming influence

Past research has shown that regularly seeing plants — even from a window — can improve hospital patients' and prison inmates' physical and mental health[2]. Nadkarni went further by studying people in solitary confinement, where inmates typically spend 23 hours a day alone in bare-walled cells.

Her team divided inmates at the Snake River Correctional Institution in Ontario, Oregon, into 2 groups of 24. Those in one group could choose to exercise or, up to five times per week, go to a 'blue room' to watch 45-minute-long videos showing natural scenes such as mountains, forests and oceans. Those in the other group were offered exercise, but no videos.

The researchers and prison staff measured inmates' moods and stress levels, and tracked violent incidents over a year. They found that inmates who had access to videos reported feeling calmer and were involved in 26% fewer violent incidents. The results suggest that nature imagery can help even

society’s most nature-deprived populations, which includes prison inmates, but also residents of nursing homes and inner city areas, says Nadkarni.

The blue room has also helped Snake River to save thousands of dollars in medical costs resulting from altercations and self-harm, says Renee Smith, the institution’s behavioral health systems manager. “We were pretty excited,” she says. The programme is already being replicated in three other states.

Benj Drummond

Nalini Nadkarni interviews a prisoner who participated in the study.

A controversial idea

“It’s certainly a pretty creative naturalistic experiment,” says Lisa Nisbet, a psychologist at Trent University in Peterborough, Canada. “You couldn’t get a much more deprived group of people.”

But she and others caution that it is impossible to know whether exposure to nature had the beneficial effect because no group was shown videos with other content. Without this additional control group, “you can’t really draw any definitive conclusions,” says Marc Berman, a psychologist at the University of Chicago in Illinois.

The study authors acknowledge this limitation, which they say is due to there being an insufficient number of prison staff to implement the additional control condition. But they say that inmates specifically mentioned the videos’ nature content during interviews. One wrote: “The nature project help’s [*sic*] me think clearer to know there is so much more beauty in this world then [*sic*] this prison”.

Not everyone is embracing the study. Opponents of solitary confinement worry that the paper could provide cover for perpetuating a practice that many consider to be cruel and counterproductive. “I would hate to think that this study will be used to justify keeping solitary confinement prisoners in conditions where they are deprived of opportunities to actually experience nature,” says Craig Haney, a psychologist at the University of California, Santa Cruz.

Nadkarni says her collaboration has helped inmates even if it hasn’t dramatically reformed the prison system. “As an ecologist, it is not in my power to change the system of mass incarceration,” she says. “One thing I can do is think about ways that bring the therapeutic value of nature to people who are incarcerated.”

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Comments

Comments

There are currently no comments.

Volcanic views, stalking storks and the ephemeral eclipse

August's sharpest science shots, selected by *Nature*'s photo team.

01 September 2017

Souvenirs of travel

Image Slideshow

1. 

There was plenty to interest the scientifically inclined in the latest National Geographic Travel Photographer of the Year contest. The

Grand Prize winner was this shot of the Colima Volcano in Mexico erupting in December 2015.

Sergio Tapiro Velasco/National Geographic Travel Photographer of the Year

2. 

This picture of Caribbean reef sharks (*Carcharhinus perezii*) was taken with a remote camera in the Gardens of the Queen, a marine protected area near Cuba. This image and the next two earned honourable mentions in the Nature category.

Shane Gross/National Geographic Travel Photographer of the Year

3.

This picture from the Tamba area of Japan shows fireflies signalling for mates above the stairs leading to a shrine.

Yutaka Takafuji/National Geographic Travel Photographer of the Year

4. 

This shot of Mount Bromo erupting in 2016 in Indonesia was taken from the patio of a local hotel.

Reynold Riksa Dewantara/National Geographic Travel Photographer of the Year

Eclipse excitement

Jasman Mander

North Americans turned into literal lunatics on 21 August, as an eclipse sent thousands of obsessed sky-watchers scrambling to see the Moon block out the Sun. Here, a composite image shows the progression of the eclipse as seen from the Lowell Observatory in Madras, Oregon.

Go northwest!

Dan Goldman/AP/REX/Shutterstock

The Northwest Passage through the Arctic Ocean has become a much-examined signifier of climate change. As ice thins, more ships than ever before are attempting to push through this previously impassable sea route. On 29 July, the icebreaker MSV *Nordica* — pictured here — completed the route earlier in the year than ever before. Just a few weeks later, a reinforced

Russian tanker made the journey successfully without an icebreaker escort.

Harvey's toll

Jonathan Bachman/Reuters

Storm Harvey is still bringing death and destruction to the United States, as record rainfall in Texas triggered flooding and evacuations. These people in Houston, Texas, were among many forced to take to the waters to escape.

Stork, stalking

Nicky Classen/Solent News/REX/Shutterstock

This yellow-billed stork (*Mycteria ibis*) began hunting for fish right alongside a photographer’s hide in Kwa-Zulu Natal, South Africa. Nicky Classen was inside the hide earlier this month to capture the shot.

Catching dinner

John Thys/AFP/Getty

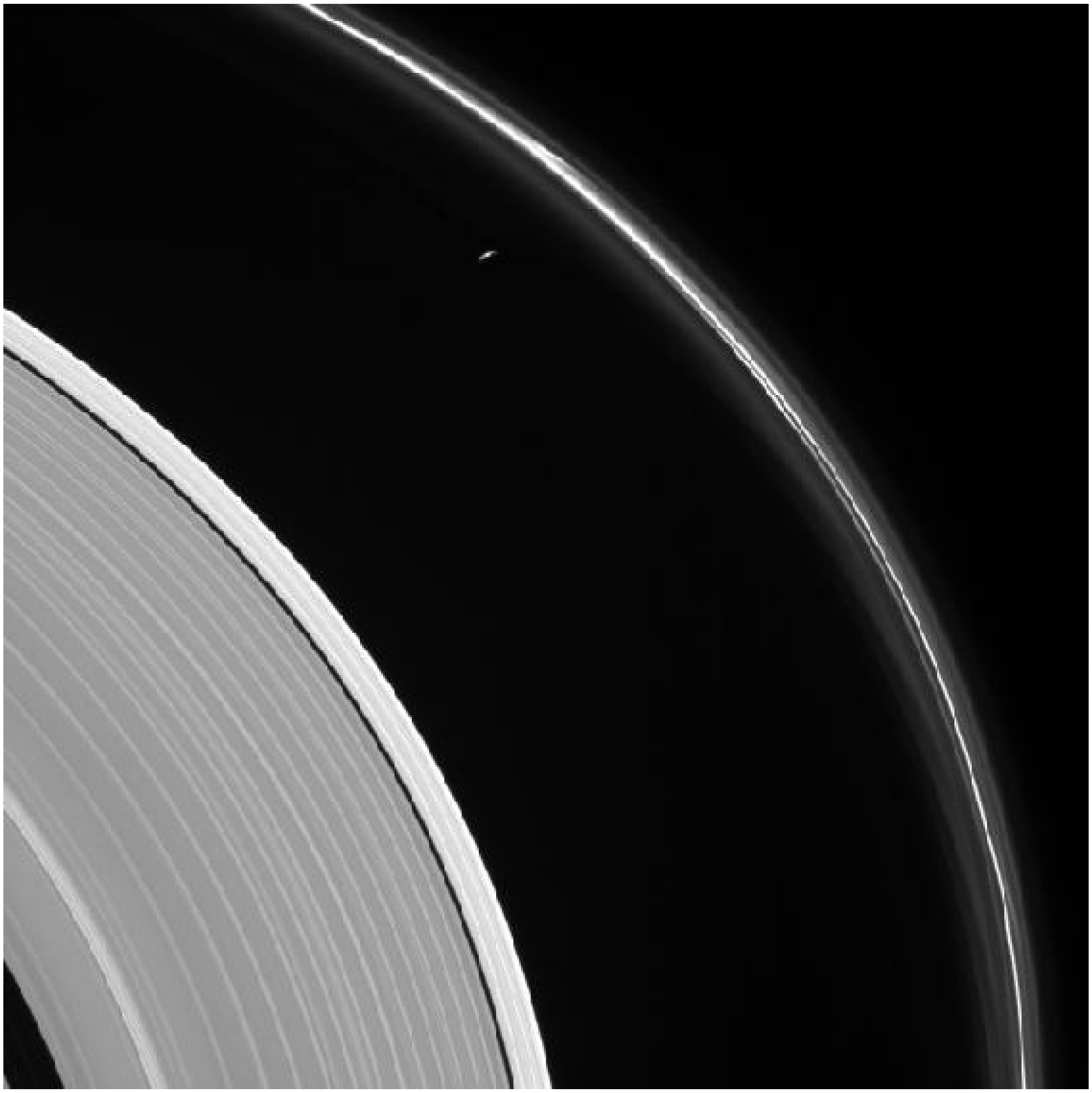
In the Netherlands, lions that were once trained to do tricks in circuses have been taught other skills. This lioness is catching a piece of meat during hunting training.

***Do svidaniya*!**

Joel Kowsky/NASA

On 28 July, a Soyuz rocket shuttled three crew members of Expedition 52 to the International Space Station. The mission plans to test out flexible solar panels that roll out like blankets; explore the physics of neutron stars; and test in rats an experimental drug to deal with bone-mass loss caused by weightlessness.

Cassini’s legacy



NASA/JPL-Caltech/SSI

On 15 September, NASA's Cassini spacecraft will begin a plunge into Saturn's clouds that will lead to its destruction and the end of its 13 years of data collection. *Nature* looks back at some of the pictures the probe has captured, and what they have meant for science.

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Comments

There are currently no comments.

How labs are coping with Hurricane Harvey's devastating floods

Advance planning has kept some Texas facilities safe during the unprecedented storm.

31 August 2017 Clarified:

1. 01 September 2017

Win McNamee/Getty

Now that the rains have cleared over downtown Houston, the long road to recovery can begin.

Hurricane Harvey swept ashore on 25 August and dumped record-breaking amounts of rain on Houston, Texas, over the next several days. As the storm begins to dissipate, scientists in its wake are starting to take stock of the personal and professional toll.

Many institutions in Houston were relatively well prepared for Harvey, having put precautions in place after suffering major losses when Tropical Storm Allison flooded the city in 2001. Facilities in other parts of the state have not been so lucky, but researchers hit by Harvey — now downgraded to a tropical depression — are not being left to fend for themselves. As of 31 August, roughly 200 scientific laboratories across the country have offered computer time, lab space, animal care and spare rooms to researchers displaced by the storm, using the hashtag #SciHelpTX on Twitter.

When Harvey made landfall as a category 4 hurricane, it hit facilities at the University of Texas at Austin Marine Science Institute in Port Aransas particularly hard, ripping the roof off Brett Baker's microbial-ecology lab. Baker says that one of his graduate students has already arranged to transfer to a lab at the University of California, Berkeley, and a postdoc is heading to Uppsala University in Sweden. "Our institute is on a barrier island," Baker says, and it took a direct hit from the storm. Baker spent some time crying, he adds, but is now so busy with logistics that he hasn't fully processed his feelings.

Lessons learnt

Most of the biomedical-research facilities in Houston, including those at Rice University, MD Anderson Cancer Center and the University of Texas Health Science Center, had installed special doors and floodgates to hold back storm waters after Allison. Those precautions saved equipment and animals, says Anirban Maitra, a pathologist at MD Anderson. "I think they prevented a mega-catastrophe," he adds.

Baylor College of Medicine lost 60,000 breast-cancer specimens in the 2001 storm. But the lessons that it learnt have paid off, says spokesperson Lori Williams. "We built a wall around the entire campus," she says. "We've had

no animals lost, no research lost."

The University of Houston (UH), by contrast, does not have special flood infrastructure. So the institution has been dealing with flooded basement labs, and has struggled to keep animals dry and fed. Forty baby rhesus monkeys had their formula milk rationed, says Amr Elnashai, vice-president for research and technology transfer at UH. A few had to be weaned a week early. Supplies of liquid nitrogen and helium are also running low, endangering frozen samples if they cannot be restocked soon. "If the worst is over, then we are fine," says Elnashai. "If there is another hit, then we are in deep trouble."

Personal costs

Meanwhile, staff at the Johnson Space Center in Houston are camping out at mission control to keep the International Space Station and the James Webb Space Telescope (JWST) programmes going. "I came in for a shift Friday night and I've been here ever since," says flight director Courtenay McMillan. Staff have been sleeping on makeshift beds and air mattresses, and subsisting on provisions provided by co-workers and friends. "We have not run out of coffee, which is the most important thing," McMillan adds.

The JWST was in the middle of a 100-day test in a thermal vacuum chamber when Harvey struck, but is unharmed. And a Soyuz capsule landing scheduled for this weekend in Kazakhstan — which the space centre will help to coordinate — will go ahead with only minor modifications to the plan, says McMillan.

Although many institutions have fared relatively well despite the storm's ferocity, researchers and staff are still dealing with personal losses. Officials estimate that at least 38 people have died as a result of the storm. Maitra says that one administrator on his team has been evacuated to a hotel. "She had to leave in a hurry with her kids in the middle of the night. They were stuck on the third floor of her complex for three days. It is just heartbreaking."

Louise Prockter, director of the Lunar Planetary Institute in Houston, was

travelling when Harvey swept into town. She has been trying to support her staff remotely from Washington DC. “Some of our staff have lost all their property,” she says. “It is a mess. For some people, normal is a long, long way off.”

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Clarifications

Clarified:

Louise Prockter originally stated that a lot of the staff at the Lunar Planetary Institute lost all of their property. She misspoke and says it should be some of the staff that lost all of their property.

Comments

Comments

There are currently no comments.

Nature News

周六, 16 9月 2017

Nature News

[周六, 16 9月 2017]

- **Nature News**

Nature News

Nature is a weekly international journal publishing the finest peer-reviewed research in all fields of science and technology on the basis of its originality, importance, interdisciplinary interest, timeliness, accessibility, elegance and surprising conclusions. Nature also provides rapid, authoritative, insightful and arresting news and interpretation of topical and coming trends affecting science, scientists and the wider public.

- **Cassini crashes into Saturn — but could still deliver big discoveries** [周五, 15 9月 08:00]
  Data from spacecraft could help determine the age of Saturn's rings and the persistence of its magnetic field.
- **Seismologists stumped by mystery shock after North Korean nuclear test** [周四, 14 9月 08:00]
  A second jolt felt minutes after this month's detonation continues to confound researchers.
- **Scientists' sexual-harassment case sparks protests at University of Rochester** [周四, 14 9月 08:00]
  Researchers who worked with Florian Jaeger have filed a complaint with the US government after the university cleared his name.
- **Support Ismail Serageldin** [周三, 13 9月 08:00]
  Egypt's courts must listen to dozens of Nobel prizewinners who have defended the founder of the Alexandria Library.
- **Pregnant mice illuminate risk factors that could lead to autism** [周三, 13 9月 08:00]
  Studies highlight link between immune response and unusual neural wiring.
- **Hurricane havoc, deep-ocean floats and Mexico's fatal quake** [周三, 13 9月 08:00]
  The week in science: 8–14 September 2017.
- **Jordan seeks to become an oasis of water-saving technology** [周三, 13 9月 08:00]
  As strains on the desert nation's supply increase, scientists collaborate on projects to keep water flowing.
- **UK gender-equality scheme spreads across the world** [周三, 13 9月 08:00]
  The United States is set to trial a version that will also cover race and disability, while other countries have already embraced the voluntary rating system.
- **The new economy of excrement** [周三, 13 9月 08:00]

Entrepreneurs are finding profits turning human waste into fertiliser, fuel and even food.

- **First quantum computers need smart software** [周三, 13 9月 08:00]
  Early devices must solve real-world problems, urge Will Zeng and colleagues.
- **Q&A: The AI composer** [周三, 13 9月 08:00]
  Computer scientist Luc Steels uses artificial intelligence to explore the origins and evolution of language. He is best known for his 1999–2001 Talking Heads Experiment, in which robots had to construct a language from scratch to communicate with each other. Now Steels, who works at the Free University of Brussels (VUB), has composed an opera based on the legend of Faust, with a twenty-first-century twist. He talks about Mozart as a nascent computer programmer, how music maps onto language, and t…
- **Statues: a mother of gynaecology** [周三, 13 9月 08:00]
- **Statues: for those deserving respect** [周三, 13 9月 08:00]
- **Units: Don't tamper with SI-unit consistency** [周三, 13 9月 08:00]
- **Planet of the five rings** [周三, 13 9月 08:00]
  It's a dream come true.
- **Wallaby milk acts as a placenta for babies** [周二, 12 9月 08:00]
  Gene-expression analysis suggests that marsupial placentas take two different forms.
- **Giraffes could have evolved long necks to keep cool** [周二, 12 9月 08:00]
  Another explanation offered for one of animal kingdom’s most distinctive features.
- **Global fingerprints of sea-level rise revealed by satellites** [周一, 11 9月 08:00]
  Geological processes send more meltwater from glaciers and ice sheets to Earth's mid-latitudes.
- **Deadly Mexico earthquake had unusual cause** [周六, 09 9月 08:00]
  US Geological Survey says tremor was within the Cocos Plate, not at the plate boundary.

Cassini crashes into Saturn — but could still deliver big discoveries

Data from spacecraft could help determine the age of Saturn's rings and the persistence of its magnetic field.

15 September 2017 Updated:

1. 15 September 2017

NASA/JPL-Caltech

An artist's conception of one of Cassini's 'grand finale' orbits around the gas giant Saturn.

At 4:55 a.m. California time on 15 September, hundreds of scientists watched their life’s work go up in flames. The Cassini spacecraft disintegrated in Saturn’s atmosphere in a mission-ending move meant to keep the probe from contaminating the planet’s moons, including Titan and Enceladus, that could harbor signs of life.

Cassini’s final images, transmitted in the hours before its death, included an evocative sequence of Enceladus setting behind Saturn, as well as a final close-up look at some of the planet's rings.

The spacecraft’s last radio signal died away Friday morning as planned when the probe entered the atmosphere at about 113,000 kilometres an hour, roughly 10 degrees north of the planet’s equator. As Cassini plunged to its death, it transmitted a last burst of data from its Ion and Neutral Mass Spectrometer. This instrument measures the chemical composition of gases, and provided scientists with their first direct taste of Saturn’s atmosphere. That data “will be the most exciting result scientifically,” says Ralph Lorenz, a planetary scientist at the Johns Hopkins University Applied Phyics Laboratory in Laurel, Maryland.

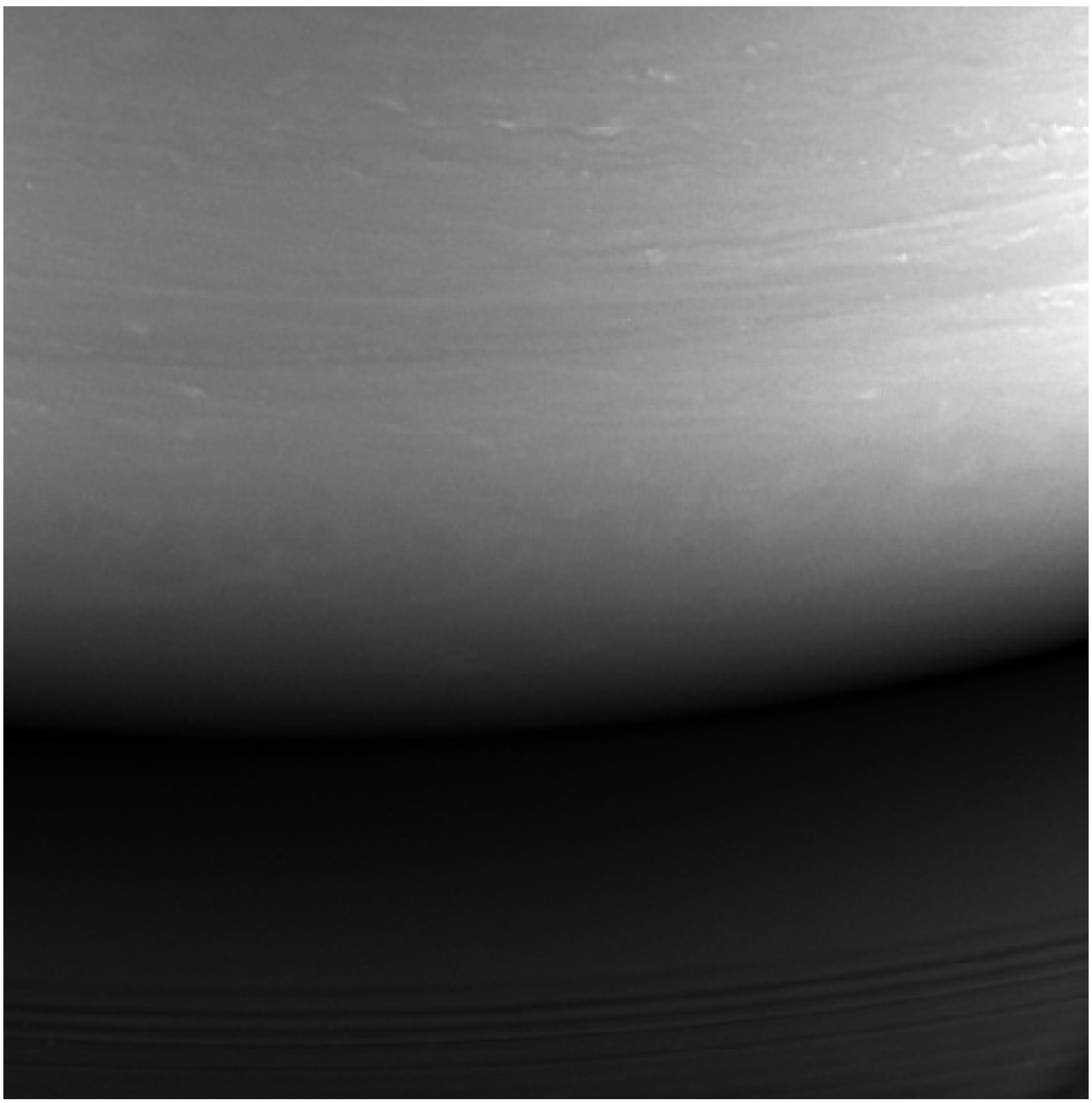
Hidden in the dust

But the research team’s work is not yet over. Many discoveries about Saturn’s moons, rings and interior are likely to emerge in the coming months. Since April, Cassini has carried out a series of 22 orbits, looping between the giant planet and its rings — a perspective never before captured.

During these orbits, Cassini’s Cosmic Dust Analyser, which looks at the size and composition of small particles, has been directly measuring the composition of material in Saturn’s main rings for the first time, says Sascha Kempf, a space physicist at the University of Colorado Boulder. “The data set is rich and surprising,” he says. “Stay tuned.”

The dust data also look set to answer a long-standing question: how old the rings are. By studying how dust falls onto the rings' icy particles and dirties them, the team can estimate how long the rings have been around. Some scientists argue that they date back billions of years, whereas others think that they are much more recent, on the order of 100 million years or fewer. “Please give us a few more days to verify our conclusions, but we are pretty sure that we know the age of the rings," Kempf says. This knowledge will help researchers to narrow down how they formed.

Cassini's gravity measurements are helping researchers to pinpoint other key information about Saturn. By analysing the gravitational effect of the rings on Cassini — a force best measured as the probe plunges between the planet and the rings — researchers are narrowing down their estimates of the rings' mass, as well as the mass of the planet's core, says Luciano Iess, a planetary scientist at the University of Rome La Sapienza.



NASA/JPL-Caltech/SSI

Cassini's last image shows Saturn's night side lit up by light reflected from the planet's rings.

The rings' mass can also be used to help tease out their age, since the more massive the rings, the older they may be. Preliminary analysis of data from Cassini's grand-finale orbits have given Iess and his colleagues their best estimate yet of the rings' total mass. “We cannot release any value yet,” Iess says, “but this is the first indication that we have that probably the rings didn't form together with Saturn.” By comparing those results with the estimate from Cassini's dust analyser, researchers hope to be able to settle the question of ring age once and for all.

A puzzling match

Cassini’s magnetometer has already made some unexpected discoveries. Saturn’s axis of rotation and its magnetic axis turn out to be almost perfectly aligned, says Linda Spilker, the mission’s project scientist at NASA’s Jet Propulsion Laboratory (JPL) in Pasadena, California. That has puzzled researchers, because models have suggested that there needs to be at least a slight offset between the two axes for the planet to maintain a magnetic field.

The finding “suggests that we don’t really understand Saturn’s internal structure and how the planetary dynamo is generated yet”, says Michele Dougherty, a space physicist at Imperial College London. She estimates that it will take another three to six months to crunch through the data and understand exactly what they mean.

Other potential discoveries will require researchers to put together all of Cassini’s data sets from all of its instruments over its entire 13-year study of Saturn. That includes watching the planet and its moons change over time: “We have a whole half-season of changes on Saturn and Titan to study,” says Bonnie Buratti, a planetary scientist at JPL. And finishing the geological mapping of Titan will enable researchers to better understand the moon’s varied terrains, from its windswept dunes to its frozen mountains, says planetary scientist Rosaly Lopes, also at JPL.

Cassini scientists have another year’s worth of funding to tease more secrets out of the data. But after that, there are no US missions on the books to return to Saturn — unless researchers can persuade NASA or other space agencies otherwise. Scientists have submitted proposals to NASA to study Saturn and some of its moons, projects that will be up for consideration later this year as the agency decides on its next set of missions.

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Updates

Updated:

The headline and text have been updated to reflect the fact that Cassini crashed into Saturn as planned.

Comments

Comments

There are currently no comments.

Seismologists stumped by mystery shock after North Korean nuclear test

A second jolt felt minutes after this month's detonation continues to confound researchers.

14 September 2017

JUNG Yeon-Je/AFP/Getty

South Korean officials examine seismic recordings after a nuclear test in North Korea on 3 September.

Eight-and-a-half minutes after North Korea set off a nuclear bomb on 3

September, a second burst of energy shook the mountain where the test had just occurred. More than a week later, researchers are still puzzling over what caused that extra release of seismic energy — and what it says about North Korea's nuclear-testing site, or the risks of a larger radiation leak. Monitoring stations in South Korea have already picked up minute levels of radiation from the test.

A number of theories have emerged to explain the second event, ranging from a tunnel collapse or a landslide to a splintering of the rock inside Mount Mantap, the testing site. But seismologists can't agree and say that they may not get enough evidence to pin down the cause.

"This is an interesting mystery at this point," says Göran Ekström, a seismologist at Columbia University in New York City.

The nature of the first seismic signal is clearer because it matches the profile of a bomb blast. The US Geological Survey (USGS) determined the magnitude of the seismic event associated with the nuclear explosion at 6.3, whereas the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) in Vienna calculated it at 6.1 on the basis of a separate analysis. The explosion was many times the size of past North Korean tests and was the largest seismic signal from a nuclear test ever detected by the international network of seismic monitoring stations used by the CTBTO.

The second event came 8.5 minutes later and registered as magnitude-4.1, reported the USGS. The agency suggested that it was associated with the test and may have been a "structural collapse". The possibility that the smaller shock was caused by a tunnel collapse inside the testing site has dominated discussion in the media. But Paul Earle, a seismologist at the USGS, told *Nature* that was just one possibility that was raised in the immediate aftermath of the explosion. The USGS, he said, was "basing that on previous nuclear tests of comparable size that had a collapse".

Possible signs of a collapse are visible on satellite images taken of the testing site, according to an analysis released on 12 September by 38 North, a partnership of the US-Korea Institute and the Johns Hopkins School of Advanced International Studies in Washington, DC.

Left: Planet Labs. Right: Pleiades © CNES 2017 Distribution Airbus DS/Spot Image

Satellite images before and after the 3 September nuclear test show evidence of landslides and a region of the mountainside that might have sunk.

But the seismic signal doesn't match what would be expected from a collapse, says Lianxing Wen, a geophysicist at the State University of New York at Stony Brook. A collapse would produce mostly vertical movement of rock, but his own unpublished work suggests that the seismic clues point to a large horizontal movement as well, something he says would be more consistent with a landslide.

Sliding scale

Although the satellite data do show a lot of landslides on Mount Mantap, other researchers argue that they could not have caused the magnitude-4.1 event. Much larger landslides, such as at Bingham Canyon mine in Utah in 2013, haven't produced seismic signals close to that size, says Ekström.

He also argues that the seismic signals he has seen do not match the pattern expected from a landslide. Such an event would have longer-duration signals (matching the time that it takes rocks to fall down a slope) and fewer high-frequency waves (because the energy in a landslide is released more slowly than in earthquakes or explosions) than what was recorded in the North

Korean event. He says that a collapse cannot yet be ruled out. The crater formed by a collapse sometimes does not become visible at the surface until much later.

Another theory comes from Ekström's colleague at Columbia, seismologist Won-Young Kim. Kim rules out a collapse, a landslide and the possibility that there was an earthquake triggered by the explosion. He says that the seismic event was probably a rock burst — a violent fracturing of rock around one of the many tunnels under Mount Mantap. That could explain the frequency of the seismic waves, which were lower than an earthquake rupture but higher than a landslide, as well as the other features, he says.

The characterization of landslides and rock bursts could help researchers to assess how unstable Mantap is. Even if the whole mountain isn't going to collapse, as some have warned, subtler signs from landslides or rock bursts could indicate whether a major section of the mountain above the tunnels may have cracked. If so, that could lead to contamination of the mountainous area by radioactive material. "It is difficult to imagine how to contain that, given the altitude and remoteness of the place," says Kim.

Stations outside of North Korea have started to detect radiation from the latest test. On 13 September, the South Korean Nuclear Safety and Security Commission in Seoul announced that several ground- and sea-based monitoring stations downwind of the test site had detected the radioactive isotope xenon-133, an indicator of a nuclear test. However, no other isotopes were detected, preventing a determination of what type of bomb was used. It also did not indicate whether radiation is leaking from the site at a higher rate than expected, said Cheol-Su Kim, the head of the environmental radioactivity assessment department at the Korea Institute of Nuclear Safety in Daejeon, South Korea.

Based on South Korea's ground-based network of reporting stations, overall radiation levels there ranged from 50–300 nanosieverts per hour — no higher than the country's background level.

With reporting by Mark Zastrow

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Comments

Commenting is currently unavailable.

| Section menu | 主菜单 |

Scientists' sexual-harassment case sparks protests at University of Rochester

Researchers who worked with Florian Jaeger have filed a complaint with the US government after the university cleared his name.

14 September 2017 Corrected:

1. 15 September 2017

Adam Fenster/REUTERS

The University of Rochester says it will examine claims that it retaliated against people who reported allegations of harassment.

A sexual-harassment case in the sciences is rocking the University of Rochester in New York, prompting campus protests over the university's handling of allegations against linguist Florian Jaeger.

Seven current and former faculty members of the brain and cognitive sciences department, along with a former graduate student, have filed complaints against the university with the US government. They allege that Jaeger, a full professor in the department, sexually harassed graduate students and postdocs and created a hostile work environment. They also allege that the university, which last year investigated the matter and twice cleared Jaeger of wrongdoing, retaliated against the faculty members who lodged the complaint.

The reports involve at least 11 women who interacted with Jaeger at various points since he arrived in Rochester in 2007. Among other things, the complaints allege sexual encounters with graduate students, parties with students involving illegal drugs and sex, and remarks Jaeger made about the sexual attractiveness of students in front of other faculty members. Jaeger is also accused of pressuring a female student into sharing a house with him and professionally isolating students who would not sleep with him.

Since the details became public in an 8 September news article in *Mother Jones*, University of Rochester administrators have faced protests from students and others on campus. In response, its president, Joel Seligman, has said the university would hire an independent investigator to review claims of retaliation and new allegations in the complaints that were not reviewed earlier by the university. The university will also ask an independent evaluator to review its procedures for dealing with claims of harassment and discrimination, and set up a commission to explore issues of women and gender in academia.

Jaeger will remain off-campus for the rest of the current semester. He declined an interview request from *Nature*.

“This is a very extraordinary case,” says Ann Olivarius, a senior partner at the McAllister Olivarius law firm in London who is licensed to practice law in multiple US states and is co-leading the legal case against the university. (Olivarius was one of the plaintiffs in the US lawsuit that established in 1980 that sexual harassment at a university constituted illegal discrimination.) “It’s the first time in all the decades that I’ve worked in this area,” she says, “that senior faculty combined with junior faculty to make a stand and say, ‘This behaviour is unacceptable and we need to do something about it'.”

The group filed its eight identical complaints — one per complainant — with the US Equal Employment Opportunity Commission (EEOC) beginning on 30 August. The commission is responsible for enforcing federal laws that make it illegal to discriminate against an employee because of their gender, among other factors.

Richard Aslin, a developmental psychologist and member of the US National Academy of Sciences, resigned from the university in December in protest over its handling of the Jaeger investigation. He had worked at the university for more than three decades, including stints as a dean and as a vice-provost. Six of the seven other co-authors of the complaint have also left, or plan to leave, the university — most for reasons directly related to the incident.

Controversy on campus

In a 10 September statement, Seligman wrote that the core allegations “were investigated, appealed and found to be unsubstantiated”. And in an e-mail to department members on 9 September, department chair Greg DeAngelis wrote, “I want to assure you that [department] faculty and staff care deeply about the safety, security, and well-being of our students and the importance of a welcoming and safe workplace.” (DeAngelis did not respond to *Nature*'s request for comment on the matter.)

But the university response did not go over well with many students, some of whom set up a Facebook page to protest the administration's handling of the case. On 12 September hundreds of them met for a heated three-hour town hall with Seligman; the following day, hundreds more turned out to protest in front of the university library. The protesters had been planning to turn out at Jaeger's undergraduate linguistics class, but another instructor has taken over that class for the rest of the semester.

In a 12 September e-mail to students in that class, Jaeger wrote: “I am incredibly sorry for the emotional turmoil you must be experiencing....I will likely respond in more in depth to the allegations against me,” but “it will take time to reply in a way that does not unwittingly cause harm to witnesses.”

Yiyun Huang/Campus Times

Protesters attended a three-hour town hall with University of Rochester president Joel Seligman on 12 September.

Jaeger works on developing computational frameworks for language production and understanding, including how noise affects communication. He has won a number of prestigious fellowships and this summer co-directed a summer institute in cognitive neuroscience in Santa Barbara, California, that was sponsored by the Kavli Foundation of Los Angeles, California, and the US government.

On 9 September, Jaeger had been scheduled to give the closing keynote address at the Architectures and Mechanisms of Language Processing conference at Lancaster University, UK. After the *Mother Jones* story appeared on 8 September, he and the conference organisers mutually agreed to cancel the talk, according to a university spokeswoman.

Jaeger’s behaviour came under scrutiny in early 2016, when he allegedly said at several faculty meetings that he saw no problem with faculty members dating students. Aslin and other faculty members began discussing the subject and discovered what they say is a string of sexual predations by Jaeger over the years. “We had all these concrete examples of something that we knew was wrong,” says Jessica Cantlon, an associate professor in the department.

She and Aslin led the formal complaint to the university on behalf of students, arguing that Jaeger had violated its policy against discrimination and harassment. The university investigated and concluded — initially, and then again after an appeal — that Jaeger had not violated any university policies. That included its policy on intimate relationships, which forbids such relationships between faculty members and any member of the university community over whom they exercise academic authority. While the university's investigation was underway, Jaeger was granted a full professorship.

Two investigations

The complainants say that the investigation did not gather enough information to accurately assess whether Jaeger violated university policies or not. “They must have a really peculiar definition of what sexual misconduct is, and one that doesn’t align with the rest of the world,” Cantlon says. The 11 women from whom the group gathered witness statements describe Jaeger — among other things — allegedly sending photographs of his genitalia, describing how a student should walk in front of him while reading manuscripts to him as he sat on a couch, and having loud sex with students within earshot of other students.

“The problem isn’t being sexual — the problem is doing that across boundaries that involve power and authority over people,” says Elissa Newport, a cognitive psychologist at Georgetown University in Washington DC. As head of the University of Rochester brain and cognitive sciences department from 1998 to 2010, she hired Jaeger there; she is now among the complainants. “It’s important for faculty members to understand that these are students in your charge, and you don’t take advantage of that.”

After the initial investigation found that Jaeger had not violated any university policies, one of the complainants filed a separate complaint alleging that Jaeger had engaged in retaliatory behaviour against her. The university commissioned an external investigator, who found no evidence of retaliation.

In the EEOC filings, the wider group of eight complainants now also alleges additional instances of retaliation. In one instance the department chair allegedly disparaged them in front of the entire department faculty; in another, provost Robert Clark sent a memo to the department’s faculty criticizing what he called “rumors” and “misinformation” about the investigation. “The University considers the matter closed,” he wrote. “I affirm that Dr. Jaeger is a valued member of our faculty.”

The university will now look into these new allegations of retaliation. “I think it shows that the original investigation was flawed,” Cantlon says. “Like the students said in the town hall, the university’s claims and actions don’t pass the smell test.” (Sara Miller, a spokeswoman for the university, says that “we do not believe the original investigation was flawed”.)

The complainants allege that Rochester administrators searched their university e-mails without their knowledge, a step that Cantlon says was the last straw for her. Like the other complainants who are still on the department’s faculty, she is looking for a new job. “I was on a particular trajectory in my career that’s been disrupted,” she says. “Now I’ll move my whole laboratory, and go and try to start somewhere else.”

Looking ahead

Erika Marín-Spiotta, a biogeochemist at the University of Wisconsin–Madison, says that sexual harassment can derail or even end the careers of many scientists. She is leading a US$1.1-million initiative funded by the US National Science Foundation to develop strategies to help scientists respond to and prevent sexual harassment on campus and in the field. “We so often hear that people don’t know how to respond in these instances,” Marín-Spiotta says. She hopes her group can roll out tools in the next few years to help faculty members better intervene in incidents of sexual harassment involving graduate students in their departments. The Rochester case, she notes, is rare in having so many faculty members unite and come forward on behalf of their younger colleagues.

The EEOC will now investigate the complaint — including a response yet to be filed by university administrators — and determine whether discrimination occurred. If the commission does find evidence of discrimination, it could attempt to broker a settlement with the university or pursue a legal remedy. In the meantime, Rochester is left to deal with a department in turmoil.

Newport says that she and the other complainants see larger principles at stake. “The main reason we decided to go public is because we wanted the university’s processes to be reformed,” she says. “It wasn’t meant to be about Florian — it’s meant to be about harassment and retaliation.”

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Corrections

Corrected:

> This story originally stated that after the initial investigation into Jaeger, the eight complainants filed a second complaint containing allegations that they said showed the university had retaliated against them. In fact, the complaint filed at that time came from just one of the complainants

and did not contain such allegations. These allegations surfaced later in complaints the group of eight filed with the US Equal Employment Opportunity Commission.

Comments

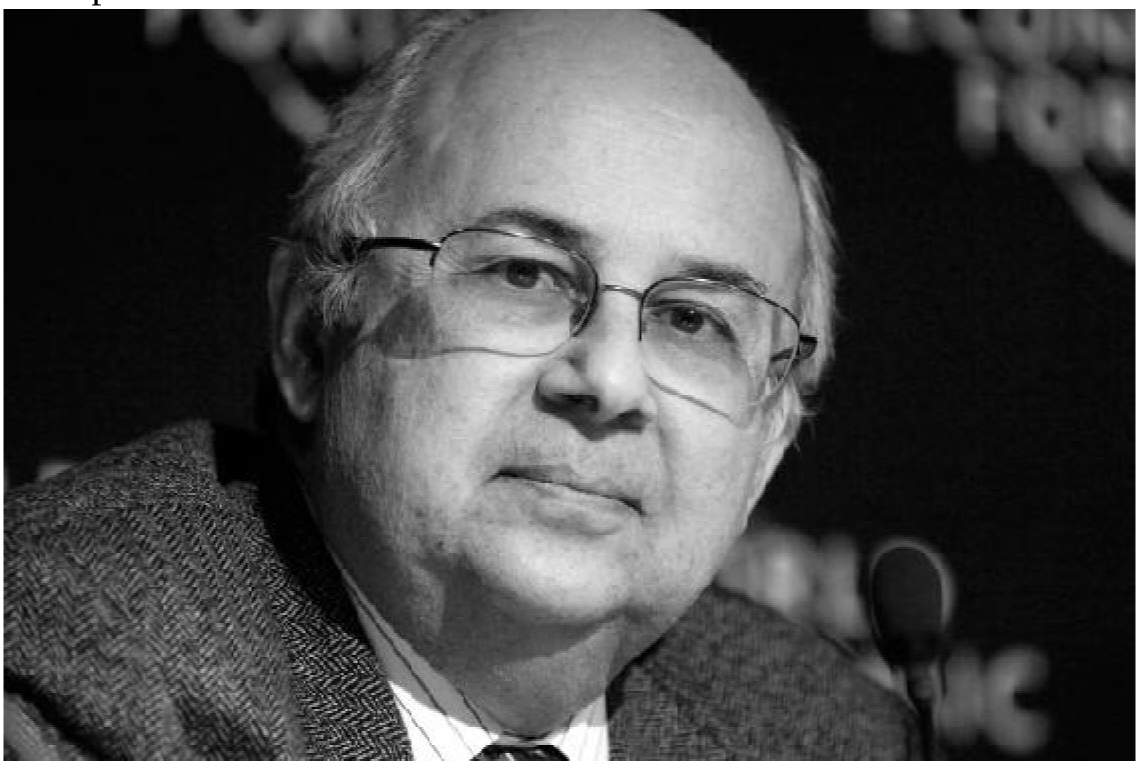
Comments

There are currently no comments.

Support Ismail Serageldin

Egypt’s courts must listen to dozens of Nobel prizewinners who have defended the founder of the Alexandria Library.

13 September 2017



Adrian Moser/Bloomberg/Getty

An appeals court in Egypt will next week consider the conviction of Ismail Serageldin.

Next week, an appeals court in Egypt will consider the case of Ismail Serageldin — the retired founding director of the Bibliotheca Alexandrina, or Alexandria Library — who has been convicted of negligent management of the library and sentenced to three-and-a-half years in jail. Some 90 Nobel prizewinners, among others, have signed a letter of concern stating their confidence in Serageldin's integrity. The guilty verdict he received appears to be a miscarriage of justice. The sentence is cruel and unduly harsh. He should go free.

Serageldin disputes the charges, which many fear are politically motivated. He is a forthright proponent of a liberal interpretation of Islam who was appointed by the regime that was overthrown in the 2011 revolution in Egypt, part of the Arab Spring uprising across the Middle East. His case is significant in a region where the hopes of the Arab Spring — including those for a flourishing of education and science — have mostly been dashed.

The political turmoil that followed the uprising against the regime of Egypt's then-president, Hosni Mubarak, was a time for opportunists. Some library workers with grudges, together with those who considered Serageldin a Mubarak stooge, issued more than 100 different accusations against him, ranging from corruption to money laundering. Prosecutors investigated for more than a year. Finding no evidence, they dropped the criminal charges and instead referred three minor accusations of negligent management to an administrative court in 2012.

One of the three charges claims that the 110 permanent library staff (the other 2,300 employees are on renewable contracts) were not given enough to do, and thus their government salaries were being wasted. Another refers to a collective life-insurance policy that had been taken out on behalf of staff, which they objected to. The charge claims that Serageldin, who cancelled the policy after three years, deceived the board of directors into agreeing to repay staff for the contributions they had made. The third charge claims that Serageldin incorrectly negotiated a favourable rent for a cafeteria to operate in the Bibliotheca Alexandrina, without putting it out to public tender.

Nothing happened for a few years while the court waited for the prosecution to submit a technical report about the case, which finally arrived this year. Serageldin says that the report led him to expect a dismissal of all charges. Instead, the court found him guilty. And rather than dishing out the usual modest fine for such cases, it issued a prison sentence, something usually reserved for cases in which negligence leads to loss of life.

The ruling incited a media storm in Egypt and the international academic community. The letter from the Nobel prizewinners declares that they have "confidence in the integrity of Ismail Serageldin" and notes their appreciation of his work in the creation of the library, which they describe as "a beacon of enlightened values for the region and for the world".

The Mediterranean city of Alexandria became the main intellectual and cultural centre of the ancient Hellenic world when the original Bibliotheca Alexandrina was created there in the fourth century bc. Many of the great scientists in the region worked there, from Euclid to Archimedes. It burnt down in the second century ad and scholarship in the region went into decline.

Serageldin returned to Egypt from abroad to revive the library in 2001, recreating its spirit for the digital age. He wanted to do something meaningful for his country and left a prestigious post as vice-president of the World Bank to do so.

The library is now a thriving haven of scholarship, rationalism and internationalism. It has gained respect, nationally as well internationally. During the days of the Arab Spring, impassioned employees and other supporters formed a human chain to protect the facility from being plundered. By contrast, tens of thousands of manuscripts and books were lost in a fire after clashes at the Institut d'Egypte in Cairo. (Fortunately some of the documents, including the 20 scholarly volumes of the historically valuable *Description de l'Égypte* commissioned by Napoleon in the early nineteenth century, had at least been digitalized at the Bibliotheca Alexandrina.)

Now, it is Serageldin himself who needs support from all who care about what he achieved and what it stands for.

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Pregnant mice illuminate risk factors that could lead to autism

Studies highlight link between immune response and unusual neural wiring.

13 September 2017

Steve Gschmeissner/SPL/Getty

Studies in mice show infection in pregnancy can affect neural development of babies.

A century ago, a largely forgotten, worldwide epidemic that would kill nearly a million people was beginning to take hold. Labelled as sleepy sickness — or more properly encephalitis lethargica — the disease caused a number of bizarre mental and physical symptoms and frequently left people in a catatonic state, sometimes for decades. (Oliver Sacks described his successful treatment of some of them in 1969, in the book *Awakenings*.) The cause has never been officially pinned down, but the most common suggestion is that some kind of infectious agent triggered an autoimmune response, which targeted and inflamed part of the brain.

The role of the immune system in mental disorders is subject to much important research at the moment. The onset of conditions from depression and psychosis to obsessive–compulsive disorder has been linked to the abrupt changes in biology and physiology that occur when the body responds to infection, especially in childhood. And some researchers have traced the possible chain of events back a generation. Studies have highlighted that pregnant women could react to infection in a way that influences their baby's developing brain, which could lead to cognitive and neurodevelopmental problems in the child.

One consequence of this 'maternal immune activation' (MIA) in some women could be to increase the risk of autism in their children. And two papers published online this week in *Nature* (S. Kim *et al. Nature* http://dx.doi.org/10.1038/nature23910; 2017 and Y. S. Yim *et al. Nature* http://dx.doi.org/10.1038/nature23909; 2017) use animal models to examine how this might happen, as well as suggest some possible strategies to reduce the risk.

Kim *et al.* looked at the impact of MIA on the brains and behaviour of mice. They found that pregnant female animals exposed to circumstances similar to a viral infection have offspring that are more likely to show atypical behaviour, and they unpick some of the cellular and molecular mechanisms responsible. Some of their results confirm what scientists already suspected: pregnancy changes the female mouse's immune response, specifically, by turning on the production of a protein called interleukin-17a. But the authors also conducted further experiments that give clues about the mechanisms at work.

The types of bacteria in the mouse's gut seem to be important. When the scientists used antibiotics to wipe out common gut microorganisms called segmented filamentous bacteria in female mice, this seemed to protect the animals' babies from the impact of the simulated infection. The offspring of mice given the antibiotic treatment did not show the unusual behaviours, such as reduced sociability and repetitive actions. Segmented filamentous bacteria are known to encourage cells to produce more interleukin-17a, and an accompanying News & Views article (C. M. Powell *Nature* http://dx.doi.org/10.1038/nature24139; 2017) discusses one obvious implication: some pregnant women could use diet or drugs to manipulate their gut microbiome to reduce the risk of harm to their baby if an infection triggers their immune response. Much science still needs to be done before such a course could be recommended — not least further research to confirm and build on these results.

Yim *et al.* analysed the developing brain of mice born to mothers who showed MIA. They traced the abnormalities to a region called the dysgranular zone of the primary somato-sensory cortex (S1DZ). The authors genetically engineered the mice so that neurons in this region could be activated by light, and they showed that activation of S1DZ induced the same telltale atypical behaviours, even in mice that were born to mothers with no MIA.

It’s unusual to be able to demonstrate such a direct link between the activities of brain regions and specific behaviours — although plenty of work on mental disorders makes a strong theoretical case for linking particular conditions to over- and under-active brain zones and circuitry.

Encephalitis lethargica, for example, has been linked to changes in the deep regions of the basal ganglia, and the disease produces symptoms that are similar to those often seen in autism, including stereotyped and repetitive behaviours. Yim *et al.*’s study shows that the S1DZ region projects to one of those deep brain regions — the striatum — and that this connection helps to trigger repetitive actions in the animals. But S1DZ also connects to a separate, distinct, region in the cortex, and this is what seems to drive the changes in sociability.

Taking the two studies together, it’s tempting to draw parallels with mechanisms that might increase the risk of autism in some people and explain some of its symptoms. Scientists and others should be cautious about doing so — much can change when results from animal models are applied to human biology. But the studies do offer some intriguing leads.

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Hurricane havoc, deep-ocean floats and Mexico’s fatal quake

The week in science: 8–14 September 2017.

13 September 2017

Events | Policy | Environment | People | Facilities | Awards | Trend watch

EVENTS

Hurricane Irma wreaks lethal havoc Caribbean islands and the US state of Florida are reeling in the wake of Hurricane Irma, which has killed at least 30 people since it first made landfall in Barbuda on 5 September. At its height, Irma was a category-5 storm, with winds that reached speeds of more than 297 kilometres per hour. The hurricane caused extensive damage on its march through the Caribbean, levelling buildings, downing power lines and flooding roads and homes. Photos and reports from Barbuda, Anguilla and St Martin reveal barely habitable islands where many people are without shelter, food or even clean water days after the storm hit. As *Nature* went to press, Irma had been downgraded to a tropical depression, and was churning its way through Georgia.

Gerben van Es/Dutch Defense Ministry/AFP/Getty

Fatal quake A deadly magnitude-8.2 earthquake struck the southern coast of Mexico on 7 September, killing dozens of people and injuring at least 200. The tremor prompted mass evacuations along the country’s Pacific coast, as scenes of demolished buildings, teetering streetlight posts and blacked-out subway stations circulated on social media. The region in which the earthquake struck is one of the most active seismic zones in Mexico, and includes the area where the Cocos plate dives under the North American plate. But this quake occurred within the Cocos plate, as it warped or bent, not at the boundary with the North American plate, according to the US Geological Survey. Seismologists say this type of fault does not usually produce such large earthquakes, and they are not yet sure why this tremor was so massive.

POLICY

AI computing deal Computing giant IBM announced on 7 September that it plans to invest US$240 million in research on artificial intelligence (AI), in a ten-year partnership with the Massachusetts Institute of Technology in Cambridge. The deal aims to recruit at least 100 AI experts from industry and academia to a new MIT–IBM Watson AI Lab. The partnership will seek to create machine-learning algorithms and AI hardware. It will also study the social impacts of AI and its business applications, focusing on health care and cybersecurity. The announcement comes after five years of declining revenues for IBM, in an industry where talent is scarce and in high demand from competitors such as Google and Microsoft.

US budget US President Donald Trump and Congress have reached a temporary agreement to fund the government until 8 December. On 8 September, Trump signed into law a stopgap spending bill that would continue the current funding levels for federal agencies into the start of the 2018 fiscal year, which begins on 1 October.

Brexit plans The British government has laid out how it would like to handle future scientific relationships with the European Union after it leaves the bloc next year. A policy document published on 6 September lacks specific proposals but says the United Kingdom would "welcome discussion" about remaining a member of the huge Horizon 2020 funding programme, as well as involvement in space, nuclear and defence research-and-development programmes. But it warns that any payments required to remain part of such projects would be weighed "against other spending priorities".

ENVIRONMENT

Record wildfires While the southeastern United States has endured two category-4 hurricanes within two weeks, the western states have been going up in flames. Fires have torched about 3.3 million hectares so far this year — an area larger than the US state of Maryland — and the country is set to exceed the annual average of hectares burnt over the past 10 years. Flames destroyed a historic, 103-year-old hotel in Montana's Glacier National Park in late August, and a wildfire continues to burn in Sierra National Forest near Yosemite National Park in California. Los Angeles saw its largest fire on record in early September, with more than 2,000 hectares destroyed, as did

British Columbia in Canada, where about 895,000 hectares have burnt.

PEOPLE

Nobel winner dies Nobel-prizewinning physicist Nicolaas Bloembergen (pictured) died on 5 September, aged 97. The Dutch-born American won the 1981 prize jointly with Arthur Leonard Schawlow for his contribution to the development of laser spectroscopy, a technique used to study the properties of atoms. Bloembergen, who spent more than 40 years of his career at Harvard University in Cambridge, Massachusetts, explored ways to make lasers in a wider range of wavelengths, and carried out pioneering early experiments in nuclear magnetic resonance.

FACILITIES

Deep-ocean floats The US National Oceanic and Atmospheric Administration (NOAA) has partnered with Microsoft co-founder Paul Allen to probe the depths of the Atlantic Ocean east of Brazil. Under the joint initiative, which was announced on 7 September, Paul G. Allen Philanthropies, based in Seattle, Washington, will provide US$4 million to help NOAA deploy 25 autonomous floats. Known as Deep Argo, the network will collect data on water temperature and salinity down to 6,000 metres every 15 days, allowing researchers to study ocean circulation and long-term climate trends. The project builds on Argo, a collection of nearly 4,000 floats that monitor the upper 2,000 metres of the ocean.

Canadian telescope Construction of the Canadian Hydrogen Intensity Mapping Experiment (CHIME) was completed on 7 September. The radio telescope, which is near the town of Penticton, British Columbia, will allow astronomers to study hydrogen emissions from ancient galaxies to probe the rate of expansion of the early Universe. The telescope will also hunt for mysterious signals known as fast radio bursts (FRBs), with researchers hoping to see as many as a dozen per day. Testing and calibration will now begin, with hydrogen mapping and FRB searches expected to start by the end of the year.

AWARDS

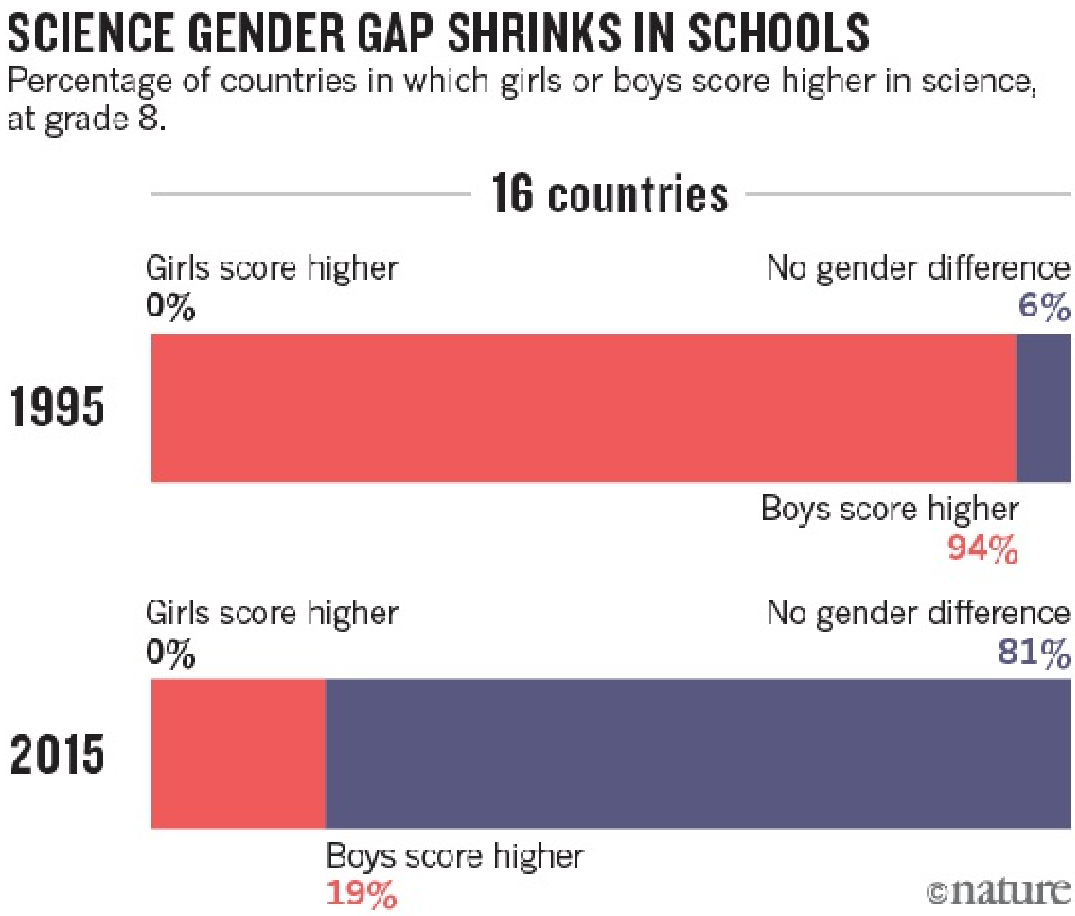
Lasker honours The Lasker Awards — prestigious medical prizes often called the American Nobels — are honouring women's health this year, the Lasker Foundation announced on 5 September. One award went to Douglas Lowy and John Schiller at the US National Cancer Institute for their foundational research on vaccines against human papillomavirus (HPV). The virus is a leading cause of cervical cancer, and studies suggest that HPV infections also increase a woman's risk of acquiring HIV. The vaccines are now recommended in the United States for people aged 26 and younger. Another prize went to Planned Parenthood, a US-based non-profit organization that strives to make reproductive health-care services, including HPV vaccines and cervical-cancer screening, available to all — including those without health insurance.

China award The winners of the Future Science Prize, three awards for discoveries made in China, were announced on 9 September. Shi Yigong of Tsinghua University in Beijing won the life-science category for work on the eukaryotic spliceosome, while Pan Jian-Wei at the University of Science and Technology of China in Hefei netted the physical-science prize for work on quantum optical technology. Xu Chenyang of Peking University in Beijing won the mathematics and computer-science award for research on birational algebraic geometry. Each will receive US$1 million, and an awards ceremony will be held in Beijing on 29 October.

Balzan prizes The 2017 Balzan prizes have been awarded to astrophysicist Michaël Gillon at the University of Liège, Belgium, for his discoveries of exoplanets around nearby stars, and to the immunologists Robert Schreiber at Washington University in St. Louis, Missouri, and James Allison at the University of Texas MD Anderson Cancer Center in Houston for their research into how tumours evade immune control and the development of cancer immunotherapies. Each prize comes with 750,000 Swiss francs (US$790,000), half of which must be given to research projects, preferably carried out by young scientists. The Balzan Foundation, based in Zurich, Switzerland, changes the research areas it recognizes each year. In 2018, they will include fluid dynamics and chemical ecology.

TREND WATCH

A report into the gender gap in science education contains some good news. *Cracking the Code*, released by the United Nations Educational, Scientific and Cultural Organization on 28 August, found that in high- and middle-income countries, the gap in school test scores has shrunk massively since 1995. In 13 out of 16 countries, the study found no difference in science test scores between girls and boys. But girls in regions such as Latin America and sub-Saharan Africa remain particularly disadvantaged.



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Comments

Comments

There are currently no comments.

Jordan seeks to become an oasis of water-saving technology

As strains on the desert nation’s supply increase, scientists collaborate on projects to keep water flowing.

13 September 2017

Umm El-Jimal, Jordan

Neil Brandvold for Nature

Bert de Vries heads a project to restore an ancient water system near the town of Umm el-Jimal, Jordan.

For centuries, the land now called Jordan has been one of the world's driest places. Today, the nation's water supply is more constrained than ever: wells are running dry, groundwater is increasingly polluted and precious water leaks from old pipes. Waves of refugees are stretching resources even thinner: Jordan's population has swelled from 5.9 million in 2006 to 9.5 million in 2016.

The average amount of water available annually per person is less than 150 cubic metres — one-sixtieth the amount that is available to a person in the United States. Researchers, who expect the situation to worsen as temperatures rise and precipitation levels drop with climate change, are coming to Jordan to collaborate on water-technology research and development.

Samer Talozi, a water expert at the Jordan University of Science and Technology in Irbid, says that the country has become an international test bed because of the environmental, structural and social challenges to its water supply. "If we can build systems that work in Jordan," he says, "they will work everywhere."

But not all technologies evolving in Jordan are new. In August, Hassan Fahad al-Rhaibeh, the mayor of the Jordanian town of Umm el-Jimal, was re-elected after pledging to restore reservoirs built by Arabs as early as AD 90. Winter rains and run-off from mountains in Syria — 10 kilometres to the north — once streamed through canals and into basalt-block reservoirs, which stored the water throughout parched summers. People maintained the system for 800 years, through the Roman, Byzantine and Islamic eras, until the town was abandoned around AD 900. Today, those living around the ruins rely almost entirely on deep wells drilled after 1990. They complain that the well water smells and tastes salty.

Mayor al-Rhaibeh recalls an evening in November 2015, after archaeologists and engineers had restored the first of the original reservoirs — a rectangular basin the size of four Olympic swimming pools. "About one hour before midnight," he says, "water began streaming into the reservoir, and I stayed up late into the night to watch it."

The project continued this summer under the watch of Bert de Vries, an archaeologist at Calvin College in Grand Rapids, Michigan. Engineers from the college's Clean Water Institute mapped which canals channel the most run-off. Al-Rhaibeh expects that, once completed, the system will provide 10% of the supply needed to support about 4,000 people in the community surrounding the ruins. "It's becoming apparent that if people don't return to some reliance on surface water, they will run out and farms will dry up," de Vries says.

In 2012, a report from US intelligence agencies predicted that water scarcity, coupled with poverty, social tensions and weak political institutions, could lead to conflict in the Middle East. It was not the first such warning. The US Agency for International Development has invested more than US$700 million since 2000 to develop water technology in Jordan, as a way of preventing that outcome.

Neil Brandvold for Nature

This ancient canal system was recently excavated near Umm el-Jimal, Jordan.

Researchers are choosing to work in Jordan, as opposed to other arid nations, because of its geopolitical stability and support from the Jordanian government. Talozi spent this summer teaching officials and private-sector staff how to use modelling software from the Jordan Water Project, an international consortium of researchers based at Stanford University in California. The software takes into account an array of factors, including urban growth and water prices, to guide decisions about repairing or replacing water infrastructure and siting developments that might pollute groundwater, such as a refugee camp or a landfill. “Previously, there was software for the management of water according to physical parameters like precipitation, surface run-off and the efficiencies of the system,” Talozi says, “but we wanted software that not only recognizes physical elements, but institutional behaviours that govern those systems, and considers economics.”

He is also collaborating with scientists at the Massachusetts Institute of Technology in Cambridge on a low-pressure ‘drip’ irrigation technology that’s thrifty with water and requires about half the energy of standard drip irrigation. The team has tested its technology in olive, citrus and pomegranate farms this summer, and plans a version in the next two years that will be powered by solar energy.

And the Helmholtz Centre for Environmental Research in Leipzig, Germany, is collaborating with the Jordanian government to test small, soil-filtered waste-treatment facilities that could lessen the leakage and inefficiencies seen in large plants, which can pollute nearby groundwater. Securing Jordan’s water supply would also benefit Germany, says Roland Müller, a biotechnologist at Helmholtz. “The flow of Syrian refugees to Germany more or less started when camps in Jordan could not support them.”

Talozi says the country might take its cue from ancient systems in Petra and Umm el-Jimal and store more rain — although these conduits alone cannot support today’s population. Migrants are not the only cause of shortages, he says. “Jordanians want to go to the grocery store and buy apples and tomatoes and lettuce year round, not just eat wheat and barley.”

But to de Vries, the resurrection of ruins in Umm el-Jimal serves as a hopeful reminder that people have survived harsh conditions by ingenuity. “As civilizations rotated through this land, one constant over time is the reuse and reliance of the water system," he says. "People in antiquity were not backwards; they were clever and thought of a technology we can revive."

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UK gender-equality scheme spreads across the world

The United States is set to trial a version that will also cover race and disability, while other countries have already embraced the voluntary rating system.

13 September 2017

Christopher Furlong/Getty

The Athena-SWAN programme measures progress towards gender equality at UK universities.

A programme that grades UK universities on gender equality in science is going global. Versions of the rating scheme have started up in the past two years in Australia and Ireland, and a small-scale pilot begins next month in the United States.

The British programme, Athena SWAN (Scientific Women's Academic Network), launched at ten universities in 2005 and has since spread to more than 140 UK institutions. The voluntary scheme relies on universities supplying self-assessments to the Equality Challenge Unit, a non-profit organization that judges the institutions on their inclusiveness and equality in hiring, promoting and retaining female staff.

In addition to gender equality, the US project — called STEM Equity Achievement Change (SEA Change) — will assess inclusiveness with regards to race, ethnicity, sexual orientation, disability, socioeconomic status and other marginalized groups, says Shirley Malcom, who directs the education and human-resources programmes at the American Association for the Advancement of Science (AAAS) in Washington DC, which will oversee the project. The US effort will assess the experiences of both students and university staff. "We've had a lot of intervention programmes and it's not moving the needle," says Malcom. "We are exploring this strategy in order to try something that's better."

Around eight or nine currently unnamed US institutions will participate in the pilot scheme, which uses Athena SWAN as a model. Over a period of 12 to 18 months, individual departments or institutions as a whole will gather data on equality and identify problem areas. They are then expected to set plans and targets, such as boosting student diversity, closing pay gaps or making the campus climate more supportive. An AAAS panel will assess the submitted reviews and issue a bronze, silver or gold award accordingly.

Most higher-education institutions in the United Kingdom now have at least one Athena SWAN rating. The scheme has been expanded in Britain to include the arts, humanities and social sciences, and has spread to Ireland and Australia, where the first 40 participating institutions will learn of their ratings in early 2018. There are also calls to launch similar schemes in India and Japan.

Funding incentive

A major reason for the scheme's rapid rise in the United Kingdom was its link to funding. In 2011 the UK government's chief medical officer, Sally Davies, made holding a silver award a requirement for receiving grants from a £816-million (US$1.1-billion) pot of government biomedical funding. But the scheme spread well beyond the institutions competing for that funding. This was motivated in part by "moral pressure" but also because some staff thought that future funding decisions could become linked to such ratings, says Athene Donald, a physicist at the University of Cambridge, UK. Major funders such as the UK Research Councils recommend that institutions seek accreditation, but have not made it a requirement.

Success in the United States may depend on a major funder such as the US National Science Foundation requiring certification as a prerequisite for funding, says Curt Rice, who is head of the Norway government's Committee on Gender Balance and Diversity in Research.

Evaluations of the British programme have been positive. In a 2016 survey of UK academics, almost 90% of respondents who were aware of Athena SWAN felt that the scheme's initiatives had a positive impact on the work environment. Some institutions saw particular success. Between the University of Liverpool receiving a bronze award in 2013 and a silver in 2016, the proportion of women promoted to professor posts increased from 28% to 50%. Other participating universities have made similar gains.

With thousands of public and private institutions in the United States, the pilot will have to adapt to the US higher-education system, says Malcom. Holding institutions accountable for every aspect of diversity will be impossible, she says, but examining data that they already collect will be a place to start. "My sense is that we really can't address the gender issues without looking at these other aspects" of diversity, she says. The AAAS hopes to expand the $200,000 pilot scheme to universities across the United States, but will need more funding.

SEA Change has the potential to succeed, says Renee Horton, president of the National Society of Black Physicists. But she cautions that deep-rooted, prevailing and often unconscious prejudices that underlie inequality in the United States could make it difficult for universities to assess themselves, which means oversight by the AAAS would be essential. "Institutions struggling with diversity and inclusion likely have causative elements which they are unable to identify,” she says.

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The new economy of excrement

Entrepreneurs are finding profits turning human waste into fertiliser, fuel and even food.

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Will Swanson for Nature

Semi-dried sludge on its way to becoming fuel at the Pivot plant in Rwanda.

On the outskirts of Kigali, Rwanda, septic trucks full of human excrement bump and slosh their way up orange dirt roads to their final destination: the Nduba landfill. Until recently, the trucks would spill their contents into giant open pits. But since 2015, workers in green jumpsuits have greeted them outside a row of sheds and plastic-roofed greenhouses, ready to process the faecal sludge into a dry, powdery fuel.

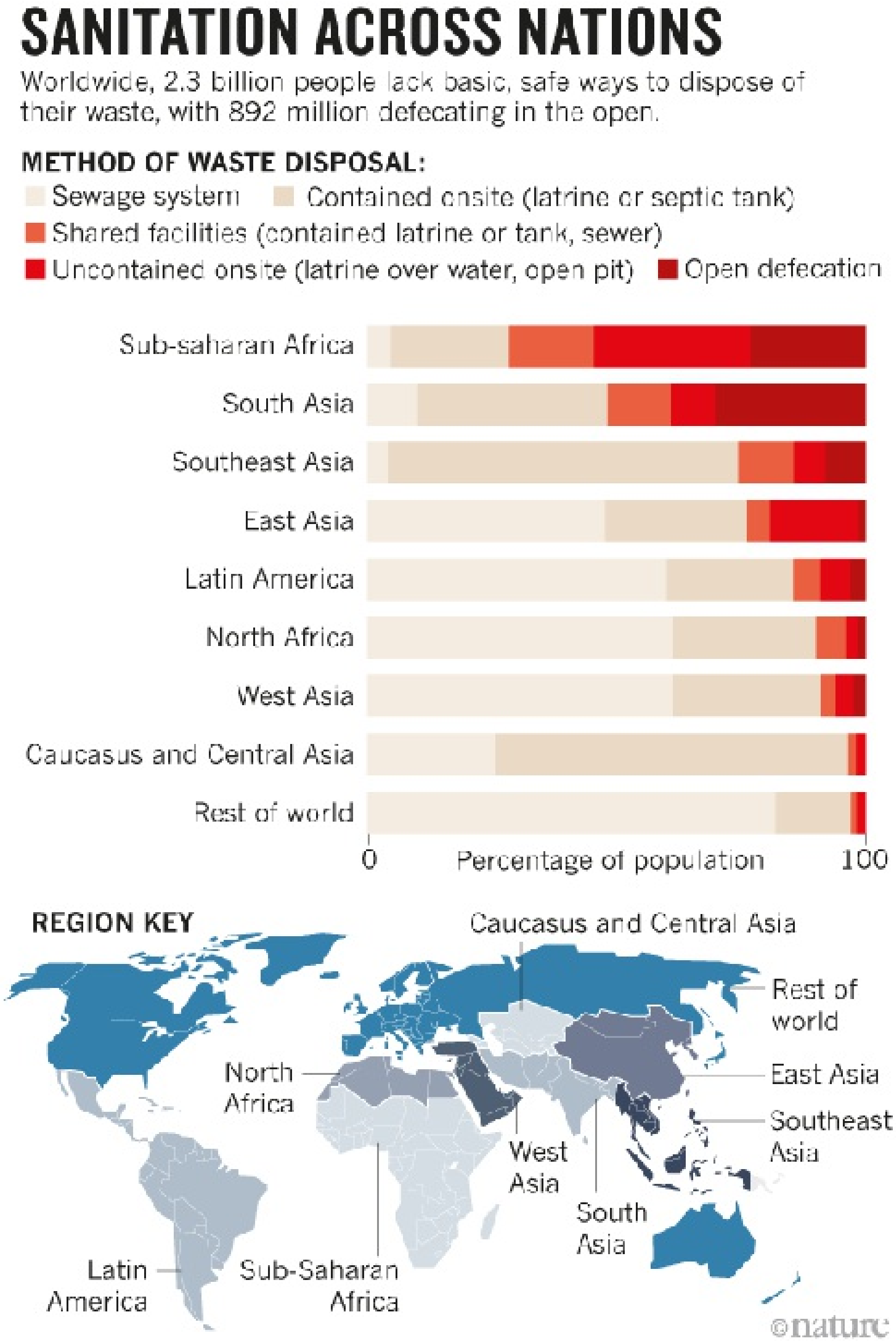
The facility is called Pivot, and its founder is Ashley Muspratt, a sanitation engineer who lived in Ghana, Kenya and Rwanda for more than seven years before moving back to the United States last year. Muspratt insists that Pivot is not a treatment plant. It's a business. Its product powers local industries such as cement and brick plants. “I describe us as dual sanitation and renewable-fuel company,” Muspratt says. “Our model really is to build factories.”

Muspratt is part of a growing band of entrepreneurs trying to address one of the biggest challenges in public health — poor sanitation — and to turn a profit doing it. According to a report published by the World Health Organization and United Nations children's charity Unicef in July, 2.8 billion people — 38% of the world's population — have no access to sewers and deposit their waste in tanks and pit latrines (see 'Sanitation across nations'). These often overfill or are emptied without regard to safety. By 2030, some estimate that the number of people using tanks and pits will rise to 5 billion, while at the same time international aid for water and sanitation is predicted to shrink. High-profile initiatives such as the Millennium Development Goals have been pretty good at “getting bums on toilet seats or feet on squat pans”, says Claire Furlong, an environmental engineer at the IHE Delft Institute for Water Education in the Netherlands. “But those toilets filled up. What do we do with that?”

