

# New Scientist

WEEKLY September 15-21, 2018

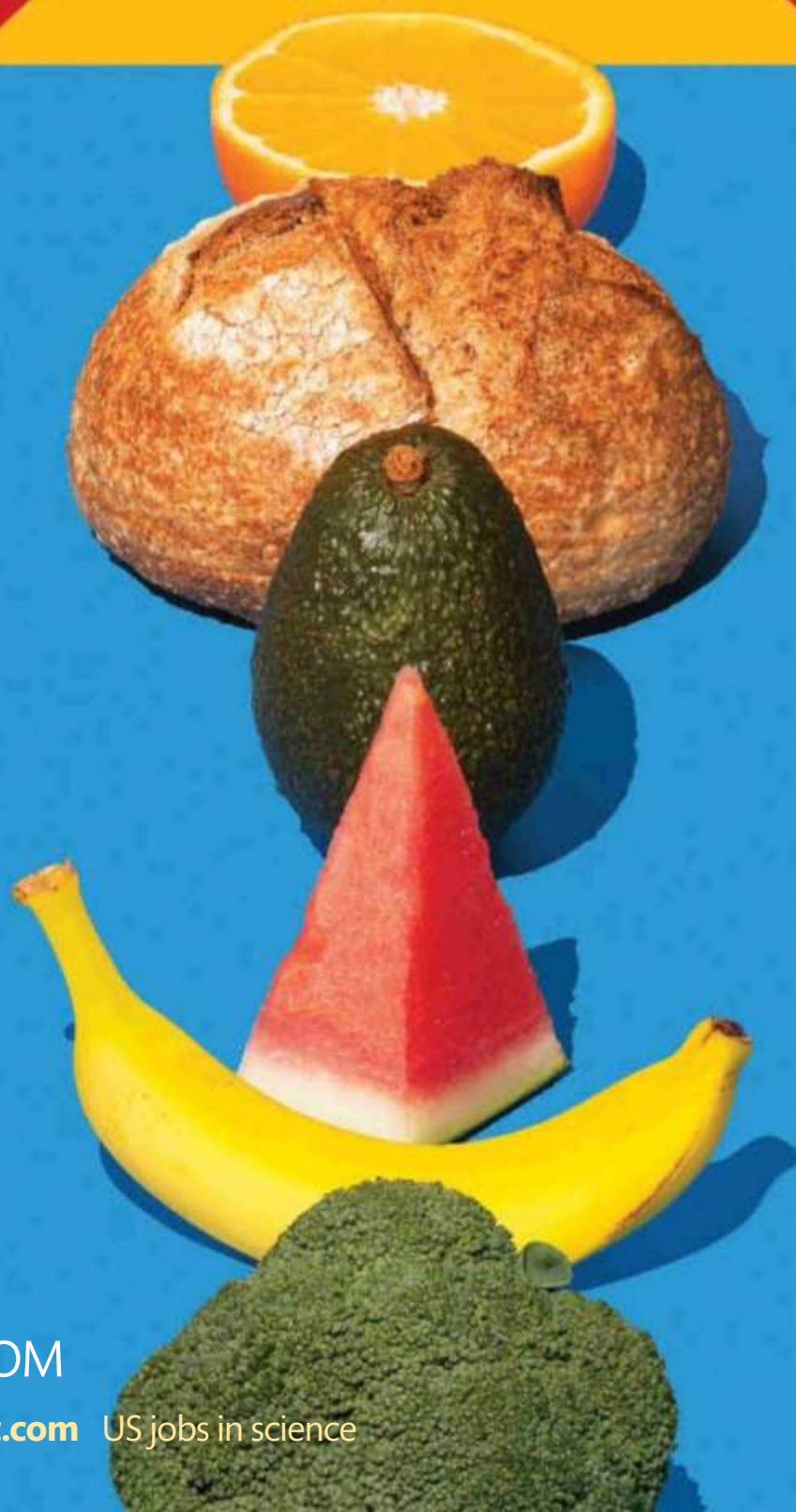
**DAWN OF DOODLING**  
Earliest human artwork found

**SEEING DOUBLE**  
Antimatter can be in two places at once

**FROZEN IN BATTLE**  
Gruesome end of Iran's Pompeii

## ARE THESE FOODS MAKING YOU SICK?

The surprising truth about the world's gut problem

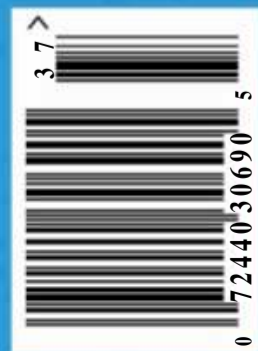


**CHEMICAL BRAINS**  
Creating consciousness in the lab

**PLUS SHEEP CULTURE/HOBBIT DOOM**

Science and technology news [www.newscientist.com](http://www.newscientist.com) US jobs in science

No3195  
US\$6.99  
CAN\$6.99





Headlines grab attention,  
but only details inform.  
For over 28 years, that's how  
Orbis has invested.

By digging deep into a  
company's fundamentals,  
we find value others miss.  
And by ignoring short-term  
market distractions, we've  
remained focused on  
long-term performance.

For more details,  
ask your financial adviser  
or visit [Orbis.com](http://Orbis.com)



Avoid  
distracting  
headlines'



# CIVILISATION

*Discover how our species built a global civilisation, how we gained and lost by doing so, and what might happen next.*

Buy your copy from all good magazine retailers.

**NewScientist**

## New Scientist

### Management

**Executive chairman** Bernard Gray  
**Finance director** Jenni Prince  
**Chief technology officer** Chris Corderoy  
**Marketing director** Jo Adams  
**Human resources** Shirley Spencer  
**Non-executive director** Louise Rogers

### Publishing and commercial

**Customer services manager** Gavin Power  
**HR co-ordinator** Serena Robinson  
**Facilities manager** Ricci Welch  
**Executive assistant** Sarah Gauld  
**Receptionist** Alice Catling

### Display advertising

**Tel** +1 617 283 3213  
**Email** displayads@newscientist.com  
**Commercial director** Chris Martin  
 Richard Holliman, Justin Viljoen,  
 Henry Vowden, Helen Williams

### Recruitment advertising

**Tel** +1 617 283 3213  
**Email** nssales@newscientist.com  
**Recruitment sales manager** Mike Black  
**Key account managers**  
 Reiss Higgins, Viren Vadgama  
**US sales manager** Jeanne Shapiro

### Marketing

**Head of marketing** Lucy Dunwell  
 David Hunt, Chloe Thompson

### Web development

Maria Moreno Garrido, Tom McQuillan,  
 Amardeep Sian

### New Scientist Live

**Tel** +44 (0)20 7611 1206  
**Email** live@newscientist.com  
**Creative director** Valerie Jamieson  
**Sales director** Jacqui McCarron  
**Exhibition Sales Manager** Charles Mostyn  
**Event manager** Henry Gomm  
**Conference producer** Natalie Gorohova  
**Head of marketing** Sonia Morjaria-Shann  
**Marketing executive** Sasha Marks

### US Newsstand

**Tel** +1 212 237 7987  
 Distributed by Time/Warner Retail,  
 Sales and Marketing, 260 Cherry Hill Road,  
 Parsippany, NJ 07054

### Syndication

Tribune Content Agency  
**Tel** 1 800 637 4082  
**Email** tca-articlesales@tribpub.com

### Subscriptions

**newscientist.com/subscribe**  
**Tel** 1 888 822 3242 or +1 636 736 4901  
**Email** ns.subs@quadrantsubs.com  
**Post** New Scientist, PO Box 3806,  
 Chesterfield MO 63006-9953



Volume 239 No 3195

## On the cover

- 7 Dawn of doodling**  
Earliest human artwork found
- 8 Seeing double**  
Antimatter can be in two places at once
- 36 Frozen in battle**  
Gruesome end of Iran's Pompeii
- 32 Are these foods making you sick?**  
The surprising truth about the world's gut problem
- 28 Chemical brains**  
Creating consciousness in the lab
- Plus** Sheep culture (12),  
Hobbit doom (9)



**Insight** The battle for privacy in a world of face recognition **22**

## Leader

- 5** The Large Hadron Collider is a decade old – and it's not done yet

## News

- 6 THIS WEEK** World's oldest drawing. Hurricane Florence. UN climate plans. California to ditch fossil fuels. Alcohol advice row
- 8 NEWS & TECHNOLOGY** Antimatter can be in two places at once. Bots don't spread rumours, humans do. Go to space as an avatar. Hobbit extinction linked to volcano. Schrödinger's legacy. Sheep culture. Hate speech detectors are easily fooled. Brain's moods revealed. Tiny spy radio. The woman who heard stars. Rain in the Sahara

- 18 IN BRIEF** Jupiter's blue spot. Robot uses echolocation like a bat. Ancient Roman mill. Shark eats veg. Probiotics are useless. Butcherbirds kill with whiplash

## Analysis

- 22 INSIGHT** How face recognition technology infiltrated society
- 24 COMMENT** Is the financial crash of 2008 still playing havoc with our minds?
- 25 ANALYSIS** The hunt for a hole-maker on the International Space Station

## Features

- 28 "I want to make a chemical brain"** Lee Cronin's quest to create consciousness in the lab
- 32 What's up with your gut?** The surprising truth about the foods that are making us sick
- 36 The horror of Hasanlu** Gruesome end to the Pompeii of Iran lay buried for 3000 years
- 40 AI, warbot** Artificial intelligence is set to rewrite the rules of warfare

## Culture

- 44 Giving voice to Earth** Poetry can express our environmental crisis in a more human way
- 45 Prudery isn't justice** Don't let disgust steer collective behaviour  
PLUS: This week's cultural picks
- 46 The last Trump** An ill-judged tweet kicks off nuclear war in a timely satire

## Regulars

- 26 APERTURE**  
Stargazers' paradise
- 52 LETTERS**  
Life expectancy and poverty
- 55 OLD SCIENTIST**  
Where it all began
- 56 FEEDBACK**  
Pigeons on a bullet train
- 57 THE LAST WORD**  
Hot sauce

SUBSCRIPTION OFFER

# More ideas... more discoveries... and now even more value

**SAVE 77% AND  
GET A FREE BOOK  
WORTH \$35**



**"A beautifully  
produced book which  
gives an excellent  
overview of just what  
makes us tick"**

## Subscribe today

**PRINT + APP + WEB**

Weekly magazine delivered to your door  
+ full digital access to the app and web

**Only \$3.33 per week**

*(Print or digital only packages also available)*

**+**

**HOW TO BE HUMAN**

Take a tour around the human body and brain  
in the ultimate guide to your amazing existence.  
Find witty essays and beautiful illustrations in  
this 270 page hard back edition.

**To subscribe visit [newscientist.com/11380](http://newscientist.com/11380)  
or call 1-888-822-3242 and quote 11380**

**NewScientist**

## LEADER

New  
Scientist

## Editorial

**Editor** Emily Wilson  
**Managing editor** Rowan Hooper  
**Art editor** Craig Mackie  
**Editor at large** Jeremy Webb

## News

**News editor** Penny Sarchet  
**Editors** Jacob Aron, Timothy Revell, Jon White  
**Reporters** (UK) Andy Coghlan, Alison George, Jessica Hamzelou, Michael Le Page, Clare Wilson, Sam Wong  
 (US) Leah Crane, Chelsea Whyte  
 (Aus) Alice Klein

## Features

**Chief features editor** Richard Webb  
**Editors** Catherine de Lange, Gilead Amit, Julia Brown, Daniel Cossins, Kate Douglas, Joshua Howgego, Tiffany O'Callaghan, Sean O'Neill  
**Feature writer** Graham Lawton

## Culture and Community

**Editors** Liz Else, Mike Holderness, Simon Ings, Frank Swain

## Subeditors

**Chief subeditor** Eleanor Parsons  
 Tom Campbell, Hannah Joshua, Chris Simms

## Design

Kathryn Brazier, Joe Hetzel,  
 Dave Johnston, Ryan Wills

## Picture desk

**Chief picture editor** Adam Goff  
 Kirstin Kidd, David Stock

## Production

Mick O'Hare, Melanie Green,  
 Alan Blagrove, Anne Marie Conlon

## Contact us

[newscientist.com/contact](http://newscientist.com/contact)

## General &amp; media enquiries

[enquiries@newscientist.com](mailto:enquiries@newscientist.com)

## US

210 Broadway #201  
 Cambridge, MA 02139  
**Tel** +1 617 283 3213

## UK

25 Bedford Street, London, WC2E 9ES  
**Tel** +44 (0)20 7611 1200

## AUSTRALIA

PO Box 2315, Strawberry Hills, NSW 2012



© 2018 New Scientist Ltd, England.

New Scientist ISSN 0262 4079 is published weekly except for the last week in December by New Scientist Ltd, England.

New Scientist (Online) ISSN 2059 5387  
 New Scientist Limited, 387 Park Avenue South, New York, NY 10016  
 Periodicals postage paid at New York, NY and other mailing offices

Postmaster: Send address changes to New Scientist, PO Box 3806, Chesterfield, MO 63006-9953, USA.

Registered at the Post Office as a newspaper and printed in USA by Fry Communications Inc, Mechanicsburg, PA 17055



HAROLD CUNNINGHAM/GETTY

# Smashing achievement

The Large Hadron Collider is a decade old – and it's not done yet

NEXT July will mark 50 years since humans set foot on the moon. The rumblings of commemoration can already be heard – even now Ryan Gosling, deputising for Neil Armstrong in the film *First Man*, is being castigated for failing to plant an American flag in the lunar regolith.

The moon landing was the first truly global media event, and an iconic expression of the human desire to explore and explain the universe. It is odd, then, that the anniversary of an event embodying that same aspiration has passed on 10 September with so little fanfare. With a global audience of more than 1 billion, the switch-on of the Large Hadron Collider was actually seen by more people than the moon landing. As we said at the time, it was “to physics what the Apollo programme was to space exploration”.

No doubt the reticence is in part due to the ignominious failure of the gleaming new particle accelerator just 10 days after start-up. But in truth, the euphoria of the early days has given way to a more sober reality.

Let's celebrate the positives. For a start, the LHC did not destroy

the world by sucking it into a black hole, as doom-mongers predicted at the time. Fake news.

Then there is the Higgs boson, of course. Its discovery by the LHC in 2012 represented the crowning glory of the standard model of particle physics, our best stab so far at ordering the bric-a-brac of reality. This was the final confirmation of a theoretical idea conceived five years before Armstrong took his one small step – an inspiring validation of purely intellectual human endeavour.

**“If things have gone quiet around the LHC, it is the silence of committed, concentrated endeavour”**

It is also where the problems start. “There's an enormous elephant in the room, and that's that we know the standard model is not a final theory,” says Tara Shears of the University of Liverpool and the LHCb experiment. It fails to explain the nature of phenomena such as dark matter or dark energy, or even why the measured Higgs mass teeters on the very lowest boundary of what's

possible in a stable universe.

Supersymmetry was the much-vaunted successor to the standard model, predicting a swarm of additional particles to shore it up. “The LHC has meticulously searched in the open as well as in various nooks and crannies for these and has shown that they are not there,” says Ben Allanach of the University of Cambridge, a former supersymmetry adherent.

That is a blow to theorists' egos, conditioned by a string of successes culminating in the Higgs discovery. It suggests that, whatever better theory is out there, it will not have the beauty of supersymmetry.

But no one said probing the essence of reality was easy. The LHC has already determined the contents of the universe with greater precision than any machine before it. Planned upgrades and new analysis techniques will further sharpen its eye. Hints of anomalies already seen may yet lead to insights. If things have gone quiet around the LHC, it is the silence of committed, concentrated endeavour. In Shears's words, “we have to wait, work hard, and see”. We'll hang on in there – happy birthday, LHC. ■

## THIS WEEK



NASA

## Bracing for Florence

MORE than a million residents along the Atlantic coast of the US were ordered to evacuate early this week, as Hurricane Florence neared the coastlines of North and South Carolina, Virginia and Maryland.

Governors in all four states declared an emergency ahead of what has been predicted to be the worst deluge to hit the Carolinas in 30 years, and the fiercest storm to hit the US this year. The governor of South Carolina gave residents of the state's entire coastline an evacuation deadline of noon on Tuesday.

When *New Scientist* went to press, the hurricane was expected to make landfall on Thursday around Wilmington, North Carolina, near the state's border with South Carolina.

The US National Hurricane Center issued warnings of storm surges and

flooding, 220 kilometre per hour winds and large swells and rip-currents affecting Bermuda and portions of the US East Coast.

On Tuesday, Florence was nearing the highest hurricane rating, category 5. At this level, it could bring winds of more than 251 kilometres per hour.

"Life-threatening freshwater flooding is likely from a prolonged and exceptionally heavy rainfall event, which may extend inland over the Carolinas and Mid-Atlantic for hundreds of miles as Florence is expected to slow down as it approaches the coast and moves inland," said the latest National Hurricane Center bulletin on Monday.

The centre also warned that damaging winds could spread well inland into parts of the Carolinas and Virginia.

## English health body in alcohol row

TWO advisers to Public Health England (PHE) have said they may quit their roles at the agency, after it launched an alcohol awareness campaign in partnership with an organisation that receives funding from the drinks industry.

The campaign, launched this week by PHE and alcohol education charity Drinkaware, encourages middle-aged people to have at least two alcohol-free days a week. Drinkaware is largely funded by donations from UK alcohol producers, retailers and supermarkets.

The move prompted Ian Gilmore and John Britton, who co-chair PHE advisory boards, to say that health officials had failed to learn lessons from the way tobacco and alcohol industries use partnerships with health bodies to undermine or neutralise policies intended to reduce consumption.

However, Leigh Lewis, chair of Drinkaware, stressed the organisation's independence as a charity.

## Climate talks hit sticking points...

LITTLE progress was made at the latest round of climate talks in Bangkok last week, where officials debated the rules that will govern the 2015 Paris climate agreement.

Almost every country has now signed the agreement, and so they are committed to cutting their greenhouse emissions. This includes the US, despite its stated intention to withdraw from the pact.

In Bangkok, officials tried to narrow

down how countries should go about meeting their obligations. But there were numerous sticking points, such as China wanting different rules for developed and developing countries, and rich countries failing to provide the funds they promised to help other countries cut their emissions.

"Small islands have contributed an almost immeasurably small fraction of global emissions, yet we face devastating climate impacts," said Amjad Abdulla from the Alliance of Small Island States. "Climate finance is not a handout. It is a logical and fair response to this history."

## ... but elsewhere there's progress

WHILE headway was slow in the latest UN climate talks (see left), elsewhere there is some much needed good news on the climate front. California is planning to go carbon neutral by 2045 and achieve net negative emissions after that. Also, investors across the globe responsible for \$6 trillion in funds now plan to divest from fossil fuels.

On 10 September, the governor of California signed an executive order calling for state-wide carbon neutrality by no later than 2045. That exceeds by far any of the targets that countries signed up to in the Paris climate agreement. A few countries and states have set themselves similarly ambitious goals, but California is now the biggest economy to do so.

Meanwhile, the divestment movement continues to gather pace. According to a report from Arabella Advisors, more than 1000 institutional investors with \$6 trillion in assets have committed to divest from fossil fuels, compared with just \$52 billion four years ago.



JEWEL SAMAD/AFP/GETTY IMAGES



For new stories every day, visit [news scientist.com/news](http://news scientist.com/news)

# The oldest human drawing

Archaeologists say they have found a 73,000-year-old drawing. **Clare Wilson** reports

FROM a cursory glance, the lines on this small, brown stone could be mistaken for a natural formation. In fact, it is the first known drawing ever made by human hands.

"This is the beginnings of cultural modernity and sophisticated behaviour," says Colin Renfrew at the University of Cambridge, who was not involved in its discovery. "You would be astonished if you found another animal species producing something like that. It's the origins of humankind."

Laboratory analysis shows that the dark red lines, forming a rough, cross-hatched pattern, must have been drawn with a chunk of soft, coloured stone called ochre, possibly one whittled into a simple crayon.

Attempts to recreate the pattern using the same materials show that the lines were no careless scrawls but took deliberate effort.

"You have to use a lot of pressure and control or it doesn't leave enough ochre," says Christopher Henshilwood at the University

**"This is the beginnings of cultural modernity and sophisticated behaviour, the origins of humankind"**

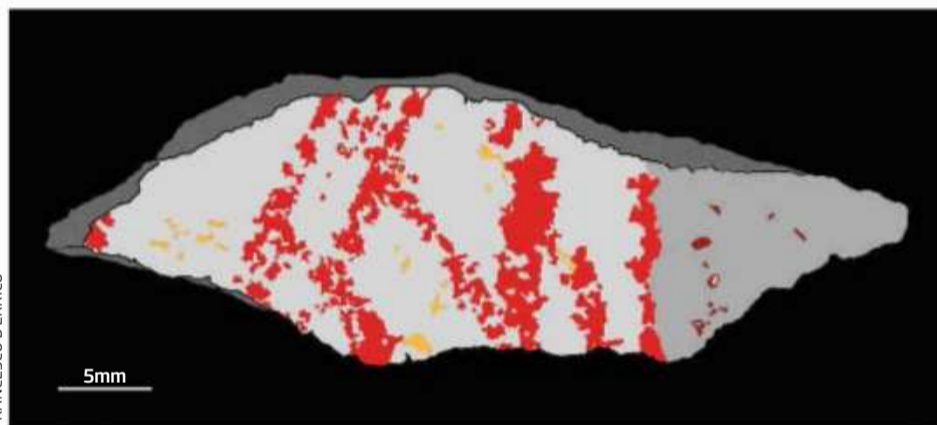
of the Witwatersrand in Johannesburg, South Africa.

Henshilwood and his colleagues dug up the drawing in a South African cave from layers of earth dated to about 73,000 years ago. This makes it nearly twice as old as any previously found Stone Age drawings or paintings by our own species – although it was recently discovered that Neanderthals were painting caves in Spain 64,000 years ago.

Modern humans, or *Homo*



CRAIG FOSTER



FRANCESCO D'ERRICO

*sapiens*, evolved in East Africa about 200,000 years ago, before spreading to the north and south of the continent. The Blombos cave, on the south coast, has been excavated for more than two decades, turning up a wealth of material from people living there as far back as 100,000 years ago.

The artefacts uncovered include shell beads and spear tips made from stone and bone. Another provocative find was a painting kit – the paint, made from ochre, charcoal and seal fat, was mixed in large sea snail shells – but so far no paintings have turned up.

The newly found drawing is on a rock just 4 by 1.5 centimetres. It was unearthed in 2011, but, covered in dirt, drew no notice, and was just labelled and stored. Only when the muck was washed off in a search for stone tools years later did a team member notice the markings, triggering microscopic

and chemical analysis of the rock and the ochre traces.

Ochre comes in various forms and hues – this particular type would have been about as hard as a child's colouring pencil, perfect for the job, says Henshilwood. Going by the width of the lines, the tip was a 2-millimetre point that may have been deliberately sharpened.

## Crayon on stone

The nine lines extend right to the edges of the rock, suggesting that they were once part of a larger artwork that was later broken up. For most lines, the team could tell the direction of the stroke, because microscopic bumps on the stone surface accumulated ochre on the opposite side to the crayon's approach. The scribbler must have gone over one line several times in a to-and-fro

Lines on this rock (repeated in the graphic) may be part of a larger work

motion, making it thicker than the rest. "There's no doubt it was done deliberately," says Henshilwood.

The stone "canvas" also told a story. The drawn-on surface is much smoother than the other sides, and its pits contain tiny traces of a different kind of ochre that is as hard as rock. This indicates it might have initially been used as a grindstone for rubbing the hard ochre into powder, perhaps used for paint (*Nature*, DOI: 10.1038/s41586-018-0514-3).

Henshilwood says we don't know if the original cross-hatch drawing was for decoration or had some symbolic meaning. "If you have a little ochre pencil, perhaps for the first time you are able to store information outside of your brain," he says. "You can carry it across the landscape and leave a message anywhere."

"This shows that the minds of these people would have been very similar to ours today," says Clive Finlayson of the Gibraltar Museum. "They were able to try to represent something by abstracting something. That suggests cognitive capacities similar to ours."

Impressive though it is, the drawing isn't the earliest ever artwork from our species. There are plentiful examples of earlier designs – including similar cross-hatchings – made by etching, a simpler technique than drawing with a crayon.

The first known etched design was found on a clam shell from Indonesia, dated to half a million years ago – so must have been made by a different species of hominin, *Homo erectus*. ■

## NEWS &amp; TECHNOLOGY

# Antimatter seen in two places at once

Leah Crane

A PARTICLE can be in two places at once – even if it is made of antimatter. The result comes from an antimatter twist on a classic experiment to show a central tenet of quantum mechanics: that all particles are also waves.

In the basic double-slit experiment, a beam of light illuminates a plate with two parallel slits in it, creating stripes of light on a screen behind.

Thinking of light as single particles, as Isaac Newton argued, you would expect just two bright lines, corresponding to the two slits. Instead, you get an interference pattern of many stripes. This can be explained either as individual particles being in two places at once and interfering with themselves, or light behaving as a wave.

Variations of the experiment have been repeated with many types of particles, showing that they are all waves as well. However until now, it had never been done with a beam of antimatter.

“Antimatter is precious, it’s hard to produce, and it’s even

harder to produce in a set-up where you can make a beam out of it,” says Michael Peskin at the SLAC National Accelerator Laboratory in California, who was not involved in the work.

Now, Akitaka Ariga at the University of Bern in Switzerland and his team have performed the double-slit experiment

with positrons, the antimatter equivalent of electrons.

The set-up starts with radioactive sodium, which sheds about 5000 positrons per second. The positrons pass through a pair of circular openings, which focus them into a beam. This is then aimed at two silicon nitride crystals, each of which acts as a set of many slits. Positrons that pass through the crystals hit a screen that records where each one lands.

Only about 100 positrons per

**Waves or particles? Antimatter can’t decide which one to be**

second hit the screen, so the experiment had to run for 200 hours to build up a strong image, revealing stripes of light and dark and showing that positron waves do interfere ([arxiv.org/abs/1808.08901](https://arxiv.org/abs/1808.08901)).

