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WEEKLY 7 February 2026

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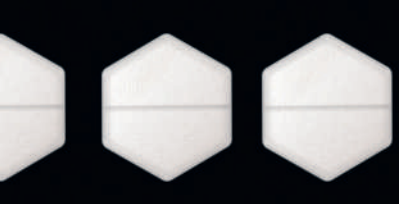

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"Your fat and brain tissue converse to influence the speed at which you age"

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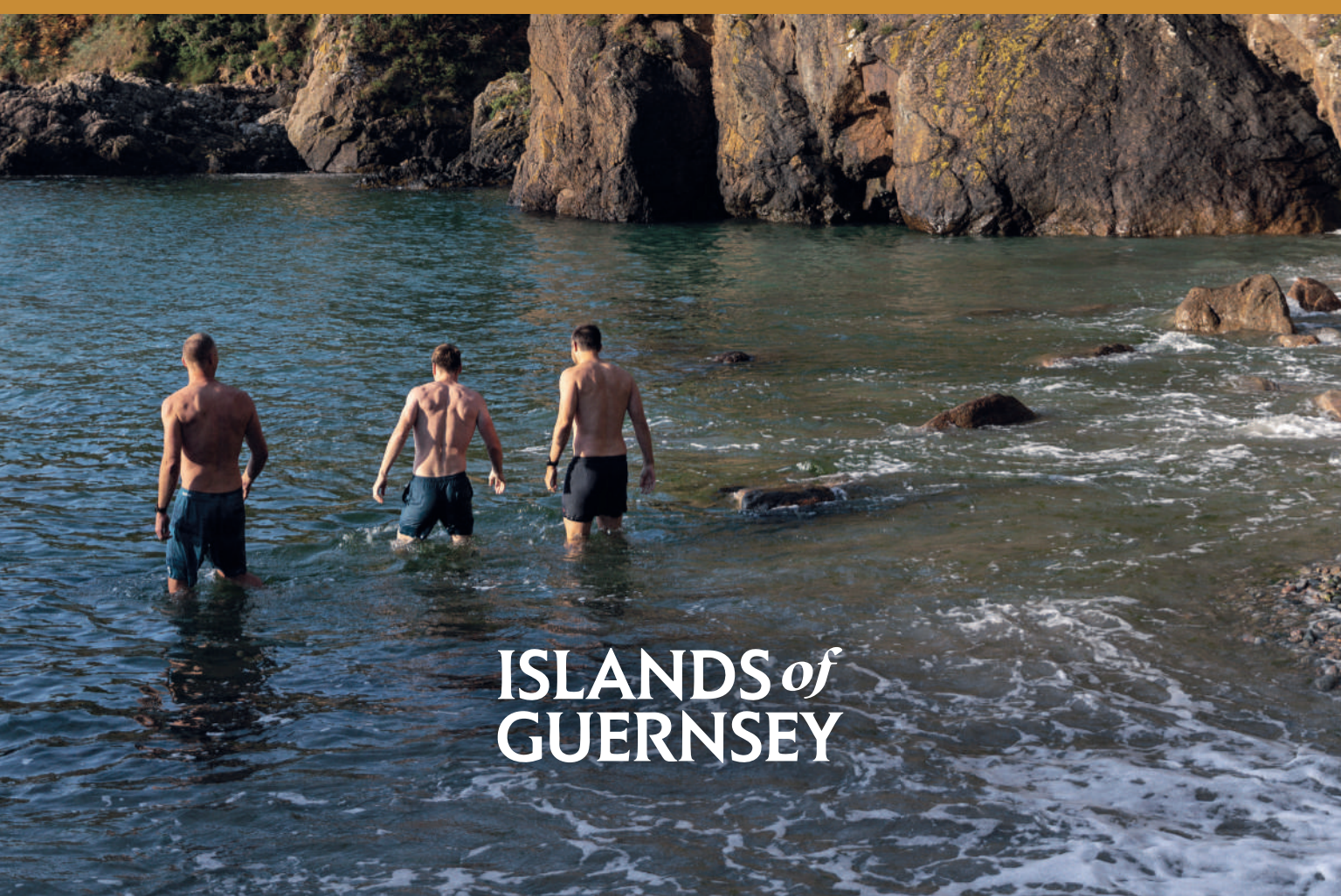

Getting personal

It is time we take the challenges of personalised medicine seriously

FEW areas of healthcare have been the subject of more hype, and achieved less genuine good, than personalised medicine. Companies are eager to track your biomarkers or supply a personalised nutrition plan – all for a healthy fee, of course – but truly useful personalised medicine is still a long way off.