Muspratt and others have a few answers. Making fertilizer or fuel is the most obvious, but researchers and entrepreneurs are exploring other uses. Some are growing plants in drying beds or breeding catfish in the artificial ponds that facilities typically use to treat sludge. Others are drying out sludge and incorporating it into building materials such as cement and bricks. Beyond that, companies are exploring whether certain fatty acids in sludge could provide important components of bioplastics and industrial chemicals. Larvae that feed on faeces are being pressed to make an oil for industrial uses, and in the future they could be used as animal food.

These approaches reflect a rethinking of sludge treatment — with the end product, and not just public health, in mind from the start. The economic model of sanitation is also changing, moving from an entirely public service to one run at least partly by private enterprises that are finding value in excrement, says Doulaye Kone, deputy director of the Water, Sanitation and Hygiene Program at the Bill & Melinda Gates Foundation in Seattle, Washington. Under the old model, he says, “there's no opportunity to sell anything, and then the government has to pay for operational costs. The day the budget dries up, everyone is in trouble.” As a result, many treatment plants in developing countries now lie abandoned.

Financing isn't the only reason that waste-to-resource initiatives fall short, warns Furlong. Many promising projects have met with resistance because they failed to address cultural elements, which can affect buy-in, whether from toilet users or national politicians. That could be something as visceral as negative attitudes to human waste, or an unwillingness to use new toilet technologies designed to capture waste in usable form. Muspratt and others instead deal with sludge as it is found in pits and latrines that already exist, to prevent their plants falling into neglect or becoming too expensive to maintain. “The driving force for me was trying to figure a way to not have white elephants all over the continent of Africa.”



Source: WHO/UNICEF

Human resource

Some people need no convincing of the benefits of sludge. In Ghana, some farmers short on fertilizer ask septic-truck drivers to dump their loads onto their fields, where they compost it using traditional methods and spread it onto millet and maize (corn). But this boost of nutrients for the crops poses a risk for those who eat and tend them: the slurry is not safely treated, and increases the chance that the produce will transmit typhoid, cholera, roundworms and various other pathogens that can cause diarrhoea, and lead to anaemia and malnutrition. In young children, repeat exposure can affect both physical and cognitive development.

Even if these farmers weren't using sludge on food crops, disease would still probably be a problem. Less than 5% of people in Ghana have sewers, and there are few treatment facilities for sludge; much of it ends up dumped into ditches or the sea.

Turning sludge into fertilizer is not a big ask, technologically — but it's hard to make a profit because market prices are cheap. Many wastewater treatment plants worldwide, including in the United States, where biosolids are a common by-product of treated sludge, give it away to avoid disposal costs. In Tema, a city east of Ghana's capital Accra, however, a new plant just sold its first few 50-kilogram bags. The operation should turn a profit within three years, says business economist Solomie Gebrezgabher, who works in the Accra office of the International Water Management Institute (IWMI).

The Tema plant uses a process that treats the sludge and composts it simultaneously. Powered by the Ghanaian sun, it consumes much less energy than composting methods that use drying and heating machines. But it takes a lot of space and time, and can be smellier. For about the first ten days, the sludge, which comes from both private homes and public toilets, dries in sand-filled beds, which allow the water to drain out and evaporate away. Then it's mixed with sawdust or food waste and transferred to a covered shed. Workers turn it regularly, and it breaks down over two months, thanks to naturally occurring microbes. During this process, it gets hot enough to destroy pathogens. Then it's spread out to cool and mature. The inexpensive process is appropriate for the conditions in Ghana, Gebrezgabher says. “It doesn't have to be high-tech.”

The team approached would-be clients with this bulky soil additive, which improves poor soil's physical qualities — such as its ability to retain water — but doesn't substantially increase the supply of nutrients. When Gebrezgabher spoke to farmers, many weren't interested. So she and her colleagues mixed in ammonium sulfate or urea to add more nutrients, as well as compressing it into easier-to-manage pellets. For farmers who were squeamish about using a product made from sludge, the team got a government safety certification. This time farmers were keen. “They were really excited about it because it has everything that they are looking for,” says Gebrezgabher. Another boost came when the government included the product — called Fortifer — in its fertilizer-subsidy programme.

With the product and the potential buyers in hand, the IWMI team partnered with the district government and a private local waste management company called Jekora Ventures, based in Accra. At full capacity, the plant, which opened in April, will process the waste from about 65,000 to 100,000 people every year into 500 tonnes of fertilizer. The company will start splitting profits with the municipality once the plant breaks even. The idea is to use those funds to improve sanitation, Gebrezgabher says. She is working with IMWI teams in other regions to replicate this model, starting with Sri Lanka. “Through not-so-sophisticated technologies, business models can be designed in developing countries that would be commercially viable,” she says.

Will Swanson for Nature

Sludge arriving at the Nduba landfill outside Kigali in Rwanda. The waste was once dumped into open pits, but now it is dried and sanitized for use as fuel.

Waste power

There is energy in sludge, too. According to a 2015 report by the United Nations University in Hamilton, Canada, if all the human faeces produced annually were converted into biogas, it would provide electricity to more than 138 million households. The leftover slurry could be dried into a charcoal-like fuel for use by a further 130,000. At Pivot's plant, workers make a solid fuel. They take most of the water out of the sludge by passing it through a microscreen. Then they spread it in greenhouses to dry. Finally, they further desiccate and sanitize it in a thermal dryer that runs on scavenged cardboard. The end result, provided as a powder or in granules, has 20% more energy than other biomass fuels such as sawdust or coffee husks, Muspratt says.

Pivot sells its fuel to cement and brick-making companies, whose ever-glowing furnaces and kilns have a constant need for the kinds of fuel that Pivot makes. The major customers are usually international firms that value sludge as a renewable energy source that they can use in place of coal. Pivot is on track to break even on operating costs, but it still relies on a little outside support. Its spot on the landfill was donated by the municipality, and its infrastructure was paid for with grants. Expecting wild profits from sludge salvage is unrealistic, says Linda Strande, an environmental engineer at the Swiss Federal Institute of Aquatic Science and Technology in Dübendorf. “We would be selling shit here if that was really going to make a huge amount of money,” she says. Most projects could expect to recoup 10–20% of annual operating costs, she says. And that's fine, because at least in making some money they reframe sludge as something of value, to be handled with more care.

Ironically, the main barrier Pivot faces is getting enough sludge. In theory, a city of at least one million people such as Kigali should be able to supply it, but nobody was bringing sludge from the hard-to-reach pit latrines in the informal settlements. Here, where two-thirds of the population lives, unlicensed workers were simply shovelling out pit latrines by hand and dumping the contents into nearby ditches or waterways.

So Pivot started a side venture to provide a safe pumping service to the settlements. It has proved popular but, partly because the latrines are unlined and leaky, Muspratt says, “the volumes we are getting out of pits are relatively modest so it hasn't been this, like, windfall of faecal sludge that we'd hoped for”. Pivot plans to start grinding up other kinds of combustible waste to blend with its fuel. Like IWMI, Pivot also intends to expand throughout Africa and to India, where millions of people who previously defecated in the open are building latrines thanks to a government initiative. “Our ultimate mission is to be the lowest cost provider of urban faecal-sludge treatment on the market,” says Muspratt.

Manna from manure

Following a cholera outbreak in 2000, the eThekwini Municipality, which includes Durban, South Africa, installed more than 85,000 urine-diverting dry toilets into rural areas on its outskirts. The diverted urine seeped into the ground, and the authorities asked households to bury the solids on their properties. But burying was a burden on the growing proportion of elderly people, and the increasing population density meant there was less land in which to bury. Even when the faeces was decomposing underground, pathogens survived for much longer than expected. Teddy Gounden and his colleagues at the water and sanitation department wanted to start collecting the waste. “But what do we do to it?” he wondered. More solid than sewage, it would gum up the town's wastewater treatment plants. Lacking urine, it didn't have enough nutrients to make good compost. Disposal at a hazardous-waste site would be expensive.

Then Gounden and his colleagues heard that a certain fly species could make much more valuable products than compost. Flies are normally a health hazard because they feed on both human faeces and food, transmitting pathogens as they flit back and forth. But the black soldier fly (*Hermetia illucens*), which is native to tropical climates, is different: it feeds voraciously in its larval stage, when it stays more or less in one place, and not at all as an adult, making it much less of a health risk.

The fly was put to work on food waste by a Cape Town-based firm, AgriProtein. It developed factories to harness the fly's special habits. The company breeds flies in cages, hatches the eggs in a nursery and then transfers the larvae to the food waste, where they eat their fill. Two weeks after hatching, the larvae naturally migrate off the waste to pupate, making both them and the remaining compost easy to harvest separately. The factories dehydrate the larvae to make an animal feed or extract a fatty oil, which has a range of uses from cosmetics to biodiesel. The leftover organic matter becomes a soil conditioner. Last year, AgriProtein opened the first industrial-scale plant of this type, with a plan for worldwide expansion close behind.

With the food-waste process working well, the company turned to a trickier source material — human waste — under the business name BioCycle. The larvae treated the new food much like the old, says David Wilco Drew, the firm's co-founder and director. In partnership with the eThekwini

Municipality, and supported by the Bill & Melinda Gates Foundation, it opened a pilot plant on the premises of a wastewater-treatment works in Durban at the end of 2016.

The material itself has proved tricky because of all the rubbish that toilet users have thrown in, Drew says. He's surprised by the ingenuity of some people, because the toilets aren't exactly open pits. “How can you get an old telephone around a U-bend?” Also conscious of the health risks associated with sludge, BioCycle has adjusted its food-waste process to account for the new input. It tests thoroughly for pathogens and heavy metals. And, instead of making products for agriculture, the plant presses the larvae into oil and the leftover organic matter into solid briquettes, both for use as fuel.

Deliveries from the urine-diverting toilets started in late July this year. At full capacity, the plant will accept 40 tonnes of material from the urine-diversion toilets per day, which it then mixes with food waste. “This is the largest faecal insect site by a mile,” Drew says.

With further research, the black soldier flies could treat sewage sludge from the city's sewer system. “There's a lot of potential,” Gounden says. Other governments “are all essentially waiting to see what the outcome is”.

To make it easier for municipalities everywhere to jump on the sludge bandwagon, Strande's team has developed a booklet and online courses to help local engineers design systems that can churn out marketable products. And to better understand the inputs to such systems, an international team led by researchers at the University of KwaZulu-Natal in Durban is developing standard methods and procedures for characterizing faecal-sludge properties such as moisture, rubbish and pathogen content, and nutrient and calorific values.

Everybody poos, says Drew. One day, he dreams, “every citizen of the world can contribute to our supply chain”.

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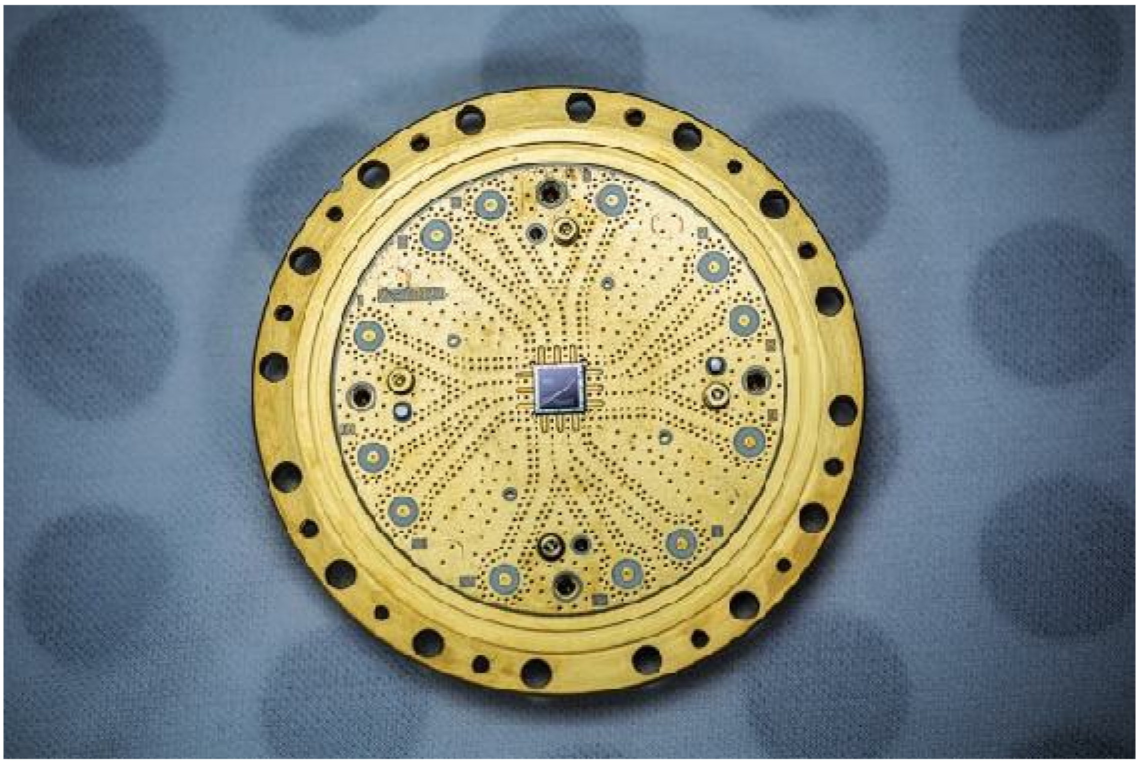
First quantum computers need smart software

13 September 2017

Early devices must solve real-world problems, urge Will Zeng and colleagues.



Rigetti Computing

An 8-qubit quantum processor built by Rigetti Computing.

The world is about to have its first quantum computers. The complexity and power of quantum hardware, such as ion traps and superconducting qubits, are scaling up. Investment is flooding in: from governments, through the billion-dollar European Quantum Technology Flagship Program, for example; from companies, including Google, IBM, Intel and Microsoft; and from venture-capital firms, which have funded start-ups. One such is ours, Rigetti Computing, which in June opened the first dedicated facility for making quantum integrated circuits: Fab-1 in Fremont, California. The vision is that commercial quantum- computing services will one day solve problems that used to be unimaginably hard, in areas from molecular design and machine learning to cybersecurity and logistics.[1]

The problem is how best to program these devices. The stakes are high — get this wrong and we will have experiments that nobody can use instead of technology that can change the world.

Listen

Reporter Lizzie Gibney talks to Will Zeng about quantum software.

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We outline three developments that are needed over the next five years to ensure that the first quantum computers can be programmed to perform useful tasks. First, developers must think in terms of 'hybrid' approaches that combine classical and quantum processors. For example, at Rigetti we have developed an interface called Quil[2], which includes a set of basic instructions for managing quantum gates and classical processors and for reading and writing to and from shared memory. Second, researchers and engineers must build and use open-source software for quantum-computing applications. Third, scientists need to establish a quantum-programming community to nurture an ecosystem of software. This community must be interdisciplinary, inclusive and focused on applications.

Hybrid systems

Today's quantum programming differs from much previous theoretical work on algorithms; it is becoming more and more practical.

Theoretical computer scientists have been developing potential algorithms for imagined quantum computers since the 1990s. Mathematician Peter Shor's famous code for breaking encryptions was one of the first; many more are listed in the Quantum Algorithm Zoo from the US National Institute of Standards and Technology (see go.nature.com/2inmtco). These algorithms are generally designed for big, noiseless quantum computers, which are unlike the devices that will be available within the next five years. These will have tens to thousands, not millions, of qubits, with little redundancy to correct for internal errors. They will calculate a limited range of things in a noisy way. For example, they will not be able to use Shor's algorithm to find the prime factors of large numbers. So their use must be targeted: they will not always beat conventional computers.

These limitations can be overcome by building quantum processors as 'accelerators' to boost the performance of conventional computers. A classical computer might, for example, optimize operations to compensate for noise in the quantum processor, or aggregate answers from sequences of short quantum programs. Such hybrid programming has been demonstrated in quantum chemistry[3] and in optimization[4]. Algorithms that run on small, superconducting quantum processors have performed steps in calculating the ground states of materials and molecular systems, for example[5, 6]. Another algorithm has solved constrained optimization problems, which are common in areas such as machine learning, logistics and scheduling[4].

We've found, however, that it can be hard to predict the performance of hybrid algorithms. For example, the quality of the quantum subroutine in hybrid algorithms for chemistry can vary greatly depending on the system that is being simulated and the mathematical tricks used. So hybrid quantum-computing algorithms need to be studied empirically, as they are for machine learning. The way to find out how a system works is to build it, see what it does and back up any rules of thumb with mathematics later. This work will begin in earnest once the first quantum computers are available, and it will accelerate fast.

To reach this stage, researchers must change their mindsets, and this could be hard. We will find that some past work has little utility. We've all seen talks on quantum algorithms whose complexities are peppered with huge exponents, meaning that they could take millions of years to complete. For the coming devices, such codes are so impractical as to be useless.

Quantum programmers must care about practical details such as noise models and exact counts of logic gates. They will have to decide which qubits in the computer to use and how to deal with ranges of operational fidelities and low-level precisions that are foreign to most modern programmers. But the gain will be worth the pain.

In turn, hardware designers need to be responsive to the choices and preferences of quantum programmers, so that their technology can become more useful.

Open software

Different classical computers behave similarly enough to enable software written for one to run on others. Early quantum computers will have their own nuances, and software for them will need to be bespoke. When each operation and instruction matters, generalized solutions need to be optimized, and software and hardware designed concurrently. Algorithms must be discovered numerically rather than algebraically, and developed using simulators and software rather than pens and paper.

Innovative digital tools are needed for developing and testing algorithms, writing software and programming the devices. Quantum programmers should keep an eye on the underlying physics, so that they are aware of different types of noise in sequences of pulses, for example. Performance benchmarks, such as a suite of standard molecules to simulate, are also necessary.

Differences between quantum and classical programming begin at the instruction level. Classical computers use Boolean logic — with basic operations such as AND, NOT, OR. Operations in quantum computations, such as multiplying tensors and matrices, are much more complex and result in unusual behaviour. For example, quantum information cannot be cloned exactly between processor registers; and reading the state of a quantum register alters the information stored in it.[7] Hybrid software needs to handle all these behaviours simply enough for programmers to be able to code easily. The result will be a new programming paradigm, as object-oriented, probabilistic and distributed programming once were.

Rigetti Computing

Inside the clean room at Rigetti Computing's Fab-1 facility in Fremont, California.

Quantum programmers must decide which aspects of the system are essential for them to consider and which they can skim over in practice. For example, executing a program on superconducting quantum processors requires instructions to be translated many times. Control and readout instructions are converted from digital to analog to quantum to analog to digital as they go from the control hardware to the qubits and back. Programmers don't want to have to deal with all the microwave engineering and physics, but they need to be aware of how these processes affect noise or the time it takes to run the code. They need tools to work directly with the devices, so that they can understand and exploit the trade-offs.

Easy programming interfaces are crucial to making quantum computers widely usable; examples include Quil and OpenQASM[8] from IBM. More sophisticated options still need to be added, such as optimizations for specific types of processors. Higher-level languages for writing and compiling quantum programs also need to be developed.

It is important that all these tools are open source. Such a model was not available at the dawn of digital computing, but its power to speed innovation, as with Linux in the early days of the web, is essential for the quantum-programming community to grow quickly. We have made a start with our quantum-programming toolkit, Forest, which is written in Python, open source and accessible to anyone. It joins an exciting early ecosystem — much of it open source — developed by different academic and industrial research groups. Other examples are LIQUi|> (embedded in F#), Scaffold (C++), Quipper (Haskell), QGL (Python), ProjectQ (Python), QCL, QuIDDPro and Chisel-Q (Scala). Researchers must resist pressure to standardize tools prematurely or keep the high-level, exploratory parts of the programming stack proprietary.

Build a community

A new breed of quantum programmer is needed to study and implement quantum software — with a skillset between that of a quantum information theorist and a software engineer. Such programmers will understand how quantum devices operate well enough to instruct them and minimize problems. They will be able to build usable software and will have a deep knowledge of the mathematics of quantum algorithms and computation. Experts from fields in which the software will be applied must be closely involved if the code is to be truly useful. For example, chemists such as Alán Aspuru-Guzik at Harvard University in Cambridge, Massachusetts, drove interest in using hybrid algorithms in quantum-chemistry calculations.

Researchers in other fields, especially in machine learning and optimization, should get on board.

Advanced kinds of education are needed to train this new breed. Several centres are well positioned to draw together the interdisciplinary skills and tools needed to offer degrees in quantum-computer engineering: the Institute for Quantum Computing at the University of Waterloo in Canada, the Institute for Quantum Information and Matter at the California Institute of Technology in Pasadena, the quantum-engineering doctoral training centres in the United Kingdom, and QuSoft, the Dutch research centre for quantum software in Amsterdam. At Rigetti we have started a Junior Quantum Engineer programme for bachelor's degree students, which includes training in quantum programming. We have partnered with the Quantum Machine Learning accelerator at the Creative Destruction Lab (a technology-transfer centre that fosters start-ups) at the University of Toronto, Canada, to provide access to and support for Forest and other programming tools.

Early-career quantum programmers have tremendous opportunities to become leaders of a transformational field. But they need support. Their supervisors must recognize that work on an open-source software project might delay their next pure research paper. They need industrial internships to gain a broader practical perspective. And they need institutional backing to work between the fields of software engineering and quantum physics.

Next steps

It is crucial that research on quantum-computing algorithms is tied more closely to research on the software that's used to implement them.

First, funders should insist that theoretical work is implemented in software and, as much as possible, tested on hardware. Second, algorithm researchers must be explicit about the architecture they are targeting. They must show evidence of how algorithms will be practically implemented on different noisy systems. Third, funders and journal editors must establish standard ways to assess algorithm performance and resource requirements. This will enable hardware and software to improve together, and will sift out the most viable algorithms more quickly. Open-source tools should be used wherever possible, and publications should encourage the publication of code alongside results.

Finally, the quantum-computing community must prioritize engagement with experts in areas such as simulation and machine learning. Quantum and classical programmers must collaborate more. We call on every current and aspiring quantum-algorithm researcher to present their work at a classical conference at least once in the next year. It falls to us to expand the community that will realize the incredible potential of quantum computing.

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Comments

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Wallaby milk acts as a placenta for babies

Gene-expression analysis suggests that marsupial placentas take two different forms.

12 September 2017

Dave Watts/NPL

The milk that a mother tammar wallaby provides its joey is more than meets the eye.

Wallabies are kicking over scientific conventions surrounding mammalian placentas, the organ responsible for protecting and nourishing a developing fetus. A study[1] finds that contrary to what scientists thought previously, mother tammar wallabies (*Macropus eugenii*) have both a functioning internal placenta and milk that performs some of the organ's usual roles.

Taxonomists usually separate marsupials — including kangaroos, wallabies and wombats — from placental mammals, also known as eutherians, such as mice and people. The separation is based partly on a supposed lack of a placenta in marsupials. But many researchers think that this distinction is incorrect, noting that marsupials develop simple, placenta-like structures during the end of pregnancy, just before the underdeveloped baby crawls from the uterus into the mother's pouch. These placental structures, just two cell layers thick, provide oxygen, nutrients and molecular signals that drive development to the fetus while protecting it from the mother's immune system.

It shouldn't be surprising that marsupial placentas look different from those of other animals since even closely related species can have very different-looking placentas that perform the same functions, says Derek Wildman, an evolutionary biologist at the University of Illinois in Urbana-Champaign. "It is the most variable organ in mammals in terms of anatomy and physiology," he says.

Mother's milk

Marsupial pregnancy is remarkably short for mammals of their size. Tammar wallabies, which can grow to between 6 and 9 kilograms, are pregnant for just 26.5 days — barely longer than rats. Yet the baby, or joey, spends nearly a year continuing to develop and nurse inside the mother's pouch: a long time compared to other mammals. This developmental mismatch led researchers to suspect that the majority of a joey's development is driven by specialized features of the mother's milk.

To determine whether the marsupial placenta functions similarly to a eutherian mammal placenta before birth, evolutionary biologist Julie Baker and evolutionary developmental biologist Michael Guernsey of Stanford University in California analysed the collection of genes expressed in the tammar wallaby's placenta. When they compared the expression patterns to those of mouse and human placentas, they found that in the final days before the fetus is born, the tissue expressed the same genes as eutherian placentas do in the early stages of fetal development.

The researchers then analysed the genes expressed in the mammary glands of tammar wallabies that were nursing joeys. They found that this glandular tissue expressed the same genes as eutherian placentas do in late fetal development.

“This is beautiful work,” says Anthony Carter, a developmental biologist at the University of Southern Denmark in Odense. He says the genetic analysis provides a persuasive argument that marsupials, contrary to common belief, have fully functioning placentas — they just take different forms.

Diverse development

The finding suggests that placentas across the animal kingdom could express the same suite of genes, regardless of any anatomical differences, says Guernsey. And those differences could occur because the placenta evolves rapidly compared with other organs.

Baker thinks that the rapid evolution could be necessary for the placenta to effectively shield the fetus from the mother’s immune system, which treats the offspring as a foreign invader. “The placenta is evolving, trying to evade the mom, and comes up with these really bizarre strategies” — including taking liquid form in the mother marsupial’s milk, she says.

Wildman says that the finding suggests that lactation may have evolved before eutherian placentas, as egg-laying mammals such as platypuses and echidnas lactate but do not have placentas. The egg-laying group came before marsupials and eutherians. He praises the paper, but says that the researchers could compare gene expresssion across more species than just mice and humans. A paper he published of 14 animals found that placentas did express different genes depending on the species.[2]

Knowing more about placenta development could help researchers to understand not only animal evolution, but also the possible functions of the human placenta, which is impossible to study in real time given that the work could harm the fetus, says Baker.

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Giraffes could have evolved long necks to keep cool

Another explanation offered for one of animal kingdom’s most distinctive features.

12 September 2017

Getty

Giraffes might have evolved their long necks to keep cool.

How did the giraffe get its long neck? The obvious answer — and some of you are probably shouting it at the page or screen right now — is that it evolved as a benefit that allowed the animals to reach and eat higher leaves.

Perhaps. Probably, even. That was certainly Charles Darwin's explanation. But it's not certain, and other possible origins for one of the animal kingdom's most distinctive features are still a topic of debate among zoologists and evolutionary biologists alike.

One such idea is reported in the *Journal of Arid Environments* (G. Mitchell *et al. J. Arid Environ.* **145,** 35–42; 2017). Long-necked giraffes, scientists argue, can point their heads and necks towards the Sun, exposing less of their skin and making it easier for them to keep cool and survive the hot, dry conditions they often endure.

Improved thermoregulation is one of the later evolutionary explanations offered for the giraffe's long neck — a debate that goes back to before the time of Darwin. The French naturalist Jean-Baptiste Lamarck suggested that giraffes' necks became stretched as they constantly reached for foliage (an idea very much ahead of its time but for which he is sometimes unfairly ridiculed). Darwin and his contemporary Alfred Russel Wallace then famously turned this Lamarckism on its head, pointing out that the long neck would have come first, and this would have handed the taller individuals a significant advantage over shorter giraffes.

That idea stood largely unchallenged until, in a letter to this journal in 1949, Chapman Pincher took issue and pointed out that the legs of a giraffe are also unusually long (all the better for a swift escape from predators) (C. Pincher *Nature* **164,** 29–30; 1949). The long neck, he said, must therefore have evolved as a way for the animal to be able to reach past its own legs when it leans to reach the ground to take a drink of water. (Never very popular, Pincher's suggestion lasted only as long as it took scientists to find and examine fossil ancestors of the giraffe, and point out that those animals had managed perfectly well with long legs and short necks for millions of years.)

Other, more credible, alternatives to the dominant 'competing browsers' idea have emerged. One of the most popular is that long necks help male giraffes use their heads to bash rivals, or that females prefer them. Both would suggest that long-necked males are sexually selected.

And then there is thermoregulation. Originally, the suggestion was that long necks (and legs) significantly tilted the balance between volume and surface area that determines how quickly animals (and other bodies) gain and lose heat. Giraffes might look as if they have a larger than usual surface area compared with barrel shaped rhinos, elephants and others — but do they? It turns out that few people have tried to measure the surface area of enough giraffes to be sure. That’s what the scientists do in the latest study.

They looked at measurements made for dozens of giraffes culled in Zimbabwe. They found that, pound for pound, the surface area of a giraffe is actually no larger than would be expected for any other animal of the same mass. And the creatures are no better at keeping cool, until, the scientists go on to suggest, they turn to face the Sun — as many giraffes are seen to do on hot days.

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Global fingerprints of sea-level rise revealed by satellites

Geological processes send more meltwater from glaciers and ice sheets to Earth's mid-latitudes.

11 September 2017

Mario Tama/Getty

Water from the Greenland ice sheet is raising sea levels unevenly across the world.

As an ice sheet melts, it leaves a unique signature behind. Complex geological processes distribute the meltwater in a distinct pattern, or 'fingerprint', that causes seas to rise unevenly around the world. Now, for the first time, researchers have observed what these sea-level fingerprints look like on a global scale.

“No one has put it together for a complete global picture like this before,” says James Davis, a geophysicist at Columbia University in Palisades, New York. The work was published in *Geophysical Research Letters* on 9 September[1].

The concept of sea-level fingerprints has been been factored into models used to predict sea-level rise for several years, says lead researcher Isabella Velicogna, a geophysicist at the University of California, Irvine. And researchers have used tide gauges for just as long to observe the fingerprints in coastal regions. But the global view provided by the latest study adds confidence to projections of future sea-level rise.

Ice sheets and glaciers have a slight gravitational pull on the water that surrounds them, making sea level a little higher at their edges — similar to how the Moon tugs on the ocean to generate tides, but on a fraction of the scale. When a glacier or ice sheet melts, it loses mass; therefore, the gravitational pull it exerts on nearby ocean water weakens and the sea level falls. At the same time, the land rises up because the ice is no longer weighing it down, which causes a further drop in sea level.

The loss of mass changes Earth's gravitational field causing the fresh meltwater and ocean water to move away towards faraway coastlines; the resulting pattern of sea-level rise is the fingerprint of melting from that particular ice sheet or glacier. For example, the latest study found that ice melt in Antarctica causes sea level to rise 52% faster in California and Florida than it does in other parts of the world, Velicogna says. Much of Earth’s middle and lower latitudes bear the brunt of rising sea levels because they’re sandwiched between Antarctica and Greenland, which are home to massive ice sheets that are shedding mass as meltwater or icebergs.

Velicogna and co-author Chia-Wei Hsu, also at the University of California, Irvine, used gravity data from NASA's two Gravity Recovery and Climate Experiment (GRACE) satellites, which measure changes in mass on Earth’s surface. The scientists looked at satellite data from April 2002 to October 2014, and matched it with measurements from pressure stations on the ocean floor. These instruments measure the total mass above them.

Velicogna says that the findings should be used to create a roadmap for better placement of ocean-bottom pressure stations, which in turn can be used to improve calculations of sea-level fingerprints in the future.

“We know sea-level change throughout the world won’t be uniform, and it’s useful for people to know how those changes might show up,” says Mark Tamisiea, a geophysicist at the University of Texas at Austin.

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Comments

Comments

There are currently no comments.

Deadly Mexico earthquake had unusual cause

US Geological Survey says tremor was within the Cocos Plate, not at the plate boundary.

09 September 2017

Carlos Jasso/Reuters

The magnitude-8.2 quake damaged buildings in Mexico City.

A deadly magnitude-8.2 earthquake struck the southern coast of Mexico on 7 September, killing dozens of people and injuring at least 200. The tremor, which Mexican President Enrique Peña Nieto said was the strongest registered in the past century, prompted mass evacuations along the country's Pacific coast.

Scenes of demolished buildings, teetering streetlight posts and blacked-out subway stations have been circulating on social media. Mexico’s Federal Commission of Electricity calculates that 1.85 million residents across the country were affected by power cuts.

According to the National Seismological Service of Mexico, the quake hit the Gulf of Tehuantepec near the state of Chiapas just before midnight local time. The country’s earthquake early-warning system gave residents anywhere from a few seconds to more than a minute of warning, depending on their proximity to the tremor’s epicentre. In Mexico City, more than 725 kilometres away, that amounted to 86 seconds of advance notice.

Mexico City resident and agronomist Obed Mejía Yáñez was in a 23rd-floor apartment at the moment alarms went off in his building. “I was writing my thesis when it hit. The lights went on and off, and the windows began to crack," he says. "I said 'this is it' and even thought about jumping out the window. I got very scared. I had never felt an earthquake like this."

Although buildings in the capital suffered some structural damage, the southern states of Oaxaca, Chiapas and Tabasco were the most affected, with more than 30 confirmed deaths. In Oaxaca, patients were evacuated to the streets in hospital beds and several buildings collapsed, including the city hall in Juchitán.

The region where the earthquake struck is one of the most active seismic zones in the country: this is where the Cocos Plate dives, or subducts, under the North American plate. "Earthquakes of this size are not uncommon at subduction zone boundaries," notes Jascha Polet, a seismologist at California State Polytechnic University in Pomona.

But this quake was different: it occurred within the Cocos plate as it warped or bent, not at the boundary with the North American plate, according to the US Geological Survey.

"The type of faulting that occurred here does not usually produce earthquakes of this magnitude," says Polet. "There have been others in the past 50 years of similar type and location, but none that was even close to this size." It is still too early to say why the earthquake was so massive, she adds, but "it is sure to inspire much future research".

Mexico's seismology agency has registered at least 337 aftershocks, with the strongest reaching a magnitude of 6.1.

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Comments

Comments

There are currently no comments.

Nature News

周二, 26 9月 2017

Nature News

[周二, 26 9月 2017]

- **Nature News**

Nature News

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  A new coalition could face battles over gene editing and climate regulations.
- **World’s botanic gardens should work together** [周一, 25 9月 08:00]
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- **Three ways to make proton therapy affordable** [周一, 25 9月 08:00]
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- **CRISPR used to peer into human embryos' first days** [周三, 20 9月 08:00]
  Gene-edited embryos enable researchers to unpick role of a crucial gene, with more studies likely to follow.
- **Sexual competition among ducks wreaks havoc on penis size** [周三, 20 9月 08:00]
  When forced to compete for mates, some birds develop longer penises and others almost nothing at all.
- **Pair of deadly Mexico quakes puzzles scientists** [周三, 20 9月 08:00]
  Latest big tremor could be linked to major earthquake earlier this month.

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- **[Marine scientists allege Japan has blocked researchers from joining South Korean ship]** [周二, 19 9月 08:00]
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- **[Researchers unite in quest for ‘standard model’ of the brain]** [周二, 19 9月 08:00]
  Modelled on big physics projects, the International Brain Lab will bring together some of the world’s pre-eminent neuroscientists to probe a single behaviour.
- **[Cancer patients need better care, not just more technology]** [周二, 19 9月 08:00]
  Treating cancer with the latest drugs and techniques is costly and will not improve survival globally, warn Richard Sullivan, C. S. Pramesh and Christopher M. Booth.

What Germany’s election results mean for science

A new coalition could face battles over gene editing and climate regulations.

25 September 2017

Omer Messinger/NurPhoto via Getty Images

Angela Merkel is set to continue as Germany's chancellor, but is negotiating to form a new governing coalition.

As Germany reels from an unexpected surge for the far right in the 24 September elections, researchers don’t expect much effect on the country’s generous support for science. But with smaller parties standing to gain political influence, battles over issues such as the regulation of gene-edited

organisms and how to cut greenhouse-gas emissions could grow fiercer.

Angela Merkel is set for a fourth term as Germany’s chancellor and will lead negotiations with other parties to form a coalition government, after her centre-right Christian Democratic Union (CDU) won the largest share of the seats in parliament, albeit with a diminished lead. Her coalition partner in the last government, the Social Democrats (SPD), came second, but it, too, lost support, and has pledged to move into opposition. Other minor parties are instead expected to enter government, in negotiations that Merkel hopes to complete by the end of the year.

Merkel has ruled out — as being too radical — partnerships with the far-right AfD (Alternative for Germany) party and the socialist Left Party. Most expect her to strike an agreement with the Green Party and the liberal Free Democrats (FDP). That would form a ‘Jamaica coalition’, named as such because the parties’ colours match the green, yellow and black of the Jamaican flag. (A fourth party, the CSU, shares a platform with Merkel's CDU; it campaigns only in Bavaria).

The negotiations are expected to focus on hot political issues, such as Germany’s handling of the refugee crisis. All four parties strongly support science, but there are some key differences. The Greens want the same strict regulation for organisms that have been gene edited with precision technologies such as CRISPR, as has been put in place for those modified with conventional, less precise techniques. But the other three parties have hinted that they may support a more liberal form of regulation.

Overall, Germany already tightly regulates research on genetically modified organisms (GMOs), and animals in general, and is unlikely to tighten that further under a new government, says Tobias Erb, a director at Germany’s Max Planck Institute for Terrestrial Microbiology in Marburg. “But I do expect that it will remain complicated, and might even get more complicated, to release GMOs — and in particular GM plants — if the Greens become part of the next government coalition,” he says.

Power struggles

Germany’s climate and energy policies could be another area of conflict within a future coalition, says Oliver Geden, a policy expert with the German Institute for International and Security Affairs in Berlin.

The Greens want to shut down the country’s dirtiest coal power plants, and support a climate-protection law to help Germany meet its plans to reduce greenhouse-gas emissions by 80–95% from 1990 levels by 2050. But the FDP, a pro-business party in favour of free-market economics, advocates against detailed central planning to force cuts to carbon dioxide emissions — of the sort that has previously been proposed both by the Greens and by the outgoing CDU/SPD coalition. The FDP does favour eliminating “inefficient” subsidies in the energy sector and strengthening the European emissions-trading scheme. “We should expect a lot of ambiguity, even hypocrisy, when it comes to climate policy,” says Geden.

The strong presence of the AfD in parliament will make for noisy debates. Having won 13% of votes, the party is now the third largest after the SPD and CDU/CSU. The AfD did not make election statements on science, and declined to answer *Nature*’s questions before the election, but party leaders have previously expressed climate scepticism and distrust of genetic engineering.

The AfD’s rise means that for the first time, a party is represented in parliament that opposes Germany’s plans to cut greenhouse-gas emissions by moving to renewable-energy sources — termed the ‘*Energiewende*’, or energy transition. But its sceptical stance on climate and energy issues is unlikely to sway the next government, Geden says.

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Comments

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There are currently no comments.

World's botanic gardens should work together

A study suggests a possible way to save more species.

25 September 2017

Ray Tang/Anadolu Agency/Getty

Botanic gardens safeguard species and can help to conserve them in the wild.

"There are three things which have stimulated men throughout the ages to travel far and wide over the surface of the globe," wrote Arthur Hill, assistant director of the Royal Botanic Gardens, Kew, in 1915. "And these are gold, spices and drugs." (A. W. Hill *Ann. Missouri Bot. Gard.* **2,** 185–240; 1915).

It was these last two, Hill went on to argue, that served as the impetus to create some of the earliest botanic gardens. Yet over the years the remit has shifted and expanded, as the medicinal and culinary repositories of old has given way to complex institutions tasked with delighting and educating the public — while providing a hub for research and conservation.

A study published this week in *Nature Plants* highlights the fruits of those efforts: a survey of 1,116 botanical collections shows that they hold representatives from about 30% of the world's plant species (R. Mounce *et al. Nature Plants* http://dx.doi.org/10.1038/s41477-017-0019-3; 2017). It is a testament to the resourcefulness of their staff that such gardens are able to foster so much diversity in the face of mounting pressures to boost revenue.

But with 20% of the world's plant diversity threatened with extinction, the study also suggests that there is room for improvement when it comes to conservation. The collections, for example, are unbalanced: 76% of the missing species are from tropical regions. Less than 5% of non-vascular genera, such as mosses, are represented at all. (And although seed banks can pick up some of the slack, certain species are still best preserved as living specimens.)

Some of this reflects bias in the data. Only about one-third of the world's botanic gardens were included in the study, and gardens with fewer resources are less likely to upload information about their collection to a database. But the data also point to a need to focus conservation efforts on neglected taxa.

Given limited resources, the best way to do this is to coordinate efforts between botanic gardens. Many zoos have long done this. The crop research community came together in 2011 to preserve plant genetic resources that are important for agriculture. And botanical gardens around the world have embraced the Global Strategy for Plant Conservation, adopted in 2010 by the United Nations Convention on Biological Diversity. But to realize the strategy's goal of protecting at least 75% of threatened plant species in botanical collections by 2020, gardens must come together to structure and bolster their conservation efforts.

There are signs that such an approach would take off. Botanic gardens, despite the occasional outbreak of one-upmanship, have a history of

collaboration that will provide fertile soil for a targeted approach to conservation. These gardens should embrace an active role in plant conservation, and should not limit themselves to educating the public about the need for it. Who else has the ability to coax the world's most finicky plants to thrive in new ground, or to force a recalcitrant seed to germinate?

A good example is a meeting planned for April 2018, when experts in rhododendron cultivation will meet botanic-garden staff from areas of the world that host endangered rhododendron species. The effort could provide an excellent test case for botanic gardens: rhododendrons are charismatic megaflora — their showy flowers are prized by gardeners around the world, which means that the public cares about their preservation. At the same time, they are particularly vulnerable to climate change, and their seeds often do not remain viable in storage, making live cultivation particularly important.

As efforts such as this take off, more botanic gardens can legitimately sell themselves to the public as protectors of the world's plants, and entice visitors to view their rare specimens. Kew Gardens executed this beautifully when it saved a tiny Rwandan water lily (*Nymphaea thermarum*) from extinction in 2009 by painstakingly working out how to germinate its seeds. The media campaign around the lily enticed crowds to come and see one of the world's few living samples. (In this case, the strategy worked perhaps too well: so great was the public's thirst for the lily that a thief made off with one in 2014.)

More botanic gardens can and should put their unique skills to work to preserve plant diversity. Many have already grown to be much more than collections of spices and drugs. With better coordination, more could yet strike gold.

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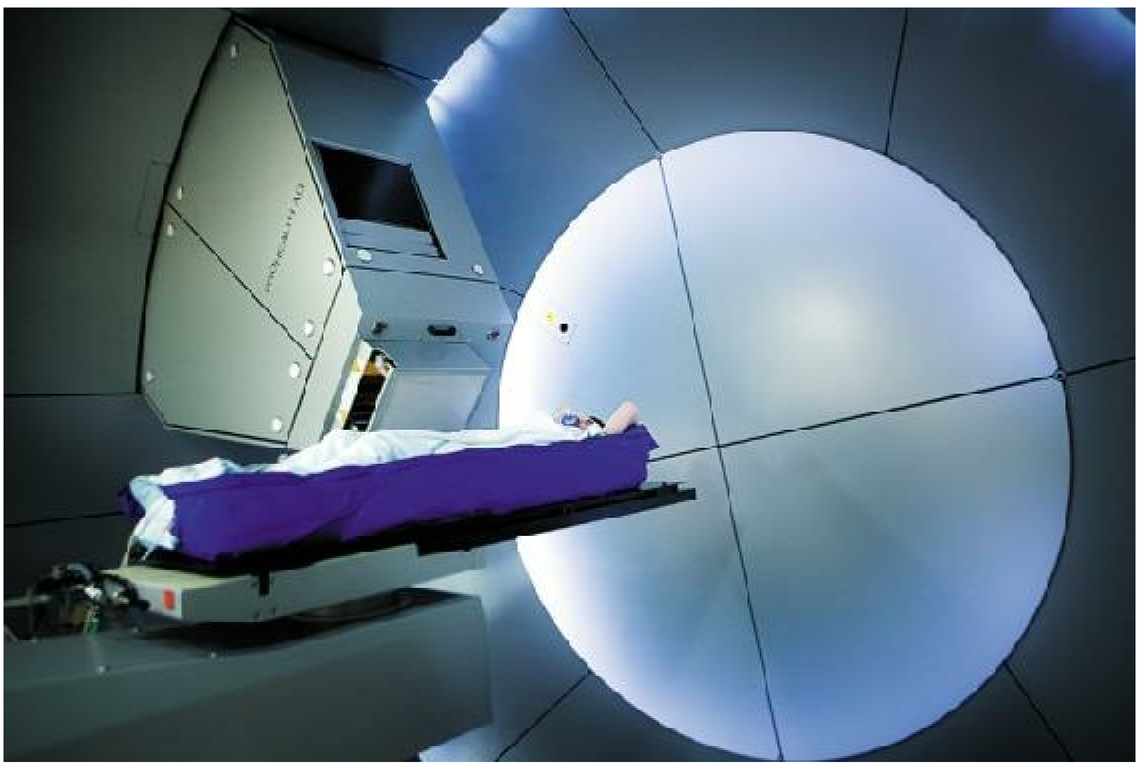
Comments

There are currently no comments.

Three ways to make proton therapy affordable

25 September 2017

Shrink accelerators, sharpen beams and broaden health-care coverage so more people can get this type of radiation treatment, argue Thomas R. Bortfeld and Jay S. Loeffler.



BSIP/UIG/Getty

A proton-therapy machine at the Rinecker Proton Therapy Center in Munich, Germany.

If cost was not an issue, proton therapy would be the treatment of choice for

most patients with localized tumours. Protons can be targeted more precisely than X-rays[1], so the tissues around the tumour receive two to three times less radiation. This lowers the chance of causing secondary tumours[2] or impairing white blood cells and the immune system[3]. High doses of protons can be delivered safely to hard-to-treat tumours: for instance, those at the base of the skull or in the liver. Such accuracy is crucial when treating cancers in children.

Yet most hospitals do not offer proton therapy. The equipment is huge and expensive. Housed in multistorey buildings with halls the size of tennis courts, one proton centre with 2–3 treatment rooms typically costs more than US$100 million to build. To reach deep-seated tumours, the protons must be sped up to 60% of the speed of light (a kinetic energy of 235 megaelectronvolts; MeV) using a particle accelerator, such as a cyclotron or synchrotron. Rotatable gantries with wheels typically 10 metres across and weighing 100–200 tonnes direct the protons at the patient from a range of angles. Concrete shields, metres thick, are necessary to block stray neutrons.

“Nothing so big and so useless has ever been discovered in medicine,” said Amitabh Chandra, director of health policy research at the John F. Kennedy School of Government at Harvard University in Cambridge, Massachusetts. He has compared a proton-therapy system to the Death Star from *Star Wars*.

Nonetheless, there are now more than 60 proton-therapy centres around the world, with 26 in the United States alone. Almost half of them (12) treated their first patient within the past three years. But construction delays and closures are also common. The companies that build the facilities and the investment groups that own them are increasingly struggling to make a profit. The Scripps Proton Therapy Center in San Diego, California, filed for bankruptcy in March, just three years after opening its doors.

What has gone wrong? Patient charges are high, often three to four times more than the priciest X-ray treatments. Fewer patients are being treated with protons than was anticipated: common diseases such as prostate cancer can be cured as effectively using other forms of radiation and surgery[4]. And in the United States, major insurance companies are denying proton therapy to up to 30% of eligible patients[5] on the basis that there are too few rigorously

designed and completed clinical trials providing evidence of better outcomes. In our experience, however, this is a vicious cycle: such trials are difficult to conduct when patients are denied private health coverage[5].

The solution is to make proton-therapy facilities smaller and cheaper, with costs of around $5 million to $10 million, similar to high-end X-ray systems. A dozen 'miniaturized' facilities are in operation. We have installed one at Massachusetts General Hospital in Boston. Now academics, private researchers and investors need to make proton-therapy systems even smaller and more competitive so that more patients can benefit.

Shrinking infrastructure

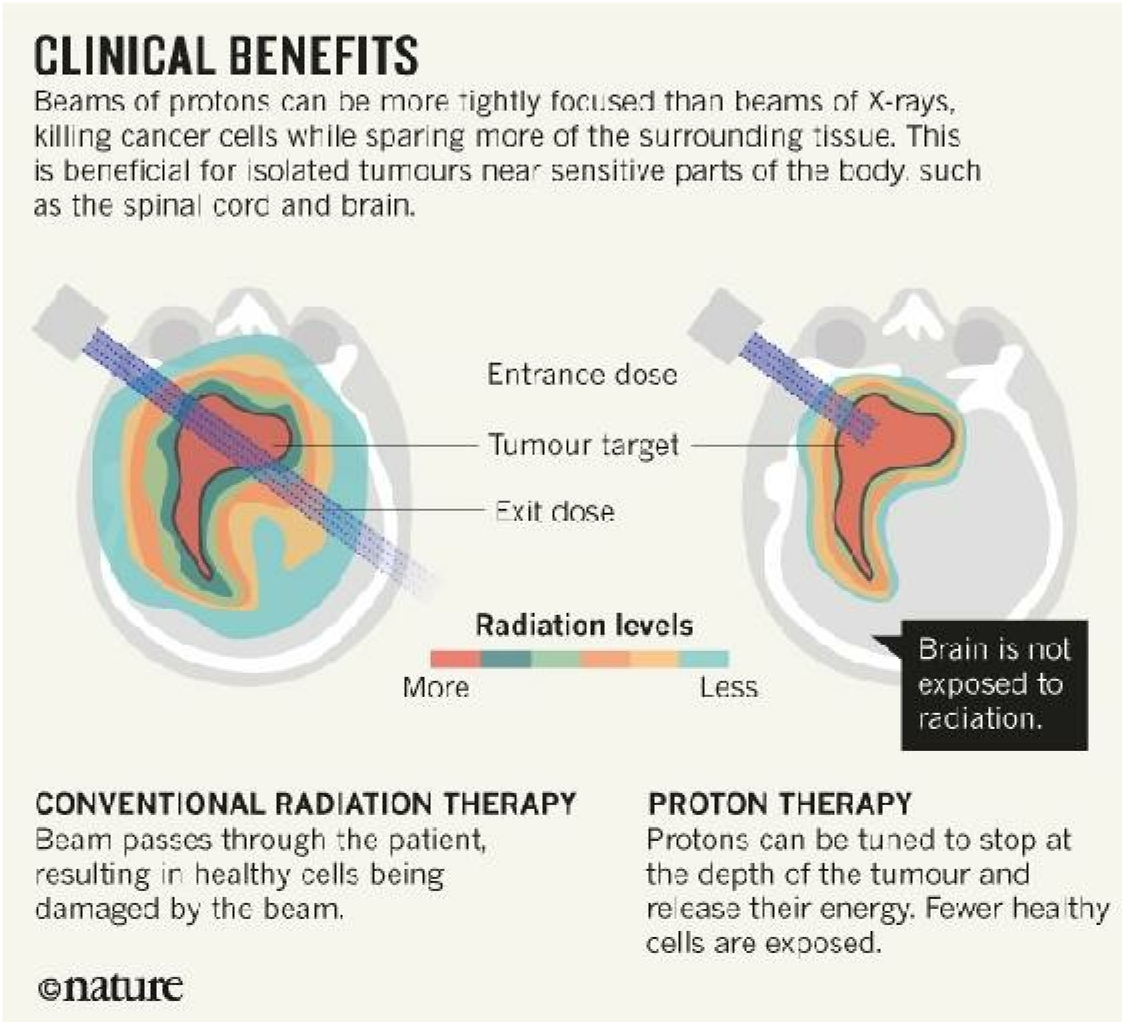
Proton-therapy technology is much more compact today than it was a few decades ago[6]. Superconducting magnets can confine protons in a tighter space. The weight of accelerators has gone down from hundreds of tonnes to less than 20, and their diameters have shrunk by a factor of 3 since the early 1990s. The smallest therapeutic accelerator so far is less than 2 metres in diameter — about the same footprint as a king-sized bed.

Yet, combined with the gantry and other equipment needed, even the most compact systems for sale today occupy a couple of hundred square metres. This is much larger than a conventional treatment room of 50 square metres. Most hospitals lack the money and space to construct a special building for proton therapy.

We have been testing how smaller systems can be squeezed into existing hospital buildings, working with the proton-technology vendor ProTom International in Wakefield, Massachusetts, and engineers at the Massachusetts Institute of Technology in Cambridge. Getting an accelerator and gantry into two basement X-ray rooms in our central Boston hospital cost about $30 million, less than one-third of the cost of a dedicated centre but still about five times more than a top-end X-ray unit.

Both the equipment and the price tag need to shrink further if proton therapy is to replace X-rays. Fitting the facility into one room is the goal. This would

allow hospitals to simply replace existing X-ray equipment with proton units without building work. Getting there will be technically challenging, even with rapid advances in magnets[6].



Source: Dose levels from Fig. 1a, A. J. Lomax *et al. Radiother Oncol.* **51**, 257–271 (1999)

Gantries might need to have a smaller range of movement or be abandoned altogether[7]. Moving the patient relative to the beam is easier: fixed beams and a rotating chair were used in particle therapy before the 1990s. But it is difficult to position the patient accurately and repeatedly.

Three developments that have emerged in the past three years hold promise.

Narrow 'pencil' beams that paint the radiation dose precisely onto a tumour reduce the need to treat patients from many angles (see 'Clinical benefits'). Rapid imaging methods can detect tiny changes in the patient's position, so that the beam can be shifted. And advanced 'soft robotics' built using malleable outer materials will soon allow patients to be positioned quickly and comfortably using robotic hands.

Pushing affordable proton technology forwards will require combined efforts from device companies, venture capitalists, academics and medical practitioners. But these groups currently work in silos. Most technology development is left to industry. Hospitals buy off-the-shelf and do not actively seek input from researchers. Only a few national labs in different countries work on technologies related to proton therapy. There are plans for a medical-research beamline at CERN, Europe's particle-physics lab near Geneva, Switzerland. But, overall, there has been little work in universities with the clear goal of improving the affordability and clinical utility of proton-therapy systems.

Clinical utility

Although the utilization of proton therapy is growing, the gap between the number of patients receiving the treatment and those who could potentially benefit from it is still substantial (see 'Unmet need')[8]. The primary reason is cost; availability is another barrier, as are a lack of knowledge of the therapy's benefits and difficulties referring patients.

As technology improves, the number of patients who could benefit clinically from proton therapy will rise, too. The therapy is not like a pill: its success depends on how it is delivered. It has more room for improvement than other, more-established radiation treatments, such as X-rays. Developing proton therapy's physical advantages — in particular its ability to focus and thus lower the overspill of radiation — would make it the best treatment for most patients who need radiation therapy. In some cases, it might outperform surgery.

Sharpening the spot of the proton beam gives it the precision of a scalpel.

Unlike X-ray photons, fast protons entering the patient are slowed because they interact with body tissues. Most of the beam's energy is deposited at a point (called the Bragg peak). The speed of the proton, or its kinetic energy, determines the depth at which the spot reaches below the skin. Protons with energies of around 50 MeV penetrate to a depth of a few centimetres; those at more than 200 MeV reach 30 cm. Uncertainties in this slowing process can affect whether the dose spot hits the tumour as intended, or overshoots into healthy organs.

Better imaging methods are needed to locate and guide the proton spot. Its position is currently known to within only 0.5 cm. This is similar to X-rays but blurs the radiation dose, making it impossible to stop the beam precisely in front of crucial structures such as the spinal cord. Improving the accuracy and precision from centimetres to millimetres is necessary. This is a particular challenge when targeting moving tumours, such as those in the lung and liver. Higher accuracy would mean that smaller margins would need to be irradiated around tumours — overshoot is the standard way to deal with uncertainties. This would transform treatments for lung cancer, for example, in which proton therapy does not yet show a substantial physical advantage over X-rays.

Several methods for measuring the range of the proton spot have been explored[9]. When protons interact with atomic nuclei, they give off γ-rays that can be tracked. Sound waves are also given off when tissues expand and contract as they are heated by pulses of protons. Such techniques have reached accuracies of a few millimetres in experimental settings, but do not yet have the millimetre accuracy needed for use in patients. The technical hurdles are surmountable but require more concerted efforts, both public and private.

Health-care policy

The high cost of proton therapy means that most countries and insurers restrict its use. England and several European nations, including Denmark and the Netherlands, offer proton therapy only for cancer types for which the reduction of long-term side effects is thought to be greatest, such as tumours

in the skull base (chordoma and chondrosarcoma), in the eyes (melanoma) and many tumours in children. In 2014, the American Society for Therapeutic Radiation Oncology (ASTRO) released a list of diagnoses that its experts recommended insurers should cover.

But individuals and tumours vary. Sarcomas, for instance, occur in many different forms and sites. The benefit of proton treatment depends on tumour size, shape and proximity to organs. People with breast cancer are not on the ASTRO list. But those with a tumour on their left breast might benefit because proton therapy could help to spare the heart from radiation damage[3].

The Netherlands has taken a step in the right direction, using individual treatment plans and a biological model of complications in normal tissues to select patients who stand to benefit most from proton therapy. But the probabilities of side effects predicted by biological dose–response models are uncertain. The models consider only severe complications, such as blindness, which are rare. They do not consider more common aspects such as a reduced IQ score in children, for instance.

In the United States, several hospitals have tried to recoup the costs of proton centres by focusing on common and easy-to-treat tumours such as prostate cancer. Insurers are reluctant to cover such treatment, but many wealthy men pay for themselves. So the most common cancer treated with protons is one in which it makes the least clinical difference.

Because there are relatively few proton centres, patients must be referred to them from other hospitals. But many oncologists are unaware of what the therapy can do, and local, private physicians and hospitals fear losing revenue if their patients are treated elsewhere. Patients, too, are loath to travel long distances, sometimes between countries. As a consequence, too few patients are referred.

Sweden has improved these logistics. Since 2015, its proton centre in Uppsala has been run as a shared facility for all major hospitals in the country. Physicians and staff at the referring hospitals are involved in planning and in the treatment of their patients in Uppsala, and uptake has improved. This centralized approach might not work as well in a larger country. The United States will face its first test in 2019, when a proton

centre will open in Manhattan that will be shared among a consortium of hospitals.

Greater use raises another problem. The specialized personnel needed are in short supply. One solution is to make the workflow of proton therapy similar to that of conventional X-ray therapy. Another is to rely more on automation, in particular for systems that guide treatment planners on the basis of knowledge pooled from experts.

Next steps

Partnerships are needed to make proton-therapy technology more practically useful. Hospitals must share knowledge about treating and interacting with patients as well as using therapy systems. Applied physicists and engineers in academia and at national and international labs should work with medical physicists on improving the beams, imaging and robotics. For example, a CERN spin-off company called ADAM (Application of Detectors and Accelerators to Medicine), based in Geneva, is working with its parent institution in the United Kingdom on a linear mini-accelerator for medicine. National physics and engineering societies and funding agencies should coordinate some of this research and publicize needs and progress.

As costs fall, the charges for proton therapy should be lowered to the level of sophisticated X-ray therapy within the next five to ten years. Insurance companies should move to the 'reference pricing' model, which establishes a common level of payment for different therapies that have similar anticipated outcomes[10]. This will help to build the evidence for the benefit of proton therapy (or lack of it) in new clinical applications. The Mayo Clinic in Rochester, Minnesota, has already entered into such arrangements with insurers. Collaborations between hospitals and health-care funders on a broader scale are needed[5].

To get the ball rolling, these ideas could be discussed at the upcoming Particle Therapy Co-Operative Group meeting in May 2018. The European and American societies for radiation oncology should be involved. Symposia or satellite workshops should be organized to discuss the technical questions

at meetings of the American Physical Society and Physics for Health in Europe.

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Comments

Commenting is currently unavailable.

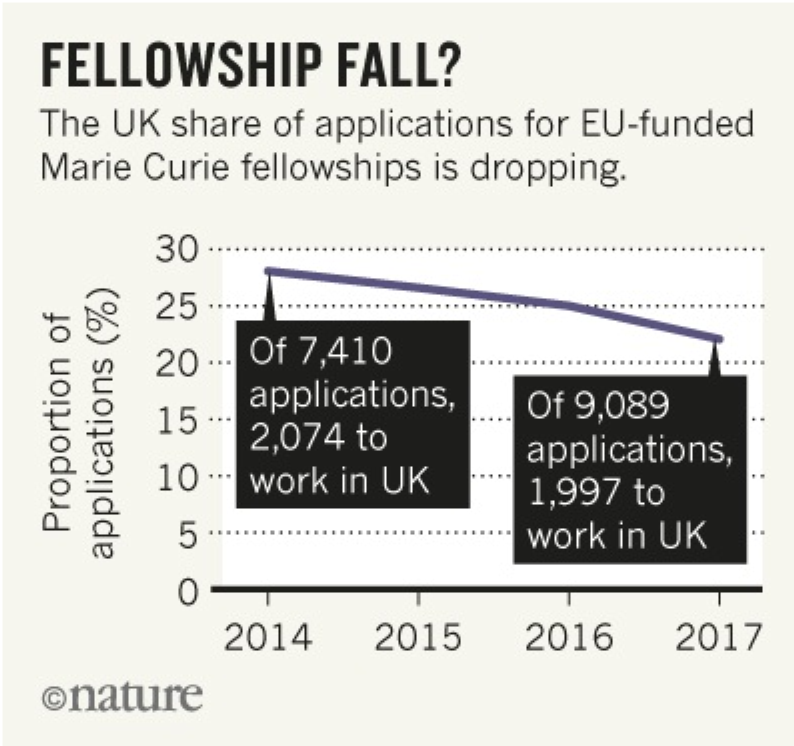
United Kingdom sees dip in European research applications after Brexit vote

But overall data don't show a big impact on UK's involvement with European science.

21 September 2017

The number of researchers applying for Europe-funded Marie Curie fellowships in the United Kingdom has dipped slightly since the country's vote to leave the European Union, data released to *Nature* show. But there is no evidence yet of a sharp collapse in interest, which some scientists had feared in the wake of the Brexit referendum.

Every year, the European Commission funds thousands of experienced researchers — most of them European — to undertake work in other EU countries, typically for one or two years, with individual fellowships usually worth between €150,000 (US$180,000) and €200,000. More than 9,000 academics have applied for the popular programme this year, in an application round that closed on 14 September. Of those, 1,997 people — around 22% of the total — requested to work in the United Kingdom. In 2016, the United Kingdom had received 2,211 applications, some 25% of the total that year; while in 2014, the UK share of applicants reached 28%.



Source: European Commission

Although the numbers hint at a decline in interest in working in Britain, they give no clear sign that the Brexit vote has immediately dented the United Kingdom's attractiveness to EU scientists. But "the slipping success rates show that British science is not impenetrable, so we must not be complacent", says Mike Galsworthy, co-founder of the advocacy group Scientists for EU. He says the results may suggest that other European countries are increasingly attractive to researchers.

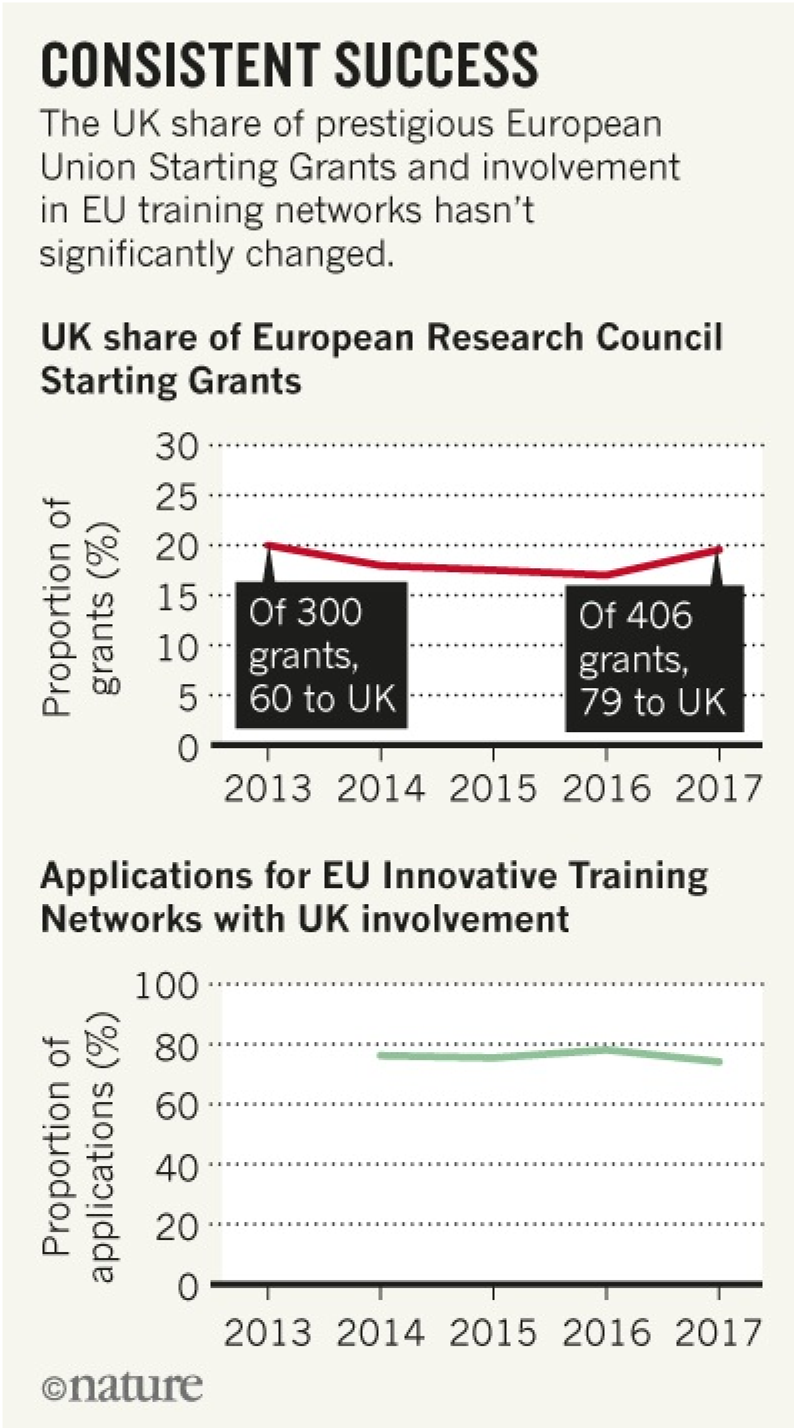
"It is unreasonable to expect an immediate effect from Brexit. The university and research system in the UK is massive, and it will take many years for the system to bleed out and gradually lose its competiveness," says Andre Geim, a physicist at the University of Manchester, UK, who won a Nobel prize for his work in graphene.

Geim told Bloomberg News last month that he hasn't received any applications under the Marie Curie scheme this year, unlike in previous years. But he is sponsoring two applicants who applied to work with his colleagues,

he clarifies to *Nature*. A spokesperson for the University of Manchester says that for the university as a whole, “Marie Curie application numbers have remained consistent over the past four years. This includes 2017, and we have several being processed in graphene at the moment.”

Strong starting grants

Other statistics on the United Kingdom’s involvement in Europe-funded grant schemes since the Brexit vote give a more optimistic picture — although it isn’t possible to conclude from any of the data whether changes in 2017 represent significant deviations from existing trends, notes statistician Michael Lavine at the University of Massachusetts Amherst.



Source: European Commission

For example, Britain has seen a [negligible decline in its involvement in multinational European research collaborations] called Innovative Training

Networks (ITNs) — which, similarly to the fellowships, are paid for under the Marie Skłodowska-Curie actions, a €6.2-billion slice of the European Commission's Horizon 2020 funding programme. In 2016, 78% of ITNs had at least one British partner; the 2017 awards — all of which were applied for after the Brexit vote — show a slight dip to 74%.

And Britain has achieved its usual success in winning European Research Council (ERC) 'starting grants', awards of up to €1.5 million over 5 years for highly promising early-career researchers to start their own laboratories anywhere they wish. The United Kingdom secured 19.5% of the 406 starting grants awarded in 2017, up from 17% in 2016; its success rates have fluctuated between 17% and 20% in the past four years.

UK nationals, relative to non-British Europeans, are making up an increasing proportion of the United Kingdom's starting-grant winners, however. This year, Britain is hosting 79 grantees under the scheme — more than any other EU country — and just under half (47%) are UK nationals. In 2014, UK nationals represented just over one-quarter of those with ERC starting grants in the United Kingdom.

Funding guarantee

Two months after the Brexit vote, the UK government announced that it would underwrite EU grants won before the date scheduled for the United Kingdom to leave the EU. This promise has reassured some European researchers that they can have a future in Britain even without EU membership, says evolutionary biologist Simone Immler, a Swiss national who moved her ERC starting grant to the University of East Anglia in Norwich, UK, despite the Brexit vote.

Immler says that what really matters to researchers is getting their dream post, and that they will continue to come to the United Kingdom as long as there is a chance of this happening. "The beauty of these grants is they allow people to choose a host institution that they would like to go to, and they are likely to be offered a permanent position there," she says. "But if these grants stopped, it would hurt."

Michael Browne, head of European Research and Innovation at University College London, says that the most important thing is to ensure that British researchers do not drop out of European projects as a result of the Brexit vote, even temporarily. He says that EU research consortiums are highly competitive, and if one partner leaves, another will quickly step in to plug the gap, which makes it hard to re-enter. “That’s why my main message to researchers would be to, despite the uncertainty, really try to stay plugged into European platforms and networks,” he says.

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Comments

Comments

There are currently no comments.

Fossilized poo reveals that vegetarian dinosaurs had a taste for crabs

Ancient crustaceans in dino dung from Utah illuminate herbivores’ broad diet.

21 September 2017

Cory Richards/NGC

Fossilized faeces from the Kaiparowits Formation in southern Utah yields clues to dinosaurs' diets.

Plant-eating dinosaurs usually found plenty to eat, but occasionally they went

looking for a nutritional boost. Fossilized dinosaur droppings from Utah now reveal that 75 million years ago, some of the animals were snacking on prehistoric crayfish or crabs.

The work suggests that big herbivorous dinosaurs sometimes munched on crustaceans, likely to get extra protein and calcium into their bodies before laying eggs, says Karen Chin, a palaeontologist at the University of Colorado Boulder. She and her colleagues report the discovery on 21 September in *Scientific Reports*[1].

“It’s a very unusual case of an herbivorous dinosaur supplementing its diet with something else,” says Paul Barrett, a palaeontologist at the Natural History Museum in London.

Direct evidence of dinosaur diets is hard to come by. Some fossil animals have been found with their gut contents intact, but fossilized dinosaur dung — the most convincing remains of what a dinosaur actually ate — is rare. “Think of a cow pat — these things get broken down in the environment very easily,” says Barrett. Most of the fossilized faeces, called coprolites, that researchers uncover come from meat-eating dinosaurs; these are better preserved than those of plant-eating dinosaurs thanks to minerals in the bones of the creatures that carnivores consumed.

Chin has long hunted for coprolites from herbivorous dinosaurs. In 2007, she reported[2] finding fossilized chunks of rotting wood inside coprolites, between about 80 million and 74 million years old, from the Two Medicine rock formation in Montana. Plant-eating dinosaurs may have chewed the wood in search of insects and other organisms scurrying inside rotting logs, she proposed.

Then, in 2013, she found many similar coprolites in the Kaiparowits Formation of Grand Staircase–Escalante National Monument in southern Utah. Along with rotting wood, they contained puzzling fragments of thin, convex structures. When Chin examined slices of the structures under a microscope, they looked very much like the outer covering of a crustacean’s leg or claw. She consulted Rodney Feldmann, a palaeontologist at Kent State University in Ohio, who confirmed that they probably came from a crayfish or crab.

Dietary supplement

At the time the Kaiparowits rocks formed, around 75 million years ago, the landscape was a wet, subtropical environment much like today's Texas coast. Chin thinks that local dinosaurs — probably the duck-billed group called hadrosaurs — went in search of dietary supplements near the shoreline. "You get so many invertebrates hanging out in rotting logs," she says. "There's bugs to eat, and rotting detritus — it's a really rich place." The fungi that helped to break down the logs would also have provided extra protein.

K. Chin et al./Sci. Rep. (CC BY 4.0)

Fossilized faeces (brown) from the collections of the Denver Museum of Nature and Science show crustacean fragments (black).

Some modern birds with mostly plant-based diets add insects and other sources of protein before they lay eggs, she notes. "You can't imagine a 20-

foot hadrosaur going after a butterfly," Chin says. "They would go for some place that had a predictable, concentrated source of food — some place like rotting logs."

The rotting wood probably wasn't a main source of dinosaur food year-round, says Jordan Mallon, a palaeontologist at the Canadian Museum of Nature in Ottawa. "Hadrosaurs were some of the biggest animals in their ecosystems, so they probably couldn't have afforded to be too selective about what they were eating anyway, lest they starve to death."

Mallon thinks the dinosaurs might have accidentally snaffled up a crayfish or two while feeding, as opposed to seeking the crustaceans out on purpose. Either way, he says, the latest findings "provide an excellent glimpse in the lives of these animals, 75 million years ago".

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Comments

Comments

There are currently no comments.

Jellyfish caught snoozing give clues to origin of sleep

The brainless marine creatures are the simplest organisms known to seek slumber.

21 September 2017

Norbert Wu/Minden/NGC

New research suggests that *Cassiopea* jellyfish eschew the night life, tucking into bed and going to sleep when the sun goes down.

The purpose and evolutionary origins of sleep are among the biggest mysteries in neuroscience. Every complex animal, from the humblest fruit fly to the largest blue whale, sleeps — yet scientists can't explain why any

organism would leave itself vulnerable to predators, and unable to eat or mate, for a large portion of the day. Now, researchers have demonstrated for the first time that even an organism without a brain — a kind of jellyfish — shows sleep-like behaviour, suggesting that the origins of sleep are more primitive than thought.

Researchers observed that the rate at which *Cassiopea* jellyfish pulsed their bell decreased by one-third at night, and the animals were much slower to respond to external stimuli such as food or movement during that time. When deprived of their night-time rest, the jellies were less active the next day.