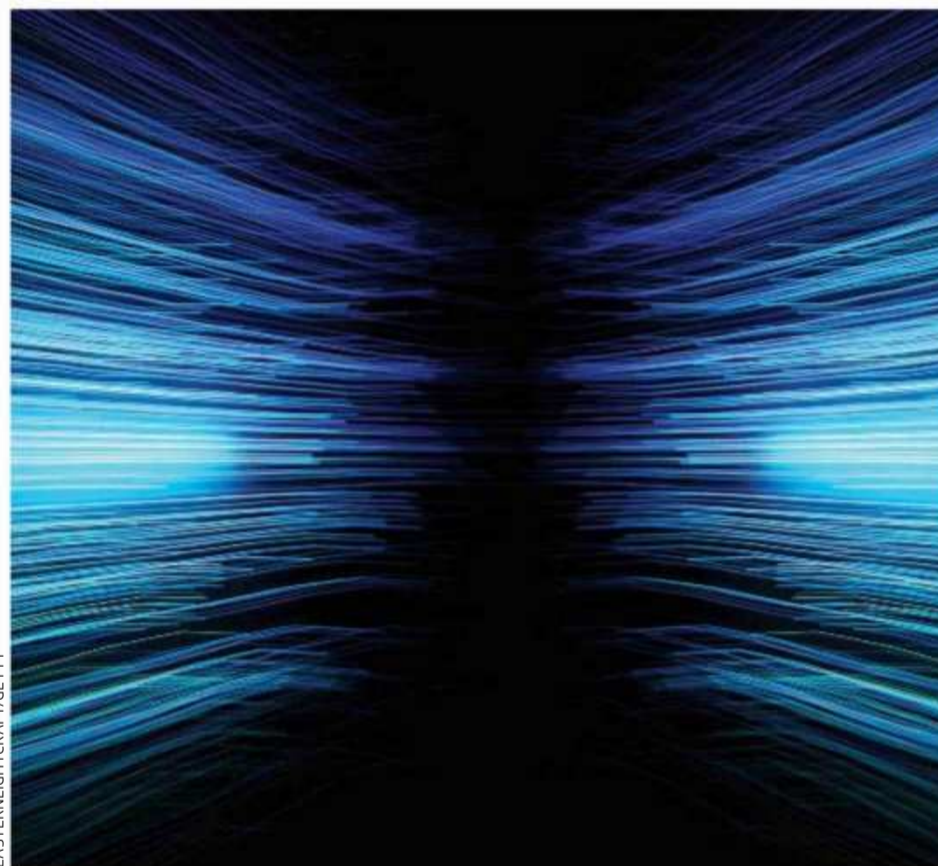
This isn’t the first time that antimatter particles have been shown to also behave like waves, says Peskin, but it is satisfying to achieve the classic double-slit. “It’s a big technical challenge.”

This experiment was a first step for the researchers’ ongoing efforts to study the effect of gravity on antimatter, such as whether it floats upwards. Their eventual goal is to determine how the interference pattern changes when the positrons are under a varying gravitational force.

“It’s possible that gravity doesn’t work exactly the same for antiparticles and particles, and this could be part of the reason the universe doesn’t appear to be made of the same amount of particles and antiparticles,” says David Christian at the Fermi National Accelerator Laboratory in Illinois.

If gravity does act differently on matter and antimatter, it is only a very slight distinction, so experiments will need to be extremely precise to reveal it.

“The effect of gravity on an individual particle is really tiny, even if it’s the gravity of the whole Earth,” says Christian. ■



EASTERNLIGHTCRAFT/GETTY

## How falsehoods spread after a mass shooting

WHEN the gunman who attacked students and staff at Marjory Stoneman Douglas High School in Parkland, Florida, this February stopped shooting, 17 people were left dead or fatally injured.

On top of this, shortly after the tragedy, Twitter bots began sending out emotionally charged quips and conspiracy theories about what took

place. However, a retrospective analysis of those tweets suggests that humans were the ones who spread them furthest.

A team at the University of South Carolina downloaded 7 million tweets posted during a one-month period shortly after the shooting, and isolated those originally posted by 400 bot accounts. Only automated accounts that appeared to be trying to influence people’s opinions were included, rather than, for example, benign bot accounts used by news organisations to publish links to stories.

The malicious bots sometimes appeared to simply make up provocative statements, or sourced their content from untrustworthy or politically extreme websites. But it was the human response to this content that really got the snowball rolling. Over 90 per cent of retweets were from human-run accounts ([arxiv.org/abs/1808.09325](https://arxiv.org/abs/1808.09325)).

About one-third of the tweets

**“The malicious bots sometimes appeared to simply make up provocative statements”**

shared in this way could be described as attempts to “bait” users by targeting their beliefs, says Vanessa Kitzie, who worked on the project. For example, one popular tweet referred “gun control dolts”, while another described CNN as “Marxist”. It is not clear who was behind the bots tweeting about Parkland.

Automated accounts succeed when they trick both humans and social media website algorithms, which select popular content, and get them to share the messages far and wide, says Fil Menczer at the University of Indiana. Chris Baraniuk ■

For daily news stories, visit [news scientist.com/news](http://news scientist.com/news)

## Control a real space robot with VR

A JAPANESE airline wants to send you to space. Well, not you exactly, but a robot avatar that you can control in real time, while seeing through its eyes and feeling what it feels through virtual reality.

All Nippon Airways and the Japan Aerospace Exploration Agency have just announced the Avatar X programme to build humanoid drones and send them to space.

"The giant leap will be in bringing human consciousness and presence to a remote location," says programme co-director Kevin Kajitani.

As well as allowing people to experience space through an avatar, the robots could be used for farming and construction, and for generally helping out astronauts, he says.

The partners hope to begin building and testing avatars on Earth in 2019, moving to low Earth orbit for more trials in the early 2020s, and then sending robots to the moon and Mars.

The robots could help out on the International Space Station, says Frances Zhu at Cornell University in New York. "Say we've got a robot on the ISS, and the human is on Earth with a virtual reality set," she says. "The robot on the ISS doesn't need life support, it won't have any health problems, it's not creating any waste and you're limiting the risk of human life."

But it would be more efficient to have a single person in charge of several more-autonomous robots, says Chris Atkeson at Carnegie Mellon University in Pennsylvania. And as for letting the general public experience space, the avatar encounter might be less attention-grabbing than hoped, he says.

"You're going to have to give them something to do to keep them occupied for more than 15 minutes," says Atkeson. "If you want to save a lot of money, just make a video game. Fake it, and you can make something much more entertaining."

Leah Crane ■



PETER VERREUSSEL/GETTY

## Volcano could have helped doom hobbits

ABOUT 50,000 years ago on the Indonesian island of Flores, nearly all the large animals disappeared at once. The losses included dwarf elephants, carnivorous birds – and a species of diminutive hominin known as the "hobbit", or *Homo floresiensis*.

It's not clear why. A volcanic eruption might have been a trigger. But there is also tentative evidence that a new threat had reached the island: *Homo sapiens*.

Hobbits were first described in 2004, after bones were found in the Liang Bua cave on Flores. They stood 1 metre tall and had brains the size of grapefruit. In 2016, researchers led by Thomas Sutikna at the University of Wollongong, Australia, concluded that the species probably vanished from Flores about 50,000 years ago.

Now Sutikna and his colleagues have dated 300,000 animal fossils and 10,000 stone tool fragments from Liang Bua, revealing that the local ecosystem changed significantly at this time.

Before this cut-off, the Liang

Bua area was dominated by elephants the size of large cows. There were also two big scavenger birds: a large vulture and the giant marabou stork that stood 1.8 metres tall. Finally, the area was home to Komodo dragons, the world's largest lizard.

All four species last appear at Liang Bua 50,000 years ago.

**"There is another possible culprit: fragments of stone tools point to the arrival of our species on the island"**

The next sediments were laid down 46,000 years ago. "We no longer see those large animals," says research team member Matthew Tocheri of Lakehead University in Canada.

Komodo dragons clung on elsewhere on Flores – today they live on the island's north coast – but the other three species are extinct.

The loss of the elephants may have triggered an ecological collapse. "Once they go, clearly the marabou stork and vulture

An eruption 50,000 years ago may have disrupted Flores's ecosystem

disappear right away, because there's nothing large enough for them to survive on," says Tocheri. Komodo dragons may have survived on the coast because they eat marine carrion, he says.

With the elephants gone, the hobbits lost a major food source, too. So what killed the elephants?

The sediments reveal there was a big volcanic eruption 50,000 years ago, which could have disrupted the ecosystem, says Hannah O'Regan at the University of Nottingham, UK. It is possible, then, that the hobbits were driven extinct as a consequence of the volcanic eruption.

But there is another possibility. Before 50,000 years ago, the tools at Liang Bua were mostly made from volcanic rock called silicified tuff – probably by hobbits. After this time, the tools were mostly made of chert, a material favoured by *H. sapiens* (*Journal of Human Evolution*, doi.org/ctqm). This may be evidence that our species had arrived on Flores. They could have hunted the elephants to extinction, says Tocheri, which might have left the hobbits unable to cope. **Michael Marshall** ■

## NEWS &amp; TECHNOLOGY

FIELD NOTES Schrödinger at 75, Dublin, Ireland

# Biology's greatest hits pull a crowd

Graham Lawton

"I'M A neuroscientist, and we have a technical expression in the field," quips consciousness researcher Christoph Koch. "My brain is full."

I know how he feels. After 24 talks delving deep into some of the most exciting ideas in science, mine is fit to burst. Over the past two days, I've met six Nobel prizewinners, plus some good bets for future invitees to Stockholm. All are here in Dublin to celebrate the 75th anniversary of one of the most famous lectures in science.

In 1943, Austrian physicist Erwin Schrödinger stood in the physics lecture theatre at Trinity College Dublin and delivered his three-part lecture *What Is Life?*. Later published as a book, his ideas are widely credited with inspiring the molecular biology revolution. At the time, the molecular basis of life was unknown. Within 10 years, the structure of DNA had been discovered, and the genetic code was cracked eight years after that.

Schrödinger moved to Dublin in 1939 after fleeing Nazi Germany and Austria. He was 53 and had already done the work that made him famous, including his eponymous wave equation and his infamous cat. He won a share of the 1933 physics Nobel prize for his work in quantum mechanics, but, as an outspoken critic of the Nazis, he was dismissed from his position at the University of Graz in Austria. He fled to Italy, the UK, and then Belgium.

In 1940, he received a speculative offer from the Irish Taoiseach Éamon de Valera – a former mathematician – to

become the director of the planned Dublin Institute for Advanced Studies. Luckily for de Valera, Schrödinger was an admirer of the Irish physicist William Hamilton, whose reformulation of Newtonian mechanics inspired his own work. He was glad to escape to neutral Ireland and stayed there until 1956.

As director of the institute, it was Schrödinger's duty to deliver annual public lectures. Like many a Nobel prizewinner, he used his academic freedom to think outside his subject. In *What Is Life?*, he used his knowledge of physics and atomic theory to

**Erwin Schrödinger delivered his landmark lecture in 1943**

speculate that life would turn out to be based on some sort of "aperiodic crystal". He also floated the idea of a genetic code.

James Watson and Francis Crick famously sent their 1953 *Nature* paper on the structure of DNA to Schrödinger, saying "we thought you might be interested in the enclosed reprints – you will see that it looks as though your term 'aperiodic crystal' is going to be a very apt one".

Watson himself made a rare public appearance at the meeting, having seemingly put recent controversies around racist remarks behind him. He declined to speak to any journalists.

But it wasn't just scientists and journalists in attendance – the celebration was open to the general public. Given how productive the life sciences are right now, with daily advances in neuroscience, genetics, immunology, bioengineering, gerontology and related disciplines, this added up

to a mouth-watering prospect. Dublin's 1200-seater National Concert Hall was packed full for the duration of the conference.

As a feast of scientific information, the event succeeded brilliantly, serving up an excellent crash course in modern life science. But as an exercise in futurology, it was less satisfying. Most of the speakers dwelt firmly in the present, or replayed their greatest, Nobel prizewinning hits.

**"As a feast of information, the event served as an excellent crash course in modern life science"**

That was always likely. Twenty-five years ago, Dublin hosted a similar conference to mark the 50th birthday of *What Is Life?*. It attempted to recapture Schrödinger's spirit of speculation but, according to Mike Murphy of the University of Cambridge, who organised both conferences, it failed. "One of our goals for the 2018 conference is to encourage the speakers to look to the future and to take risks in speculating on future challenges and predictions," he said.

Sadly the conference, on 5 and 6 September, didn't quite manage it. But who can blame scientists for declining to speculate? Back at the 1993 meeting, nobody could have predicted some of the recurring highlights of this meeting: gene editing, optogenetics, cancer immunotherapy, ancient DNA sequencing, memory research and theories of consciousness.

In fact, even Schrödinger himself was a reluctant crystal-ball gazer, admitting in the preface to his book that his speculations were based on "second-hand and incomplete knowledge" and that he was risking making a fool of himself.

I hope I'm still around in 25 years to attend Schrödinger at 100 and refill my brain with the science no one dared predict this time. ■



WOLFGANG PFANDLER/SCIENCE PHOTO LIBRARY

**NewScientistJobs**

# ENGINEER YOUR RECRUITMENT STRATEGY WITH PRECISION

Reach your ideal engineering candidate  
in print, online and on social media.

Visit [newscientistjobs.com](http://newscientistjobs.com) and  
connect with thousands of engineering  
professionals the easy way

Contact us on  
617-283-3213 or  
[nssales@newscientist.com](mailto:nssales@newscientist.com)



## NEWS &amp; TECHNOLOGY

# Sheep culture seen in migration routes

Frank Swain

SOME sheep have a cultural tradition of migrating – but this knowledge can be lost in a generation if their journeys are interrupted.

Every spring, bighorn sheep migrate to higher altitudes, following nutritious new vegetation as it emerges from the melting snow. This behaviour is known as “surfing the green wave”. But is knowledge of these routes inherited genetically, or must it be learned?

To answer this question, Brett Jesmer at the University of Wyoming and his colleagues looked at how the sheep behaved when moved to new locations by people, known as translocation.

They studied data from 129 bighorn sheep from four populations that had lived in the same area for more than 200 years. The animals were fitted

with GPS collars, and the team compared their movements with those of 80 sheep translocated into new populations in unfamiliar environments.

Between 65 and 100 per cent of sheep living in the same area as their ancestors climbed 1000 metres up mountainsides to graze on new vegetation as it appeared in spring. By contrast, only seven of the translocated sheep behaved in this way. Because the other 73 translocated sheep didn't migrate, it seems that migration cues aren't hardwired into the animal's genetics.

This suggests that knowledge about migration routes is learned and then transferred to other members of the herd, including youngsters who will make up the next generation. Biologists call this information “culture” and its transfer “cultural transmission”.

The researchers suspected that this cultural knowledge



**Bighorn sheep follow the green wave of tasty new vegetation**

becomes more sophisticated as the generations pass. To explore this idea, they looked at data from 189 GPS-tagged moose. Those that migrated the furthest belonged to populations that had been

established in the same region for 110 years. Migration distance was lower for moose that had lived in an area for just 10 years (*Science*, doi.org/ctpm).

“If migrations are cut off, within a few generations, centuries of knowledge are lost,” says Jesmer. ■

## It is easy to fool a hate speech detector

A FEW innocuous words or spelling errors are enough to trip up software designed to flag hate speech. The finding casts doubt on the use of technology to tame online discourse.

Social media sites are under increasing pressure to act on abusive accounts and content. Recently, Twitter, YouTube, Facebook and Apple removed high-profile conspiracy theorist Alex Jones from their platforms citing hate speech and bullying. But tackling the millions of anonymous accounts used to post abuse online is much more difficult.

N. Asokan at Aalto University in Finland and his colleagues

investigated seven different systems used to identify offensive text. These included a tool built to detoxify arguments in Wikipedia's edits section, another called Perspective, and several other systems.

Offensive-speech filters typically flag content using either a predefined list of offensive words, or an artificial intelligence algorithm that has been trained on thousands of examples.

The systems tested had each been built by different teams and so had been trained on different data sets of offensive and innocuous material. Asokan found that none of the filters performed well when set to work on data sets belonging to a different system. This suggests that the filters would struggle when applied to real-world content in a forum or social network ([arxiv.org/abs/1808.09115](https://arxiv.org/abs/1808.09115)).

In addition, the team tested

different techniques for bypassing the filters. All of the systems failed to identify offensive speech when spelling errors were introduced, or when numbers were substituted for letters, such as N3w Scientist. They also found that adding innocuous words increased the likelihood that offensive content would bypass the filters.

Some words were particularly effective at masking hateful content

**“Social media sites are under increasing pressure to act on abusive accounts and content”**

because of their strong positive connotations, says Asokan. For example, a sentence that Perspective assigned a “toxicity” score of 0.99 – with 1 being peak obscenity – could be

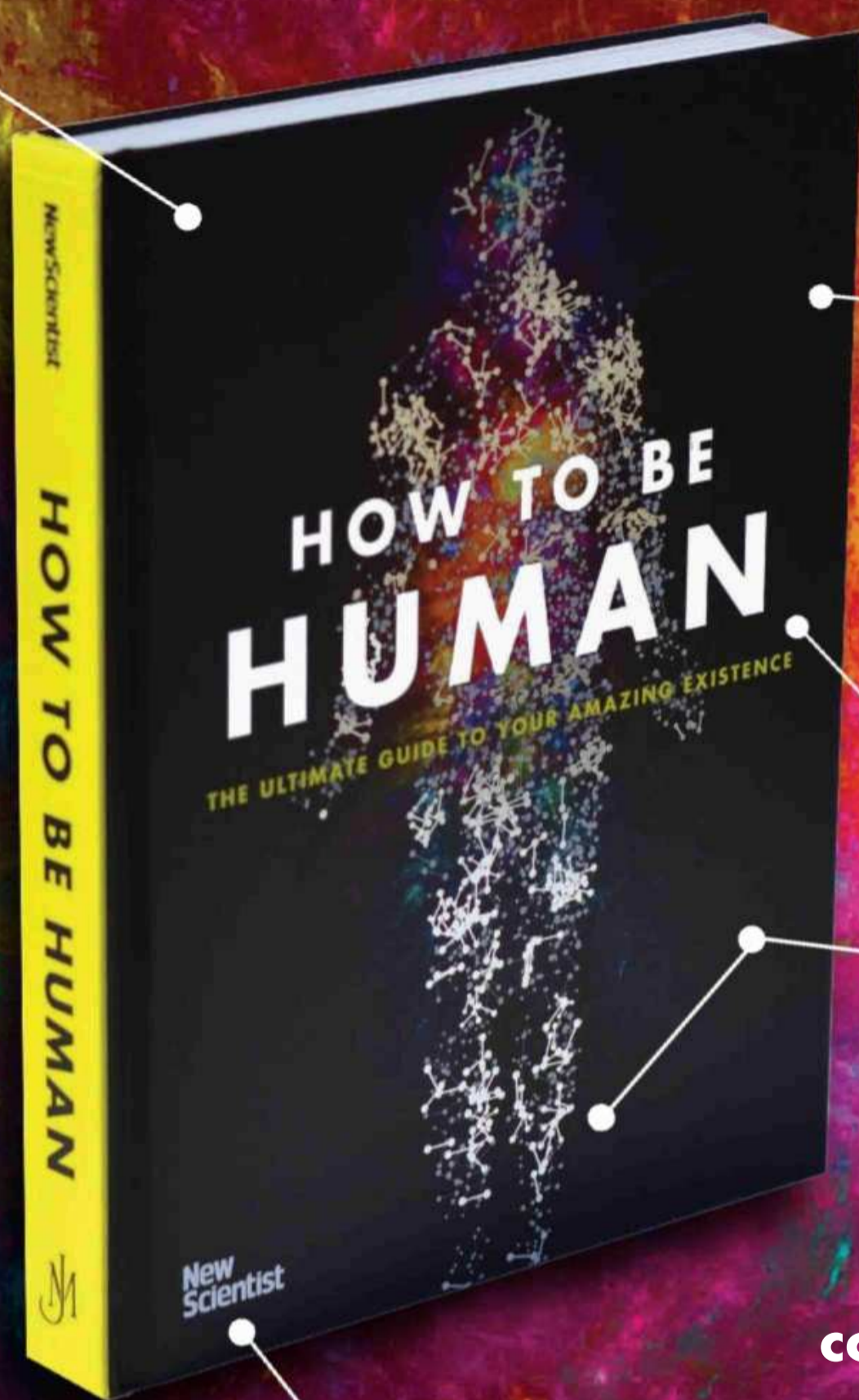
reduced to 0.15 simply by adding the word “love”. Both simple keyword filters and complex AIs were equally vulnerable to these workarounds.

Perspective, which was created by Google's counter-abuse team and Jigsaw, a subsidiary of Google's parent company Alphabet, has recently been updated to try to deal with some of these issues. “We welcome people to scrutinise the technology,” says Dan Keyserling at Jigsaw. He says Perspective shouldn't be used to automatically block content, but should instead provide information for people who may or may not intervene.

A major problem is that there is little agreement among those building the filters and society in general on what constitutes hate speech, says Tommi Gröndahl, who also worked on the latest study. Frank Swain ■

**Humanity will need the equivalent of 2 Earths to support itself by 2030.**

**People lying down solve anagrams in 10% less time than people standing up.**



**About 6 in 100 babies (mostly boys) are born with an extra nipple.**

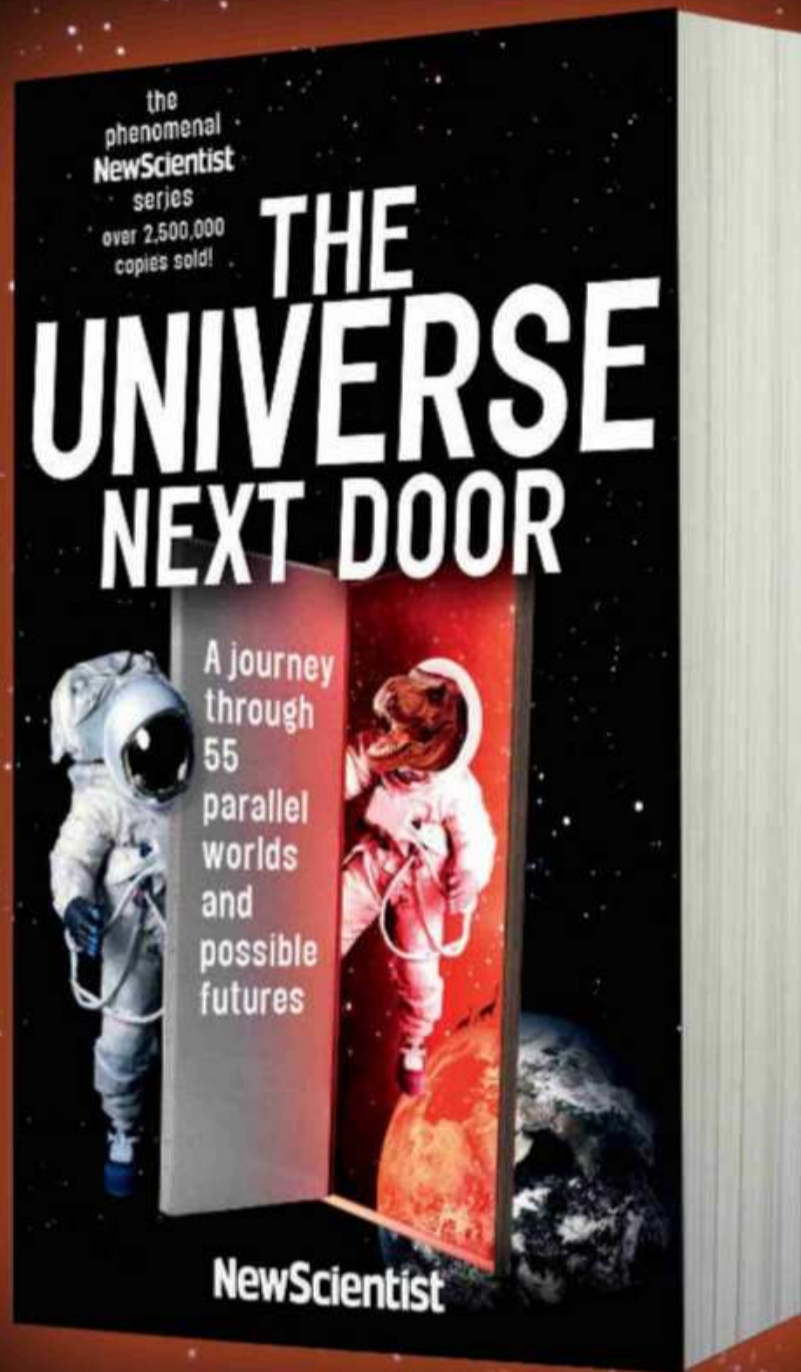
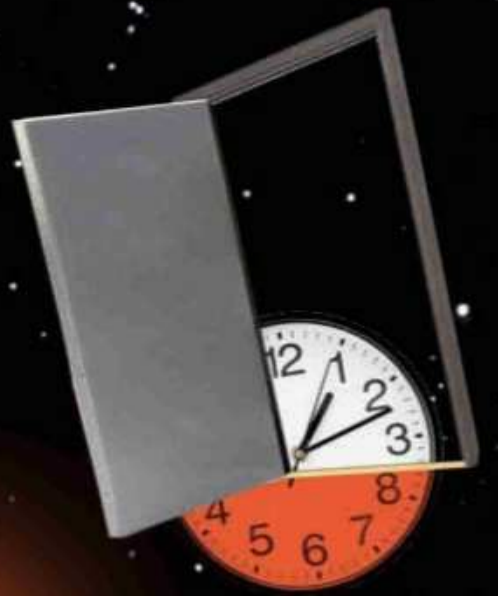
**60% of us experience 'inner speech' where everyday thoughts take a back-and-forth conversational style.**

**We spend 50% of our lives daydreaming.**

**AVAILABLE NOW**

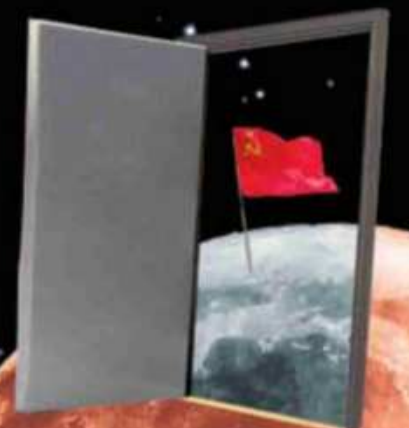
[newscientist.com/howtobehuman](http://newscientist.com/howtobehuman)

WHAT IF TIME STARTED  
FLOWING BACKWARDS?