The idea remains a good one, though. We all differ: in our genetics, in our microbiomes, in every detail of our bodies. And our quirks can make a big difference to our health.

Two stories this week exemplify this. Almost all of us will be infected by the Epstein-Barr virus at some point in our lives, but, as we report on page 12, genetic variants mean some of us are less able to expel it from our bodies. This may help explain why the virus is harmless to most people, but may be behind autoimmune conditions such as multiple sclerosis in some. Likewise, some people are resilient to the misfolded proteins that would otherwise cause Alzheimer's disease (see page 6).

> **"It is vital to identify the people whose bodies are most likely to respond to a treatment"**

Understanding these disease processes – and ultimately intervening in them – requires us to understand the complexity and diversity of human biology. It means gathering huge volumes of data on everything from people's DNA to their immune systems, and figuring out the mechanisms at work in different people.

It also means designing clinical trials of new treatments with greater care. No longer can we simply give the same treatment to a large group of people with a condition, because their responses may well vary enormously. Instead, it is vital to identify the people whose bodies are most likely to respond to the treatment.

We have already done this in one area of medicine: cancer. While we label all kinds of growths as "cancer", the reality is that they are distinct and require different treatment protocols. There is no one "cure for cancer", but many.

These are big challenges, but if we want to make progress in treating conditions like Alzheimer's and multiple sclerosis, it is time for us to meet them. ▮

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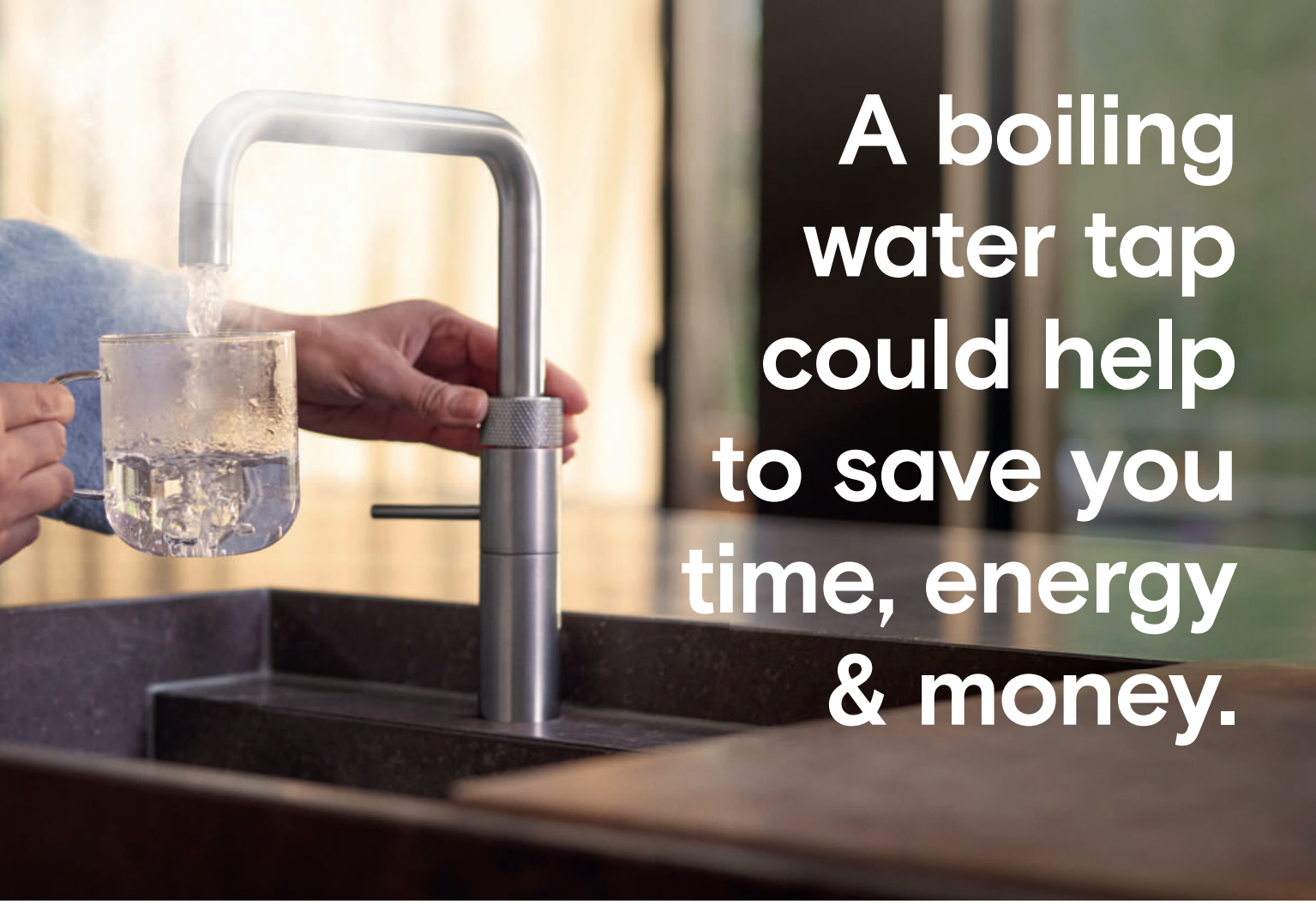