“Everyone we talk to has an opinion about whether or not jellyfish sleep. It really forces them to grapple with the question of what sleep is,” says Ravi Nath, the paper’s first author and a molecular geneticist at the California Institute of Technology (Caltech) in Pasadena. The study was published on 21 September in *Current Biology*[1].

“This work provides compelling evidence for how early in evolution a sleep-like state evolved,” says Dion Dickman, a neuroscientist at the University of Southern California in Los Angeles.

Mindless sleep

Nath is studying sleep in the worm *Caenorhabditis elegans*, but whenever he presented his work at research conferences, other scientists scoffed at the idea that such a simple animal could sleep. The question got Nath thinking: how minimal can an animal’s nervous system get before the creature lacks the ability to sleep? Nath’s obsession soon infected his friends and fellow Caltech PhD students Michael Abrams and Claire Bedbrook. Abrams works on jellyfish, and he suggested that one of these creatures would be a suitable model organism, because jellies have neurons but no central nervous system. Instead, their neurons connect in a decentralized neural net.

Cassiopea jellyfish, in particular, caught the trio’s attention. Nicknamed the upside-down jellyfish because of its habit of sitting on the sea floor on its bell, with its tentacles waving upwards, *Cassiopea* rarely moves on its own.

This made it easier for the researchers to design an automated system that used video to track the activity of the pulsing bell. To provide evidence of sleep-like behaviour in *Cassiopea* (or any other organism), the researchers needed to show a rapidly reversible period of decreased activity, or quiescence, with decreased responsiveness to stimuli. The behaviour also had to be driven by a need to sleep that increased the longer the jellyfish was awake, so that a day of reduced sleep would be followed by increased rest.

Other researchers had already documented a nightly drop in activity in other species of jellyfish, but no jellyfish had been known to display the other aspects of sleep behaviour. In a 35-litre tank, Nath, Abrams and Bedbrook tracked the bell pulses of *Cassiopea* over six days and nights and found that the rate, which was an average of one pulse per second by day, dropped by almost one-third at night. They also documented night-time pulse-free periods of 10–15 seconds, which didn't occur during the day.

Restless night

Without an established jellyfish alarm clock, the scientists used a snack of brine shrimp and oyster roe to try to rouse the snoozing *Cassiopea*. When they dropped food in the tank at night, *Cassiopea* responded to its treat by returning to a daytime pattern of activity. The team used the jellyfish's preference for sitting on solid surfaces to test whether quiescent *Cassiopea* had a delayed response to external stimuli. They slowly lifted the jellyfish off the bottom of the tank using a screen, then pulled it out from under the animal, leaving the jelly floating in the water. It took longer for the creature to begin pulsing and to reorient itself when this happened at night than it did during the day. If the experiment was immediately repeated at night, the jellyfish responded as if it were daytime. Lastly, when the team forced *Cassiopea* to pull an all-nighter by keeping it awake with repeated pulses of water, they found a 17% drop in activity the following day.

"This work shows that sleep is much older than we thought. The simplicity of these organisms is a door opener to understand why sleep evolved and what it does," says Thomas Bosch, an evolutionary biologist at Kiel University in Germany. "Sleep can be traced back to these little metazoans — how much

further does it go?” he asks.

That’s what Nath, Abrams and Bedbrook want to find out. Amid the chaos of finishing their PhD theses, they have begun searching for ancient genes that might control sleep, in the hope that this might provide hints as to why sleep originally evolved.

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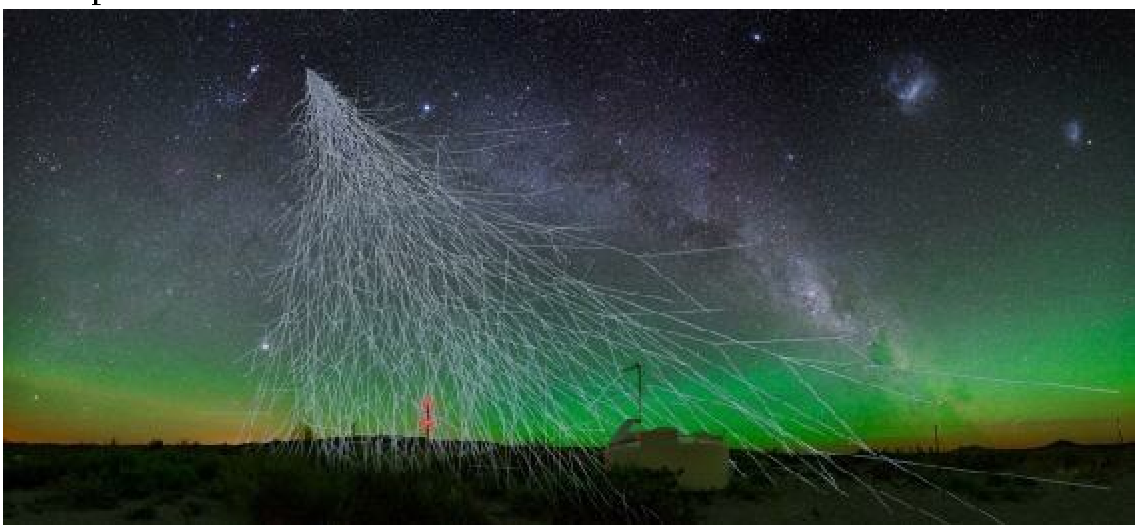
Comments

Commenting is currently unavailable.

High-energy cosmic rays come from outside our Galaxy

Giant observatory announces long-awaited result.

21 September 2017



A. Chantelauze/S. Staffi/L. Bret

The fallout from a high-energy cosmic ray can cover many square kilometres (artist's impression).

The Pierre Auger Observatory in Argentina finally has solid evidence that the most energetic particles in nature come from sources outside the Milky Way. Scientists have suspected this for decades, but weren't able to confirm it — until now.

"For the first time, we have proof that the highest-energy cosmic rays are of extragalactic origin," says Alan Watson, a UK astronomer and co-founder of the observatory. The result comes as a relief to the researchers, after previous claims regarding their origin made ten years ago by the Pierre Auger

Collaboration subsequently turned out to be premature.

The international team analysed 12 years' worth of data, and found that particles in the upper range of energies were more likely to come from a region of the sky outside the Milky Way's disk. That asymmetry is roughly consistent with the distribution of neighbouring galaxies, the researchers report in the 22 September issue of *Science*[1].

The study does not pinpoint individual sources of the cosmic rays, or explain how they reach their highest energies. But the researchers hope that it is a first step towards understanding their origins.

Invisible shower

Most cosmic rays are protons or other charged particles, including atomic nuclei as heavy as iron. When such a particle rains onto Earth's upper atmosphere and collides with an atomic nucleus in the air, it produces a shrapnel burst of subatomic particles. These hit other nuclei and produce more particles, generating an invisible 'shower' that is often spread over many square kilometres by the time it hits the ground.

To detect these showers, the Pierre Auger Observatory has 1,600 car-sized water tanks placed at 1.5 kilometre intervals, to cover 3,000 square kilometres of grassy plains in Argentina's Mendoza province. Four sets of telescopes monitor the sky over the array, and — on moonless nights — can detect flashes of ultraviolet light generated by the showers. From its location relatively close to the equator, the array can pick up cosmic rays coming from the entire southern sky as well as from much of the northern sky, covering 85% of the celestial sphere.

The Pierre Auger Observatory

Cosmic rays were detected using 1,600 water tanks placed at 1.5 kilometre intervals.

The observatory needs to be that big in order to catch enough of the most sought-after particles. Cosmic rays have been detected with energies beyond 10^{20} electronvolts (eV); by comparison, the Large Hadron Collider near Geneva, Switzerland, the world's most powerful particle accelerator, pushes protons to just 7×10^{12} eV. However, cosmic rays become increasingly rare the higher their energies. A particle in the 10^{20} eV range, on average, hits a square kilometre of Earth only once per century.

The researchers looked at 32,187 particles that had energies above 8×10^{18} eV, detected by the observatory from its beginning in 2004 until 2016. The Galaxy's magnetic field bends the paths of charged particles, which can randomize their direction by the time they hit Earth. But these particles were still 6% more likely than average to come from a particular region of the sky, which is outside the Milky Way’s disk.

Surprise skew

Most researchers expected a skew, but not such a strong one, says Piera Ghia, an astroparticle physicist at the CNRS Institute of Nuclear Physics in Orsay, France, who helped to coordinate the data analysis. Astrophysicist Francis Halzen of the University of Wisconsin–Madison agrees. “It’s really very big. To me, it was a surprise,” says Halzen, who is spokesperson for IceCube, a major neutrino observatory at the South Pole.

When magnetic deflection is taken into account, the asymmetry seen by the Pierre Auger Observatory is consistent with the distribution of galaxies lying within 90 megaparsecs (around 300 million light years) or so from the Milky Way, says Silvia Mollerach, an Auger astrophysicist at the Balseiro Institute in San Carlos de Bariloche, Argentina.

The results strongly disfavour the supermassive black hole at the centre of the Milky Way as a major source of the higher-energy particles. “The most likely sources continue to be the usual suspects,” Mollerach says: astrophysical phenomena that generate extremely intense magnetic fields, inside which charged particles can pinball around and gain energy. These include active galactic nuclei — supermassive black holes spewing jets of matter at near-light speed — and the stellar explosions called γ-ray bursts.

The latest claim is quite conservative compared to one that the collaboration made in 2007. Back then, it found a correlation between 27 extremely high-energy cosmic rays (above 57×10^{18} eV) it had seen up until that point and a set of known active galactic nuclei[2]. The paper caused a sensation, but the statistical significance of the result was weak and soon melted away as the array collected more data. “In retrospect, it was a mistake that we published too early,” says Auger spokesperson Karl-Heinz Kampert, a physicist at the University of Wuppertal in Germany.

This time, the team took no chances: it accumulated much more data and is confident that the results are solid, Kampert says. Halzen agrees. “I don't think there is any doubt about the statistical significance” of the latest results, he says.

Now that the researchers have more data, they will again try to find correlations with potential sources. The results of that study should appear within a few months. The collaboration also plans to join forces with a smaller observatory in Utah, the Telescope Array, to try to map the origins of cosmic rays across the entire sky.

The Pierre Auger Observatory is also in the initial stages of a US$12-million upgrade that should enable it to better measure the relative abundance of protons and heavier nuclei in the flux of cosmic rays.

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Comments

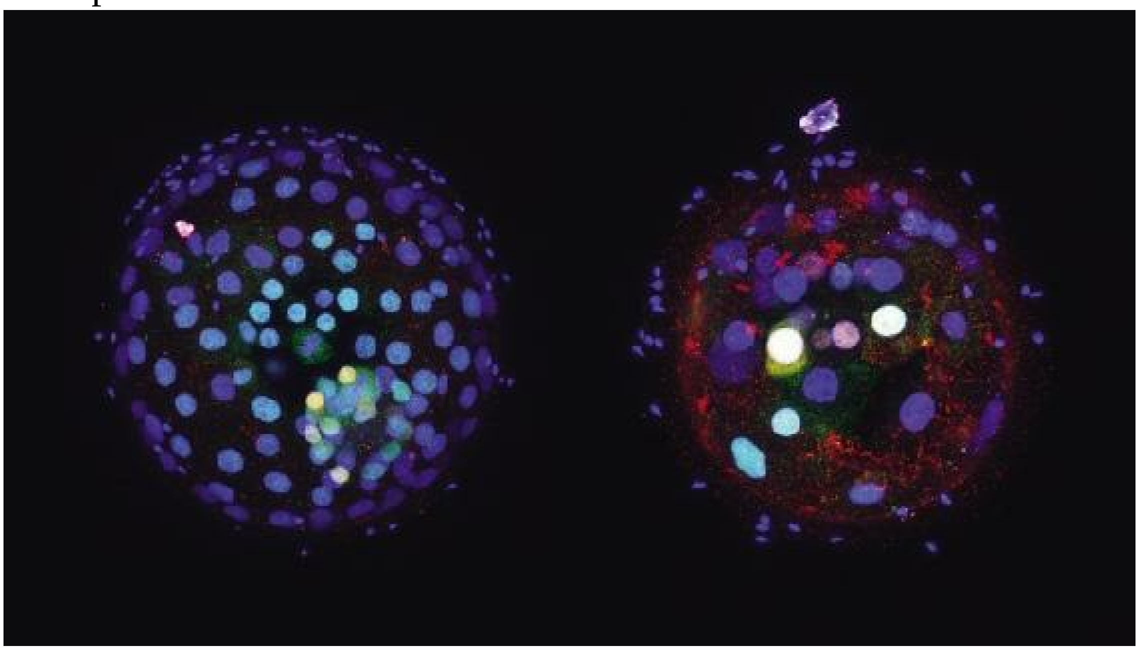
Comments

There are currently no comments.

CRISPR used to peer into human embryos' first days

Gene-edited embryos enable researchers to unpick role of a crucial gene, with more studies likely to follow.

20 September 2017



Niakan et al. DOI 10.1038/nature24033.

CRISPR was used to disrupt a protein important in human embryo development.

Gene-edited human embryos have offered a glimpse into the earliest stages of development, while hinting at the role of a pivotal protein that guides embryo growth.

The first-of-its-kind study stands in contrast to previous research that attempted to fix disease-causing mutations in human embryos, in the hope of eventually preventing genetic disorders. Whereas those studies raised concerns over potential 'designer babies', the latest paper describes basic research that aims to understand human embryo development and causes of miscarriage.

Published online today in *Nature*[1], the study relied on CRISPR–Cas9, a gene-editing system that can make precise changes to DNA in the genome. In this case, researchers harnessed CRISPR–Cas9 to disrupt the production of a protein called OCT4 that is important for embryo development.

Researchers have traditionally done such studies in mouse embryos, which are more plentiful and carry fewer ethical considerations than human embryos. But the latest study highlights key differences between the role of OCT4 in human and in mouse embryos, underscoring the limitations of relying on animal models, says stem-cell scientist Dieter Egli of Columbia University in New York City.

"If we are to truly understand human embryonic development and improve human health, we need to work directly on human embryos," he says. "We cannot rely only on inference from model organisms."

Regulated research

To perform the study, a team led by developmental biologist Kathy Niakan of the Francis Crick Institute in London used a total of 58 embryos that had been generated in fertility clinics as a result of *in vitro* fertilization (IVF) treatments. The embryos were no longer needed for IVF and had been donated for research. The UK Human Fertilisation and Embryology Authority granted permission to do the study — the first time a national regulator has approved research involving gene editing in human embryos (previous studies in other countries were endorsed by local review boards).

The team injected the molecular machinery needed for CRISPR–Cas9 gene editing when the fertilized eggs, or zygotes, consisted of just one cell and then followed their development in the lab for a week.

It soon became clear that normal development had derailed in embryos that lacked normal levels of OCT4. About half of the controls (which had unaltered, normal OCT4 levels) developed to form multicellular embryos called blastocysts. Of the edited embryos with disrupted OCT4 levels, only 19% made it that far.

The results will reassure scientists that CRISPR–Cas9 is efficient enough for studies in human embryos, says Fredrik Lanner, a developmental biologist at the Karolinska Institute in Stockholm. “If you do this in mice, you can test hundreds of embryos,” he says. “But you have a limited access to human embryos.”

Lanner, whose lab is conducting studies with CRISPR of other genes that are crucial for embryo development, points to the importance of painstakingly optimizing the experimental conditions in mouse embryos before moving the studies to human embryos, as Niakan’s team had done.

Striking differences

But additional studies in human embryos will still be needed to pinpoint what OCT4 is doing. The differences between mouse and human embryos were striking, says Amy Ralston, a developmental biologist at Michigan State University in East Lansing who has studied the protein in mice. Niakan's team found that human embryos stopped growing earlier than mouse embryos lacking the protein and showed different patterns of gene expression. There were also unexpected abnormalities in the cells that give rise to the placenta.

The latter finding is particularly important, Niakan says, because researchers have poor models for studying placenta development — and for understanding how the process can go awry. The research could also eventually yield ways to boost the success rate of IVF and help explain why some pregnancies fail, she says.

“It’s an exciting first step,” says Ralston. “This paper opens up a new era of human functional genetics.”

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Comments

Commenting is currently unavailable.

| 章节菜单 | 主菜单 |

Sexual competition among ducks wreaks havoc on penis size

When forced to compete for mates, some birds develop longer penises and others almost nothing at all.

20 September 2017

Gerrit Vyn/NPL

Male ruddy ducks regenerate their penises each year.

Male ducks respond to sexual competition by growing either an extra-long penis or a nub of flesh, a new study finds. The unusual phenomena occurred in two species studied: the lesser scaup (*Aythya affinis*) and the ruddy duck (*Oxyura jamaicensis*). It suggests that penis size — in line with many traits and behaviours meant to impress or allow impregnation of the opposite sex — involves a trade-off between the potential to reproduce and to survive.

Patricia Brennan, an evolutionary biologist at Mount Holyoke College in South Hadley, Massachusetts, compared the penises of ducks kept in male–female pairs to those housed with multiple males per female. The findings are published in a study on 20 September in *The Auk: Ornithological Advances*[1].

“If they were alone with a female, the males just grew a normal-sized penis, but if there were other males around, they had the ability to change dramatically,” Brennan says. “So evolution must be acting on the ability to be plastic — the ability to invest only in what is needed in your current circumstance.”

Because evolutionary success relies on reproduction, genitals are adapted to meet the varied circumstances that every animal faces. Some male ducks, for example, have penises in the shape of corkscrews to navigate the labyrinth-like vaginas of their female counterparts. An earlier study by Brennan found that females’ anatomy evolved to prevent access to undesirable males who force copulation[2]. To mate successfully with their chosen partners, Brennan says, female ducks assume a posture that allows males to enter them fully and deposit sperm near eggs.

Close competition

However, evolutionary changes in the size of body parts are generally thought to happen over generations, not within an individual’s lifetime. Brennan wondered whether ducks might buck this trend because some species’ penises emerge anew every breeding season and degenerate afterwards. Similarly, acorn barnacles (*Semibalanus balanoides*) — hermaphroditic, shelled sea creatures cemented to rocks — generate their penises only when it's time to mate. Because they use their penises to grope for other barnacles to inseminate, the organ’s length depends on the proximity of a barnacle’s neighbours.

Brennan and her colleagues fenced off habitats so that ducks would live either in pairs or in groups with almost twice as many males as females for two breeding seasons over the course of two years. The lesser scaups grew longer penises when they were forced to compete for females than when they were coupled up. A larger reproductive organ likely improves their chances of fertilizing an egg.

But the results of the social environment on ruddy ducks were more complicated. During the first year, only the largest males in the groups grew long penises (about 18 centimetres each), whereas smaller males developed half-centimetre stubs. In the second year, smaller males grew normal-sized penises, but they lasted for just five weeks, whereas the largest males kept their penises for three months.

Stressed-out species

Clues may lie in the drama of ruddy-duck life. The birds have some of the largest penis-to-body ratios found in nature — with penises sometimes longer than their bodies. “I can’t imagine they could grow any longer,” Brennan says. The birds have also been known to fight to the death, which suggests that smaller ruddy ducks might be too stressed to develop penises normally. “Bullying may increase stress hormones, and those could counteract the effects of androgen hormones” that control penis growth, Brennan says.

This response to stress could be adaptive. The same androgen hormones that trigger penis growth every season in birds also underlie colouration. They cause the duck’s feathers to turn from dull brown to chestnut when it’s time to breed, and their bills to go from grey to bright blue. To females, the wardrobe change signals a male’s readiness. To neighbouring males, it foreshadows a fight. “I think the small ones go through it quickly so that there’s less danger of getting beaten up,” Brennan says.

The study is “really interesting”, says Charlie Cornwallis, an evolutionary biologist at Lund University in Sweden. “This suggests there is a cost to having a large penis because individuals are investing according to the competition they face from other males.” Cornwallis says that few studies have investigated the effect of environmental and social conditions on penis size, and that these evolutionary trade-offs could be more common than imagined.

Families who picnic at the Livingston Ripley Waterfowl Conservancy in Litchfield, Connecticut, where the study was conducted, overlook the birds’ bargains as well. “People watch the ducks on the weekends, but they have no idea what’s really going on,” Brennan says. “I now have a love–hate relationship with ducks.”

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Comments

Comments

There are currently no comments.

Pair of deadly Mexico quakes puzzles scientists

Latest big tremor could be linked to major earthquake earlier this month.

20 September 2017

ALFREDO ESTRELLA/AFP/GETTY

The tremor that struck central Mexico on 19 September levelled buildings in Mexico City.

A magnitude-7.1 earthquake struck central Mexico on 19 September, killing more than 200 people and reducing buildings to rubble in the states of Puebla, Morelos and Guerrero, as well as in Mexico City. The event came 12 days after a magnitude-8.1 tremor hit off the state of Chiapas — Mexico's largest quake in more than a century — and 32 years to the day after the country's most damaging tremor, an 8.0, killed thousands.

Like the recent Chiapas quake, the 19 September tremor struck in the middle of the Cocos geological plate — rather than along its edge, where it begins its plunge beneath the North American plate. Mexico's national seismological service placed the epicentre of the quake at a depth of 57 kilometres, near the border of the states of Puebla and Morelos and about 120 kilometres from Mexico City. The earthquake occurred on a 'normal' fault, in which one part of Earth's crust moves higher than land on the other side.

Whether the 7 September and 19 September quakes are linked — and if so, how — remains to be seen. They are too far apart (about 650 kilometres) for the second one to be considered an aftershock of the first.

Searching for clues

Big earthquakes can increase the long-term risk of seismic activity nearby by transferring stress within Earth's crust to adjacent geological faults. But that sort of 'static stress' transfer usually happens only within a radius equal to about three to four times the length of the original fault's rupture, says Gavin Hayes, a seismologist at the US Geological Survey in Golden, Colorado.

The 7 September earthquake ruptured about 100 kilometres of the crust, which would imply its stress transfer reached no more than about 300 to 400 kilometres away, Hayes says. That puts the 19 September quake, whose epicentre was 650 kilometres away, outside the zone of influence. "But the time coincidence makes it pretty suspicious," Hayes says. "A lot of people will think that they are related, and there's going to be a lot of work on that."

Another possibility is that the 19 September quake is an example of 'dynamic triggering', in which seismic waves rippling outward from one quake affect faults much more quickly — and at much larger distances — than in static stress transfer. But dynamic triggering usually happens within hours or days of the initial quake, making the 12-day gap between the 7 September event and the latest big tremor hard to explain, says Eric Fielding, a geophysicist at

NASA's Jet Propulsion Laboratory in Pasadena, California, who studies dynamic triggering.

Shifting ground

His team has been analysing satellite radar images of the landscape around the 7 September quake, looking for changes in ground level that indicate which parts of the landscape have uplifted and which have dropped down as a result of that event. The data come from Europe’s Sentinel radar satellites and Japan’s ALOS-2 satellite. Fielding's team will be looking for similar information in the coming days from the 19 September quake. Radar images can help to reveal where geological stress is transferred within the ground after an earthquake.

The Cocos plate begins its dive downward off the western coast of Mexico, and then flattens out for hundreds of kilometres before taking a second, steeper dive and plunging below the North American plate. The 19 September quake happened where this second bend occurs, thanks to the geological stresses that have built up where the weight of the steeply descending plate tugs on the flat section.

Much of the worry about Mexico's seismic danger has focused off the western coast, where the slab begins its dive. There, on the plate boundary itself, is where the deadly earthquake struck in 1985, flattening buildings — particularly in Mexico City, which is built atop a shaky foundation of dried-up lake sediments. That disaster prompted Mexico to build an earthquake early-warning system, which on 19 September provided crucial seconds of warning for people to prepare for the shaking.

Many ‘seismic gaps’ remain off Mexico's west coast, where geological stress built up by the diving plate has yet to be released by an earthquake. They include the Guerrero gap, near Acapulco, considered by many scientists to be a major threat.

The death toll from the 19 September quake is expected to rise.

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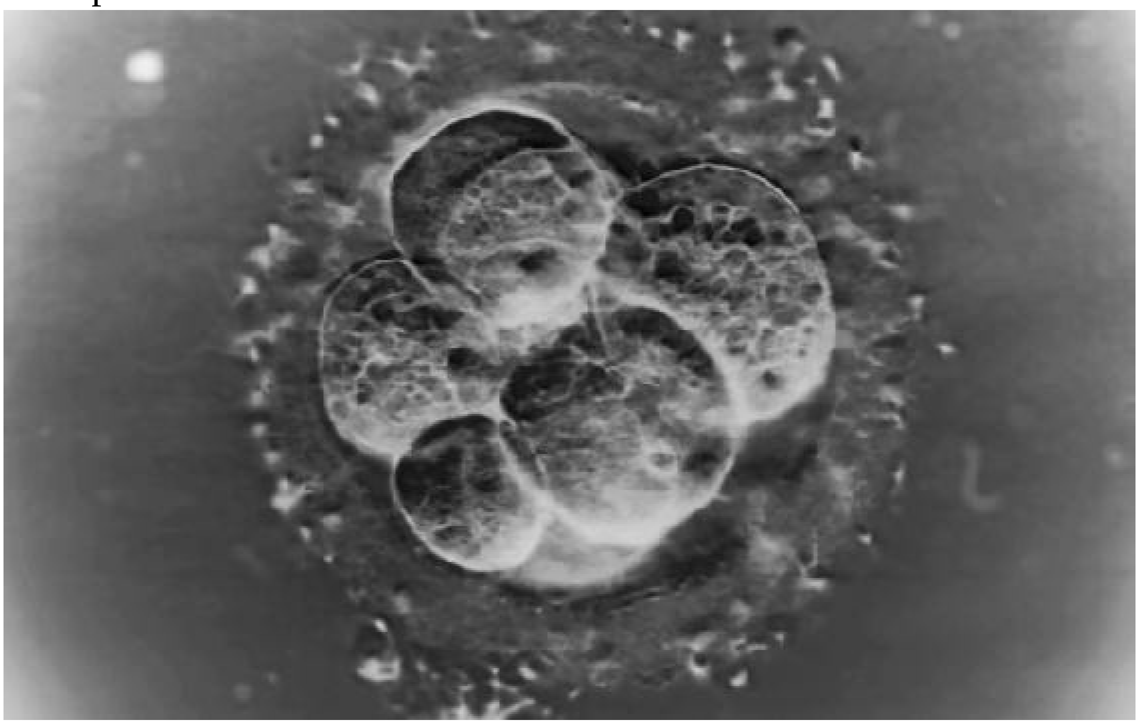
Comments

There are currently no comments.

Take stock of research ethics in human genome editing

Progress in the use of CRISPR–Cas9 for human germline editing highlights some pressing ethical considerations for research on embryos.

20 September 2017



Zephyr/SPL

Gene editing of human embryos raises pressing ethical considerations.

This week, *Nature* publishes the results of experiments that used genome editing to modify the DNA of a human embryo. Kathy Niakan at the Francis Crick Institute in London and her colleagues have used the CRISPR–Cas9 technique to introduce mutations into a gene called *OCT4*, and show how the gene is required to steer cell fate as a fertilized egg starts to divide and proliferate (N. M. E. Fogarty *et al. Nature* http://dx.doi.org/10.1038/nature24033; 2017).

The research addresses a fundamental question of human biology, but understanding the events of early development could also help to refine culture conditions for embryos in future *in vitro* fertilization (IVF) treatments. It also provides crucial information about the mechanism that underpins the gene-editing technique. The embryos, which had been donated by couples who had undergone IVF treatment, were allowed to develop in the laboratory for only a few days.

Nature published a related paper last month, which explored how gene editing of embryos using CRISPR–Cas9 could correct a specific genetic mutation (H. Ma *et al. Nature* **548,** 413–419; 2017). Those experiments, by Shoukhrat Mitalipov at Oregon Health and Science University in Portland and his colleagues, did not use embryos from IVF clinics. Instead, the researchers made them in the lab by fertilizing donated eggs with sperm from a male donor who carries the mutated gene.

The publication of these studies seems a good time for all involved to take stock and discuss how they should navigate this type of research.

Ethical consensus

The development of CRISPR–Cas9 as an efficient genome-editing tool is under scrutiny because it brings with it the possibility that scientists could make permanent modifications to the human germ line. Specialist groups have charted these ethical challenges and made some recommendations about how best to take forward research that applies gene editing to human embryos. Consensus guidelines — such as those based on the efforts of an interdisciplinary ethics consortium called the Hinxton Group, as well as separate efforts by the US National Academies of Science, Engineering, and Medicine, the International Society for Stem Cell Research and others — have advised that editing the human germ line can be justified for the scientific purpose of research into fundamental biology.

But they also say that substantial basic research is needed to check the safety, accuracy and feasibility of genome editing as a potential clinical tool. Therefore, clinical applications can be considered only after strong research groundwork has been done, and only then for cases that are deemed acceptable after careful examination of alternatives and further societal debate.

Both research studies published in *Nature* aim to answer some fundamental scientific questions. And, in keeping with consensus guidelines, both studies have undergone strict and thorough ethical assessment during their inception, execution and peer review (as outlined in our policy). Both studies were licensed by the relevant authorities, and had full ethical approval and consent from the couples who donated the embryos, eggs and sperm.

These studies are valuable on several counts. They provide important insights into the biology of human embryos, and the possible mechanisms of genome editing in this context. They also highlight technical and ethical issues that inform researchers, funders, journals and regulators as they plan and assess future projects in this field.

In particular, they show the importance of properly assessing the suitability of the type and number of embryos needed for research projects that explore different aspects of human germline editing.

Using donated surplus embryos from IVF might be a better way to answer some research questions than using embryos fertilized in the lab. The inherent variability of donated embryos could offer a more rigorous and realistic testing ground for checking issues such as the rate of unintended ‘off-target’ genetic changes, which can occur when using CRISPR–Cas9 editing. But, for the time being, targeted correction of specific mutations will probably continue to rely on donated eggs and sperm that carry the mutated DNA and which are then used to make a fertilized egg in the research laboratory.

In both cases, *Nature* fully supports the principle that all donors should be informed of the details of the exact research to be carried out with their donated material — as described in the methods section of both papers.

In keeping with the sensitive nature of a donation, researchers must show that they have balanced scientific and ethical considerations to determine the appropriate number of embryos used. They must ensure that experiments will provide robust scientific answers, while minimizing the use of this precious material. This may imply, as was the case in both the published studies, that researchers must first perform the intended work in human pluripotent stem cells or mouse embryos to optimize the conditions. Journals, reviewers and editors should consider which questions arising during peer review can be answered using systems other than human embryos.

One point for the research community to consider is whether these initial studies might be peer reviewed and considered for publication before the hypothesis is tested in embryos. This independent peer review could happen in parallel with consideration of the project by the regulators, and could inform decisions on embryo provenance and the limits of experiments.

The particular requirements of studies will differ, but a strong framework for assessing them as early as possible seems the best way to ensure that they meet the highest standards. Regulators, funders, scientists and editors need to continue working together to define the details of the path forward for germline genome editing, so that the valuable resources and tools now at our disposal are used with good judgement.

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Snow leopards, ancient zero and Cassini’s big finish

The week in science: 15–21 September 2017.

20 September 2017

Conservation | Politics | Events | Research | Funding | Trend watch

CONSERVATION

Snow leopard moves off endangered list Snow leopards are no longer officially endangered, according to the latest International Union for Conservation of Nature (IUCN) Red List, which now puts them in the less-threatened ‘vulnerable’ category. But populations of the leopard (*Panthera uncia)* are still declining, the IUCN warns, and the risk of extinction is still high. The list, updated on 14 September, outlines the risks to 87,967 species. In other changes, five of the six most prominent species of ash tree in North America have been classified as critically endangered because of the threat posed by an invasive beetle, and the Christmas Island pipistrelle bat (*Pipistrellus murrayi*) is officially extinct.

Vincent J. Musi/NGC

POLITICS

Gender bias The UK Parliament's influential House of Commons science and technology select committee came under fire after announcing eight members on 12 September, all of whom are men. Norman Lamb, the new head of the cross-party body (which does not select its membership), added his voice to complaints about the lack of women. The Conservatives have since put forward two further members, one of whom, Vicky Ford, is a woman. That leaves one unfilled Labour Party position on the committee, which is tasked with holding the government to account on scientific topics.

India–Japan talks Japan and India have agreed to cooperate on a range of science and technology activities, including an exchange programme between the mathematical and life sciences to foster talented theoretical biologists. The agreements were part of the 12th India–Japan Annual Summit, held on 13–14 September in Ahmedabad and Gandhinagar, India, which included discussions about disaster risk management, infrastructure and development. India's Department of Biotechnology and Japan's National Institute of Advanced Industrial Science and Technology also re-signed a five-year memorandum of understanding to promote research collaborations in the life sciences and biotechnology.

Dual-use research Experiments involving dangerous biological agents that could be misused to cause harm, such as some viruses and bacteria, are poorly regulated in the United States, according to a 14 September report by the US National Academies of Sciences, Engineering, and Medicine. The US government requires special oversight of experiments on only 15 biological agents and toxins, and does not sufficiently address potential threats posed by synthetic-biology experiments, the report concludes. The analysis also finds that most researchers do not know how to identify and mitigate biosecurity risks associated with such experiments, and that there is no established procedure for seeking advice from federal agencies. The report calls for international engagement on the topic, and for better training to help scientists recognize and address any biosecurity risks that their research presents.

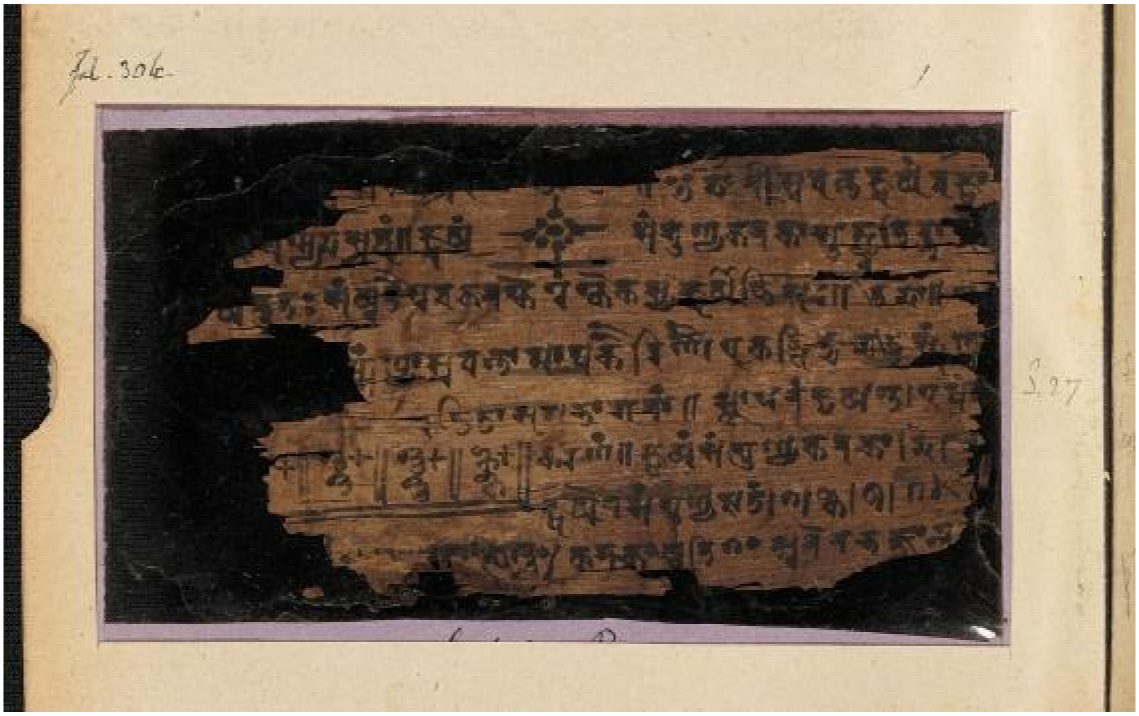
EVENTS

Nuclear letter Eighty-five nonproliferation experts signed a letter on 13 September urging US President Donald Trump to reaffirm support for an international deal, signed in July 2015, that limits Iran's nuclear programme. The International Atomic Energy Agency has verified Iran's compliance with the deal, which called for the country to limit uranium enrichment and stop producing plutonium in exchange for a partial lift of international sanctions. But observers have become alarmed by statements in which Trump suggested that he might not recertify Iran's compliance to the US Congress in mid-October — something that he needs to do every 90 days to prevent US sanctions from snapping back into place.

Media policy A document leaked anonymously from the US Centers for Disease Control and Prevention (CDC) suggests that the agency is becoming more tight-lipped than in the past. On 12 September, the news website Axios reported that the e-mail notice, dated 31 August, instructs all CDC employees not to speak to reporters “even for a simple data-related question”. Several health journalists pushed back, calling the move a “gag order”. According to an updated CDC media-policy document sent to *Nature* by Shelly Diaz, senior press officer at the agency, employees must coordinate with the public-affairs office when they are approached by reporters.

RESEARCH

Ancient zero Indian mathematics was already using a symbol for zero in the third century ad, some 500 years earlier than previously thought, the Bodleian Libraries of the University of Oxford, UK, announced on 14 September. The claim follows new carbon dating of the birch-bark leaves of the Bodleian’s Bakhshali manuscript, discovered in 1881 in what is now Pakistan. The manuscript uses a dot, not yet as a number in its own right, but as a ‘placeholder’ to denote numbers such as 10 or 100. The Babylonians and Mayans had done this long before, but the Bakhshali symbol is the forerunner of the zero we recognize today: the first recorded use of zero by itself is by an Indian mathematician in the seventh century. Part of the Bakhshali manuscript will be displayed in an exhibition on Indian science and innovation that opens on 4 October at the Science Museum in London.



Bodleian Libraries/Univ. Oxford

Cassini grand finale On 15 September, the Cassini spacecraft plunged into Saturn's atmosphere in a planned move to end the probe's 13-year study of the planet and its moons. Engineers steered the craft, which was low on fuel, towards its fiery death to keep Cassini from contaminating the gas giant's moons, including Titan and Enceladus, which could harbour signs of life. The spacecraft hurtled towards its end at about 113,000 kilometres per hour, entering Saturn's atmosphere roughly 10 degrees north of the planet's equator. Cassini's final images, transmitted in the hours before its death, included shots of Enceladus setting behind Saturn, as well as a final close-up of some of the planet's rings.

Gravity satellites A battery failure caused one of the twin Gravity Recovery and Climate Experiment (GRACE) satellites to lose contact with Earth for four days starting on 4 September, NASA announced on 14 September. Operators recovered the link but are now planning for the mission to end no later than November, when the satellite will move out of full sunlight and lose all battery power. GRACE, a joint project between NASA and the German aerospace agency DLR, has been in orbit since 2002, and was meant to last for only five years. It has made fundamental hydrological measurements, such as tracking the melting of Greenland's ice sheet and the depletion of groundwater around the world. A follow-on mission is planned for launch in early 2018.

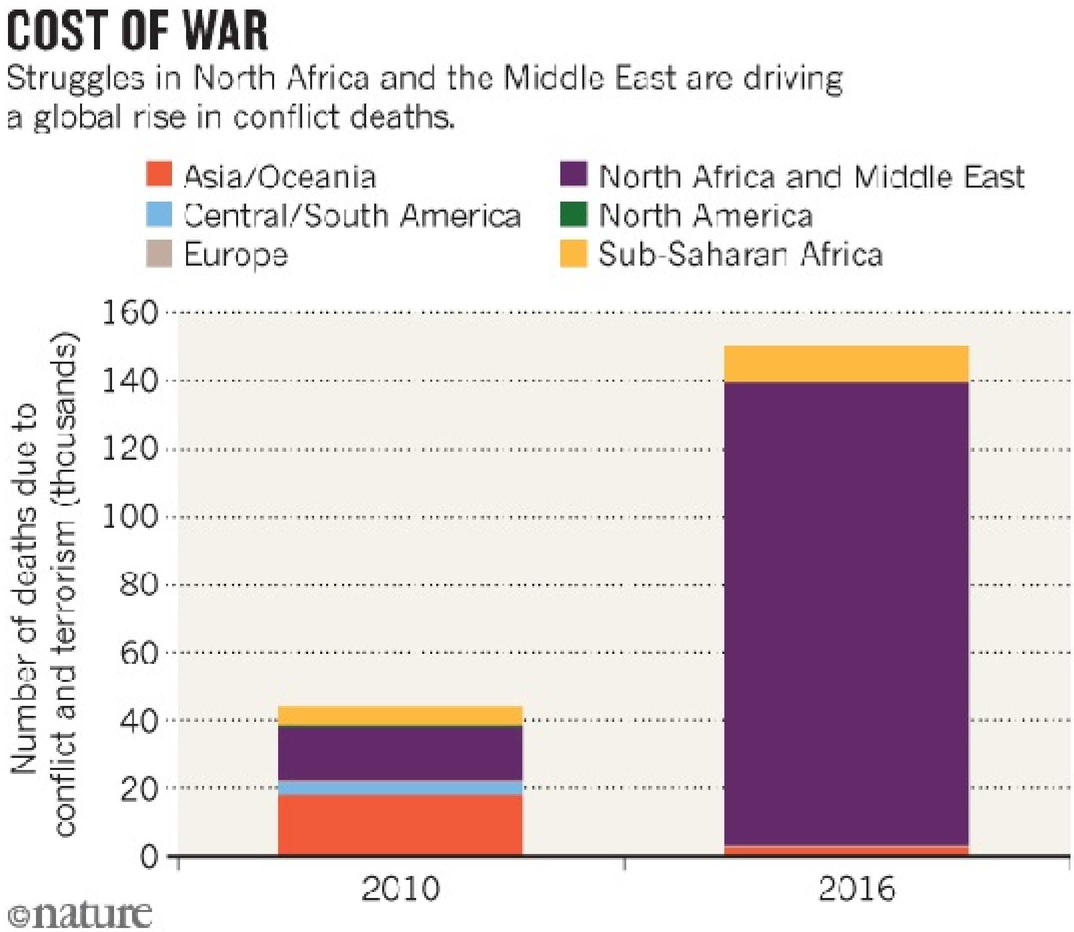
Polar station The Canadian High Arctic Research Station in Cambridge Bay will officially open its doors in October. Planning and construction of the station, which is meant to fill a gap in the region's research infrastructure, took ten years. The Can$200-million (US$164-million) facility will be the headquarters of the country's major polar-science research agency, Polar Knowledge Canada. It will support Arctic-focused research endeavours related to renewable energy, environmental science, sea-ice changes and improving local infrastructure. The station includes necropsy and genomics labs, as well as teaching spaces and public spaces for community outreach.

FUNDING

Job cuts Australia's national science agency plans to cut up to 57 research positions from its digital-innovation and minerals-research groups. On 13 September, an e-mail sent to staff at the Commonwealth Scientific and Industrial Research Organisation (CSIRO) said that the cuts were necessary to shift these groups' "science capability in line with market demands". The agency, which also plans to recruit up to 25 new staff members, aims to generate 45% of its revenue from non-government sources by 2019. The lay-offs follow substantial job cuts at the agency in the past 5 years, including about 275 staff positions axed in 2016.

TREND WATCH

Deaths from conflict and terrorism have jumped since 2010, says a 14 September report. The global total was around 150,000 in 2016, driven mainly by conflicts in North Africa and the Middle East. Overall, non-communicable diseases accounted for 72.3% of deaths in 2016, with ischaemic heart disease, diabetes and mental-health and substance-use disorders all rising worldwide. But deaths from infectious diseases have decreased, and deaths among children under 5 years old fell below 5 million for the first time.



Source: GBD 2016 Causes of Death Collaborators Lancet 390, 1151–1210 (2017)

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Sharks can live a lot longer than researchers realized

Errors in past studies could undermine conservation plans.

20 September 2017

F1online/FLPA

The sand tiger shark (*Carcharias taurus*) can live up to twice as long as was once thought.

Many sharks are living much longer than was thought, according to a major review[1] of studies on these important and often endangered top predators. This means that many estimates of how threatened particular species are — and decisions about whether they can be fished safely — could be based on faulty data.

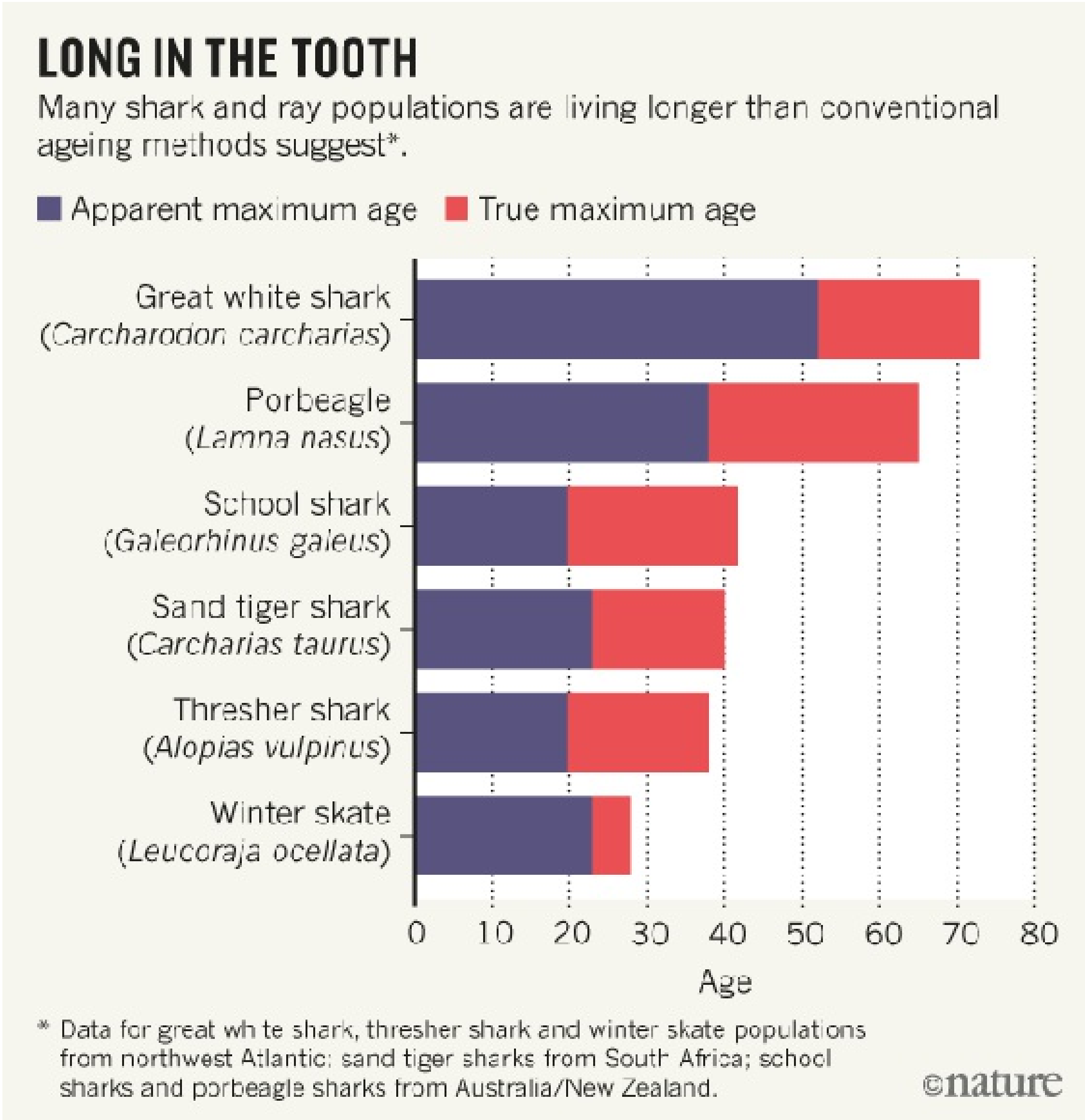
Scientists usually estimate how old sharks are by slicing through their spines and counting distinctive pairs of bands seen inside, which are often assumed to show age in the same way as the rings of a tree. But a growing number of cases are suggesting that the method can be problematic. For example, a 2014 study[2] showed that sand tiger sharks (*Carcharias taurus*), which were thought to live for around two decades, can actually survive for up to twice that. And in 2007, researchers found[3] that New Zealand porbeagle sharks (*Lamna nasus*) had been under-aged by an average of 22 years.

To investigate the scale of the problem, fisheries researcher Alastair Harry of James Cook University in Townsville, Australia, reviewed evidence for age underestimation. He reports in *Fish and Fisheries*[1] that of 53 populations of sharks and rays for which there are good data, 30% have probably had their ages underestimated (see graphic). "Current evidence points to it being systemic, rather than restricted to a few isolated cases," says Harry. "We really can't ignore it anymore."

Sharks aren't trees

Growth rings are used to determine age in fish of all kinds. In teleosts (a group that contains the majority of bony fish), researchers tend to look at otoliths, lumps of calcium carbonate in the inner ear that build up layers regularly throughout the fish's life. But sharks and rays don't have otoliths, so researchers often use sections of vertebrae instead. Sometimes, when sharks stop growing, so do their vertebrae, which means that counting the rings can make an animal seem younger than it is.

Harry's paper looked at two methods of checking whether the age estimated from counting rings is correct: chemical marking and bomb-carbon dating. In the former, researchers capture an animal and inject it with fluorescent dye that is taken up by its spine, making a permanent mark. When the animal is recaptured later, it is possible to count how many bands have formed since this known date. In the second method, scientists can look for carbon traces of 1950s nuclear-bomb tests in animals that were alive then, and use this to estimate age.



Source: Ref. 1

Harry has done “a very nice job”, says shark scientist Steven Campana of the University of Iceland in Reykjavik, who has worked on more than 100 ageing studies in sharks and rays, as well as in bony fish. “I fully agree with his conclusions: the shark age-underestimation problem is indeed a big one.”

Management headache

The study has wide-ranging implications, says Lisa Natanson, a fisheries biologist with the US National Oceanic and Atmospheric Administration in Narragansett, Rhode Island, who was one of the paper's reviewers. If age information is wrong, models that guide fisheries' decisions about how many animals can safely be caught will also be wrong.

Key processes such as growth, mortality and reproduction change with age, although precisely what this means for conservation will vary with each species. On the one hand, if living longer means that an animal matures and starts reproducing later in life, underestimating age will mean that it is more vulnerable than has been realized. On the other, living longer might give animals more breeding years, making a population more robust.

Emerging technologies could help to solve the ageing problem. Methods include looking at aspartic acid, an amino acid that is produced in living organisms in one of two forms, then slowly converts to the other in inert tissues through a process called racemization. Near-infrared spectroscopy could be useful too, says Natanson: "Complete reliance on backbones has got to disappear."

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Comments

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How the Internet of cells has biologists buzzing

Networks of nanotubes may allow cells to share everything from infections and cancer to dementia-linked proteins.

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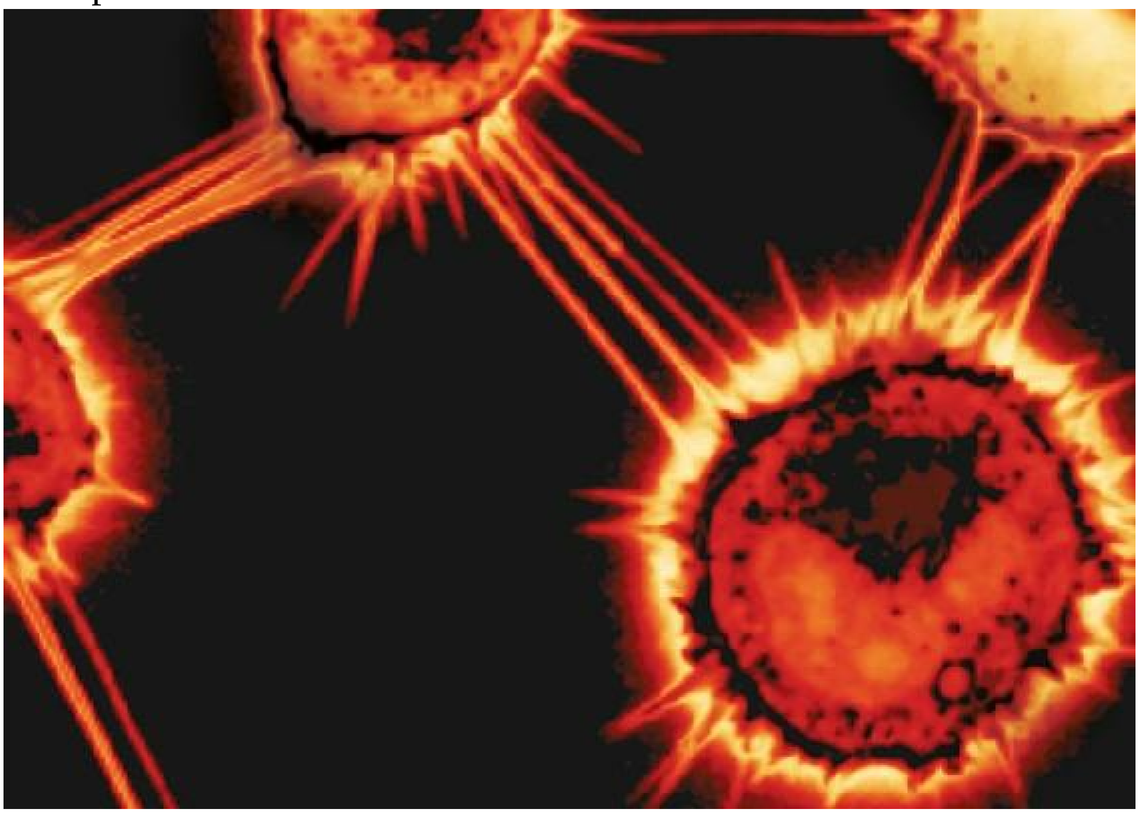


Karine Gousset/Chiara Zurzolo/Pasteur Institute

Prions spread between mouse cells through tunnelling nanotubes.

Yukiko Yamashita thought she knew the fruit-fly testis inside out. But when she carried out a set of experiments on the organ five years ago, it ended up leaving her flummoxed.

Her group had been studying how fruit flies maintain their sperm supply and had engineered certain cells involved in the process to produce specific sets of proteins. But instead of showing up in the engineered cells, some proteins seemed to have teleported to a different group of cells entirely.

Yamashita, a developmental biologist at the University of Michigan in Ann Arbor, and the postdoctoral researcher with whom she was working, Mayu Inaba, called the phenomenon “mysterious trafficking”. They were convinced it was real — but they couldn't understand how it worked. So they shelved the project until one day, more than a year later, Inaba presented Yamashita with some images of tiny tubes reaching out from one cell to another — delicate structures that might have been responsible for the trafficking. Yamashita was sceptical, but decided to dig out images from her own postdoc project 12 years earlier. Sure enough, slender spikes jutted out towards the targeted cells. “It was really eye-opening,” Yamashita says. The group published its work in 2015, arguing that the tubes help testis cells to communicate precisely, sending a message to some of their neighbours and not others[1]. “We thought the protein was trafficked,” Yamashita says, “but we didn't think there was an actual track.”

Yamashita's tubes joined a growing catalogue of cryptic conduits between cells. Longer tubes, reported in mammalian cells, seem to transport not just molecular signals but much larger cargo, such as viral particles, prions or even mitochondria, the cell's energy-generating structures. These observations suggest an unanticipated level of connectivity between cells, says Amin Rustom, a neurobiologist at the University of Heidelberg in Germany, who first spotted such tubes as a graduate student almost 20 years ago. If correct, he says, “it would change everything in medical applications and biology, because it would change how we see tissues”.

But Richard Cheney, a cell biologist at the University of North Carolina in Chapel Hill, is not ready to start revising the textbooks. Cheney has followed the field and at one point collaborated with Rustom's PhD adviser. There's no question that long, thin protrusions are popping up all over the place, he says. The question is, what are they doing — sending simple messages when cells reach out and touch each other, or opening a breach and facilitating wholesale transport? “I'd probably bet on contact-based signalling, where you don't need very many copies of a molecule, as opposed to them acting like interstate highways," he says.

The problem with betting either way is that these tiny tubes are tough to study. Arguing that they exist at all is hard enough, let alone making the case that they actually have a function. Yamashita used the tried-and-tested genetic- engineering methods and well-characterized genes available in the fruit fly to argue that her tubes were sending signals by direct contact. But researchers looking for tubes in mammalian cells don't have those resources. More than one researcher has been accused of mistaking a scratch on a cell plate for a cell-produced nanotube. Evidence derived from real mammalian tissue is even sparser.

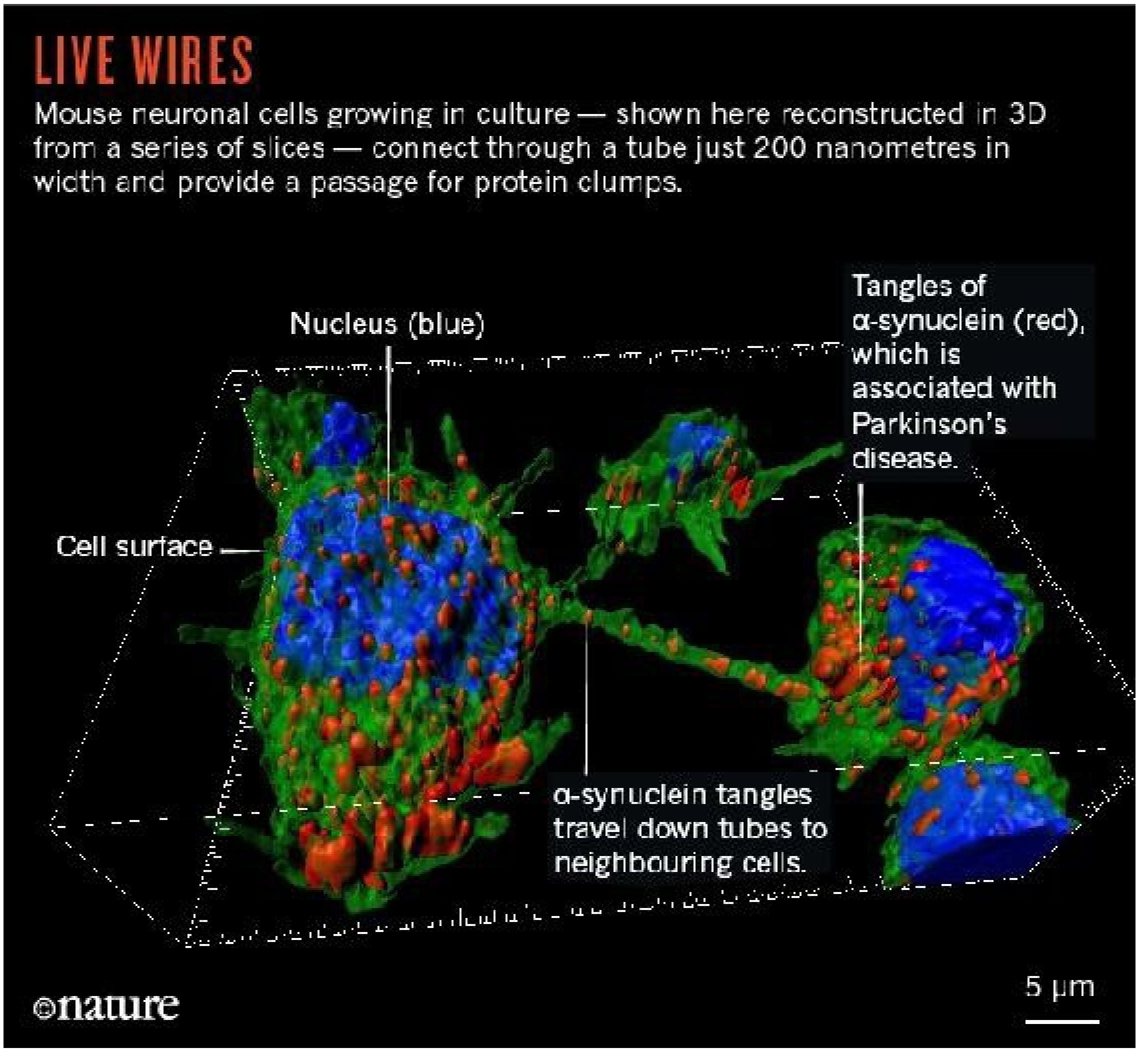
LISTEN

Adam Levy takes a closer look at the tiny tubes spotted between cells.

You may need a more recent browser or to install the latest version of the Adobe Flash Plugin.

Nonetheless, there has been a recent rash of interest in the tubes. One of the believers is George Okafo, a director of emerging platforms at the drug company GlaxoSmithKline (GSK) in Stevenage, UK. He thinks that cell-to-cell protrusions could explain why diseases such as Alzheimer's disease, Parkinson's disease and malaria, as well as HIV and prion infections, are so difficult to treat (see 'Live wires'). "There's a characteristic that isn't targeted by a lot of conventional therapies, and that's how a disease spreads from cell to cell."

Last September, Okafo organized an invitation-only conference to bring together GSK staff and around 40 researchers in the field. (He is now collaborating with some of them.) In March this year, the US National Institutes of Health asked for grant applications from groups studying how organelles communicate in stressed or cancerous cells, a move that excites tube enthusiasts. And in December, the American Society for Cell Biology will host a session devoted to the topic at its annual meeting.



Chiara Zurzolo/Pasteur Institute

Long pipeline

Scientists know that some cells build wire-like extensions as a kind of temporary foothold to move themselves from place to place. The first important hint that they might be involved in something more complex came in 1999, from cell biologist Thomas Kornberg at the University of California, San Francisco. He was watching fly larvae develop wings, and saw a sea of filaments projecting from the wing buds towards the signalling centre that is essential for their growth[2]. He coined the term cytoneme — or cell thread —

to describe these filaments. He suggested that some cellular chatter that was thought to happen by diffusion could, in fact, be orchestrated by cytonemes. The idea was surprising and was slow to catch on, but it is now making its way into textbooks.

In 2004, two research groups separately published observations of something even more radical: nanotubes in mammalian cells that seemed to move cargo such as organelles and vesicles back and forth. Rustom spotted thin, straight tubes connecting cultured rat cells after he forgot a washing step in an experiment. He and his adviser at the University of Heidelberg, Hans-Hermann Gerdes, engineered cells to make fluorescent proteins and watched the molecules flow from one cell to another. Their accidental sighting grew into a *Science* paper[3] that described the structures as “nanotubular highways”. (Some sceptics think that Gerdes chose the term nanotube to ride on the coat-tails of carbon nanotubes, a hot topic in materials science.)

In the same year, Daniel Davis and his team at Imperial College London described networks of 'membrane nanotubes', strands of cells' outer membranes that stretched for several cell lengths to connect different types of immune cell; lipids produced by one cell showed up on the surface of another[4]. Davis attributes their discovery to his team's willingness to think through the implications of their sighting. “The crucial thing is not that we saw them,” he says. “The crucial thing is deciding what you're going to dig into and investigate.” His team went on to describe different sorts of nanotube, some holding vesicles and mitochondria inside, and others with bacteria 'surfing' the casing[5].

Meanwhile, other labs have reported cell-connecting tubes in neurons, epithelial cells, mesenchymal stem cells, several sorts of immune cell and multiple cancers. Further types of tube have been spotted as well. In 2010, Gerdes and his team reported that some tubes end in gap junctions: gateways that bestow the neuron-like ability to send electrical signals and can also pass along peptides and RNA molecules[6]. Yamashita speculates that such connections may be more than conceptually related to neuronal synapses. “Membrane protrusions might have evolved first, and higher organisms could have started upgrading them to make neurons for more complicated functions,” she says.

Most researchers who study these cellular pipelines care less about their evolutionary origin than about their role in human health and disease. The strongest evidence for a role in disease came in 2015, also from a team at the University of Heidelberg, led by cancer researcher Frank Winkler. Like others, his team had not set out to study cell protrusions; they wanted to test a system for watching human gliomas grow. Cells derived from the tumours were injected into the brains of mice with windows in their skulls — hardened glass kept in place with dental cement — through which the researchers could watch the cells.

As the tumour cells invaded, they sent tubular protrusions ahead of them. A closer look showed many tubes connecting cells through gap junctions. Interconnected cells managed to survive doses of radiation that killed isolated cells, apparently because gap junctions helped to spread the load of toxic ions to neighbours[7]. When radiation did kill linked tumour cells, nuclei from those cells sometimes travelled down a tube, with the tube then expanding into the cleared space to form a vigorous new cancer cell. These 'tumour microtubes' were also found in biopsies from patients, and denser, longer tubes correlated with more resistant forms of cancer and a poorer prognosis. Winkler speculates that a drug that could keep these tubes from sprouting or extending might create a new class of cancer treatment; indeed, he thinks that existing cancer drugs such as paclitaxel may work by disrupting tumour microtubes. Winkler's team has filed a patent application for a compound that interferes with microtubes as a treatment for glioma.

The work has captured imaginations. “It was a seminal paper,” says Okafo. “Prior to that there was still some scepticism about whether these phenomena existed *in vivo*.” But it's not clear whether Winkler's results apply to other scenarios. Various sorts of brain cell are known to send out cell protrusions as they grow and proliferate. The tubes that Winkler's team reported are much larger than the 'tunnelling nanotubes' that were originally described by Gerdes, and, unlike most tunnelling nanotubes reported so far, contain microtubules — filaments that move components around in cells. However, Winkler thinks that his work provides evidence for a broad role for tunnelling-nanotube-like structures. He thinks they may not be able to reach full size in culture, and the tubes he does see vary considerably in length and thickness. Winkler recalls discussing his work with Gerdes before Gerdes' death in 2013. “He said that this was what the field was waiting for. It was exactly the proof that he thought we could find.”

In other fields, too, the tubes are gaining traction. Eliseo Eugenin, who studies HIV at Rutgers New Jersey Medical School in Newark, suggests that HIV-infected cells send out multiple nanotubes filled with virus to reach uninfected cells. Circulation and one-on-one cellular contact would be too inefficient to cause the rapid amplification of the virus seen in newly infected patients. “The mathematics don't work,” he says. He thinks that other researchers are sceptical of nanotubes because they are unable to reconcile themselves to the idea that cells are constantly exchanging materials, including genetic information. “Our definition of a cell is falling apart,” Eugenin says. “That is why people don't believe in these tubes, because we have to change the definition of a cell.”

Battle lines

When the definition of the cell is at stake, it is little wonder that scepticism remains strong. Emil Lou, a cancer researcher at the University of Minnesota in Minneapolis, says his grant proposal to hunt for and characterize nanotubes in human cancers was pooh-poohed because a reviewer was not convinced that the structures existed.

Others argue that they do exist — but only in the rarefied world of the Petri dish. Michael Dustin, an immunologist at the University of Oxford, UK, says that he has seen cells in dishes form structures that would never occur in the dense tissue of an organism. For example, white blood cells primed to produce antibodies produce a “beautifully symmetric” bull's-eye pattern in a dish, very different from the chaos and asymmetry they show in the body.

Then there are mechanistic quibbles: some researchers think that the tubes are open at both ends, with cargo flowing in and out. But that would cause cytoplasm to mix and result in the cells fusing, says Jennifer Lippincott-Schwartz, a cell biologist at the Howard Hughes Medical Institute Janelia Research Campus in Ashburn, Virginia. “The people who think there is a connection need to talk to some biophysicists,” she says. Instead, she thinks that membrane tubes may jut out and make minimal contact, just enough to allow recipient cells to reach out and engulf the tube contents.

These disagreements could be contributing to a lack of rigour in the field. Chiara Zurzolo, a cell biologist at the Pasteur Institute in Paris, who has spotted prions and other neurodegenerative proteins travelling through nanotubes, says that many papers do not try to assess whether a tube is closed or open-ended, for example, or even whether the tubes allow the movement of vesicles or similar material. The proliferation of tube types, and the different names for them, make coherent discussion difficult. “We have to be rigorous in what we call these structures. At the moment it is very messy,” she says.

But getting clear images of living cells will always trump semantics, says Ian Smith, a cell biologist at the University of California, Irvine. “What is really needed in the field is direct visualization of this process,” he says. Most microscopy techniques can't get a clear view of these structures in action, even in cultured cells. Smith is developing methods to visualize membrane nanotubes using lattice light-sheet microscopy, which monitors planes of light to build up 3D images. He hopes that the technique will be able to capture the process of material transfer from one cell to another, from start to finish[8]. Smith admits that he's taking a career risk: a colleague recently warned him this area was 'fringey'. But he takes this as a challenge.

Lou is encouraged that the criticism against membrane tubes has morphed. At first people would tell him that the structures were artefacts or optical illusions, he recalls. “Then it graduated to, 'well, just because they grow in a plate doesn't mean that it has anything to do with biology', and then it was, 'well you are probably misidentifying these or mischaracterizing them'.” He likes that direction. “I think we have to take it seriously as a therapeutic target. I couldn't have said that five years ago.

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Comments

There are currently no comments.

Bring on the bodyNET

20 September 2017

Stretchable sensors, circuits and batteries are about to change our relationships with electronics and each other, explain Bryant Chu and colleagues.

Amir Foudeh, Jie Xu, Sihong Wang and Zhenan Bao

Unobtrusive 'elastronic' transistors can behave like skin and stretch without tearing.

Electronics are set to merge with our bodies to extend our perceptions. Smartphones and watches will give way to the bodyNET[1]: a network of sensors, screens and smart devices woven into our clothing, worn on our skin and implanted in our bodies (see 'Superhuman powers'). A pregnant woman might wear tiny biometric sensors to monitor her baby's heartbeat, displayed on a film attached to her skin. She could transmit its kicks to the father wirelessly, so that he can experience the vibrations recreated by 'haptics' — interfaces that provide tactile feedback — on his stomach.

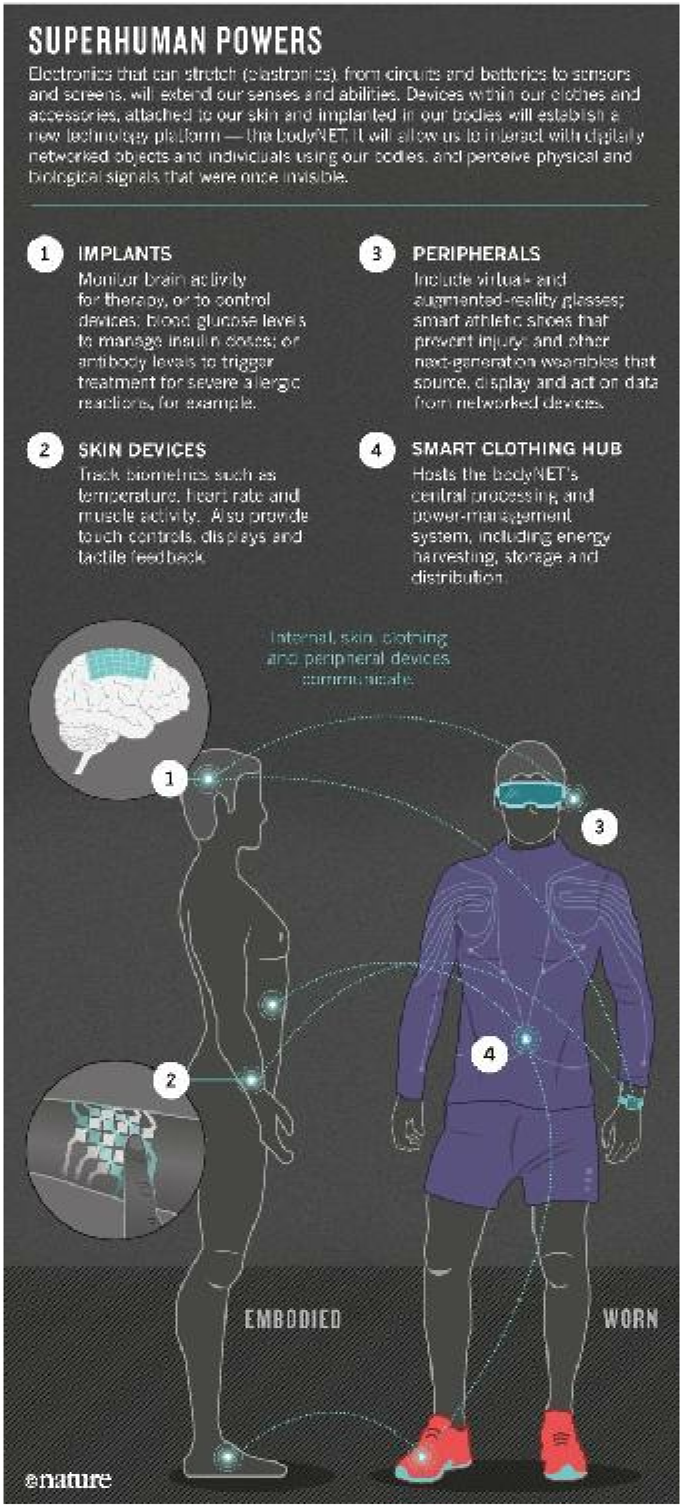
The bodyNET is not yet complete, and labs around the world are developing its components. The core technology is electronics that stretch — elastronics — made from soft plastic circuits thinner than paper that can deform without tearing, biodegrade and even heal themselves (see go.nature.com/2vtutzz). Elastronic sensors respond to touch, pressure, temperature, humidity and light, as well as to chemical and biological signals[2–10].

There is much still to do. Researchers must improve the technical performance of elastronic materials, design innovative architectures for stretchable circuits and drive down costs through mass production. There are also social and cultural concerns. These include widespread fears of merging technology intimately with the body, as well as anxieties about privacy and data security.