WHAT  
IF THE  
RUSSIANS  
GOT TO  
THE MOON  
FIRST?

WHAT IF DINOSAURS  
STILL RULED THE EARTH?



**AVAILABLE NOW**

[newscientist.com/books](http://newscientist.com/books)

 **New  
Scientist**



## NEWS &amp; TECHNOLOGY

# Brain's emotion code is cracked

Andy Coghlan

PATTERNS of electrical brain activity have been used to tell when people are sad, happy or depressed. The advance could lead to new ways of treating those with depression or anxiety using devices that constantly monitor their mood via brain signals.

Ultimately, the aim is to program the devices so they activate mood-uplifting brain networks when they detect potentially dangerous negative emotions.

By activating electrodes implanted in specific regions of people's brains – a process called deep brain stimulation, or DBS – it is already possible to ease conditions including depression, bipolar disorder, Tourette's syndrome and obsessive compulsive disorder. There have also been advances towards "mind-reading": deducing memories and internal thoughts by monitoring the brain's electrical activity.

Now it is possible to decipher mood too. "We've discovered how mood variations can be decoded from neural signals in the human

brain," says Maryam Shanechi at the University of Southern California, who is lead researcher on the project. "It's a significant step towards creating new therapies that use brain stimulation to treat debilitating mood and anxiety disorders."

Shanechi and her colleagues recruited seven people with epilepsy who had each been

temporarily fitted with implanted electrodes to identify major sources of their seizures.

By monitoring the electrical output from the electrodes, the team homed in on "fingerprint" patterns of activity across the brain that closely corresponded with the specific moods each person was experiencing.

To make this possible, each participant had periodically filled out questionnaires on their mood. For each answer, they rated how they felt on a seven-point scale.

**Altering brain activity could help relieve depression and anxiety**

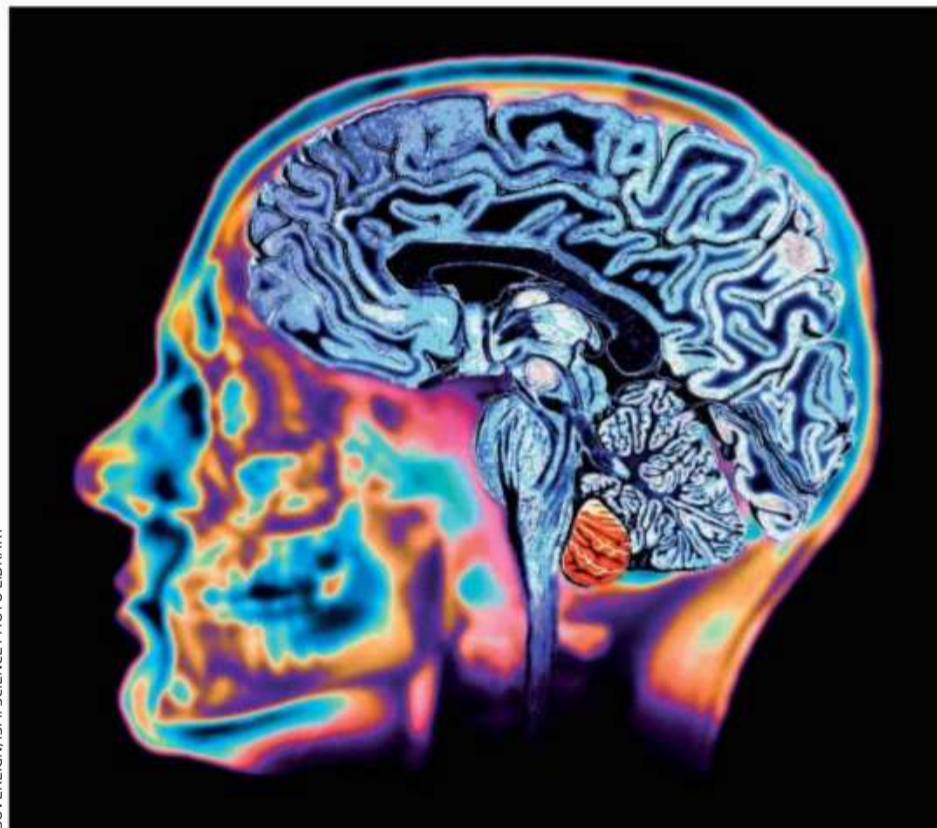
"We were able to uncover the patterns of brain signals that matched the self-reported moods," says Shanechi. "We then used this knowledge to build a decoder that would independently recognise the patterns of signals corresponding to a certain mood." The decoder successfully detected the mood of the seven people 75 per cent of the time.

The patterns were different for each study participant, but almost all the patterns were confined to the limbic system, the network of brain regions crucial for triggering emotion and mood swings (*Nature Biotechnology*, doi.org/ctp2).

Shanechi stresses that decoding is only a first step. For a device to be able to treat people as well as monitor mood, for example, the team needs to establish which parts of the brain must be stimulated to head off impending depression or anxiety.

The safety and inconvenience of implanting electrodes is also a major hurdle, but non-invasive systems are being developed that use electrodes on the head to stimulate brain regions.

"Mood is very hard to measure," says Thomas Schlaepfer, who uses DBS to treat depression at University Hospital Freiburg in Germany. "The fact they find mood correlates with predictive electrical signals is stunning, and a lovely concept." ■



SOVEREIGN, ISM/SCIENCE PHOTO LIBRARY

## Glass box of atomic vapour is a tiny radio

RADIOS are shrinking. An atomic receiver has been developed in a tiny glass box and its ability to handle a wide range of frequencies could make it excellent for spying.

David Anderson at Rydberg Technologies in Michigan and his colleagues built their radio receiver to be smaller and more secure than traditional radios. At its heart is a

centimetre-sized glass box full of caesium vapour. The caesium atoms are prepared so that some of their electrons have more energy than normal, which makes them highly sensitive to certain frequencies of electromagnetic waves.

Radio transmissions work by modulating an electromagnetic wave to encode the sounds you want to transmit. The waves are generally received by an antenna, which converts them into electricity. Then speaker circuits turn those electrical signals back into sounds.

In the new radio receiver, the

caesium atoms act as the antenna. When an electromagnetic wave hits the atoms, it temporarily bumps some of their electrons up to a higher energy level, changing the atoms' quantum state.

To turn that into sound, the team shines a laser through the box. Atoms in different states absorb laser light differently, so measuring the light that passes through reveals these

**"Instead of spies needing to have multiple antennas at a receiving station, one vapour receiver would do"**

quantum states. They, in turn, can be translated back into the original signal (arxiv.org/abs/1808.08589).

Unlike traditional radio receivers, this compact design works in multiple frequency bands, well beyond what a car radio can pick up, says Anderson.

It could be useful for espionage. "If you think about a scanning spy radio, trying to pick up someone talking, you could scan all kinds of secure channels that are in the area," says Anderson. "Instead of requiring multiple types of antenna at a receiving station, you could use one vapour receiver to do all of it." Leah Crane ■

## NEWS &amp; TECHNOLOGY

## INTERVIEW

# The woman who heard stars spin



DAVID HARTLEY/REX/SHUTTERSTOCK

## Leah Crane

IN 1974, the discovery of pulsars won the Nobel prize. But it didn't go to the woman who found them in 1967 – instead, her supervisor took the glory. Now Jocelyn Bell Burnell (pictured), who first detected these fast-rotating neutron stars that sweep a beam of radio waves or other radiation across the sky, has been awarded the \$3 million Special Breakthrough Prize in Fundamental Physics.

### How did you discover pulsars?

When I came to Cambridge, I found myself suffering from what I now know is impostor syndrome. But I was a bit of a survivor and I decided that until they threw me out I was going to work my very hardest. So I was being extremely thorough, and I spotted an anomalous signal.

I tracked this spot of sky for several months with the telescope, picking up pulses. We established that the object had to be small because the pulses were short and sharp, but it had to be big because the pulses were always at the same rate – they weren't getting tired and slowing down. We eventually found that they were small in width and big in mass, but it took some time to get our heads around that.

### What questions about the universe can we answer with pulsars?

There are a pair of pulsars orbiting each other in a close binary system that is proving very important for checking Einstein's theory of gravity. People are a bit worried that we don't understand gravity, but so far these pulsars are showing us Einstein was right.

### Why did you leave astronomy research?

I got engaged to be married between discovering pulsars two and three, and I wore my engagement ring into the lab, which was a mistake. At that time in Britain, married women didn't work. I really had quite a tough time, and I moved away from radio astronomy.

### Where did your career go next?

The phase following my PhD was extremely miscellaneous. I was married to a man who had to move jobs regularly, so we were moving up and down the country. I had the opportunity to try many different roles outside a research career.

I had acquired a whole raft of skills, which is why I've been asked

**"I was a bit of a survivor and I decided that until they threw me out I was going to work my very hardest"**

to be president of various bodies, like the Institute of Physics.

I was also part of a group of women who established the Athena SWAN initiative. It started quite a long time ago with a small group of senior women meeting after work, wondering what we could do to improve the position of women in science. We decided to create a prize for the universities that are best for women, so they'd compete for it. And they did!

### Do you have any plans for the \$3 million prize money?

I've been talking to the Institute of Physics, which I'm glad to say is very happy to go along with this idea I have. It is that the money goes to graduate studentships in physics for people who are from under-represented groups.

I've come up with this because my feeling is that a lot of the thrust behind my discovery of pulsars was because I was an outsider. If we can support more people from under-represented groups, we can have more of these interesting ideas. ■

## Solar and wind farms may bring rain to Sahara

COVERING the Sahara desert in solar panels and wind farms wouldn't only help power the world, it would also improve the local climate. Rainfall there would more than double and there would be a modest increase in vegetation cover.

"There would be a slight greening of the Sahara," says Fred Kucharski of the Abdus Salam International Centre for Theoretical Physics in Italy. This wouldn't be enough to return the Sahara to the much greener state it was in just 6000 years ago, but the overall impact would be beneficial. And the greening effect could be amplified by other measures, such as tree planting.

Its plentiful sun and wind, sparse population and closeness to Europe make the Sahara desert prime real estate for solar and wind farms. Morocco is already building large solar plants. But any changes made to land surfaces – from cutting down forests to covering deserts in solar panels – affect climate.

According to a climate model used by a team including Kucharski, covering the entire desert in either solar or wind farms would lead to more air rising up above the Sahara and thus to more rainfall there. Building both would have an even greater effect.

This would happen because installing dark solar panels would change the brightness of the ground surface, and turbines would alter the drag, or air resistance, at the surface.

As rainfall increases, more vegetation grows. This boosts evaporation and warms the surface, leading to more air rising up above the Sahara (*Science*, doi.org/ctpk).

Covering only part of the Sahara would have a smaller effect, says Kucharski. And the team's model suggests that covering other deserts in solar and wind farms would have little effect – perhaps because they are smaller than the Sahara.

Michael Le Page ■

NEW  
SCIENTIST  
DISCOVERY

# Cutting-edge Japan: from Tokyo to Okinawa

Explore the diverse faces of Japan. Journey from buzzing Tokyo to snow-capped mountains; from hot springs to subtropical coral reefs

**DEPARTURE:**

**4 NOVEMBER 2018**

**TOKYO › HAKONE › KYOTO › OKINAWA**

**11 days from £4995 per person**

## TECHNOLOGY AND INNOVATION

Begin your adventure in futuristic Tokyo. Visit the University of Tokyo and enjoy a talk from a robotics designer on campus. Experience the awe-inspiring Miraikan, Japan's Museum of Emerging Science and Innovation, before heading for the stunning scenery around Hakone.

## OUTSTANDING NATURAL BEAUTY

In the shadow of Mount Fuji, visit the volcanic Owakudani valley and walk between steam vents and hot springs. Then catch the bullet train to Kyoto and explore its peaceful temples and lavish gardens where bamboo thickets crowd the skyline.

## TAKE PART IN RESEARCH

Round off your trip with three days on the subtropical island of Okinawa. Get stuck in at the Okinawa Institute of Science and Technology where you'll take part in environmental research, learn about sustainable living and how coral is being restored.

**SPEAK TO OUR SPECIALIST TEAM AT STEPPES TRAVEL TO FIND OUT MORE**

Visit [newscientist.com/travel/Japan](http://newscientist.com/travel/Japan) or call +44 (0)1285 600 129

**SteppesTravel**

## IN BRIEF



## Image made by million artists illustrates cultural evolution

THIS community-generated digital artwork sheds light on how cultural phenomena evolve.

Called *Place*, it is a collaborative art project launched by the website Reddit on 1 April 2017. Users could edit any single pixel on a 1000 by 1000 square, choosing from 16 colours. They then had to wait between 5 and 20 minutes before they could place another pixel. In the 72 hours that followed, over a million people battled for control of the canvas, painting mascots, logos, Pokémon, images, patterns, memes, affiliations and national flags.

Thomas Müller and James Winters at the Max Planck

Institute for the Science of Human History saw this as an opportunity to study cultural evolution, in which theory suggests that as ideas and behaviours are shared, they start to adopt more predictable patterns.

Müller and Winters used that theory to predict that after an initial increase in complexity, *Place* should simplify. The data bore this out, with the file size of *Place* – a marker of complexity – peaking around the 30-hour mark and decreasing thereafter.

Early artists could spread out, making *Place* chaotic, but as the canvas filled, structure emerged. Artworks' survival depended on maintaining the borders of that structure, which required the evolution of rules among users, mirroring how cultural phenomena like language and art establish order (*PLoS One*, doi.org/ctnb).

## Expect more tsunamis in a warmer world

ONE of the highest tsunamis on record was probably caused by global warming – and a warmer world will mean more of the same.

A landslide near the end of the Tyndall Glacier in Alaska sent 180 million tonnes of rock into Taan Fjord on 17 October 2015. On the other side of the valley, the resulting wave climbed 193 metres according to a new study – one of the highest tsunamis on record.

The researchers say the landslide was caused by the glacier's retreat, probably as a result of global warming. They warn that the risk of such events will rise as Earth heats up (*Scientific Reports*, doi.org/ctm9).

Glaciers carve out steep-sided valleys, and there is usually a fjord or lake where they end. Globally, glaciers are retreating, leaving unstable slopes. Thawing of

exposed mountainsides can destabilise them further.

Fortunately, the areas at risk are remote with few residents, and such tsunamis weaken rapidly with distance, unlike those caused by undersea earthquakes. However, there is still potential for disaster. Co-author Bretwood Higman of non-profit organisation Ground Truth Trekking points at Glacier Bay in Alaska, an at-risk area that thousands of people at a time visit in cruise ships.

## Ancient mega mill fed Roman sailors

IN 1937, a Roman complex with 16 water wheels was discovered in Barbegal in southern France – the largest ancient water-powered factory found in the world. But rather than producing flour for the nearby Roman city of Arelate as previously assumed, it seems it specialised in ship's biscuits.

During digs in 1937, limescale deposits from the mill wheels were found. Isotopic analysis by Cees Passchier of the Johannes Gutenberg University in Germany and his team has now shown the limescale wasn't deposited year-round and suggests the mills shut in late summer and autumn (*Science Advances*, doi.org/ctnf).

A city would need a year-round supply of flour. Instead, the team think the mills' flour was destined for ship's biscuits for Roman vessels in the Mediterranean. There would have been no demand for this in winter when the fleet laid up to avoid storms.

## Jupiter's iconic red spot has a blue rival

JUPITER is famous for its Great Red Spot, and now it has a blue spot, too.

The blue spot was discovered when a team led by Kimberly Moore at Harvard University analysed data on the magnetic field within Jupiter collected by NASA's Juno probe.

Unlike Earth's highly uniform field with poles at opposite ends of the planet, Jupiter's field is irregular and asymmetric. The magnetic field generated inside the planet flows into space via a zone in the northern hemisphere and re-enters by converging on the blue spot, just below Jupiter's equator.

The spot isn't actually blue, but appears so because of the colour scale used to map the magnetic field.

## Robot uses its ears to 'see' like a bat

BATS use sound to navigate their surroundings in the dark, now a robot called Robat can do the same.

The four-wheeled autonomous robot (pictured below) is equipped with a speaker to mimic a bat's mouth and two microphones, positioned on the left and right, to mimic a bat's ears.

As it moves, Robat's speakers produce a high-frequency chirp every half a metre. It can then identify the distance to obstacles by calculating the delay between the sound and its echo. Any difference in what the two microphones pick up gives information on direction. This is known as echolocation, the same technique bats use in the dark.

To put Robat to the test, Yossi Yovel at Tel Aviv University in Israel and his colleagues placed it in a greenhouse in a botanical garden. Robat was able to drive through plant-lined paths avoiding obstacles, such as a bucket and a chair, while drawing a map of the surroundings. Bats can probably also identify specific objects using echolocation, so Yovel and his team gave Robat an algorithm to classify if something was a plant or not.

A robot like this could be useful in situations with limited visibility, such as extreme weather or searching rubble for survivors after a disaster (*PLoS Computational Biology*, [doi.org/ctpj](https://doi.org/10.1371/journal.pcbi.1005611)).



## Taking probiotics may be useless or might cause harm

PROBIOTICS, living microorganisms used by millions of people to boost their gut microbiome or restore it after taking antibiotics, may not work and could even do harm.

The findings come from two studies led by Eran Elinav of the Weizmann Institute of Science in Israel. In the first, his team sampled the microbiome of healthy people. Then the 15 volunteers took either a placebo or a probiotic supplement. The probiotic organisms colonised the gut of some, but

in others they were expelled (*Cell*, [doi.org/gd4wmt](https://doi.org/10.1016/j.cell.2018.08.011)).

Next, the team measured what happens to people who take probiotics after antibiotic use. A group of 21 people took an identical course of antibiotics and were then split into three groups. The first let their microbiome recover by itself, while the second took probiotics. The third received a dose of their original microbiome by faecal microbiota transplant.

Probiotic bacteria colonised the gut of everyone in the second

group after antibiotics had cleared the way. However, this prevented the return of the person's normal microbiome for up to six months, longer than in those allowed to recover naturally.

For people given a dose of their own pre-antibiotic microbiome, a native gut microbiome was restored in days (*Cell*, [doi.org/gd4wmx](https://doi.org/10.1016/j.cell.2018.08.011)).

While the clinical impact of lengthy microbiome disturbance was not measured, earlier studies have found a link between gut microbe disruption and ill health.

## Shark likes some veg with its meat

THE bonnethead shark is the first known omnivorous shark, getting some of its nutrients from seagrass.

Biologists had previously noticed that bonnetheads, a relative of the hammerhead, eat lots of seagrass as well as crustaceans and other shellfish. But because the shark's digestive system looks almost identical to those of other meat-eating sharks – and so seems best suited to a high-protein diet – it was assumed that the seagrass ingestion was accidental.

To test this, Samantha Leigh at the University of California, Irvine, and her colleagues fed five wild-caught bonnetheads a diet of 90 per cent seagrass and 10 per cent squid for three weeks before dissecting their digestive tracts. They found enzymes for carbohydrate digestion were as active as those in fish with an omnivorous or herbivorous diet.

Analysing blood and liver tissue showed them that the sharks take up seagrass nutrients, absorbing more than 50 per cent of its organic matter – carbohydrates, proteins and vitamins – making them relatively efficient plant-eaters (*Proceedings of the Royal Society B*, [doi.org/ctnc](https://doi.org/10.1098/rspb.2018.1111)).



DUNCAN USHER/MINDEN PICTURES

## Butcherbirds use whiplash to kill

SHRIKES, dubbed "butcherbirds" because they impale dead prey on thorns, are also known for killing animals much heavier than themselves – and now we know how.

High-speed camera footage of captive shrikes shows that they use their beaks to powerfully grip prey by the nape of the neck, before flinging them around with such force that they sustain fatal whiplash injuries.

Diego Sustaita of California State University in San Marcos and his colleagues filmed loggerhead shrikes killing mice. The shrikes were being "trained" for release into the wild on

California's San Clemente Island, so no mice were fed to the birds solely for the research.

The team found that mice were flung around with a force six times that of gravitational acceleration and that the motions of their head and body progressively became shifted out of phase. They died through the inertial forces on the neck created by their own body spinning round (*Biology Letters*, [doi.org/ctnd](https://doi.org/10.1098/rsbl.2018.0111)).

This, says Sustaita, explains how many species of shrikes are able to kill prey up to twice their own body weight, such as lizards and snakes.

# JOIN US AT THE WORLD'S G

New  
Scientist  
Live

“ Everyone had a brilliant  
time – thought-provoking  
and huge fun ”

Over 120 talk

THE MANY WORLDS OF QUANTUM MECHANICS • THE NATURE OF  
GUT HEALTH • GENOME EDITING • EXPLORING CONSCIOUSNESS  
FUSION FUTURE • GRAVITATIONAL WAVES • NEUTRINOS

Book now at [newscientistlive.com/dps](https://www.newscientistlive.com/dps)

MAIN STAGE  
SPONSOR






COSMOS ZONE  
SPONSOR



EARTH ZONE  
SPONSOR

# REATEST SCIENCE FESTIVAL

 newscientistlive  
 @newscilive  
 newscilive  
#nslive



s including ...

**OF TIME • HOW TO LOSE WEIGHT, FIND LOVE AND LIVE FOREVER  
BUSINESS USING PSYCHEDELICS • ARTIFICIAL INTELLIGENCE  
TRINOS • WHAT SHOULD WE DO ABOUT PLASTIC?**

20 - 23 September, ExCel London



TECHNOLOGY  
ZONE SPONSOR

**BAE SYSTEMS**

HUMANS  
ZONE SPONSOR

Technicians make it happen

# Invasion of the face snatchers

Face recognition has rapidly wormed its way into everything from policing to shopping. Is it too late to hold back the tide? **Frank Swain** reports

LAST December, Ed Bridges was mingling with the crowds of Christmas shoppers on the streets of Cardiff, UK, when the police snapped a picture of him. He has been trying to get them to delete it ever since.

Bridges hasn't been convicted of a crime, nor is he suspected of committing one. He is simply one of a vast number of people who have been quietly added to face-recognition databases without their consent, and most often, without their knowledge.

For years, critics have warned that the technology is an unparalleled invasion of privacy, but the rise of face recognition seems unstoppable. Police forces across the world have launched face-recognition programmes, setting up cameras to scan crowds at football matches, festivals, protests and on busy streets in a bid to identify criminal suspects.

The tech giants are also in on the game. Facebook relies on face recognition to automatically tag photos. Snapchat uses it to overlay fun animations onto your face. The latest iPhone ditched fingerprint scanners in favour of using face recognition to unlock devices. Amazon's Rekognition image analysis software promises, among other things, that it can spot faces from a library of suspects for law enforcement.

It is surprising just how far this tech reaches. US airline JetBlue is trialling it to speed up boarding. Visitors to Madison Square Garden in New York are scanned on entry to see if they might pose a problem to organisers. Jaywalkers in Shenzhen, China,

**China has already widely deployed face-recognition technology**

risk being fined and having their mugshot taken by cameras placed at pedestrian crossings. It seems nobody can escape.

Yet around the world, face databases are running into problems. India's supreme court is due to rule on whether its national ID scheme Aadhaar breaches citizen's privacy. The system – which includes

**"Visitors to Madison Square Garden in New York are scanned to see if they might pose a problem"**

mandatory enrolment in a face-recognition programme – contains details on 1.2 billion citizens, and has suffered huge leaks of sensitive data.

In the US, an audit of the FBI in 2016 found that it had built up a database of more than 400 million face images, including half the US adult population, without proper oversight. Suspected criminals made up less than 10 per cent of the library.

Meanwhile China is using face-recognition technology to monitor and discriminate against

the Muslim population in the north-west province of Xinjiang. As well as scanning people's faces before they enter markets or buy fuel, the system alerts authorities if targeted individuals stray 300 metres beyond their home or workplace, effectively building virtual checkpoints to hem in Uighur Muslims.

Such discrimination aside, you might feel reassured about having your face stored in a database if it helps solve crime. However, despite its popularity with law enforcement, face



VCG/VCG VIA GETTY IMAGES



For daily news stories, visit [news scientist.com/news](http://news scientist.com/news)

recognition is often inaccurate (see graphic, right).

Figures released by the South Wales Police show that when the technology was deployed at a music festival in Swansea in May, 12 people were flagged by the cameras as matching the police database of faces, but only two of the matches were correct.

Similarly, the American Civil Liberties Union (ACLU) recently demonstrated how Amazon's Rekognition erroneously identified members of Congress in a database of unrelated mugshots. It is now calling for a moratorium on the use of the technology by law enforcement.

"There's a worry the tech will spread, and start to be used before we've had the debate about whether it should be used at all," says Neema Singh Guliani of the ACLU. "This is very imperfect

technology, going into institutions that are themselves imperfect. That combination makes problems, which should not be swept under the rug."

Critics warn that innocent people are being put at risk by software that wrongly identifies them as criminals. "In very simple terms, tech is outpacing legislation," says Paul Wiles, the UK's biometrics commissioner, who is charged with overseeing the government's use and retention of DNA and fingerprints.

In the UK, these biometrics were restricted by a law passed in 2012, but there are no such restrictions on technology such as face recognition, voice recognition and iris scanning, which have taken off since then. "There's been a significant development of biometrics as part of a bigger development of capacity to store and use data," says Wiles.