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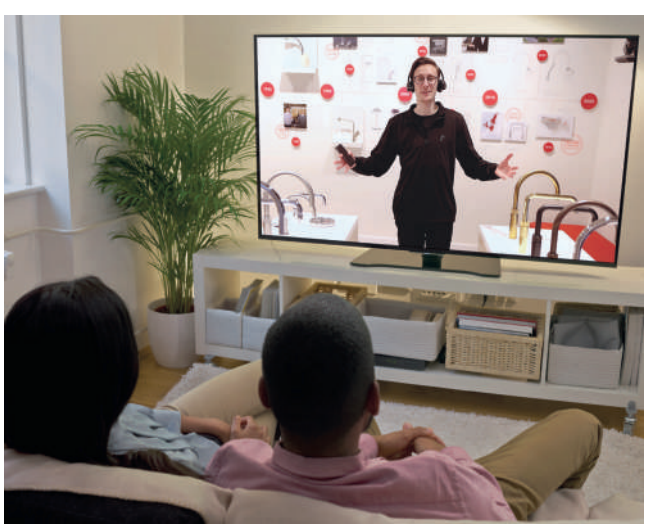

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Zoology

Rare black leopard spotted on camera

Leopards may not change their spots, but they can change the colour of their coats. This rare sighting of a black leopard, called Giza, was captured by wildlife photographer Andy Rouse at the Laikipia Wildlife Conservancy in Kenya. Giza's distinctive dark fur is the result of a genetic mutation that causes an overproduction of black pigment. However, you can still, just about, see her spots.

ANDY ROUSE/SWNS

Health

Is this the key to Alzheimer's resilience?

We are now starting to understand why some people don't develop dementia despite showing signs of Alzheimer's disease in their brain, reports **Grace Wade**