Yet we are optimistic that the benefits of bodyNETs will outweigh the challenges. These extensions of ourselves will allow us to sense and communicate with others and our surroundings in new and sophisticated ways, beyond our existing five senses. Being able to see how a patient is feeling in real time, or whether a loved one is in need of emotional support, could make us more aware and empathetic. Rather than replacing us, such technology will extend our human qualities.

For example, augmented-reality cosmetics or decorative displays on the body could change colour to indicate our mood. Digital tattoos, powered by batteries in clothing, could reveal our emotions through biometric data relating to posture, imperceptible facial expressions, heart rate and skin conductivity. Flight information could be displayed on glasses as you look up at a plane. Or imagine being able to respond remotely to health alerts about a child's emergency.

Here we highlight research priorities for the bodyNET.



Claire Welsh/*Nature*

Eight technical challenges

Materials. Electronic components that behave much like skin need to be developed. The conductivity of stretchable polymer semiconductors and conductors must match that of rigid ones. Biocompatible substrates need to become more durable so that they can be worn on the skin for months. These materials will have to survive sweating, bathing and normal wear and tear, as well as washing cycles if incorporated into clothing.

Circuits. New designs for stretchable circuits are needed. These must compensate for electrical properties that change when the components are distorted. They must be made thinner and cheaper to fabricate. Processes for manufacturing circuits using elastronic materials are underdeveloped and often involve many steps, resulting in low final yields. It is hard to achieve high precision by aligning layers using shadow masks, for example; and most printing methods can pattern materials at low resolution only, thus limiting the speed of the circuits.

Sensors. Skin-like devices that can measure pressure, strain and temperature, as well as the presence and level of certain chemicals, need to be developed further to monitor body movements and health conditions. Changes in temperature and pressure, in particular, are hard for sensors to separate, because each affects the other. Some sensors have been prototyped using stretchable conductors, semiconductors and (charge-holding) dielectric materials, but solving the problem will require new types of circuit.

Energy storage and harvesting. Stretchable batteries must become smaller and more efficient, providing weeks of use. Battery electrodes made from stretchable materials, such as polymer and inorganic composites, are bulkier than coin batteries of similar power. And batteries that stretch mechanically, using moving components, suffer from wear and tear. Energy-harvesting strategies, too, are limited. Piezoelectric generators that harvest energy from motion provide only spikes of low power. Thin-film solar cells capture energy from sunlight but are ineffective under clothing. Flexible thermoelectric materials are not yet good enough to collect useful amounts of power from body heat.

Modelling. Advanced simulation techniques will help researchers to design complex elastronic circuits and architectures. Being able to test many designs before fabrication would lower the cost of prototyping. For example, mathematical models of molecules and materials will predict electrical properties and mechanical behaviour such as crack propagation under extreme stretching.

Mass fabrication. Elastronics are currently made only in small quantities in research labs. Mass-production techniques, such as roll-to-roll coating, patterning and printing, would reduce the cost and increase the reliability of the circuits. New materials require years of development before they can be commercialized. It took the semiconductor industry decades to evolve high-speed, high-performance mass manufacturing, and a similar process is needed to produce elastronics at scale.

Peripherals. Shifting communications technologies from separate devices, such as smartphones, to integrated devices on the body will make our interactions with them more natural. This trend has begun with wearables such as the Samsung Gear and the Apple Watch, but these are still limited in function. Elastronics on the skin would offer entirely new 'superpowers' through touch-sensitive haptic devices, thin and stretchable displays, gesture-based controls and audio systems that stay on the body indefinitely. Mixed-reality devices networked to the bodyNET that allow you to remotely interact with other people and objects need to be developed.

Digital communication. BodyNETs will require a digital communications network to connect their layers, and this is yet to be built. It must bridge the digital and physical worlds between individuals, objects and environments. Data must be transmitted reliably across implants, skin sensors, devices embedded in clothing and those packaged as peripherals, as well as from one person's bodyNET to another's. Built spaces could become personalized, with room conditions controlled by skin temperature and perspiration, lighting by circadian rhythm, and furniture by body size and muscle activity. People who speak different languages could soon communicate using real-time translation, emotion tracking and dynamic augmented-reality graphics.

Five cultural challenges

Human needs. Translating data into useful forms rooted in human needs will be essential. Our interviews with users of wearables revealed that raw data — blood pressure, pulse or galvanic skin response, for example — are of little use unless they prompt an action or are applied to improve lives, by alerting users to potential heat stroke on a warm day, for instance. Users who tested being able to track emotions with virtual-reality mock-ups said they valued being able to empathize more easily with others, especially in high-stakes situations such as mitigating work disagreements and clearing up cross-cultural confusion. The full potential of bodyNETs will be harnessed through global networks, and different sociocultural ecosystems must be factored into designs.

Body modification. The relationship between technology and the body needs to be considered. We must reframe fears and preconceptions. The only types of body modification accepted by most people today are those achieved by medical and restorative procedures such as joint replacements. Artificial intelligence often incites a fear of the unknown, and combining living tissue with electronics provokes aversion. We think that this mentality will shift as public knowledge increases, elastronics that work with the body advance, and human-centred applications such as continuous, personalized health care — rather than novelties — begin to improve daily life. Medicine and communication are two paths forward. Long-term treatments such as insulin dosing can be revolutionized by replacing existing devices with networked, biocompatible ones that conform to the body's tissues. Body decoration is also increasingly accepted. Its long history could continue, with elastronics serving as a new medium for expression as well as performing technical functions.

Data security. Data privacy and security are essential. Medical and health and wellness data must remain individual property. Fitness trackers have been criticized for having confusing and vague privacy policies that potentially allow third-party sharing of health information. BodyNETs would face the same challenges. This is not a new issue. Sharing credit-card information was unheard of, until online shopping drove the development of security protocols and users gained trust in the process. Similarly, bodyNET technology must be secured from potential attacks and used for applications that improve the lives of its users. Legal structures must be created to ensure that use of this technology requires consent, and that it is not exploited for malicious purposes, such as denying healthcare on the basis of diet, selling data for profit, or worse.

Data influence. Biometric information gained through sensors influences behaviour and can have unintended consequences. It is crucial that measurements are robust. Inaccurate data can lead, for example, to medical emergencies being missed, or flagged incorrectly. In 2016, a lawsuit was filed against Fitbit, a manufacturer of wearables, over the accuracy of its heart-rate measurements. Decisions to design such devices for health purposes will need to be made carefully, recognizing that users might operate devices for health monitoring regardless of recommendations. As biometrics are developed further, the complexity of devices will increase, as will the chance of error. So it is important that procedures for debugging bodyNETs are formalized. Our group is exploring acquiring data with pairs of sensors to increase accuracy.

User interaction. More must be learnt about how to present bodyNET data effectively, both visually and physically. Should invisible emotions be represented by a colour-changing glow around an individual, an animal avatar, or something else? Hardware and software interfaces need to be designed with user interaction as a priority. BodyNETs will allow us to use our natural embodied intelligence to experience the data-rich world in completely new ways.

Next steps

We think that the business landscape for elastronics could eventually resemble that for printed circuit boards. Dedicated elastronic circuit manufacturers will fabricate components for large system-integration and digital-communications companies. These large companies would develop their own commercial devices or sell components to start-ups that produce their own devices.

Applications for the first bodyNETs must be developed now. Initial devices will probably be simple but reliable systems of biometric sensors that display information in an actionable way. For example, a stretchable 'sleeve' might display a person's mood or comfort level. Later versions would be more complex, and could include augmented-reality glasses powered by elastronics embedded in clothing.

Social-science studies will be crucial to understanding the short- and long-term impacts of these new forms of interactions, and to exposing unintended consequences. We must develop the bodyNET system responsibly, mindful of its repercussions. Multidisciplinary partnerships should be created, and governments must develop privacy and regulatory legislation.

The bodyNET's disruptive potential is great. Conversations must start now to ensure that we create the best possible version, both technically and ethically, of this transformative technology.

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Comments

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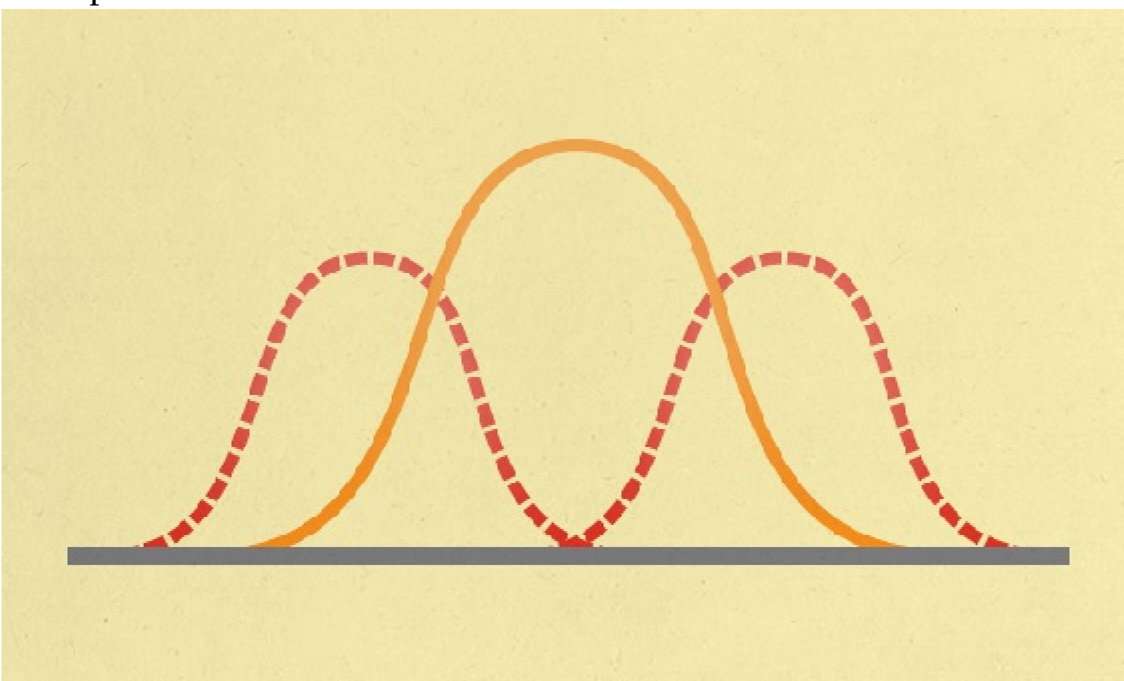
'One-size-fits-all' threshold for *P* values under fire

Scientists hit back at a proposal to make it tougher to call findings statistically significant.

19 September 2017



Researchers are at odds over when to dub a discovery 'significant'. In July, 72 researchers took aim at the *P* value, calling for a lower threshold for the popular but much-maligned statistic. In a response published on 18 September[1], a group of 88 researchers have responded, saying that a better solution would be to make academics justify their use of specific *P* values, rather than adopt another arbitrary threshold.

P values have been used as measures of significance for decades, but academics have become increasingly aware of their shortcomings and the potential for abuse. In 2015, one psychology journal banned *P* values entirely.

The statistic is used to test a ‘null hypothesis’, a default state positing that there is no relationship between the phenomena being measured. The smaller the *P* value, the less likely it is that the results are due to chance — presuming that the null hypothesis is true. Results have typically been deemed ‘statistically significant’ — and the null hypothesis dismissed — when *P* values are below 0.05.

In a July preprint, since published in *Nature Human Behaviour*[2], researchers, including leaders in the push for greater reproducibility, said that this threshold should be reduced to 0.005 to keep false positives from creeping into social sciences and biomedical literature.

But “setting this one threshold for all sciences is too extreme,” says Daniel Lakens, an experimental psychologist at Eindhoven University of Technology in the Netherlands and lead author of the new commentary, which was posted to the PsyArXiv preprint server. “The moment you ask people to justify what they are doing, science will improve,” he adds.

Unintended consequences

Some researchers worry that lowering *P* value cut-offs may exacerbate the ‘file-drawer problem’, when studies containing negative results are left unpublished. A more stringent *P* value threshold could also lead to more false negatives — claiming that an effect doesn’t exist when in fact it does. “Before you implement any policy, you want to be more certain that there are no unintended negative consequences,” says Lakens.

Instead, Lakens and colleagues say, researchers should select and justify *P* value thresholds for their experiments, before collecting any data. These levels would be based on factors such as the potential impact of a discovery, or how surprising it would be. Such thresholds could then be evaluated via their registered reports, a type of scientific article in which methods and proposed analyses are peer-reviewed before any experiments are conducted.

“I don’t think researchers will ever have an incentive to say they need to use a more stringent threshold of evidence,” counters Valen Johnson, a statistician at Texas A&M; University in College Station who is a co-author of the July manuscript. And many scientists are likely to go easy on their own work, says another co-author, Daniel Benjamin, a behavioural economist at the University of Southern California, Los Angeles.

But Lakens thinks that any attempts to manipulate *P* values will be obvious from the justifications that researchers pick. “At least everyone agrees that it’s good to change the mindless use of 0.05,” he says.

Setting specific thresholds for standards of evidence is “bad for science”, says Ronald Wasserstein, executive director of the American Statistical Association, which last year took the unusual step of releasing explicit recommendations on the use of *P* values for the first time in its 177-year history. Next month, the society will hold a symposium on statistical inference, which follows on from its recommendations.

Wasserstein says he hasn’t yet taken a position on the current debate over *P* value thresholds, but adds that “we shouldn’t be surprised that there isn’t a single magic number”.

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Marine scientists allege Japan has blocked researchers from joining South Korean ship

Controversy over vessel's name may impede oceanographic collaboration.

19 September 2017

Choul Jib Lee/Getty

Islands between Japan and South Korea are the source of a long-running territorial dispute.

South Korea's flagship research ship *Isabu* seems to have sailed into a controversy with the Japanese government over its name. The incident has hindered some oceanographic research collaborations between the two countries**.**

The ship's name refers to a sixth-century Korean general, Kim Isabu. In South Korea, he is known for his maritime conquests, which in some historical accounts included two islets that are the subject of a decades-long territorial dispute between South Korea and Japan. Known as Dokdo in South Korea and Takeshima in Japan, the small islets are located roughly midway between the two countries, more than 200 kilometres from each mainland. The 5,900-tonne ship launched late last year and is currently cruising the Philippine Sea. Its name was an option in a public poll held by the ship's operator, the Korea Institute of Ocean Science and Technology in Ansan.

The Japanese government has issued no formal protest over the ship's name, but four scientists in South Korea and Japan have told *Nature* that researchers at Japan's national marine-research agency have been instructed not to participate in any collaborations or cruises involving *Isabu*. An e-mail sent in January by an official at the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) in Yokusuka, and seen by *Nature*, suggests that the order came from Japan's science ministry. The e-mail states that the ministry cancelled a proposed agreement to allow JAMSTEC researchers to collaborate on the ship.

A senior researcher at JAMSTEC, who asked to remain anonymous, says that he and other JAMSTEC researchers have been told not to use the ship or any data it obtains.

JAMSTEC's actions regarding *Isabu* seem to be directed from more-senior officials. An e-mail sent earlier this year from a JAMSTEC staff member to an employee of a government-supported research institute in South Korea that is involved with *Isabu* suggests that JAMSTEC is acting on the wishes of its supervising authority, the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT). The e-mail said: "We have consulted MEXT on your request to add the collaboration on the research activities using your new research vessel 'ISABU', and got a negative answer from MEXT due to a non-scientific reason." The e-mail goes on to state that

JAMSTEC cannot “carry out the collaboration using your new research vessel”.

When contacted by *Nature*, the JAMSTEC staff member who sent the e-mail declined to answer questions. JAMSTEC president Asahiko Taira told *Nature* that he had no knowledge of that specific e-mail, and he had not issued an order, or personally received one from the government, prohibiting the organization’s involvement with *Isabu*. But he says cooperation with South Korea using the ship “could be very difficult” and would require permission from MEXT. “The name of *Isabu* is a little bit unfortunate,” he says, but he adds that JAMSTEC will remain involved with an ongoing 16-nation collaboration to survey the region between the Indian and Pacific oceans, to which South Korea has committed *Isabu*. Pulling out of the collaboration over South Korea’s use of the ship would “be a pretty stupid thing to do”, he says.

MEXT’s director of deep-sea research, Tatsuya Watanabe, says that the ministry had discussed the South Korean ship with JAMSTEC, but would not comment on whether the ministry had instructed JAMSTEC to avoid collaborations on the ship, or whether the ministry had an issue with the ship’s name.

So far, the controversy has disrupted at least one planned research project between researchers from both countries. A university-based Japanese marine scientist, who also asked for anonymity, says that he had planned a cruise on *Isabu* in collaboration with JAMSTEC before the tensions arose. But the agency’s researchers have since told him that JAMSTEC instruments cannot be used on *Isabu*. His project will go ahead without the equipment, reducing the data resolution.

Sang-Mook Lee, a marine geophysicist at Seoul National University, says that disruptions to the two countries’ research collaborations will restrict the ship’s scientific capability. “Had we known that the Japanese would react in such a way, I don’t think Koreans would have chosen the name,” he says.

But the senior JAMSTEC researcher says that the dispute is unlikely to have a major impact on Japan’s marine research because the country has its own research ships and marine projects. Even so, he is upset that the ship was given such a politically-charged name: “Scientists should be politically neutral.”

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Comments

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Researchers unite in quest for ‘standard model’ of the brain

Modelled on big physics projects, the International Brain Lab will bring together some of the world’s pre-eminent neuroscientists to probe a single behaviour.

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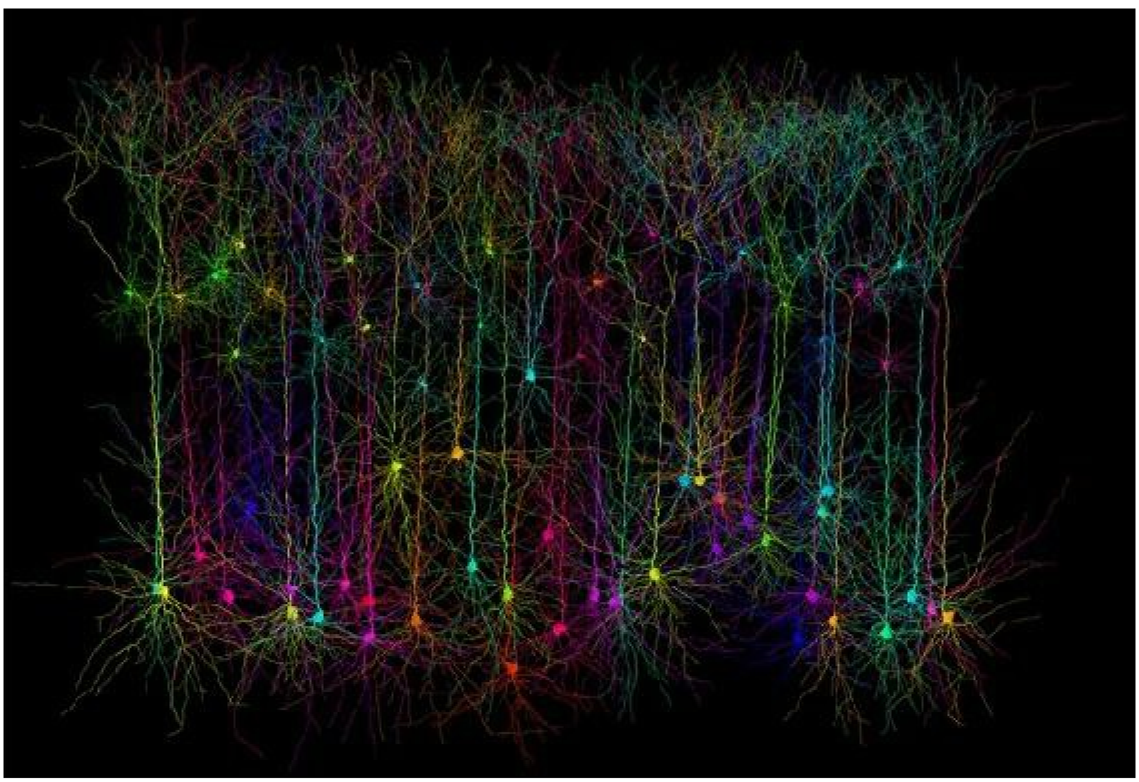
1. 19 September 2017,
2. 21 September 2017



M. Häusser and H. Cuntz/UCL

Scientists aim to surpass small-scale neural models (pictured) to show how brains generate behaviour.

Leading neuroscientists are joining forces to study the brain — in much the same way that physicists team up in mega-projects to hunt for new particles.

The International Brain Lab (IBL), launched on 19 September, combines 21 of the foremost neuroscience laboratories in the United States and Europe into a giant collaboration that will develop theories of how the brain works by focusing on a single behaviour shared by all animals: foraging. The Wellcome Trust in London, and the Simons Foundation in New York City have together committed more than US$13 million over five years to kick-start the IBL.

The pilot effort is an attempt to shake up cellular neuroscience, conventionally done by individual labs studying the role of a limited number of brain circuits during simple behaviours. The 'virtual' IBL lab will instead ask how a mouse brain, in its entirety, generates complex behaviours in constantly changing environments that mirror natural conditions.

The project will use chips that can record the electrical signals of thousands of neurons at once. It will also use other emerging technologies, such as optogenetics toolkits that control neurons with light. "It's a new approach that will likely yield important new insights into brain and behaviour," says Tobias Bonhoeffer, a director of the Max Planck Institute for Neurobiology in Martinsried, Germany, who is also a Wellcome Trust governing-board member.

Large-scale neuroscience projects are hardly rare. In 2013, the European Commission announced the 10-year Human Brain Project, which will cost more than €1 billion ($1.1 billion); and in 2014, US president Barack Obama launched the US Brain Initiative to develop neuro-technologies, with $110 million of funding that year. The Allen Institute for Brain Science, in Seattle, Washington, has been creating comprehensive maps of brain anatomy and neural circuitry since 2003. Japan, China, Canada and other countries also have, or are planning, their own big neuroscience initiatives.

But none operates quite like the IBL, which will be governed in a similar way to large-scale physics projects such as ATLAS and CMS, at Europe’s particle-physics lab CERN, which reported evidence for the Higgs boson in 2012. The two collaborations, at CERN’s Large Hadron Collider near Geneva, Switzerland, brought together experimentalists and theoreticians from hundreds of labs worldwide to test the predictions of particle physics’ standard model.

Like the massive CERN teams, the IBL has created a flat hierarchy and a collaborative decision-making process with near-daily web meetings. Instead of acting only when group consensus is reached, teams will make decisions by simple consent. “No one will be able to stop a proposed experiment being carried out without a very convincing proposal of why it would be a disaster,” says Alexandre Pouget, an IBL member and a theoretician at the University of Geneva in Switzerland.

So far, says Andreas Herz, a theoretical neuroscientist at the Ludwig Maximilian University of Munich, Germany, "neuroscience has been stuck in an exploratory phase". The IBL will aim to generate and test unifying theories about how the brain encodes and computes information – seeking to come up with the equivalent of physicists’ standard model.

But the IBL is hardly unique among big neuroscience projects in melding theory and practice, points out neuroanatomist Katrin Amunts at the Jülich Research Centre in Germany. Amunts also chairs the scientific board of Europe’s Human Brain Project, an initiative that is taking a more conventional approach to collaboration in its own attempts to understand how the brain works. “The future will show which is the best,” she says.

The IBL’s principal investigators, who include data-analysis experts as well as experimental and theoretical neuroscientists, will dedicate around 20% of their time to the effort. During its first two years, the IBL will build informatics tools for automatic data-sharing and establish a reliable experimental protocol for a basic foraging task in mice. Members will be required to register their experiments before they start, and results will be instantly visible to the whole collaboration.

“It is a big challenge — and it’s not the way the field works at the moment,” says Anne Churchland, an IBL member at Cold Spring Harbor Laboratory, New York.

In experimental neuroscience, the slightest parameter change can alter the outcomes of the experiment. The IBL's standard protocol attempts to address all possible sources of variability, from the mice's diets to the timing and quantity of light they are exposed to each day and the type of bedding they sleep on. Every experiment will be replicated in at least one separate lab, using identical protocols, before its results and data are made public.

“This sort of approach will help solve the reproducibility crisis,” says Christof Koch, president of the Allen Institute for Brain Science.

Expanding the IBL beyond its pilot phase will require much more than $13 million, Pouget acknowledges. After the foraging protocol is established, the project's second phase will test specific theories relating to how the brain integrates diverse information to make moment-by-moment decisions. He also hopes to enrol many more labs and broaden the suite of behaviours studied.

For Herz, a theoretician who is part of an influential computational-neuroscience network, it's about time neuroscience adopted such rigour. “A hundred years from now,” he says, “people will look back and wonder why it hadn't, until now, been possible to do a more physics-based approach of designing experiments to consolidate or disprove theories.”

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Corrections

Corrected:

> An earlier version of this article mis-stated the total funding for the International Brain Lab.

Corrected:

> An earlier version of this story erroneously located the Simons Foundation in Washington DC.

Comments

Comments

There are currently no comments.

Cancer patients need better care, not just more technology

19 September 2017

Treating cancer with the latest drugs and techniques is costly and will not improve survival globally, warn Richard Sullivan, C. S. Pramesh and Christopher M. Booth.

Prashanth Vishwanathan/Bloomberg/Getty

A patient awaiting treatment for cancer in an Indian hospital.

In Nigeria, Malaysia, India and many other low- and middle-income countries, it is common to see hundreds of people queueing in the street to see a cancer doctor. It's also common in those regions to see people with curable cancer having chemotherapy, but not radiotherapy or surgery. In fact, 90% of people in low-income countries lack access to basic radiotherapy.

In wealthy countries, the push to develop new drugs, surgery and radiation techniques to treat cancer is at best unsustainable. Of 277 cancer-drug therapies for which clinical trials were published in 2011–15, only 15% identified treatments that led to meaningful improvements in patient survival or quality of life[1]. Indeed, studies reveal that the more expensive the drug, the less clinical benefit it seems to give[2] (see 'A world of difference', panel a).

In middle- and low-income countries the technology-centric approach to cancer threatens to do more harm than good.

For the past 15 years, we have worked as clinical researchers in some 40 countries and conducted more than a dozen studies on national cancer-control planning. Our experiences — along with epidemiological and other data collected over 20 years — indicate that the countries that rate relatively poorly on measures of cancer survival and mortality do so largely because of deficits at the political, economic and social level.

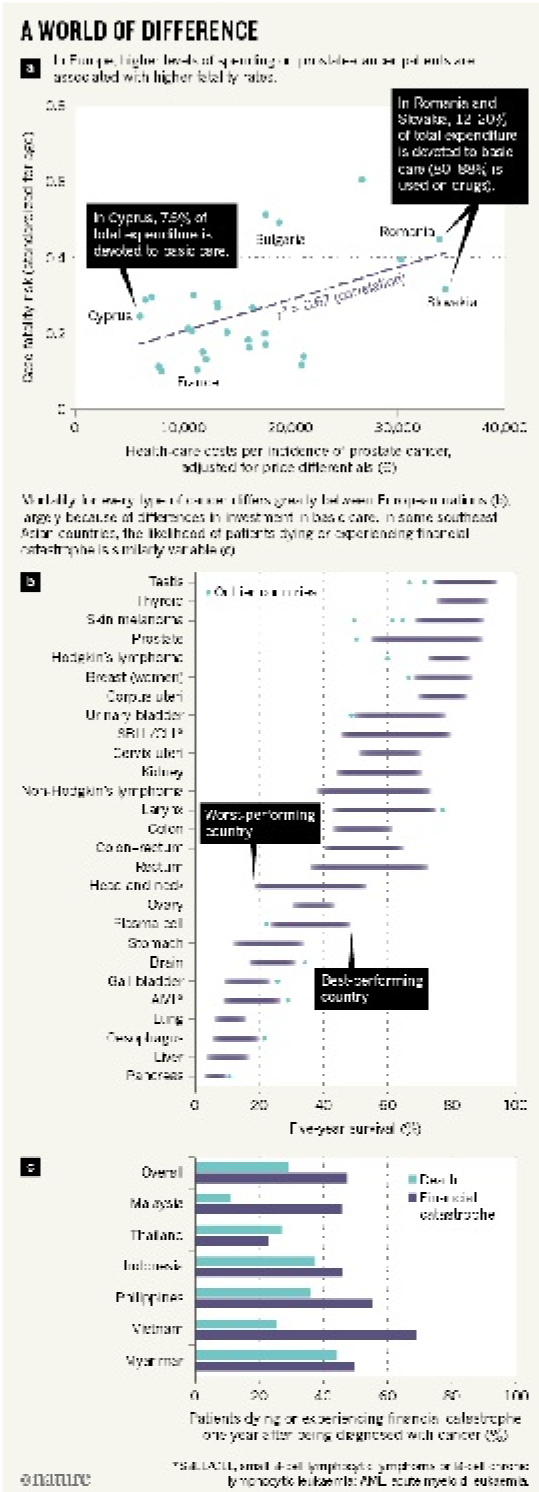
To improve the survival and well-being of the roughly 16 million people who have cancer worldwide, researchers, physicians, policymakers and patient organizations must focus on education, stigma, training and staffing to ensure that the right care is delivered to the right patient at the right time.

A growing problem

Cancer is on the rise. Ten years ago, 12.7 million people worldwide were living with the disease, with an economic impact of nearly US$290 billion. By 2030, 21.7 million people are expected to be affected, at an anticipated cost of $458 billion — largely because of a growing and ageing population as well as lifestyle changes. But the numbers vary dramatically across countries.

Among European nations, there are huge differences in mortality and morbidity for every type of the disease, according to the EUROCARE-5 database[3] (see 'A world of difference', panel b). For example, in 2014 there was a 14.5% difference in survival rates for patients with breast cancer living in Denmark (one of the best-performing countries) and those in Lithuania (the worst). For rectal cancer, survival rates differed from country to country by as much as 32%.

Likewise, in Asia the proportion of patients who died one year after being diagnosed with solid tumours, such as breast or colorectal cancer, ranged from 12% (in Malaysia) to 45% (in Myanmar), according to a 2012 study[4]. Meanwhile, the proportion of patients facing destitution after paying for treatment ranged from one-quarter in Thailand to two-thirds in Vietnam[4] (see 'A world of difference', panel c).



Sources: (A,B) Ref. 3; (C) Ref. 4

Many hospitals in emerging economies and most in low-income countries lack the basic infrastructure and personnel needed to treat diverse cancers. The Tata Memorial Centre in Mumbai, for instance (where C.S.P. works), is the oldest and largest cancer-treatment and research centre in India. It has 164 senior faculty members, who see roughly 40,000 patients each year. Compare that to the MD Anderson Cancer Center in Houston, Texas, which sees 33,000 patients per year but has more than 11 times as many senior faculty members (1,834).

Similarly, in sub-Saharan Africa, only 16 countries have access to basic pathology services — trained staff with the equipment needed to make a diagnosis of cancer. Throughout much of Africa, there is on average one pathologist for every 2.3 million people. In high-income countries, there is typically one pathologist for every 15,000 to 20,000 people[5].

Even in well-resourced urban areas, a lack of guidelines and auditing undermines the effectiveness of many clinical labs. In 2011, only 5% of the 954 pathology labs in Kampala, Uganda, met the minimum tissue-handling and reporting standards defined by the World Health Organization (WHO) Regional Office for Africa[6]. In our experience, poorly trained staff often make incorrect diagnoses, or produce reports without analysing tissue.

Another barrier to improving outcomes is that patients do not see doctors early enough in their disease. The five-year survival rate for breast cancer is only 68.4% in Tunisia. This is in part because, in many low- and middle-income countries, women with cancer can be stigmatized by their communities. Many must obtain permission from their husbands to see a doctor, and are fearful that a cancer diagnosis will lead to divorce.

Everywhere, a lack of education and awareness, affordability and availability of treatment are the main factors preventing patients from being diagnosed early enough[7,8]. Given all this, it is alarming that many low- and middle-income countries are devoting more of their meagre cancer-care budgets to technology, especially through the private sector.

Consider the cost

The past decade has witnessed an explosion of targeted and immunotherapeutic drugs for cancer. The number of new technologies in surgery, particularly in robotics, has also risen exponentially. New radiation techniques such as tomotherapy (a form of computed tomography in which radiation is targeted at specific slices of the body) and proton-beam therapy are also being rolled out each year.

Many emerging economies are now investing in these high-tech interventions[9], even though they lack the purchasing and negotiating powers of high-income countries and do not have systems to determine the cost-effectiveness of what they're buying.

The drug bevacizumab, for example, costs between $4,000 and $5,000 per month in the United States compared to the drug tamoxifen, which costs approximately $50 per month. The former is now considered a standard treatment in India for patients with metastatic colon cancer, despite trials showing that it improves median survival by only 6 weeks[10]. Meanwhile, in many parts of India, there aren't enough pathologists to test a woman's breast cancer for the oestrogen receptor. Such information would enable many thousands of women to receive tamoxifen, which increases the cure rate of breast cancer by 10% (ref. 11).

Furthermore, despite considerable uncertainty about the cost-effectiveness of proton-beam therapy, there are plans to install at least 18 such machines across Brazil, Russia, India, China and South Africa. Each machine costs around $140 million[12]. These same countries currently have an average deficit of around 60% in both human resources and equipment for basic radiotherapy, which is much more effective in increasing cure rates and relieving suffering[13].

Less than 5% of patients in low-income countries have access to safe, affordable and timely cancer surgery; for middle-income countries the situation is only marginally better, at around 22% (ref. 14). Yet these same countries are spending hundreds of millions of US dollars each year on immunotherapeutic drugs.

In short, in most emerging economies, there is a chronic under-use of therapies that can save lives (such as cervical-cancer screening, basic surgery and radiotherapy) and a chronic over-use of interventions that, at huge expense to the patient, provide no meaningful benefit.

Three major shifts

To better balance innovation in cancer drugs and therapies with the requisite social, economic and structural investments requires three major shifts.

Change global mindsets. Media hype fuels the perception that new must mean better[15]. The complexity of the disease probably also makes it easy for the various players of the medical–industrial complex to persuade policymakers to prioritize high-tech solutions.

Cancer-advocacy bodies, research-funding organizations and patient groups must stop advocating access to expensive (and often low-value) technologies, especially in low- and middle-income countries. In the past year, hundreds of policy briefings produced by groups such as these have asked governments for investments.

Also, more scientific rigour, media scrutiny and public debate globally could make it harder for the cancer community (including researchers, physicians and patient groups) to celebrate marginal wins and endorse policy focused on technological innovation[15].

In parallel, the bar must be raised, such that health-insurance companies, governments and other payers fund only those interventions that have a meaningful impact on patients' lives. This means basing decisions about which technologies to incorporate into routine clinical care, and how much to invest in them, on survival and quality of life. Surrogate endpoints, such as lack of tumour growth and radiological and biomarker responses, have increasingly been used in recent years, even though, in many cases, investigators have not been able to correlate them with outcomes that are meaningful to patients[16, 17].

Fund human capital and social development. Spending needs to be redistributed more evenly between people, basic technologies and the delivery of safe, affordable cancer care. Governments and development organizations, such as the World Bank and the WHO, need to prioritize education and the employment of more cancer-specific health-care workforces. They also need to address the basic social factors that determine whether patients are seen and diagnosed early enough.

This multi-pronged approach has proved successful in other contexts. The international effort to combat HIV/AIDS has been as much about social engineering as developing drugs and vaccines. Researchers working on antiretrovirals have actively supported and engaged with those in community development, education and the design of effective pathways for care.

For cancer, some collaborations have already yielded important advances. A partnership involving Moi University in Eldoret, Kenya, Indiana University in Indianapolis and other high-income cancer centres has helped more than 4,500 Kenyans obtain high-quality cancer care over the past five years — largely through sharing models of care and facilitating the training of surgeons and other carers[18]. And the Indian government's support for the transfer of cost-effective, Indian-made radiation equipment to countries such as Vietnam and Mongolia, among others, has provided numerous underserved communities with access to radiation therapy.

Governments must not insist on replicating models established in high-income countries. In place of medical oncologists, for example, surgeons could be trained to deliver basic low-risk chemotherapy, and nurses taught to deliver palliative care. Expanding the skill sets of general doctors and surgeons, and training more pathologists, would also help.

Likewise, investing more in cancer prevention and public health would pay huge dividends. It has been estimated that, across Europe, driving tobacco usage down to a level at which less than 5% of the population uses it would plough some €10 billion (US$12 billion) back into economies each year by preventing premature deaths due to tobacco-related cancers.

Implement standards and systems for accountability. In our experience, pharmaceutical companies are beginning to recognize that without improvements to systems and processes, their sales will stagnate, particularly in emerging and low-income economies. But expensive cancer medicines are still a major drain on resources. National health-insurance systems, such as those in India and Mexico, need to do a much better job of spending government money only on effective care. Developing country-specific management guidelines, as has been done by the National Cancer Grid of India, and linking government insurance reimbursements to adherence to these could further encourage providers to deliver evidence-based care. Indeed, the misuse of technology in cancer care for profit is a major issue in many countries where health care is unregulated[19].

Systems of accreditation for cancer centres (public and private) could also help to ensure that institutions offer interventions only after demonstrating competence and achieving certain scores from patient feedback and peer review. They may also encourage the establishment of specialist centres. Data from the past 25 years have shown that cancer patients do much better if the surgeon treating them has operated on many others with the same condition as part of a multidisciplinary team[20].

Cancer 'moonshots' may improve individual outcomes in high-income countries with strong governance, but they will not solve the rising economic and social burden of cancer globally. What we need are 'earthshots' that focus on building infrastructure and delivering affordable, equitable and effective care.

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There are currently no comments.

Nature News

周三, 27 9月 2017

Nature News

[周三, 27 9月 2017]

- **Nature News**

Nature News

Nature is a weekly international journal publishing the finest peer-reviewed research in all fields of science and technology on the basis of its originality, importance, interdisciplinary interest, timeliness, accessibility, elegance and surprising conclusions. Nature also provides rapid, authoritative, insightful and arresting news and interpretation of topical and coming trends affecting science, scientists and the wider public.

- **Biochemist chosen as Canada's chief science adviser** [周二, 26 9月 08:00]
  Mona Nemer is a former administrator at the University of Ottawa whose research has focused on cardiovascular problems.
- **Steps towards transparency in research publishing** [周二, 26 9月 08:00]
  As research and editorial processes become increasingly open, scientists and editors need to be proactive but also alert to risks.
- **Deadly Mexico quakes not linked** [周二, 26 9月 08:00]
  Despite close timing, researchers doubt that the first big tremor set off the second.
- **Giant iceberg’s split exposes hidden ecosystem** [周二, 26 9月 08:00]
  Biologists rush to study creatures living beneath Larsen C ice shelf before they disappear.
- **The drug-maker's guide to the galaxy** [周二, 26 9月 08:00]
  How machine learning and big data are helping chemists search the vast chemical universe for better medicines.
- **What Germany’s election results mean for science** [周一, 25 9月 08:00]
  A new coalition could face battles over gene editing and climate regulations.
- **World’s botanic gardens should work together** [周一, 25 9月 08:00]
  A study suggests a possible way to save more species.
- **Three ways to make proton therapy affordable** [周一, 25 9月 08:00]
  Shrink accelerators, sharpen beams and broaden health-care coverage so more people can get this type of radiation treatment, argue Thomas R. Bortfeld and Jay S. Loeffler.
- **United Kingdom sees dip in European research applications after Brexit vote** [周四, 21 9月 08:00]
  But overall data don't show a big impact on UK's involvement with European science.
- **Fossilized poo reveals that vegetarian dinosaurs had a taste for crabs** [周四, 21 9月 08:00]
  Ancient crustaceans in dino dung from Utah illuminate herbivores’ broad diet.
- **Jellyfish caught snoozing give clues to origin of sleep** [周四, 21 9月

08:00]
The brainless marine creatures are the simplest organisms known to seek slumber.

- **High-energy cosmic rays come from outside our Galaxy** [周四, 21 9月 08:00]
Giant observatory announces long-awaited result.
- **CRISPR used to peer into human embryos' first days** [周三, 20 9月 08:00]
Gene-edited embryos enable researchers to unpick role of a crucial gene, with more studies likely to follow.
- **Sexual competition among ducks wreaks havoc on penis size** [周三, 20 9月 08:00]
When forced to compete for mates, some birds develop longer penises and others almost nothing at all.
- **Pair of deadly Mexico quakes puzzles scientists** [周三, 20 9月 08:00]
Latest big tremor could be linked to major earthquake earlier this month.
- **Take stock of research ethics in human genome editing** [周三, 20 9月 08:00]
Progress in the use of CRISPR–Cas9 for human germline editing highlights some pressing ethical considerations for research on embryos.
- **Snow leopards, ancient zero and Cassini’s big finish** [周三, 20 9月 08:00]
The week in science: 15–21 September 2017.
- **How the Internet of cells has biologists buzzing** [周三, 20 9月 08:00]
Networks of nanotubes may allow cells to share everything from infections and cancer to dementia-linked proteins.
- **Bring on the bodyNET** [周三, 20 9月 08:00]
Stretchable sensors, circuits and batteries are about to change our relationships with electronics and each other, explain Bryant Chu and colleagues.
- **Relativity: A steep ascent of physics** [周三, 20 9月 08:00]
Robert P. Crease applauds the third volume of a thrilling guide to a special pursuit.
- **Sea-level rise: No chaos in the satellite-data record** [周三, 20 9月 08:00]
- **The coded messenger** [周三, 20 9月 08:00]
It's in your make-up.
- **'One-size-fits-all’ threshold for P values under fire** [周二, 19 9月 08:00]
Scientists hit back at a proposal to make it tougher to call findings statistically significant.
- **Marine scientists allege Japan has blocked researchers from joining South Korean ship** [周二, 19 9月 08:00]
Controversy over vessel's name may impede oceanographic collaboration.
- **Researchers unite in quest for ‘standard model’ of the**

brain [周二, 19 9月 08:00]

Modelled on big physics projects, the International Brain Lab will bring together some of the world’s pre-eminent neuroscientists to probe a single behaviour.

- ## Cancer patients need better care, not just more technology

  [周二, 19 9月 08:00]

  Treating cancer with the latest drugs and techniques is costly and will not improve survival globally, warn Richard Sullivan, C. S. Pramesh and Christopher M. Booth.

Biochemist chosen as Canada's chief science adviser

Mona Nemer is a former administrator at the University of Ottawa whose research has focused on cardiovascular problems.

26 September 2017 Updated:

1. 27 September 2017

Geoff Robins/AFP/Getty

Canadian prime minister Justin Trudeau's government launched its search for a chief science adviser in late 2016.

Canadian Prime Minister Justin Trudeau has appointed biochemist Mona Nemer as his country's chief government science adviser, fulfilling his campaign promise to establish the position.

Nemer was most recently vice-president of research at the University of Ottawa. Her scientific work has focused on the genetics of cardiovascular disease and birth defects.

In her new role, Nemer will have a budget of Can$2 million and report to Trudeau and science minister Kirsty Duncan. The country has been without a science adviser for nearly a decade; the last time such a post existed was 2004-2008.

The initial reaction to her appointment has been positive.

“I do know her and she’s fantastic,” says Jim Woodgett, a biologist at the Samuel Lunenfeld Research Institute in Toronto, Canada, who has advocated reforms to Canada's funding institute for health research. “She’s tough, but very very fair. She has the stature, and trust of other scientists.”

“She’ll do a great job,” tweeted innovation policy expert Rob Annan. And Arvind Gupta, the former president of the University of British Columbia, called Nemer “an inspired choice”.

As chief science adviser, Nemer will advise the government on ensuring that government science is publicly available and that scientists are able to speak freely about their work, according to the official job description. The adviser is also charged with ensuring that scientific analyses are incorporated into the government's decisions.

Trudeau's middle-left Liberal government created the position in part as a response to the science community’s dissatisfaction with the previous Conservative government headed by Stephen Harper between 2006-2015. Under Harper, the government was accused of muzzling scientists and sidelining scientific evidence in policymaking.

Nemer's appointment has been a long time coming. Trudeau was elected in October 2015, and appointed Duncan as science minister weeks later —

charging her with establishing the adviser post. The job hunt started in December 2016, and applications were in hand by the mid-February 2017. It has taken the government more than half a year to settle on a candidate.

“I’m quite happy that they have finally appointed someone,” says Deb Daviau, president of the Professional Institute of the Public Service of Canada, the union for government scientists. “It’s been a couple of years coming.”

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Updates

Updated:

Updated with comments from Woodgett and Daviau.

Comments

Comments

There are currently no comments.

Steps towards transparency in research publishing

As research and editorial processes become increasingly open, scientists and editors need to be proactive but also alert to risks.

26 September 2017

Colin Hawkins/Alamy

Various initiatives are opening up the scholarly review and publication process.

Progress in the transparency of both research and editorial processes is gathering pace. This was demonstrated at the International Congress on Peer Review and Scientific Publication in Chicago, Illinois, earlier this month, and in various discussions that are under way among publishers, researchers and others.

The examples given here relate to initiatives by the Nature Research journals, some of which follow pioneering work by other publishers.

Take the improvements in researchers' descriptions of what they did and did not do in their experiments. One such initiative is the checklist introduced by *Nature* and the Nature journals in 2013 for life-sciences submissions.

At the congress, Malcolm Macleod of the University of Edinburgh, UK, and his colleagues discussed the results of an independent study of the impacts that this checklist has had on Nature journals' content. They looked at the completeness of reporting in journals following the initiatives. They analysed papers published in Nature journals — 223 submitted before May 2013 and 225 after. They looked for whether and how authors had identified and addressed sources of bias. They found that the proportion of papers reporting on all four measures — randomization, blinding, exclusions and sample-size calculations (their selected ways of mitigating bias) — increased from zero to 16%.

There was no such growth in a set of equivalent papers from outside the Nature group. Meanwhile, reporting on individual criteria and statistics increased markedly in the Nature journal papers.

We have highlighted elsewhere some of the further steps we have taken. And we have heard anecdotally from some researchers how this has begun to influence the design of their experiments.

Five steps to transparency

Credit to Macleod and his colleagues: there were no fewer than five welcome types of transparency in this project itself. These embody a gradual trend in which the public release of research results is moving farther away from the traditional form of a single, wrap-up publication.

First, the authors published a formal research protocol in a peer-reviewed journal (F. Cramond *et al. Scientometrics* **108,** 315–328; 2016). Such publications are a mechanism, already established in clinical and other interventions research, by which authors ensure that their research is well designed. Editors report that the peer-review process of these papers is much more collaborative in spirit than it is for papers making claims about results. (Even better if the journal commits to publishing the outcome regardless of its conclusions, which avoids pressures to cherry-pick data or model results. *Nature Human Behaviour* is so far the only Nature journal publishing such 'pre-registration protocols'.)

Second, the authors posted the final draft paper describing their conclusions on a preprint server before submission (M. R. Macleod and the NPQIP Collaborative Group. Preprint at bioRxiv http://dx.doi.org/10.1101/187245; 2017). Third and fourth, the group released the data-analysis plan and the analysis code before data collection was completed. These were registered on the Open Science Framework (https://osf.io/mqet6/#). Fifth, the complete data set was publicly deposited on Figshare (http://dx.doi.org/10.6084/m9.figshare.5375275.v1; 2017).

This is an example of the research process being disaggregated, publicly, into its components: peer-reviewed research design, a preprint of outcomes that invites community responses, the release of code and data, and final publication. Such a practice allows greater access to the thinking behind a project. It also provides an opportunity to directly distribute credit to the authors for their efforts on the various components.

In peer review, examples of experiments and innovations abound. The Nature Research group has recently run four separate initiatives. One is double-blind peer review, in which authors' identities are hidden from referees. Since this was introduced for all the Nature journals in 2015 as a standard option, author take-up has been between 9% and 14% across the journals.

Other initiatives pursue greater transparency. On *Nature Communications*, following the example of other publishers, such as EMBO Press, the default since January 2016 is for authors to have the anonymous referees' reports and their responses published with their paper. Authors can opt out, and about 60% of papers have their referees' reports published. Authors in ecology and evolution are the most positive, and those in some areas of physics significantly less so (see *Nature Commun.* http://dx.doi.org/10.1038/ncomms13626; 2016).

Other exploratory initiatives reflect a community desire for greater transparency. For example, in a trial on *Nature*, we have since March 2016 allowed referees to be accredited on the published paper if they wish. So far, the proportion of referees across the disciplines who have selected this option has been about 50%. If this is extended to *Nature Communications*, it will be interesting to see whether referees will want to include their names on the reports that are already displayed with the paper. Other publishers' experiences suggest that many will not.

In a separate trial that started this month, *Nature Communications* is being open about its submitted papers. The journal is pointing readers to the authors' submitted version if it is posted on a preprint server, once the paper has been selected for peer review (see go.nature.com/2fmvtrj).

Are there risks to all this transparency? It may give rise to different sorts of bias. For example, we hear from some authors that they don't want to know who authored a positive review, so that they can avoid future positive peer-review bias themselves. Meanwhile, some researchers and editors fear that referee identification encourages positively biased or softened peer review.

As *Nature* and the Nature Research journals explore ever-greater transparency in editorial processes and support it in research processes, we welcome readers' thoughts and suggestions: nature@nature.com.

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There are currently no comments.

Deadly Mexico quakes not linked

Despite close timing, researchers doubt that the first big tremor set off the second.

26 September 2017

Pedro Pardo/AFP/Getty

Mexico’s second large quake in 12 days caused further damage to the country’s capital.

When a magnitude-7.1 earthquake struck central Mexico on 19 September, seismologists immediately wondered whether the tremor had any connection to the much larger jolt that hit off the country’s west coast 12 days earlier. Preliminary studies suggest that there is no direct link, but the pair of events this month has drawn renewed attention to Mexico's seismic hazards.

The two quakes struck in a geologically surprising area — in the middle of the Cocos tectonic plate. This piece of Earth's outer shell dives beneath the North American plate off the country's Pacific coast, which is where most of the region's quakes tend to occur. But farther to the east, beneath Mexico itself, the Cocos plate flattens out for hundreds of kilometres under the North American plate before taking a second, steeper dive into Earth's depths. This month's quakes happened at two different spots in this flat section, owing to geological stresses from the weight of the plate as it plunges downward.

Shifting ground

The 19 September earthquake, which has killed more than 320 people, struck about 120 kilometres south of Mexico City, much of which is built on an ancient lake bed. That location makes the city vulnerable because tremors shake the sediments like a bowl of jelly (V. M. Cruz-Atienza *et al. Sci. Rep.* **6,** 38807; 2016).

At the National Autonomous University of Mexico (UNAM) in Mexico City, scientists clocked the highest ground accelerations recorded at the site since measurements began in 1964, says Victor Cruz-Atienza, head of the UNAM seismology department. The acceleration was nearly double that seen on 19 September 1985, when a magnitude-8.0 quake along the coast of Michoacan sent seismic energy rippling into the capital, killing more than 5,000 people.

Because the epicentre of the 19 September 2017 quake was so much closer to Mexico City than the one in 1985, which struck 350 kilometres away from the city, the shaking was much stronger. At least 45 buildings collapsed in the capital after last week's quake.

If the 19 September tremor had lasted longer, the damage and death toll could have been even worse. UNAM calculations suggest that the magnitude-7.1 quake ruptured a section of the Cocos plate about 40 kilometres long and took only about 10 seconds, says Cruz-Atienza, so structures didn't shake for long enough to cause more of them to fall. Building regulations have also been considerably strengthened since the 1985 disaster.

Some 95 people lost their lives in the magnitude-8.1 quake on 7 September. It was Mexico's largest earthquake in more than a century, tearing about 80 kilometres of the Cocos plate and lasting for more than 40 seconds.

Looking for links

The occurrence of two earthquakes in such a short time in the middle of the Cocos plate had some scientists wondering whether they could be linked. But others are sceptical: "We don't think there is a causal relationship between the events," says Cruz-Atienza.

In the long term, big earthquakes can increase the risk of nearby seismic activity by transferring stress within Earth's crust to adjacent geological faults. But that sort of 'static stress' transfer would normally not happen at a distance as great as the 650 kilometres between the first and second quakes, says Gavin Hayes, a seismologist at the US Geological Survey in Golden, Colorado. Initial calculations by seismologists Ross Stein at Temblor — a California technology firm in Redwood City that runs an earthquake education app — and Shinji Toda of Tohoku University in Sendai, Japan, suggest that the static-stress increase after the first quake was negligible.

A large earthquake can also set off another by 'dynamic triggering' as its seismic waves ripple outwards, affecting geological faults at much greater distances than static-stress transfer does. But dynamic triggering usually happens within hours or days of the initial quake, making the 12-day gap between the 7 September event and the 19 September tremor hard to explain, says Eric Fielding, a geophysicist at NASA's Jet Propulsion Laboratory in Pasadena, California.

"If that happened, the question is why it waited so long to go," he says.

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Commenting is currently unavailable.

Giant iceberg’s split exposes hidden ecosystem

Biologists rush to study creatures living beneath Larsen C ice shelf before they disappear.

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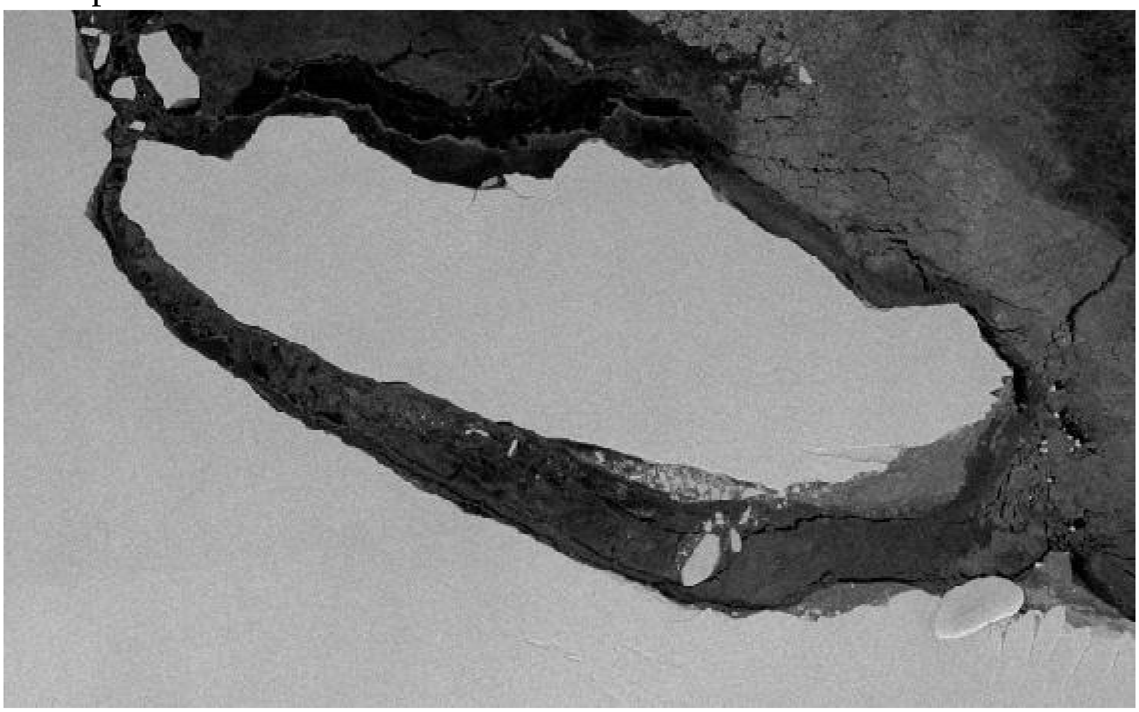

Copernicus Sentinel-1 via BAS

The calved iceberg is about the size of Delaware.

Biologists are racing to secure a visit to a newly revealed region of the Southern Ocean as soon as it is safe to sail there. One of the largest icebergs ever recorded broke free from the Larsen C ice shelf on the Antarctic Peninsula in July. As it moves away into the Weddell Sea, it will expose 5,800 square kilometres of sea floor that have been shielded by ice for up to

120,000 years. If researchers can get to the area quickly enough, they'll have the chance to study the ecosystem beneath before the loss of the ice causes it to change.

"I cannot imagine a more dramatic shift in environmental conditions in any ecosystem on Earth," says Julian Gutt, a marine ecologist at the Alfred Wegener Institute for Polar and Marine Research in Bremerhaven, Germany.

It is difficult for Antarctic scientists to respond quickly to sudden events, because polar-research vessels are usually booked months, if not years, in advance. A German research mission led by Boris Dorschel, head of bathymetry at the Alfred Wegener Institute, was already scheduled to visit the Larsen area and will now include a biodiversity survey of the exposed region in March 2019.

Hopes for reaching the region this Antarctic summer lie with the British Antarctic Survey (BAS) in Cambridge. The agency has a fast-track proposal sparked by the calving event, led by BAS senior biodiversity scientist Katrin Linse, to send a research vessel in early 2018. The proposal is now being considered by a British funding council. South Korean researchers are also considering whether to divert a mission currently planned for the South Shetland Islands, says Hyoung Chul Shin, a biological oceanographer at the Korea Polar Research Institute in Incheon.

If the BAS proposal is successful, it will be the first time marine biologists have been able to explore such an ecosystem so soon after the break-up of the ice. Nearby sections of ice shelf, at Larsen A and Larsen B, broke away in 1995 and 2002, respectively. But it was several years before the ocean cleared of sea ice and biologists could safely visit the area. Gutt was first in with a detailed survey, leading a team of about 50 scientists on the German research vessel *Polarstern* in 2007. The group sampled hundreds of species in areas exposed by the break-ups at Larsen A and B, and saw signs of a unique ecosystem with more deep-sea species than elsewhere on the Antarctic continental shelf (J. Gutt *et al. Deep-Sea Res. II* **58,** 74–83; 2011). But other species were already moving in, including fast-growing sea squirts, krill and minke whales. "By then, a lot had happened," says Linse.

Getting to the Larsen C exposed region before it starts to change is crucial, says Gutt, to see what a sub-ice-shelf ecosystem looks like. Video footage taken by geophysicists on a US Antarctic Program cruise at the Larsen B site in March 2005 had unexpectedly showed most of the sea floor covered with a white mat, which the team interpreted as a layer of sulfur-eating microbes, as well as large clams, which were also chemotrophic — that is, living on energy sources other than the Sun. It was the first report of a chemotrophic ecosystem in the Antarctic. But when the *Polarstern* arrived two years later, Gutt's team saw only dead clamshells and a layer of decaying plant matter and sediment.

One thing the researchers won't have to worry about is disturbance from commercial fishing fleets. The Larsen C region is the first area to be protected by a 2016 agreement by the multinational Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) to automatically designate any areas of ocean exposed by the collapse or retreat of ice shelves as a Special Area for Scientific Study. This prohibits commercial fishing — of the Antarctic toothfish, for example — for an initial period of two years.

Ice shelf break-up events could become much more common with climate change, says Andrea Kavanagh, director of the Pew Charitable Trusts' Global Penguin Conservation Campaign in Washington DC, and the CCAMLR protection will allow scientists to monitor how these changes affect wildlife. "It's really important to be able to separate the effects of fishing versus climate," she says.

Biologists will discuss research priorities for Larsen C and future exposed regions at a swiftly organized meeting at Florida State University's Coastal and Marine Laboratory in St Teresa on 18–19 November. Meanwhile, Linse's team is waiting to learn whether the BAS mission proposal will be approved, and monitoring the iceberg in satellite images. "We need the wind to blow the iceberg out a bit more and to blow the sea ice out of there," says BAS spokeperson Athena Dinar.

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The drug-maker's guide to the galaxy

How machine learning and big data are helping chemists search the vast chemical universe for better medicines.

26 September 2017

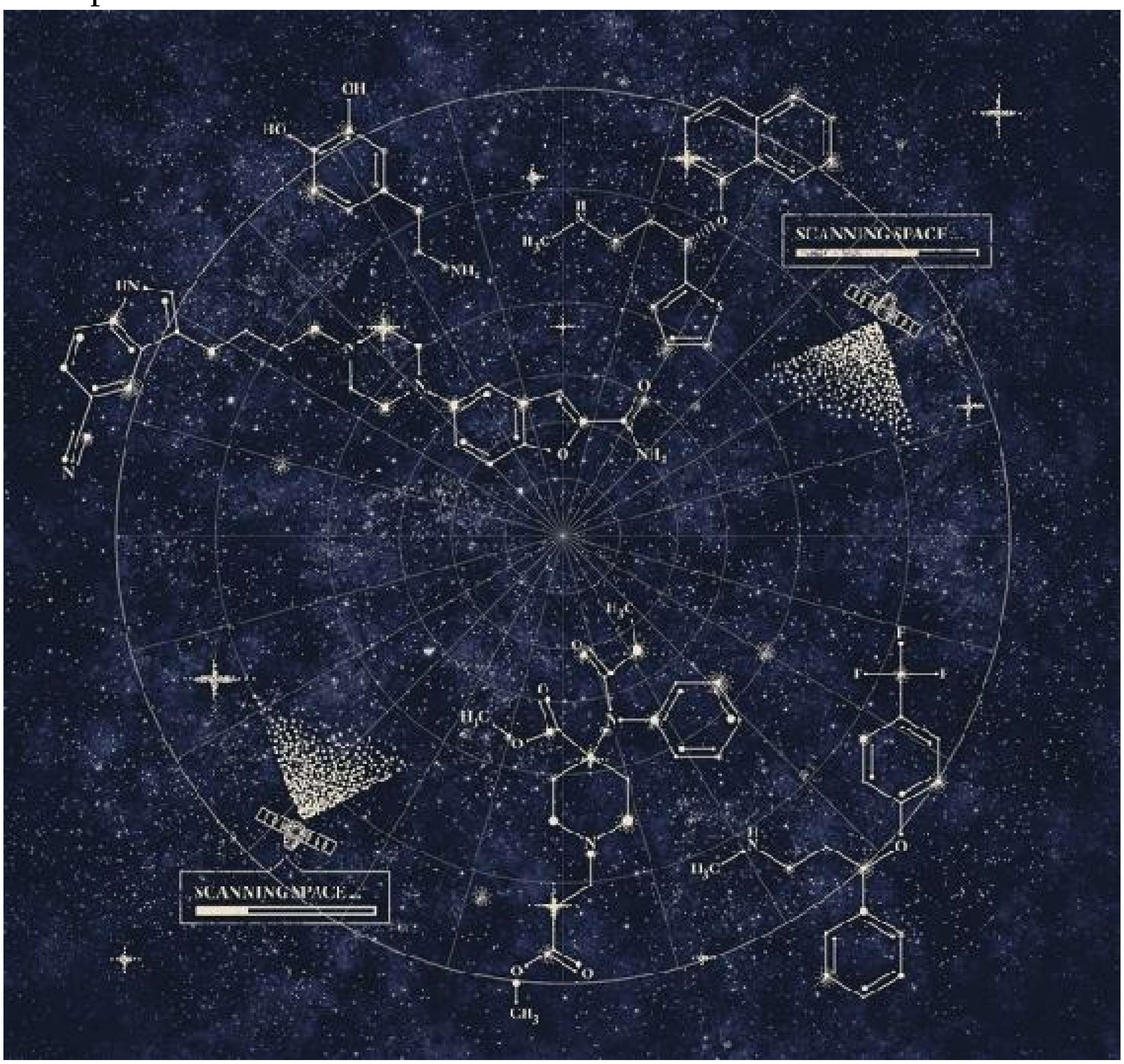


Illustration by Vasava

In 2016, the pharmaceutical firm Sunovion gave a group of seasoned employees an unusual assignment. At the firm's headquarters in Marlborough, Massachusetts, the chemists were all asked to play a game to see who could discover the best leads for new drugs. On their workstations was a grid of hundreds of chemical structures, just ten of which were labelled with information on their biological effects. The experts had to select other molecules that could turn out to be drug candidates, using their hard-earned knowledge of chemical structure and biology. Of the 11 players, 10 struggled through the task for several hours. But one breezed through in milliseconds — because it was an algorithm.

That computer program was the brainchild of Willem van Hoorn, head of chemoinformatics at Exscientia, a start-up that uses artificial intelligence (AI) to design drugs. The firm, based in Dundee, UK, wanted to extend a nascent partnership with Sunovion, so the stakes were high. “My credibility was on the line,” says van Hoorn. Twenty rounds of gameplay later, he tallied up the points. Relief swept over him. His algorithm had mastered at least some of the dark arts of chemistry; only one drug-hunting expert had beaten the machine.

Exscientia and Sunovion have continued to work together to discover psychiatric drugs ever since. “This competition really helped to get buy-in from the people who make the chemistry research decisions,” says Scott Brown, Sunovion's director of computational chemistry.

Exscientia is just one of a growing number of groups in industry and academia that are turning to computers to explore the mind-bogglingly large chemical universe. Chemists estimate that 10^{60} compounds with drug-like characteristics could be made — that's more small molecules than there are atoms in the Solar System. The hope is that algorithms will catalogue, characterize and compare the properties of millions of compounds *in silico* to help researchers quickly and affordably find the best drug candidates for a target. Proponents argue that these strategies could make medicines safer, ensure that fewer drugs fail in clinical trials and enable the discovery of new classes of therapeutics. They could also help to open up areas of chemical space left unexplored or assumed to be barren.

But many medicinal chemists remain sceptical of the hype, unconvinced that the ineffable complexity of chemistry can be reduced to mere lines of code. Even advocates of AI acknowledge that many attempts have fallen flat: computer-generated compounds can be riddled with components that are difficult to make, such as 3- or 4-atom rings, and infested with reactive groups that would set off safety alarms. “The execution of some computational approaches can suffer badly when researchers just don't know the field,” says van Hoorn. “The compounds they come up with are just laughable.” But he says that an expert human touch could yet tame these overzealous digital designers. “I think some of these ideas could work if the computer scientists would just collaborate with people who actually breathe chemistry.”

Space exploration

To navigate the chemical universe, it helps to have a map. In 2001, chemist Jean-Louis Reymond, at the University of Berne in Switzerland, started using computers to chart as much of the massive space as possible. Sixteen years on, he has amassed the largest database of small molecules in the world, a gigantic virtual collection of 166 billion compounds. The database, called GDB-17, includes all the chemically feasible organic molecules made of up to 17 atoms — as many as Reymond's computers could cope with. “Just for a computer to compile a list of the compounds in the database would now take over 10 hours,” says Reymond.

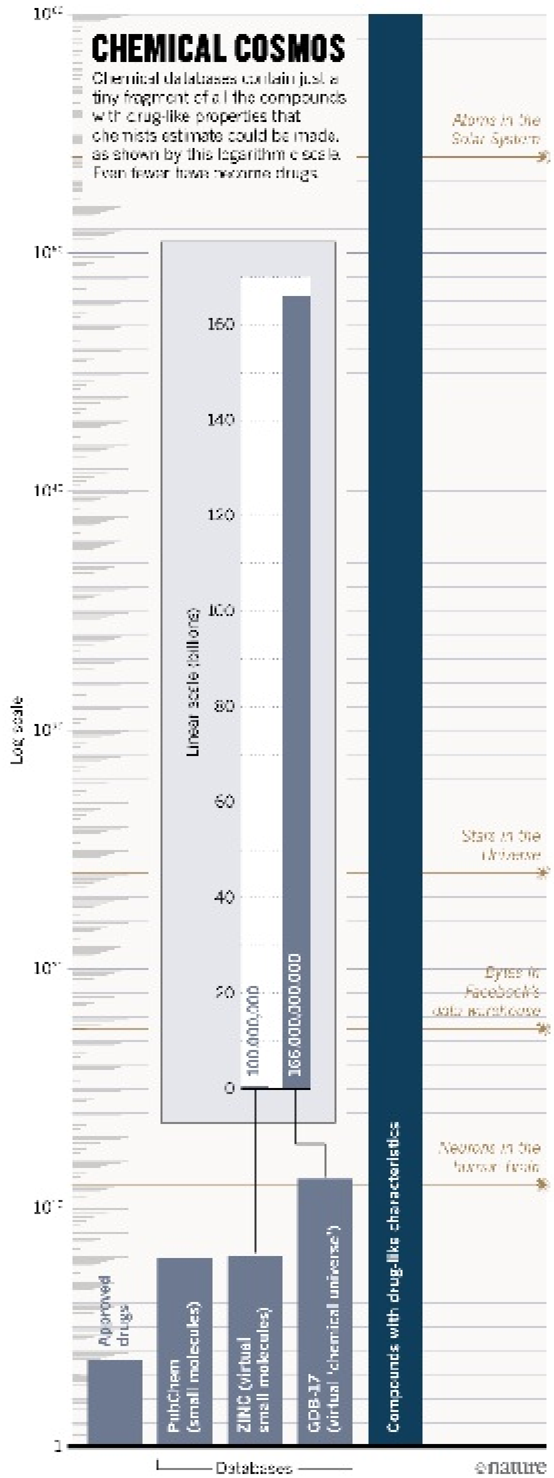
To make sense of this plethora of possible drug starting points, Reymond has come up with a way to organize his chemical universe. Taking inspiration from the periodic table, he has grouped compounds in a multidimensional space in which neighbouring compounds have related properties. Positions are assigned according to 42 characteristics, such as how many carbon atoms each compound has.

For each drug that has made it to market, there are millions of compounds that are chemically almost identical to it — just sporting an extra hydrogen here or double bond there. And some of these will work better than the drug that was approved. Chemists couldn't possibly conceive of all of these variations unaided. “There is no way you can get at these isomers using a pen and a piece of paper," says Reymond.

But Reymond and his team can identify therapeutically promising 'near neighbours' of proven drugs by searching for similarities between compounds. By using a particular drug as a starting point, the team can comb through all 166 billion compounds in the database for compelling follow-on candidates in just 3 minutes. In a proof-of-principle experiment, Reymond started with a known molecule that binds the nicotinic acetylcholine receptor, a useful target for disorders involving the nervous system or muscle function, and compiled a shortlist of 344 related compounds. The team synthesized three, and found that two could activate the receptor potently, and could be useful for treating muscular atrophy in ageing[1]. The approach is like using a geological map to work out where to dig for gold, Reymond says. "You need some way to choose where you are going to dig," he says.

An alternative approach uses computers to pan lots of locations for gold without worrying too much about the starting location. In drug-hunting terms, this means screening vast chemical libraries *in silico* to find small molecules that bind to a given protein. First, researchers have to take a snapshot of a protein using X-ray crystallography to determine the shape of its binding site. Then, using molecular-docking algorithms, computational chemists can chug through compound collections to find the best fits for any given site.

As computing power has exploded, the capabilities of these algorithms have improved. Chemists at the University of California, San Francisco, led by Brian Shoichet, showcased the potential of this approach in 2016 in a search for a new class of painkiller. The team screened more than 3 million commercially available compounds to find candidates that would selectively activate μ-opioid receptor signalling to relieve pain without disturbing the closely related β-arrestin signalling pathway — which is thought to be associated with opioid side effects including a lowered breathing rate and constipation. The researchers quickly whittled down a massive compound library to just 23 highly ranked compounds for follow-up[2].



In a test tube, seven of the candidates had the desired activity. Further development turned one of these into PZM21, a compound that acts on the μ-opioid receptor without activating β-arrestin. The biotechnology firm

Epiodyne, based in San Francisco, California, and co-founded by Shoichet, is now trying to develop a safer painkiller based on the findings. Shoichet plans to use the same approach to find compounds that modulate other G-protein-coupled receptors (GPCRs), a family of proteins that accounts for an estimated 40% of drug targets.

His team is also running similar experiments with a virtual nebula of 100 million compounds that have never been made before but that should be easy to synthesize. Industry drug developers are also testing out this approach: the biotech firm Nimbus Therapeutics, based in Cambridge, Massachusetts, incorporates into its docking screens virtual compounds with characteristics of naturally occurring chemicals that usually have to be laboriously sourced from natural environments such as soil. The jury is still out on whether these will lead to drugs, but Don Nicholson, chief executive of the company, says that for at least one drug-design programme, “this is where all our hits are coming from”.

Preliminary results from such virtual screens are shaking one of Shoichet's core assumptions about chemical space: that it's only worth looking in established, drug-rich regions. Well-characterized galaxies of molecules are so awash with biologically active compounds that some argue it is a waste of time searching elsewhere. “Throughout my career I have believed that line of reasoning. It just made sense, even if there wasn't that much evidence to support it,” says Shoichet. But unpublished results from his screens of 100 million compounds are stoking his interest in the less-explored regions of chemical space. “I'm starting to think that those galaxies are full of gold.”

In silico insight

These data-searching approaches are tried and tested, but the computers involved can follow only scripted instructions. The latest frontier in computational drug discovery is machine learning, in which algorithms use data and experience to teach themselves which compounds bind to which targets, finding patterns that are invisible to the human eye. Around a dozen firms have sprung up to create drug-hunting algorithms that they can test in partnership with large pharmaceutical companies.

Andrew Hopkins, chief executive of Exscientia, makes a strong case for the power of these approaches. It takes on average 4.5 years to discover and optimize candidates for preclinical testing[3], and chemists often synthesize thousands of compounds to get to a promising lead (which even then has only a slim chance of making it to market). Exscientia's approach — which uses various algorithms, including the one that impressed Sunovion's research and development executives — may be able to reduce this timeline to just one year, and shrink the number of compounds that a drug-discovery campaign needs to consider.