After being photographed shopping in Cardiff, Bridges was snapped again in March, when he joined a protest against an arms fair being held in the city. "At lunchtime this face-recognition van suddenly appeared across the road from the main group of protesters," he says. "I felt it was done to intimidate us, so we would not use our right to peacefully protest."

"Protesters, activists, will think twice if they know when they speak out about government abuse they're going to be recognised," says Guliani.

### "There's a very real concern face recognition will contribute to a surveillance structure"

"There's a very real concern face recognition will contribute to a surveillance structure, where people don't feel like they can walk around with anonymity and privacy."

Bridges is now taking legal action to challenge the use of face-recognition technology by South

Wales Police. Assisting him is Megan Goulding, a lawyer at the human rights group Liberty. "Part of the reason we're challenging the use of face recognition at all is we think it's pretty impossible to protect yourself," she says. "Because of the indiscriminate nature of the technology, it can happen without your knowledge or consent."

Liberty is pushing for a judicial review, a legal mechanism that allows individuals to challenge the actions of public bodies. Goulding hopes that a legal case would rule that the way face recognition is being used breaches human rights and data protections laws, leading to a halt in its use.

### Face the future

If the South Wales Police are found to have acted unlawfully, it would prevent other police forces using the technology in the same way. Goulding expects a ruling early next year, but Wiles is cautious about relying on a single decision. "I think the danger is the government responds on an ad-hoc basis, face recognition today, voice recognition tomorrow, and so on. What they should be doing is setting out a strategy for the police in general."

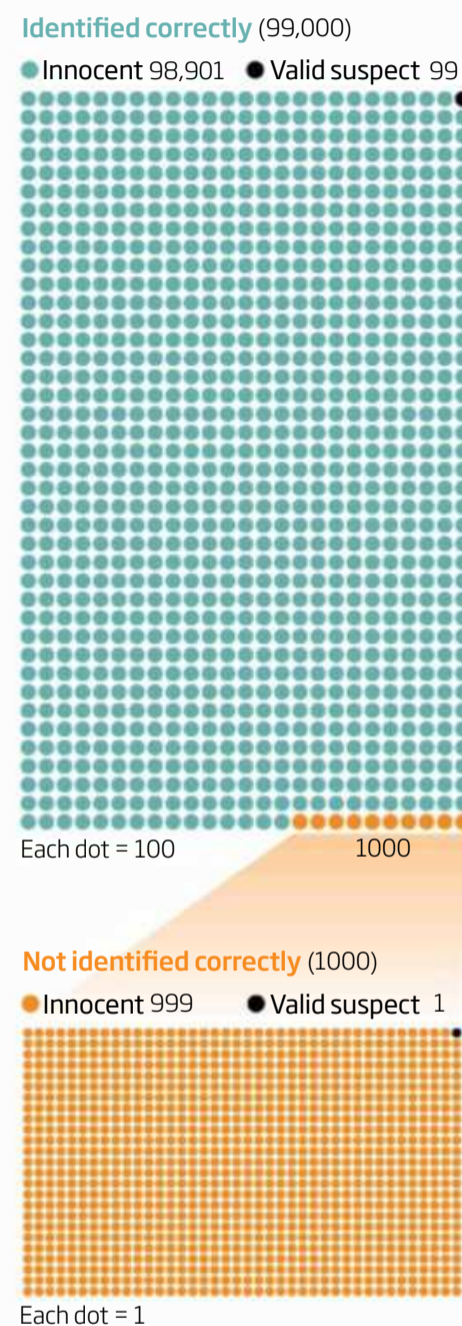
Similar conversations are happening elsewhere. In July, Microsoft called for government regulation on the development and use of face-recognition technology. "I think we need trials that protect privacy but allow development," says Wiles. "These should be peer reviewed, published, all the usual things you expect from a medical trial."

Such trials would demonstrate the reliability and limitations of the software, such as whether it is less accurate when matching people from minority groups. Only then can a sensible public debate about the technology take place, says Wiles.

Wiles points to the approach of the Scottish government. In July it published a document that

### Scan the crowd

Even if a face-recognition algorithm is 99 per cent accurate, it will misidentify huge numbers of innocent people



recommends general principles for the use and retention of biometric data. A commissioner can then draw up codes of practice for each application, so that different rules can apply for matching the faces of people who have been arrested to mugshots compared with automatically scanning faces in crowds. "It's a clever solution to what seems an insoluble problem," says Wiles.

However, this is a compromise too far for Goulding. "In our view we don't think it's possible to balance the existence of this technology. The impact on rights is too grave." ■



## COMMENT

# A bubble set to burst?

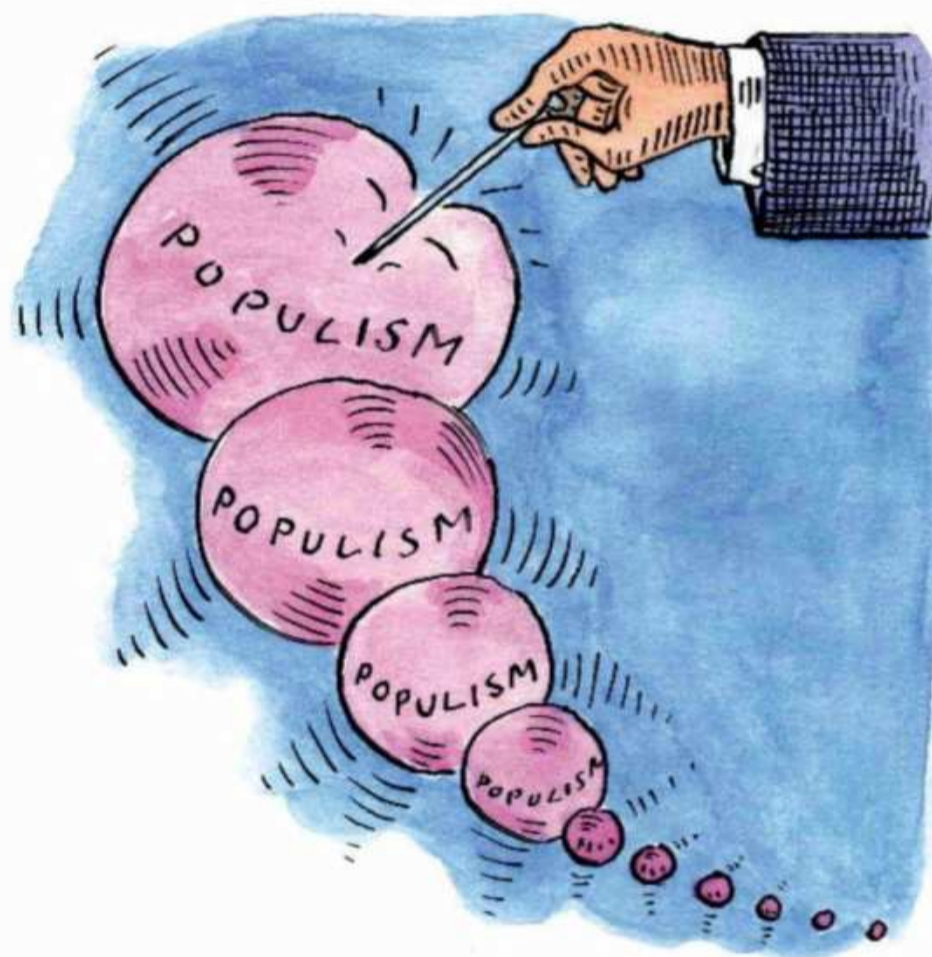
A decade after the financial crash, theory says the surge in populism that followed it should end. Will it, asks **Simon Oxenham**

ON 15 September 2008, investment bank Lehman Brothers collapsed, precipitating a global financial crash. In the years that followed, politics took an apparently unexpected turn. We saw Brexit, the election of Donald Trump and the rise of far-right movements in Europe after decades of steadily increasing social liberalism. Sweden is just the latest example.

Many are now wondering if this is the new normal. In 2015, Manuel Funke, then at the Free University of Berlin, and his colleagues turned to data analysis for an answer. They found that over the past 140 years, every major financial crisis has been followed by a surge in support for far-right movements. The good news for liberalism is that this faded after 10 years. If this pattern holds once more, we should be on schedule to see the surge in populism petering out.

Funke and his colleagues wrote: "After a crisis, voters seem to be particularly attracted to the political rhetoric of the extreme right, which often attributes blame to minorities or foreigners... Votes for far-right parties increase strongly, government majorities shrink, fractionalization of parliaments rises and the overall number of parties represented in parliament jumps." Although some political after-effects are measurable for a decade, the political upheaval is mostly temporary, they add.

Funke's work is rooted in data analysis, finding evidence for the apparent link between political trends and financial crises, but not for deeper behavioural



reasons behind that link.

However, other studies already suggest reasons why, in times of turmoil, support rises for protectionist policies favoured by far-right and populist movements, be they on immigration, "unfair" trade or security. The studies point to negativity bias, a common trait in which people subconsciously respond more and pay more attention to negative than to positive events.

After taking into account socio-economic factors, those who are more biologically responsive to and devote more attention to negative events tend to favour "protective" policies.

So after a deep economic shock

and the threat to livelihoods and national prosperity that follows, protective politics may simply find a more receptive audience. If Funke's cycles hold, the appeal of such politics fades again as economic recovery takes hold, which is the case now.

Not all political scientists agree that these cycles will apply now. Justin Murphy at the University of Southampton, UK, expects the pendulum to continue to swing further in the opposite direction this time. To him, the root cause

**"Political and behavioural science are in a fast-moving world now - past narratives may no longer apply"**

of the contemporary rise of the populist right may be linked to a backlash against social liberals overstating the extent to which freedom of thought or behaviour has been restricted – despite declines in racism and sexism in the US and UK in recent decades.

There is clearly a case to be made that at least some overzealous elements among the left are harming their own cause and may be sparking a backlash at the ballot box. This was demonstrated in an incident earlier this year when renowned liberal psychologist Steven Pinker outlined his thoughts on how to deconstruct and fight back against false and illogical racist and sexist claims made by alt-right activists.

When a cut-down clip appeared on YouTube, Pinker was branded a racist and darling of the alt-right in a blow-up that saw left-wing activists up in arms against one another. It is hard to deny that a divided left combined with self-destructive radical elements isn't at least somewhat responsible for the rise of the far right.

A larger factor, however, may ironically be a decline in voting. Simon Hix at the London School of Economics has charted the combined votes for all political parties across Europe for the past century and points to a sharp and steady rise in non-voting over the past three decades.

Non-voters were a minority in the pre and post-war years, but they now form the single largest block in the electorate, dwarfing far-right groups and the impact of the divided left. As a result, even small shifts in support for

For more opinion articles, visit [newscientist.com/opinion](http://newscientist.com/opinion)

populism may translate into outsized effects on election results.

If apathetic voters are tempted back to the polling booths, that might herald a return to a more familiar political landscape. However, it is also possible that the trend of increasing apathy will continue to grow, fuelled by the knock-on effects of the rise of social media.

Social media use may be leading to a replacement effect where people feel so satisfied expressing their feelings online that they don't vote. It could also be changing the way we think about democracy in other ways, enabling filter bubbles, creating echo chambers and allowing the emergence of micro-targeted political messaging of the sort that has hit headlines of late.

Anyone hoping for an easy answer to the question of what happens next will probably be disappointed. Political and behavioural science is messy and exists in a rapidly changing world where the narratives of the past may no longer apply. So many new factors are at play that future elections are likely to continue to be more unpredictable than before.

With all this in mind, it would be a brave pundit that staked their reputation on Funke's 10-year rule to predict the bursting of the populist bubble. The first test may be the US mid-terms. But they are typically a show of electoral punishment of the incumbent, says Funke, who suggests the outcome in November will be more of a reflection of Trump's recent performance than any kind of bellwether for broader effects.

So it might take a presidential election in the US to really tell what is going on. Which means you may have to wait another few years to see if the political shake-up that followed the 2008 crisis is over. That's if the next crash isn't on us by then. ■

Simon Oxenham is a science writer based in the UK

## ANALYSIS Sabotage on the ISS?



# In space, no one can hear you drill

**Leah Crane**

THERE was a minor panic in low Earth orbit recently when flight controllers for the International Space Station (ISS) noticed that it was slowly leaking air into space. The six astronauts on board were instructed to put aside all other work and trace the leak.

They found a 2-millimetre-wide hole in a Soyuz capsule that was docked with the ISS and sealed it up. Some are now saying that the hole could have been deliberate sabotage.

Roscosmos, the Russian space agency, set up a special commission to investigate the leak. At first, it seemed the most likely explanation was an unfortunate encounter with a tiny meteorite. But the mystery deepened on closer inspection: the hole seems to have come from inside the station. It looks strikingly like it came from a power drill (see photo, right).

"It was done by a human hand – there are traces of a drill sliding along the surface," Roscosmos head Dmitry Rogozin told a Russian news agency.

He said that the special commission will continue to investigate and find out who drilled the hole, and whether

it was an accident. "We have already ruled out the meteorite version," Rogozin said. "We are checking the Earth version. But there is another version that we do not rule out: deliberate interference in space."

Maxim Surayev, a Russian politician and former cosmonaut, speculated that a member of the ISS crew who wanted to return to Earth may have drilled the hole.

"We're all human, and anyone might want to go home, but this method is really low," he told Russian news agency RIA Novosti. "If a cosmonaut pulled this strange stunt – and that can't be ruled out – it's really bad."

But the simplest explanation is that

**This tiny hole would have leaked away all the air in the ISS in 18 days**



it was a manufacturing mistake that nobody caught until it started to make trouble. "To me, the speculations of sabotage sound like a desperate stretch to avoid implicating Russian space programme workmanship," says Jonathan McDowell at the Harvard-Smithsonian Center for Astrophysics. "It feeds into this more general impression that quality control in the Russian space programme is poor."

In particular, the mechanical failures of several Russian Proton rockets since 2007 have raised concerns that the programme's quality control measures aren't stringent enough. In the US, any concerns about the safety of an aircraft or spacecraft can be reported anonymously, reducing incentives to keep a mistake quiet. That's not so in Russia, which might encourage workers to slap some glue over the hole and say nothing to avoid being fired, says McDowell.

US-Russia relations are already strained by the political situation on the ground. At the moment, NASA is unable to fly its astronauts to space, instead relying on Russian vehicles, but that deal expires next year. NASA plans for private spacecraft made by SpaceX and Boeing to pick up the slack.

"I think at the political level it will accelerate the desire to get the commercial crew going and get us off our dependency on the Russian vehicles," says McDowell. "If it can happen once, it can happen again, and maybe in a more vital place." ■

# APERTURE





## Stargazers' paradise

NESTLED beside the Chiricahua Mountains, about 400 kilometres from the city of Phoenix, is a village that attracts astronomers, amateur stargazers and photographers from around the world. They are drawn there by the spectacular night sky, which can be seen thanks to the village's "no outdoor light" rule. Jack Newtown (middle right) came up with the idea of a purpose-built community for star lovers in 2001, and co-founded the 450-acre Arizona Sky village.

Photographer Fabian Weiss spent a week in the village last November, showing up every night at the doorsteps of several residents, including Jim Lamm (pointing at a star map, bottom row) and Fred Espenak (bottom left). Espenak is a retired NASA astrophysicist and was one of the village's first residents.

Specialised stargazing gadgets are common in the village - Espenak's home (shown in the neighbouring picture) has two domed observatories and a variety of telescopes (bottom right). Resident Rick Beno has one of the biggest telescope domes there (upper right). He hosts visiting school trips and teaches classes about the sky and stars.

"It was an interesting experience," Weiss says, "because the normal rhythm was totally shifted: not much to do in daylight and endless hours at night."

Besides nebulas, galaxies and the Milky Way (top left), Weiss saw a shooting star through his binoculars. "It's one of the most memorable memories from the trip," he says. "All of a sudden, the other planets felt so close, and I felt much more part of the universe than before." Yvaine Ye

### Photographer

**Fabian Weiss**

Laif/eyevine

## INTERVIEW

# 'I want to make a chemical brain'

Chemist Lee Cronin's ambition to understand life's deepest questions is matched only by the unorthodoxy of his methods, **Rowan Hooper** discovers

**W**HEN Lee Cronin was 9 he was given a Sinclair ZX81 computer and a chemistry set. Unlike most children, Cronin imagined how great it would be if the two things could be combined to make a programmable chemical computer.

Now 45 and the Regius Chair of Chemistry at the University of Glasgow, Cronin leads a research team of more than 50 people, but his childhood obsessions remain. He is constructing chemical brains, and has ambitions to create artificial life – using a radical new approach.

## What drives you?

Everything I'm doing now, I've wanted to do since I was a boy. I wanted to discover something new about the universe. It was stressful for my parents because anything they bought, I just took apart. Once I tried to build a carbon dioxide laser. When I was 7 or 8, I ripped the logic unit out of the washing machine and the cathode ray tube from the TV and tried to connect it all up and make my first computer.

## Your poor parents. Were they scientists?

No, my father works in construction and my mother was a nurse but they separated when I was 9 and later divorced. I had learning difficulties and was in remedial class at school. I wasn't interested in what the teachers were doing. I taught myself the maths of relativity when I was 7. I'm determined to answer questions now because I was told I wasn't any good.

## What are you doing to pursue those childhood dreams?

There are four missions in my lab: to build a robot that can do all of chemistry (and

digitise it – we call it the "chemputer"), to create artificial life, to understand information and to make a chemical brain. They're all effectively about the same thing: understanding the interaction of information in chemistry.

## What does "information in chemistry" mean?

It is another way of asking how chemical systems can process information, beyond information storage or logic operations or molecular electronics. It's asking how biological cells process information and what the physical principles are that allow this to happen.

## And this can help with your ambition of creating artificial life?

Information as a concept refers to data about reality that is encoded and needs an encoder. So I think that information only exists if there is biology, though not everyone agrees with this approach. But, if we create new chemical systems that process information, perhaps that can be viewed as a new type of life form. Making a new type of life form is a vital endeavour if we are to start to understand the missing physics in biology and chemistry, and the missing rules of the universe that allowed the emergence of life in the first place.

## Life is a slippery thing to define...

Here's an idea: let's think of living things as machines that can produce complex objects that could not have randomly formed – from DNA to iPhones, they require information to assemble them. By thinking about life in this way, we can design a way to measure whether something is alive and then use that to make a machine to discover the route to life. ➤





**Lee Cronin's programmable molecule-maker: "we want to build a robot that can do all of chemistry"**

I want to do for chemistry what the Large Hadron Collider has done for physics. They had a theory that predicted the existence of the Higgs boson, developed a model to find out what energy range to look in, then built the LHC to look for it. We are developing a new origin-of-life theory and model so we can work out what time is required, what resources are needed and what scale a machine needs to be to find the right route to a new life form.

**How far have you got?**

In my lab I'm creating a physical model of the world in which you have simple rocks and simple organic molecules and then develop a way of getting from there to genetics. I want to understand what the difference is between stuff that is just complicated to make, such as an arrangement of molecules, and stuff that requires information to make, such as basic cellular machinery.

We're looking for molecules that have high molecular weight, that are abundant and that require more information to make them than just a random mess. If we start to see such molecules forming, what does it mean? It can't be alive according to standard definitions of life, and it's happening through random chemistry, but if the selected molecules direct the creation of the next, increasingly complex molecules... isn't that like life? I don't have proof that this can happen yet, but my guess is that all matter wants to be Darwinian, and we'll get a selfish molecule that will try to convert all the other molecules to be it.

**"Consciousness will never be realised in silicon - we need to create chemical brains"**

**You say you want to make a chemical brain too. Why?**

Your brain is made of molecules and you can think. What is it about your brain that allows this? Instead of trying to image a brain to find out, why don't I just make one? There are 100 billion neurons in the brain, each with about 1000 connections. Overall, there are more potential configurations of the neurons and their connections in your brain than there are atoms in the universe. That's why consciousness will never be realised in silicon computers and why Elon Musk is foolish. He keeps going on about strong AI – machines that can think like humans. We'll have



improved AI, but silicon doesn't allow enough available states for things to get really interesting. We'll need to create chemical brains to understand consciousness.

**What about Google DeepMind? They're doing some amazing stuff.**

DeepMind is brilliant, but I doubt they are ever going to understand what human intelligence really is unless they go beyond silicon-based computers. They are able to mimic some aspects, but ultimately I think it is more like a very good simulation tailored for specific jobs.

I don't think it is even possible to simulate the brain on a computer because we are missing so many rules, and the substrate is not complex enough. I want to make a chemical brain not to beat DeepMind, but to uncover the missing science, and perhaps make different types of non-biological or "inorganic" intelligence.

**How would you go about making a chemical brain?**

We are trying to see how a physical neural network, rather than an electronic circuit,

can be used to physically compute and process information within a polymer, so we can make a physical, chemical, "wet" brain. We use a gel with conducting fibres on top of an electrode array. We tickle the bottom with random electrical inputs, or give it the output of a webcam: show it human faces and see if we can train the gel to recognise them. When we've got a brain gel that we've trained for one problem, we'll see if we can solve other ones with it.

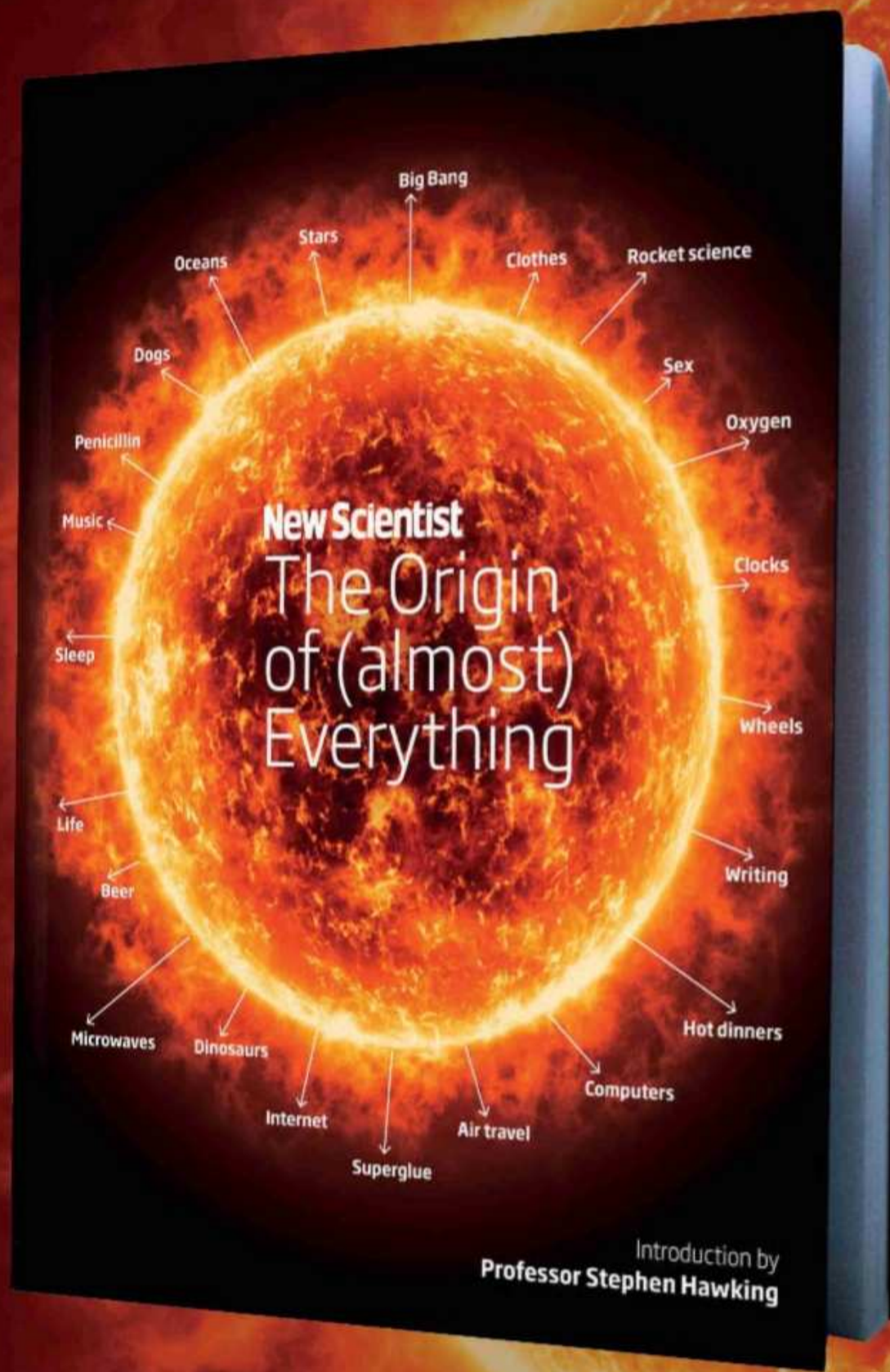
**Do you think this could affect how we see consciousness?**

If we make a brain in the lab, and show that we can generate self-awareness in a certain chemical environment, that might change our view on consciousness. Take the chemical environment inside a jellyfish: they might be conscious on a basic level, or at least aware of their environment, but in a different way to whatever we imagine consciousness to be. That's if consciousness and free will really exist. I have my doubts. ■

Rowan Hooper is managing editor at *New Scientist*.



# Where did we come from? How did it all begin?



And where does belly-button fluff come from?  
Find the answers in our latest book. On sale now.



Introduction by **Professor Stephen Hawking**

**New  
Scientist**

## COVER STORY

# What's up with your gut?

Forget gluten – there are more surprising culprits behind our digestive problems, says Chloe Lambert

**S**OUTH Beach, paleo, vegan, juice cleanse... and FODMAPs. Short for fermentable oligosaccharides, disaccharides, monosaccharides and polyols, the name FODMAPs certainly doesn't have instant appeal, but a diet focused on avoiding these substances is catching on with the public and the medical profession alike. The low-FODMAP diet is based not on celebrities' waistlines or detox bunkum, but on the premise that a healthy gut leads to a happy life. So popular is it proving that there are now claims the diet could alleviate everything from indigestion to chronic fatigue.