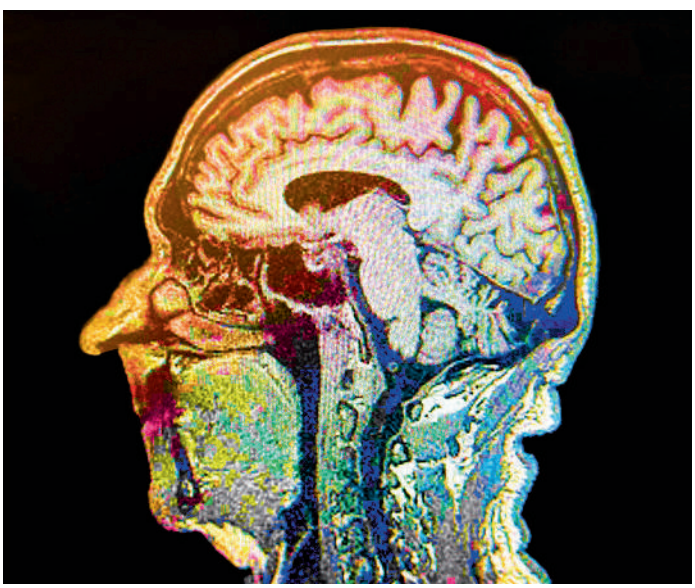
PEOPLE with Alzheimer's-related brain changes, but no symptoms of the disease, have unusual changes in their brain that may shield them from cognitive decline.

In Alzheimer's disease, clumps of misfolded proteins known as amyloid plaques and tau tangles build up in the brain, which is widely thought to drive cognitive decline. But not everyone with these hallmarks experiences symptoms – a phenomenon known as resilience. In 2022, Henne Holstege at Amsterdam University Medical Center in the Netherlands and her colleagues found that some centenarians maintain good cognition despite these plaques and tangles.

Now, she and her colleagues have conducted another study to better understand why that is. The team analysed the brains of 190 deceased individuals, 88 of whom had been diagnosed with Alzheimer's and 53 of whom showed no signs of the condition when they died, aged between 50 and 99. The remaining 49 were centenarians who didn't have Alzheimer's or any other type of dementia, though 18 showed signs of cognitive impairment on a test taken in the year before their death.

The researchers focused on a brain region called the middle temporal gyrus, which is one of the first areas where amyloid plaques and tau tangles co-occur in Alzheimer's. They found that a group of 18 of the centenarians – eight of whom showed no cognitive impairments – had amyloid plaque levels comparable to those seen in people with an Alzheimer's diagnosis, yet their tau levels were similar to those who died aged 50 to 99 without the condition (medRxiv, doi.org/qpxw). This suggests preventing tau build-up is key, says Holstege.

However, amyloid plaques are still associated with cognitive decline. Holstege thinks this is because they set the stage for tau to accumulate in the brain. Nevertheless, it is possible to have amyloid plaques and never develop significant tau tangles. "Without amyloid, we don't see tau spreading," she says.



PETER DAZELEY/GETTY IMAGES

By analysing brain scans, we can better understand the spread of Alzheimer's

A crucial distinction

The researchers found further evidence of this when they examined nearly 3500 proteins in the group's brains. Only five of these proteins were significantly associated with the abundance of amyloid plaques, yet nearly 670 were associated with the abundance of tau tangles. Many of these 670 proteins play roles in cell growth, communication and metabolism, including the breakdown of waste products. "Some things change [in the brain] with amyloid, but everything changes with tau," says Holstege.

When the researchers zeroed in on tau in the 18 centenarians with elevated amyloid plaques, they discovered that 13 of them had substantial tau spreading, with tangles appearing throughout the middle temporal gyrus. Although this pattern of spread resembles that seen in Alzheimer's, the overall amount of tau in these individuals remained low.

That distinction is crucial, says Holstege. Alzheimer's is partly diagnosed based on how widely tau has spread throughout the brain, but this suggests it is the build-up of tau, not its spread, that drives cognitive decline.

In a separate study, Katherine Prater at the University of Washington in Seattle and her colleagues analysed the brains of 33 deceased people: 10 had been diagnosed with Alzheimer's, 10 had no signs of the condition and 13 were considered resilient. Most of these individuals were over 80 years of age when they died, and all of them had completed a cognitive assessment less than a year before death.

"We are certainly not close to a therapeutic treatment yet, but biology is showing us there is hope"

The team also found tau spreading, but not accumulating, in the brains of those with Alzheimer's resilience. It isn't clear how that can happen, but Prater believes part of the answer may lie in microglia. These are immune cells specialised to the brain that help regulate inflammation and clear away debris.

Prater and her team genetically analysed their cohort's microglia, specifically those in the dorsolateral prefrontal cortex, a brain region critical for managing complex tasks.