In 2015, Exscientia finished a 12-month campaign for Sumitomo Dainippon Pharma, which owns Sunovion and is based in Osaka, Japan. The researchers trained their AI tools to find small molecules that modulate two GPCRs at the same time, and found they needed to synthesize fewer than 400 compounds in order to identify a good candidate. The drug that emerged is now moving towards clinical trials for psychiatric disease, says Hopkins. Since May, the company has inked deals worth hundreds of millions of dollars with Sanofi, based in Paris, and GlaxoSmithKline, based in Brentford, UK.

In addition to identifying leads, machine-learning algorithms can also help drug developers to decide early on which compounds to kill, says Brandon Allgood, chief technology officer of Numerate, an AI drug-design firm based in San Bruno, California. There's no point in making and testing a compound if it's going to fail on toxicity or absorption testing a few months later, he says. With AI, “it takes just a millisecond to rule it in or out”, says Allgood, who trained as a cosmologist before he started using AI tools to study the chemical cosmos. Numerate has struck two deals with pharmaceutical companies this year, including one with Servier, based in Suresnes, France, to put AI-discovered drugs through clinical trials for heart failure and arrhythmias.

Industry investment is blossoming, but computational approaches still have a lot to prove. Reymond's collection is gigantic compared with other libraries, but it covers the minutest fraction of the chemical universe (see 'Chemical cosmos'). Despite the 166 billion compounds in his database, he still has further to go in his quest than an astronomer who is trying to count all the stars in the night sky but has only managed to record one. Screens that rely on matching proteins with drugs need accurate crystal structures to yield the best results, and these data take time, money and expertise to generate. These methods also struggle to cope with proteins in motion and they cannot rank their suggestions very well. Machine-learning algorithms, for their part, are only as good as the training data sets that they are based on, performing particularly poorly when they encounter compounds that look unlike molecules they have seen before. What's more, the programs run as black boxes, and cannot indicate why they predict a compound will be a good fit.

Many computational approaches also have an annoying habit of suggesting candidates that are nightmares to cook up in a lab. Chemists must then laboriously figure out a recipe for the suggested compound, which can take months or more. Even then, there is no guarantee that the molecule will work once it is made. Reymond's approach predicts a compound's activity profile correctly only 5–10% of the time, and that means chemists have to toil away on up to 20 compounds to find one that acts as expected. “I would say the bottleneck in our exploration of chemical space is the ability to dare to make compounds,” says Reymond. To this end, he recently shaved his chemical universe down to a shortlist of 10 million molecules that are easy to make, and yet still cover a broad range of properties.

Mark Murcko, chief scientific officer at Relay Therapeutics in Cambridge, Massachusetts, thinks computational chemists should focus less on coming up with new algorithmic strategies, and more on improving the data sets they learn from. “One of the best ways that I know of to make a predictive model better is to keep feeding it more and more, and better and better, data,” he says. Relay and others have bench chemists working closely with computational scientists, synthesizing compounds proposed by both humans and algorithms and using the resulting findings to inform future decisions.

For Hopkins, such collaborations are key. It took decades for computer scientists to write programs that could compete with chess grandmasters. Then, in 1997, IBM's Deep Blue beat Garry Kasparov. But the loss did not mark the end of chess. Instead, Kasparov created a doubles version in which each team consists of a human player and an AI. “Together the human and AI can outperform any human, but they can also outperform any algorithm,” says Hopkins. He wants the same mix of data-crunching, creativity and common sense to transform drug discovery. “I believe we are at the Kasparov–Deep Blue moment.”

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What Germany’s election results mean for science

A new coalition could face battles over gene editing and climate regulations.

25 September 2017

Omer Messinger/NurPhoto via Getty Images

Angela Merkel is set to continue as Germany's chancellor, but is negotiating to form a new governing coalition.

As Germany reels from an unexpected surge for the far right in the 24 September elections, researchers don’t expect much effect on the country’s generous support for science. But with smaller parties standing to gain political influence, battles over issues such as the regulation of gene-edited

organisms and how to cut greenhouse-gas emissions could grow fiercer.

Angela Merkel is set for a fourth term as Germany’s chancellor and will lead negotiations with other parties to form a coalition government, after her centre-right Christian Democratic Union (CDU) won the largest share of the seats in parliament, albeit with a diminished lead. Her coalition partner in the last government, the Social Democrats (SPD), came second, but it, too, lost support, and has pledged to move into opposition. Other minor parties are instead expected to enter government, in negotiations that Merkel hopes to complete by the end of the year.

Merkel has ruled out — as being too radical — partnerships with the far-right AfD (Alternative for Germany) party and the socialist Left Party. Most expect her to strike an agreement with the Green Party and the liberal Free Democrats (FDP). That would form a ‘Jamaica coalition’, named as such because the parties’ colours match the green, yellow and black of the Jamaican flag. (A fourth party, the CSU, shares a platform with Merkel's CDU; it campaigns only in Bavaria).

The negotiations are expected to focus on hot political issues, such as Germany’s handling of the refugee crisis. All four parties strongly support science, but there are some key differences. The Greens want the same strict regulation for organisms that have been gene edited with precision technologies such as CRISPR, as has been put in place for those modified with conventional, less precise techniques. But the other three parties have hinted that they may support a more liberal form of regulation.

Overall, Germany already tightly regulates research on genetically modified organisms (GMOs), and animals in general, and is unlikely to tighten that further under a new government, says Tobias Erb, a director at Germany’s Max Planck Institute for Terrestrial Microbiology in Marburg. “But I do expect that it will remain complicated, and might even get more complicated, to release GMOs — and in particular GM plants — if the Greens become part of the next government coalition,” he says.

Power struggles

Germany’s climate and energy policies could be another area of conflict within a future coalition, says Oliver Geden, a policy expert with the German Institute for International and Security Affairs in Berlin.

The Greens want to shut down the country’s dirtiest coal power plants, and support a climate-protection law to help Germany meet its plans to reduce greenhouse-gas emissions by 80–95% from 1990 levels by 2050. But the FDP, a pro-business party in favour of free-market economics, advocates against detailed central planning to force cuts to carbon dioxide emissions — of the sort that has previously been proposed both by the Greens and by the outgoing CDU/SPD coalition. The FDP does favour eliminating “inefficient” subsidies in the energy sector and strengthening the European emissions-trading scheme. “We should expect a lot of ambiguity, even hypocrisy, when it comes to climate policy,” says Geden.

The strong presence of the AfD in parliament will make for noisy debates. Having won 13% of votes, the party is now the third largest after the SPD and CDU/CSU. The AfD did not make election statements on science, and declined to answer *Nature*’s questions before the election, but party leaders have previously expressed climate scepticism and distrust of genetic engineering.

The AfD’s rise means that for the first time, a party is represented in parliament that opposes Germany’s plans to cut greenhouse-gas emissions by moving to renewable-energy sources — termed the ‘*Energiewende*’, or energy transition. But its sceptical stance on climate and energy issues is unlikely to sway the next government, Geden says.

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World’s botanic gardens should work together

A study suggests a possible way to save more species.

25 September 2017

Ray Tang/Anadolu Agency/Getty

Botanic gardens safeguard species and can help to conserve them in the wild.

“There are three things which have stimulated men throughout the ages to travel far and wide over the surface of the globe,” wrote Arthur Hill, assistant director of the Royal Botanic Gardens, Kew, in 1915. “And these are gold, spices and drugs.” (A. W. Hill *Ann. Missouri Bot. Gard.* **2,** 185–240; 1915).

It was these last two, Hill went on to argue, that served as the impetus to create some of the earliest botanic gardens. Yet over the years the remit has shifted and expanded, as the medicinal and culinary repositories of old has given way to complex institutions tasked with delighting and educating the public — while providing a hub for research and conservation.

A study published this week in *Nature Plants* highlights the fruits of those efforts: a survey of 1,116 botanical collections shows that they hold representatives from about 30% of the world's plant species (R. Mounce *et al. Nature Plants* http://dx.doi.org/10.1038/s41477-017-0019-3; 2017). It is a testament to the resourcefulness of their staff that such gardens are able to foster so much diversity in the face of mounting pressures to boost revenue.

But with 20% of the world's plant diversity threatened with extinction, the study also suggests that there is room for improvement when it comes to conservation. The collections, for example, are unbalanced: 76% of the missing species are from tropical regions. Less than 5% of non-vascular genera, such as mosses, are represented at all. (And although seed banks can pick up some of the slack, certain species are still best preserved as living specimens.)

Some of this reflects bias in the data. Only about one-third of the world's botanic gardens were included in the study, and gardens with fewer resources are less likely to upload information about their collection to a database. But the data also point to a need to focus conservation efforts on neglected taxa.

Given limited resources, the best way to do this is to coordinate efforts between botanic gardens. Many zoos have long done this. The crop research community came together in 2011 to preserve plant genetic resources that are important for agriculture. And botanical gardens around the world have embraced the Global Strategy for Plant Conservation, adopted in 2010 by the United Nations Convention on Biological Diversity. But to realize the strategy's goal of protecting at least 75% of threatened plant species in botanical collections by 2020, gardens must come together to structure and bolster their conservation efforts.

There are signs that such an approach would take off. Botanic gardens, despite the occasional outbreak of one-upmanship, have a history of

collaboration that will provide fertile soil for a targeted approach to conservation. These gardens should embrace an active role in plant conservation, and should not limit themselves to educating the public about the need for it. Who else has the ability to coax the world's most finicky plants to thrive in new ground, or to force a recalcitrant seed to germinate?

A good example is a meeting planned for April 2018, when experts in rhododendron cultivation will meet botanic-garden staff from areas of the world that host endangered rhododendron species. The effort could provide an excellent test case for botanic gardens: rhododendrons are charismatic megaflora — their showy flowers are prized by gardeners around the world, which means that the public cares about their preservation. At the same time, they are particularly vulnerable to climate change, and their seeds often do not remain viable in storage, making live cultivation particularly important.

As efforts such as this take off, more botanic gardens can legitimately sell themselves to the public as protectors of the world's plants, and entice visitors to view their rare specimens. Kew Gardens executed this beautifully when it saved a tiny Rwandan water lily (*Nymphaea thermarum*) from extinction in 2009 by painstakingly working out how to germinate its seeds. The media campaign around the lily enticed crowds to come and see one of the world's few living samples. (In this case, the strategy worked perhaps too well: so great was the public's thirst for the lily that a thief made off with one in 2014.)

More botanic gardens can and should put their unique skills to work to preserve plant diversity. Many have already grown to be much more than collections of spices and drugs. With better coordination, more could yet strike gold.

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Three ways to make proton therapy affordable

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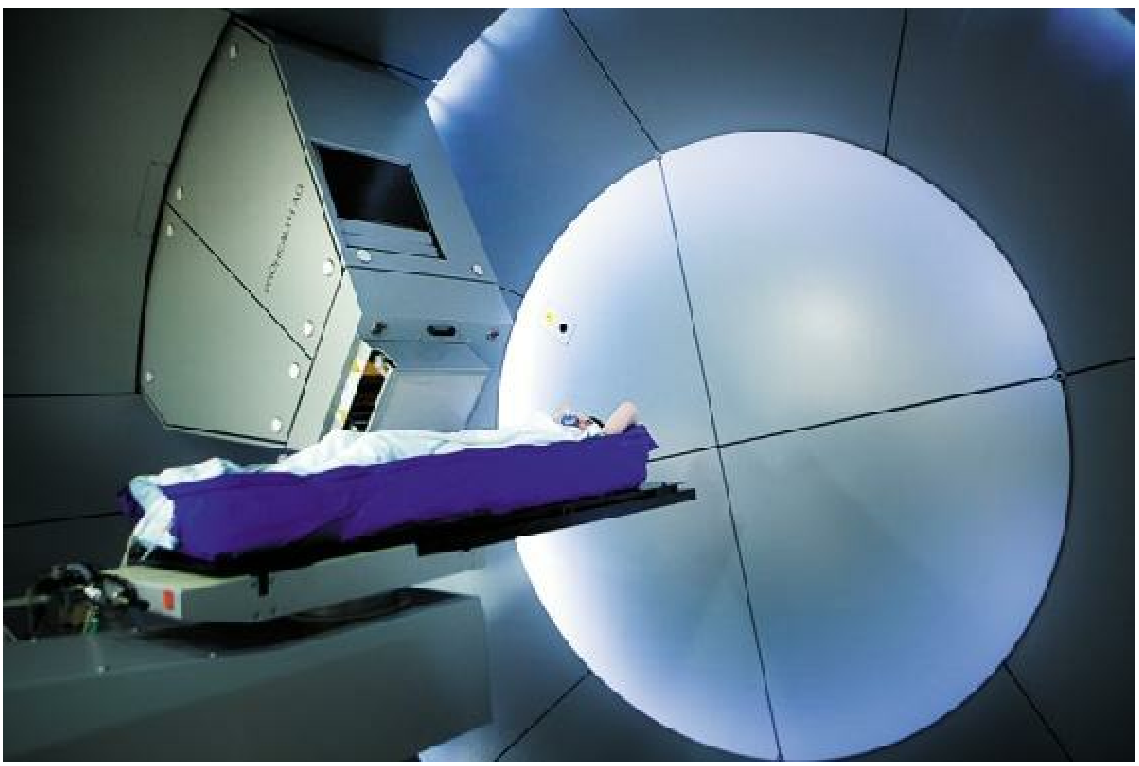
Shrink accelerators, sharpen beams and broaden health-care coverage so more people can get this type of radiation treatment, argue Thomas R. Bortfeld and Jay S. Loeffler.



BSIP/UIG/Getty

A proton-therapy machine at the Rinecker Proton Therapy Center in Munich, Germany.

If cost was not an issue, proton therapy would be the treatment of choice for

most patients with localized tumours. Protons can be targeted more precisely than X-rays[1], so the tissues around the tumour receive two to three times less radiation. This lowers the chance of causing secondary tumours[2] or impairing white blood cells and the immune system[3]. High doses of protons can be delivered safely to hard-to-treat tumours: for instance, those at the base of the skull or in the liver. Such accuracy is crucial when treating cancers in children.

Yet most hospitals do not offer proton therapy. The equipment is huge and expensive. Housed in multistorey buildings with halls the size of tennis courts, one proton centre with 2–3 treatment rooms typically costs more than US$100 million to build. To reach deep-seated tumours, the protons must be sped up to 60% of the speed of light (a kinetic energy of 235 megaelectronvolts; MeV) using a particle accelerator, such as a cyclotron or synchrotron. Rotatable gantries with wheels typically 10 metres across and weighing 100–200 tonnes direct the protons at the patient from a range of angles. Concrete shields, metres thick, are necessary to block stray neutrons.

“Nothing so big and so useless has ever been discovered in medicine,” said Amitabh Chandra, director of health policy research at the John F. Kennedy School of Government at Harvard University in Cambridge, Massachusetts. He has compared a proton-therapy system to the Death Star from *Star Wars*.

Nonetheless, there are now more than 60 proton-therapy centres around the world, with 26 in the United States alone. Almost half of them (12) treated their first patient within the past three years. But construction delays and closures are also common. The companies that build the facilities and the investment groups that own them are increasingly struggling to make a profit. The Scripps Proton Therapy Center in San Diego, California, filed for bankruptcy in March, just three years after opening its doors.

What has gone wrong? Patient charges are high, often three to four times more than the priciest X-ray treatments. Fewer patients are being treated with protons than was anticipated: common diseases such as prostate cancer can be cured as effectively using other forms of radiation and surgery[4]. And in the United States, major insurance companies are denying proton therapy to up to 30% of eligible patients[5] on the basis that there are too few rigorously

designed and completed clinical trials providing evidence of better outcomes. In our experience, however, this is a vicious cycle: such trials are difficult to conduct when patients are denied private health coverage[5].

The solution is to make proton-therapy facilities smaller and cheaper, with costs of around $5 million to $10 million, similar to high-end X-ray systems. A dozen 'miniaturized' facilities are in operation. We have installed one at Massachusetts General Hospital in Boston. Now academics, private researchers and investors need to make proton-therapy systems even smaller and more competitive so that more patients can benefit.

Shrinking infrastructure

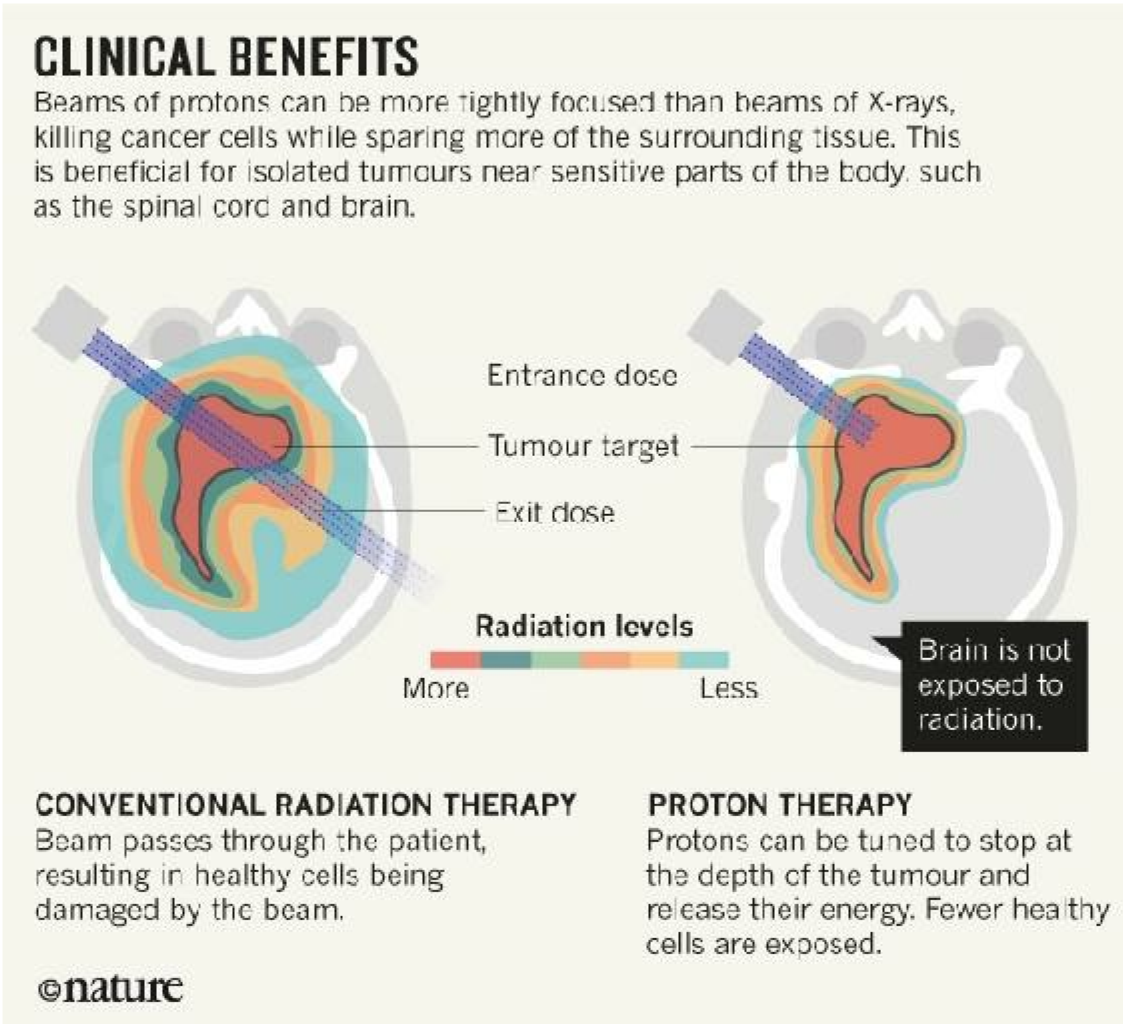
Proton-therapy technology is much more compact today than it was a few decades ago[6]. Superconducting magnets can confine protons in a tighter space. The weight of accelerators has gone down from hundreds of tonnes to less than 20, and their diameters have shrunk by a factor of 3 since the early 1990s. The smallest therapeutic accelerator so far is less than 2 metres in diameter — about the same footprint as a king-sized bed.

Yet, combined with the gantry and other equipment needed, even the most compact systems for sale today occupy a couple of hundred square metres. This is much larger than a conventional treatment room of 50 square metres. Most hospitals lack the money and space to construct a special building for proton therapy.

We have been testing how smaller systems can be squeezed into existing hospital buildings, working with the proton-technology vendor ProTom International in Wakefield, Massachusetts, and engineers at the Massachusetts Institute of Technology in Cambridge. Getting an accelerator and gantry into two basement X-ray rooms in our central Boston hospital cost about $30 million, less than one-third of the cost of a dedicated centre but still about five times more than a top-end X-ray unit.

Both the equipment and the price tag need to shrink further if proton therapy is to replace X-rays. Fitting the facility into one room is the goal. This would

allow hospitals to simply replace existing X-ray equipment with proton units without building work. Getting there will be technically challenging, even with rapid advances in magnets[6].



Source: Dose levels from Fig. 1a, A. J. Lomax *et al. Radiother Oncol.* **51**, 257–271 (1999)

Gantries might need to have a smaller range of movement or be abandoned altogether[7]. Moving the patient relative to the beam is easier: fixed beams and a rotating chair were used in particle therapy before the 1990s. But it is difficult to position the patient accurately and repeatedly.

Three developments that have emerged in the past three years hold promise.

Narrow 'pencil' beams that paint the radiation dose precisely onto a tumour reduce the need to treat patients from many angles (see 'Clinical benefits'). Rapid imaging methods can detect tiny changes in the patient's position, so that the beam can be shifted. And advanced 'soft robotics' built using malleable outer materials will soon allow patients to be positioned quickly and comfortably using robotic hands.

Pushing affordable proton technology forwards will require combined efforts from device companies, venture capitalists, academics and medical practitioners. But these groups currently work in silos. Most technology development is left to industry. Hospitals buy off-the-shelf and do not actively seek input from researchers. Only a few national labs in different countries work on technologies related to proton therapy. There are plans for a medical-research beamline at CERN, Europe's particle-physics lab near Geneva, Switzerland. But, overall, there has been little work in universities with the clear goal of improving the affordability and clinical utility of proton-therapy systems.

Clinical utility

Although the utilization of proton therapy is growing, the gap between the number of patients receiving the treatment and those who could potentially benefit from it is still substantial (see 'Unmet need')[8]. The primary reason is cost; availability is another barrier, as are a lack of knowledge of the therapy's benefits and difficulties referring patients.

As technology improves, the number of patients who could benefit clinically from proton therapy will rise, too. The therapy is not like a pill: its success depends on how it is delivered. It has more room for improvement than other, more-established radiation treatments, such as X-rays. Developing proton therapy's physical advantages — in particular its ability to focus and thus lower the overspill of radiation — would make it the best treatment for most patients who need radiation therapy. In some cases, it might outperform surgery.

Sharpening the spot of the proton beam gives it the precision of a scalpel.

Unlike X-ray photons, fast protons entering the patient are slowed because they interact with body tissues. Most of the beam's energy is deposited at a point (called the Bragg peak). The speed of the proton, or its kinetic energy, determines the depth at which the spot reaches below the skin. Protons with energies of around 50 MeV penetrate to a depth of a few centimetres; those at more than 200 MeV reach 30 cm. Uncertainties in this slowing process can affect whether the dose spot hits the tumour as intended, or overshoots into healthy organs.

Better imaging methods are needed to locate and guide the proton spot. Its position is currently known to within only 0.5 cm. This is similar to X-rays but blurs the radiation dose, making it impossible to stop the beam precisely in front of crucial structures such as the spinal cord. Improving the accuracy and precision from centimetres to millimetres is necessary. This is a particular challenge when targeting moving tumours, such as those in the lung and liver. Higher accuracy would mean that smaller margins would need to be irradiated around tumours — overshoot is the standard way to deal with uncertainties. This would transform treatments for lung cancer, for example, in which proton therapy does not yet show a substantial physical advantage over X-rays.

Several methods for measuring the range of the proton spot have been explored[9]. When protons interact with atomic nuclei, they give off γ-rays that can be tracked. Sound waves are also given off when tissues expand and contract as they are heated by pulses of protons. Such techniques have reached accuracies of a few millimetres in experimental settings, but do not yet have the millimetre accuracy needed for use in patients. The technical hurdles are surmountable but require more concerted efforts, both public and private.

Health-care policy

The high cost of proton therapy means that most countries and insurers restrict its use. England and several European nations, including Denmark and the Netherlands, offer proton therapy only for cancer types for which the reduction of long-term side effects is thought to be greatest, such as tumours

in the skull base (chordoma and chondrosarcoma), in the eyes (melanoma) and many tumours in children. In 2014, the American Society for Therapeutic Radiation Oncology (ASTRO) released a list of diagnoses that its experts recommended insurers should cover.

But individuals and tumours vary. Sarcomas, for instance, occur in many different forms and sites. The benefit of proton treatment depends on tumour size, shape and proximity to organs. People with breast cancer are not on the ASTRO list. But those with a tumour on their left breast might benefit because proton therapy could help to spare the heart from radiation damage[3].

The Netherlands has taken a step in the right direction, using individual treatment plans and a biological model of complications in normal tissues to select patients who stand to benefit most from proton therapy. But the probabilities of side effects predicted by biological dose–response models are uncertain. The models consider only severe complications, such as blindness, which are rare. They do not consider more common aspects such as a reduced IQ score in children, for instance.

In the United States, several hospitals have tried to recoup the costs of proton centres by focusing on common and easy-to-treat tumours such as prostate cancer. Insurers are reluctant to cover such treatment, but many wealthy men pay for themselves. So the most common cancer treated with protons is one in which it makes the least clinical difference.

Because there are relatively few proton centres, patients must be referred to them from other hospitals. But many oncologists are unaware of what the therapy can do, and local, private physicians and hospitals fear losing revenue if their patients are treated elsewhere. Patients, too, are loath to travel long distances, sometimes between countries. As a consequence, too few patients are referred.

Sweden has improved these logistics. Since 2015, its proton centre in Uppsala has been run as a shared facility for all major hospitals in the country. Physicians and staff at the referring hospitals are involved in planning and in the treatment of their patients in Uppsala, and uptake has improved. This centralized approach might not work as well in a larger country. The United States will face its first test in 2019, when a proton

centre will open in Manhattan that will be shared among a consortium of hospitals.

Greater use raises another problem. The specialized personnel needed are in short supply. One solution is to make the workflow of proton therapy similar to that of conventional X-ray therapy. Another is to rely more on automation, in particular for systems that guide treatment planners on the basis of knowledge pooled from experts.

Next steps

Partnerships are needed to make proton-therapy technology more practically useful. Hospitals must share knowledge about treating and interacting with patients as well as using therapy systems. Applied physicists and engineers in academia and at national and international labs should work with medical physicists on improving the beams, imaging and robotics. For example, a CERN spin-off company called ADAM (Application of Detectors and Accelerators to Medicine), based in Geneva, is working with its parent institution in the United Kingdom on a linear mini-accelerator for medicine. National physics and engineering societies and funding agencies should coordinate some of this research and publicize needs and progress.

As costs fall, the charges for proton therapy should be lowered to the level of sophisticated X-ray therapy within the next five to ten years. Insurance companies should move to the 'reference pricing' model, which establishes a common level of payment for different therapies that have similar anticipated outcomes[10]. This will help to build the evidence for the benefit of proton therapy (or lack of it) in new clinical applications. The Mayo Clinic in Rochester, Minnesota, has already entered into such arrangements with insurers. Collaborations between hospitals and health-care funders on a broader scale are needed[5].

To get the ball rolling, these ideas could be discussed at the upcoming Particle Therapy Co-Operative Group meeting in May 2018. The European and American societies for radiation oncology should be involved. Symposia or satellite workshops should be organized to discuss the technical questions

at meetings of the American Physical Society and Physics for Health in Europe.

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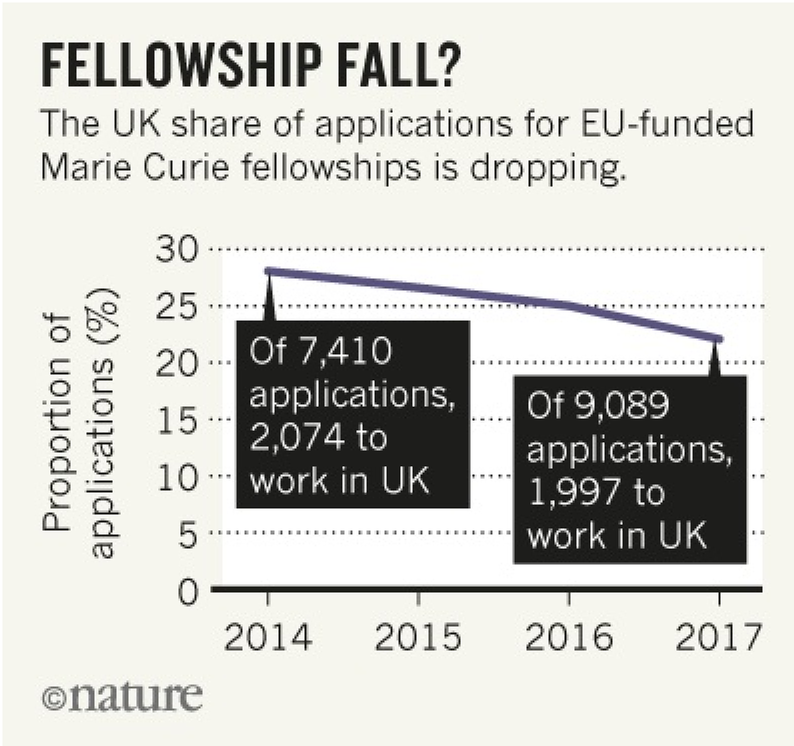
United Kingdom sees dip in European research applications after Brexit vote

But overall data don't show a big impact on UK's involvement with European science.

21 September 2017

The number of researchers applying for Europe-funded Marie Curie fellowships in the United Kingdom has dipped slightly since the country's vote to leave the European Union, data released to *Nature* show. But there is no evidence yet of a sharp collapse in interest, which some scientists had feared in the wake of the Brexit referendum.

Every year, the European Commission funds thousands of experienced researchers — most of them European — to undertake work in other EU countries, typically for one or two years, with individual fellowships usually worth between €150,000 (US$180,000) and €200,000. More than 9,000 academics have applied for the popular programme this year, in an application round that closed on 14 September. Of those, 1,997 people — around 22% of the total — requested to work in the United Kingdom. In 2016, the United Kingdom had received 2,211 applications, some 25% of the total that year; while in 2014, the UK share of applicants reached 28%.



Source: European Commission

Although the numbers hint at a decline in interest in working in Britain, they give no clear sign that the Brexit vote has immediately dented the United Kingdom's attractiveness to EU scientists. But "the slipping success rates show that British science is not impenetrable, so we must not be complacent", says Mike Galsworthy, co-founder of the advocacy group Scientists for EU. He says the results may suggest that other European countries are increasingly attractive to researchers.

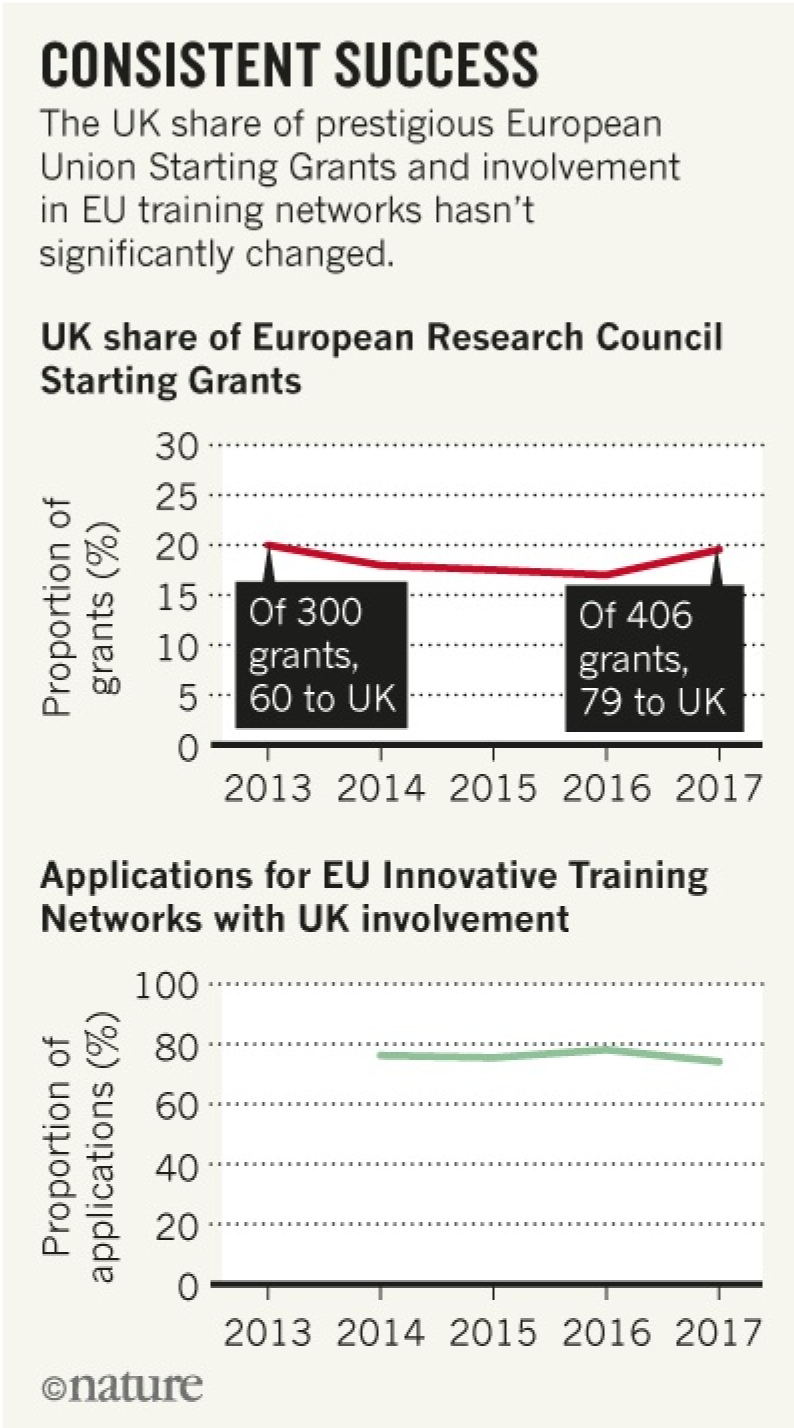
"It is unreasonable to expect an immediate effect from Brexit. The university and research system in the UK is massive, and it will take many years for the system to bleed out and gradually lose its competiveness," says Andre Geim, a physicist at the University of Manchester, UK, who won a Nobel prize for his work in graphene.

Geim told Bloomberg News last month that he hasn't received any applications under the Marie Curie scheme this year, unlike in previous years. But he is sponsoring two applicants who applied to work with his colleagues,

he clarifies to *Nature*. A spokesperson for the University of Manchester says that for the university as a whole, “Marie Curie application numbers have remained consistent over the past four years. This includes 2017, and we have several being processed in graphene at the moment.”

Strong starting grants

Other statistics on the United Kingdom’s involvement in Europe-funded grant schemes since the Brexit vote give a more optimistic picture — although it isn’t possible to conclude from any of the data whether changes in 2017 represent significant deviations from existing trends, notes statistician Michael Lavine at the University of Massachusetts Amherst.



Source: European Commission

For example, Britain has seen a negligible decline in its involvement in multinational European research collaborations called Innovative Training

Networks (ITNs) — which, similarly to the fellowships, are paid for under the Marie Skłodowska-Curie actions, a €6.2-billion slice of the European Commission's Horizon 2020 funding programme. In 2016, 78% of ITNs had at least one British partner; the 2017 awards — all of which were applied for after the Brexit vote — show a slight dip to 74%.

And Britain has achieved its usual success in winning European Research Council (ERC) 'starting grants', awards of up to €1.5 million over 5 years for highly promising early-career researchers to start their own laboratories anywhere they wish. The United Kingdom secured 19.5% of the 406 starting grants awarded in 2017, up from 17% in 2016; its success rates have fluctuated between 17% and 20% in the past four years.

UK nationals, relative to non-British Europeans, are making up an increasing proportion of the United Kingdom's starting-grant winners, however. This year, Britain is hosting 79 grantees under the scheme — more than any other EU country — and just under half (47%) are UK nationals. In 2014, UK nationals represented just over one-quarter of those with ERC starting grants in the United Kingdom.

Funding guarantee

Two months after the Brexit vote, the UK government announced that it would underwrite EU grants won before the date scheduled for the United Kingdom to leave the EU. This promise has reassured some European researchers that they can have a future in Britain even without EU membership, says evolutionary biologist Simone Immler, a Swiss national who moved her ERC starting grant to the University of East Anglia in Norwich, UK, despite the Brexit vote.

Immler says that what really matters to researchers is getting their dream post, and that they will continue to come to the United Kingdom as long as there is a chance of this happening. "The beauty of these grants is they allow people to choose a host institution that they would like to go to, and they are likely to be offered a permanent position there," she says. "But if these grants stopped, it would hurt."

Michael Browne, head of European Research and Innovation at University College London, says that the most important thing is to ensure that British researchers do not drop out of European projects as a result of the Brexit vote, even temporarily. He says that EU research consortiums are highly competitive, and if one partner leaves, another will quickly step in to plug the gap, which makes it hard to re-enter. “That’s why my main message to researchers would be to, despite the uncertainty, really try to stay plugged into European platforms and networks,” he says.

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Comments

Comments

There are currently no comments.

Fossilized poo reveals that vegetarian dinosaurs had a taste for crabs

Ancient crustaceans in dino dung from Utah illuminate herbivores’ broad diet.

21 September 2017

Cory Richards/NGC

Fossilized faeces from the Kaiparowits Formation in southern Utah yields clues to dinosaurs' diets.

Plant-eating dinosaurs usually found plenty to eat, but occasionally they went

looking for a nutritional boost. Fossilized dinosaur droppings from Utah now reveal that 75 million years ago, some of the animals were snacking on prehistoric crayfish or crabs.

The work suggests that big herbivorous dinosaurs sometimes munched on crustaceans, likely to get extra protein and calcium into their bodies before laying eggs, says Karen Chin, a palaeontologist at the University of Colorado Boulder. She and her colleagues report the discovery on 21 September in *Scientific Reports*[1].

“It’s a very unusual case of an herbivorous dinosaur supplementing its diet with something else,” says Paul Barrett, a palaeontologist at the Natural History Museum in London.

Direct evidence of dinosaur diets is hard to come by. Some fossil animals have been found with their gut contents intact, but fossilized dinosaur dung — the most convincing remains of what a dinosaur actually ate — is rare. “Think of a cow pat — these things get broken down in the environment very easily,” says Barrett. Most of the fossilized faeces, called coprolites, that researchers uncover come from meat-eating dinosaurs; these are better preserved than those of plant-eating dinosaurs thanks to minerals in the bones of the creatures that carnivores consumed.

Chin has long hunted for coprolites from herbivorous dinosaurs. In 2007, she reported[2] finding fossilized chunks of rotting wood inside coprolites, between about 80 million and 74 million years old, from the Two Medicine rock formation in Montana. Plant-eating dinosaurs may have chewed the wood in search of insects and other organisms scurrying inside rotting logs, she proposed.

Then, in 2013, she found many similar coprolites in the Kaiparowits Formation of Grand Staircase–Escalante National Monument in southern Utah. Along with rotting wood, they contained puzzling fragments of thin, convex structures. When Chin examined slices of the structures under a microscope, they looked very much like the outer covering of a crustacean’s leg or claw. She consulted Rodney Feldmann, a palaeontologist at Kent State University in Ohio, who confirmed that they probably came from a crayfish or crab.

Dietary supplement

At the time the Kaiparowits rocks formed, around 75 million years ago, the landscape was a wet, subtropical environment much like today's Texas coast. Chin thinks that local dinosaurs — probably the duck-billed group called hadrosaurs — went in search of dietary supplements near the shoreline. "You get so many invertebrates hanging out in rotting logs," she says. "There's bugs to eat, and rotting detritus — it's a really rich place." The fungi that helped to break down the logs would also have provided extra protein.

K. Chin et al./Sci. Rep. (CC BY 4.0)

Fossilized faeces (brown) from the collections of the Denver Museum of Nature and Science show crustacean fragments (black).

Some modern birds with mostly plant-based diets add insects and other sources of protein before they lay eggs, she notes. "You can't imagine a 20-

foot hadrosaur going after a butterfly," Chin says. "They would go for some place that had a predictable, concentrated source of food — some place like rotting logs."

The rotting wood probably wasn't a main source of dinosaur food year-round, says Jordan Mallon, a palaeontologist at the Canadian Museum of Nature in Ottawa. "Hadrosaurs were some of the biggest animals in their ecosystems, so they probably couldn't have afforded to be too selective about what they were eating anyway, lest they starve to death."

Mallon thinks the dinosaurs might have accidentally snaffled up a crayfish or two while feeding, as opposed to seeking the crustaceans out on purpose. Either way, he says, the latest findings "provide an excellent glimpse in the lives of these animals, 75 million years ago".

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Comments

Comments

There are currently no comments.

Jellyfish caught snoozing give clues to origin of sleep

The brainless marine creatures are the simplest organisms known to seek slumber.

21 September 2017

Norbert Wu/Minden/NGC

New research suggests that *Cassiopea* jellyfish eschew the night life, tucking into bed and going to sleep when the sun goes down.

The purpose and evolutionary origins of sleep are among the biggest mysteries in neuroscience. Every complex animal, from the humblest fruit fly to the largest blue whale, sleeps — yet scientists can't explain why any

organism would leave itself vulnerable to predators, and unable to eat or mate, for a large portion of the day. Now, researchers have demonstrated for the first time that even an organism without a brain — a kind of jellyfish — shows sleep-like behaviour, suggesting that the origins of sleep are more primitive than thought.

Researchers observed that the rate at which *Cassiopea* jellyfish pulsed their bell decreased by one-third at night, and the animals were much slower to respond to external stimuli such as food or movement during that time. When deprived of their night-time rest, the jellies were less active the next day.

“Everyone we talk to has an opinion about whether or not jellyfish sleep. It really forces them to grapple with the question of what sleep is,” says Ravi Nath, the paper’s first author and a molecular geneticist at the California Institute of Technology (Caltech) in Pasadena. The study was published on 21 September in *Current Biology*[1].

“This work provides compelling evidence for how early in evolution a sleep-like state evolved,” says Dion Dickman, a neuroscientist at the University of Southern California in Los Angeles.

Mindless sleep

Nath is studying sleep in the worm *Caenorhabditis elegans*, but whenever he presented his work at research conferences, other scientists scoffed at the idea that such a simple animal could sleep. The question got Nath thinking: how minimal can an animal’s nervous system get before the creature lacks the ability to sleep? Nath’s obsession soon infected his friends and fellow Caltech PhD students Michael Abrams and Claire Bedbrook. Abrams works on jellyfish, and he suggested that one of these creatures would be a suitable model organism, because jellies have neurons but no central nervous system. Instead, their neurons connect in a decentralized neural net.

Cassiopea jellyfish, in particular, caught the trio’s attention. Nicknamed the upside-down jellyfish because of its habit of sitting on the sea floor on its bell, with its tentacles waving upwards, *Cassiopea* rarely moves on its own.

This made it easier for the researchers to design an automated system that used video to track the activity of the pulsing bell. To provide evidence of sleep-like behaviour in *Cassiopea* (or any other organism), the researchers needed to show a rapidly reversible period of decreased activity, or quiescence, with decreased responsiveness to stimuli. The behaviour also had to be driven by a need to sleep that increased the longer the jellyfish was awake, so that a day of reduced sleep would be followed by increased rest.

Other researchers had already documented a nightly drop in activity in other species of jellyfish, but no jellyfish had been known to display the other aspects of sleep behaviour. In a 35-litre tank, Nath, Abrams and Bedbrook tracked the bell pulses of *Cassiopea* over six days and nights and found that the rate, which was an average of one pulse per second by day, dropped by almost one-third at night. They also documented night-time pulse-free periods of 10–15 seconds, which didn't occur during the day.

Restless night

Without an established jellyfish alarm clock, the scientists used a snack of brine shrimp and oyster roe to try to rouse the snoozing *Cassiopea*. When they dropped food in the tank at night, *Cassiopea* responded to its treat by returning to a daytime pattern of activity. The team used the jellyfish's preference for sitting on solid surfaces to test whether quiescent *Cassiopea* had a delayed response to external stimuli. They slowly lifted the jellyfish off the bottom of the tank using a screen, then pulled it out from under the animal, leaving the jelly floating in the water. It took longer for the creature to begin pulsing and to reorient itself when this happened at night than it did during the day. If the experiment was immediately repeated at night, the jellyfish responded as if it were daytime. Lastly, when the team forced *Cassiopea* to pull an all-nighter by keeping it awake with repeated pulses of water, they found a 17% drop in activity the following day.

"This work shows that sleep is much older than we thought. The simplicity of these organisms is a door opener to understand why sleep evolved and what it does," says Thomas Bosch, an evolutionary biologist at Kiel University in Germany. "Sleep can be traced back to these little metazoans — how much

further does it go?” he asks.

That’s what Nath, Abrams and Bedbrook want to find out. Amid the chaos of finishing their PhD theses, they have begun searching for ancient genes that might control sleep, in the hope that this might provide hints as to why sleep originally evolved.

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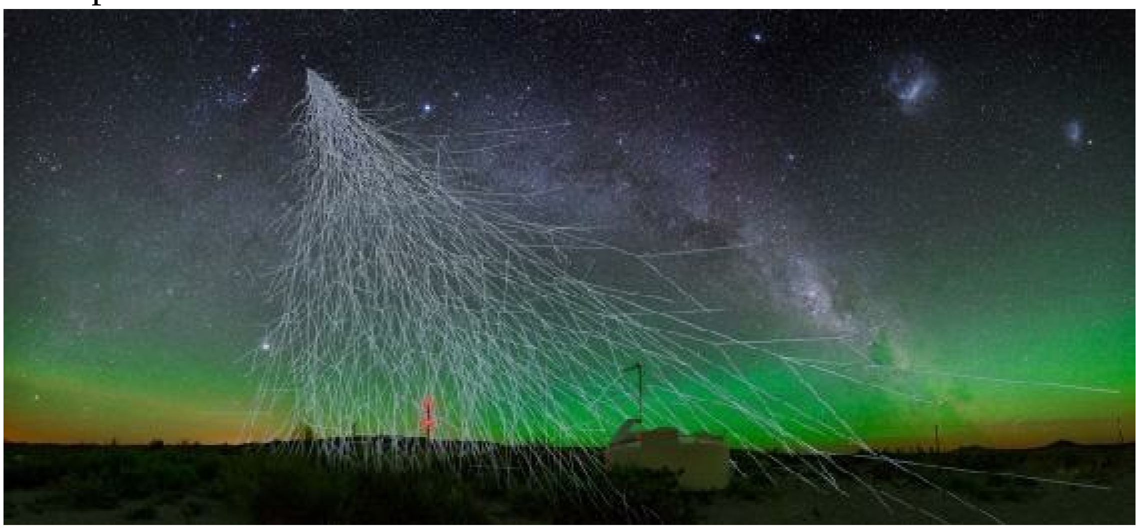
Comments

Commenting is currently unavailable.

High-energy cosmic rays come from outside our Galaxy

Giant observatory announces long-awaited result.

21 September 2017



A. Chantelauze/S. Staffi/L. Bret

The fallout from a high-energy cosmic ray can cover many square kilometres (artist's impression).

The Pierre Auger Observatory in Argentina finally has solid evidence that the most energetic particles in nature come from sources outside the Milky Way. Scientists have suspected this for decades, but weren't able to confirm it — until now.

"For the first time, we have proof that the highest-energy cosmic rays are of extragalactic origin," says Alan Watson, a UK astronomer and co-founder of the observatory. The result comes as a relief to the researchers, after previous claims regarding their origin made ten years ago by the Pierre Auger

Collaboration subsequently turned out to be premature.

The international team analysed 12 years' worth of data, and found that particles in the upper range of energies were more likely to come from a region of the sky outside the Milky Way's disk. That asymmetry is roughly consistent with the distribution of neighbouring galaxies, the researchers report in the 22 September issue of *Science*[1].

The study does not pinpoint individual sources of the cosmic rays, or explain how they reach their highest energies. But the researchers hope that it is a first step towards understanding their origins.

Invisible shower

Most cosmic rays are protons or other charged particles, including atomic nuclei as heavy as iron. When such a particle rains onto Earth's upper atmosphere and collides with an atomic nucleus in the air, it produces a shrapnel burst of subatomic particles. These hit other nuclei and produce more particles, generating an invisible 'shower' that is often spread over many square kilometres by the time it hits the ground.

To detect these showers, the Pierre Auger Observatory has 1,600 car-sized water tanks placed at 1.5 kilometre intervals, to cover 3,000 square kilometres of grassy plains in Argentina's Mendoza province. Four sets of telescopes monitor the sky over the array, and — on moonless nights — can detect flashes of ultraviolet light generated by the showers. From its location relatively close to the equator, the array can pick up cosmic rays coming from the entire southern sky as well as from much of the northern sky, covering 85% of the celestial sphere.

The Pierre Auger Observatory

Cosmic rays were detected using 1,600 water tanks placed at 1.5 kilometre intervals.

The observatory needs to be that big in order to catch enough of the most sought-after particles. Cosmic rays have been detected with energies beyond 10^{20} electronvolts (eV); by comparison, the Large Hadron Collider near Geneva, Switzerland, the world's most powerful particle accelerator, pushes protons to just 7×10^{12} eV. However, cosmic rays become increasingly rare the higher their energies. A particle in the 10^{20} eV range, on average, hits a square kilometre of Earth only once per century.

The researchers looked at 32,187 particles that had energies above 8×10^{18} eV, detected by the observatory from its beginning in 2004 until 2016. The Galaxy's magnetic field bends the paths of charged particles, which can randomize their direction by the time they hit Earth. But these particles were still 6% more likely than average to come from a particular region of the sky, which is outside the Milky Way’s disk.

Surprise skew

Most researchers expected a skew, but not such a strong one, says Piera Ghia, an astroparticle physicist at the CNRS Institute of Nuclear Physics in Orsay, France, who helped to coordinate the data analysis. Astrophysicist Francis Halzen of the University of Wisconsin–Madison agrees. “It’s really very big. To me, it was a surprise,” says Halzen, who is spokesperson for IceCube, a major neutrino observatory at the South Pole.

When magnetic deflection is taken into account, the asymmetry seen by the Pierre Auger Observatory is consistent with the distribution of galaxies lying within 90 megaparsecs (around 300 million light years) or so from the Milky Way, says Silvia Mollerach, an Auger astrophysicist at the Balseiro Institute in San Carlos de Bariloche, Argentina.

The results strongly disfavour the supermassive black hole at the centre of the Milky Way as a major source of the higher-energy particles. “The most likely sources continue to be the usual suspects,” Mollerach says: astrophysical phenomena that generate extremely intense magnetic fields, inside which charged particles can pinball around and gain energy. These include active galactic nuclei — supermassive black holes spewing jets of matter at near-light speed — and the stellar explosions called γ-ray bursts.

The latest claim is quite conservative compared to one that the collaboration made in 2007. Back then, it found a correlation between 27 extremely high-energy cosmic rays (above 57×10^{18} eV) it had seen up until that point and a set of known active galactic nuclei[2]. The paper caused a sensation, but the statistical significance of the result was weak and soon melted away as the array collected more data. “In retrospect, it was a mistake that we published too early,” says Auger spokesperson Karl-Heinz Kampert, a physicist at the University of Wuppertal in Germany.

This time, the team took no chances: it accumulated much more data and is confident that the results are solid, Kampert says. Halzen agrees. “I don't think there is any doubt about the statistical significance” of the latest results, he says.

Now that the researchers have more data, they will again try to find correlations with potential sources. The results of that study should appear within a few months. The collaboration also plans to join forces with a smaller observatory in Utah, the Telescope Array, to try to map the origins of cosmic rays across the entire sky.

The Pierre Auger Observatory is also in the initial stages of a US$12-million upgrade that should enable it to better measure the relative abundance of protons and heavier nuclei in the flux of cosmic rays.

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Comments

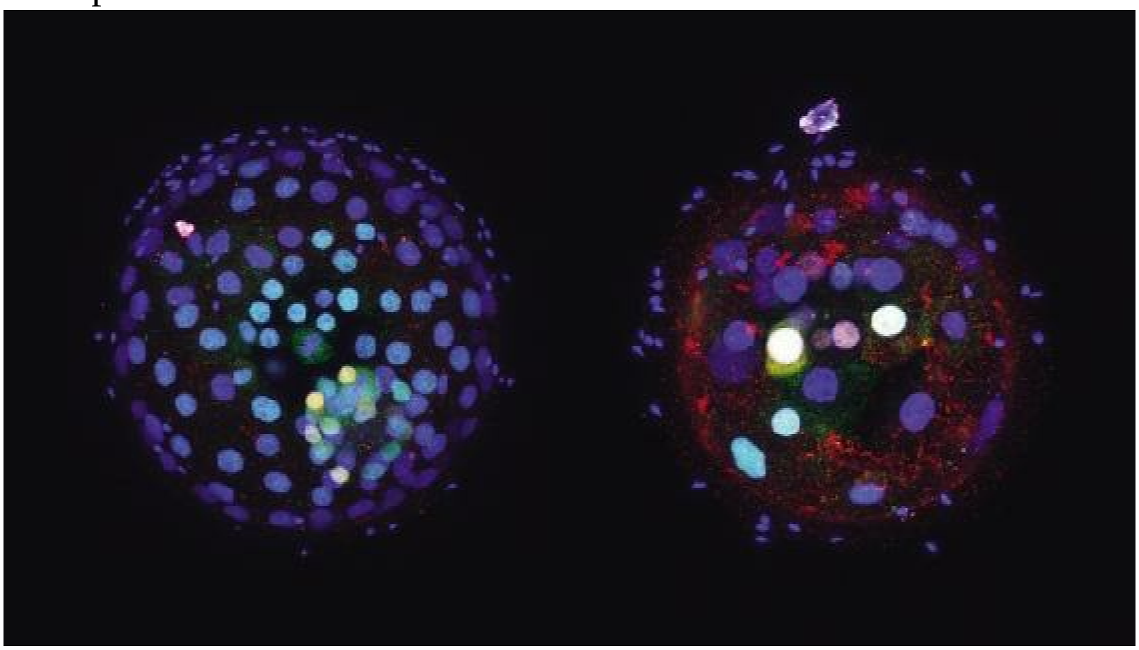
Comments

There are currently no comments.

CRISPR used to peer into human embryos' first days

Gene-edited embryos enable researchers to unpick role of a crucial gene, with more studies likely to follow.

20 September 2017



Niakan et al. DOI 10.1038/nature24033.

CRISPR was used to disrupt a protein important in human embryo development.

Gene-edited human embryos have offered a glimpse into the earliest stages of development, while hinting at the role of a pivotal protein that guides embryo growth.

The first-of-its-kind study stands in contrast to previous research that attempted to fix disease-causing mutations in human embryos, in the hope of eventually preventing genetic disorders. Whereas those studies raised concerns over potential 'designer babies', the latest paper describes basic research that aims to understand human embryo development and causes of miscarriage.

Published online today in *Nature*[1], the study relied on CRISPR–Cas9, a gene-editing system that can make precise changes to DNA in the genome. In this case, researchers harnessed CRISPR–Cas9 to disrupt the production of a protein called OCT4 that is important for embryo development.

Researchers have traditionally done such studies in mouse embryos, which are more plentiful and carry fewer ethical considerations than human embryos. But the latest study highlights key differences between the role of OCT4 in human and in mouse embryos, underscoring the limitations of relying on animal models, says stem-cell scientist Dieter Egli of Columbia University in New York City.

"If we are to truly understand human embryonic development and improve human health, we need to work directly on human embryos," he says. "We cannot rely only on inference from model organisms."

Regulated research

To perform the study, a team led by developmental biologist Kathy Niakan of the Francis Crick Institute in London used a total of 58 embryos that had been generated in fertility clinics as a result of *in vitro* fertilization (IVF) treatments. The embryos were no longer needed for IVF and had been donated for research. The UK Human Fertilisation and Embryology Authority granted permission to do the study — the first time a national regulator has approved research involving gene editing in human embryos (previous studies in other countries were endorsed by local review boards).

The team injected the molecular machinery needed for CRISPR–Cas9 gene editing when the fertilized eggs, or zygotes, consisted of just one cell and then followed their development in the lab for a week.

It soon became clear that normal development had derailed in embryos that lacked normal levels of OCT4. About half of the controls (which had unaltered, normal OCT4 levels) developed to form multicellular embryos called blastocysts. Of the edited embryos with disrupted OCT4 levels, only 19% made it that far.

The results will reassure scientists that CRISPR–Cas9 is efficient enough for studies in human embryos, says Fredrik Lanner, a developmental biologist at the Karolinska Institute in Stockholm. “If you do this in mice, you can test hundreds of embryos,” he says. “But you have a limited access to human embryos.”

Lanner, whose lab is conducting studies with CRISPR of other genes that are crucial for embryo development, points to the importance of painstakingly optimizing the experimental conditions in mouse embryos before moving the studies to human embryos, as Niakan’s team had done.

Striking differences

But additional studies in human embryos will still be needed to pinpoint what OCT4 is doing. The differences between mouse and human embryos were striking, says Amy Ralston, a developmental biologist at Michigan State University in East Lansing who has studied the protein in mice. Niakan's team found that human embryos stopped growing earlier than mouse embryos lacking the protein and showed different patterns of gene expression. There were also unexpected abnormalities in the cells that give rise to the placenta.

The latter finding is particularly important, Niakan says, because researchers have poor models for studying placenta development — and for understanding how the process can go awry. The research could also eventually yield ways to boost the success rate of IVF and help explain why some pregnancies fail, she says.

“It’s an exciting first step,” says Ralston. “This paper opens up a new era of human functional genetics.”

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Comments

Commenting is currently unavailable.

| 章节菜单 | 主菜单 |

Sexual competition among ducks wreaks havoc on penis size

When forced to compete for mates, some birds develop longer penises and others almost nothing at all.

20 September 2017

Gerrit Vyn/NPL

Male ruddy ducks regenerate their penises each year.

Male ducks respond to sexual competition by growing either an extra-long penis or a nub of flesh, a new study finds. The unusual phenomena occurred in two species studied: the lesser scaup (*Aythya affinis*) and the ruddy duck (*Oxyura jamaicensis*). It suggests that penis size — in line with many traits and behaviours meant to impress or allow impregnation of the opposite sex — involves a trade-off between the potential to reproduce and to survive.

Patricia Brennan, an evolutionary biologist at Mount Holyoke College in South Hadley, Massachusetts, compared the penises of ducks kept in male–female pairs to those housed with multiple males per female. The findings are published in a study on 20 September in *The Auk: Ornithological Advances*[1].

“If they were alone with a female, the males just grew a normal-sized penis, but if there were other males around, they had the ability to change dramatically,” Brennan says. “So evolution must be acting on the ability to be plastic — the ability to invest only in what is needed in your current circumstance.”

Because evolutionary success relies on reproduction, genitals are adapted to meet the varied circumstances that every animal faces. Some male ducks, for example, have penises in the shape of corkscrews to navigate the labyrinth-like vaginas of their female counterparts. An earlier study by Brennan found that females’ anatomy evolved to prevent access to undesirable males who force copulation[2]. To mate successfully with their chosen partners, Brennan says, female ducks assume a posture that allows males to enter them fully and deposit sperm near eggs.

Close competition

However, evolutionary changes in the size of body parts are generally thought to happen over generations, not within an individual’s lifetime. Brennan wondered whether ducks might buck this trend because some species’ penises emerge anew every breeding season and degenerate afterwards. Similarly, acorn barnacles (*Semibalanus balanoides*) — hermaphroditic, shelled sea creatures cemented to rocks — generate their penises only when it's time to mate. Because they use their penises to grope for other barnacles to inseminate, the organ’s length depends on the proximity of a barnacle’s neighbours.

Brennan and her colleagues fenced off habitats so that ducks would live either in pairs or in groups with almost twice as many males as females for two breeding seasons over the course of two years. The lesser scaups grew longer penises when they were forced to compete for females than when they were coupled up. A larger reproductive organ likely improves their chances of fertilizing an egg.

But the results of the social environment on ruddy ducks were more complicated. During the first year, only the largest males in the groups grew long penises (about 18 centimetres each), whereas smaller males developed half-centimetre stubs. In the second year, smaller males grew normal-sized penises, but they lasted for just five weeks, whereas the largest males kept their penises for three months.

Stressed-out species

Clues may lie in the drama of ruddy-duck life. The birds have some of the largest penis-to-body ratios found in nature — with penises sometimes longer than their bodies. “I can’t imagine they could grow any longer,” Brennan says. The birds have also been known to fight to the death, which suggests that smaller ruddy ducks might be too stressed to develop penises normally. “Bullying may increase stress hormones, and those could counteract the effects of androgen hormones” that control penis growth, Brennan says.

This response to stress could be adaptive. The same androgen hormones that trigger penis growth every season in birds also underlie colouration. They cause the duck’s feathers to turn from dull brown to chestnut when it’s time to breed, and their bills to go from grey to bright blue. To females, the wardrobe change signals a male’s readiness. To neighbouring males, it foreshadows a fight. “I think the small ones go through it quickly so that there’s less danger of getting beaten up,” Brennan says.

The study is “really interesting”, says Charlie Cornwallis, an evolutionary biologist at Lund University in Sweden. “This suggests there is a cost to having a large penis because individuals are investing according to the competition they face from other males.” Cornwallis says that few studies have investigated the effect of environmental and social conditions on penis size, and that these evolutionary trade-offs could be more common than imagined.

Families who picnic at the Livingston Ripley Waterfowl Conservancy in Litchfield, Connecticut, where the study was conducted, overlook the birds' bargains as well. “People watch the ducks on the weekends, but they have no idea what's really going on,” Brennan says. “I now have a love–hate relationship with ducks.”

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Comments

Comments

There are currently no comments.

Pair of deadly Mexico quakes puzzles scientists

Latest big tremor could be linked to major earthquake earlier this month.

20 September 2017

ALFREDO ESTRELLA/AFP/GETTY

The tremor that struck central Mexico on 19 September levelled buildings in Mexico City.

A magnitude-7.1 earthquake struck central Mexico on 19 September, killing more than 200 people and reducing buildings to rubble in the states of Puebla, Morelos and Guerrero, as well as in Mexico City. The event came 12 days after a magnitude-8.1 tremor hit off the state of Chiapas — Mexico's largest quake in more than a century — and 32 years to the day after the country's most damaging tremor, an 8.0, killed thousands.

Like the recent Chiapas quake, the 19 September tremor struck in the middle of the Cocos geological plate — rather than along its edge, where it begins its plunge beneath the North American plate. Mexico's national seismological service placed the epicentre of the quake at a depth of 57 kilometres, near the border of the states of Puebla and Morelos and about 120 kilometres from Mexico City. The earthquake occurred on a 'normal' fault, in which one part of Earth's crust moves higher than land on the other side.

Whether the 7 September and 19 September quakes are linked — and if so, how — remains to be seen. They are too far apart (about 650 kilometres) for the second one to be considered an aftershock of the first.

Searching for clues

Big earthquakes can increase the long-term risk of seismic activity nearby by transferring stress within Earth's crust to adjacent geological faults. But that sort of 'static stress' transfer usually happens only within a radius equal to about three to four times the length of the original fault's rupture, says Gavin Hayes, a seismologist at the US Geological Survey in Golden, Colorado.

The 7 September earthquake ruptured about 100 kilometres of the crust, which would imply its stress transfer reached no more than about 300 to 400 kilometres away, Hayes says. That puts the 19 September quake, whose epicentre was 650 kilometres away, outside the zone of influence. "But the time coincidence makes it pretty suspicious," Hayes says. "A lot of people will think that they are related, and there's going to be a lot of work on that."

Another possibility is that the 19 September quake is an example of 'dynamic triggering', in which seismic waves rippling outward from one quake affect faults much more quickly — and at much larger distances — than in static stress transfer. But dynamic triggering usually happens within hours or days of the initial quake, making the 12-day gap between the 7 September event and the latest big tremor hard to explain, says Eric Fielding, a geophysicist at

NASA's Jet Propulsion Laboratory in Pasadena, California, who studies dynamic triggering.

Shifting ground

His team has been analysing satellite radar images of the landscape around the 7 September quake, looking for changes in ground level that indicate which parts of the landscape have uplifted and which have dropped down as a result of that event. The data come from Europe’s Sentinel radar satellites and Japan’s ALOS-2 satellite. Fielding's team will be looking for similar information in the coming days from the 19 September quake. Radar images can help to reveal where geological stress is transferred within the ground after an earthquake.

The Cocos plate begins its dive downward off the western coast of Mexico, and then flattens out for hundreds of kilometres before taking a second, steeper dive and plunging below the North American plate. The 19 September quake happened where this second bend occurs, thanks to the geological stresses that have built up where the weight of the steeply descending plate tugs on the flat section.

Much of the worry about Mexico's seismic danger has focused off the western coast, where the slab begins its dive. There, on the plate boundary itself, is where the deadly earthquake struck in 1985, flattening buildings — particularly in Mexico City, which is built atop a shaky foundation of dried-up lake sediments. That disaster prompted Mexico to build an earthquake early-warning system, which on 19 September provided crucial seconds of warning for people to prepare for the shaking.

Many ‘seismic gaps’ remain off Mexico's west coast, where geological stress built up by the diving plate has yet to be released by an earthquake. They include the Guerrero gap, near Acapulco, considered by many scientists to be a major threat.

The death toll from the 19 September quake is expected to rise.

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doi:10.1038/nature.2017.22650

Comments

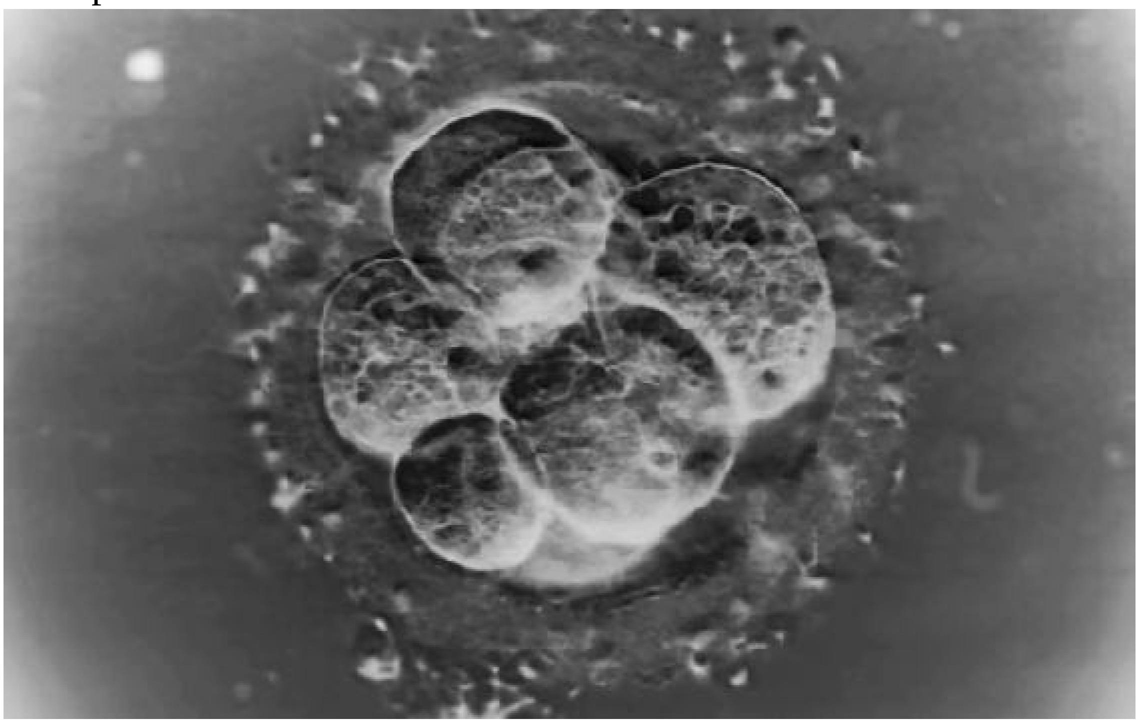
Comments

There are currently no comments.

Take stock of research ethics in human genome editing

Progress in the use of CRISPR–Cas9 for human germline editing highlights some pressing ethical considerations for research on embryos.

20 September 2017



Zephyr/SPL

Gene editing of human embryos raises pressing ethical considerations.

This week, *Nature* publishes the results of experiments that used genome editing to modify the DNA of a human embryo. Kathy Niakan at the Francis Crick Institute in London and her colleagues have used the CRISPR–Cas9 technique to introduce mutations into a gene called *OCT4*, and show how the gene is required to steer cell fate as a fertilized egg starts to divide and proliferate (N. M. E. Fogarty *et al. Nature* http://dx.doi.org/10.1038/nature24033; 2017).

The research addresses a fundamental question of human biology, but understanding the events of early development could also help to refine culture conditions for embryos in future *in vitro* fertilization (IVF) treatments. It also provides crucial information about the mechanism that underpins the gene-editing technique. The embryos, which had been donated by couples who had undergone IVF treatment, were allowed to develop in the laboratory for only a few days.

Nature published a related paper last month, which explored how gene editing of embryos using CRISPR–Cas9 could correct a specific genetic mutation (H. Ma *et al. Nature* **548,** 413–419; 2017). Those experiments, by Shoukhrat Mitalipov at Oregon Health and Science University in Portland and his colleagues, did not use embryos from IVF clinics. Instead, the researchers made them in the lab by fertilizing donated eggs with sperm from a male donor who carries the mutated gene.

The publication of these studies seems a good time for all involved to take stock and discuss how they should navigate this type of research.

Ethical consensus

The development of CRISPR–Cas9 as an efficient genome-editing tool is under scrutiny because it brings with it the possibility that scientists could make permanent modifications to the human germ line. Specialist groups have charted these ethical challenges and made some recommendations about how best to take forward research that applies gene editing to human embryos. Consensus guidelines — such as those based on the efforts of an interdisciplinary ethics consortium called the Hinxton Group, as well as separate efforts by the US National Academies of Science, Engineering, and Medicine, the International Society for Stem Cell Research and others — have advised that editing the human germ line can be justified for the scientific purpose of research into fundamental biology.

But they also say that substantial basic research is needed to check the safety, accuracy and feasibility of genome editing as a potential clinical tool. Therefore, clinical applications can be considered only after strong research groundwork has been done, and only then for cases that are deemed acceptable after careful examination of alternatives and further societal debate.

Both research studies published in *Nature* aim to answer some fundamental scientific questions. And, in keeping with consensus guidelines, both studies have undergone strict and thorough ethical assessment during their inception, execution and peer review (as outlined in our policy). Both studies were licensed by the relevant authorities, and had full ethical approval and consent from the couples who donated the embryos, eggs and sperm.

These studies are valuable on several counts. They provide important insights into the biology of human embryos, and the possible mechanisms of genome editing in this context. They also highlight technical and ethical issues that inform researchers, funders, journals and regulators as they plan and assess future projects in this field.

In particular, they show the importance of properly assessing the suitability of the type and number of embryos needed for research projects that explore different aspects of human germline editing.

Using donated surplus embryos from IVF might be a better way to answer some research questions than using embryos fertilized in the lab. The inherent variability of donated embryos could offer a more rigorous and realistic testing ground for checking issues such as the rate of unintended 'off-target' genetic changes, which can occur when using CRISPR–Cas9 editing. But, for the time being, targeted correction of specific mutations will probably continue to rely on donated eggs and sperm that carry the mutated DNA and which are then used to make a fertilized egg in the research laboratory.

In both cases, *Nature* fully supports the principle that all donors should be informed of the details of the exact research to be carried out with their donated material — as described in the methods section of both papers.

In keeping with the sensitive nature of a donation, researchers must show that they have balanced scientific and ethical considerations to determine the appropriate number of embryos used. They must ensure that experiments will provide robust scientific answers, while minimizing the use of this precious material. This may imply, as was the case in both the published studies, that researchers must first perform the intended work in human pluripotent stem cells or mouse embryos to optimize the conditions. Journals, reviewers and editors should consider which questions arising during peer review can be answered using systems other than human embryos.

One point for the research community to consider is whether these initial studies might be peer reviewed and considered for publication before the hypothesis is tested in embryos. This independent peer review could happen in parallel with consideration of the project by the regulators, and could inform decisions on embryo provenance and the limits of experiments.

The particular requirements of studies will differ, but a strong framework for assessing them as early as possible seems the best way to ensure that they meet the highest standards. Regulators, funders, scientists and editors need to continue working together to define the details of the path forward for germline genome editing, so that the valuable resources and tools now at our disposal are used with good judgement.

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Snow leopards, ancient zero and Cassini’s big finish

The week in science: 15–21 September 2017.

20 September 2017

Conservation | Politics | Events | Research | Funding | Trend watch

CONSERVATION

Snow leopard moves off endangered list Snow leopards are no longer officially endangered, according to the latest International Union for Conservation of Nature (IUCN) Red List, which now puts them in the less-threatened ‘vulnerable’ category. But populations of the leopard (*Panthera uncia)* are still declining, the IUCN warns, and the risk of extinction is still high. The list, updated on 14 September, outlines the risks to 87,967 species. In other changes, five of the six most prominent species of ash tree in North America have been classified as critically endangered because of the threat posed by an invasive beetle, and the Christmas Island pipistrelle bat (*Pipistrellus murrayi*) is officially extinct.