Over the past few years, we have become much more clued up about the extensive influence of the gut in health and disease, and the impact our lifestyle choices can have on what some researchers like to call our "second brain". Gluten, a protein found in grains such as wheat, barley and rye, has taken much of the blame, with a growing number of people claiming that they have some sort of gluten intolerance. Global sales of gluten-free food rose 12.6 per cent in 2016, and specialist supermarket aisles now heave with gluten-free products, even though the idea that people can be gluten-sensitive even if they don't have the autoimmune disorder coeliac disease has been largely debunked.

Now the gut health tide is turning once again, and it appears that gut problems linked to certain foods like bread might be real for many. What's more, the secret to dealing with these problems could fly in the face of established healthy eating advice.

The most common cause of gut problems is irritable bowel syndrome (IBS), a catch-all term for a poorly understood constellation of

symptoms including bloating, diarrhoea and constipation. It affects millions, although it doesn't appear to be on the rise, with the incidence in the West put at between 5 and 15 per cent of the population. If, however, it feels like you can't go to a dinner party without someone talking about their gut problems, that might be down to a shift in awareness. "People are noticing symptoms more and reporting them," says Peter Gibson at Monash University in Melbourne. "Sixty years ago we had no criteria to diagnose IBS, and people with gut symptoms just put up with it."

IBS symptoms overlap with those of coeliac disease. For coeliacs, consuming gluten causes symptoms such as diarrhoea, constipation, cramps and fatigue, and triggers a faulty immune reaction which damages the lining of the gut. Although unrelated to IBS in origin, coeliac disease has been attracting attention because it is proving to be more common than previously thought, affecting 1 per cent of people. However, many who test negative for it – showing no signs of making antibodies in response to gluten, or of gut damage – still complain that wheat products make them feel unwell. This has been labelled non-coeliac gluten sensitivity, although the condition remains controversial.

Some argue that gluten is poorly digested by many people, and that its ubiquity in modern, processed food is at odds with the diet that the human gut evolved to deal with. "Wheat is a friend that has outstayed its welcome for some of us," says David Sanders at the University of Sheffield, UK. Scepticism over whether gluten can cause symptoms in non-coeliacs has been fuelled by the fact that cutting it out has become a fashionable lifestyle choice. Studies ►



MARINA MUJIN



## IS YOUR MICROBIOME MAKING YOU SICK?

In the last 10 years, interest in the microbiome - the vast colonies of bacteria and other organisms living in our digestive system - has intensified, including its possible role in gut complaints such as irritable bowel syndrome. Studies have shown that the faecal microbiota of people with IBS differs significantly from those of people who don't have it. Some suggest that a course of antibiotics raises the risk of developing a functional gut disorder like IBS - another hint that an imbalance in gut bacteria might be involved.

Some scientists now believe that this imbalance or "dysbiosis" seen in IBS affects the immune and nervous systems, driving people's symptoms and the way the brain perceives them.

An unhealthy microbiome might even play a role in the fact that people with IBS are more prone to certain psychological problems such as stress, which in turn seems to further exacerbate their IBS symptoms.

A recent study that transplanted the microbiota of humans with IBS into mice found that the mice showed not only physical symptoms associated with IBS, such as faster transit of food through the gut and an altered immune response, but behavioural ones too, such as anxiety.

### PROBIOTIC PROMISE

The hope is that treating dysbiosis in people with IBS, for example by using probiotics that seed the gut with "friendly" bacteria, could provide relief. The jury is still out, however, on whether probiotics really work. According to one recent study, they could actually prevent bacteria recolonising the gut after a course of antibiotics. Still, for IBS patients, they might help, says Peter Whorwell at the University of Manchester, UK. "So I say to patients, 'Try a probiotic. If it seems to work, carry on with it, and if it doesn't, try another one.'" (See "What to eat for a healthy gut", page 35.)

Such research is also spurring ➤

the idea that altering the microbiome might bring about changes in mental health more broadly, a field of research termed psychobiotics. "We know that during times of stress you produce a state of dysbiosis and that this can contribute to gastrointestinal issues," says Monika Fleshner, a physiologist at the University of Colorado, Boulder. And we have started to understand that it works the other way too, she says. "We can protect that community of bacteria from the impacts of stress, and promote those bacteria in the gut that we know are important for mental health." Fleshner's team has found that a prebiotic diet improves sleep and the activity of serotonin, a brain chemical involved in depression and its treatment.

In a study of 45 healthy volunteers, Philip Burnet at the University of Oxford found that those who took Bimuno, a commercially available prebiotic supplement, for three weeks showed a dip in the stress hormone cortisol. They also performed better in tests of emotional processing: they were more drawn to happy than sad faces compared with people who took a placebo. "People are naturally morbid and drawn to negative things, but those on Bimuno completely reversed this and were more drawn to happy faces," says Burnet. "Antidepressants have been shown to do the same thing and it usually precedes a change in mood."

He is testing whether altering gut bacteria might improve memory and problem-solving abilities in people with schizophrenia - common symptoms that don't respond to current medication.

Could a gut-targeting supplement or diet ever make sleeping pills or antidepressants unnecessary? "I think they'll be a useful add-on," says Burnet. "Alongside drug and cognitive therapy, maybe patients will have microbiome therapy."

As for diet, the evidence points towards variety as being good for you: consuming a wide range of foods nurtures a healthy, diverse mix of microbes. In other words, it's time to stop reaching for the same old sandwich.

show that many non-coeliacs are choosing to avoid gluten because they believe doing so is healthy, despite little evidence for its benefits.

In one study of 22,000 adults in the US, the proportion eating a gluten-free diet more than tripled from 0.52 per cent in 2009 to 1.69 per cent in 2013, although the proportion who had coeliac disease stayed roughly constant. Also in 2013, 30 per cent of adults in the US reported trying to cut down on gluten.

"The gluten-free craze is a marketer's dream and the perfect worried-well scenario," says Kevin Whelan at King's College London. "We are seeing people avoiding it in the belief this will help them lose weight or improve their overall health. But beyond coeliac disease, gluten's role in optimising health is nowhere near what people think it is."

Even if gluten is not itself the culprit, we are now understanding why so many people believe they are sensitive to it. A growing body of evidence over the past few years points the finger at FODMAPs. These carbohydrates are present in numerous foods, including wheat, which contains some called fructans. "If you go on a gluten-free diet you reduce probably 50 per cent of your FODMAPs," says Gibson. Rather than having some sort of sensitivity to gluten, it seems that for some people with IBS, FODMAPs could be the trigger.

That was illustrated by a recent trial in which 59 non-coeliac adults on gluten-free diets were fed identical-tasting cereal bars packed with either gluten, fructans or neither. Those who had the fructan bar reported 15 per cent more bloating and 13 per cent more overall gut symptoms compared with the control group, whereas those who had the gluten bar felt no worse afterwards. "Like many studies, that showed the fructans were

## "Too much fibre, fruit and veg could be causing a rise in gut complaints"

the signals. If gluten is a cause of IBS, it's nowhere near as frequent as people say," says Gibson, a pioneer of research in this area.

As well as being present in wheat and grains, FODMAPs are found in fruits and vegetables such as onions, garlic, apples and chickpeas. MRI studies show that when digested, these compounds increase the production of gas and the volume of water in the bowel, causing distension. That doesn't cause an issue for most people, but for up to 70 per cent of people with IBS, reducing intake of these foods provides relief from pain and bloating.

The low-FODMAP diet is considered so effective for IBS that it is now recommended by the National Health Service in the UK and bodies including the Gastroenterological Society of Australia.

The type and quantity of FODMAPs that trigger symptoms varies enormously between individuals, but Gibson says the worst offenders are those in onions, garlic, wheat, rye and barley. This variability means anyone embarking on a low-FODMAP diet should seek the help of a trained professional rather than relying on internet articles, although health authorities are still struggling to train enough people to meet the demand, Gibson says.

## Not for good health

As the buzz around the low-FODMAP diet spreads, it is attracting attention for its potential in other gastrointestinal conditions, including acid reflux and indigestion. The diet is now being recommended in the management of inflammatory bowel diseases (IBDs) such as Crohn's - conditions that are becoming more frequent in the West, possibly because of smoking and additives in the food we eat. "IBS-like symptoms are very common in people with IBD," says Gibson. "You wouldn't put them on a low-FODMAP diet if they've got very active inflammation, but if it's well controlled it is very effective."

After researchers noticed that people with IBS felt more tired when they ate lots of FODMAPs and less so on a low-FODMAP diet, there has been hope it might help people with chronic fatigue syndrome, who also have a high incidence of IBS. But Gibson says the evidence so far is weak and the diet's effect on fatigue only happens among people with IBS.

Although it is appealing to think that we might all benefit from fewer FODMAPs in our life, "if you don't have bowel problems there is absolutely no rationale for being on a low-FODMAP diet", says Gibson. "This is not a diet for good health." One drawback to the diet is that it cuts out foods that are important sources of vitamins, fibre and nutrients such as calcium. Recently, there have also been concerns that it depresses levels of good bacteria in the gut, and the long-term consequences of the diet remain unclear.

Many people trying to avoid FODMAPs struggle to work out which foods to eliminate. "It has helped an awful lot of people," says Peter Whorwell, a gastroenterologist at the University of Manchester, UK. "But for one patient it will be tomatoes, the other lettuce, the other none of the above."



MISCHA KEIJSER/GETTY



CHRISCHRISW/GETTY

The simplest way to feed a healthy gut is to eat a varied diet, especially fruit and vegetables

## WHAT TO EAT FOR A HEALTHY GUT

There are plenty of claims about foods to boost gut health, but not all of them stand up to scrutiny

**Probiotics** - foods prepared with live "good" bacteria, such as yogurt, or supplements - have been shown to help with conditions like irritable bowel syndrome; they may also be beneficial for people with weakened immune systems. But their long-term effects on overall health are not yet known.

Fermented foods and drinks such as kimchi, sauerkraut, kombucha and kefir are gaining in popularity. Their effects on health again aren't yet clear, but consuming them won't do any harm and might improve the microbial diversity in your gut.

For people in good general health, prebiotics, which encourage the growth of good bacteria, are the way to go, says Monika Fleshner at the University of Colorado, Boulder. "It's difficult to introduce a bacteria that will stay there and colonise," says Fleshner. "If you provide existing bacteria in the gut with prebiotic nutrients that will help their growth, it seems a more natural way to support your gut ecology than trying to ingest a live bacteria and hoping it sticks."

The simplest way to feed a healthy gut is to eat a diversity of fruits and vegetables.

But for prebiotics, good sources include green bananas; vegetables in the sunflower family such as artichokes, radicchio, lettuce, chicory, tarragon and salsify; and those related to lilies such as leeks, asparagus, onions, garlic, shallots and chives.

### NO JUNK PLEASE

Gastroenterologist and science writer Giulia Enders recommends cooking carbohydrates such as potatoes and pasta and later eating them cold or reheating them. The period of cooling makes starch more resistant to human digestion, meaning it stays intact to feed microbes in the large intestine.

Tim Spector at King's College London has shown that intermittent fasting may encourage the growth of helpful anti-inflammatory bacteria. He also recommends avoiding junk food, because additives such as emulsifiers seem to kill good bacteria. In a bit of DIY research, Spector found that when his son went on a fast-food diet for 10 days, his gut microbes reduced by 40 per cent. Don't try that at home.

Intriguingly, a third of people with IBS who try the diet reap no benefits at all. For them, some researchers are now looking at a more controversial alternative.

When it comes to gut health, one of the most common pieces of advice has been to eat plenty of fibre, such as wholegrain bread and fibrous vegetables, which help keep the gut working properly and can also reduce the risk of cancer and cardiovascular disease. But it now seems that fibre may also be part of the problem. Some types of fibre release gas when fermented in the bowel, causing irritation in sensitive individuals.

Whorwell was one of the first to demonstrate that reducing fibre could be beneficial in IBS, with a study finding that wheat bran made 55 per cent of people with IBS feel worse and only 10 per cent feel better. The idea has been gaining ground, although it has lately been overshadowed by the fuss over FODMAPs. Whorwell often advises his patients to try switching from wholegrain to white bread. "Fibre is just as important as FODMAPs in aggravating irritable bowel," he says.

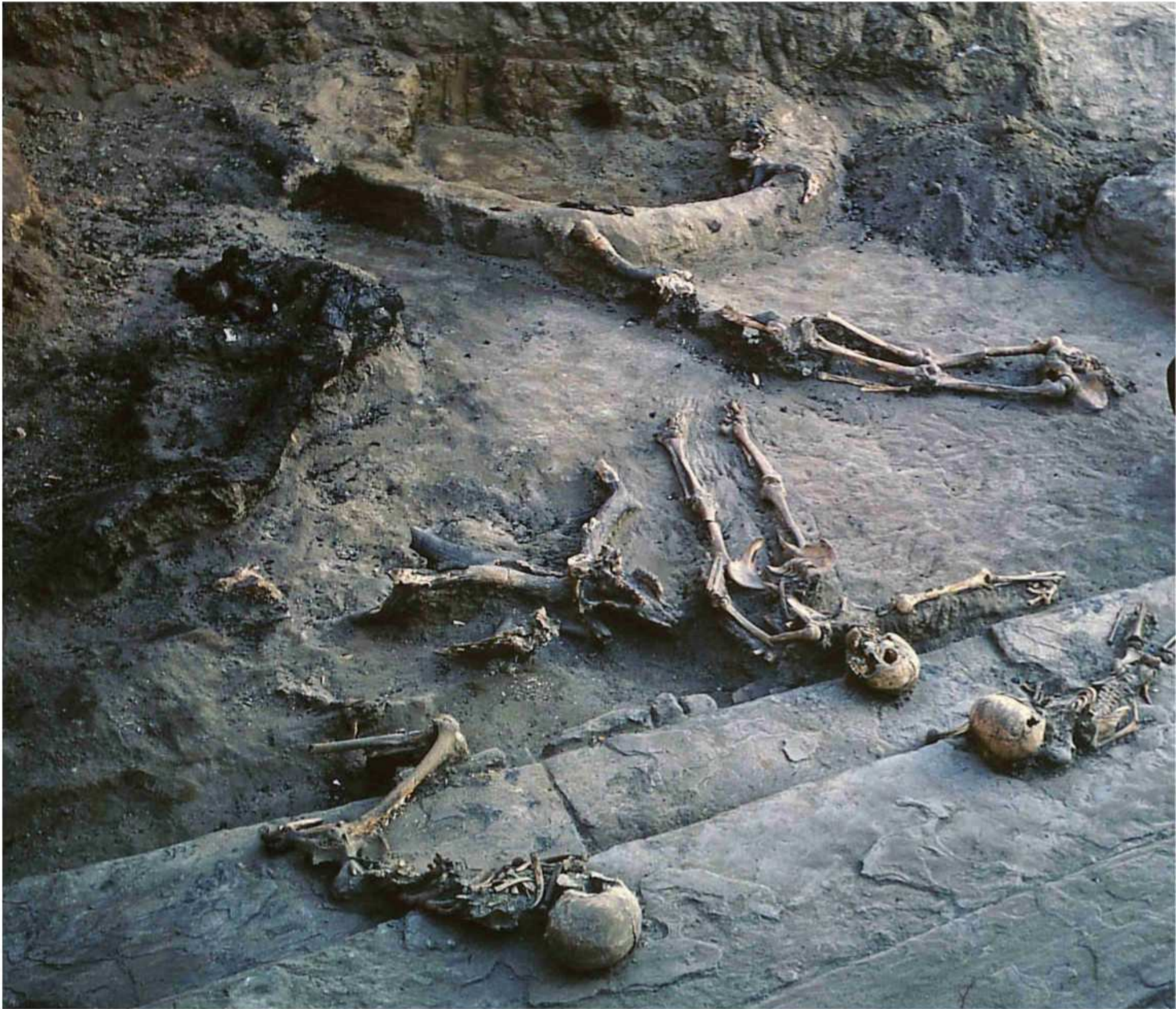
Whorwell even speculates that a push for healthier diets - high in fibre and fruit and vegetables - may be contributing to a rise in gut complaints. "Thirty years ago, nobody had heard of five a day," he says. "It amazes me how many vegetables people are eating these days."

The trouble is that advising patients to eliminate both FODMAPs and fibre flies in the face of good nutrition. In future, IBS treatment will probably involve supplements containing targeted combinations of beneficial, slow-fermented fibres, says Whelan, who is studying fibre's effects on the gut.

And although gastroenterologists remain divided over the issue of gluten, some believe it may yet prove to have adverse effects beyond coeliac disease. "The research evidence is nowhere near catching up with the marketing machine," says Whelan. "But I think non-coeliac gluten sensitivity exists. Some people, when given a gluten challenge, do get symptoms, though identifying who they are and how they differ from people actually responding to fructans is difficult."

The good news for those with gut problems is that the diversity of symptoms and causes are being investigated like never before. For those who don't, however, it might be time to step off the bandwagon, says Sanders. "If you don't have any symptoms, you don't need to be on any of these diets." ■

Chloe Lambert is a freelance journalist based in London



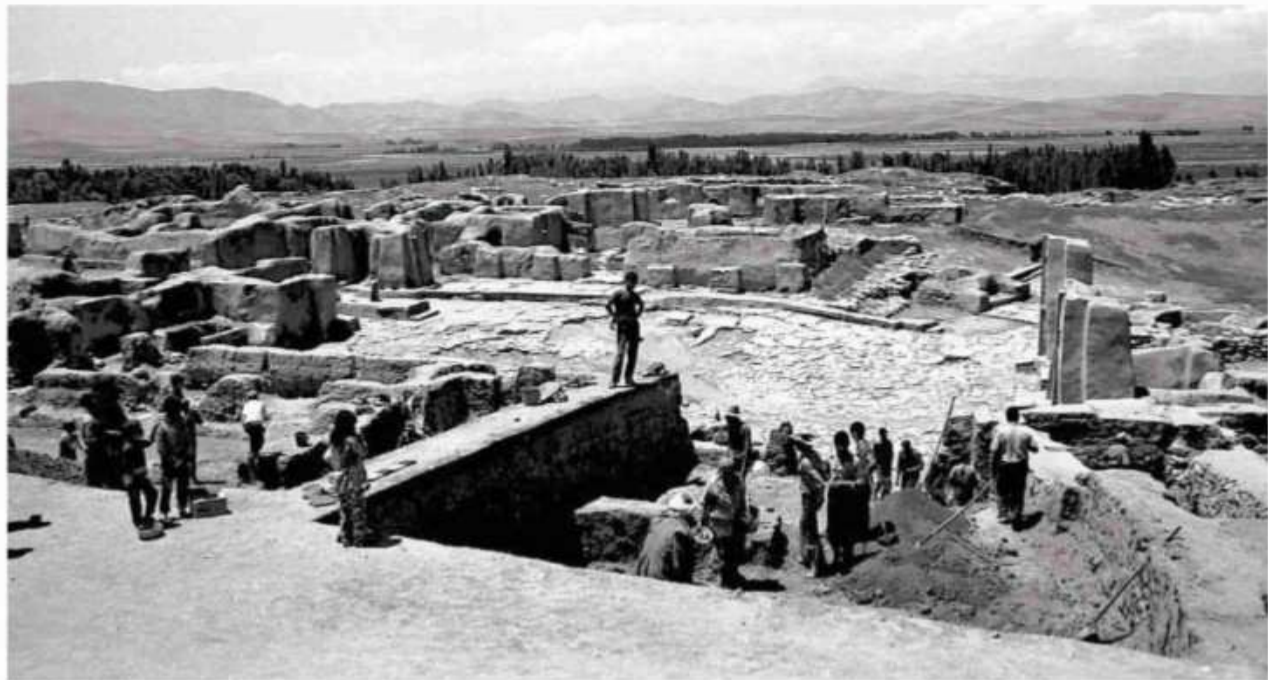
# The horror of Hasanlu

The truth about this once great Iron Age city lay buried for three millennia. Now, at last, the story of 'the Pompeii of Iran' can be told. [Catherine Brahic](#) reports



PENN MUSEUM

Stop the clocks: a fire set during the sacking of Hasanlu preserved details of the gruesome attack (left) and the town (right) for three millennia beneath the sand



PENN MUSEUM

**T**HE Iron Age citadel of Hasanlu was grand, with paved streets and palatial homes that rose two, sometimes three, storeys high around columned courtyards. Its people were rich, and lived off fertile lands generously irrigated by Iran's Lake Urmia. Then they were massacred.

The town was destroyed just before 800 BC in a brutal assault. Now, finally, the remarkable story of Hasanlu is being pieced together from artefacts gathered half a century ago. These are revealing a unique snapshot of history. Here, as in the ancient Roman city of Pompeii, time stopped short – only instead of capturing a natural disaster, Hasanlu captures the reality of Iron Age warfare in all its brutal detail. Yet, while everyone knows about Pompeii, few have heard of Hasanlu. That is set to change.

In 1956, a young American archaeologist called Robert Dyson travelled to Iran, seeking a site where he could study the origins of sedentary life and farming. He singled out a mound, about 500 metres in diameter and 25 metres high, that stood in a valley at the south end of Lake Urmia. Previous digs had revealed it to be entirely artificial, the result of millennia of dust, dirt and debris building up around a succession of settlements that had occupied the spot starting in 5000 or 6000 BC. It was known locally as Hasanlu.

Dyson began by digging trenches around the base of the mound and then, in 1958, on top of it. It wasn't long before he and his assistants discovered the charred remains of a magnificent Iron Age residence built around a courtyard. A fire had clearly destroyed the building's wooden structure, causing the floors to collapse on top of each other and freeze its contents – and inhabitants – in time

and space. The archaeologists uncovered walls, floors, staircases, everyday objects, skeletons dressed in armour and then a silver cup, adorned with two rows of small figures.

Two days later, they struck gold. "Out of the ground emerged a large bucket-shaped vessel," Dyson wrote to the director of the Penn Museum, his funder at the University of Pennsylvania, "pressed flat by the weight of the earth, eight inches high and two feet in circumference! And shining in golden splendor as only gold can do. What a fabulous treasure – covered with mythological figures the details and composition of which are completely new to us!"

With that, everything changed. The dig went into turbo-mode, says Michael Danti of Boston University, who worked with Dyson decades later. Huge plazas were traced and excavated, revealing the full scale of the citadel – the settlement's inner sanctum containing public buildings and elite homes – which was about 30,000 square metres. Dozens and dozens of bodies were found, some burnt, others slain or impaled and left to die.

Mary Voigt, now emerita at William and Mary University, Virginia, arrived in 1970. "It was a really easy site, in terms of understanding the layers," she says. "Once you got down not even a metre, you were on top of the citadel. If you were in a building, you would start to get all the things that were on the top floor first, and then underneath you would have the ground floor. And once you'd cleared away the toppled bricks and slabs of stone, you would find all the people."

The first trench Voigt dug turned out to be in a courtyard. "I found a little kid who was just lying on the pavement." The child was still ➤



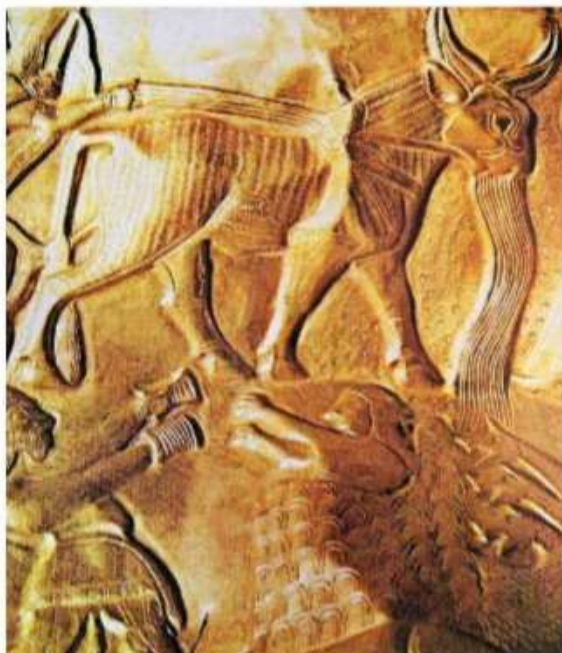
Many lion-shaped pins were found in the town's ruins

AGE FOTOSTOCK/ALAMY



Conical helmets were worn by the warriors of Hasanlu

PENN MUSEUM



WORLD HISTORY ARCHIVE/ALAMY



Dyson's dig struck gold in the form of an embossed bowl

wearing a bronze bracelet and next to them was a spear point and an empty quiver. "The unusual thing about the site," she says, "is all this action is going on and you can read it directly: somebody runs across the courtyard, kills the little kid, dumps their quiver because it's out of ammunition. If you keep going, there are arrow points embedded in the wall."

Next, Voigt moved to what had been a stable, and found more bodies – all women – on top of the stable's collapsed roof. "They were in an elite part of the city yet none of them had any jewellery," she says. "Maybe they had been stripped or maybe they were servants. Who knows? But they were certainly herded back there and systematically killed. It's very vivid. Too vivid."

Subsequent studies, led by Janet Monge of the Penn Museum, showed that most of these women had died from cranial trauma, their skulls smashed by a blunt instrument.

## Terrible atrocities

Yet this was just one of a long list of apparent atrocities at Hasanlu. Skeletons were found with their hands grasping at their abdomens or necks. Many lacked hands. Others had no heads. In one door frame, a complete skeleton lay sandwiched between two half skeletons. Elsewhere, traces of a metal blade were found embedded inside a child's skull. "I come from a long line of undertakers. Dead people are not scary to me," says Voigt. "But when I dug that site I had screaming nightmares."

In the early 1970s, the excavations were shut down by rumblings of the Iranian revolution. Back in the US, the project catapulted Dyson to academic heights. Many of his assistants and students also went on to have illustrious careers. But Hasanlu itself fell into obscurity. No one ever got around to writing a full excavation report. "Dyson couldn't write; he had writer's block," says Danti.

Today, stacks of notebooks, diaries, drawings, diagrams and photographs from the excavations are kept in two rooms in the Penn Museum. In the basement, behind several locked doors, are thousands of objects. Everything that didn't go to Iran's National Museum in Tehran is packed away here.

In recent years, Danti together with Megan Cifarelli of Manhattanville College in New York and a few others have been painstakingly re-examining all this evidence in an attempt to reconstruct the events that led up to the destruction of Hasanlu. The invaders, they conclude, came armed with heavy spiked maces, iron swords, knives, pointed helmets and a single purpose: to wipe out a culture



that had stood on that spot for centuries. They hit the lower town first, killing as they went. All around, people fled their homes and made for the higher citadel, seeking protection. But Hasanlu's fortifications weren't up to the task. Soldiers flooded through a breach in the wall and continued their gruesome work. Men, women and children were slain, alongside their dogs and horses. The looting was as thorough as the killing. At some point in the midst of all this, someone – probably a soldier – lit a fire.

Wooden beams and reed matting went up in an almighty blaze. As the flames spread, some soldiers continued towards the grand buildings and temples of the inner sanctum. On the third storey of a magnificent residence, three came across a treasury and caught sight of the large and delicately embossed gold bowl, as well as an equally precious goblet made of fine silver. They grabbed both and raced to get out. Greed was, literally, their downfall. Before they could reach the stairway, flames engulfed the building, which collapsed beneath them. Their bodies plummeted and were flattened under mud bricks and burning timber, where they were found, three millennia later, together with the objects of their desire.

All around, other houses collapsed. A group of 70 inhabitants who had sought refuge in a building across the street perished in their

## The town that time forgot

For millennia, Hasanlu occupied a strategic position in a fertile valley. In 800 BC it was razed to the ground, but were the neighbouring Assyrian or Urartian civilisations responsible?



hideout. Elsewhere, a man and a boy hid in a grain store, which was then consumed in the blaze. When their skeletons were exhumed by Dyson's team in the mid-20th century, they appeared to be in an embrace, with the older man holding his hands up to his mouth as though to whisper into the youth's ear. The press dubbed them the lovers of Hasanlu.

In a bitter twist of irony, the flames that destroyed the mighty citadel would also save it for posterity. As the wooden frameworks gave way and the multi-storeyed buildings

**“Dead people are not scary to me, but when I dug that site I had screaming nightmares”**

flattened, they quenched the fire and preserved everything inside them in tightly compacted layers of dust and crushed clay bricks. Occupants, enemy soldiers, their weapons and their jewels, the hand-painted bowls they ate from, the jars they drank wine from and the layouts of their homes and palaces – everything was entombed.

The destruction was complete. “That narrows down who could have done it,” says Danti. There were two major forces in the area at the time. The Assyrians had been a regional power for millennia and now ruled from the cities of Nimrud and Nineveh to the west of Hasanlu, but their reign was in decline. The Urartians were a smaller but growing power to the north (see map, below left). Which was to blame?

The many Assyrian objects found at Hasanlu had originally led people to believe that the city was an Assyrian ally or outpost by the time it was sacked. But Cifarelli isn't convinced. She has been going through the Hasanlu records trying to correct what she calls “some of the problematic conclusions that have been drawn about the site in the past”. She believes the “extraordinary collection of exotic goods” points to a people “doing their own thing”. “It's more likely that they were itinerant traders,” she says, who brought the objects back from their travels, to Assyria among other places.

In fact, a link to the Urartians looks stronger. Digs into Hasanlu's lower level reveal that the town had experienced a lesser attack in 1100 BC. Excavating a cemetery on the outskirts of the settlement, Cifarelli found a grave dating from not long after this attack, containing a warrior with Urartian-style armour and weapons, and wearing intriguing armlets that were too small to be removed, suggesting he must have worn them since childhood. Later graves revealed the rise of a new “warrior”

social class, equipped with similar armour and swords. Cifarelli suspects that in the century or so after the 1100 BC attack one or more warriors moved into Hasanlu from the north bringing their military technology with them.

It looks as though the town was preparing to defend itself during this period. As well as a growing army, the settlement had gained new fortifications around the citadel. And Danti's research indicates where the threat came from. In 2014, he published an analysis of the skeletons found with the golden bowl. From their dress, he concluded that they were Urartians. Ironically, they even wore the same armlets Cifarelli found in the cemetery.

We know that around this time, the Urartians travelled past Hasanlu to visit one of their holy sites. “Hasanlu may have been resistant to Urartian invasions,” says Cifarelli. “It seems likely that when they didn't capitulate, the Urartians destroyed the site. They did that in a way that was intentional and spectacular. It would have been a smoking heap of rubble that could have been seen for miles.” The scale of the attack, she says, looks like a message to surrounding villages. Danti agrees that the invaders weren't mere thieves. “Whoever destroyed the site really had an axe to grind against the people who lived there,” he says. “It was one of these invasions that was designed to wipe out a cultural identity.”

But there is another potential motive. John Curtis of the British Museum in London points out that Hasanlu occupied a very desirable position in the middle of a fertile valley. It also seems to have been an important trade route connecting Lake Urmia to the Fertile Crescent – the birthplace of farming – in modern-day Iraq. The site was clearly important, says Curtis. It had been occupied on and off for some 5000 years, right back to the origins of agriculture, and there were fortifications. “It might have been in a position to control the trade route,” he says, “an obstacle that the Urartians had to remove. And there was probably quite a lot to plunder in the city itself.”

Whatever the motivation for the attack, it laid waste to the town. Almost three millennia later, Hasanlu is finally rising from the dust. Five years ago, a museum opened near the site to show some of its excavated artefacts. Now the Iranian government is seeking international recognition. In June, the Cultural Heritage and Handicrafts Organization of Iran announced that it was putting together a dossier for UNESCO, in a bid to make Hasanlu a World Heritage Site. Cifarelli is optimistic this will bring benefits to the local economy. “And, of course, it's an acknowledgment of the importance of the site,” she says. ■



PATRYK HARDZINA

# AI, *warbot*

“ONLY the dead have seen the end of war,” the philosopher George Santayana once bleakly observed. Our martial instincts are deep-rooted. Our near relatives chimpanzees fight “total war” that sometimes leads to the annihilation of rival groups of males. Archaeological and ethnographical evidence suggests that warfare among our hunter-gatherer ancestors was chronic.

Over the millennia, we have fought these wars according to the same strategic principles based in our understanding of each other’s minds. But now we have introduced another sort of military mind – one that even though we program how it thinks, may not end up thinking as we do. We are only just beginning to work through the potential impact of artificial intelligence on human warfare, but all the indications are that they will be profound and troubling, in ways that are both unavoidable and unforeseeable.

We aren’t talking here about the dystopian sci-fi trope of malign, humanoid robots with a free rein and a killer instinct, but the far more limited sort of artificial intelligence that already exists. This AI is less a weapon per se, more a decision-making technology. That makes it useful for peaceful pursuits and warfare alike, and thus hard to regulate or ban.

This “connectionist” AI is loosely based on the neural networks of our brains. Networks of artificial neurons are trained to spot patterns in vast amounts of data, gleaning information they can use to optimise a “reward function” representing a specific goal, be that optimising clicks on a Facebook feed, playing a winning game of poker or Go, or indeed winning out on the battlefield.

In the military arena, swarms of autonomous drones are already deployed

Artificial intelligence is set to rewrite the rules of warfare in subtle and terrifying ways, says  
**Kenneth Payne**

from pods on aircraft, and autonomous software can manoeuvre vehicles with increasing dexterity. In the air – in simulators at least – it has outfought skilled pilots. There are systems that scan hours of imagery looking for targets, that automatically respond to incoming missile threats, that prioritise information for human pilots and that shift radar bands in a lightning-fast battle of detection and deception.

This raises obvious, much discussed ethical questions. Can AI systems really know who to target? Shouldn’t people have the final say in life-or-death decisions? But the implications for how war is prosecuted – for strategy – have been less widely explored. To understand how profound they are, we must first understand strategy’s very human underpinnings.

Social intelligence gives humans a powerful advantage in conflict. In war, size matters. Victory generally goes to the big battalions, a logic described in a formula derived by the British engineer Frederick Lanchester from studies of aerial combat in the first world war. He found that wherever a battle devolves to a melee of all against all, with ranged weapons as well as close combat, a group’s fighting power increases as the square of its size.

That creates a huge incentive to form

ever-larger groups in violent times. Humans are good at this, because we are good at understanding others. We forge social bonds with unrelated humans, including with strangers, based on ideas, not kinship. Trust is aided by shared language and culture. We have an acute radar for deception, and a willingness to punish non-cooperating free-riders. All these traits have allowed us to assemble, organise and equip large and increasingly potent forces to successfully wage war.

Social intelligence also allows weaker, smaller groups to stave off defeat. The use of deception, fortification, terrain and disciplined formations can offset the advantages of scale and shock. In the film *300*, crack Spartan troops at one point charge headlong into the vastly outnumbering Persian army at the Battle of Thermopylae. In reality, that would spell disaster. As the Ancient Greek historian Herodotus relates, the Spartans used the narrow confines of a mountain pass and arranged themselves into a disciplined formation with interlocked shields to hold off the Persians. This, too, is strategic intelligence.

Underlying it is theory of mind – the human ability to gauge what others are thinking and how they will react to a given situation, friend or foe. The ancient Chinese strategist Sun Tzu counselled leaders to know themselves and know their enemies, so that in 100 battles they would never be defeated. Theory of mind is essential to answer strategy’s big questions. How much force is enough? What does the enemy want, and how hard will they fight for it?

Strategic decision-making is often instinctive and unconscious, but also can be shaped by deliberate reflection and an

attempt at empathy. This has survived even into the nuclear era. Some strategic thinkers held that nuclear weapons changed everything because their destructive power threatened punishment against any attack. Rather than denying aggressors their goals, they deterred them from ever attacking.

That certainly did require new thinking, such as the need to hide nuclear weapons, for example on submarines, to ensure that no "first strike" could destroy all possibility for retaliation. Possessing nuclear weapons certainly strengthens the position of militarily weaker states; hence the desire of countries from Iran to North Korea to acquire them.

But even in the nuclear era, strategy remains human. It involves chance and can be emotional. There is scope for misperception and miscommunication, and a grasp of human psychology can be vital for success.

## What are you thinking?

Take the Cuban missile crisis, an event intensely studied by psychologists and strategists since. In 1962, US President John F. Kennedy was given alarming evidence that the Soviet Union was positioning nuclear missiles on Cuba. His immediate reaction was anger, and a desire to strike out militarily, even at the risk of escalating the cold war. But that soon gave way to a deliberate, reflective attempt to empathise with Nikita Khrushchev's blustering. The Soviet leader had tried to bully Kennedy at their first meeting, and during the crisis sent first an emollient letter, then a tougher one. Kennedy crafted a solution that, crucially, saved Khrushchev's face. In a tense stand-off, social intelligence and theory of mind were decisive.

Artificial intelligence changes all this. First, it swings the logic of strategy decisively towards attack. AI's pattern recognition makes it easier to spot defensive vulnerabilities, and allows more precise targeting. Its distributed swarms are hard to kill, but can concentrate rapidly on critical weaknesses before dispersing again. And it allows fewer soldiers to be risked than in warfare today.

This all creates a powerful spur for moving first in any crisis. Combined with more accurate nuclear weapons in development, this undermines the basis of cold-war nuclear deterrence, because a well-planned, well-coordinated first strike could defeat all a defender's retaliatory forces. Superior AI

**Autonomous drones are already deployed militarily, here on the Iraq-Turkey border**

## "AI does not experience the emotion and empathy felt by human strategists"

capabilities would increase the temptation to strike quickly and decisively at North Korea's small nuclear arsenal, for example.

By making many forces such as crewed aircraft and tanks practically redundant, AI also increases uncertainty about the balance of power between states. States dare not risk having second-rate military AI, because a marginal advantage in AI decision-making accuracy and speed could be decisive in any conflict. AI espionage is already under way, and the scope for a new arms race is clear. It is difficult to tell who is winning, so safer to go all out for the best AI weapons.

Were that all, it would be tempting to say AI represents just another shift in strategic balance, as nuclear weapons did in their time. But the most unsettling, unexplored change is that AI will make decisions about the application of force very differently to humans. AI doesn't naturally experience emotion, or empathy, of the sort that guides human strategists such as Kennedy. We might attempt to encode rules of engagement into an AI ahead of any conflict – a reward function that tells it what outcome it should strive towards and how. At the tactical level, say with air-to-air combat between two swarms of rival autonomous aircraft, matching our goals to the reward function that we set our AI might be doable: win the combat, survive, minimise

civilian casualties. Such goals translate into code, even if there may be tensions between them.

But as single actions knit together into military campaigns, things become much more complex. Human preferences are fuzzy, sometimes contradictory and apt to change in the heat of battle. If we don't know exactly what we want, and how badly, ahead of time, machine fleets have little chance of delivering those goals. There is plenty of scope for our wishes and an AI's reward function to part company. Recalibrating the reward function takes time, and you can't just switch AI off mid-battle – hesitate for a moment, and you might lose.

That is before we try to understand how the adversary may respond. Strategy is a two-player game, at least. If AI is to be competitive, it must anticipate what the enemy will do.

The most straightforward approach, which plays to AI's tremendous abilities in pattern recognition and recall, is to study an adversary's previous behaviour and look for regularities that might be probabilistically modelled. This method was used by AlphaGo, the DeepMind AI that beat the human champion Lee Sedol at the board game Go in 2016. The Go board represents a large, yet still limited, "toy universe" with a vast array of possible future moves. Yet given its opponent's likely response, the machine can narrow the search to the moves most likely to lead to victory, and then work out a winning course of action – all at blinding speed.

With enough past behaviour to go on,



John F. Kennedy's human reactions were decisive in de-escalating the 1962 Cuban missile crisis



UNDERWOOD ARCHIVES/GETTY

this works even in a game such as poker where, unlike Go, not all information is freely available and a healthy dose of chance is involved: AI can now beat world-class poker players when it plays them repeatedly.

This approach could work well at the tactical level – anticipating how an enemy pilot might respond to a manoeuvre, for example. But it falls down as we introduce high-level strategic decisions. There is too much unique about any military crisis for previous data to model it.

An alternative method is for an AI to attempt to model the internal deliberations of an adversary. But this only works where the thing being modelled is less sophisticated, as when an iPhone runs functional replicas of classic 1980s arcade games. Our strategic AI might be able to intuit the goals of an equally sophisticated AI, but not how the AI will seek to achieve them. The interior machinations of an AI that learns as it goes are something of a black box, even to those who have designed it.

Where the enemy is human, the problem becomes more complex still. AI could perhaps incorporate themes of human thinking, such as the way we systematically inflate low-risk outcomes. But that is AI looking for patterns again. It doesn't understand what things mean to us; it lacks the evolutionary logic that drives our social intelligence. When it comes to understanding what others intend – “I know that you know that she knows” – machines still have a long way to go.

Does that matter? Humans aren't

infallible mind-readers, and in the history of international crises misperception abounds. In his sobering account of nuclear strategy, *The Doomsday Machine*, Daniel Ellsberg describes a time when the original US early warning system signalled an incoming Soviet strike. In fact, the system's powerful radar beams were echoing back from the surface of the moon. Would a machine have paused for thought to ascertain that error before launching a counterstrike, as the humans involved did?

Humans try to reason about what adversaries want, and understand that within the context of their own experience, motivations and emotions. Machines might not share Kennedy's emotional knee-jerk response in

**“We can't bury our heads and say it won't happen - the technology already exists”**

1962, but they also don't share his capacity to reflect on his adversary's perspective.

An AI's own moves are often unexpected. In its second game against Lee, AlphaGo made a radical move wholly unforeseen by onlooking human experts. This wasn't remarkable creativity or a searing insight into Lee's game plan. The game-winning “move 37” was down to probabilistic reasoning and a flawless memory of how hundreds of thousands of earlier games had played out. The last

thing we need is a blindingly fast, offensively brilliant AI that makes startling and unanticipated moves in confrontation with other machines.

There won't necessarily be time for human judgement to intercede in a battle of automatons before things get out of hand. At the tactical level, keeping a human in the loop would ensure defeat by faster all-machine combatants. Despite the stated intentions of liberal Western governments, there will be ever-less scope for human oversight of blurringly fast tactical warfare.

## Cold probabilities

The same may be true at more elevated strategic levels. Herman Kahn, a nuclear strategist on whom the character Dr Strangelove was partly based, conceived of carefully calibrated “ladders” of escalation. A conflict is won by dominating an adversary on one rung, and making it clear that you can suddenly escalate several more rungs of intensity, with incalculable risk to the enemy – what Kahn called “escalation dominance”.

In the real world, the rungs of the ladder are rather imprecise. Imagine two competing AI systems, made of drones, sensors and hypersonic missiles, locked in an escalatory game of chicken. If your machine backs off first, or even pauses to defer to your decision, it loses. The intensity and speed of action pushes automation ever higher. But how does the machine decide what it will take to achieve escalation dominance over its rival? There is no enemy mind about which to theorise; no scope for compassion or empathy; no person to intimidate and coerce. Just cold, inhuman probabilities, decided in an instant.

That was move 37 of AlphaGo's second game against the world champion. Perhaps it is also early December 2041, and a vast swarm of drones skimming over the ocean at blistering speed, approaching the headquarters of the US Pacific Fleet. We can't bury our heads and say it won't happen, because the technology already exists to make it happen. We won't be able to agree a blanket ban, because the strategic advantage to anyone who develops it on the sly would be too great. The solution to stop it happening is dispiritingly familiar to scholars of strategic studies – to make sure you win the coming AI arms race. ■

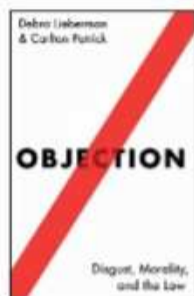
Kenneth Payne is at the School of Security Studies, King's College London. He is author of *Strategy, Evolution and War: From apes to artificial intelligence* (Georgetown University Press, 2018)

For more books and arts coverage, visit [newscientist.com/culture](http://newscientist.com/culture)

# Prudery isn't justice

When disgust steers collective behaviour, watch out, warns **Simon Ings**

*Objection: Disgust, morality, and the law* by Debra Lieberman and Carlton Patrick, Oxford University Press



WE WANT the law to be fair and objective. We also want laws that work in the real world, protecting and reassuring us, and maintaining

our social and cultural values.

The moral dilemma is that we can't have both. This may be because humans are hopelessly irrational and need a rational legal system to keep them in check. But it may also be that rationality has limits; trying to sit in judgement over everything is as cruel and farcical as gathering cats in a sack.

This dilemma is down to disgust, say Debra Lieberman, a psychologist at the University of Miami, and Carlton Patrick, a legal scholar at the University of

**Justice is famously blind and impartial, but it is also human**

Central Florida. In *Objection*, they join forces to consider why we find some acts disgusting without being reprehensible (like nose-picking), while others seem reprehensible without being disgusting (like drunk driving).

Disgust is such a powerful intuitive guide that it has informed our morality and hence our legal

**"Sitting in judgement over everything is as cruel and farcical as gathering cats in a sack"**

system. But it maps badly over a jurisprudence built on notions of harm and culpability.

Worse, terms of disgust are frequently wielded against people we intend to marginalise, making disgust a dangerously fissile element in our moral armoury.

Can science help us manage it? The prognosis is not good. If you were to ask a cultural anthropologist, a psychologist, a neuroscientist, a behavioural economist and a sociologist to explain disgust, you would

receive different, often mutually contradictory, opinions.

The authors make their own job much more difficult, however, by endorsing a surreally naive model of the mind – one in which "both 'emotion' and 'cognition' require circuitry" and it is possible to increase a child's devotion to family by somehow manipulating this "circuitry".

From here, the reader is ushered into the lollipop van of evolutionary psychology, where "disgust is best understood as a type of software program instantiated in our neural hardware", which "evolved originally to guide our ancestors when making decisions about what to eat".

The idea that disgust is to some degree taught and learned, conditioned by culture, class and contingency, is not something easily explored using the authors' over-rigid model of the mind. Whenever they lay this model aside, however, they handle ambiguity well.

Their review of the literature on disgust is cogent and fair. They point out that although the decriminalisation of homosexuality and gay marriage argues persuasively for legal rationalism, there are other acts – like the violation of corpses – that we condemn without a strictly rational basis (the corpse isn't complaining). This plays to the views of bioethicist Leon Kass, who calls disgust "the only voice left that speaks up to defend the central core of our humanity".

*Objection* explores an ethical territory that sends legal purists sprawling. The authors emerge from this interzone battered, but essentially unbowed. ■



MIRRORPIX

## DON'T MISS

### Visit

What can follow four days of New Scientist Live at ExCeL London? Try the capital's new Science Gallery, launching Friday 21 September with *Hooked*, a show exploring the world of addiction and recovery.

### Watch

On 21 September, Emma Stone and Jonah Hill star in Netflix's delirious retread of Norwegian TV hit *Maniac* (pictured below). An inventor (Justin Theroux) claims he can repair damaged minds.

### Read

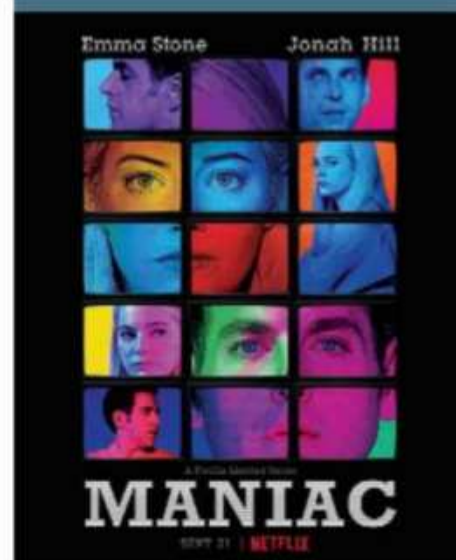
Why does a personality test from the 1920s hold sway over our jobs, our internet and our lives? *What's Your Type? The strange history of Myers-Briggs and the birth of personality testing* (William Collins) is Merve Imre's answer.

### Watch

From 15 September, Bertha DocHouse in London is screening Fritz Ofner and Eva Hausberger's disturbing documentary *Weapon Of Choice*, the story of the Glock semi-automatic pistol.

### Listen

Bob Hirshon hosts *Science Update*, a radio news feature produced by the AAAS, the world's largest general scientific society. As we went to press, its breaking story was the way Russian cyberbots are actively fuelling disinformation about vaccines.



# Giving voice to a planet's suffering

Poetry can express our environmental crisis in a more human way, says **Niall Firth**



PLAINPICTURE/MINT IMAGES

POETRY and nature have always gone hand in hand, but now there is new bite as poets increasingly address environmental issues, adding politics and activism to their literary armoury.

A big cash prize also helps. One of the biggest poetry prizes is the Ginkgo Prize (formerly the Resurgence Prize), which closed for submissions on 15 August. It awards £5000 to the best poem on an ecological theme.

Sally Carruthers, executive director of the Poetry School, which helps manage the prize, says the recent rise of eco-poetry is being driven by the era in which we live and by people sharing their work on social media, particularly Instagram. "In times of political unrest, poetry thrives as an activist medium," she says. "People have something gritty to write about."

The best environmental poetry doesn't berate or shout at you. Instead the signs are subtle, the absences and disturbances are cumulative, as in Karen McCarthy Woolf's collection *Seasonal Disturbances* (Carcenet). Here nature often seems ill at ease with itself: "No birds nesting or singing in the trees; / no

**"In times of political unrest, poetry thrives - there's something gritty worth writing about"**

bellowing, roaring or squeaking savage or small..."

Or take Beverley Bie Brahic's poem *The Fête du Miel*, from her new book *The Hotel Eden* (Carcenet). Here, bees are left confused by a shifting climate: "Last winter was so warm the bees thought / Summer never

**A decline in honeybee populations: trouble that's hard to put into words**

ended, the beekeepers write."

Poetry about the environment has also been scooping up big prizes usually reserved for longer forms. In June, poet Robert Minhinnick won the Wales Book of the Year for his *Diary of the Last Man* (Carcenet) – poetry described as "environmentalism turned into elegy" by the judges.

Perhaps this isn't surprising. Good poetry has the ability to pack an emotional punch without cliché and to avoid the didactic tone that can kill a piece of art. As Carruthers explains: "A great eco-poem must have an understanding of how we interact as species and ecosystems, that destruction and risk are part of the world in which we find ourselves and that we need to act now."

While some of the best eco-poetry is about the resilience of nature, other works address the ways our changing climate affects minds and bodies. Carrie Etter's pamphlet *Scar*, for example, is a single poem about the effects of climate change on her home state of Illinois: "more tornadoes / one scours a half-mile-wide path through Fairdale / flattens / twists / hurls homes / cars / a child's treehouse / its scar in the earth visible / from space". It will be included in her collection *The Weather in Normal* (Seren Books).

Other poets, like Dom Bury and Seán Hewitt, are bridging the gap between the personal and the global. Bury, the winner of last year's prestigious UK National Poetry Competition for *The Opened Field*, runs workshops on eco-poetry and what he calls the "emotional impact of climate change".

Hewitt, winner of the Resurgence Prize in 2017 with his poem *Ilex*, describes his new work (including *Lantern*, from Offord Road Books next year) as trying "to change, through poetry, the ways in which we view our relationship to the natural world".

I was commissioned in June to write a series of mini-poems for Ice Alive, a sci-art project. As Joseph Cook, a co-founder of Ice Alive and a glacial microbiologist, explains: "The arts can add depth and value back to the science of climate change."

Crucially, it can also engage those who haven't found a way to express their unease at our endangered world. ■

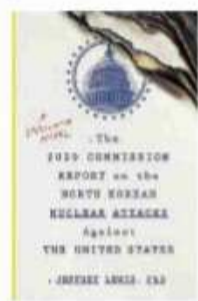
The winners of the Ginkgo Prize will be announced at the Poetry in Aldeburgh festival, from 2 to 4 November

## CULTURE

# The last Trump

An ill-judged tweet kicks off nuclear war in a satire pitting North Korea against the US. By **Jacob Aron**

*The 2020 Commission Report on the North Korean Nuclear Attacks Against the United States* by Jeffrey Lewis, Penguin



IN THE past year, whenever US-North Korea relations were at a particularly low point, I would wake up in the middle of the night, reach for my phone and check Twitter to see if nuclear war had begun.