Vincent J. Musi/NGC

POLITICS

Gender bias The UK Parliament's influential House of Commons science and technology select committee came under fire after announcing eight members on 12 September, all of whom are men. Norman Lamb, the new head of the cross-party body (which does not select its membership), added his voice to complaints about the lack of women. The Conservatives have since put forward two further members, one of whom, Vicky Ford, is a woman. That leaves one unfilled Labour Party position on the committee, which is tasked with holding the government to account on scientific topics.

India–Japan talks Japan and India have agreed to cooperate on a range of science and technology activities, including an exchange programme between the mathematical and life sciences to foster talented theoretical biologists. The agreements were part of the 12th India–Japan Annual Summit, held on 13–14 September in Ahmedabad and Gandhinagar, India, which included discussions about disaster risk management, infrastructure and development. India’s Department of Biotechnology and Japan’s National Institute of Advanced Industrial Science and Technology also re-signed a five-year memorandum of understanding to promote research collaborations in the life sciences and biotechnology.

Dual-use research Experiments involving dangerous biological agents that could be misused to cause harm, such as some viruses and bacteria, are poorly regulated in the United States, according to a 14 September report by the US National Academies of Sciences, Engineering, and Medicine. The US government requires special oversight of experiments on only 15 biological agents and toxins, and does not sufficiently address potential threats posed by synthetic-biology experiments, the report concludes. The analysis also finds that most researchers do not know how to identify and mitigate biosecurity risks associated with such experiments, and that there is no established procedure for seeking advice from federal agencies. The report calls for international engagement on the topic, and for better training to help scientists recognize and address any biosecurity risks that their research presents.

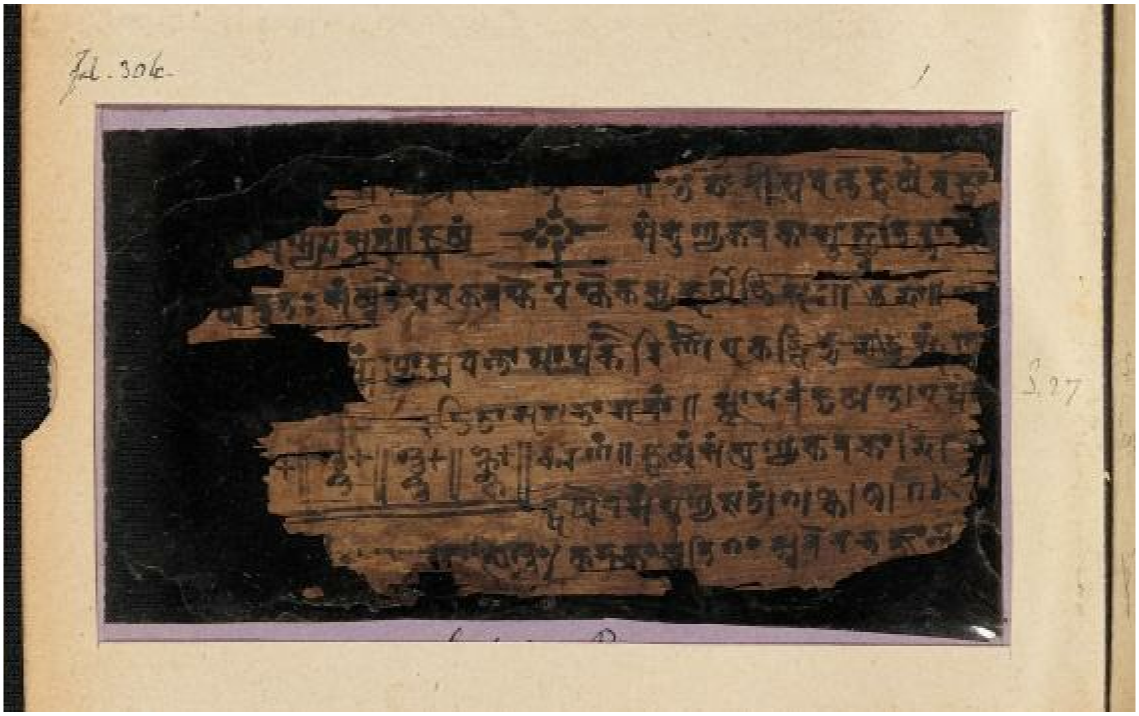
EVENTS

Nuclear letter Eighty-five nonproliferation experts signed a letter on 13 September urging US President Donald Trump to reaffirm support for an international deal, signed in July 2015, that limits Iran’s nuclear programme. The International Atomic Energy Agency has verified Iran’s compliance with the deal, which called for the country to limit uranium enrichment and stop producing plutonium in exchange for a partial lift of international sanctions. But observers have become alarmed by statements in which Trump suggested that he might not recertify Iran’s compliance to the US Congress in mid-October — something that he needs to do every 90 days to prevent US sanctions from snapping back into place.

Media policy A document leaked anonymously from the US Centers for Disease Control and Prevention (CDC) suggests that the agency is becoming more tight-lipped than in the past. On 12 September, the news website Axios reported that the e-mail notice, dated 31 August, instructs all CDC employees not to speak to reporters “even for a simple data-related question”. Several health journalists pushed back, calling the move a “gag order”. According to an updated CDC media-policy document sent to *Nature* by Shelly Diaz, senior press officer at the agency, employees must coordinate with the public-affairs office when they are approached by reporters.

RESEARCH

Ancient zero Indian mathematics was already using a symbol for zero in the third century ad, some 500 years earlier than previously thought, the Bodleian Libraries of the University of Oxford, UK, announced on 14 September. The claim follows new carbon dating of the birch-bark leaves of the Bodleian’s Bakhshali manuscript, discovered in 1881 in what is now Pakistan. The manuscript uses a dot, not yet as a number in its own right, but as a ‘placeholder’ to denote numbers such as 10 or 100. The Babylonians and Mayans had done this long before, but the Bakhshali symbol is the forerunner of the zero we recognize today: the first recorded use of zero by itself is by an Indian mathematician in the seventh century. Part of the Bakhshali manuscript will be displayed in an exhibition on Indian science and innovation that opens on 4 October at the Science Museum in London.



Bodleian Libraries/Univ. Oxford

Cassini grand finale On 15 September, the Cassini spacecraft plunged into Saturn's atmosphere in a planned move to end the probe's 13-year study of the planet and its moons. Engineers steered the craft, which was low on fuel, towards its fiery death to keep Cassini from contaminating the gas giant's moons, including Titan and Enceladus, which could harbour signs of life. The spacecraft hurtled towards its end at about 113,000 kilometres per hour, entering Saturn's atmosphere roughly 10 degrees north of the planet's equator. Cassini's final images, transmitted in the hours before its death, included shots of Enceladus setting behind Saturn, as well as a final close-up of some of the planet's rings.

Gravity satellites A battery failure caused one of the twin Gravity Recovery and Climate Experiment (GRACE) satellites to lose contact with Earth for four days starting on 4 September, NASA announced on 14 September. Operators recovered the link but are now planning for the mission to end no later than November, when the satellite will move out of full sunlight and lose all battery power. GRACE, a joint project between NASA and the German aerospace agency DLR, has been in orbit since 2002, and was meant to last for only five years. It has made fundamental hydrological measurements, such as tracking the melting of Greenland's ice sheet and the depletion of groundwater around the world. A follow-on mission is planned for launch in early 2018.

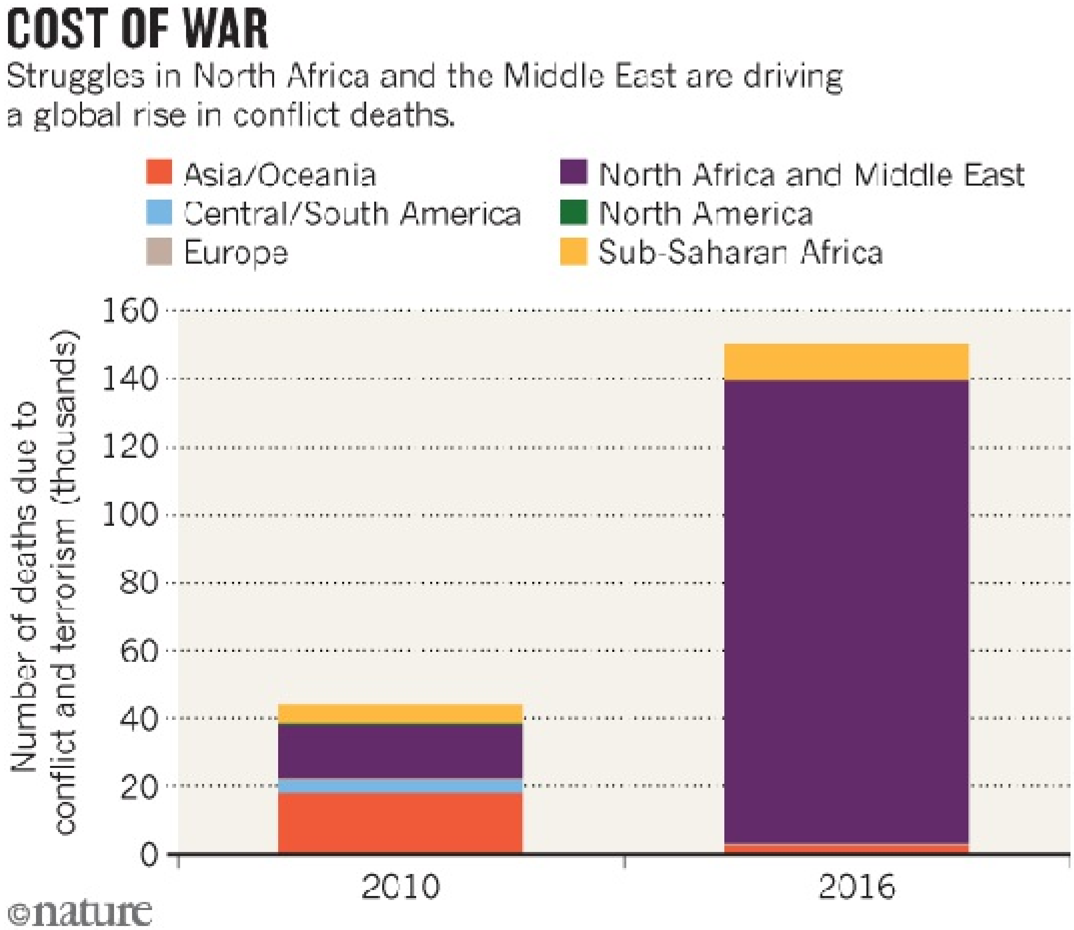
Polar station The Canadian High Arctic Research Station in Cambridge Bay will officially open its doors in October. Planning and construction of the station, which is meant to fill a gap in the region's research infrastructure, took ten years. The Can$200-million (US$164-million) facility will be the headquarters of the country's major polar-science research agency, Polar Knowledge Canada. It will support Arctic-focused research endeavours related to renewable energy, environmental science, sea-ice changes and improving local infrastructure. The station includes necropsy and genomics labs, as well as teaching spaces and public spaces for community outreach.

FUNDING

Job cuts Australia's national science agency plans to cut up to 57 research positions from its digital-innovation and minerals-research groups. On 13 September, an e-mail sent to staff at the Commonwealth Scientific and Industrial Research Organisation (CSIRO) said that the cuts were necessary to shift these groups' "science capability in line with market demands". The agency, which also plans to recruit up to 25 new staff members, aims to generate 45% of its revenue from non-government sources by 2019. The lay-offs follow substantial job cuts at the agency in the past 5 years, including about 275 staff positions axed in 2016.

TREND WATCH

Deaths from conflict and terrorism have jumped since 2010, says a 14 September report. The global total was around 150,000 in 2016, driven mainly by conflicts in North Africa and the Middle East. Overall, non-communicable diseases accounted for 72.3% of deaths in 2016, with ischaemic heart disease, diabetes and mental-health and substance-use disorders all rising worldwide. But deaths from infectious diseases have decreased, and deaths among children under 5 years old fell below 5 million for the first time.



Source: GBD 2016 Causes of Death Collaborators Lancet 390, 1151–1210 (2017)

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Comments

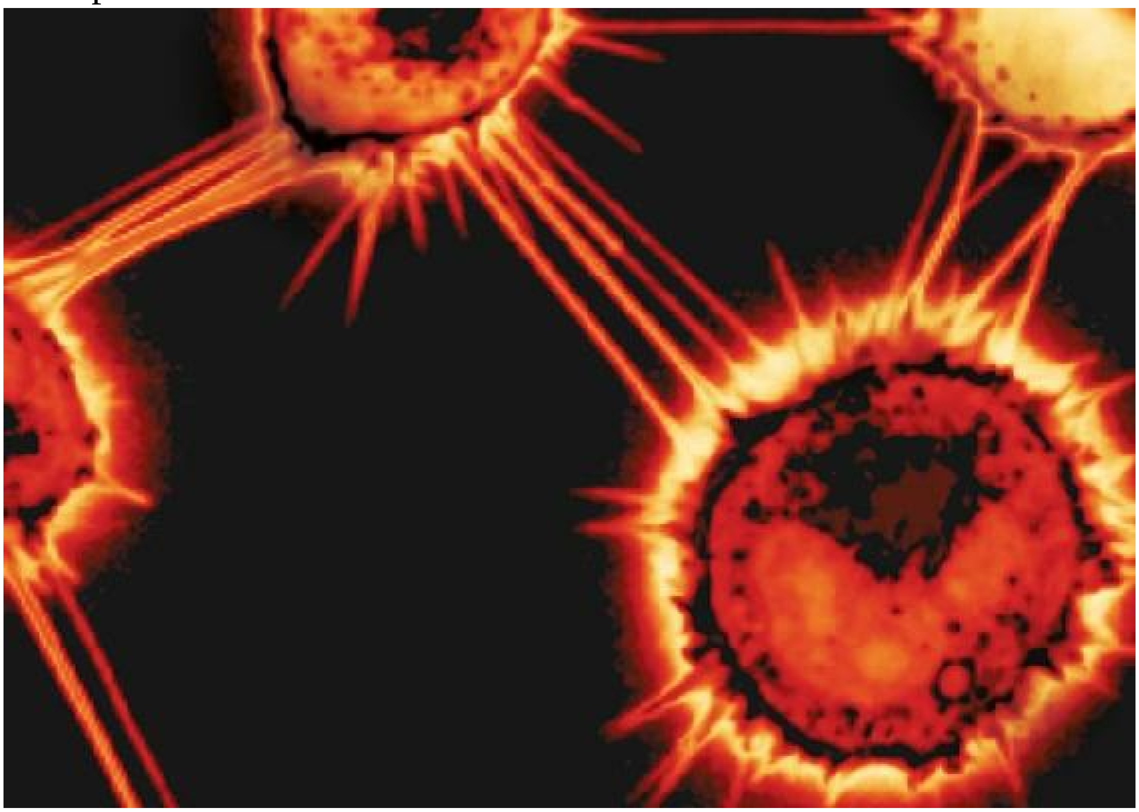
Comments

There are currently no comments.

How the Internet of cells has biologists buzzing

Networks of nanotubes may allow cells to share everything from infections and cancer to dementia-linked proteins.

20 September 2017



Karine Gousset/Chiara Zurzolo/Pasteur Institute

Prions spread between mouse cells through tunnelling nanotubes.

Yukiko Yamashita thought she knew the fruit-fly testis inside out. But when she carried out a set of experiments on the organ five years ago, it ended up leaving her flummoxed.

Her group had been studying how fruit flies maintain their sperm supply and had engineered certain cells involved in the process to produce specific sets of proteins. But instead of showing up in the engineered cells, some proteins seemed to have teleported to a different group of cells entirely.

Yamashita, a developmental biologist at the University of Michigan in Ann Arbor, and the postdoctoral researcher with whom she was working, Mayu Inaba, called the phenomenon “mysterious trafficking”. They were convinced it was real — but they couldn't understand how it worked. So they shelved the project until one day, more than a year later, Inaba presented Yamashita with some images of tiny tubes reaching out from one cell to another — delicate structures that might have been responsible for the trafficking. Yamashita was sceptical, but decided to dig out images from her own postdoc project 12 years earlier. Sure enough, slender spikes jutted out towards the targeted cells. “It was really eye-opening,” Yamashita says. The group published its work in 2015, arguing that the tubes help testis cells to communicate precisely, sending a message to some of their neighbours and not others[1]. “We thought the protein was trafficked,” Yamashita says, “but we didn't think there was an actual track.”

Yamashita's tubes joined a growing catalogue of cryptic conduits between cells. Longer tubes, reported in mammalian cells, seem to transport not just molecular signals but much larger cargo, such as viral particles, prions or even mitochondria, the cell's energy-generating structures. These observations suggest an unanticipated level of connectivity between cells, says Amin Rustom, a neurobiologist at the University of Heidelberg in Germany, who first spotted such tubes as a graduate student almost 20 years ago. If correct, he says, “it would change everything in medical applications and biology, because it would change how we see tissues”.

But Richard Cheney, a cell biologist at the University of North Carolina in Chapel Hill, is not ready to start revising the textbooks. Cheney has followed the field and at one point collaborated with Rustom's PhD adviser. There's no question that long, thin protrusions are popping up all over the place, he says. The question is, what are they doing — sending simple messages when cells reach out and touch each other, or opening a breach and facilitating wholesale transport? “I'd probably bet on contact-based signalling, where you don't need very many copies of a molecule, as opposed to them acting like interstate highways," he says.

The problem with betting either way is that these tiny tubes are tough to study. Arguing that they exist at all is hard enough, let alone making the case that they actually have a function. Yamashita used the tried-and-tested genetic- engineering methods and well-characterized genes available in the fruit fly to argue that her tubes were sending signals by direct contact. But researchers looking for tubes in mammalian cells don't have those resources. More than one researcher has been accused of mistaking a scratch on a cell plate for a cell-produced nanotube. Evidence derived from real mammalian tissue is even sparser.

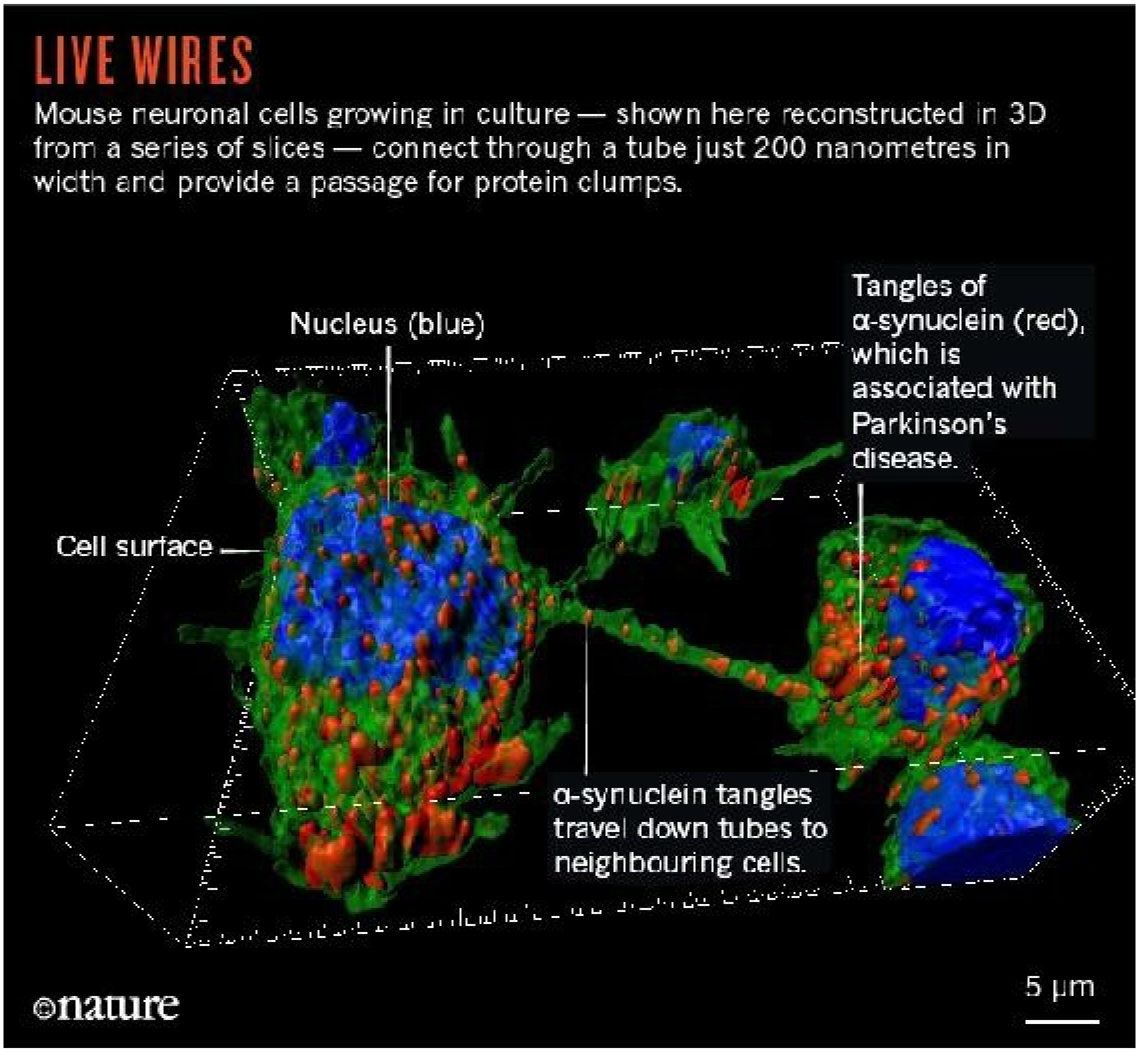
LISTEN

Adam Levy takes a closer look at the tiny tubes spotted between cells.

You may need a more recent browser or to install the latest version of the Adobe Flash Plugin.

Nonetheless, there has been a recent rash of interest in the tubes. One of the believers is George Okafo, a director of emerging platforms at the drug company GlaxoSmithKline (GSK) in Stevenage, UK. He thinks that cell-to-cell protrusions could explain why diseases such as Alzheimer's disease, Parkinson's disease and malaria, as well as HIV and prion infections, are so difficult to treat (see 'Live wires'). "There's a characteristic that isn't targeted by a lot of conventional therapies, and that's how a disease spreads from cell to cell."

Last September, Okafo organized an invitation-only conference to bring together GSK staff and around 40 researchers in the field. (He is now collaborating with some of them.) In March this year, the US National Institutes of Health asked for grant applications from groups studying how organelles communicate in stressed or cancerous cells, a move that excites tube enthusiasts. And in December, the American Society for Cell Biology will host a session devoted to the topic at its annual meeting.



Chiara Zurzolo/Pasteur Institute

Long pipeline

Scientists know that some cells build wire-like extensions as a kind of temporary foothold to move themselves from place to place. The first important hint that they might be involved in something more complex came in 1999, from cell biologist Thomas Kornberg at the University of California, San Francisco. He was watching fly larvae develop wings, and saw a sea of filaments projecting from the wing buds towards the signalling centre that is essential for their growth[2]. He coined the term cytoneme — or cell thread —

to describe these filaments. He suggested that some cellular chatter that was thought to happen by diffusion could, in fact, be orchestrated by cytonemes. The idea was surprising and was slow to catch on, but it is now making its way into textbooks.

In 2004, two research groups separately published observations of something even more radical: nanotubes in mammalian cells that seemed to move cargo such as organelles and vesicles back and forth. Rustom spotted thin, straight tubes connecting cultured rat cells after he forgot a washing step in an experiment. He and his adviser at the University of Heidelberg, Hans-Hermann Gerdes, engineered cells to make fluorescent proteins and watched the molecules flow from one cell to another. Their accidental sighting grew into a *Science* paper[3] that described the structures as “nanotubular highways”. (Some sceptics think that Gerdes chose the term nanotube to ride on the coat-tails of carbon nanotubes, a hot topic in materials science.)

In the same year, Daniel Davis and his team at Imperial College London described networks of 'membrane nanotubes', strands of cells' outer membranes that stretched for several cell lengths to connect different types of immune cell; lipids produced by one cell showed up on the surface of another[4]. Davis attributes their discovery to his team's willingness to think through the implications of their sighting. “The crucial thing is not that we saw them,” he says. “The crucial thing is deciding what you're going to dig into and investigate.” His team went on to describe different sorts of nanotube, some holding vesicles and mitochondria inside, and others with bacteria 'surfing' the casing[5].

Meanwhile, other labs have reported cell-connecting tubes in neurons, epithelial cells, mesenchymal stem cells, several sorts of immune cell and multiple cancers. Further types of tube have been spotted as well. In 2010, Gerdes and his team reported that some tubes end in gap junctions: gateways that bestow the neuron-like ability to send electrical signals and can also pass along peptides and RNA molecules[6]. Yamashita speculates that such connections may be more than conceptually related to neuronal synapses. “Membrane protrusions might have evolved first, and higher organisms could have started upgrading them to make neurons for more complicated functions,” she says.

Most researchers who study these cellular pipelines care less about their evolutionary origin than about their role in human health and disease. The strongest evidence for a role in disease came in 2015, also from a team at the University of Heidelberg, led by cancer researcher Frank Winkler. Like others, his team had not set out to study cell protrusions; they wanted to test a system for watching human gliomas grow. Cells derived from the tumours were injected into the brains of mice with windows in their skulls — hardened glass kept in place with dental cement — through which the researchers could watch the cells.

As the tumour cells invaded, they sent tubular protrusions ahead of them. A closer look showed many tubes connecting cells through gap junctions. Interconnected cells managed to survive doses of radiation that killed isolated cells, apparently because gap junctions helped to spread the load of toxic ions to neighbours[7]. When radiation did kill linked tumour cells, nuclei from those cells sometimes travelled down a tube, with the tube then expanding into the cleared space to form a vigorous new cancer cell. These 'tumour microtubes' were also found in biopsies from patients, and denser, longer tubes correlated with more resistant forms of cancer and a poorer prognosis. Winkler speculates that a drug that could keep these tubes from sprouting or extending might create a new class of cancer treatment; indeed, he thinks that existing cancer drugs such as paclitaxel may work by disrupting tumour microtubes. Winkler's team has filed a patent application for a compound that interferes with microtubes as a treatment for glioma.

The work has captured imaginations. “It was a seminal paper,” says Okafo. “Prior to that there was still some scepticism about whether these phenomena existed *in vivo*.” But it's not clear whether Winkler's results apply to other scenarios. Various sorts of brain cell are known to send out cell protrusions as they grow and proliferate. The tubes that Winkler's team reported are much larger than the 'tunnelling nanotubes' that were originally described by Gerdes, and, unlike most tunnelling nanotubes reported so far, contain microtubules — filaments that move components around in cells. However, Winkler thinks that his work provides evidence for a broad role for tunnelling-nanotube-like structures. He thinks they may not be able to reach full size in culture, and the tubes he does see vary considerably in length and thickness. Winkler recalls discussing his work with Gerdes before Gerdes' death in 2013. “He said that this was what the field was waiting for. It was exactly the proof that he thought we could find.”

In other fields, too, the tubes are gaining traction. Eliseo Eugenin, who studies HIV at Rutgers New Jersey Medical School in Newark, suggests that HIV-infected cells send out multiple nanotubes filled with virus to reach uninfected cells. Circulation and one-on-one cellular contact would be too inefficient to cause the rapid amplification of the virus seen in newly infected patients. “The mathematics don't work,” he says. He thinks that other researchers are sceptical of nanotubes because they are unable to reconcile themselves to the idea that cells are constantly exchanging materials, including genetic information. “Our definition of a cell is falling apart,” Eugenin says. “That is why people don't believe in these tubes, because we have to change the definition of a cell.”

Battle lines

When the definition of the cell is at stake, it is little wonder that scepticism remains strong. Emil Lou, a cancer researcher at the University of Minnesota in Minneapolis, says his grant proposal to hunt for and characterize nanotubes in human cancers was pooh-poohed because a reviewer was not convinced that the structures existed.

Others argue that they do exist — but only in the rarefied world of the Petri dish. Michael Dustin, an immunologist at the University of Oxford, UK, says that he has seen cells in dishes form structures that would never occur in the dense tissue of an organism. For example, white blood cells primed to produce antibodies produce a “beautifully symmetric” bull's-eye pattern in a dish, very different from the chaos and asymmetry they show in the body.

Then there are mechanistic quibbles: some researchers think that the tubes are open at both ends, with cargo flowing in and out. But that would cause cytoplasm to mix and result in the cells fusing, says Jennifer Lippincott-Schwartz, a cell biologist at the Howard Hughes Medical Institute Janelia Research Campus in Ashburn, Virginia. “The people who think there is a connection need to talk to some biophysicists,” she says. Instead, she thinks that membrane tubes may jut out and make minimal contact, just enough to allow recipient cells to reach out and engulf the tube contents.

These disagreements could be contributing to a lack of rigour in the field. Chiara Zurzolo, a cell biologist at the Pasteur Institute in Paris, who has spotted prions and other neurodegenerative proteins travelling through nanotubes, says that many papers do not try to assess whether a tube is closed or open-ended, for example, or even whether the tubes allow the movement of vesicles or similar material. The proliferation of tube types, and the different names for them, make coherent discussion difficult. “We have to be rigorous in what we call these structures. At the moment it is very messy,” she says.

But getting clear images of living cells will always trump semantics, says Ian Smith, a cell biologist at the University of California, Irvine. “What is really needed in the field is direct visualization of this process,” he says. Most microscopy techniques can't get a clear view of these structures in action, even in cultured cells. Smith is developing methods to visualize membrane nanotubes using lattice light-sheet microscopy, which monitors planes of light to build up 3D images. He hopes that the technique will be able to capture the process of material transfer from one cell to another, from start to finish[8]. Smith admits that he's taking a career risk: a colleague recently warned him this area was 'fringey'. But he takes this as a challenge.

Lou is encouraged that the criticism against membrane tubes has morphed. At first people would tell him that the structures were artefacts or optical illusions, he recalls. “Then it graduated to, 'well, just because they grow in a plate doesn't mean that it has anything to do with biology', and then it was, 'well you are probably misidentifying these or mischaracterizing them'.” He likes that direction. “I think we have to take it seriously as a therapeutic target. I couldn't have said that five years ago.

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Comments

Comments

There are currently no comments.

Bring on the bodyNET

20 September 2017

Stretchable sensors, circuits and batteries are about to change our relationships with electronics and each other, explain Bryant Chu and colleagues.

Amir Foudeh, Jie Xu, Sihong Wang and Zhenan Bao

Unobtrusive 'elastronic' transistors can behave like skin and stretch without tearing.

Electronics are set to merge with our bodies to extend our perceptions. Smartphones and watches will give way to the bodyNET[1]: a network of sensors, screens and smart devices woven into our clothing, worn on our skin and implanted in our bodies (see 'Superhuman powers'). A pregnant woman might wear tiny biometric sensors to monitor her baby's heartbeat, displayed on a film attached to her skin. She could transmit its kicks to the father wirelessly, so that he can experience the vibrations recreated by 'haptics' — interfaces that provide tactile feedback — on his stomach.

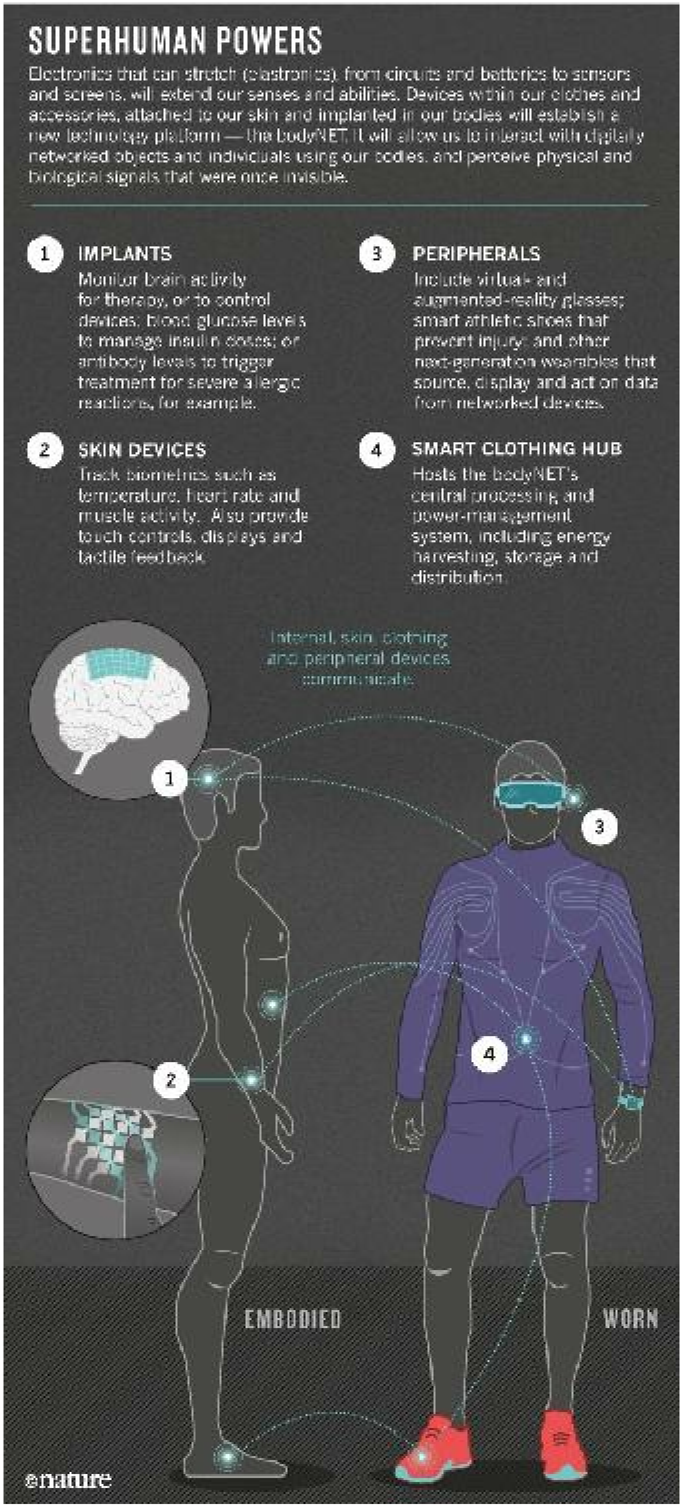
The bodyNET is not yet complete, and labs around the world are developing its components. The core technology is electronics that stretch — elastronics — made from soft plastic circuits thinner than paper that can deform without tearing, biodegrade and even heal themselves (see go.nature.com/2vtutzz). Elastronic sensors respond to touch, pressure, temperature, humidity and light, as well as to chemical and biological signals[2–10].

There is much still to do. Researchers must improve the technical performance of elastronic materials, design innovative architectures for stretchable circuits and drive down costs through mass production. There are also social and cultural concerns. These include widespread fears of merging technology intimately with the body, as well as anxieties about privacy and data security.

Yet we are optimistic that the benefits of bodyNETs will outweigh the challenges. These extensions of ourselves will allow us to sense and communicate with others and our surroundings in new and sophisticated ways, beyond our existing five senses. Being able to see how a patient is feeling in real time, or whether a loved one is in need of emotional support, could make us more aware and empathetic. Rather than replacing us, such technology will extend our human qualities.

For example, augmented-reality cosmetics or decorative displays on the body could change colour to indicate our mood. Digital tattoos, powered by batteries in clothing, could reveal our emotions through biometric data relating to posture, imperceptible facial expressions, heart rate and skin conductivity. Flight information could be displayed on glasses as you look up at a plane. Or imagine being able to respond remotely to health alerts about a child's emergency.

Here we highlight research priorities for the bodyNET.



Claire Welsh/*Nature*

Eight technical challenges

Materials. Electronic components that behave much like skin need to be developed. The conductivity of stretchable polymer semiconductors and conductors must match that of rigid ones. Biocompatible substrates need to become more durable so that they can be worn on the skin for months. These materials will have to survive sweating, bathing and normal wear and tear, as well as washing cycles if incorporated into clothing.

Circuits. New designs for stretchable circuits are needed. These must compensate for electrical properties that change when the components are distorted. They must be made thinner and cheaper to fabricate. Processes for manufacturing circuits using elastronic materials are underdeveloped and often involve many steps, resulting in low final yields. It is hard to achieve high precision by aligning layers using shadow masks, for example; and most printing methods can pattern materials at low resolution only, thus limiting the speed of the circuits.

Sensors. Skin-like devices that can measure pressure, strain and temperature, as well as the presence and level of certain chemicals, need to be developed further to monitor body movements and health conditions. Changes in temperature and pressure, in particular, are hard for sensors to separate, because each affects the other. Some sensors have been prototyped using stretchable conductors, semiconductors and (charge-holding) dielectric materials, but solving the problem will require new types of circuit.

Energy storage and harvesting. Stretchable batteries must become smaller and more efficient, providing weeks of use. Battery electrodes made from stretchable materials, such as polymer and inorganic composites, are bulkier than coin batteries of similar power. And batteries that stretch mechanically, using moving components, suffer from wear and tear. Energy-harvesting strategies, too, are limited. Piezoelectric generators that harvest energy from motion provide only spikes of low power. Thin-film solar cells capture energy from sunlight but are ineffective under clothing. Flexible thermoelectric materials are not yet good enough to collect useful amounts of power from body heat.

Modelling. Advanced simulation techniques will help researchers to design complex elastronic circuits and architectures. Being able to test many designs before fabrication would lower the cost of prototyping. For example, mathematical models of molecules and materials will predict electrical properties and mechanical behaviour such as crack propagation under extreme stretching.

Mass fabrication. Elastronics are currently made only in small quantities in research labs. Mass-production techniques, such as roll-to-roll coating, patterning and printing, would reduce the cost and increase the reliability of the circuits. New materials require years of development before they can be commercialized. It took the semiconductor industry decades to evolve high-speed, high-performance mass manufacturing, and a similar process is needed to produce elastronics at scale.

Peripherals. Shifting communications technologies from separate devices, such as smartphones, to integrated devices on the body will make our interactions with them more natural. This trend has begun with wearables such as the Samsung Gear and the Apple Watch, but these are still limited in function. Elastronics on the skin would offer entirely new 'superpowers' through touch-sensitive haptic devices, thin and stretchable displays, gesture-based controls and audio systems that stay on the body indefinitely. Mixed-reality devices networked to the bodyNET that allow you to remotely interact with other people and objects need to be developed.

Digital communication. BodyNETs will require a digital communications network to connect their layers, and this is yet to be built. It must bridge the digital and physical worlds between individuals, objects and environments. Data must be transmitted reliably across implants, skin sensors, devices embedded in clothing and those packaged as peripherals, as well as from one person's bodyNET to another's. Built spaces could become personalized, with room conditions controlled by skin temperature and perspiration, lighting by circadian rhythm, and furniture by body size and muscle activity. People who speak different languages could soon communicate using real-time translation, emotion tracking and dynamic augmented-reality graphics.

Five cultural challenges

Human needs. Translating data into useful forms rooted in human needs will be essential. Our interviews with users of wearables revealed that raw data — blood pressure, pulse or galvanic skin response, for example — are of little use unless they prompt an action or are applied to improve lives, by alerting users to potential heat stroke on a warm day, for instance. Users who tested being able to track emotions with virtual-reality mock-ups said they valued being able to empathize more easily with others, especially in high-stakes situations such as mitigating work disagreements and clearing up cross-cultural confusion. The full potential of bodyNETs will be harnessed through global networks, and different sociocultural ecosystems must be factored into designs.

Body modification. The relationship between technology and the body needs to be considered. We must reframe fears and preconceptions. The only types of body modification accepted by most people today are those achieved by medical and restorative procedures such as joint replacements. Artificial intelligence often incites a fear of the unknown, and combining living tissue with electronics provokes aversion. We think that this mentality will shift as public knowledge increases, elastronics that work with the body advance, and human-centred applications such as continuous, personalized health care — rather than novelties — begin to improve daily life. Medicine and communication are two paths forward. Long-term treatments such as insulin dosing can be revolutionized by replacing existing devices with networked, biocompatible ones that conform to the body's tissues. Body decoration is also increasingly accepted. Its long history could continue, with elastronics serving as a new medium for expression as well as performing technical functions.

Data security. Data privacy and security are essential. Medical and health and wellness data must remain individual property. Fitness trackers have been criticized for having confusing and vague privacy policies that potentially allow third-party sharing of health information. BodyNETs would face the same challenges. This is not a new issue. Sharing credit-card information was unheard of, until online shopping drove the development of security protocols and users gained trust in the process. Similarly, bodyNET technology must be secured from potential attacks and used for applications that improve the lives of its users. Legal structures must be created to ensure that use of this technology requires consent, and that it is not exploited for malicious purposes, such as denying healthcare on the basis of diet, selling data for profit, or worse.

Data influence. Biometric information gained through sensors influences behaviour and can have unintended consequences. It is crucial that measurements are robust. Inaccurate data can lead, for example, to medical emergencies being missed, or flagged incorrectly. In 2016, a lawsuit was filed against Fitbit, a manufacturer of wearables, over the accuracy of its heart-rate measurements. Decisions to design such devices for health purposes will need to be made carefully, recognizing that users might operate devices for health monitoring regardless of recommendations. As biometrics are developed further, the complexity of devices will increase, as will the chance of error. So it is important that procedures for debugging bodyNETs are formalized. Our group is exploring acquiring data with pairs of sensors to increase accuracy.

User interaction. More must be learnt about how to present bodyNET data effectively, both visually and physically. Should invisible emotions be represented by a colour-changing glow around an individual, an animal avatar, or something else? Hardware and software interfaces need to be designed with user interaction as a priority. BodyNETs will allow us to use our natural embodied intelligence to experience the data-rich world in completely new ways.

Next steps

We think that the business landscape for elastronics could eventually resemble that for printed circuit boards. Dedicated elastronic circuit manufacturers will fabricate components for large system-integration and digital-communications companies. These large companies would develop their own commercial devices or sell components to start-ups that produce their own devices.

Applications for the first bodyNETs must be developed now. Initial devices will probably be simple but reliable systems of biometric sensors that display information in an actionable way. For example, a stretchable 'sleeve' might display a person's mood or comfort level. Later versions would be more complex, and could include augmented-reality glasses powered by elastronics embedded in clothing.

Social-science studies will be crucial to understanding the short- and long-term impacts of these new forms of interactions, and to exposing unintended consequences. We must develop the bodyNET system responsibly, mindful of its repercussions. Multidisciplinary partnerships should be created, and governments must develop privacy and regulatory legislation.

The bodyNET's disruptive potential is great. Conversations must start now to ensure that we create the best possible version, both technically and ethically, of this transformative technology.

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'One-size-fits-all' threshold for *P* values under fire

Scientists hit back at a proposal to make it tougher to call findings statistically significant.

19 September 2017

Researchers are at odds over when to dub a discovery 'significant'. In July, 72 researchers took aim at the *P* value, calling for a lower threshold for the popular but much-maligned statistic. In a response published on 18 September[1], a group of 88 researchers have responded, saying that a better solution would be to make academics justify their use of specific *P* values, rather than adopt another arbitrary threshold.

P values have been used as measures of significance for decades, but academics have become increasingly aware of their shortcomings and the potential for abuse. In 2015, one psychology journal banned *P* values entirely.

The statistic is used to test a 'null hypothesis', a default state positing that there is no relationship between the phenomena being measured. The smaller the *P* value, the less likely it is that the results are due to chance — presuming that the null hypothesis is true. Results have typically been deemed 'statistically significant' — and the null hypothesis dismissed — when *P* values are below 0.05.

In a July preprint, since published in *Nature Human Behaviour*[2], researchers, including leaders in the push for greater reproducibility, said that this threshold should be reduced to 0.005 to keep false positives from creeping into social sciences and biomedical literature.

But “setting this one threshold for all sciences is too extreme,” says Daniel Lakens, an experimental psychologist at Eindhoven University of Technology in the Netherlands and lead author of the new commentary, which was posted to the PsyArXiv preprint server. “The moment you ask people to justify what they are doing, science will improve,” he adds.

Unintended consequences

Some researchers worry that lowering *P* value cut-offs may exacerbate the ‘file-drawer problem’, when studies containing negative results are left unpublished. A more stringent *P* value threshold could also lead to more false negatives — claiming that an effect doesn’t exist when in fact it does. “Before you implement any policy, you want to be more certain that there are no unintended negative consequences,” says Lakens.

Instead, Lakens and colleagues say, researchers should select and justify *P* value thresholds for their experiments, before collecting any data. These levels would be based on factors such as the potential impact of a discovery, or how surprising it would be. Such thresholds could then be evaluated via their registered reports, a type of scientific article in which methods and proposed analyses are peer-reviewed before any experiments are conducted.

“I don’t think researchers will ever have an incentive to say they need to use a more stringent threshold of evidence,” counters Valen Johnson, a statistician at Texas A&M; University in College Station who is a co-author of the July manuscript. And many scientists are likely to go easy on their own work, says another co-author, Daniel Benjamin, a behavioural economist at the University of Southern California, Los Angeles.

But Lakens thinks that any attempts to manipulate *P* values will be obvious from the justifications that researchers pick. “At least everyone agrees that it’s good to change the mindless use of 0.05,” he says.

Setting specific thresholds for standards of evidence is “bad for science”, says Ronald Wasserstein, executive director of the American Statistical Association, which last year took the unusual step of releasing explicit recommendations on the use of *P* values for the first time in its 177-year history. Next month, the society will hold a symposium on statistical inference, which follows on from its recommendations.

Wasserstein says he hasn't yet taken a position on the current debate over *P* value thresholds, but adds that "we shouldn't be surprised that there isn't a single magic number".

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Marine scientists allege Japan has blocked researchers from joining South Korean ship

Controversy over vessel's name may impede oceanographic collaboration.

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Choul Jib Lee/Getty

Islands between Japan and South Korea are the source of a long-running territorial dispute.

South Korea's flagship research ship *Isabu* seems to have sailed into a controversy with the Japanese government over its name. The incident has hindered some oceanographic research collaborations between the two countries**.**

The ship's name refers to a sixth-century Korean general, Kim Isabu. In South Korea, he is known for his maritime conquests, which in some historical accounts included two islets that are the subject of a decades-long territorial dispute between South Korea and Japan. Known as Dokdo in South Korea and Takeshima in Japan, the small islets are located roughly midway between the two countries, more than 200 kilometres from each mainland. The 5,900-tonne ship launched late last year and is currently cruising the Philippine Sea. Its name was an option in a public poll held by the ship's operator, the Korea Institute of Ocean Science and Technology in Ansan.

The Japanese government has issued no formal protest over the ship's name, but four scientists in South Korea and Japan have told *Nature* that researchers at Japan's national marine-research agency have been instructed not to participate in any collaborations or cruises involving *Isabu*. An e-mail sent in January by an official at the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) in Yokusuka, and seen by *Nature*, suggests that the order came from Japan's science ministry. The e-mail states that the ministry cancelled a proposed agreement to allow JAMSTEC researchers to collaborate on the ship.

A senior researcher at JAMSTEC, who asked to remain anonymous, says that he and other JAMSTEC researchers have been told not to use the ship or any data it obtains.

JAMSTEC's actions regarding *Isabu* seem to be directed from more-senior officials. An e-mail sent earlier this year from a JAMSTEC staff member to an employee of a government-supported research institute in South Korea that is involved with *Isabu* suggests that JAMSTEC is acting on the wishes of its supervising authority, the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT). The e-mail said: "We have consulted MEXT on your request to add the collaboration on the research activities using your new research vessel 'ISABU', and got a negative answer from MEXT due to a non-scientific reason." The e-mail goes on to state that

JAMSTEC cannot “carry out the collaboration using your new research vessel”.

When contacted by *Nature*, the JAMSTEC staff member who sent the e-mail declined to answer questions. JAMSTEC president Asahiko Taira told *Nature* that he had no knowledge of that specific e-mail, and he had not issued an order, or personally received one from the government, prohibiting the organization’s involvement with *Isabu*. But he says cooperation with South Korea using the ship “could be very difficult” and would require permission from MEXT. “The name of *Isabu* is a little bit unfortunate,” he says, but he adds that JAMSTEC will remain involved with an ongoing 16-nation collaboration to survey the region between the Indian and Pacific oceans, to which South Korea has committed *Isabu*. Pulling out of the collaboration over South Korea’s use of the ship would “be a pretty stupid thing to do”, he says.

MEXT’s director of deep-sea research, Tatsuya Watanabe, says that the ministry had discussed the South Korean ship with JAMSTEC, but would not comment on whether the ministry had instructed JAMSTEC to avoid collaborations on the ship, or whether the ministry had an issue with the ship’s name.

So far, the controversy has disrupted at least one planned research project between researchers from both countries. A university-based Japanese marine scientist, who also asked for anonymity, says that he had planned a cruise on *Isabu* in collaboration with JAMSTEC before the tensions arose. But the agency’s researchers have since told him that JAMSTEC instruments cannot be used on *Isabu*. His project will go ahead without the equipment, reducing the data resolution.

Sang-Mook Lee, a marine geophysicist at Seoul National University, says that disruptions to the two countries’ research collaborations will restrict the ship’s scientific capability. “Had we known that the Japanese would react in such a way, I don’t think Koreans would have chosen the name,” he says.

But the senior JAMSTEC researcher says that the dispute is unlikely to have a major impact on Japan’s marine research because the country has its own research ships and marine projects. Even so, he is upset that the ship was given such a politically-charged name: “Scientists should be politically neutral.”

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Researchers unite in quest for ‘standard model’ of the brain

Modelled on big physics projects, the International Brain Lab will bring together some of the world’s pre-eminent neuroscientists to probe a single behaviour.

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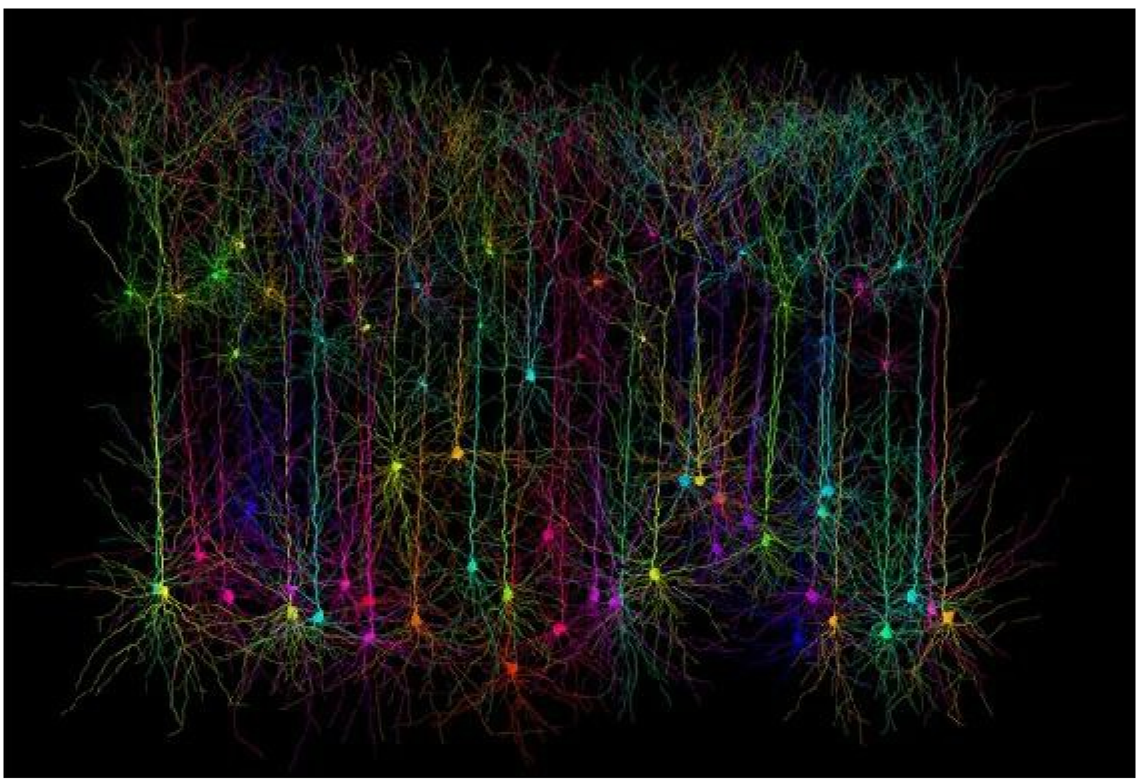
2. 21 September 2017



M. Häusser and H. Cuntz/UCL

Scientists aim to surpass small-scale neural models (pictured) to show how brains generate behaviour.

Leading neuroscientists are joining forces to study the brain — in much the same way that physicists team up in mega-projects to hunt for new particles.

The International Brain Lab (IBL), launched on 19 September, combines 21 of the foremost neuroscience laboratories in the United States and Europe into a giant collaboration that will develop theories of how the brain works by focusing on a single behaviour shared by all animals: foraging. The Wellcome Trust in London, and the Simons Foundation in New York City have together committed more than US$13 million over five years to kick-start the IBL.

The pilot effort is an attempt to shake up cellular neuroscience, conventionally done by individual labs studying the role of a limited number of brain circuits during simple behaviours. The 'virtual' IBL lab will instead ask how a mouse brain, in its entirety, generates complex behaviours in constantly changing environments that mirror natural conditions.

The project will use chips that can record the electrical signals of thousands of neurons at once. It will also use other emerging technologies, such as optogenetics toolkits that control neurons with light. "It's a new approach that will likely yield important new insights into brain and behaviour," says Tobias Bonhoeffer, a director of the Max Planck Institute for Neurobiology in Martinsried, Germany, who is also a Wellcome Trust governing-board member.

Large-scale neuroscience projects are hardly rare. In 2013, the European Commission announced the 10-year Human Brain Project, which will cost more than €1 billion ($1.1 billion); and in 2014, US president Barack Obama launched the US Brain Initiative to develop neuro-technologies, with $110 million of funding that year. The Allen Institute for Brain Science, in Seattle, Washington, has been creating comprehensive maps of brain anatomy and neural circuitry since 2003. Japan, China, Canada and other countries also have, or are planning, their own big neuroscience initiatives.

But none operates quite like the IBL, which will be governed in a similar way to large-scale physics projects such as ATLAS and CMS, at Europe's particle-physics lab CERN, which reported evidence for the Higgs boson in 2012. The two collaborations, at CERN's Large Hadron Collider near Geneva, Switzerland, brought together experimentalists and theoreticians from hundreds of labs worldwide to test the predictions of particle physics' standard model.

Like the massive CERN teams, the IBL has created a flat hierarchy and a collaborative decision-making process with near-daily web meetings. Instead of acting only when group consensus is reached, teams will make decisions by simple consent. "No one will be able to stop a proposed experiment being carried out without a very convincing proposal of why it would be a disaster," says Alexandre Pouget, an IBL member and a theoretician at the University of Geneva in Switzerland.

So far, says Andreas Herz, a theoretical neuroscientist at the Ludwig Maximilian University of Munich, Germany, "neuroscience has been stuck in an exploratory phase". The IBL will aim to generate and test unifying theories about how the brain encodes and computes information – seeking to come up with the equivalent of physicists' standard model.

But the IBL is hardly unique among big neuroscience projects in melding theory and practice, points out neuroanatomist Katrin Amunts at the Jülich Research Centre in Germany. Amunts also chairs the scientific board of Europe's Human Brain Project, an initiative that is taking a more conventional approach to collaboration in its own attempts to understand how the brain works. "The future will show which is the best," she says.

The IBL's principal investigators, who include data-analysis experts as well as experimental and theoretical neuroscientists, will dedicate around 20% of their time to the effort. During its first two years, the IBL will build informatics tools for automatic data-sharing and establish a reliable experimental protocol for a basic foraging task in mice. Members will be required to register their experiments before they start, and results will be instantly visible to the whole collaboration.

"It is a big challenge — and it's not the way the field works at the moment," says Anne Churchland, an IBL member at Cold Spring Harbor Laboratory, New York.

In experimental neuroscience, the slightest parameter change can alter the outcomes of the experiment. The IBL's standard protocol attempts to address all possible sources of variability, from the mice's diets to the timing and quantity of light they are exposed to each day and the type of bedding they sleep on. Every experiment will be replicated in at least one separate lab, using identical protocols, before its results and data are made public.

"This sort of approach will help solve the reproducibility crisis," says Christof Koch, president of the Allen Institute for Brain Science.

Expanding the IBL beyond its pilot phase will require much more than $13 million, Pouget acknowledges. After the foraging protocol is established, the project's second phase will test specific theories relating to how the brain integrates diverse information to make moment-by-moment decisions. He also hopes to enrol many more labs and broaden the suite of behaviours studied.

For Herz, a theoretician who is part of an influential computational-neuroscience network, it's about time neuroscience adopted such rigour. "A hundred years from now," he says, "people will look back and wonder why it hadn't, until now, been possible to do a more physics-based approach of designing experiments to consolidate or disprove theories."

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Corrections

Corrected:

> An earlier version of this article mis-stated the total funding for the International Brain Lab.

Corrected:

> An earlier version of this story erroneously located the Simons Foundation in Washington DC.

Comments

Comments

There are currently no comments.

Cancer patients need better care, not just more technology

19 September 2017

Treating cancer with the latest drugs and techniques is costly and will not improve survival globally, warn Richard Sullivan, C. S. Pramesh and Christopher M. Booth.

Prashanth Vishwanathan/Bloomberg/Getty

A patient awaiting treatment for cancer in an Indian hospital.

In Nigeria, Malaysia, India and many other low- and middle-income countries, it is common to see hundreds of people queueing in the street to see a cancer doctor. It's also common in those regions to see people with curable cancer having chemotherapy, but not radiotherapy or surgery. In fact, 90% of people in low-income countries lack access to basic radiotherapy.

In wealthy countries, the push to develop new drugs, surgery and radiation techniques to treat cancer is at best unsustainable. Of 277 cancer-drug therapies for which clinical trials were published in 2011–15, only 15% identified treatments that led to meaningful improvements in patient survival or quality of life[1]. Indeed, studies reveal that the more expensive the drug, the less clinical benefit it seems to give[2] (see 'A world of difference', panel a).

In middle- and low-income countries the technology-centric approach to cancer threatens to do more harm than good.

For the past 15 years, we have worked as clinical researchers in some 40 countries and conducted more than a dozen studies on national cancer-control planning. Our experiences — along with epidemiological and other data collected over 20 years — indicate that the countries that rate relatively poorly on measures of cancer survival and mortality do so largely because of deficits at the political, economic and social level.

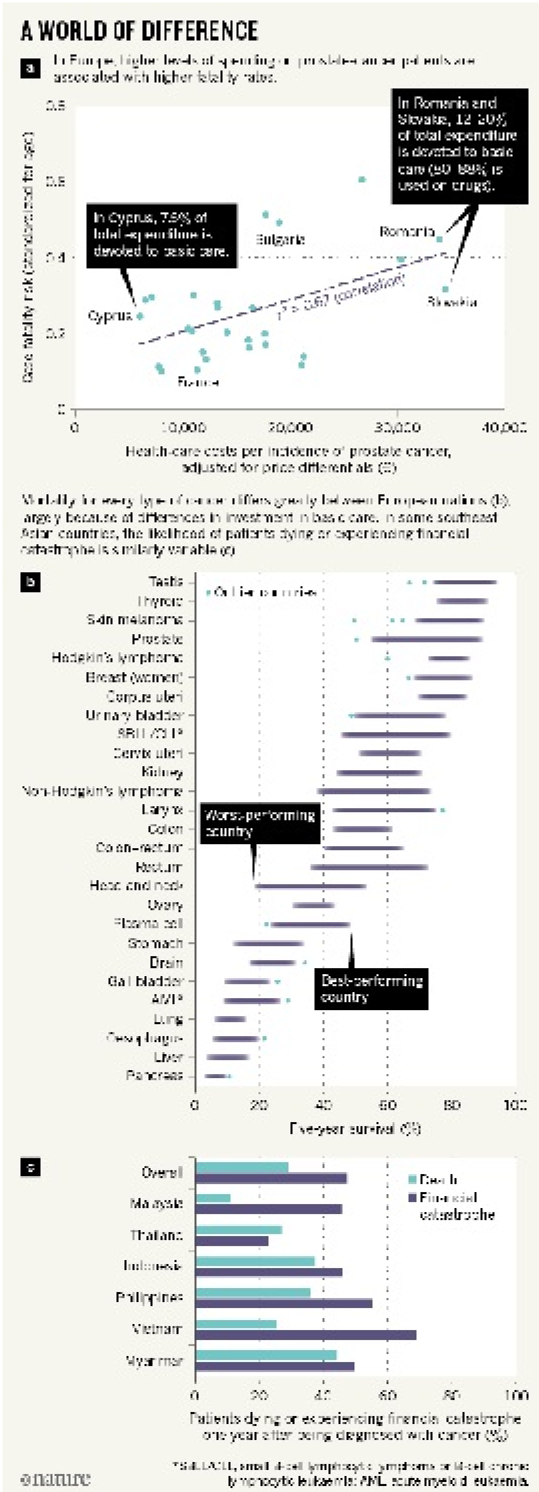
To improve the survival and well-being of the roughly 16 million people who have cancer worldwide, researchers, physicians, policymakers and patient organizations must focus on education, stigma, training and staffing to ensure that the right care is delivered to the right patient at the right time.

A growing problem

Cancer is on the rise. Ten years ago, 12.7 million people worldwide were living with the disease, with an economic impact of nearly US$290 billion. By 2030, 21.7 million people are expected to be affected, at an anticipated cost of $458 billion — largely because of a growing and ageing population as well as lifestyle changes. But the numbers vary dramatically across countries.

Among European nations, there are huge differences in mortality and morbidity for every type of the disease, according to the EUROCARE-5 database[3] (see 'A world of difference', panel b). For example, in 2014 there was a 14.5% difference in survival rates for patients with breast cancer living in Denmark (one of the best-performing countries) and those in Lithuania (the worst). For rectal cancer, survival rates differed from country to country by as much as 32%.

Likewise, in Asia the proportion of patients who died one year after being diagnosed with solid tumours, such as breast or colorectal cancer, ranged from 12% (in Malaysia) to 45% (in Myanmar), according to a 2012 study[4]. Meanwhile, the proportion of patients facing destitution after paying for treatment ranged from one-quarter in Thailand to two-thirds in Vietnam[4] (see 'A world of difference', panel c).



Sources: (A,B) Ref. 3; (C) Ref. 4

Many hospitals in emerging economies and most in low-income countries lack the basic infrastructure and personnel needed to treat diverse cancers. The Tata Memorial Centre in Mumbai, for instance (where C.S.P. works), is the oldest and largest cancer-treatment and research centre in India. It has 164 senior faculty members, who see roughly 40,000 patients each year. Compare that to the MD Anderson Cancer Center in Houston, Texas, which sees 33,000 patients per year but has more than 11 times as many senior faculty members (1,834).

Similarly, in sub-Saharan Africa, only 16 countries have access to basic pathology services — trained staff with the equipment needed to make a diagnosis of cancer. Throughout much of Africa, there is on average one pathologist for every 2.3 million people. In high-income countries, there is typically one pathologist for every 15,000 to 20,000 people[5].

Even in well-resourced urban areas, a lack of guidelines and auditing undermines the effectiveness of many clinical labs. In 2011, only 5% of the 954 pathology labs in Kampala, Uganda, met the minimum tissue-handling and reporting standards defined by the World Health Organization (WHO) Regional Office for Africa[6]. In our experience, poorly trained staff often make incorrect diagnoses, or produce reports without analysing tissue.

Another barrier to improving outcomes is that patients do not see doctors early enough in their disease. The five-year survival rate for breast cancer is only 68.4% in Tunisia. This is in part because, in many low- and middle-income countries, women with cancer can be stigmatized by their communities. Many must obtain permission from their husbands to see a doctor, and are fearful that a cancer diagnosis will lead to divorce.

Everywhere, a lack of education and awareness, affordability and availability of treatment are the main factors preventing patients from being diagnosed early enough[7,8]. Given all this, it is alarming that many low- and middle-income countries are devoting more of their meagre cancer-care budgets to technology, especially through the private sector.

Consider the cost

The past decade has witnessed an explosion of targeted and immunotherapeutic drugs for cancer. The number of new technologies in surgery, particularly in robotics, has also risen exponentially. New radiation techniques such as tomotherapy (a form of computed tomography in which radiation is targeted at specific slices of the body) and proton-beam therapy are also being rolled out each year.

Many emerging economies are now investing in these high-tech interventions[9], even though they lack the purchasing and negotiating powers of high-income countries and do not have systems to determine the cost-effectiveness of what they're buying.

The drug bevacizumab, for example, costs between $4,000 and $5,000 per month in the United States compared to the drug tamoxifen, which costs approximately $50 per month. The former is now considered a standard treatment in India for patients with metastatic colon cancer, despite trials showing that it improves median survival by only 6 weeks[10]. Meanwhile, in many parts of India, there aren't enough pathologists to test a woman's breast cancer for the oestrogen receptor. Such information would enable many thousands of women to receive tamoxifen, which increases the cure rate of breast cancer by 10% (ref. 11).

Furthermore, despite considerable uncertainty about the cost-effectiveness of proton-beam therapy, there are plans to install at least 18 such machines across Brazil, Russia, India, China and South Africa. Each machine costs around $140 million[12]. These same countries currently have an average deficit of around 60% in both human resources and equipment for basic radiotherapy, which is much more effective in increasing cure rates and relieving suffering[13].

Less than 5% of patients in low-income countries have access to safe, affordable and timely cancer surgery; for middle-income countries the situation is only marginally better, at around 22% (ref. 14). Yet these same countries are spending hundreds of millions of US dollars each year on immunotherapeutic drugs.

In short, in most emerging economies, there is a chronic under-use of therapies that can save lives (such as cervical-cancer screening, basic surgery and radiotherapy) and a chronic over-use of interventions that, at huge expense to the patient, provide no meaningful benefit.

Three major shifts

To better balance innovation in cancer drugs and therapies with the requisite social, economic and structural investments requires three major shifts.

Change global mindsets. Media hype fuels the perception that new must mean better[15]. The complexity of the disease probably also makes it easy for the various players of the medical–industrial complex to persuade policymakers to prioritize high-tech solutions.

Cancer-advocacy bodies, research-funding organizations and patient groups must stop advocating access to expensive (and often low-value) technologies, especially in low- and middle-income countries. In the past year, hundreds of policy briefings produced by groups such as these have asked governments for investments.

Also, more scientific rigour, media scrutiny and public debate globally could make it harder for the cancer community (including researchers, physicians and patient groups) to celebrate marginal wins and endorse policy focused on technological innovation[15].

In parallel, the bar must be raised, such that health-insurance companies, governments and other payers fund only those interventions that have a meaningful impact on patients' lives. This means basing decisions about which technologies to incorporate into routine clinical care, and how much to invest in them, on survival and quality of life. Surrogate endpoints, such as lack of tumour growth and radiological and biomarker responses, have increasingly been used in recent years, even though, in many cases, investigators have not been able to correlate them with outcomes that are meaningful to patients[16, 17].

Fund human capital and social development. Spending needs to be redistributed more evenly between people, basic technologies and the delivery of safe, affordable cancer care. Governments and development organizations, such as the World Bank and the WHO, need to prioritize education and the employment of more cancer-specific health-care workforces. They also need to address the basic social factors that determine whether patients are seen and diagnosed early enough.

This multi-pronged approach has proved successful in other contexts. The international effort to combat HIV/AIDS has been as much about social engineering as developing drugs and vaccines. Researchers working on antiretrovirals have actively supported and engaged with those in community development, education and the design of effective pathways for care.

For cancer, some collaborations have already yielded important advances. A partnership involving Moi University in Eldoret, Kenya, Indiana University in Indianapolis and other high-income cancer centres has helped more than 4,500 Kenyans obtain high-quality cancer care over the past five years — largely through sharing models of care and facilitating the training of surgeons and other carers[18]. And the Indian government's support for the transfer of cost-effective, Indian-made radiation equipment to countries such as Vietnam and Mongolia, among others, has provided numerous underserved communities with access to radiation therapy.

Governments must not insist on replicating models established in high-income countries. In place of medical oncologists, for example, surgeons could be trained to deliver basic low-risk chemotherapy, and nurses taught to deliver palliative care. Expanding the skill sets of general doctors and surgeons, and training more pathologists, would also help.

Likewise, investing more in cancer prevention and public health would pay huge dividends. It has been estimated that, across Europe, driving tobacco usage down to a level at which less than 5% of the population uses it would plough some €10 billion (US$12 billion) back into economies each year by preventing premature deaths due to tobacco-related cancers.

Implement standards and systems for accountability. In our experience, pharmaceutical companies are beginning to recognize that without improvements to systems and processes, their sales will stagnate, particularly in emerging and low-income economies. But expensive cancer medicines are still a major drain on resources. National health-insurance systems, such as those in India and Mexico, need to do a much better job of spending government money only on effective care. Developing country-specific management guidelines, as has been done by the National Cancer Grid of India, and linking government insurance reimbursements to adherence to these could further encourage providers to deliver evidence-based care. Indeed, the misuse of technology in cancer care for profit is a major issue in many countries where health care is unregulated[19].

Systems of accreditation for cancer centres (public and private) could also help to ensure that institutions offer interventions only after demonstrating competence and achieving certain scores from patient feedback and peer review. They may also encourage the establishment of specialist centres. Data from the past 25 years have shown that cancer patients do much better if the surgeon treating them has operated on many others with the same condition as part of a multidisciplinary team[20].

Cancer 'moonshots' may improve individual outcomes in high-income countries with strong governance, but they will not solve the rising economic and social burden of cancer globally. What we need are 'earthshots' that focus on building infrastructure and delivering affordable, equitable and effective care.

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Nature News

周四, 28 9月 2017

Nature News

[周四, 28 9月 2017]

- **Nature News**

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Nature News

周五, 29 9月 2017

Nature News

[周五, 29 9月 2017]

- **Nature News**

Nature News

Nature is a weekly international journal publishing the finest peer-reviewed research in all fields of science and technology on the basis of its originality, importance, interdisciplinary interest, timeliness, accessibility, elegance and surprising conclusions. Nature also provides rapid, authoritative, insightful and arresting news and interpretation of topical and coming trends affecting science, scientists and the wider public.

- **Roads are slicing up giant pandas' habitat** [周三, 27 9月 08:00]
  Panda populations are rising, but the species has less living space today than three decades ago.
- **Giant, tree-dwelling rat discovered in Solomon Islands** [周三, 27 9月 08:00]
  But elusive coconut-cracking rodent may already be close to extinction.
- **Oldest traces of life on Earth may lurk in Canadian rocks** [周三, 27 9月 08:00]
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Giant, tree-dwelling rat discovered in Solomon Islands

But elusive coconut-cracking rodent may already be close to extinction.

27 September 2017

Velizar Simeonovski/The Field Museum

An artist's illustration of the newly-discovered giant rat, *Uromys vika*.

Mammalogist Tyrone Lavery first heard stories about ‘vika’, a giant, coconut-cracking, tree-dwelling rat from the Solomon Islands, in 2010. After years of searching for the elusive animal, he has finally confirmed its existence, making it the first new rodent species to be described from the islands in more than 80 years.

Lavery made ten separate survey visits to Vangunu island in the Western Province of the Pacific Ocean archipelago. But the only rat he could spot or capture was the introduced black rat (*Rattus rattus*). For years, the only non-anecdotal evidence he had that vika was real was a “really big rodent pellet, too huge to be from a black rat”, that he discovered on a hike in 2012. Just as he began to worry that the animal had gone extinct, a local conservationist gave him a call: a 46-centimetre-long, orange-brown rat had been collected from a felled tree.

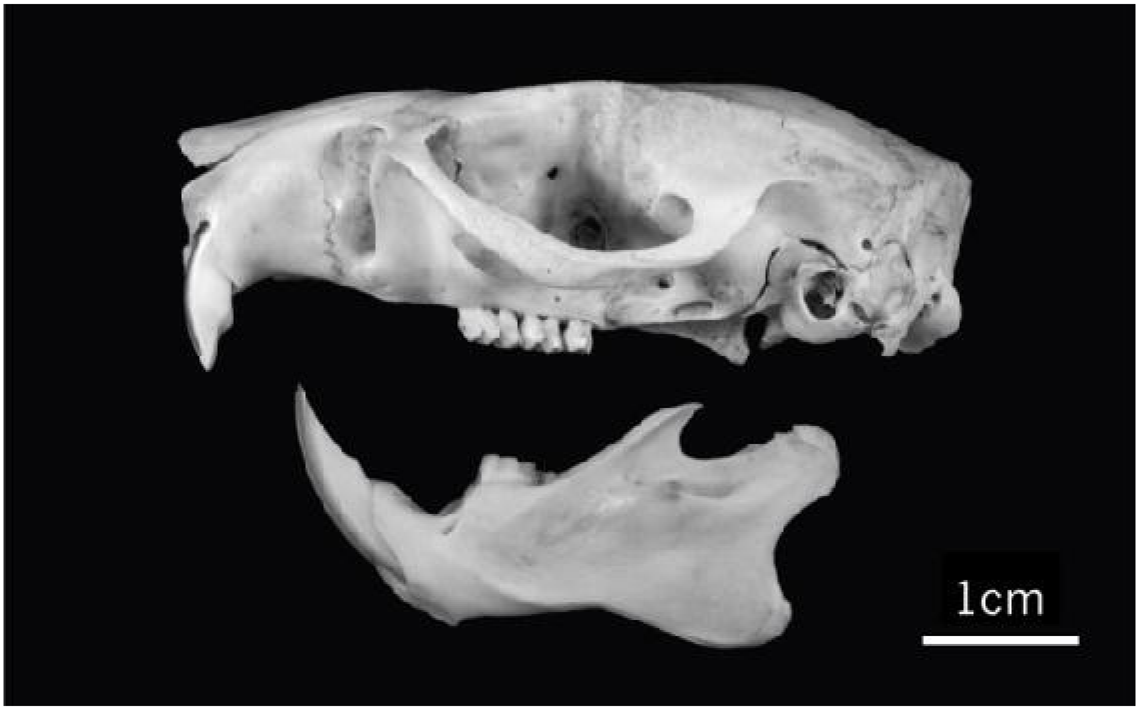
“To finally have vika in the hand was a very special feeling,” says Lavery, a postdoctoral researcher at The Field Museum in Chicago, Illinois, and lead author on the paper that describes *Uromys vika* (in honour of the local name), published on 27 September in the *Journal of Mammalogy*[1].