That a social media service could play a role in the end of the world once seemed absurd, but such is the reality of 2018. I was reminded of this when, as I was idly scrolling through my feed, a message stopped me in my tracks.

"LITTLE ROCKET MAN WON'T BE BOTHERING US MUCH LONGER!" screamed the scowling face of the Tweeter-in-Chief. "Is this it?" I wondered, before noticing the username – not @realDonaldTrump, the US president's genuine account, but @tehDonaldJTrump.

Investigating further, I discovered this was a parody account set up to promote *The 2020 Commission Report on the North Korean Attacks Against the United States*, a fictional but all-too-real account of a nuclear conflict in which Twitter plays a defining role.

It is written by Jeffrey Lewis, an arms control expert at the Middlebury Institute of International Studies at Monterey in California who is frequently quoted in the pages of *New*

*Scientist*. The story takes the form of an official US report published in 2023 to determine the causes of a North Korean nuclear attack.

Its tone – set midway between bureaucratic sterility and a Tom Clancy thriller – works very well. It helps that both genres heavily favour acronyms. The set-up: a technical glitch in a South Korean passenger jet (inspired by real-life aircraft failures) leaves the pilot drifting along the Korean border. The North Koreans mistake the plane for a US bomber and shoot it down, sparking a retaliation from South Korean missiles.

Lewis ratchets up the tension as Korean leaders Kim Jong-un and Moon Jae-in decide how to act. Then "Hurricane Donald", as one chapter is titled, comes in to play. His ill-fated "rocket man" tweet prompts Kim to retaliate with nuclear strikes on South Korea, Japan and the US mainland.

Maps lay out the devastation in chilling detail. A nuke exploding

over New York City creates a 1-kilometre-wide fireball. Most residential buildings in central Manhattan are destroyed – including Trump Tower – and people within a 6.5 kilometre radius receive radiation burns.

Needless to say, hospitals are plunged into chaos. Without medical treatment, radiation kills 50 to 90 per cent of those

**"That social media could play a role in the end of the world once seemed absurd. Welcome to 2018"**

exposed. You can follow Lewis's example and create your own scientifically accurate nuclear destruction with the online tool NUKEMAP, if that is the kind of thing you enjoy.

The commission reports the stories of those who survived the blast. I was shocked to reach the end of the book and discover that these testimonies were adapted

from accounts by people who survived the nuclear bombs dropped on Hiroshima and Nagasaki. Grounding these historical words in our present-day reality brings home the true horror of nuclear weapons.

If the book has one flaw, it is the portrait of Donald Trump. While the US president is known for his outlandish statements and short attention span, the Trump in the novel is too broad. For all his flaws, I don't believe that Trump would declare a nuclear fireball rising over the coast of Florida to be "absolutely beautiful". A statement from the fictional Trump at the end of the report decrying it as "FAKE NEWS" also comes across as generic bashing.

That said, I couldn't put the book down, reading most of it in the course of one increasingly intense evening. If fear of nuclear war is going to keep you up at night, at least it can be a page-turner. ■

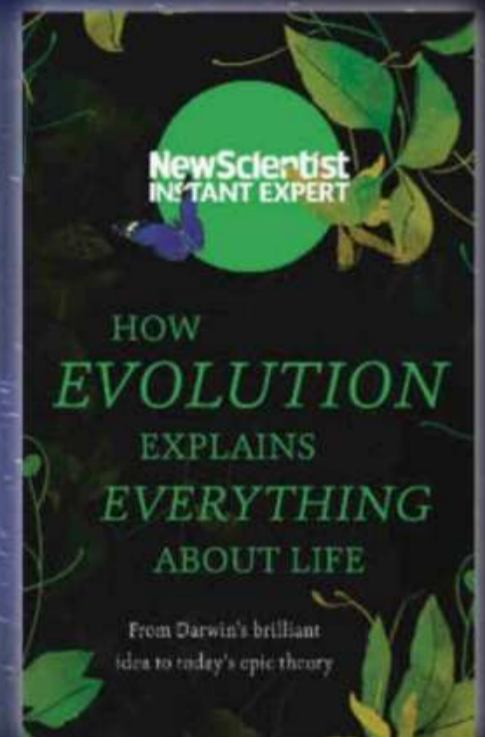
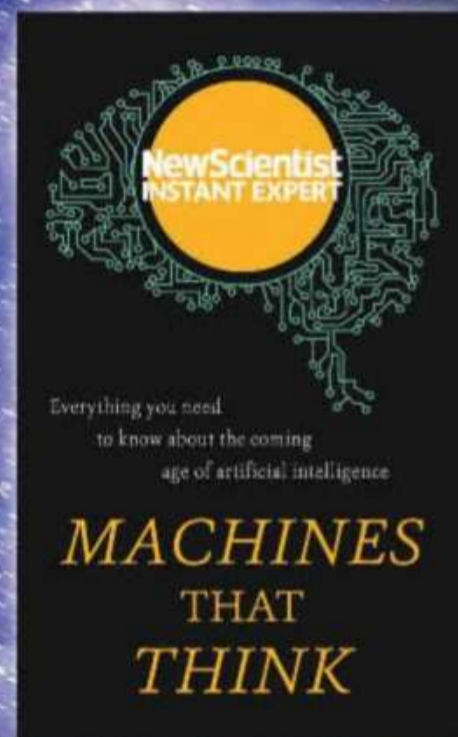
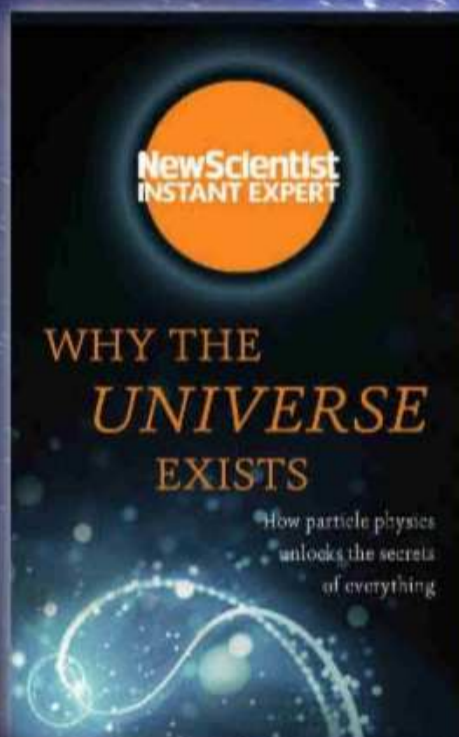
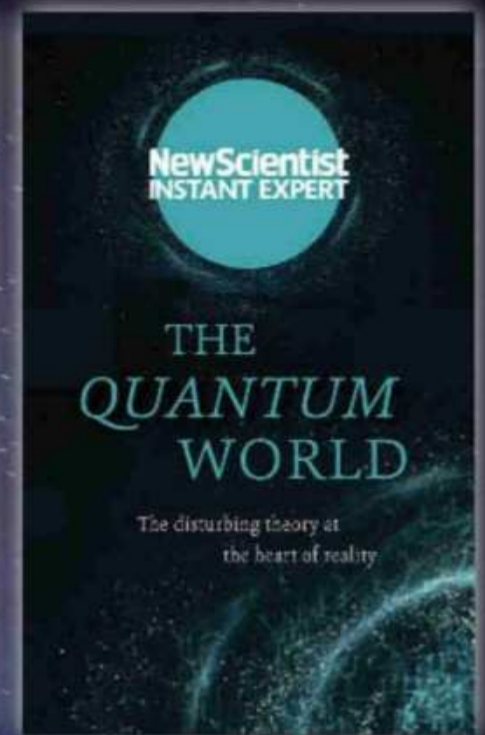
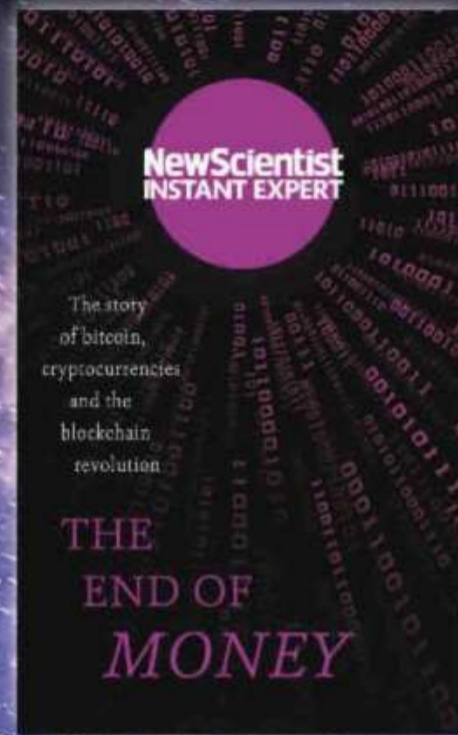
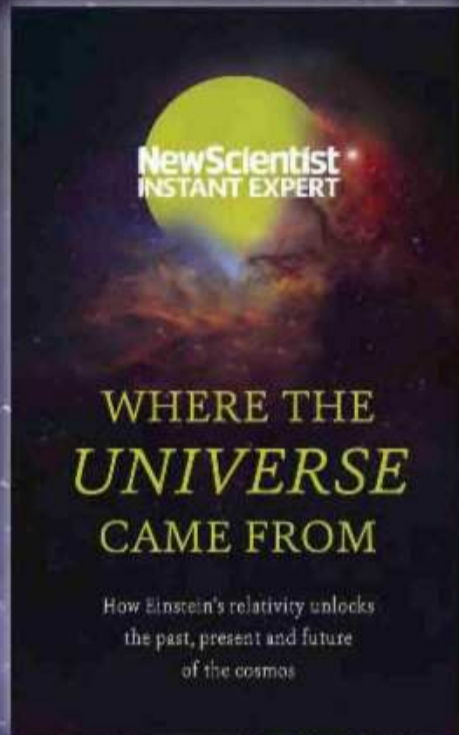
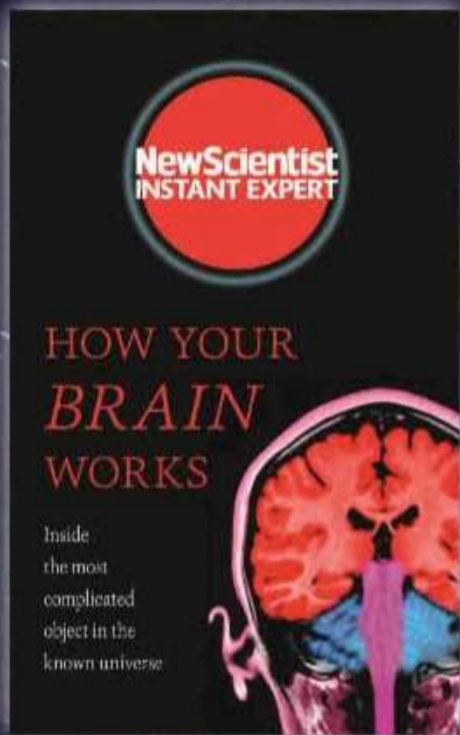


South Korea reports on a nuclear test by its northern neighbour



# INTRODUCING THE New Scientist INSTANT EXPERT SERIES

DEFINITIVE, ENGAGING AND ACCESSIBLE GUIDES TO  
THE MOST IMPORTANT SUBJECTS IN SCIENCE.



# Berkeley

UNIVERSITY OF CALIFORNIA

## Department of Chemistry Faculty Position in Chemistry

The Department of Chemistry, at the University of California, Berkeley, invites applications for two faculty positions at the assistant professor level with an expected start date of July 1, 2019. We will consider creative and energetic candidates who show extraordinary promise or accomplishment in research and teaching in any area of chemistry. Preference will be given to candidates in the broadly defined fields of chemical biology, experimental physical chemistry, and analytical chemistry. The basic qualification for this position is a Ph.D. or equivalent international degree in the physical sciences or life sciences at the time of application.

The Department of Chemistry and the Berkeley campus value diversity, equity and inclusion as exemplified by the following principles of community:

- We recognize the intrinsic relationship between diversity and excellence in all our endeavors.
- We embrace open and equitable access to opportunities for learning and development as our obligation and goal.

Our excellence can only be fully realized by faculty, students and staff who share a commitment to these principles. Successful candidates for our faculty positions will demonstrate evidence of a commitment to equity and inclusion in higher education through their teaching, research and service activities. Financial and in-kind resources are available to pursue activities that help accelerate our efforts to achieve our equity and inclusion goals.

All applicants should submit a recently updated curriculum vitae, a statement of research plans, a statement of teaching, and a 2-3-page statement on your contributions to diversity, equity, and inclusion, including information about your understanding of these issues, your record of activities to date, and your specific plans and goals for advancing equity and inclusion if hired as a Berkeley faculty member (for additional information, go to <https://ofew.berkeley.edu/recruitment/contributions-diversity>). In addition, applicants should provide at least three but no more than five letters of recommendation. A cover letter is optional. Applications should be submitted electronically through our web-based system at: <https://aprecruit.berkeley.edu/apply/JPF01881>.

All recommendation letters will be treated as confidential per University of California policy and California state law. Please refer potential referees, including when letters are provided via a third party (i.e., dossier service or career center), to the UC statement on confidentiality (<http://apo.berkeley.edu/evalltr.html>) prior to submitting their letters.

The deadline for receipt of the application materials is October 1, 2018. Please direct questions to Lauren Nakashima ([ltnakashima@berkeley.edu](mailto:ltnakashima@berkeley.edu)).

UC Berkeley is committed to diversity in all aspects of our mission and to addressing the family needs of faculty, including dual career couples and single parents.

The University of California is an Equal Opportunity/Affirmative Action Employer. All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, disability, age or protected veteran status. For the complete University of California nondiscrimination and affirmative action policy see: <http://policy.ucop.edu/doc/4000376/NondiscrimAffirmAct>.



THE UNIVERSITY OF  
CHICAGO

Position Title: **Assistant Professor of Chemistry**

Req # **03779**

The Department of Chemistry at The University of Chicago invites applications for the position of Assistant Professor of Chemistry in all areas of chemistry. Applicants must apply online to the University of Chicago Academic Career website at <http://tinyurl.com/y9yhvxg9> and upload a cover letter, a curriculum vitae with a list of publications, a succinct outline of research plans, and a one page teaching statement. In your cover letter, please specify one sub-discipline that best represents your research interests (inorganic, materials, organic, physical, and theoretical chemistry or chemical biology). In addition, three reference letters are required. At the time of hire the successful candidate must have completed all requirements for a Ph.D. in Chemistry or a related field. Joint appointments with other departments are possible. Review of applications will begin on **October 08, 2018** and will continue until all positions are filled.

*The University of Chicago is an Affirmative Action/Equal Opportunity/Disabled/Veterans Employer and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender identity, national or ethnic origin, age, status as an individual with a disability, protected veteran status, genetic information, or other protected classes under the law. For additional information please see the University's Notice of Nondiscrimination at [http://www.uchicago.edu/about/non\\_discrimination\\_statement/](http://www.uchicago.edu/about/non_discrimination_statement/).*

*Job seekers in need of a reasonable accommodation to complete the application process should call 773-702-0287 or email [ACOppAdministrator@uchicago.edu](mailto:ACOppAdministrator@uchicago.edu) with their request.*



RADCLIFFE INSTITUTE  
FOR ADVANCED STUDY  
HARVARD UNIVERSITY

### Academic Fellowships

The Radcliffe Institute Fellowship Program at Harvard University welcomes fellowship applications in natural sciences and mathematics. The Radcliffe Institute for Advanced Study provides scientists the time and space to pursue their career's best work. At Radcliffe you will have the opportunity to challenge yourself, meet and explore the work of colleagues in other fields, and take advantage of Harvard's many resources, including the extensive library system. The Radcliffe Institute Fellowship Program invites applications from people of all genders, and from all countries. We seek to build a diverse fellowship program.

Scientists in any field who have a doctorate in the area of the proposed project (by December 2017) and at least two published articles or monographs are eligible to apply for a Radcliffe Institute fellowship. The stipend amount of \$77,500 is meant to complement sabbatical leave salaries of faculty members. Residence in the Boston area and participation in the Institute community are required during the fellowship year.

**Applications for 2019-2020 are due by October 4, 2018.**

**For more information, please visit [www.radcliffe.harvard.edu](http://www.radcliffe.harvard.edu) or email [sciencefellowships@radcliffe.harvard.edu](mailto:sciencefellowships@radcliffe.harvard.edu).**

Picture yourself among one of the largest communities of underrepresented minorities in STEM during the Annual Biomedical Research Conference for Minority Students (ABRCMS)



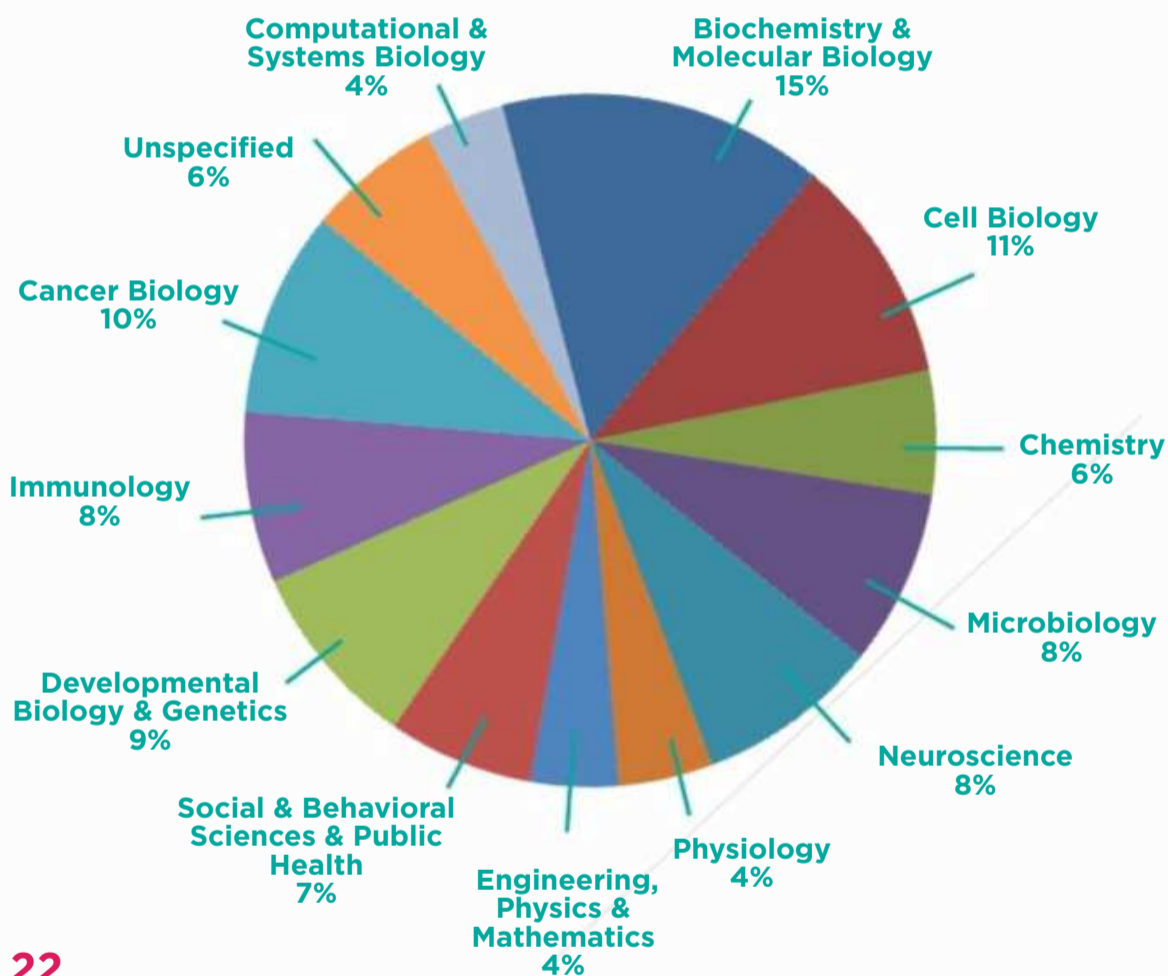
# ABRCMS 2018

INDIANAPOLIS, INDIANA

NOVEMBER 14-17, 2018

## Be a Part of ABRCMS to:

- Present your scientific research in one of the 12 STEM disciplines
- Explore 380+ graduate schools, summer research experiences, and professional society opportunities
- Network with 2,300 students from more than 350 colleges and universities, and 700 researchers, Program Directors, and faculty members



## Important Dates

**Judge Travel Award Deadline: July 20**

**Student Travel Award Deadline: August 22**

**Abstract Submission Deadline: September 7**

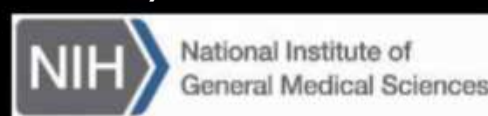
**Judges needed.** If you know a postdoctoral scientist or faculty member who is active in research, encourage them to participate as an ABRCMS poster and oral presentation judge. Travel awards available. Learn more at [www.abrcms.org/judges](http://www.abrcms.org/judges).

[www.abrcms.org](http://www.abrcms.org)



Managed by  
**AMERICAN  
SOCIETY FOR  
MICROBIOLOGY**

Funded by



## POSTDOCTORAL OPPORTUNITIES

Find these and many more postdoctoral opportunities on our New Scientist Jobs online jobs board!

Go to [www.NewScientistJobs.com](http://www.NewScientistJobs.com)

Enter the Job ID # listed below to read about the position. Find more jobs by entering your criteria into the grey search box.

- 1401652925 **Postdoctoral Researcher**  
New York City, New York (US) - The Earth Institute, Columbia University
- 1401652878 **Postdoctoral Opportunity**  
Backman Biophotonics Lab Evanston, Illinois - Northwestern University
- 1401652875 **Research Fellow**  
Boston, Massachusetts (US) - Dana-Farber Cancer Institute
- 1401652850 **Research Fellow**  
Marasco Lab Boston, Massachusetts (US) - Dana-Farber Cancer Institute
- 1401652519 **Postdoctoral Scholar**  
The Pennsylvania State University - Pennsylvania State University
- 1401652518 **Postdoctoral Scholar**  
The Pennsylvania State University - Pennsylvania State University
- 1401651920 **Postdoctoral Associate**  
Durham, North Carolina (US) - Duke Molecular Physiology Institute
- 1401651918 **Postdoctoral Associate Opportunities**  
Durham, North Carolina (US) - Duke Human Vaccine Institute
- 1401651917 **Postdoctoral Associate Opportunity**  
Durham, North Carolina (US) - Duke Human Vaccine Institute
- 1401651708 **NASA Postdoctoral Program** - Application Deadline November 1, 2018  
NASA / Universities Space Research Association
- 1401646847 **NRC Research Associateship Programs** - November 1 Deadline  
Washington D.C. - National Academy of Sciences
- 1401651327 **Fellowships for Postdoctoral Scholars**  
Woods Hole, MA - Woods Hole Oceanographic Institution (WHOI)
- 1401652562 **Three Postdoc Research Positions** - Data Driven Machine Learning Saudi Arabia (SA)  
KAUST King Abdullah University of Science and Technology
- 1401652880 **Postdoctoral Position** - Vascular smooth muscle and endothelial cell ion channels  
University of Tennessee Memphis Health Science Center

# NewScientist | Jobs

## Contractual editors:

### Physical Sciences, Engineering, Environmental Sciences, Medicine, Life Sciences

Cactus Communications is a leading provider of scientific communication services to more than 198,000 clients across 116 countries.

We engage a team of highly skilled editors who are experts in various academic fields. CACTUS is honoured to be ranked 12th (after a screening of more than 47,000 companies) on the 2017 list of Top 100 Companies for Remote/Freelance Jobs (<https://tinyurl.com/ya7ub8yw>).

We are currently looking to hire editors on a contractual work-from-home basis in the Biomedical Sciences, Physical Sciences and Engineering, and Humanities.

Editors typically devote six to eight hours a day.

#### WHAT YOU WILL DO

- Edit manuscripts such that the final text is in standard scientific English and is free of unclear or unidiomatic sentences
- Adhere to job-specific guidelines and format manuscripts according to the target journal when required
- Understand client and industry requirements and adapt your working approach accordingly
- Meet deadlines (which are driven by client deadlines)

#### Desired skills and experience

##### What you need

- A Post Doc/PhD/Masters/Bachelor's degree or expertise in one or more specialized subject areas in Medicine, Life Sciences, or Physical Sciences (detailed subject-area list below) OR
- A Master's degree in Economics and Statistics/Business and Finance/Psychology and Psycho-social Healthcare
- Excellent editing skills and attention to detail (prior editing experience would be great)

#### WHY THIS IS A GREAT OPPORTUNITY

- You can telecommute from anywhere. You will also have the flexibility to keep your own work hours as long as you meet the deadlines.
- Assured volume of work. You will receive a considerable amount of work, and accordingly, you can be assured of a predictable income from CACTUS each month. You can choose to do from 60,000 words to more than 120,000 words.
- You will develop an understanding of the finer points of editing.
- You will have access to articles on the latest industry trends and publication and writing tips on our learning and discussion platform.
- You will gain an inside view into research carried out worldwide.
- You have the potential to earn above USD 3000 per month.

Please send us your resume and mention 'New Scientist' and 'assured volume of work'.

Apply Now at <https://tinyurl.com/yavet6h8>

# 1

### STEADY INFLOW OF ASSIGNMENTS

With over 200,000 clients we can provide numerous assignments to freelancers who consistently deliver quality work.

# 2

### SYSTEMS AND PROCESSES

With an efficient workflow-management system and dedicated in-house personnel, we ensure that you are able to deliver your work in a hassle-free manner.

# 3

### FLEXIBILITY

Creativity strikes at all hours, be it late afternoon or early morning. A freelance position will give you the opportunity to work whenever you can, wherever you can.

## EDITOR'S PICK

## Life expectancy is much worse if you're poor



From Alan Taman,  
Birmingham, UK

Clare Wilson and Andy Coghlan cover many of the possible explanations for the decrease in the improvement of life expectancy in the UK (25 August, p 20). But they miss one out.

The effect is historically far more noticeable in the poor than the

wealthy. There is a measurable gradient of difference across all social classes. This has been known since the time of the Whitehall studies into the health of UK civil servants, led by Michael Marmot (28 July 2012, p 42). The first of these, published in 1984, showed that civil servants in lower grades died on average sooner than those in more senior positions, though the latter had far more responsibility in their roles (and also tended to come from higher socioeconomic groups).

One crucial question is: why are poorer people affected more than those who are better off, across all societies? This is key to admitting to the presence of health inequality, and the injustice it entails. In turn, I would argue, it raises a key ethical question that anyone looking at changes in health outcomes needs to consider.

## Another possible effect on the rate of allergies

From Peter Basford,  
Potters Bar, Hertfordshire, UK  
Penny Sarchet discusses what causes allergies (11 August, p 29). In an earlier article on the non-specific effects of vaccines, Michael Brooks writes that some may protect against allergies, while others encourage them (17 August 2013, p 38). Nigel Curtis of the Royal Children's Hospital Melbourne and the University of Melbourne, Australia, suggested that vaccines using weakened viruses stimulate the "type 1" immune system that combats viruses and bacteria, whereas vaccines using dead viruses may stimulate the "type 2" system that fights parasites.

So measles and BCG vaccines might help to compensate for the lack of type 1 immune training in

the outdoor environment and push towards natural type 1 dominance. Whooping cough vaccine may push the system towards type 2 dominance and hence vulnerability to allergies.

Has this been discredited? If not, has any progress been made in, for example, double-blind trials of different vaccines?

## Why do relatives have a veto on organ wishes?

From Douglas Nichols,  
Hobart, Tasmania, Australia  
You report that an "opt-out" system for organ donation could reduce transplant rates, as relatives are less confident their late family member agreed and so may be more likely to veto donation (25 August, p 16).

I have always wondered why families are permitted to veto an individual's decision about organ

## Concerned about the future?

## Wildlife filmmaker Richard Brock says:

“There is still time to save the planet. My **WILDLIFE WINNERS AND LOSERS** series is my contribution. Now it's your turn.

## Watch these free films.

Choose from 80+ films of different lengths to inspire you to take action.

They're free to watch and share with as many people as possible. Use the series to give you ammunition to help save the planet.”

Watch these on our YouTube channel:  
[youtube.com/brockinitiative](https://www.youtube.com/brockinitiative)

[RB@brockinitiative.org](mailto:RB@brockinitiative.org)  
[www.brockinitiative.org](http://www.brockinitiative.org)

As part of the BBC's prestigious Natural History Unit, Richard has witnessed the changing threats to the natural world first hand. His credits include work on the landmark series *Life on Earth* and *The Living Planet* alongside David Attenborough.

*Richard Brock*

wildlife  
**W&L**  
winners and losers  
how to turn losers into winners

twitter.com/Winners\_Losers\_

facebook.com/winnerslosersfilms

## “Who’s testing our thoughts to see how well we understand them?”

Dave Probert responds to our report that AIs are being tested to see how well they understand our thoughts (8 September, p 10)

donation. They aren’t allowed to veto instructions on the distribution of assets after death, as specified in a will. Remove the ability for families to veto and the potential problems of the opt-out system would vanish. If that can’t be done, we could allow a veto for opt-out cases unless the individual concerned has specifically – and optionally – indicated a wish to donate.

### Contraception is not just women’s responsibility

From Catherine Sinclair, Kirk Ireton, Derbyshire, UK  
I was pleased to see the variety of speakers depicted in your ad for New Scientist Live (25 August). It is great to see the scientific community become more inclusive and thereby enriched and inspirational.

However, I am disturbed by the

cartoon accompanying Ian Angus’s comment on population (25 August, p 22). All eight parents depicted as causing runaway global warming appear to be women. My understanding was that half of parents are men.

Angus rightly reiterates that contraception should be available to all, but then refers to women choosing whether and when to bear children. Can men not choose contraception?

### A finding on solar cycles comes around again

From Bruce Denness, Whitwell, Isle of Wight, UK  
Michael Marshall reports that a team from the China University of Geosciences in Beijing has found evidence of the 11-year solar sunspot cycle in Precambrian sedimentary rocks of south China (18 August, p 6). More than

50 years ago, Roger Anderson observed not only the 11-year cycle, but also resonances at 5.5 and 2.75 years in Precambrian “varved” sediments consisting of annual layers. Hubert Lamb added other examples in his 1972 book *Climate Present, Past and Future*.

### Always searching for another particle

From Andy Bebington, London, UK

Michael Brooks introduces us to the search for a particle that combines an axion and a flavon – an axiflavon – or a combination of this plus a Higgs, or some more convoluted combination (18 August, p 28). This reminded me of reading in *New Scientist* in the mid-1960s of the search for the omega-minus, a particle needed to complete a symmetry model of particle physics. We

needed to find one then, we need to find one now – *plus ça change, plus c’est la même chose?*

The editor writes:

■ Yes, the omega-minus was discovered, confirming our model of the quarks (27 February 1964, p 523). The axiflavon is slightly different in that it wouldn’t in itself confirm any grand theoretical framework.

### The roots of secure computing hardware

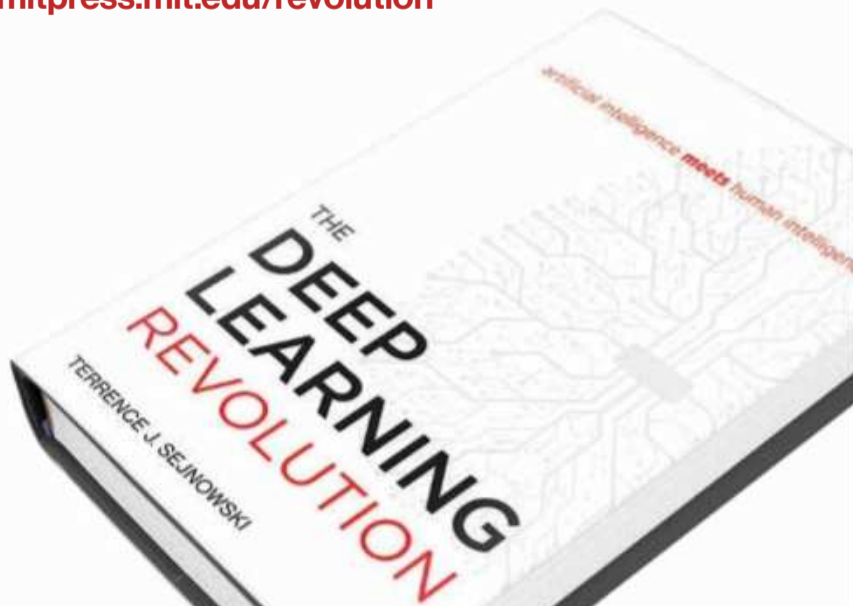
From Mike Whittaker, Stapleton, Shropshire, UK  
Sally Adee mentions work on more secure computer hardware carried out by Ruby Lee and Howie Shrobe (11 August, p 36). From the late 1970s, the late Roger Needham and others, including Bjarne Stroustrup, who went on to design the C++ programming ▶



“If you want to understand AI, you need to read *The Deep Learning Revolution*.”

—Erik Brynjolfsson, Professor at MIT Sloan School of Management

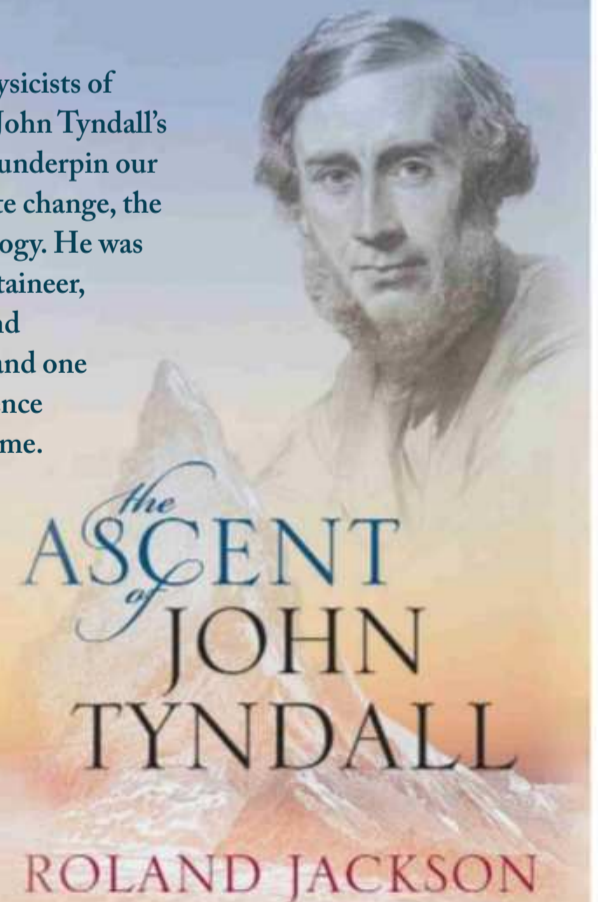
[mitpress.mit.edu/revolution](http://mitpress.mit.edu/revolution)



## SUMMER READING

One of the foremost physicists of mid-Victorian Britain, John Tyndall’s contribution to science underpin our understanding of climate change, the atmosphere, and glaciology. He was also a pioneering mountaineer, friend to the political and literary elite of his day, and one of the great popular science communicators of his time.

Roland Jackson’s biography makes perfect summer reading.



9780198788959 | 576 pages | £25

OXFORD  
UNIVERSITY PRESS

language, worked on the CAP computer, which embodied a "capability architecture", at the University of Cambridge's Computer Laboratory.

This also had security as a fundamental concept. Access to all sections of memory, for example, was controlled by "capability tokens". The system, being experimental, subject to being upgraded and built in-house, occupied several mainframe racks, though I am sure it would occupy a tiny fraction of today's central processing units.

### If there's a London cat killer, we should worry

From Anne Barnfield,  
London, Ontario, Canada

I agree with Ian Adam in finding Stephen Harris's claims regarding foxes killing cats unconvincing (Letters, 18 August). If a fox had "weak jaws", why would it chew off, and then remove, the head (which it presumably could not then eat), rather than going for the "soft underbelly" where the internal organs would be available

as food? There is an established link between animal abuse and abuse of humans, concurrently or as an escalation of behaviour. If this is a person, then they need to be stopped, for the sake of the cats, but also, potentially, for that of other humans.

The editor writes:

■ Our longer online version of Harris's piece noted that because foxes have weak jaws, they start chewing at narrower parts of a carcass, including the neck, where they can more easily get a grip with the sharper molars at the side of their mouth. Sheep farmers have seen foxes do this to dead lambs.

### The five commandments of robotics need work

From Brian Horton, West Launceston, Tasmania, Australia  
Douglas Heaven suggests five commandments for robots (4 August, p 38). I agree with the last commandment, that a robot should have an off switch, but I think the others need more work.

For example, the first prevents

a robot from allowing a human to come to harm "unless it is supervised by another human". Does this make it OK for a soldier to send a robot into a house with instructions to "kill anything that moves", if the soldier is right behind, "supervising"? The second, requiring that a robot must be able to explain itself, won't work because humans can't do that either (Letters, 28 April).

### An expert palate could distinguish canned beer

From Alastair Mouat,  
Broughton, Peeblesshire, UK  
Bob Holmes describes the importance of yeast to the flavour of alcoholic drinks (18 August, p 32). This brings to mind a weekly event in the laboratory of the brewery in Edinburgh where I began my career in the 1960s.

The company owned several breweries throughout the UK, which all produced the same brand of canned beer. We collected samples from each brewery and carried out a range of physical tests to ensure that they were producing an identical beer.

The final test was a blind tasting with glasses of the beers set up in random order. To us lesser mortals they all tasted the same. But the head brewer identified them: "this one is Tadcaster, this Belfast, ah, this is good, it's ours..." Each brewery had its own strain of yeast, developed over many years, and each yeast produced its own subtle flavours.

### Dismissing anecdote can drive pseudoscience

From Echo Gonzalez,  
Chicago, Illinois, US

Rowan Hooper was disappointed by talks at the International Dream Conference (14 July, p 10). I share his sceptical opinion of parapsychology. But isn't it just as dangerous to dismiss hypotheses simply because they are difficult or impossible to prove via the scientific method?

Say someone has anecdotal dream-related experiences that cannot be explained yet by science. If they find, on attempting to discuss these, that the scientific community's only response is to dismiss this realm of study as head-shakingly laughable, that person is more likely to seek answers in pseudoscience. That is dangerous.

TOM GAULD



### For the record

- Actual allergy to gluten does exist, but is very rare (11 August, p 28).
- In a nuclear reactor, a moderator slows neutrons after they are released (1 September, p 32).
- A study finds that eukaryotic cells first appeared between 1.21 and 1.84 billion years ago (25 August, p 5).

Letters should be sent to:  
Letters to the Editor, New Scientist,  
25 Bedford Street, London, WC2E 9ES  
Email: letters@newscientist.com

Include your full postal address and telephone number, and a reference (issue, page number, title) to articles. We reserve the right to edit letters. New Scientist Ltd reserves the right to use any submissions sent to the letters column of *New Scientist* magazine, in any other format.



# OLD SCIENTIST

Where it all began



FRANKE + MANS/PLAINPICTURE

THERE are few better ways to get a measure of changing social attitudes than to look at how stories about sex are reported. At *New Scientist* we have never shied away from covering such topics, but it is hard to imagine that today we would cover them in the same way we sometimes did in the 90s.

In 1995, our Feedback column – a repository for curious and amusing studies – covered news of a startling side effect of the antidepressant clomipramine. A paper in *The Canadian Journal of Psychiatry* reported that four people taking the drug had orgasms every time they yawned. One woman took the drug for three months to treat her depression, but asked if she could be allowed to continue using it after her symptoms had stopped since she enjoyed the side effect. We then went on to describe another patient, a male, who also asked to continue taking the drug after his symptoms had cleared. I can't imagine today that we would go into the same detail about how he tackled the logistical problem this threw up. Our closing remark is still pertinent, however: would people taking the drug seek out the most boring person they could find at parties?

In 1993, we reported (again in Feedback) news of particular interest to those who had had a heart attack. A specialist insisted the risk of another heart attack during sex was less than that when simply getting out of bed in the morning. Since we didn't give any more detail, it is clear the real reason we mention the study is because it is about sex.

Thankfully there are some things we would still report in the same way today. In 1994, we told the story of Marge Alvarez's experience in a wildlife park near Mexico City when an alligator tried to have sex with her alligator boots. Wardens deployed the single tranquilliser dart they kept for emergencies, but missed. In the end, they had to use a fire hose. "I've seen alligators do strange things, but this beats all," said the warden. **Mick O'Hare** ■

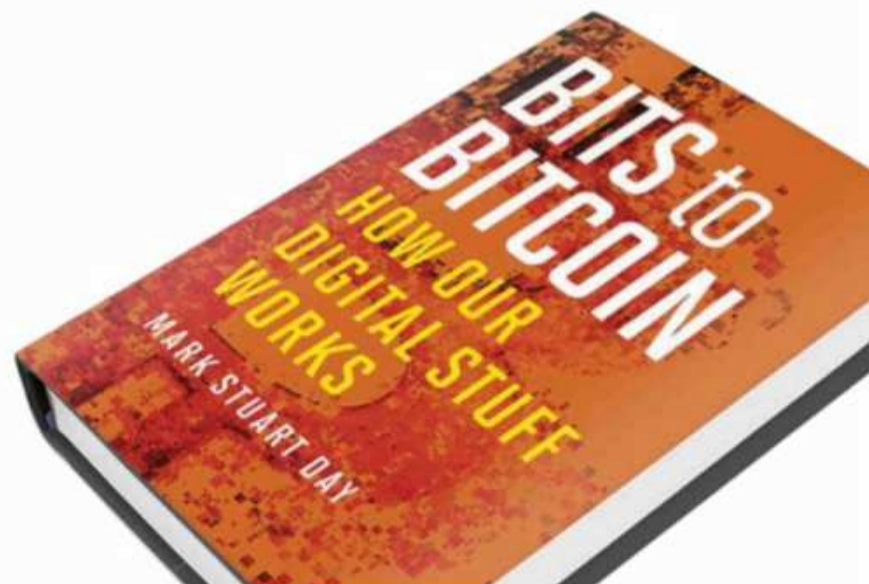
To delve more into the *New Scientist* archives, go to [newscientist.com/article-type/old-scientist/](http://newscientist.com/article-type/old-scientist/)

redmolotov.com 0121 559 2685. Ethically sourced. Up to 5XL  
Free UK postage on orders over £50



An accessible guide to our digital infrastructure, explaining the basics of operating systems, networks, security, and other topics for the general reader.

[mitpress.mit.edu/bits](http://mitpress.mit.edu/bits)





**TWO** pigeon racers in China have been charged with fraud after smuggling their birds onto a bullet train to beat the competition. The ruse took place during the Grand Prix of the Shanghai Pigeon Association, a 652-kilometre flight from Shangqiu to Shanghai.

Court statements revealed the pair had secretly trained their birds in Shangqiu as well as Shanghai. When the birds were released by race officials, they quickly returned to their Shangqiu loft. The men then smuggled them onto the high speed train, hidden inside milk cartons, and released them in Shanghai to fly the short distance home.

Competitors cried foul when the two birds shattered race records, seemingly completing the 8-hour race in half that time. The men fessed up, and were fined \$160,000.

PAUL MCDEVITT

A PANACEA we have an appetite for: *NBC News* reports that cheese and yogurt, as well as protecting against heart disease, "were found

to protect against death from any cause". Feedback plans to keep a few Dairy Lea triangles in our pocket from now on, to ward off infectious disease, traffic accidents and old age.

**AN INVESTIGATION** by a concerned horticulturist has accused many Australian supermarkets of unwittingly selling fake honey. Robert Costa commissioned an assessment of 28 jars of honey, using nuclear magnetic resonance imaging to untangle the contents.

The results showed that many of the jars labelled "100% pure honey" actually seemed to have been bulked out with sugar syrup. There is no suggestion the brands knew of the adulteration, which is suspected to have originated in China.

Beekeeper Phil McCabe told *ABC News*: "Adulterated honey isn't honey at all. By and large [the impurity] is some kind of syrup that's been converted to look like honey, it tastes

like honey. Everything about it seems to be honey, when in fact it's just sugar syrup or something else." Feedback must wonder, does honey by any other name taste as sweet? Answers on a postcard, please.

**COMBINING** tabloid mainstays of crime, exotic locations and celebrities, several newspapers were powerless to resist claims that former *Top Gear* star Richard Hammond had been gassed by thieves in his St Tropez villa.

In her *Sunday Express* column, wife Mindy Hammond described how thieves targeted the home following a raucous cocktail party, taking cash and valuables.

British holiday-makers have been circulating warnings of ether-scented robbers for years. This prompted the UK's Royal College of Anaesthetists to issue a statement dismissing the idea as a myth, citing the pharmacological, logistical, chemical and medical implausibilities of such a scheme.

Those searching for a stupefying agent would do better to look in their cocktail glass. As one commenter put it: "Perhaps the thieves were just very quiet."

**A MORE** unusual theft was seen in Philadelphia, when \$40,000 of creepy crawlies were stolen from the Philadelphia Insectarium and Butterfly Pavilion. Ninety per cent of the museum's creatures were snatched overnight, including scorpions, millipedes, and a six-eyed sand spider, said to be one of the most venomous in the world.

Suspicion has fallen on a group of disgruntled ex-employees, inferred from two staff jerseys left pinned to the wall with knives at the scene, as well as security camera footage showing them loading animals into waiting vehicles.

Philadelphians who find themselves offered suspiciously cheap deals on scorpions and spiders are encouraged to notify the relevant authorities.

**ANOTHER** victim of the devil's weed? A fleeing suspect was

captured by police officers in the US after being overcome by an algal bloom. Abraham Duarte fled his vehicle following a traffic stop in Cape Coral, Florida, leaping into a nearby canal to swim away.

But Duarte didn't count on the thick layer of swampy green algae coating the water's surface, and after swallowing some, returned to waiting cops and requested they take him to hospital.

After being given the all clear by doctors, Duarte was jailed for possession of seven vials of cannabis extract THC, and resisting arrest.

**A STRAY** kangaroo is on the loose in Austria - and that's not a typo. The marsupial has been spotted in the forests near the town of Kirchsschlag, a mere 14,000 kilometres away from its usual habitat. "We have called all the zoos and kangaroo breeders around us, but no one is missing a kangaroo," a police official told the AFP news agency.



**FISHY** business in the Persian Gulf. A fishmonger in Kuwait pushed their luck a little too far by sticking plastic googly eyes on their wares to make them appear fresher. After complaints from customers, the shop was shut down by the Ministry of Commerce, according to a report in *Al Bayan* newspaper.

You can send stories to Feedback by email at [feedback@newscientist.com](mailto:feedback@newscientist.com). Please include your home address. This week's and past Feedbacks can be seen on our website.

Instagram channel *WeirdWorld* claims: "Applying a male's underarm sweat to a female's lips can help women relax and boost their mood." Citation needed, if anyone lives to tell the tale

## Hot sauce

Why is there no insulation for saucepans? Or around kitchen sinks or bathtubs? Is it difficult and expensive, or just a lazy tradition inherited from wasteful innocent times?

■ There is no insulation on saucepans because it would hamper the heating of the pan's contents. Pots and pans use heat-conducting materials to make heat transfer more efficient.

Plastic baths keep bathwater hot much better than old-fashioned metal ones. However, if a long, lingering bath is your desire, you could remove the bath panel and fill the air space around the bath with mineral wool – the kind used for loft insulation. You may also wish to consider using bubble-bath because this diminishes evaporation from the water surface, the main source of heat loss from plastic baths.

As for sinks, how long does it take to wash some dishes? If you have lots of dishes, the water will probably get dirty and should be replaced for hygiene reasons before it has cooled.

One lazy tradition inherited from wasteful innocent times is lying soaking in a bath for ages, like the Romans.

*David Muir  
Edinburgh, UK*

■ Using gas, and to a lesser extent electric radiant cooking, a pot is heated from the sides as well as the bottom. Insulating it would be a little self-defeating.

Energy and water efficiency were two of the driving forces behind the design decisions I made for my self-contained, all-solar-powered motorhome.

Using my induction cooker, I tested a collapsible silicone kettle against a conventional metal one. There was no significant difference in time or energy taken to boil the same volume of water. An immersion kettle took less time but the same energy. I concluded that the heat loss through vessel sides and top was small relative to the heat input. The bigger waste is likely to be boiling more water than required.

**"A cooking pot is heated from the sides and the bottom. Insulating it would be a little self-defeating"**

I haven't pursued side or lid insulation for pots, but I use a slow cooker, which puts the heated pot in a vacuum-insulated container.

I did consider whether large-diameter pots were more water and energy efficient than small-diameter ones, but the differences were minimal.

I based my selection of a motorhome sink on minimising thermal mass, maximising depth of water for minimum volume, and being able to fit our largest dish or pot into the sink to wash it.

Insulation was a given, but I had to add it myself.

*Julian Lawrence  
Karana Downs, Queensland,  
Australia*

■ Tradition certainly plays a role; our ancestors of centuries ago had little understanding of energy conservation, and few effective options for insulating material. Even so, shortages of fuel led people to use techniques such as haybox cooking, in which food is first heated to boiling then kept in a box insulated with straw until cooked. It was slow, but it worked.

Nowadays a wide variety of insulated cookware is available and generally works well, especially for people who work all day and like to come back to ready-cooked meals.

As for sinks and pipes, modern materials have led to all sorts of insulated plumbing, whereas insulation in the past tended to be expensive and fragile. Newer baths and hot water pipes are made of plastic, which is reasonably insulating, so they retain heat fairly well. In flats where I lived as a child, the hot water supply was heated centrally and distributed through metal pipes. These conducted heat away from the water, until my father showed the owner how to make insulating cement jackets for the pipes.

*Jon Richfield  
Somerset West, South Africa*

■ A range in stainless steel pots, with evacuated double walls and lids, was popular in Switzerland some 20 years ago. It was marketed abroad at least as far as Austria and I secured a set for my godchildren who lived there.

Since then, they have faded

from the hardware departments of Geneva and appeared absent in the rest of Switzerland these past four years. This cannot be due to poor durability because the pots I took to Austria were still in regular use, and good condition, when I cooked New Year's lunch earlier this year.

*Peter Urben  
Kenilworth, Warwickshire, UK*

## This week's questions

### FOOD FOR THOUGHT

Ignoring the idiom that variety is the spice of life, what single dish could I make that would provide all my nutritional needs forever more? A vegetarian option would be good too.

*Adoni Patrikios  
Australia*

### WING COMMANDER

Is there a pecking order in a flock of birds and which are the stragglers at the end?

*Jo Dunn  
Cape Town, South Africa*

### HEIGHT OF SUMMER

Most of us in the UK enjoyed the weather this summer. I remember the fine summers of 1976 and 1987 when temperatures reached above 30°C. What is the hottest temperature we could have at the UK's latitude given ideal conditions? Could it exceed 40°C? Not that I'm hoping it would.

*Adrian Hutchings  
Bournemouth, Hampshire, UK*

We pay £25 for every answer published in New Scientist. To answer a question or ask a new one please email [lastword@newscientist.com](mailto:lastword@newscientist.com). Questions should be scientific enquiries about everyday phenomena, and both questions and answers should be concise. We reserve the right to edit items for clarity and style. Please include a postal address, daytime telephone number and email address.

You can also send questions and

answers to The Last Word, New Scientist, 25 Bedford Street, London, WC2E 9ES.

New Scientist Ltd retains total editorial control over the published content and reserves all rights to reuse question and answer material that has been submitted by readers in any medium or in any format and at any time in the future. All unanswered questions and previous questions and answers are at [newscientist.com/lastword/](http://newscientist.com/lastword/)