“I’m really excited by this animal,” says Kristofer Helgen, a zoologist at the University of Adelaide, Australia, who has identified many new species. “The Solomons have an incredible rodent fauna," he says, but most of the species suspected of inhabiting the islands are known only from hearsay, or from historical evidence such as partly fossilized bones found in caves, or skulls and skins in museums, often dating back to the 1880s. “This is a first-class discovery.”

Endangered

The animal that Lavery studied was found leaving a tree that had been felled by a commercial logging company. It died from its injuries, but was photographed. Hikuna Judge, a ranger with the Zaira Resource Management Area on Vangunu and the paper's second author, sent the rat on to Lavery, who at the time was at the Queensland Museum in Brisbane, Australia.

By the time Lavery examined the animal, almost all of its soft tissues had decomposed. But the cranium was complete, and his examination of it, along with the partial skeleton, hair and mandible, and the results of a DNA analysis, showed that this was indeed a new species. Its closest known relatives, two giant silver-coloured rats, lived on Guadalcanal island, to the southeast.



Tyrone Lavery/The Field Museum

The skull of *Uromys vika*.

The rat was not weighed before it decomposed, but Lavery thinks that an adult *U. vika* probably reaches between 500 grams and 1 kilogram. As well as perhaps coconuts, it probably eats fruits and other nuts. Given that only about 80 square kilometres of primary forest remains on Vangunu, Lavery estimates that there may be no more than 100 of the animals left.

The Solomon Islands, which lie about 1,600 kilometres northeast of Australia, are biologically isolated. More than half of the islands' mammals are found nowhere else in the world. Commercial logging is a major threat to their survival.

"I hope that Judge and Lavery continue documenting the fauna," says Jake Esselstyn at Louisiana State University in Baton Rouge, who was part of a team that found a new rat species on the island of Sulawesi, Indonesia, in 2013. “I’m sure there are more unknown mammals in the Solomons, and habitat loss could drive species to extinction before they are documented. There’s a good chance that has already happened.”

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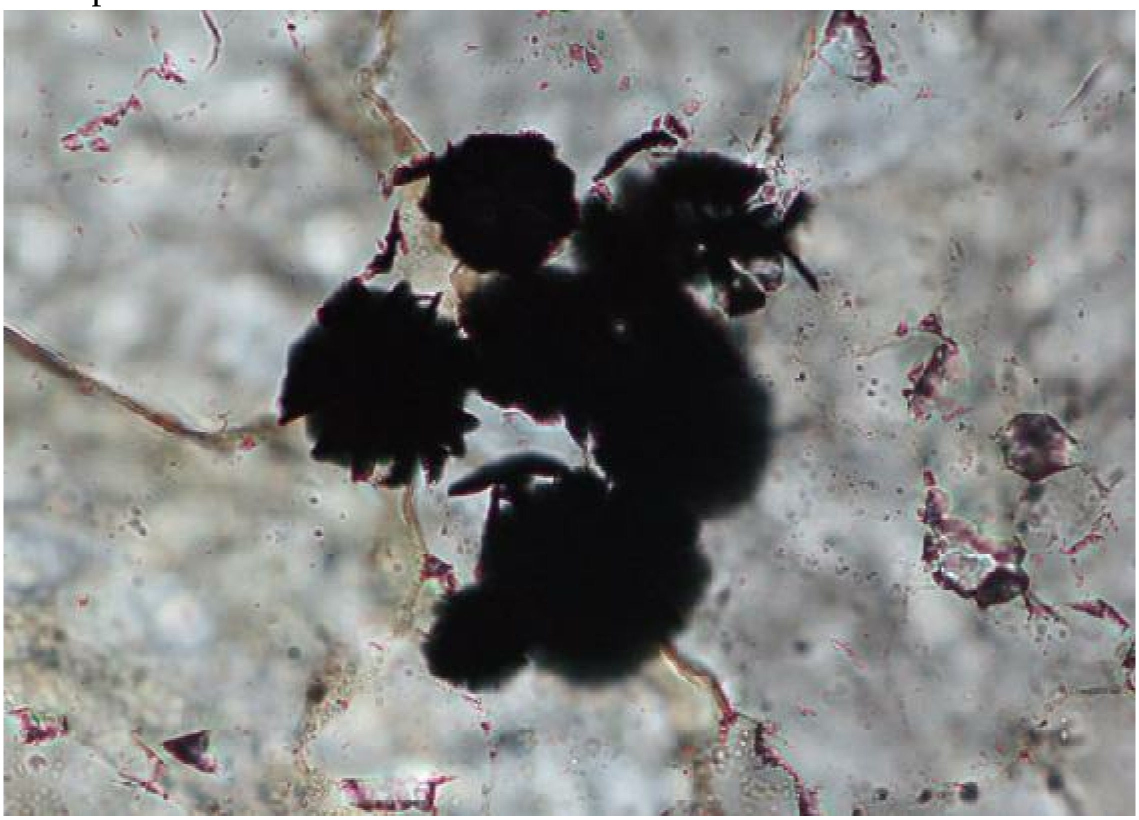
Comments

Commenting is currently unavailable.

Oldest traces of life on Earth may lurk in Canadian rocks

Researchers report chemical evidence of organisms that lived 3.95 billion years ago, but scepticism abounds.

27 September 2017



Komiya et al. Nature, 10.1038/nature24019

The microscope view shows dark grains of graphite that could contain traces of ancient life on Earth.

Ancient rocks in northeastern Canada could contain chemical traces of life from more than 3.95 billion years ago, a new study suggests[1]. If confirmed, the finding would be among the earliest known signs of life on Earth.

To some, the work adds to growing evidence that the young Earth was teeming with many different kinds of organism. “Accept it!” says Dominic Papineau, a geochemist at University College London who, in March, co-authored a report of possible fossilized microbes from Quebec that date back at least 3.77 billion years[2].

But others are sceptical that the latest work will hold up to scrutiny. Many previous claims of ancient life have been hotly contested — in part because rocks that formed billions of years ago have been severely heated and squished, making the geological context hard to interpret, and in part because the chemical traces of life can be difficult to distinguish from reactions that do not involve living organisms.

“When I read this I thought, ‘here we go again,’” says Martin Whitehouse, a geologist at the Swedish Museum of Natural History in Stockholm who, in 2002, co-authored a study[3] that criticized a similar report of ancient life in Greenland.

Rock block

The latest work investigated a set of rocks from northern Labrador, known collectively as the Saglek block. A team led by Tsuyoshi Komiya and Yuji Sano of the University of Tokyo visited the area between 2011 and 2013, fanning out among the rocky outcrops to gather samples while armed guards kept watch for polar bears.

In the 28 September issue of *Nature*, the researchers report analysing carbon isotopes in powdered rock and in individual graphite grains from the Saglek area. In some of the samples, they found relatively low amounts of the isotope carbon-13 compared to carbon-12, a lighter isotope with one less neutron in its nucleus. Organisms prefer to use carbon-12 to make organic compounds, and so material in which microbes once lived — like the Saglek rocks — becomes enriched in the lighter isotope.

Finding evidence of life in these ancient, highly deformed rocks “is surprising and exciting”, says Komiya. He says that he and his group have ruled out other possible explanations for the skewed ratio of carbon isotopes, such as decomposition of the mineral siderite. And the graphite seems to have crystallized at roughly the same temperature as that experienced by the rocks around it as they were squeezed and heated, which suggests the graphite isn’t just contamination that arrived later.

In previous papers[4, 5], Komiya’s team described the geological history of the Saglek block, and used uranium–lead dating on ancient zircon crystals inside a type of metamorphic rock called gneiss to conclude that the gneiss was 3.95 billion years old. They say that the graphite containing hints of life must be at least that old, because it lies within rocks that are apparently shot through with — and thus presumably older than — the 3.95-billion-year-old gneiss.

Yet that scenario prompts other scientists to raise a warning flag. “The graphite is in much younger sediment than the authors claim,” say geologists Monika Kusiak of the Institute of Geological Sciences at the Polish Academy of Sciences in Warsaw and Daniel Dunkley of Curtin University in Perth, Australia, who have been working to unravel the geological history of the Saglek block. They argue that the rocks that are supposedly shot through with the gneiss are not, in fact, older than it.

“Everything else in this paper is resting on the geochronology, and the geochronology is just not well-founded,” adds Whitehouse. “It’s a house of cards.”

Komiya says that he stands by his team’s interpretation.

Labrador links

The debate over the results resembles one that began in 1996, when a US–Australian–British team reported finding biologically altered graphite from at least 3.86 billion years ago inside grains of a mineral called apatite, in rocks on Akilia island off southwestern Greenland[6]. That work was criticized on many fronts[7], although some still argue that Akilia's rocks contain traces of ancient life.

Labrador's ancient rocks, including the Saglek block, lie directly across the Labrador Sea from Greenland. “There are a lot of similarities,” says Minik Rosing, a geologist at the Natural History Museum of Denmark in Copenhagen who has studied possible chemical traces of life in Greenland rocks[8]. “It's extremely complex geology.”

He applauds Komiya's team, but says that more remains to be done. “It's a good example of very sophisticated and high-quality analytical work,” he says. But the rocks are so complicated, he explains, that the graphite being studied “could be as young as 2.7 billion years old, and still pass all the tests”.

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Comments

Comments

There are currently no comments.

How the latest US travel ban could affect science

Short-term travel and meeting attendance could become harder for researchers from eight countries, including Iran.

27 September 2017

James Lawler Duggan/Reuters

US President Donald Trump has issued a series of policies to limit US immigration.

The latest version of US President Donald Trump's travel ban could make it harder for researchers from several countries to enter the United States to attend scientific meetings, perform research or visit relatives.

On 24 September, Trump announced permanent travel restrictions on citizens of Chad, Iran, Libya, North Korea, Somalia, Syria, Venezuela and Yemen. That list includes five Muslim-majority countries that were targeted in the White House's first and second travel bans, which Trump signed in January and March. Those policies, which were designed as temporary measures, have been limited by a series of federal court rulings.

Although the latest ban largely exempts students from any travel restrictions, its provisions appear poised to limit visits to the United States by working scientists. The rules vary by country; Iranians, for instance, can enter the United States only on student visas or temporary 'J' work visas, which are common among foreign postdocs in the United States. Citizens of Chad, Libya and Yemen can no longer enter the United States on business or tourist visas, and Syrians and North Koreans are barred in all circumstances.

The impact is likely to be greatest for Iran, which produces more scientists and engineers than the other countries included in the policy, says Russell Harrison, a senior legislative representative for IEEE-USA in Washington DC, which advocates for US members of the Institute of Electrical and Electronics Engineers. The White House policy will tighten security for Iranian students and researchers who already hold J visas, subjecting them to "enhanced screening and vetting requirements" if they travel outside the United States and attempt to re-enter the country.

Early impacts

Although there is no indication that the US will stop issuing student and J visas, no new long-term work visas will be available for Iranian citizens for the foreseeable future, Harrison says. "It will be difficult for researchers to get work in the United States for more than a relatively short period of time."

Iranian scientists planning brief visits to the United States are already feeling the effects of the latest ban. Arvin Haghighatfard, a graduate student at Islamic Azad University in Tehran, had hoped to present his research on the genetic basis of internet addiction at the American Society of Human Genetics conference next month in Orlando, Florida. "The president's new travel ban really disappointed me and all of my colleagues," says Haghighatfard, who says that the United States refused to consider his visa application in light of the latest restrictions.

The same is true for Hossein Azizi, a geologist from the University of Kurdistan, in Sanandaj, Iran. He recently received an invitation to visit the United States and collaborate with geologist Robert Stern of the University of Texas in Dallas. "It was one of my best days in my life," Azizi says. But uncertainty over whether he can secure a US visa has jeopardized those plans. "We know there are many problems between political men," says Azizi. But geologists' work on the formation of the Earth "belongs to humanity and science", rather than to geopolitics, he adds.

Legal challenges expected

The White House says that the latest ban will remain in place until the eight listed countries improve their processes for screening travellers. But the policy is widely expected to be challenged in court in the coming days — and it is already affecting legal challenges to the previous US travel bans.

On 25 September, the US Supreme Court cancelled its scheduled hearings for a lawsuit over the first two bans, which were partly overturned on the grounds that the original policy appeared to target Muslims. The court asked both sides to clarify whether the latest ban negated the stipulations of the earlier bans.

Some immigration experts worry that the unpredictability of Trump's administration will be more of a deterrent to foreign students and researchers than the standard US visa bureaucracy has been up to this point. Immigrant scientists report longer delays in visa processing since Trump took office, and confusion about the constantly changing travel bans, says Brendan Delaney, an immigration attorney at Hill, Frank & Delaney in Bethesda, Maryland.

"The uncertainty for people is probably the biggest issue," he says. "I think people from many countries, not just Muslim-majority countries, exhibit a higher degree of concern because they don't know where this is going.

There's just no way to know what's actually going on in the background."

Delaney expects that someone will sue the Trump administration over the latest travel ban within the next few days, and that the case will eventually reach the Supreme Court. The court's ruling, he says, "will hopefully bring a finality to where we stand on this issue".

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European detector spots its first gravitational wave

Black-hole merger pinpointed with record accuracy by the LIGO and Virgo observatories.

27 September 2017

Schiavon/INFN

One of the arms of Virgo, a gravitational-wave observatory near Pisa, Italy.

Physicists have announced their fourth-ever detection of gravitational waves, and the first such discovery made together by observatories in Europe and the United States.

The Virgo observatory near Pisa, Italy, has been hunting for ripples in the fabric of space-time since 2007. But it was being upgraded at the time of the historic first detection of gravitational waves by the twin laboratories of Virgo’s US cousin, the Advanced Laser Interferometer Gravitational-Wave Observatory (LIGO), and was also out of action for two subsequent sightings.

Virgo rejoined the hunt this year on 1 August, following a 5-year, €23-million (US$27-million) upgrade. And on 14 August, both it and LIGO picked up the gravitational vibrations emanating from a pair of rotating black holes, with masses of 31 and 25 times that of the Sun, as they merged together, physicists announced on 27 September at a press conference in Turin, Italy. The collision happened around 540 million parsecs (1.8 billion light years) away.

Observing the event with three detectors, rather than LIGO’s two, allowed researchers to dramatically increase the accuracy with which they can pinpoint the location and distance of the merging black holes.

A simulation of the black holes colliding.

Numerical Simulation: S. Ossokine, A. Buonanno (Max Planck Institute for Gravitational Physics), Simulating eXtreme Spacetimes project; Scientific Visualisation: T. Dietrich (Max Planck Institute for Gravitational Physics), R. Haas (NCSA)

For the Virgo team that has spent more than 20 years working on the project, the sighting is vindication that the time and effort was worth it. “It’s a big event for me,” says Alain Brillet, a physicist at the University of the Côte d'Azur in Nice, France who co-founded Virgo. He began lobbying to build a European gravitational wave detector in 1980, and is now about to retire. “It’s very nice to become sure that you have not worked for nothing,” he says.

“We have credibility. At least we can show that we make promises and we can deliver on our promises,” adds Jo van den Brand, a physicist at the VU University Amsterdam and spokesperson for the Virgo Collaboration.

This year's observation run ended on 25 August, and now both observatories are working on upgrades that should double their sensitivity. “This is just the beginning of observations with the network enabled by Virgo and LIGO working together. With the next observing run planned for late 2018, we can expect such detections weekly or even more often,” says David Shoemaker, a physicist at the Massachusetts Institute of Technology in Cambridge and spokesperson for the LIGO collaboration.

Triple power

Named GW170814, after the day it was detected, the wave arrived first at LIGO’s station in Livingston, Louisiana, as a ripple in space-time that subtly shifted the relative lengths of two arms of the detector as it passed. Just eight milliseconds afterward, the same wave swept past LIGO’s second detector in Hanford, Washington, before arriving at Virgo six milliseconds later.

With three detectors, physicists can be more precise about the wave's origin than was possible before. On the basis of the time that Earth’s detectors received the signal, the teams triangulated the likely location of the source, whittling it down to a patch of sky that, as seen from Earth, appears about 300 times the size of the full Moon. That region is more than 10 times smaller than LIGO has managed to pinpoint for its previous sightings.

Having three detectors also enables researchers to make a rough measurement of the wave’s polarization — a property that describes how the wave propagates through space in three dimensions. This meant physicists could test a prediction made by Albert Einstein’s theory of relativity, which, besides predicting gravitational waves, also implies that such waves should stretch and contract space in planes that lie at right angles to each other. The data from GW170814 seem to support this, Frédérique Marion, a physicist at the Laboratory of Particle Physics in Annecy-Le-Vieux, France and member of the Virgo Collaboration, told journalists at the press conference. “This was the first opportunity to check this fundamental property of gravitational waves,” she said.

The same polarization measurement also indicates how the black holes’ orbital plane (the plane on which they rotate around each other) is orientated with respect to Earth. Because this angle dictates how much gravitational-wave energy is emitted in Earth's direction, combining polarization with other data allowed researchers to derive a more precise estimate of total energy released by the event and so reduce the error in their distance estimate**.** A paper describing their findings has been accepted for publication in *Physical Review Letters*.

Precisely targeting the origin of a gravitational-wave signal is a significant step forward, says van den Brand. Some events — such as a collision of two neutron stars — are expected to produce such ripples and could emit a wide range of other kinds of radiation as well. If telescopes could be trained to look in precisely the right place after such a detection, they could spot this, and help astronomers to learn much more about the cataclysmic events.

Some 25 telescopes raced to observe the patch of sky after the latest sighting, but none saw any kind of electromagnetic radiation coming from the event. No such signals would be expected from colliding black holes, however.

Simultaneously 'seeing' a neutron-star collision with conventional telescopes and 'hearing' it through the vibrations of gravitational waves would mark a new era of astronomy. Last month, rumours swelled that the LIGO and Virgo teams might already have seen colliding neutron stars: telescopes are known to have been trained on a specific patch of sky after being alerted to another potential gravitational-wave detection. But the collaborations have yet to confirm what, if anything, their observatories saw.

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Comments

Commenting is currently unavailable.

Scientists see opportunity and risks in Catalan independence

The upcoming referendum is unsettling researchers.

27 September 2017

Pau Barrena/Bloomberg/Getty

Uncertainty over the Catalan independence vote has unsettled scientists.

There has been a run on George Orwell’s dystopian novel *1984* in this era of alternative facts. Orwell also wrote the 1938 *Homage to Catalonia*, in which he described his admiration for the region’s distinct character. It, too, may be worth a reread.

The region’s centuries-long struggle for independence from Spain is in acute crisis. The Catalonian government in Barcelona is holding a referendum on the issue on 1 October. The central government in Madrid says the vote is illegal.

Reverberations from the chaotic stand-off can be felt even in research labs, where many scientists have told *Nature* they hold conflicting views: science would have a lot to gain from independence, but also a lot to lose.

Catalonia has upped its scientific game since the economic boom of the late 1990s. It created a handful of high-level research centres and an agency that recruits and pays the salaries of top scientists, who can choose their host Catalan institute or university. These moves, among others, have allowed Catalonia to overtake the rest of Spain in some measures of scientific achievement. In the most recent round of European Research Council (ERC) starting grants, for example, 10 of the 22 awarded to researchers in Spain went to the region, which is home to just 15% of the Spanish population. Of those ten, most of the recipients were foreigners, testimony to the region’s international attractiveness.

Many scientists believe that an independent Catalonia could change the scientific landscape even more fundamentally, not least by releasing universities from old-fashioned and inflexible national laws. Yet in the event of independence, Catalonia would automatically leave the European Union, and Spain would make sure it never got back in. That would weaken the region’s research. For one thing, it would no longer be allowed to host those plentiful ERC grants.

Still, many Catalan researchers say they will vote ‘yes’. Their emotions have only been fanned by Madrid’s move in mid-September to block the budgets of public bodies, including research institutes and universities, in an attempt to stop financing of the referendum.

The political uncertainty is likely to escalate whatever the result. And this is damaging. The independence debate has distracted Catalonian politicians from other issues, including science. Frozen budgets threaten the world-class status of the institutes that the region has so carefully built up — and that it will need, whatever political solution emerges.

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Comments

There are currently no comments.

Univ.
Sussex

Don’t let disaster recovery perpetuate injustice

Poor and minority communities already bear the brunt of natural catastrophes. Rebuilding efforts must not increase disparities, warns Benjamin K. Sovacool[1].

27 September 2017

The past 40 days have seen two major earthquakes in Mexico, three hurricanes striking the Caribbean and the southern United States, and floods across Bangladesh, India and Nepal. Rebuilding efforts will take years. If things go as usual, these could leave the worst off relatively worse off and the environment more vulnerable.

Most recovery projects do produce net benefits. But many boost social inequality and environmental damage. They create winners (commonly trumpeted) and losers (often ignored). They can also interfere with environmental policies (such as those limiting exposure to toxic chemicals) or stymie efforts at climate-change mitigation (through deforestation and rebuilding with carbon-intensive materials, for example).

Some reconstruction efforts after the 2004 Indian Ocean tsunami came under criticism for prioritizing tourist venues. Such areas were often already more vulnerable, because sand dunes and mangroves had been sacrificed for better ocean views.

Coastal-protection measures implemented after the tsunami were often counterproductive. In the Maldives, the erection of sandbars (made from dredged materials) and sea walls unintentionally reduced the flow of nutrients to coral reefs, and weakened a natural bulwark against storm swells and surges.

It was a similar story in 2011 in Vermont, after Tropical Storm Irene. Gravel dredged from riverbeds to repair roads made the roads more susceptible to future storms.

Disaster-recovery efforts can also result in the redesign of urban areas in ways that favour the wealthy. The best-known example is the 1906 earthquake that ruined much of San Francisco in California. After it, city leaders tried to move Chinatown from its central location to a more marginal neighbourhood.

A century later, in New Zealand, the Canterbury quakes of 2010 and 2011 consolidated national political power at the expense of local groups. Here, disaster recovery interfered with due process and procedural justice. Community officials and residents were excluded from decision-making processes over the status of their homes when a central-government authority was granted power to acquire and dispose of property and suspend laws and regulations.

In Louisiana, recovery efforts after Hurricane Katrina in 2005 enabled private companies to capture public housing. Homes owned or occupied predominantly by poor evacuees were declared a nuisance, marked for demolition and resold at cut-throat rates. When the federal government allocated billions of dollars to the Army Corps of Engineers to fix, upgrade and rehabilitate levees and flood walls, this served only to entrench, rather than eliminate, vulnerability among some poor communities. To hasten repairs after Katrina, environmental and air-pollution standards were relaxed: hazardous wastes were not properly stored and open burning was allowed.

Clean-up efforts concentrated toxic pollution and debris in particular landfills or alongside communities of colour. Sediment left in the wake of floodwaters contained high levels of arsenic, raising its concentrations in soils at playgrounds and schools in minority neighbourhoods. Although some long-term restoration planning is worthy of praise, there is plenty to criticize. The rebuilding of canals and roads further eroded environmental buffers (such as wetlands) crucial to future storm-surge mitigation.

Disparities exist before disaster strikes; recovery plans that do not account for these inequities can easily widen or further embed them. This is a danger with Hurricane Harvey, which seems to have hit poorer and minority communities hardest. Such communities also lived nearest to the Arkema chemical plant in Crosby, Texas, which exploded after the storm. Similarly, many of the flooded Superfund sites — areas polluted with toxic chemicals and requiring long-term clean-up — are located in poor or minority communities.

We can no longer simply assume that disaster-recovery efforts sufficiently involve, protect and empower those most in need. They often don't. Plans that 'look good on paper' can be extremely problematic.

So what now? One solution is to encourage greater community involvement. Promising examples include community-based afforestation efforts in Bangladesh after Cyclone Sidr in 2007, resilience-building efforts in Indonesia prioritizing the inclusion and training of women, and the creation of grass-roots women's cooperatives to address drought in Kenya.

Managers of recovery efforts should be explicitly charged with identifying community and minority groups and seeking their input. Assessments of the social and environmental impact of recovery must be more dynamic, and conducted by panels charged to take complex existing disparities into account, to collect facts and to report grievances. We need insurance schemes that spread the risks of disasters. And we need to trial 'environmental bonds' that withhold compensation from projects that damage communities or the environment. Above all, we need to put vulnerable groups and fragile ecosystems front and centre in the aftermath of disasters.

If we do not reconceive the ethics and politics of disaster-recovery efforts, we will not be able to design more effective, fair procedures and projects. How national and international policymakers act next will be crucial to building fair and sustainable communities for the people most affected by disasters.

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Comments

Comments

There are currently no comments.

Giant pandas, gender lawsuit and more disaster havoc

The week in science: 22–28 September 2017.

27 September 2017

Events | Environment | Publishing | Politics | Research | Trend watch

EVENTS

Mexico hit by two earthquakes in 12 days A magnitude-7.1 earthquake struck central Mexico on 19 September, killing more than 320 people and reducing buildings to rubble in the states of Puebla, Morelos and Guerrero, as well as in Mexico City. The event came 12 days after a magnitude-8.1 tremor hit off the state of Chiapas — Mexico's largest quake in more than a century — and 32 years to the day after the country's most damaging tremor, an 8.0, killed thousands. Like the recent Chiapas quake, the 19 September tremor struck in the middle of the Cocos geological plate. Seismologists say that the 7 September and 19 September quakes are unlikely to be linked.

Carlos Jasso/REUTERS

Discrimination suit A former vice-president of intellectual property at Synthetic Genomics, a biotechnology company co-founded by genomics entrepreneur Craig Venter, has filed a gender-discrimination lawsuit against the firm. The suit, reported by *The San Diego Union-Tribune* on 19 September, alleges that senior-level staff at the company, based in La Jolla, California, hired and promoted women less often than men, and that women were regularly denigrated and excluded from meetings. It also enumerates the under-representation of women in senior-level positions within the company. Teresa Spehar, the plaintiff, had worked at the company for more than eight years before she was fired in June. Synthetic Genomics chief executive Oliver Fetzer stated that the company will defend itself against the allegations.

Smoke control The global authority for the World Health Organization (WHO)'s tobacco-control convention has condemned the launch this month of the Foundation for a Smoke-Free World. The foundation, based in New York City, will receive US$80 million a year in funding for 12 years from tobacco company Philip Morris International, and is led by a former WHO official. In a statement on 19 September, the WHO Framework Convention on Tobacco Control (FCTC) Secretariat called the move “a clear attempt to breach the WHO FCTC by interfering in public policy” and “a deeply alarming development aimed at damaging the treaty’s implementation, particularly through the Foundation’s contentious research programmes”.

Hurricane havoc Hurricane Maria intensified from a category 1 to a category 5 storm within 15 hours on 18 September before sweeping into Puerto Rico two days later. After making landfall as a category 4 hurricane, the storm’s pounding winds and floodwaters devastated the island, wiping out its entire electricity grid. Debris punctured several areas on the 305-metre-wide dish at the Arecibo Observatory, a radio telescope nestled in the mountains in the western part of the country. Maria is the fourth major Atlantic hurricane this season — following Harvey, Irma and Jose — and is the strongest hurricane to hit Puerto Rico since 1932.

ENVIRONMENT

Marine parks More than 1,200 scientists from 45 countries have signed an open letter urging Australia to reconsider plans to reduce protections in its marine parks. The 21 September letter states that, with its proposal to expand the size of fishing zones in marine reserves, released in July (see *Nature* http://doi.org/cdd4; 2017), the government is ignoring scientific evidence. The authors say substantial research has shown that strict protection from fishing conserves biodiversity, helps damaged ecosystems to recover and improves the health of fisheries. Public comments on the draft plans closed on 20 September.

Fred Bavendam/Minden/NGC

A pink anemonefish (*Amphiprion perideraion*) in the Great Barrier Reef Marine Park

Arctic ice Arctic sea-ice cover seems to have bottomed out for the year, at the eighth-lowest annual minimum in the 38-year satellite record, the US National Snow and Ice Data Center announced on 19 September. On 13 September, the ice cover was 4.64 million square kilometres, which is 1.25 million square kilometres more than the same date in 2012, the year of record-low ice extent. Low atmospheric pressure over much of the Arctic Ocean this summer helped to stem this year's ice loss.

Korean air South Korea announced a set of measures to fight its worsening air pollution on 26 September. The government will shut down seven ageing coal plants, introduce monitoring and levies on industrial emitters of nitrogen oxide and offer incentives to switch from diesel to electric vehicles. Such actions are aimed at achieving a 30% reduction in domestic emissions of hazardous fine particulate matter less than 2.5 micrometres in diameter

($PM_{2.5}$) by 2022. The nation's average exposure to $PM_{2.5}$ is the highest of all member nations in the Organisation for Economic Co-operation and Development.

PUBLISHING

Preprint push A preprint server for the Earth and planetary sciences called the Earth and Space Science Open Archive (ESSOAr) should launch early next year, the American Geophysical Union in Washington DC announced on 21 September. The site, to which geoscientists can post findings before peer review, faces competition. Researchers are planning to launch another service, EarthArXiv, soon on a platform hosted by the Center for Open Science in Charlottesville, Virginia; the centre already supports preprint sites for engineering, sociology and psychology, among other fields.

POLITICS

US–UK deal The United States and the United Kingdom have signed their first umbrella agreement to collaborate on science. The 20 September deal commits the countries to improving scientific cooperation, for example by enabling easy travel of people and equipment between the two nations. At the same time, the United Kingdom announced £65 million (US$88 million) in funding from existing science spending for the Deep Underground Neutrino Experiment, which will construct neutrino detectors in Batavia, Illinois, and Lead, South Dakota, to study these subatomic particles.

German election Angela Merkel is set for a fourth term as German chancellor after her Christian Democrat Union party won the largest share of seats in the nation's 24 September election. But she will have to negotiate with new allies to form a leadership coalition, after her political partners in the previous government, the Social Democrats, lost support and declared they would enter opposition. That could open up policy rifts on issues such as gene editing and climate regulations. The far-right group Alternative for Germany (AfD) saw its support surge, and it is now the third-largest in parliament, but Merkel ruled out including it in a coalition.

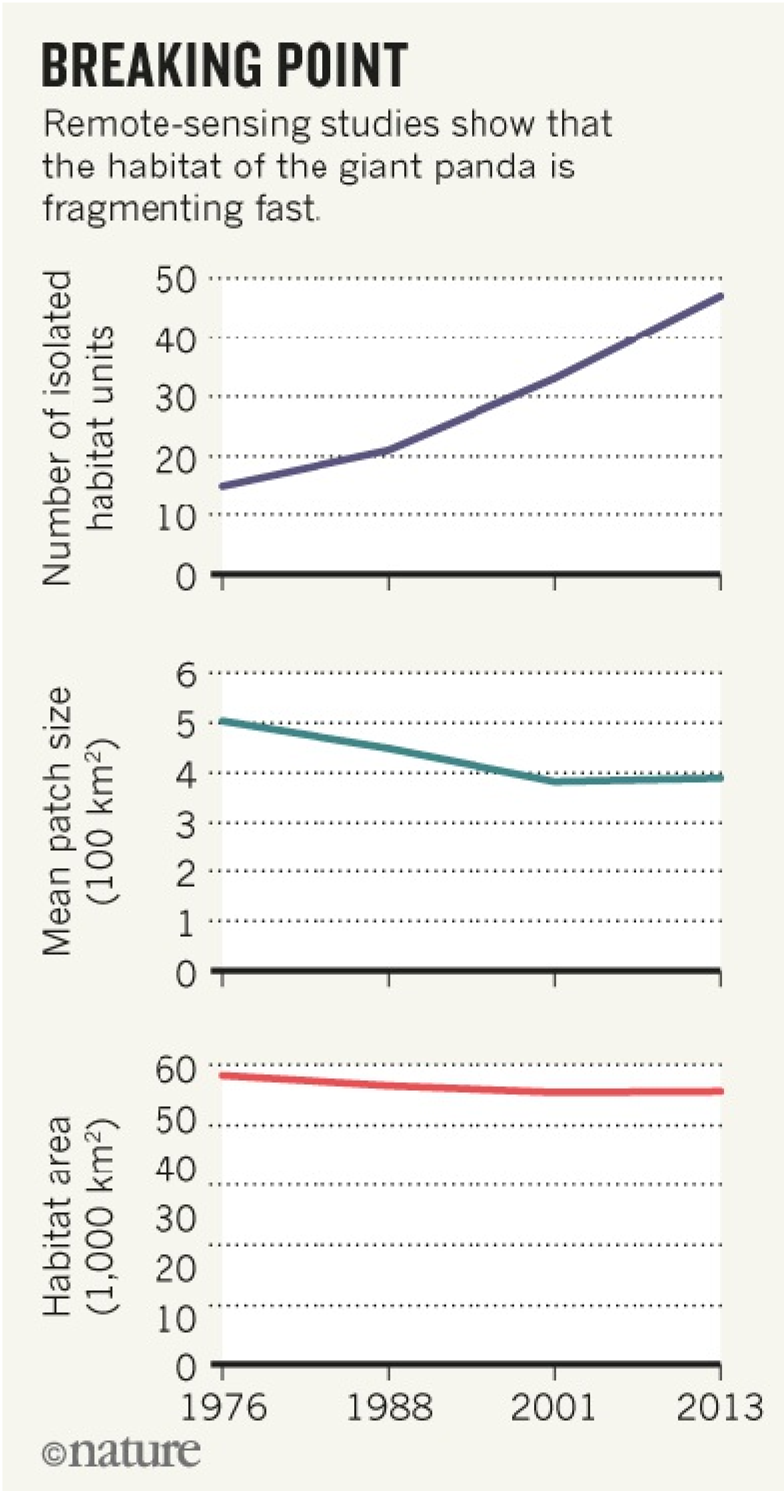
Space agency Australia will establish a national space agency. Michaelia Cash, the country's acting minister for industry, innovation and science, made the announcement on 25 September, coinciding with a meeting of the 2017 International Astronautical Congress in Adelaide. Australian scientists welcomed the news, saying that it will make international space collaborations easier and help to foster jobs in space industries. The announcement comes ahead of the release of a government-commissioned expert review into Australia's space-industry capabilities, due for completion by March 2018. The review will now also develop a charter for the space agency, Cash says.

RESEARCH

RNAi victory An RNA interference (RNAi) therapy has become the first to meet its goals in a phase III clinical trial. Companies have struggled for years to produce a successful RNAi therapy — which uses bits of RNA to interfere with the expression of target genes — prompting some experts and investors to question the feasibility of such treatments. But on 20 September, Alnylam Pharmaceuticals of Cambridge, Massachusetts, announced that its drug patisiran had significantly alleviated symptoms in a trial of 225 people with hereditary ATTR amyloidosis with polyneuropathy, a rare and potentially fatal disease caused by mutations in the *TTR* gene. Patisiran lowers levels of the TTR protein, making it easier for the body to clear clumps of mutant versions of the molecule that can lead to nerve and organ damage.

TREND WATCH

Remote-sensing data show that there is less giant panda habitat today than in 1976 (during China's first national panda survey) or than when the species was listed as endangered in 1988. Bamboo forests in which pandas live shrank by 4.9%, to about 55,500 square kilometres between 1976 and 2001. Habitat increased slightly, by 0.4%, from 2001 to 2013. But the remaining areas are more fragmented, with the number of habitat units isolated by roads and rivers tripling in the past four decades.



Source: W. Xu et al. Nature Ecol. Evol. http://doi.org/cdjr (2017)

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There are currently no comments.

Hurricanes Harvey and Irma send scientists scrambling for data

Even before getting their own lives settled, teams collect information on storm behaviour and their effects on the ecosystem.

27 September 2017

Brian Blanco/Getty

Flooding near Venus, Florida, highlights the challenges people in the state face when picking up the pieces of their personal and professional lives.

When Hurricane Irma tore through Florida in early September, 40 scientists took shelter in the Archbold Biological Station, a fortified research facility in the south-central part of the state. They huddled there with friends, family and pets while floods and pounding winds destroyed homes across the state. It will take months for those researchers and others to assess the extent of the destruction left behind by both Irma and Hurricane Harvey, which blasted through the Caribbean and the Gulf of Mexico.

But even as they try to get their own lives in order, scientists across the region have already started gathering data that they hope will improve understanding of how these extreme storms behave, how to improve public safety and how delicate ecosystems react.

It is fairly rare to see such intense hurricanes hitting the US mainland, says Joshua Wurman, a meteorologist at the Center for Severe Weather Research in Boulder, Colorado. When they made landfall, Harvey and Irma were category 4 storms — the second most extreme rating on a scale of 1 to 5 — and their swirling winds were of particular interest to Wurman and his team. So the researchers drove an instrument called a Doppler-on-wheels (DOW) to Texas and Florida to collect data from the eyes of both hurricanes.

The DOW is a mobile Doppler radar dish bolted onto the back of a flatbed truck that scientists position in the path of hurricanes and tornados. It takes high-resolution measurements of wind speed and direction, as well as the speed and quantity of precipitation, in real time.

Wurman and his colleagues measured a surprising mosaic of wind speeds in Harvey and Irma. Some pockets within the hurricanes had wind speeds of up to 225 kilometres per hour (140 miles per hour), nearly 30% higher than those of nearby pockets. “In Harvey, 140-mile-per-hour gusts were ripping apart buildings and throwing cars,” says Wurman. Understanding where the most extreme winds will materialize in a hurricane can help to improve the accuracy of public warnings, he says.

Shelter in place

The DOW crew was able to leave Texas and Florida soon after gathering the data. But the scientists who took shelter in the Archbold Biological Station — which is nestled in the headwaters of the Everglades wetland region in

Venus, Florida — live and work in the state.

Evelyn Gaiser, an aquatic ecologist at Florida International University in Miami, was one of the researchers who weathered Irma at the station. After the storm, she says, “we were all outside collecting data”.

Roughly 50 researchers work from the station throughout the year, says biologist Hilary Swain, Archbold’s executive director. Their projects range from monitoring the area’s lakes and ecosystems to carrying on a long-term observational study of a population of Florida scrub jays (*Aphelocoma coerulescens*) listed as threatened by the federal government. Initial checks on the birds found that they had weathered Irma just fine.

Gaiser studies nearby Lake Annie, and found that Irma had upended its temperature profile. Normally, layers of warm water rest on top of cooler layers — but the hurricane brought colder waters to the surface. In the next few months, Gaiser will be monitoring whether or not that inversion has affected the lake’s plant communities.

Another priority for Gaiser is checking on a long-term ecological research project that she oversees in Everglades National Park in south Florida. Officials closed the park on 6 September in preparation for Irma and started reopening certain areas on 21 September. Gaiser is not sure when her team will be able to access the project’s sites.

Increased amounts of salt water, carried in by storm surges, can disrupt the delicate balance of fresh- and saltwater systems that shape the region. “Fresh water is the lifeblood of the Everglades,” Gaiser says. She is anxious to see how the mix of water from the storm surge, rain and run-off has affected the health of the wetlands, and is planning to submit a proposal for a rapid-response research grant from the US National Science Foundation to help collect those data.

Salting a marsh

Merryl Alber, a marine ecologist at the University of Georgia in Athens, will be taking similar measurements at sites for her own long-term ecological research project on Sapelo Island, a barrier island off the Georgia coast that was also affected by Irma. In an ongoing experiment in the island's freshwater marshes, her team adds diluted salt water to 6.25-square-metre plots to simulate salinity increases from rising sea levels, storm surges or droughts.

After Irma, Alber returned to Sapelo briefly to check her experimental sites. She found that a 1.5-metre-high storm surge had raised salinity to 5 times the base levels in the artificially salted sites.

Irma's storm surge was a naturally occurring amplification of the experiment that Alber and her team have been doing for years, and Alber plans to compare its effects with their past findings. But that will take time. The labs and some of the researchers' homes on the island flooded during the storm.

The team will follow through on its annual data collection at the long-term research sites, says Alber. But with so much destruction in the region, her work isn't the only thing on her mind. "It's a little less the science we're worried about. It's the people."

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A quantum pioneer unlocks matter’s hidden secrets

Physicist Gil Lonzarich has sparked a revolution in the study of phase transitions driven by quantum fluctuations.

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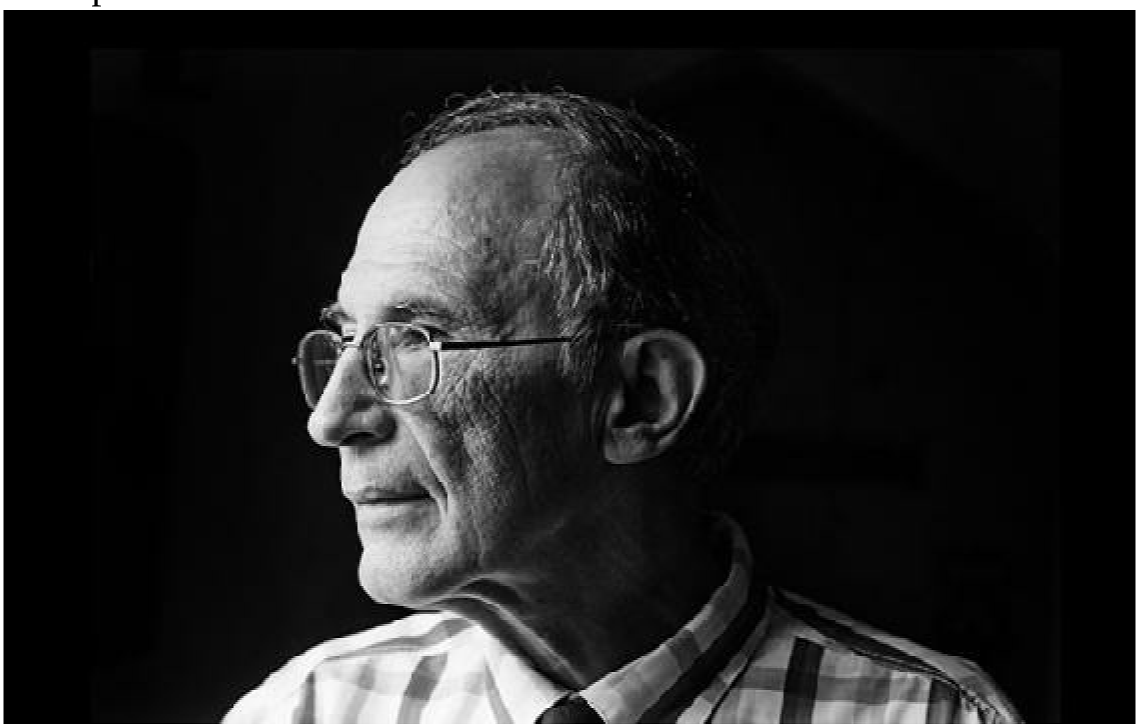


Brian David Stevens for *Nature*

In 1989, surgery for detached retinas left Gilbert Lonzarich blind for a month. Rather than feel shaken or depressed, the condensed-matter physicist at the University of Cambridge, UK, seized the opportunity, inviting his graduate students to his house to share with them how exciting it was to adapt to life without sight. Lonzarich's embrace of the experience perfectly captures his approach to life, says Andrew Mackenzie, then one of those students and now a director at the Max Planck Institute for Chemical Physics of Solids in Dresden, Germany. “Gil is one of the most positive people I've ever met. He finds interest in everything,” he says.

For more than 40 years, that optimism and curiosity has led Lonzarich to probe materials in ways never thought possible. In pioneering experiments in the 1990s, his team showed that pushing magnetic compounds to extreme pressures and close to absolute zero can make some of them conduct electricity without resistance[1]. This flew in the face of convention, which declared that magnetism and superconductivity could never mix. “It was as if nowadays you were talking about finding aliens or something,” says Malte Grosche, a colleague at Cambridge.

That work showed physicists a new way to hunt for superconductors, which lie at the heart of technologies such as magnetic resonance imagers and particle accelerators. In recent years, it has offered a potential explanation for why some materials remain superconductors at temperatures much higher than absolute zero, which could pave the way to developing efficient, cheap devices that superconduct at room temperature.

But the experiments have had an impact well beyond superconductivity. Lonzarich's method of subjecting materials to extreme conditions has become a general recipe for discovering new states of matter. Around the world, physicists now use this approach to probe a range of materials in which the collective interactions of electrons can give rise to unusual behaviour. Some of these phenomena could potentially revolutionize computing.

Lonzarich's research may be legendary in his community, but the physicist's humility and generosity are what endear him to his colleagues. He is famously unconscious of time; a casual conversation with Lonzarich can easily lead to an hours-long random walk through the byways of physics, philosophy, politics and history. That might mean a missed lunch, says Michael Sutherland, a Cambridge colleague — “but it's the most productive few hours you'll have all week”. Phone calls with peers frequently last into the small hours of the morning, and on the rare occasions when Lonzarich goes to a conference, he invariably attracts a mass of fellow attendees. “People who meet him even once or twice develop a sense of attachment and awe,” says Louis Taillefer, another former student, who is now a physicist at the University of Sherbrooke in Canada.

At 72, Lonzarich now has a part-time role in the Cambridge quantum-matter group, but he is still making new discoveries by pushing materials to ever-greater extremes. He sees this little-explored realm as just as fundamental to unravelling the laws of physics as the high-energy experiments at particle colliders, and expects that there is plenty more to discover. “Gil has never believed that we're now just filling in the details,” says Piers Coleman, a theoretical physicist at Rutgers University in Piscataway, New Jersey. “He really views the exploration of quantum matter as a true frontier.”

Collective efforts

Walking around a timeworn study at Trinity College, Cambridge, Lonzarich is eager to point out a portrait of the economist John Kenneth Galbraith, one of his heroes, and he talks enthusiastically about the impressive work of his colleagues. But when conversation turns to his own achievements, Lonzarich becomes reticent. It is human nature is to celebrate heroes, he says, but science is a collective activity, and singling out individuals for praise stifles a team.

Although colleagues are quick to highlight Lonzarich's influence, he never would — a practice that could be traced back to his upbringing, by Italian parents, on the Istria peninsula. His father told him to “always cut the larger slice of the pie for the other person”, he recalls. At school, he learnt about the Roman Republic and was intrigued by the importance placed on reason, compromise and collaborative governance.

His family moved to the United States when he was nine. By the 1960s, Lonzarich had grown into a studious young man. His interest in physics began at the University of California, Berkeley, where he earned a liberal arts degree. It was there that he met Gerie Simmons (now Lonzarich). The pair had admired each other from afar before she engineered their meeting by pretending to need a physics tutor; they married in 1967.

“On the rare occasions I've seen pictures of him from those days, he had long hair. He was a physics hippy," says Coleman. But although Lonzarich felt strongly that people should challenge the government, including the United States' nascent war in Vietnam, he became disillusioned with the counter-culture's free use of drugs and rejection of family. "I wanted to be able to do something tangible, to make good use of life. I didn't think we were doing that," he says.

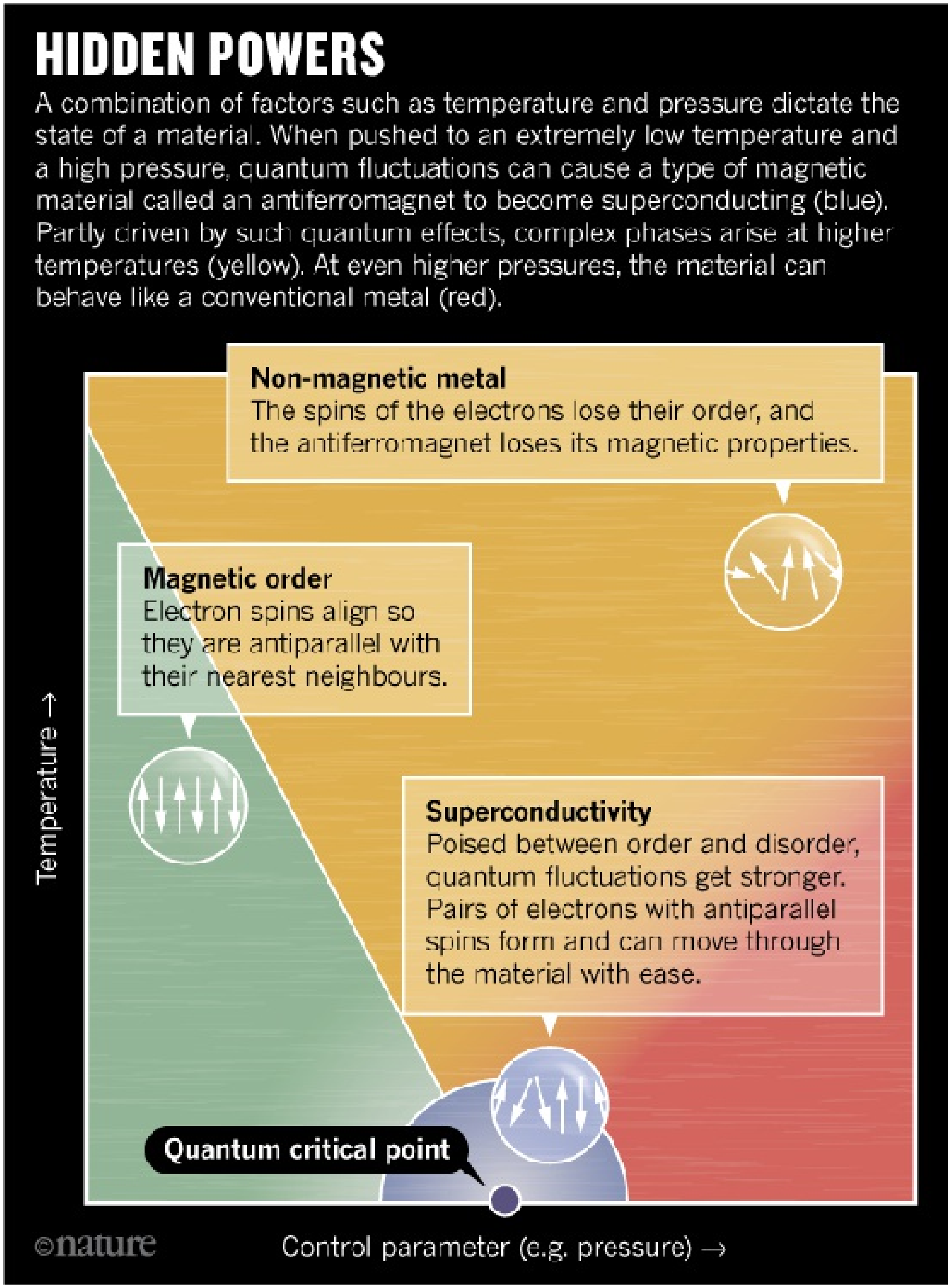
After a they spent a spell at the University of Minnesota in Minneapolis, the darker side of the movement eventually drove Gerie and Gil away from the United States altogether, to the University of British Columbia in Vancouver, Canada. There, Lonzarich became fascinated with magnetism, while working on his PhD in a new laboratory led by condensed-matter physicist Andrew Gold. When he left in 1976 for a stint at Cambridge, he found his new Rome. The collegiate structure had no real hierarchy and boasted two giants of condensed-matter physics — Brian Pippard and David Shoenberg. What was intended to be a one-year European adventure ended up lasting more than 40 years.

Lonzarich arrived at Cambridge wanting to study magnets — materials in which the spins of electrons all spontaneously align. His approach raised a few eyebrows at first: he developed his own mathematical notation and would spend weeks preparing his experiments while seeming to do nothing. But his methods soon began to bear fruit.

In magnetic materials, spins maintain their orderly arrangement only up to a point; above a certain temperature, electrons have so much energy that they can easily overcome the forces that cause their spins to align. Lonzarich reckoned that the best way to understand magnetic materials was to push them to that point, where they would be poised on the knife-edge between order and disorder. In particular, he was interested in exploring what might happen if the magnetic transition were shifted so that quantum effects could potentially alter the material's state. At higher pressures, the transition occurs at lower temperatures. And with enough pressure, a material can be 'tuned' so that its magnetic transition point occurs close to absolute zero. Here, thermal vibrations don't provide enough energy for the material to lose its magnetic order. Instead, quantum fluctuations — transient changes in electron properties, such as velocity and position, caused by the inherent uncertainty of the quantum world — dominate and can cause the material to switch states. In this regime, a region around a spot at absolute zero called the quantum critical point, magnetic materials become unstable and teeter on the brink of magnetism: they lack order but itch to align.

With larger physical forces suppressed around the quantum critical point, ordinarily weak interactions between electrons could have huge effects. And they might, Lonzarich reasoned, give rise to new states of matter through their collective interaction. “It's like in a forest; the little plants won't grow until the big tree is cut down,” he says.

In particular, Lonzarich predicted that antiferromagnets — magnetic materials in which neighbouring spins align in opposite directions below a certain temperature — would become superconducting near the quantum critical point. On the verge of magnetism, he reasoned, the electrons would be so eager to align that they might spontaneously form pairs with opposite spins. Such antiparallel pairs would stick together, and their attraction to each other would stabilize their journey through the material's atomic lattice (see 'Hidden powers').



Since the mid-1980s, various theorists had suggested that such magnetically mediated superconductivity could arise, but Lonzarich's team was the first to provide solid experimental proof. When the group pushed a sample of the antiferromagnet cerium indium-3 close to the quantum critical point by cooling it at high pressure, the researchers saw it flip into a superconducting phase — something never before seen in a magnetic material[1].

The work, which was performed in 1994, demonstrated a new category of superconductor. It also provided a road map by which to search for other superconducting materials. Today, physicists routinely push the phase transition in magnetic materials down to absolute zero to see whether this behaviour emerges.

New terrain

The quantum critical point, and the strong quantum interactions that can take place around it, can give rise to other exotic states, not just superconductivity. “It's like a breeding ground for discovering new states of matter,” says Cambridge physicist Stephen Rowley. Physicists around the world now manipulate a range of different factors — pressure, magnetic fields and chemical composition — to push phase transitions towards lower temperatures and so approach a quantum critical point.

In the late 1990s, this method led Lonzarich and then-student Christian Pfleiderer to discover strange behaviour in the material manganese silicide[2]. Experiments done in the past few years have hinted that this may be connected to swirling two-dimensional magnetic vortices, known as skyrmions, that were later described by Pfleiderer and his colleagues[3] and are now being touted as a super-efficient way to store information. By probing around a quantum critical point of strontium ruthenate oxide, in 2007 Mackenzie and his team confirmed the existence of a new phase of matter, in which electrons flow but still show an orderly spatial structure[4].

Fellow physicists say Lonzarich is unique in that he is not only a good theorist but also an exceptional experimenter. “You have to look back to Enrico Fermi to someone able to think so deeply about theory and do really good experiments,” says David Pines, a physicist and distinguished research professor at the University of California, Davis. Lonzarich grows his own samples to extreme levels of purity and pioneered a technique, known as quantum oscillation, that allows physicists to determine the electronic structure of complex, interacting systems[5]. Patricia Alireza, who runs the high-pressure laboratory at Cambridge's Cavendish Laboratory, says that Lonzarich will often encourage her to create devices that squeeze samples well beyond what was thought possible. “Gil will smile and say, 'I think we could probably do a factor of 100 better than that',” she says. “And you know what? We always do.”

Many of Lonzarich's students have continued in physics and flourished. Suchitra Sebastian, for example, led work with Lonzarich a few years ago on samarium hexaboride, an insulator that exhibits metal-like behaviour when exposed to strong magnetic fields[6]. She says that without his advice she would probably have left the field. “He is not just teaching you 'this is how you do physics' but 'this is how to survive in the world of physics',” she says. Lonzarich is modest about how much he contributed to the success of those he has mentored, saying that they taught him at least as much as the other way around.

One thing he always has for people is time, says Rowley. It helps that he is adept at escaping unnecessary bureaucracy, adds Pines. “He has many different offices so he can always hide at one.” But Lonzarich's freedom to think is largely enabled by his wife, Gerie. She ensures that grant applications are handed in on time and that flights are caught. Gil says his wife is like the Sun: “So big and important that sometimes you forget it's the reason everything is there.”

Lingering mystery

In the past few years, Lonzarich's ideas about the intimate link between superconductivity and magnetism have gained new relevance. Physicists explain conventional superconductivity using BCS theory[7], named after the initials of the surnames of the three people who published it in 1957. The theory states that an electron speeding through some materials creates a positively charged distortion in the atomic lattice behind it. This pulls in a second electron, which follows the first like a cyclist riding in a competitor's slipstream. If enough of these relatively stable 'Cooper pairs' form, they create an ordered state in which the two electrons keep one another on course and flow without resistance.

But this explanation cannot account for sandwiches of copper-based insulators known as cuprates and for iron-based semiconductors. These two classes of superconductor can carry currents without resistance at temperatures up to 133 kelvin. If such transitions can be boosted to room temperature, around 300 kelvin, those superconductors could allow for cheaper energy, medical imaging and transportation. But debate about how they work has raged for 30 years.

From the start, one camp thought that magnetic interaction — which can be more resilient to temperature than are interactions caused by distortions in the lattice — might somehow bind electrons together to create superconductivity in cuprates. Lonzarich theorized that this magnetic glue might stem from the same quantum fluctuations that ramp up around antiferromagnet quantum critical points. This idea is now hotly debated, and gained some supporting evidence last year in experiments conducted by Taillefer's team, with collaborators at the National Laboratory for Intense Magnetic Fields in Toulouse, France. The group found that stripping a cuprate of its superconductivity with a powerful magnetic field and adding increasing levels of impurities revealed a sharp phase transition — an otherwise hidden quantum critical point[8]. Although the precise nature of that point is still not clear, it seems likely that antiferromagnetic correlations are at play, says Taillefer. "Which would mean Gil had a hell of an intuition," he says.

Lonzarich is now looking beyond conventional high-temperature superconductors. With Rowley and other colleagues, he is examining the nature of ferroelectrics, a little-studied class of ionic materials that generate their own electric field. At low temperature, ferroelectrics can become superconductors in a manner that parallels how superconductivity emerges in magnetic materials. Lonzarich has a hunch that in ferroelectric materials that also exhibit magnetism, electron pairs bind so strongly that the state could survive to room temperature.

The Universe is richer than most scientists give it credit for, Lonzarich says. Each newly discovered state of matter emerges only when conditions are right and a material is sufficiently pure. Lonzarich speculates that probing the boundaries around those states could reveal more phases, and studying the boundaries of those could reveal yet more, with discoveries unfolding in a fractal manner. “What if each quantum critical point is just the beginning of another generation? There's some indication we're heading in that direction,” he says.

The idea is highly speculative, but Taillefer says people would be wise to listen. The notion that a now-familiar principle could hide deep, complex behaviour “is typical Gil”, he says. “I would definitely put my money on him.”

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Wikipedia shapes language in science papers

Experiment traces how online encyclopaedia influences research write-ups.

26 September 2017

Wikipedia is one of the world's most popular websites, but scientists rarely cite it in their papers. Despite this, the online encyclopedia seems to be shaping the language that researchers use in papers, according to an experiment showing that words and phrases in recently published Wikipedia articles subsequently appeared more frequently in scientific papers[1].

Neil Thompson, an innovation scholar at the Massachusetts Institute of Technology in Cambridge, says that this finding runs counter to an academic culture that downplays Wikipedia’s credibility as a knowledge source. "Academia is fighting Wikipedia,” he says. Many universities, including his own, warn students against citing the website as a source in assignments. But the study, posted on the Social Science Research Network (SSRN) preprint server on 20 September and which Thompson co-authored, shows how Wiki articles can serve as constantly updated open access review articles. “In its best form, that’s what Wikipedia could be,” says Thompson.

Thompson and co-author Douglas Hanley, an economist at the University of Pittsburgh in Pennsylvania, commissioned PhD students to write 43 chemistry articles on topics that weren’t yet on Wikipedia. In January 2015, they published a randomized set of half of the articles to the site. The other half, which served as control articles, weren’t uploaded.

Language mirror

By February 2017, the chemistry articles had together received more than 2 million views. The researchers then analysed the text of 50 of the highest-impact chemistry journals published by Elsevier to see whether the language used in scientific papers had shifted by November 2016, nearly two years after the Wikipedia articles were posted.

Using text-mining techniques to measure the frequency of words, they found that the language in the scientific papers drifted over the study period as new terms were introduced into the field. This natural drift equated to roughly one new term for every 250 words, Thompson told *Nature*. On top of those natural changes in language over time, the authors found that, on average, another 1 in every 300 words in a scientific paper was influenced by language in the Wikipedia article.

The influence of Wikipedia was more apparent in less-cited journals than in the most well-known publications. The authors suggest that ideas and language first published on topics entirely new to science make their way into Wikipedia before feeding back into the literature in follow-up studies, published in less-frequently cited journals. When the authors analysed papers by the author's country, they found the effect was greater in lower-income countries compared to higher-income countries. Hanley says some authors may be more reliant on Wikipedia if they have limited access to expensive journals. In this way, Wikipedia serves as an equaliser, extending science to those with less resources, he says.

Encourage site updates

Adam Dunn, a data scientist at Macquarie University in Sydney, Australia, calls the study’s randomized controlled trial an “ingenious” idea. But he questions the authors’ claim that Wikipedia is shaping the ideas of science. He thinks the study shows that scientists refer to Wikipedia as a way of standardizing their language when they write papers. "It probably is showing an effect of Wikipedia, but I’m not sure the claim is what they're suggesting,” he says.

But Pauline Zardo, who studies research translation and impact at the Queensland University of Technology in Brisbane, Australia, says that words are symbols of thought, and, to some extent, language reflects thinking. “What they're trying to do is really tricky. I don’t think you're going to get a perfect method for this.” She praises the study, which has not yet been peer-reviewed, for pointing out that academics also seek out material written for general audiences.

Thompson hopes that the study will encourage scientists to embrace Wikipedia and make it better. One way to improve the site would be for journals or funding agencies to require scientists to contribute to Wikipedia once their article is published, he says.

The journal *RNA Biology* has done just that for one its sections since 2008, mandating that authors put RNA information updates on a set of Wiki-style pages that are automatically mirrored on Wikipedia. Paul Gardner, the journal’s assistant editor-in-chief, based at the University of Canterbury in Christchurch, New Zealand, says that students, professionals and academics seem to be accessing and using the information — “we just haven’t rigorously sought to prove this, as Thompson and Hanley appear to have done".

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Commenting is currently unavailable.

Biochemist chosen as Canada's chief science adviser

Mona Nemer is a former administrator at the University of Ottawa whose research has focused on cardiovascular problems.

26 September 2017 Updated:

1. 27 September 2017

Geoff Robins/AFP/Getty

Canadian prime minister Justin Trudeau's government launched its search for a chief science adviser in late 2016.

Canadian prime minister Justin Trudeau has appointed biochemist Mona Nemer as his country's chief government science adviser, fulfilling his campaign promise to establish the position.

Nemer was most recently vice-president of research at the University of Ottawa and director of the Molecular Genetics and Cardiac Regeneration Laboratory there. Her scientific work has focused on the genetics of cardiovascular disease and birth defects.

In her new role, Nemer will have a budget of Can$2 million and report to Trudeau and science minister Kirsty Duncan. The country has been without a science adviser for nearly a decade; the last time such a post existed was from 2004 to 2008.

The initial reaction to her appointment has been positive.

“I do know her and she’s fantastic,” says Jim Woodgett, a biologist at the Lunenfeld-Tanenbaum Research Institute in Toronto, who has advocated reforms to Canada's funding institute for health research. “She’s tough, but very very fair. She has the stature, and trust of other scientists.”

“She’ll do a great job,” tweeted innovation-policy expert Rob Annan. And Arvind Gupta, former president of the University of British Columbia in Vancouver, called Nemer “an inspired choice”.

As chief science adviser, Nemer will advise the government on ensuring that government science is publicly available and that scientists are able to speak freely about their work, according to the official job description. The adviser is also charged with ensuring that scientific analyses are incorporated into the government's decisions.

Welcome decision

Trudeau's centre-left Liberal government created the position in part as a response to the science community’s dissatisfaction with the previous Conservative government headed by Stephen Harper between 2006 and 2015. Under Harper, the government was accused of muzzling scientists and sidelining scientific evidence in policymaking.

Nemer's appointment has been a long time coming. Trudeau was elected in October 2015, and appointed Duncan as science minister weeks later — charging her with establishing the adviser post. The job hunt started in December 2016, and applications were in hand by mid-February 2017. It has taken the government more than six months to settle on a candidate.

“I’m quite happy that they have finally appointed someone,” says Debi Daviau, president of the Ottawa-based Professional Institute of the Public Service of Canada, the union for government scientists. “It’s been a couple of years coming.”

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Updates

Updated:

Updated with comments from Woodgett and Daviau.

Comments

Comments

There are currently no comments.

Steps towards transparency in research publishing

As research and editorial processes become increasingly open, scientists and editors need to be proactive but also alert to risks.

26 September 2017

Colin Hawkins/Alamy

Various initiatives are opening up the scholarly review and publication process.

Progress in the transparency of both research and editorial processes is gathering pace. This was demonstrated at the International Congress on Peer Review and Scientific Publication in Chicago, Illinois, earlier this month, and in various discussions that are under way among publishers, researchers and others.

The examples given here relate to initiatives by the Nature Research journals, some of which follow pioneering work by other publishers.

Take the improvements in researchers' descriptions of what they did and did not do in their experiments. One such initiative is the checklist introduced by *Nature* and the Nature journals in 2013 for life-sciences submissions.

At the congress, Malcolm Macleod of the University of Edinburgh, UK, and his colleagues discussed the results of an independent study of the impacts that this checklist has had on Nature journals' content. They looked at the completeness of reporting in journals following the initiatives. They analysed papers published in Nature journals — 223 submitted before May 2013 and 225 after. They looked for whether and how authors had identified and addressed sources of bias. They found that the proportion of papers reporting on all four measures — randomization, blinding, exclusions and sample-size calculations (their selected ways of mitigating bias) — increased from zero to 16%.

There was no such growth in a set of equivalent papers from outside the Nature group. Meanwhile, reporting on individual criteria and statistics increased markedly in the Nature journal papers.

We have highlighted elsewhere some of the further steps we have taken. And we have heard anecdotally from some researchers how this has begun to influence the design of their experiments.

Five steps to transparency

Credit to Macleod and his colleagues: there were no fewer than five welcome types of transparency in this project itself. These embody a gradual trend in which the public release of research results is moving farther away from the traditional form of a single, wrap-up publication.

First, the authors published a formal research protocol in a peer-reviewed journal (F. Cramond *et al.* *Scientometrics* **108,** 315–328; 2016). Such publications are a mechanism, already established in clinical and other interventions research, by which authors ensure that their research is well designed. Editors report that the peer-review process of these papers is much more collaborative in spirit than it is for papers making claims about results. (Even better if the journal commits to publishing the outcome regardless of its conclusions, which avoids pressures to cherry-pick data or model results. *Nature Human Behaviour* is so far the only Nature journal publishing such ‘pre-registration protocols’.)

Second, the authors posted the final draft paper describing their conclusions on a preprint server before submission (M. R. Macleod and the NPQIP Collaborative Group. Preprint at bioRxiv http://dx.doi.org/10.1101/187245; 2017). Third and fourth, the group released the data-analysis plan and the analysis code before data collection was completed. These were registered on the Open Science Framework (https://osf.io/mqet6/#). Fifth, the complete data set was publicly deposited on Figshare (http://dx.doi.org/10.6084/m9.figshare.5375275.v1; 2017).

This is an example of the research process being disaggregated, publicly, into its components: peer-reviewed research design, a preprint of outcomes that invites community responses, the release of code and data, and final publication. Such a practice allows greater access to the thinking behind a project. It also provides an opportunity to directly distribute credit to the authors for their efforts on the various components.

In peer review, examples of experiments and innovations abound. The Nature Research group has recently run four separate initiatives. One is double-blind peer review, in which authors’ identities are hidden from referees. Since this was introduced for all the Nature journals in 2015 as a standard option, author take-up has been between 9% and 14% across the journals.

Other initiatives pursue greater transparency. On *Nature Communications*, following the example of other publishers, such as EMBO Press, the default since January 2016 is for authors to have the anonymous referees’ reports and their responses published with their paper. Authors can opt out, and about 60% of papers have their referees’ reports published. Authors in ecology and evolution are the most positive, and those in some areas of physics significantly less so (see [*Nature Commun.* http://dx.doi.org/10.1038/ncomms13626; 2016](http://dx.doi.org/10.1038/ncomms13626)).

Other exploratory initiatives reflect a community desire for greater transparency. For example, in a trial on *Nature*, we have since March 2016 allowed referees to be accredited on the published paper if they wish. So far, the proportion of referees across the disciplines who have selected this option has been about 50%. If this is extended to *Nature Communications*, it will be interesting to see whether referees will want to include their names on the reports that are already displayed with the paper. Other publishers' experiences suggest that many will not.

In a separate trial that started this month, *Nature Communications* is being open about its submitted papers. The journal is pointing readers to the authors' submitted version if it is posted on a preprint server, once the paper has been selected for peer review (see go.nature.com/2fmvtrj).

Are there risks to all this transparency? It may give rise to different sorts of bias. For example, we hear from some authors that they don't want to know who authored a positive review, so that they can avoid future positive peer-review bias themselves. Meanwhile, some researchers and editors fear that referee identification encourages positively biased or softened peer review.

As *Nature* and the Nature Research journals explore ever-greater transparency in editorial processes and support it in research processes, we welcome readers' thoughts and suggestions: nature@nature.com.

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Deadly Mexico quakes not linked

Despite close timing, researchers doubt that the first big tremor set off the second.

26 September 2017

Pedro Pardo/AFP/Getty

Mexico’s second large quake in 12 days caused further damage to the country’s capital.

When a magnitude-7.1 earthquake struck central Mexico on 19 September, seismologists immediately wondered whether the tremor had any connection to the much larger jolt that hit off the country’s west coast 12 days earlier. Preliminary studies suggest that there is no direct link, but the pair of events this month has drawn renewed attention to Mexico's seismic hazards.

The two quakes struck in a geologically surprising area — in the middle of the Cocos tectonic plate. This piece of Earth's outer shell dives beneath the North American plate off the country's Pacific coast, which is where most of the region's quakes tend to occur. But farther to the east, beneath Mexico itself, the Cocos plate flattens out for hundreds of kilometres under the North American plate before taking a second, steeper dive into Earth's depths. This month's quakes happened at two different spots in this flat section, owing to geological stresses from the weight of the plate as it plunges downward.

Shifting ground

The 19 September earthquake, which has killed more than 320 people, struck about 120 kilometres south of Mexico City, much of which is built on an ancient lake bed. That location makes the city vulnerable because tremors shake the sediments like a bowl of jelly (V. M. Cruz-Atienza *et al. Sci. Rep.* **6,** 38807; 2016).

At the National Autonomous University of Mexico (UNAM) in Mexico City, scientists clocked the highest ground accelerations recorded at the site since measurements began in 1964, says Victor Cruz-Atienza, head of the UNAM seismology department. The acceleration was nearly double that seen on 19 September 1985, when a magnitude-8.0 quake along the coast of Michoacan sent seismic energy rippling into the capital, killing more than 5,000 people.

Because the epicentre of the 19 September 2017 quake was so much closer to Mexico City than the one in 1985, which struck 350 kilometres away from the city, the shaking was much stronger. At least 45 buildings collapsed in the capital after last week's quake.

If the 19 September tremor had lasted longer, the damage and death toll could have been even worse. UNAM calculations suggest that the magnitude-7.1 quake ruptured a section of the Cocos plate about 40 kilometres long and took only about 10 seconds, says Cruz-Atienza, so structures didn't shake for long enough to cause more of them to fall. Building regulations have also been considerably strengthened since the 1985 disaster.

Some 95 people lost their lives in the magnitude-8.1 quake on 7 September. It was Mexico’s largest earthquake in more than a century, tearing about 80 kilometres of the Cocos plate and lasting for more than 40 seconds.

Looking for links

The occurrence of two earthquakes in such a short time in the middle of the Cocos plate had some scientists wondering whether they could be linked. But others are sceptical: “We don’t think there is a causal relationship between the events,” says Cruz-Atienza.

In the long term, big earthquakes can increase the risk of nearby seismic activity by transferring stress within Earth’s crust to adjacent geological faults. But that sort of ‘static stress’ transfer would normally not happen at a distance as great as the 650 kilometres between the first and second quakes, says Gavin Hayes, a seismologist at the US Geological Survey in Golden, Colorado. Initial calculations by seismologists Ross Stein at Temblor — a California technology firm in Redwood City that runs an earthquake education app — and Shinji Toda of Tohoku University in Sendai, Japan, suggest that the static-stress increase after the first quake was negligible.

A large earthquake can also set off another by ‘dynamic triggering’ as its seismic waves ripple outwards, affecting geological faults at much greater distances than static-stress transfer does. But dynamic triggering usually happens within hours or days of the initial quake, making the 12-day gap between the 7 September event and the 19 September tremor hard to explain, says Eric Fielding, a geophysicist at NASA’s Jet Propulsion Laboratory in Pasadena, California.

“If that happened, the question is why it waited so long to go,” he says.

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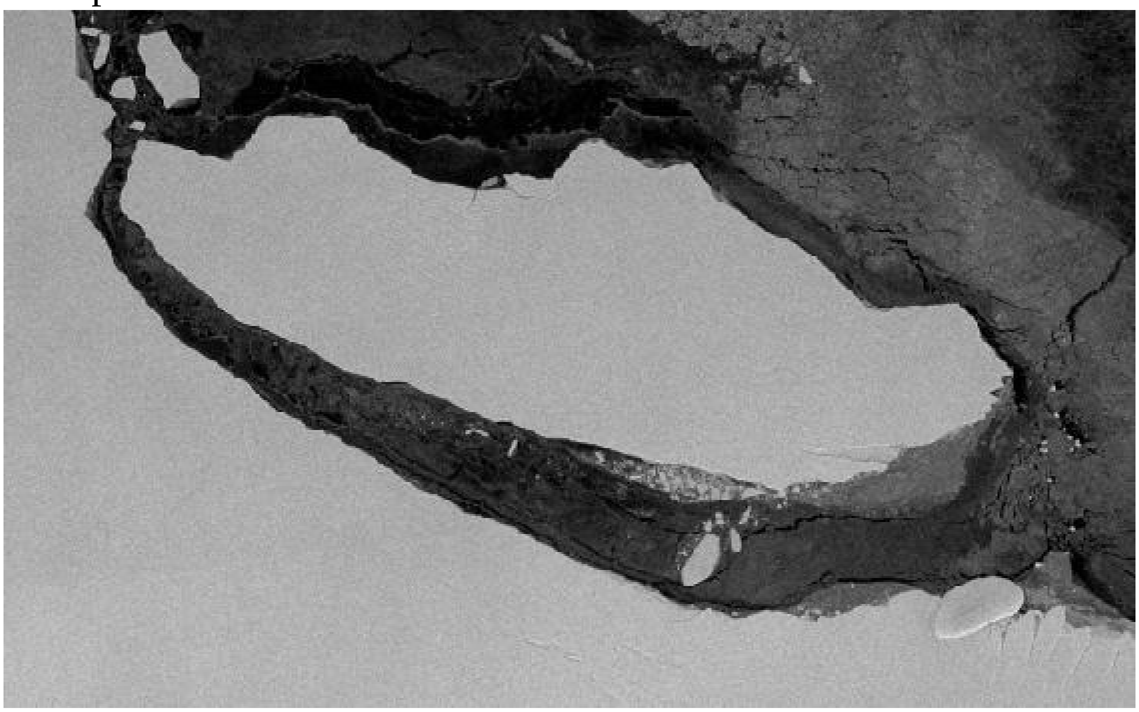
| 章节菜单 | 主菜单 |

Giant iceberg’s split exposes hidden ecosystem

Biologists rush to study creatures living beneath Larsen C ice shelf before they disappear.

26 September 2017



Copernicus Sentinel-1 via BAS

The calved iceberg is about the size of Delaware.

Biologists are racing to secure a visit to a newly revealed region of the Southern Ocean as soon as it is safe to sail there. One of the largest icebergs ever recorded broke free from the Larsen C ice shelf on the Antarctic Peninsula in July. As it moves away into the Weddell Sea, it will expose 5,800 square kilometres of sea floor that have been shielded by ice for up to

120,000 years. If researchers can get to the area quickly enough, they'll have the chance to study the ecosystem beneath before the loss of the ice causes it to change.

"I cannot imagine a more dramatic shift in environmental conditions in any ecosystem on Earth," says Julian Gutt, a marine ecologist at the Alfred Wegener Institute for Polar and Marine Research in Bremerhaven, Germany.

It is difficult for Antarctic scientists to respond quickly to sudden events, because polar-research vessels are usually booked months, if not years, in advance. A German research mission led by Boris Dorschel, head of bathymetry at the Alfred Wegener Institute, was already scheduled to visit the Larsen area and will now include a biodiversity survey of the exposed region in March 2019.

Hopes for reaching the region this Antarctic summer lie with the British Antarctic Survey (BAS) in Cambridge. The agency has a fast-track proposal sparked by the calving event, led by BAS senior biodiversity scientist Katrin Linse, to send a research vessel in early 2018. The proposal is now being considered by a British funding council. South Korean researchers are also considering whether to divert a mission currently planned for the South Shetland Islands, says Hyoung Chul Shin, a biological oceanographer at the Korea Polar Research Institute in Incheon.

If the BAS proposal is successful, it will be the first time marine biologists have been able to explore such an ecosystem so soon after the break-up of the ice. Nearby sections of ice shelf, at Larsen A and Larsen B, broke away in 1995 and 2002, respectively. But it was several years before the ocean cleared of sea ice and biologists could safely visit the area. Gutt was first in with a detailed survey, leading a team of about 50 scientists on the German research vessel *Polarstern* in 2007. The group sampled hundreds of species in areas exposed by the break-ups at Larsen A and B, and saw signs of a unique ecosystem with more deep-sea species than elsewhere on the Antarctic continental shelf (J. Gutt *et al. Deep-Sea Res. II* **58,** 74–83; 2011). But other species were already moving in, including fast-growing sea squirts, krill and minke whales. "By then, a lot had happened," says Linse.

Getting to the Larsen C exposed region before it starts to change is crucial, says Gutt, to see what a sub-ice-shelf ecosystem looks like. Video footage taken by geophysicists on a US Antarctic Program cruise at the Larsen B site in March 2005 had unexpectedly showed most of the sea floor covered with a white mat, which the team interpreted as a layer of sulfur-eating microbes, as well as large clams, which were also chemotrophic — that is, living on energy sources other than the Sun. It was the first report of a chemotrophic ecosystem in the Antarctic. But when the *Polarstern* arrived two years later, Gutt's team saw only dead clamshells and a layer of decaying plant matter and sediment.

One thing the researchers won't have to worry about is disturbance from commercial fishing fleets. The Larsen C region is the first area to be protected by a 2016 agreement by the multinational Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) to automatically designate any areas of ocean exposed by the collapse or retreat of ice shelves as a Special Area for Scientific Study. This prohibits commercial fishing — of the Antarctic toothfish, for example — for an initial period of two years.

Ice shelf break-up events could become much more common with climate change, says Andrea Kavanagh, director of the Pew Charitable Trusts' Global Penguin Conservation Campaign in Washington DC, and the CCAMLR protection will allow scientists to monitor how these changes affect wildlife. “It's really important to be able to separate the effects of fishing versus climate," she says.

Biologists will discuss research priorities for Larsen C and future exposed regions at a swiftly organized meeting at Florida State University's Coastal and Marine Laboratory in St Teresa on 18–19 November. Meanwhile, Linse's team is waiting to learn whether the BAS mission proposal will be approved, and monitoring the iceberg in satellite images. “We need the wind to blow the iceberg out a bit more and to blow the sea ice out of there,” says BAS spokeperson Athena Dinar.

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The drug-maker's guide to the galaxy

How machine learning and big data are helping chemists search the vast chemical universe for better medicines.

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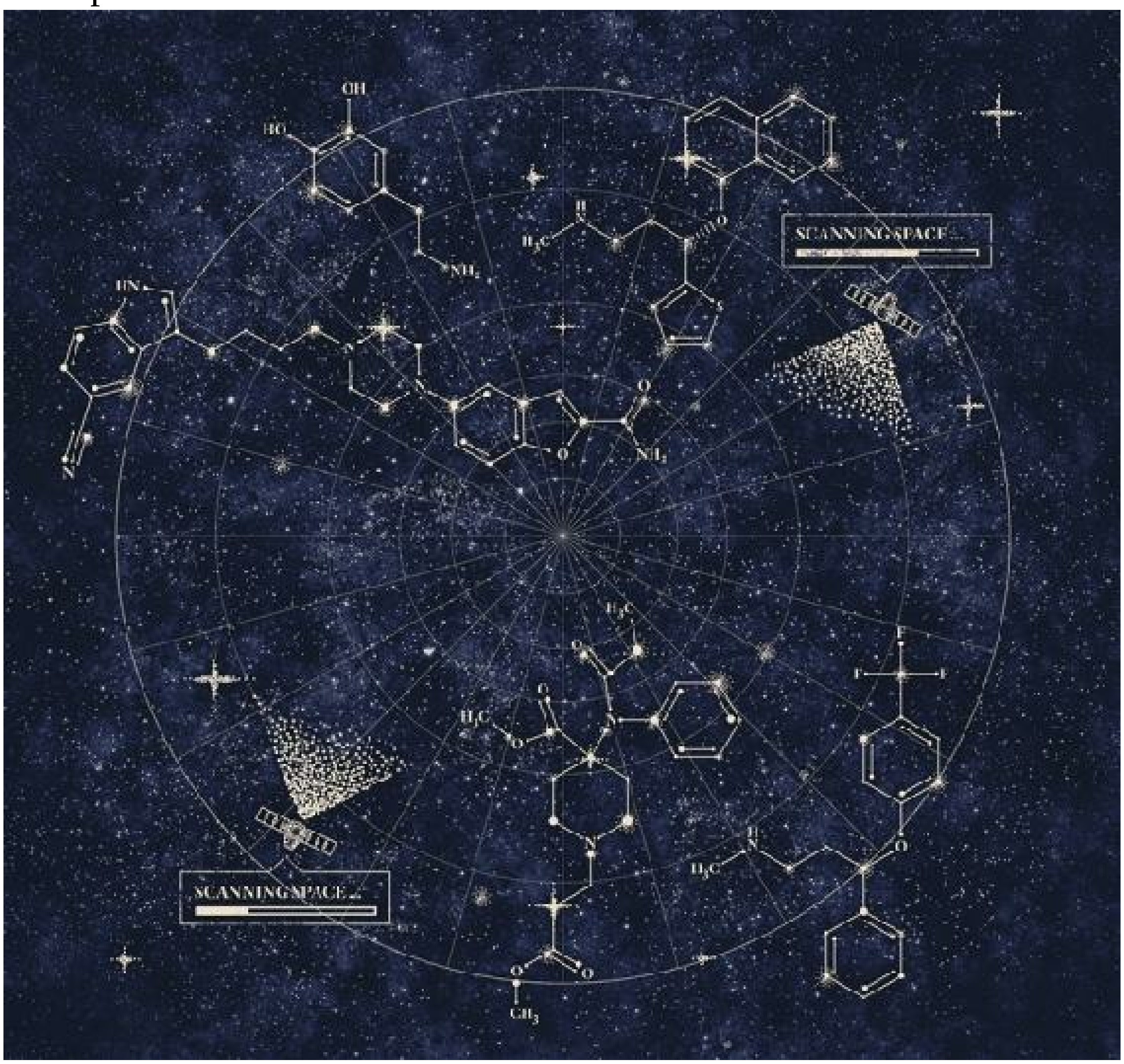


Illustration by Vasava

In 2016, the pharmaceutical firm Sunovion gave a group of seasoned employees an unusual assignment. At the firm's headquarters in Marlborough, Massachusetts, the chemists were all asked to play a game to see who could discover the best leads for new drugs. On their workstations was a grid of hundreds of chemical structures, just ten of which were labelled with information on their biological effects. The experts had to select other molecules that could turn out to be drug candidates, using their hard-earned knowledge of chemical structure and biology. Of the 11 players, 10 struggled through the task for several hours. But one breezed through in milliseconds — because it was an algorithm.

That computer program was the brainchild of Willem van Hoorn, head of chemoinformatics at Exscientia, a start-up that uses artificial intelligence (AI) to design drugs. The firm, based in Dundee, UK, wanted to extend a nascent partnership with Sunovion, so the stakes were high. “My credibility was on the line,” says van Hoorn. Twenty rounds of gameplay later, he tallied up the points. Relief swept over him. His algorithm had mastered at least some of the dark arts of chemistry; only one drug-hunting expert had beaten the machine.

Exscientia and Sunovion have continued to work together to discover psychiatric drugs ever since. “This competition really helped to get buy-in from the people who make the chemistry research decisions,” says Scott Brown, Sunovion's director of computational chemistry.

Exscientia is just one of a growing number of groups in industry and academia that are turning to computers to explore the mind-bogglingly large chemical universe. Chemists estimate that 10^{60} compounds with drug-like characteristics could be made — that's more small molecules than there are atoms in the Solar System. The hope is that algorithms will catalogue, characterize and compare the properties of millions of compounds *in silico* to help researchers quickly and affordably find the best drug candidates for a target. Proponents argue that these strategies could make medicines safer, ensure that fewer drugs fail in clinical trials and enable the discovery of new classes of therapeutics. They could also help to open up areas of chemical space left unexplored or assumed to be barren.

But many medicinal chemists remain sceptical of the hype, unconvinced that the ineffable complexity of chemistry can be reduced to mere lines of code. Even advocates of AI acknowledge that many attempts have fallen flat: computer-generated compounds can be riddled with components that are difficult to make, such as 3- or 4-atom rings, and infested with reactive groups that would set off safety alarms. “The execution of some computational approaches can suffer badly when researchers just don't know the field,” says van Hoorn. “The compounds they come up with are just laughable.” But he says that an expert human touch could yet tame these overzealous digital designers. “I think some of these ideas could work if the computer scientists would just collaborate with people who actually breathe chemistry.”

Space exploration

To navigate the chemical universe, it helps to have a map. In 2001, chemist Jean-Louis Reymond, at the University of Berne in Switzerland, started using computers to chart as much of the massive space as possible. Sixteen years on, he has amassed the largest database of small molecules in the world, a gigantic virtual collection of 166 billion compounds. The database, called GDB-17, includes all the chemically feasible organic molecules made of up to 17 atoms — as many as Reymond's computers could cope with. “Just for a computer to compile a list of the compounds in the database would now take over 10 hours,” says Reymond.

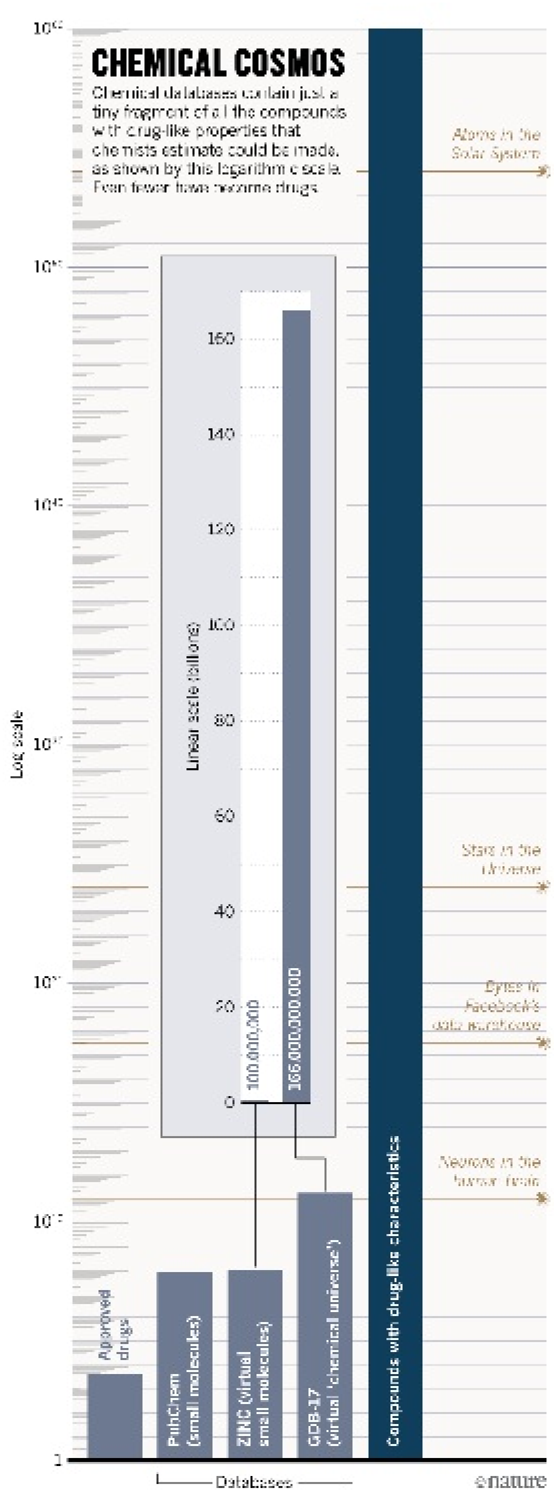
To make sense of this plethora of possible drug starting points, Reymond has come up with a way to organize his chemical universe. Taking inspiration from the periodic table, he has grouped compounds in a multidimensional space in which neighbouring compounds have related properties. Positions are assigned according to 42 characteristics, such as how many carbon atoms each compound has.

For each drug that has made it to market, there are millions of compounds that are chemically almost identical to it — just sporting an extra hydrogen here or double bond there. And some of these will work better than the drug that was approved. Chemists couldn't possibly conceive of all of these variations unaided. “There is no way you can get at these isomers using a pen and a piece of paper," says Reymond.

But Reymond and his team can identify therapeutically promising 'near neighbours' of proven drugs by searching for similarities between compounds. By using a particular drug as a starting point, the team can comb through all 166 billion compounds in the database for compelling follow-on candidates in just 3 minutes. In a proof-of-principle experiment, Reymond started with a known molecule that binds the nicotinic acetylcholine receptor, a useful target for disorders involving the nervous system or muscle function, and compiled a shortlist of 344 related compounds. The team synthesized three, and found that two could activate the receptor potently, and could be useful for treating muscular atrophy in ageing[1]. The approach is like using a geological map to work out where to dig for gold, Reymond says. "You need some way to choose where you are going to dig," he says.

An alternative approach uses computers to pan lots of locations for gold without worrying too much about the starting location. In drug-hunting terms, this means screening vast chemical libraries *in silico* to find small molecules that bind to a given protein. First, researchers have to take a snapshot of a protein using X-ray crystallography to determine the shape of its binding site. Then, using molecular-docking algorithms, computational chemists can chug through compound collections to find the best fits for any given site.

As computing power has exploded, the capabilities of these algorithms have improved. Chemists at the University of California, San Francisco, led by Brian Shoichet, showcased the potential of this approach in 2016 in a search for a new class of painkiller. The team screened more than 3 million commercially available compounds to find candidates that would selectively activate μ-opioid receptor signalling to relieve pain without disturbing the closely related β-arrestin signalling pathway — which is thought to be associated with opioid side effects including a lowered breathing rate and constipation. The researchers quickly whittled down a massive compound library to just 23 highly ranked compounds for follow-up[2].



In a test tube, seven of the candidates had the desired activity. Further development turned one of these into PZM21, a compound that acts on the μ-opioid receptor without activating β-arrestin. The biotechnology firm

Epiodyne, based in San Francisco, California, and co-founded by Shoichet, is now trying to develop a safer painkiller based on the findings. Shoichet plans to use the same approach to find compounds that modulate other G-protein-coupled receptors (GPCRs), a family of proteins that accounts for an estimated 40% of drug targets.

His team is also running similar experiments with a virtual nebula of 100 million compounds that have never been made before but that should be easy to synthesize. Industry drug developers are also testing out this approach: the biotech firm Nimbus Therapeutics, based in Cambridge, Massachusetts, incorporates into its docking screens virtual compounds with characteristics of naturally occurring chemicals that usually have to be laboriously sourced from natural environments such as soil. The jury is still out on whether these will lead to drugs, but Don Nicholson, chief executive of the company, says that for at least one drug-design programme, “this is where all our hits are coming from”.

Preliminary results from such virtual screens are shaking one of Shoichet's core assumptions about chemical space: that it's only worth looking in established, drug-rich regions. Well-characterized galaxies of molecules are so awash with biologically active compounds that some argue it is a waste of time searching elsewhere. “Throughout my career I have believed that line of reasoning. It just made sense, even if there wasn't that much evidence to support it,” says Shoichet. But unpublished results from his screens of 100 million compounds are stoking his interest in the less-explored regions of chemical space. “I'm starting to think that those galaxies are full of gold.”

In silico insight

These data-searching approaches are tried and tested, but the computers involved can follow only scripted instructions. The latest frontier in computational drug discovery is machine learning, in which algorithms use data and experience to teach themselves which compounds bind to which targets, finding patterns that are invisible to the human eye. Around a dozen firms have sprung up to create drug-hunting algorithms that they can test in partnership with large pharmaceutical companies.

Andrew Hopkins, chief executive of Exscientia, makes a strong case for the power of these approaches. It takes on average 4.5 years to discover and optimize candidates for preclinical testing[3], and chemists often synthesize thousands of compounds to get to a promising lead (which even then has only a slim chance of making it to market). Exscientia's approach — which uses various algorithms, including the one that impressed Sunovion's research and development executives — may be able to reduce this timeline to just one year, and shrink the number of compounds that a drug-discovery campaign needs to consider.

In 2015, Exscientia finished a 12-month campaign for Sumitomo Dainippon Pharma, which owns Sunovion and is based in Osaka, Japan. The researchers trained their AI tools to find small molecules that modulate two GPCRs at the same time, and found they needed to synthesize fewer than 400 compounds in order to identify a good candidate. The drug that emerged is now moving towards clinical trials for psychiatric disease, says Hopkins. Since May, the company has inked deals worth hundreds of millions of dollars with Sanofi, based in Paris, and GlaxoSmithKline, based in Brentford, UK.

In addition to identifying leads, machine-learning algorithms can also help drug developers to decide early on which compounds to kill, says Brandon Allgood, chief technology officer of Numerate, an AI drug-design firm based in San Bruno, California. There's no point in making and testing a compound if it's going to fail on toxicity or absorption testing a few months later, he says. With AI, "it takes just a millisecond to rule it in or out", says Allgood, who trained as a cosmologist before he started using AI tools to study the chemical cosmos. Numerate has struck two deals with pharmaceutical companies this year, including one with Servier, based in Suresnes, France, to put AI-discovered drugs through clinical trials for heart failure and arrhythmias.

Industry investment is blossoming, but computational approaches still have a lot to prove. Reymond's collection is gigantic compared with other libraries, but it covers the minutest fraction of the chemical universe (see 'Chemical cosmos'). Despite the 166 billion compounds in his database, he still has further to go in his quest than an astronomer who is trying to count all the stars in the night sky but has only managed to record one. Screens that rely on matching proteins with drugs need accurate crystal structures to yield the best results, and these data take time, money and expertise to generate. These methods also struggle to cope with proteins in motion and they cannot rank their suggestions very well. Machine-learning algorithms, for their part, are only as good as the training data sets that they are based on, performing particularly poorly when they encounter compounds that look unlike molecules they have seen before. What's more, the programs run as black boxes, and cannot indicate why they predict a compound will be a good fit.

Many computational approaches also have an annoying habit of suggesting candidates that are nightmares to cook up in a lab. Chemists must then laboriously figure out a recipe for the suggested compound, which can take months or more. Even then, there is no guarantee that the molecule will work once it is made. Reymond's approach predicts a compound's activity profile correctly only 5–10% of the time, and that means chemists have to toil away on up to 20 compounds to find one that acts as expected. “I would say the bottleneck in our exploration of chemical space is the ability to dare to make compounds,” says Reymond. To this end, he recently shaved his chemical universe down to a shortlist of 10 million molecules that are easy to make, and yet still cover a broad range of properties.

Mark Murcko, chief scientific officer at Relay Therapeutics in Cambridge, Massachusetts, thinks computational chemists should focus less on coming up with new algorithmic strategies, and more on improving the data sets they learn from. “One of the best ways that I know of to make a predictive model better is to keep feeding it more and more, and better and better, data,” he says. Relay and others have bench chemists working closely with computational scientists, synthesizing compounds proposed by both humans and algorithms and using the resulting findings to inform future decisions.

For Hopkins, such collaborations are key. It took decades for computer scientists to write programs that could compete with chess grandmasters. Then, in 1997, IBM's Deep Blue beat Garry Kasparov. But the loss did not mark the end of chess. Instead, Kasparov created a doubles version in which each team consists of a human player and an AI. “Together the human and AI can outperform any human, but they can also outperform any algorithm,” says Hopkins. He wants the same mix of data-crunching, creativity and common sense to transform drug discovery. “I believe we are at the Kasparov–Deep Blue moment.”

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World’s botanic gardens should work together

A study suggests a possible way to save more species.

25 September 2017

Ray Tang/Anadolu Agency/Getty

Botanic gardens safeguard species and can help to conserve them in the wild.

“There are three things which have stimulated men throughout the ages to travel far and wide over the surface of the globe,” wrote Arthur Hill, assistant director of the Royal Botanic Gardens, Kew, in 1915. “And these are gold, spices and drugs.” (A. W. Hill *Ann. Missouri Bot. Gard.* **2,** 185–240; 1915).

It was these last two, Hill went on to argue, that served as the impetus to create some of the earliest botanic gardens. Yet over the years the remit has shifted and expanded, as the medicinal and culinary repositories of old has given way to complex institutions tasked with delighting and educating the public — while providing a hub for research and conservation.

A study published this week in *Nature Plants* highlights the fruits of those efforts: a survey of 1,116 botanical collections shows that they hold representatives from about 30% of the world's plant species (R. Mounce *et al. Nature Plants* http://dx.doi.org/10.1038/s41477-017-0019-3; 2017). It is a testament to the resourcefulness of their staff that such gardens are able to foster so much diversity in the face of mounting pressures to boost revenue.

But with 20% of the world's plant diversity threatened with extinction, the study also suggests that there is room for improvement when it comes to conservation. The collections, for example, are unbalanced: 76% of the missing species are from tropical regions. Less than 5% of non-vascular genera, such as mosses, are represented at all. (And although seed banks can pick up some of the slack, certain species are still best preserved as living specimens.)

Some of this reflects bias in the data. Only about one-third of the world's botanic gardens were included in the study, and gardens with fewer resources are less likely to upload information about their collection to a database. But the data also point to a need to focus conservation efforts on neglected taxa.

Given limited resources, the best way to do this is to coordinate efforts between botanic gardens. Many zoos have long done this. The crop research community came together in 2011 to preserve plant genetic resources that are important for agriculture. And botanical gardens around the world have embraced the Global Strategy for Plant Conservation, adopted in 2010 by the United Nations Convention on Biological Diversity. But to realize the strategy's goal of protecting at least 75% of threatened plant species in botanical collections by 2020, gardens must come together to structure and bolster their conservation efforts.

There are signs that such an approach would take off. Botanic gardens, despite the occasional outbreak of one-upmanship, have a history of

collaboration that will provide fertile soil for a targeted approach to conservation. These gardens should embrace an active role in plant conservation, and should not limit themselves to educating the public about the need for it. Who else has the ability to coax the world's most finicky plants to thrive in new ground, or to force a recalcitrant seed to germinate?

A good example is a meeting planned for April 2018, when experts in rhododendron cultivation will meet botanic-garden staff from areas of the world that host endangered rhododendron species. The effort could provide an excellent test case for botanic gardens: rhododendrons are charismatic megaflora — their showy flowers are prized by gardeners around the world, which means that the public cares about their preservation. At the same time, they are particularly vulnerable to climate change, and their seeds often do not remain viable in storage, making live cultivation particularly important.

As efforts such as this take off, more botanic gardens can legitimately sell themselves to the public as protectors of the world's plants, and entice visitors to view their rare specimens. Kew Gardens executed this beautifully when it saved a tiny Rwandan water lily (*Nymphaea thermarum*) from extinction in 2009 by painstakingly working out how to germinate its seeds. The media campaign around the lily enticed crowds to come and see one of the world's few living samples. (In this case, the strategy worked perhaps too well: so great was the public's thirst for the lily that a thief made off with one in 2014.)

More botanic gardens can and should put their unique skills to work to preserve plant diversity. Many have already grown to be much more than collections of spices and drugs. With better coordination, more could yet strike gold.

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What Germany’s election results mean for science

A new coalition could face battles over gene editing and climate regulations.

25 September 2017

Omer Messinger/NurPhoto via Getty Images

Angela Merkel is set to continue as Germany's chancellor, but is negotiating to form a new governing coalition.

As Germany reels from an unexpected surge for the far right in the 24 September elections, researchers don’t expect much effect on the country’s generous support for science. But with smaller parties standing to gain political influence, battles over issues such as the regulation of gene-edited

organisms and how to cut greenhouse-gas emissions could grow fiercer.

Angela Merkel is set for a fourth term as Germany’s chancellor and will lead negotiations with other parties to form a coalition government, after her centre-right Christian Democratic Union (CDU) won the largest share of the seats in parliament, albeit with a diminished lead. Her coalition partner in the last government, the Social Democrats (SPD), came second, but it, too, lost support, and has pledged to move into opposition. Other minor parties are instead expected to enter government, in negotiations that Merkel hopes to complete by the end of the year.

Merkel has ruled out — as being too radical — partnerships with the far-right AfD (Alternative for Germany) party and the socialist Left Party. Most expect her to strike an agreement with the Green Party and the liberal Free Democrats (FDP). That would form a ‘Jamaica coalition’, named as such because the parties’ colours match the green, yellow and black of the Jamaican flag. (A fourth party, the CSU, shares a platform with Merkel's CDU; it campaigns only in Bavaria).

The negotiations are expected to focus on hot political issues, such as Germany’s handling of the refugee crisis. All four parties strongly support science, but there are some key differences. The Greens want the same strict regulation for organisms that have been gene edited with precision technologies such as CRISPR, as has been put in place for those modified with conventional, less precise techniques. But the other three parties have hinted that they may support a more liberal form of regulation.

Overall, Germany already tightly regulates research on genetically modified organisms (GMOs), and animals in general, and is unlikely to tighten that further under a new government, says Tobias Erb, a director at Germany’s Max Planck Institute for Terrestrial Microbiology in Marburg. “But I do expect that it will remain complicated, and might even get more complicated, to release GMOs — and in particular GM plants — if the Greens become part of the next government coalition,” he says.

Power struggles

Germany’s climate and energy policies could be another area of conflict within a future coalition, says Oliver Geden, a policy expert with the German Institute for International and Security Affairs in Berlin.

The Greens want to shut down the country’s dirtiest coal power plants, and support a climate-protection law to help Germany meet its plans to reduce greenhouse-gas emissions by 80–95% from 1990 levels by 2050. But the FDP, a pro-business party in favour of free-market economics, advocates against detailed central planning to force cuts to carbon dioxide emissions — of the sort that has previously been proposed both by the Greens and by the outgoing CDU/SPD coalition. The FDP does favour eliminating “inefficient” subsidies in the energy sector and strengthening the European emissions-trading scheme. “We should expect a lot of ambiguity, even hypocrisy, when it comes to climate policy,” says Geden.

The strong presence of the AfD in parliament will make for noisy debates. Having won 13% of votes, the party is now the third largest after the SPD and CDU/CSU. The AfD did not make election statements on science, and declined to answer *Nature*’s questions before the election, but party leaders have previously expressed climate scepticism and distrust of genetic engineering.

The AfD’s rise means that for the first time, a party is represented in parliament that opposes Germany’s plans to cut greenhouse-gas emissions by moving to renewable-energy sources — termed the ‘*Energiewende*’, or energy transition. But its sceptical stance on climate and energy issues is unlikely to sway the next government, Geden says.

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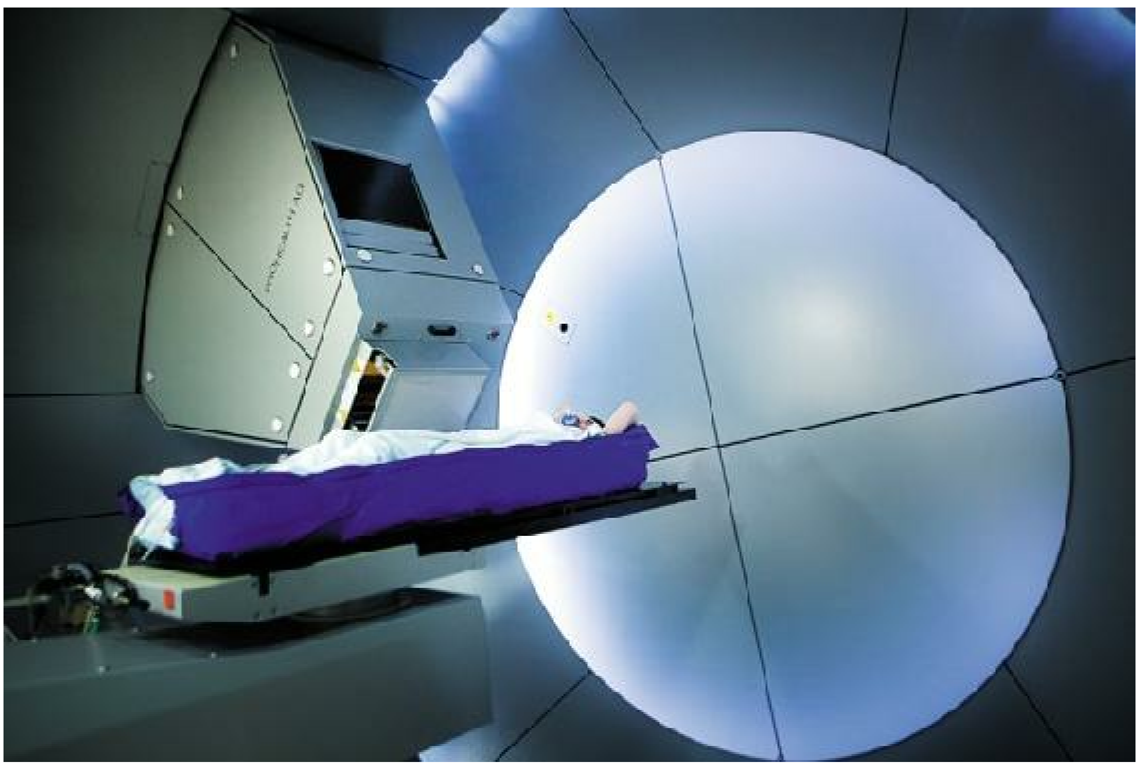
| 章节菜单 | 主菜单 |

Three ways to make proton therapy affordable

25 September 2017

Shrink accelerators, sharpen beams and broaden health-care coverage so more people can get this type of radiation treatment, argue Thomas R. Bortfeld and Jay S. Loeffler.



BSIP/UIG/Getty

A proton-therapy machine at the Rinecker Proton Therapy Center in Munich, Germany.

If cost was not an issue, proton therapy would be the treatment of choice for

most patients with localized tumours. Protons can be targeted more precisely than X-rays[1], so the tissues around the tumour receive two to three times less radiation. This lowers the chance of causing secondary tumours[2] or impairing white blood cells and the immune system[3]. High doses of protons can be delivered safely to hard-to-treat tumours: for instance, those at the base of the skull or in the liver. Such accuracy is crucial when treating cancers in children.

Yet most hospitals do not offer proton therapy. The equipment is huge and expensive. Housed in multistorey buildings with halls the size of tennis courts, one proton centre with 2–3 treatment rooms typically costs more than US$100 million to build. To reach deep-seated tumours, the protons must be sped up to 60% of the speed of light (a kinetic energy of 235 megaelectronvolts; MeV) using a particle accelerator, such as a cyclotron or synchrotron. Rotatable gantries with wheels typically 10 metres across and weighing 100–200 tonnes direct the protons at the patient from a range of angles. Concrete shields, metres thick, are necessary to block stray neutrons.

“Nothing so big and so useless has ever been discovered in medicine,” said Amitabh Chandra, director of health policy research at the John F. Kennedy School of Government at Harvard University in Cambridge, Massachusetts. He has compared a proton-therapy system to the Death Star from *Star Wars*.

Nonetheless, there are now more than 60 proton-therapy centres around the world, with 26 in the United States alone. Almost half of them (12) treated their first patient within the past three years. But construction delays and closures are also common. The companies that build the facilities and the investment groups that own them are increasingly struggling to make a profit. The Scripps Proton Therapy Center in San Diego, California, filed for bankruptcy in March, just three years after opening its doors.

What has gone wrong? Patient charges are high, often three to four times more than the priciest X-ray treatments. Fewer patients are being treated with protons than was anticipated: common diseases such as prostate cancer can be cured as effectively using other forms of radiation and surgery[4]. And in the United States, major insurance companies are denying proton therapy to up to 30% of eligible patients[5] on the basis that there are too few rigorously

designed and completed clinical trials providing evidence of better outcomes. In our experience, however, this is a vicious cycle: such trials are difficult to conduct when patients are denied private health coverage[5].

The solution is to make proton-therapy facilities smaller and cheaper, with costs of around $5 million to $10 million, similar to high-end X-ray systems. A dozen 'miniaturized' facilities are in operation. We have installed one at Massachusetts General Hospital in Boston. Now academics, private researchers and investors need to make proton-therapy systems even smaller and more competitive so that more patients can benefit.

Shrinking infrastructure

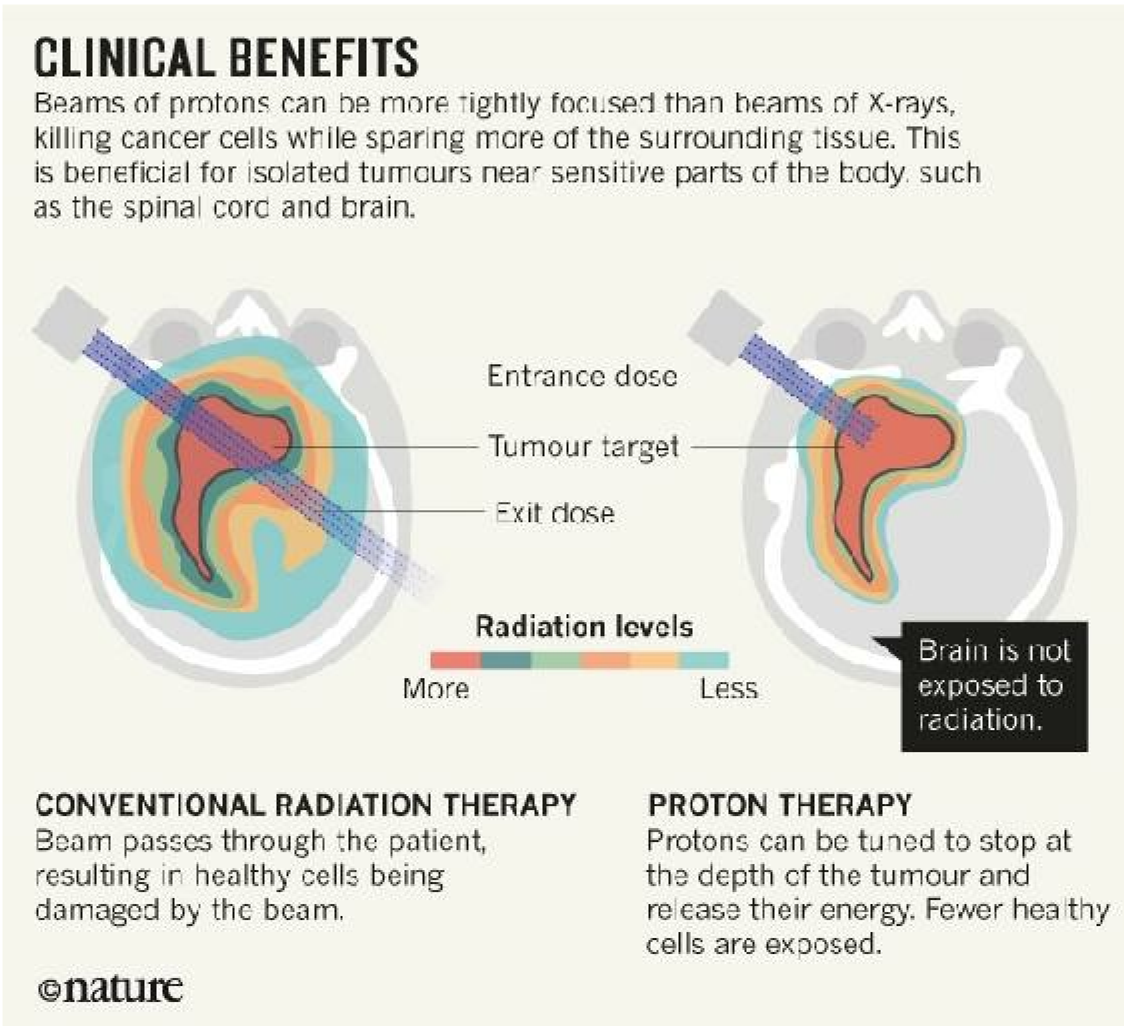
Proton-therapy technology is much more compact today than it was a few decades ago[6]. Superconducting magnets can confine protons in a tighter space. The weight of accelerators has gone down from hundreds of tonnes to less than 20, and their diameters have shrunk by a factor of 3 since the early 1990s. The smallest therapeutic accelerator so far is less than 2 metres in diameter — about the same footprint as a king-sized bed.

Yet, combined with the gantry and other equipment needed, even the most compact systems for sale today occupy a couple of hundred square metres. This is much larger than a conventional treatment room of 50 square metres. Most hospitals lack the money and space to construct a special building for proton therapy.

We have been testing how smaller systems can be squeezed into existing hospital buildings, working with the proton-technology vendor ProTom International in Wakefield, Massachusetts, and engineers at the Massachusetts Institute of Technology in Cambridge. Getting an accelerator and gantry into two basement X-ray rooms in our central Boston hospital cost about $30 million, less than one-third of the cost of a dedicated centre but still about five times more than a top-end X-ray unit.

Both the equipment and the price tag need to shrink further if proton therapy is to replace X-rays. Fitting the facility into one room is the goal. This would

allow hospitals to simply replace existing X-ray equipment with proton units without building work. Getting there will be technically challenging, even with rapid advances in magnets[6].



Source: Dose levels from Fig. 1a, A. J. Lomax *et al. Radiother Oncol.* **51**, 257–271 (1999)

Gantries might need to have a smaller range of movement or be abandoned altogether[7]. Moving the patient relative to the beam is easier: fixed beams and a rotating chair were used in particle therapy before the 1990s. But it is difficult to position the patient accurately and repeatedly.

Three developments that have emerged in the past three years hold promise.

Narrow 'pencil' beams that paint the radiation dose precisely onto a tumour reduce the need to treat patients from many angles (see 'Clinical benefits'). Rapid imaging methods can detect tiny changes in the patient's position, so that the beam can be shifted. And advanced 'soft robotics' built using malleable outer materials will soon allow patients to be positioned quickly and comfortably using robotic hands.

Pushing affordable proton technology forwards will require combined efforts from device companies, venture capitalists, academics and medical practitioners. But these groups currently work in silos. Most technology development is left to industry. Hospitals buy off-the-shelf and do not actively seek input from researchers. Only a few national labs in different countries work on technologies related to proton therapy. There are plans for a medical-research beamline at CERN, Europe's particle-physics lab near Geneva, Switzerland. But, overall, there has been little work in universities with the clear goal of improving the affordability and clinical utility of proton-therapy systems.

Clinical utility

Although the utilization of proton therapy is growing, the gap between the number of patients receiving the treatment and those who could potentially benefit from it is still substantial (see 'Unmet need')[8]. The primary reason is cost; availability is another barrier, as are a lack of knowledge of the therapy's benefits and difficulties referring patients.

As technology improves, the number of patients who could benefit clinically from proton therapy will rise, too. The therapy is not like a pill: its success depends on how it is delivered. It has more room for improvement than other, more-established radiation treatments, such as X-rays. Developing proton therapy's physical advantages — in particular its ability to focus and thus lower the overspill of radiation — would make it the best treatment for most patients who need radiation therapy. In some cases, it might outperform surgery.

Sharpening the spot of the proton beam gives it the precision of a scalpel.

Unlike X-ray photons, fast protons entering the patient are slowed because they interact with body tissues. Most of the beam's energy is deposited at a point (called the Bragg peak). The speed of the proton, or its kinetic energy, determines the depth at which the spot reaches below the skin. Protons with energies of around 50 MeV penetrate to a depth of a few centimetres; those at more than 200 MeV reach 30 cm. Uncertainties in this slowing process can affect whether the dose spot hits the tumour as intended, or overshoots into healthy organs.

Better imaging methods are needed to locate and guide the proton spot. Its position is currently known to within only 0.5 cm. This is similar to X-rays but blurs the radiation dose, making it impossible to stop the beam precisely in front of crucial structures such as the spinal cord. Improving the accuracy and precision from centimetres to millimetres is necessary. This is a particular challenge when targeting moving tumours, such as those in the lung and liver. Higher accuracy would mean that smaller margins would need to be irradiated around tumours — overshoot is the standard way to deal with uncertainties. This would transform treatments for lung cancer, for example, in which proton therapy does not yet show a substantial physical advantage over X-rays.

Several methods for measuring the range of the proton spot have been explored[9]. When protons interact with atomic nuclei, they give off γ-rays that can be tracked. Sound waves are also given off when tissues expand and contract as they are heated by pulses of protons. Such techniques have reached accuracies of a few millimetres in experimental settings, but do not yet have the millimetre accuracy needed for use in patients. The technical hurdles are surmountable but require more concerted efforts, both public and private.

Health-care policy

The high cost of proton therapy means that most countries and insurers restrict its use. England and several European nations, including Denmark and the Netherlands, offer proton therapy only for cancer types for which the reduction of long-term side effects is thought to be greatest, such as tumours

in the skull base (chordoma and chondrosarcoma), in the eyes (melanoma) and many tumours in children. In 2014, the American Society for Therapeutic Radiation Oncology (ASTRO) released a list of diagnoses that its experts recommended insurers should cover.

But individuals and tumours vary. Sarcomas, for instance, occur in many different forms and sites. The benefit of proton treatment depends on tumour size, shape and proximity to organs. People with breast cancer are not on the ASTRO list. But those with a tumour on their left breast might benefit because proton therapy could help to spare the heart from radiation damage[3].

The Netherlands has taken a step in the right direction, using individual treatment plans and a biological model of complications in normal tissues to select patients who stand to benefit most from proton therapy. But the probabilities of side effects predicted by biological dose–response models are uncertain. The models consider only severe complications, such as blindness, which are rare. They do not consider more common aspects such as a reduced IQ score in children, for instance.

In the United States, several hospitals have tried to recoup the costs of proton centres by focusing on common and easy-to-treat tumours such as prostate cancer. Insurers are reluctant to cover such treatment, but many wealthy men pay for themselves. So the most common cancer treated with protons is one in which it makes the least clinical difference.

Because there are relatively few proton centres, patients must be referred to them from other hospitals. But many oncologists are unaware of what the therapy can do, and local, private physicians and hospitals fear losing revenue if their patients are treated elsewhere. Patients, too, are loath to travel long distances, sometimes between countries. As a consequence, too few patients are referred.

Sweden has improved these logistics. Since 2015, its proton centre in Uppsala has been run as a shared facility for all major hospitals in the country. Physicians and staff at the referring hospitals are involved in planning and in the treatment of their patients in Uppsala, and uptake has improved. This centralized approach might not work as well in a larger country. The United States will face its first test in 2019, when a proton

centre will open in Manhattan that will be shared among a consortium of hospitals.

Greater use raises another problem. The specialized personnel needed are in short supply. One solution is to make the workflow of proton therapy similar to that of conventional X-ray therapy. Another is to rely more on automation, in particular for systems that guide treatment planners on the basis of knowledge pooled from experts.

Next steps

Partnerships are needed to make proton-therapy technology more practically useful. Hospitals must share knowledge about treating and interacting with patients as well as using therapy systems. Applied physicists and engineers in academia and at national and international labs should work with medical physicists on improving the beams, imaging and robotics. For example, a CERN spin-off company called ADAM (Application of Detectors and Accelerators to Medicine), based in Geneva, is working with its parent institution in the United Kingdom on a linear mini-accelerator for medicine. National physics and engineering societies and funding agencies should coordinate some of this research and publicize needs and progress.

As costs fall, the charges for proton therapy should be lowered to the level of sophisticated X-ray therapy within the next five to ten years. Insurance companies should move to the 'reference pricing' model, which establishes a common level of payment for different therapies that have similar anticipated outcomes[10]. This will help to build the evidence for the benefit of proton therapy (or lack of it) in new clinical applications. The Mayo Clinic in Rochester, Minnesota, has already entered into such arrangements with insurers. Collaborations between hospitals and health-care funders on a broader scale are needed[5].

To get the ball rolling, these ideas could be discussed at the upcoming Particle Therapy Co-Operative Group meeting in May 2018. The European and American societies for radiation oncology should be involved. Symposia or satellite workshops should be organized to discuss the technical questions

at meetings of the American Physical Society and Physics for Health in Europe.

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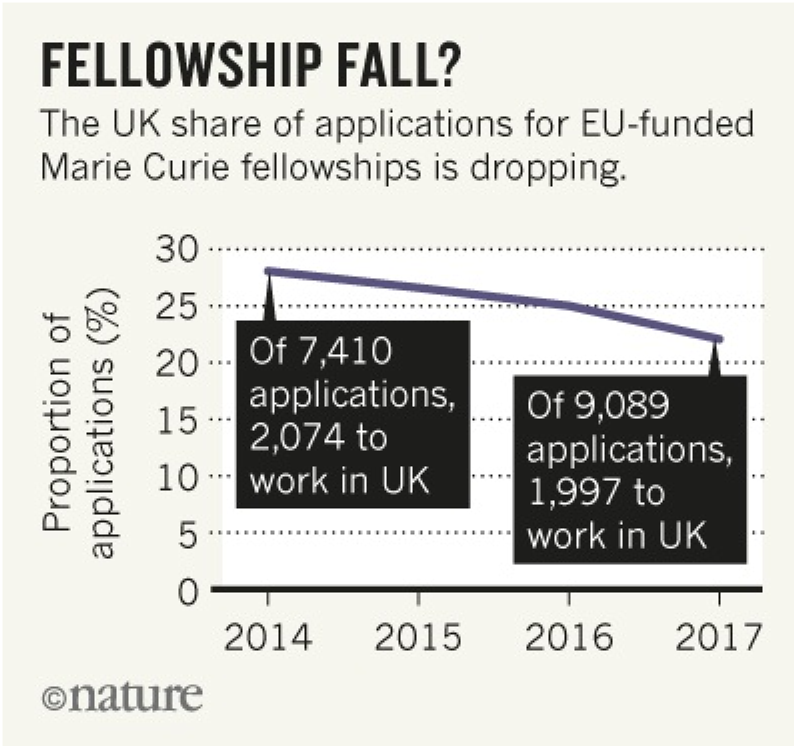
United Kingdom sees dip in European research applications after Brexit vote

But overall data don't show a big impact on UK's involvement with European science.

21 September 2017

The number of researchers applying for Europe-funded Marie Curie fellowships in the United Kingdom has dipped slightly since the country's vote to leave the European Union, data released to *Nature* show. But there is no evidence yet of a sharp collapse in interest, which some scientists had feared in the wake of the Brexit referendum.

Every year, the European Commission funds thousands of experienced researchers — most of them European — to undertake work in other EU countries, typically for one or two years, with individual fellowships usually worth between €150,000 (US$180,000) and €200,000. More than 9,000 academics have applied for the popular programme this year, in an application round that closed on 14 September. Of those, 1,997 people — around 22% of the total — requested to work in the United Kingdom. In 2016, the United Kingdom had received 2,211 applications, some 25% of the total that year; while in 2014, the UK share of applicants reached 28%.



Source: European Commission

Although the numbers hint at a decline in interest in working in Britain, they give no clear sign that the Brexit vote has immediately dented the United Kingdom's attractiveness to EU scientists. But "the slipping success rates show that British science is not impenetrable, so we must not be complacent", says Mike Galsworthy, co-founder of the advocacy group Scientists for EU. He says the results may suggest that other European countries are increasingly attractive to researchers.

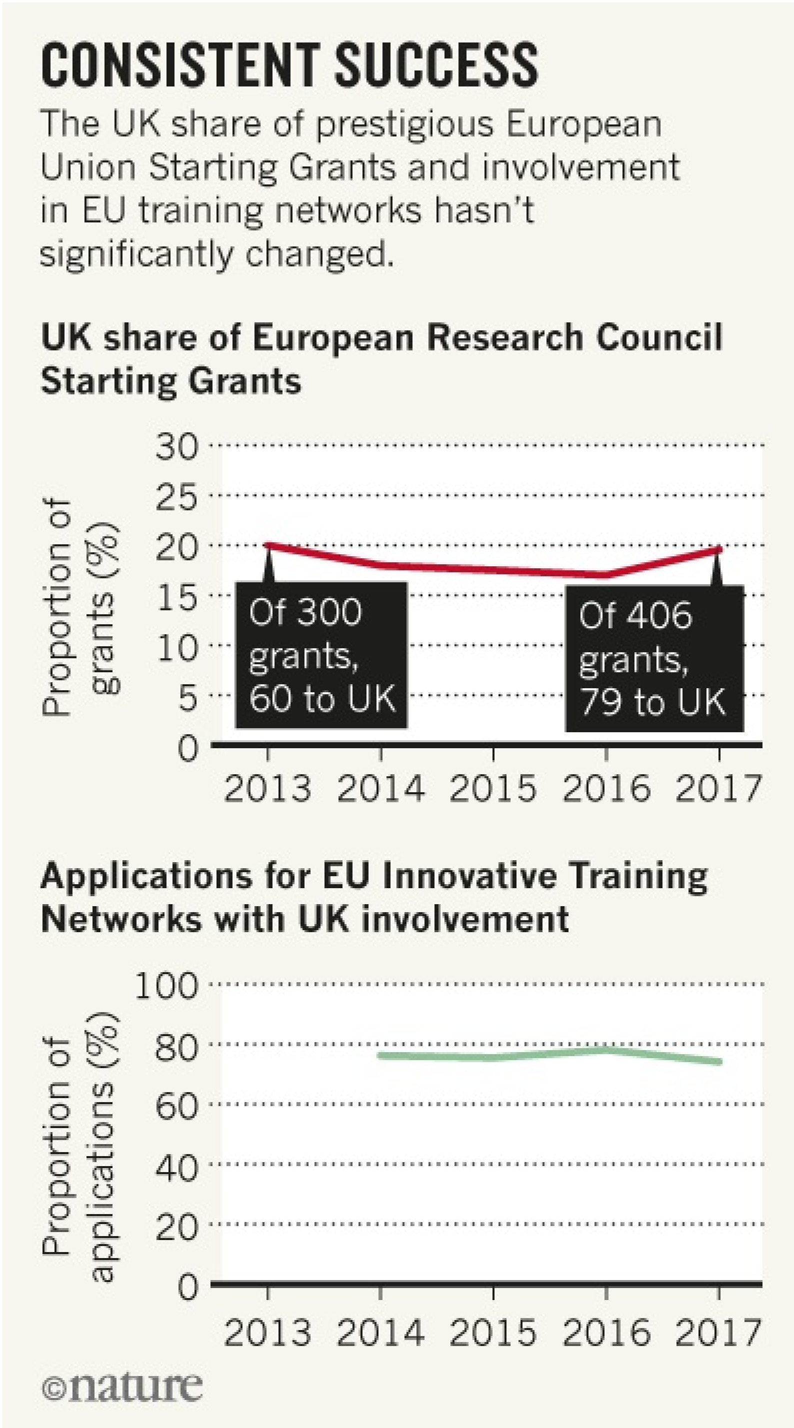
"It is unreasonable to expect an immediate effect from Brexit. The university and research system in the UK is massive, and it will take many years for the system to bleed out and gradually lose its competiveness," says Andre Geim, a physicist at the University of Manchester, UK, who won a Nobel prize for his work in graphene.

Geim told Bloomberg News last month that he hasn't received any applications under the Marie Curie scheme this year, unlike in previous years. But he is sponsoring two applicants who applied to work with his colleagues,

he clarifies to *Nature*. A spokesperson for the University of Manchester says that for the university as a whole, “Marie Curie application numbers have remained consistent over the past four years. This includes 2017, and we have several being processed in graphene at the moment.”

Strong starting grants

Other statistics on the United Kingdom’s involvement in Europe-funded grant schemes since the Brexit vote give a more optimistic picture — although it isn’t possible to conclude from any of the data whether changes in 2017 represent significant deviations from existing trends, notes statistician Michael Lavine at the University of Massachusetts Amherst.



Source: European Commission

For example, Britain has seen a [negligible decline in its involvement in multinational European research collaborations]() called Innovative Training

Networks (ITNs) — which, similarly to the fellowships, are paid for under the Marie Skłodowska-Curie actions, a €6.2-billion slice of the European Commission's Horizon 2020 funding programme. In 2016, 78% of ITNs had at least one British partner; the 2017 awards — all of which were applied for after the Brexit vote — show a slight dip to 74%.

And Britain has achieved its usual success in winning European Research Council (ERC) 'starting grants', awards of up to €1.5 million over 5 years for highly promising early-career researchers to start their own laboratories anywhere they wish. The United Kingdom secured 19.5% of the 406 starting grants awarded in 2017, up from 17% in 2016; its success rates have fluctuated between 17% and 20% in the past four years.

UK nationals, relative to non-British Europeans, are making up an increasing proportion of the United Kingdom's starting-grant winners, however. This year, Britain is hosting 79 grantees under the scheme — more than any other EU country — and just under half (47%) are UK nationals. In 2014, UK nationals represented just over one-quarter of those with ERC starting grants in the United Kingdom.

Funding guarantee

Two months after the Brexit vote, the UK government announced that it would underwrite EU grants won before the date scheduled for the United Kingdom to leave the EU. This promise has reassured some European researchers that they can have a future in Britain even without EU membership, says evolutionary biologist Simone Immler, a Swiss national who moved her ERC starting grant to the University of East Anglia in Norwich, UK, despite the Brexit vote.

Immler says that what really matters to researchers is getting their dream post, and that they will continue to come to the United Kingdom as long as there is a chance of this happening. "The beauty of these grants is they allow people to choose a host institution that they would like to go to, and they are likely to be offered a permanent position there," she says. "But if these grants stopped, it would hurt."

Michael Browne, head of European Research and Innovation at University College London, says that the most important thing is to ensure that British researchers do not drop out of European projects as a result of the Brexit vote, even temporarily. He says that EU research consortiums are highly competitive, and if one partner leaves, another will quickly step in to plug the gap, which makes it hard to re-enter. “That’s why my main message to researchers would be to, despite the uncertainty, really try to stay plugged into European platforms and networks,” he says.

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Comments

There are currently no comments.

Fossilized poo reveals that vegetarian dinosaurs had a taste for crabs

Ancient crustaceans in dino dung from Utah illuminate herbivores’ broad diet.

21 September 2017

Cory Richards/NGC

Fossilized faeces from the Kaiparowits Formation in southern Utah yields clues to dinosaurs' diets.

Plant-eating dinosaurs usually found plenty to eat, but occasionally they went

looking for a nutritional boost. Fossilized dinosaur droppings from Utah now reveal that 75 million years ago, some of the animals were snacking on prehistoric crayfish or crabs.

The work suggests that big herbivorous dinosaurs sometimes munched on crustaceans, likely to get extra protein and calcium into their bodies before laying eggs, says Karen Chin, a palaeontologist at the University of Colorado Boulder. She and her colleagues report the discovery on 21 September in *Scientific Reports*[1].

“It’s a very unusual case of an herbivorous dinosaur supplementing its diet with something else,” says Paul Barrett, a palaeontologist at the Natural History Museum in London.

Direct evidence of dinosaur diets is hard to come by. Some fossil animals have been found with their gut contents intact, but fossilized dinosaur dung — the most convincing remains of what a dinosaur actually ate — is rare. “Think of a cow pat — these things get broken down in the environment very easily,” says Barrett. Most of the fossilized faeces, called coprolites, that researchers uncover come from meat-eating dinosaurs; these are better preserved than those of plant-eating dinosaurs thanks to minerals in the bones of the creatures that carnivores consumed.

Chin has long hunted for coprolites from herbivorous dinosaurs. In 2007, she reported[2] finding fossilized chunks of rotting wood inside coprolites, between about 80 million and 74 million years old, from the Two Medicine rock formation in Montana. Plant-eating dinosaurs may have chewed the wood in search of insects and other organisms scurrying inside rotting logs, she proposed.

Then, in 2013, she found many similar coprolites in the Kaiparowits Formation of Grand Staircase–Escalante National Monument in southern Utah. Along with rotting wood, they contained puzzling fragments of thin, convex structures. When Chin examined slices of the structures under a microscope, they looked very much like the outer covering of a crustacean’s leg or claw. She consulted Rodney Feldmann, a palaeontologist at Kent State University in Ohio, who confirmed that they probably came from a crayfish or crab.

Dietary supplement

At the time the Kaiparowits rocks formed, around 75 million years ago, the landscape was a wet, subtropical environment much like today's Texas coast. Chin thinks that local dinosaurs — probably the duck-billed group called hadrosaurs — went in search of dietary supplements near the shoreline. "You get so many invertebrates hanging out in rotting logs," she says. "There's bugs to eat, and rotting detritus — it's a really rich place." The fungi that helped to break down the logs would also have provided extra protein.

K. Chin et al./Sci. Rep. (CC BY 4.0)

Fossilized faeces (brown) from the collections of the Denver Museum of Nature and Science show crustacean fragments (black).

Some modern birds with mostly plant-based diets add insects and other sources of protein before they lay eggs, she notes. "You can't imagine a 20-

foot hadrosaur going after a butterfly,” Chin says. “They would go for some place that had a predictable, concentrated source of food — some place like rotting logs.”

The rotting wood probably wasn’t a main source of dinosaur food year-round, says Jordan Mallon, a palaeontologist at the Canadian Museum of Nature in Ottawa. “Hadrosaurs were some of the biggest animals in their ecosystems, so they probably couldn’t have afforded to be too selective about what they were eating anyway, lest they starve to death.”

Mallon thinks the dinosaurs might have accidentally snaffled up a crayfish or two while feeding, as opposed to seeking the crustaceans out on purpose. Either way, he says, the latest findings “provide an excellent glimpse in the lives of these animals, 75 million years ago”.

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Comments

Comments

There are currently no comments.

Jellyfish caught snoozing give clues to origin of sleep

The brainless marine creatures are the simplest organisms known to seek slumber.

21 September 2017

Norbert Wu/Minden/NGC

New research suggests that *Cassiopea* jellyfish eschew the night life, tucking into bed and going to sleep when the sun goes down.

The purpose and evolutionary origins of sleep are among the biggest mysteries in neuroscience. Every complex animal, from the humblest fruit fly to the largest blue whale, sleeps — yet scientists can't explain why any

organism would leave itself vulnerable to predators, and unable to eat or mate, for a large portion of the day. Now, researchers have demonstrated for the first time that even an organism without a brain — a kind of jellyfish — shows sleep-like behaviour, suggesting that the origins of sleep are more primitive than thought.

Researchers observed that the rate at which *Cassiopea* jellyfish pulsed their bell decreased by one-third at night, and the animals were much slower to respond to external stimuli such as food or movement during that time. When deprived of their night-time rest, the jellies were less active the next day.

“Everyone we talk to has an opinion about whether or not jellyfish sleep. It really forces them to grapple with the question of what sleep is,” says Ravi Nath, the paper’s first author and a molecular geneticist at the California Institute of Technology (Caltech) in Pasadena. The study was published on 21 September in *Current Biology*[1].

“This work provides compelling evidence for how early in evolution a sleep-like state evolved,” says Dion Dickman, a neuroscientist at the University of Southern California in Los Angeles.

Mindless sleep

Nath is studying sleep in the worm *Caenorhabditis elegans*, but whenever he presented his work at research conferences, other scientists scoffed at the idea that such a simple animal could sleep. The question got Nath thinking: how minimal can an animal’s nervous system get before the creature lacks the ability to sleep? Nath’s obsession soon infected his friends and fellow Caltech PhD students Michael Abrams and Claire Bedbrook. Abrams works on jellyfish, and he suggested that one of these creatures would be a suitable model organism, because jellies have neurons but no central nervous system. Instead, their neurons connect in a decentralized neural net.

Cassiopea jellyfish, in particular, caught the trio’s attention. Nicknamed the upside-down jellyfish because of its habit of sitting on the sea floor on its bell, with its tentacles waving upwards, *Cassiopea* rarely moves on its own.

This made it easier for the researchers to design an automated system that used video to track the activity of the pulsing bell. To provide evidence of sleep-like behaviour in *Cassiopea* (or any other organism), the researchers needed to show a rapidly reversible period of decreased activity, or quiescence, with decreased responsiveness to stimuli. The behaviour also had to be driven by a need to sleep that increased the longer the jellyfish was awake, so that a day of reduced sleep would be followed by increased rest.

Other researchers had already documented a nightly drop in activity in other species of jellyfish, but no jellyfish had been known to display the other aspects of sleep behaviour. In a 35-litre tank, Nath, Abrams and Bedbrook tracked the bell pulses of *Cassiopea* over six days and nights and found that the rate, which was an average of one pulse per second by day, dropped by almost one-third at night. They also documented night-time pulse-free periods of 10–15 seconds, which didn't occur during the day.

Restless night

Without an established jellyfish alarm clock, the scientists used a snack of brine shrimp and oyster roe to try to rouse the snoozing *Cassiopea*. When they dropped food in the tank at night, *Cassiopea* responded to its treat by returning to a daytime pattern of activity. The team used the jellyfish's preference for sitting on solid surfaces to test whether quiescent *Cassiopea* had a delayed response to external stimuli. They slowly lifted the jellyfish off the bottom of the tank using a screen, then pulled it out from under the animal, leaving the jelly floating in the water. It took longer for the creature to begin pulsing and to reorient itself when this happened at night than it did during the day. If the experiment was immediately repeated at night, the jellyfish responded as if it were daytime. Lastly, when the team forced *Cassiopea* to pull an all-nighter by keeping it awake with repeated pulses of water, they found a 17% drop in activity the following day.

"This work shows that sleep is much older than we thought. The simplicity of these organisms is a door opener to understand why sleep evolved and what it does," says Thomas Bosch, an evolutionary biologist at Kiel University in Germany. "Sleep can be traced back to these little metazoans — how much

further does it go?” he asks.

That’s what Nath, Abrams and Bedbrook want to find out. Amid the chaos of finishing their PhD theses, they have begun searching for ancient genes that might control sleep, in the hope that this might provide hints as to why sleep originally evolved.

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Comments

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High-energy cosmic rays come from outside our Galaxy

Giant observatory announces long-awaited result.

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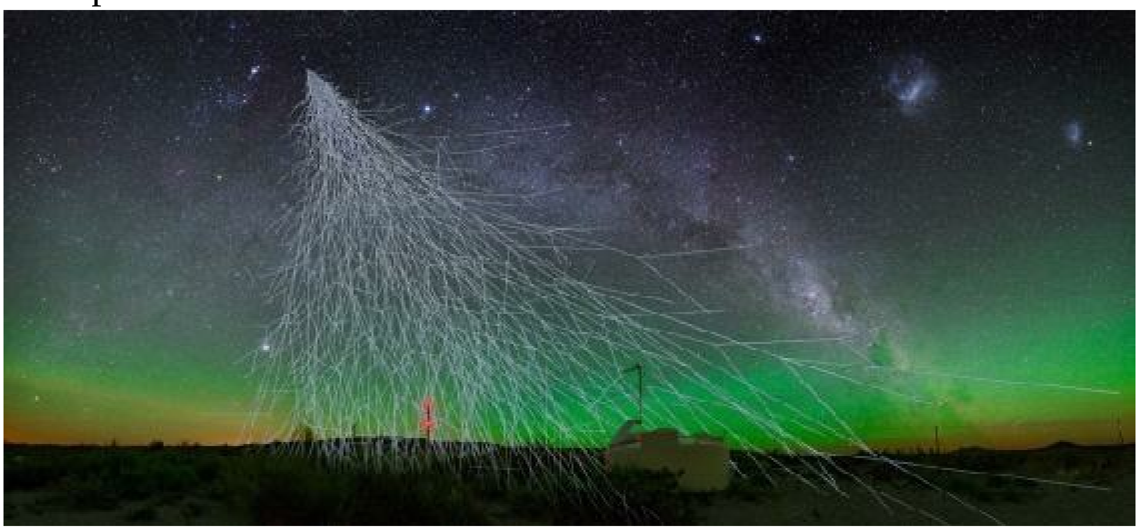

A. Chantelauze/S. Staffi/L. Bret

The fallout from a high-energy cosmic ray can cover many square kilometres (artist's impression).

The Pierre Auger Observatory in Argentina finally has solid evidence that the most energetic particles in nature come from sources outside the Milky Way. Scientists have suspected this for decades, but weren't able to confirm it — until now.

"For the first time, we have proof that the highest-energy cosmic rays are of extragalactic origin," says Alan Watson, a UK astronomer and co-founder of the observatory. The result comes as a relief to the researchers, after previous claims regarding their origin made ten years ago by the Pierre Auger

Collaboration subsequently turned out to be premature.

The international team analysed 12 years' worth of data, and found that particles in the upper range of energies were more likely to come from a region of the sky outside the Milky Way's disk. That asymmetry is roughly consistent with the distribution of neighbouring galaxies, the researchers report in the 22 September issue of *Science*[1].

The study does not pinpoint individual sources of the cosmic rays, or explain how they reach their highest energies. But the researchers hope that it is a first step towards understanding their origins.

Invisible shower

Most cosmic rays are protons or other charged particles, including atomic nuclei as heavy as iron. When such a particle rains onto Earth's upper atmosphere and collides with an atomic nucleus in the air, it produces a shrapnel burst of subatomic particles. These hit other nuclei and produce more particles, generating an invisible 'shower' that is often spread over many square kilometres by the time it hits the ground.

To detect these showers, the Pierre Auger Observatory has 1,600 car-sized water tanks placed at 1.5 kilometre intervals, to cover 3,000 square kilometres of grassy plains in Argentina's Mendoza province. Four sets of telescopes monitor the sky over the array, and — on moonless nights — can detect flashes of ultraviolet light generated by the showers. From its location relatively close to the equator, the array can pick up cosmic rays coming from the entire southern sky as well as from much of the northern sky, covering 85% of the celestial sphere.

The Pierre Auger Observatory

Cosmic rays were detected using 1,600 water tanks placed at 1.5 kilometre intervals.

The observatory needs to be that big in order to catch enough of the most sought-after particles. Cosmic rays have been detected with energies beyond 10^{20} electronvolts (eV); by comparison, the Large Hadron Collider near Geneva, Switzerland, the world's most powerful particle accelerator, pushes protons to just 7×10^{12} eV. However, cosmic rays become increasingly rare the higher their energies. A particle in the 10^{20} eV range, on average, hits a square kilometre of Earth only once per century.

The researchers looked at 32,187 particles that had energies above 8×10^{18} eV, detected by the observatory from its beginning in 2004 until 2016. The Galaxy's magnetic field bends the paths of charged particles, which can randomize their direction by the time they hit Earth. But these particles were still 6% more likely than average to come from a particular region of the sky, which is outside the Milky Way’s disk.

Surprise skew

Most researchers expected a skew, but not such a strong one, says Piera Ghia, an astroparticle physicist at the CNRS Institute of Nuclear Physics in Orsay, France, who helped to coordinate the data analysis. Astrophysicist Francis Halzen of the University of Wisconsin–Madison agrees. “It’s really very big. To me, it was a surprise,” says Halzen, who is spokesperson for IceCube, a major neutrino observatory at the South Pole.

When magnetic deflection is taken into account, the asymmetry seen by the Pierre Auger Observatory is consistent with the distribution of galaxies lying within 90 megaparsecs (around 300 million light years) or so from the Milky Way, says Silvia Mollerach, an Auger astrophysicist at the Balseiro Institute in San Carlos de Bariloche, Argentina.

The results strongly disfavour the supermassive black hole at the centre of the Milky Way as a major source of the higher-energy particles. “The most likely sources continue to be the usual suspects,” Mollerach says: astrophysical phenomena that generate extremely intense magnetic fields, inside which charged particles can pinball around and gain energy. These include active galactic nuclei — supermassive black holes spewing jets of matter at near-light speed — and the stellar explosions called γ-ray bursts.

The latest claim is quite conservative compared to one that the collaboration made in 2007. Back then, it found a correlation between 27 extremely high-energy cosmic rays (above 57×10^{18} eV) it had seen up until that point and a set of known active galactic nuclei[2]. The paper caused a sensation, but the statistical significance of the result was weak and soon melted away as the array collected more data. “In retrospect, it was a mistake that we published too early,” says Auger spokesperson Karl-Heinz Kampert, a physicist at the University of Wuppertal in Germany.

This time, the team took no chances: it accumulated much more data and is confident that the results are solid, Kampert says. Halzen agrees. “I don't think there is any doubt about the statistical significance” of the latest results, he says.

Now that the researchers have more data, they will again try to find correlations with potential sources. The results of that study should appear within a few months. The collaboration also plans to join forces with a smaller observatory in Utah, the Telescope Array, to try to map the origins of cosmic rays across the entire sky.

The Pierre Auger Observatory is also in the initial stages of a US$12-million upgrade that should enable it to better measure the relative abundance of protons and heavier nuclei in the flux of cosmic rays.

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