They found that microglia from the resilient individuals showed increased activity in genes involved with transporting messenger RNA, the genetic instructions for making proteins. This suggests that the cells are actively ferrying these instructions to where proteins are made. Activity along these genes in resilient individuals was on par with that seen in people without Alzheimer's, suggesting this is one of the processes that goes awry in the condition.

"Both these studies suggest that the human brain has ways of mitigating tau burden," says Prater, who presented the findings at a meeting of the Society for Neuroscience in San Diego, California, last year. Understanding how it does that could lead to new treatments that might prevent Alzheimer's, rather than just slow its onset and progression. "We are certainly not close to a therapeutic yet, but... biology is showing us there is hope [and] there is promise," she says. ▮

Artificial intelligence

AI-assisted mammograms cut risk of developing aggressive breast cancer

Carissa Wong

PEOPLE who are screened for breast cancer by AI-supported radiologists are less likely to develop aggressive cancers before their next screening round than those screened by radiologists alone, raising hopes that AI-aided screening could save lives.

"This is the first randomised controlled trial on the use of AI in mammography screening," says Kristina Lång at Lund University in Sweden.

The AI-supported approach involves using the software – which has been trained on more than 200,000 mammography scans from 10 countries – to rank the likelihood of cancer being present in mammograms on a scale of 1 to 10, based on visual patterns in the scans. The scans receiving a score of 1 to 9 are then assessed by one experienced radiologist, while scans receiving a score of 10 – indicating cancer is most likely to be present – are assessed by two radiologists.

An earlier study found this approach could detect 29 per cent more cancers than standard screening, where each mammogram is assessed by two radiologists, without increasing the rate of false detections. "That was terrific," says Fiona Gilbert at the University of Cambridge.

12%

How much less likely women who had AI-assisted screening were to develop cancer between scans

Now, Lång and her colleagues have found that the AI approach also reduces the likelihood of people developing so-called interval cancers. These are tumours that develop rapidly in the time interval between screenings and that tend to be particularly aggressive and more likely to spread elsewhere in the body.

The researchers made the discovery during an analysis of more than 100,000 women in Sweden, aged 55 on average. They randomly assigned about half of the women to receive their standard round of breast cancer screening, where each mammogram is assessed by two radiologists. The remaining participants were screened initially by the AI model – which was developed by biotech firm ScreenPoint Medical in Nijmegen, the Netherlands – and then the scans were assessed by radiologists, most of whom had at least five years of experience in analysing mammograms.

The women who received the AI-assisted screening were 12 per cent less likely, on average, to develop an interval cancer than the women who received the standard screening (*The Lancet*, doi.org/hbmvqw). "When we got the results, we were extremely thrilled," says Lång.

The improvement may be because the AI is better able to detect cancers at an early stage. So, while radiologists might overlook small tumours that would develop into an interval cancer, the AI can spot them.

Even so, the study was only designed to explore whether AI can work as well as standard screening, not to see if it can perform better, says Lång.

The team didn't assess whether the AI-supported approach performs better in certain ethnic groups. Further trials, including an ongoing one in the UK, will help address this, says Gilbert. ▮

Entomology

Air pollution leads ants to attack their nest-mates

COMMON air pollutants like ozone and nitric oxide can change the way ants smell, prompting their nest-mates to attack them as if they were intruders.

Ants recognise their comrades by scent, and when they encounter an ant whose smell they don't recognise, they respond aggressively, biting and sometimes killing the trespasser. But ozone, a greenhouse gas produced by cars and industrial activities, can break down the structure of alkenes, chemicals that make up part of the colony-specific scents.

To test the impact on ants, Markus Knaden at the Max Planck Institute for Chemical Ecology in Jena, Germany, and his colleagues set up artificial colonies of six ant species. They removed one individual ant from each and put it in a glass chamber filled with various concentrations of ozone, some of which matched levels measured in Jena in summer. When they put the ant back, the others attacked it (*PNAS*, DOI: 10.1073/pnas.2520139123).

JORGEORTIZ_1976/SHUTTERSTOCK

Ants respond aggressively when they don't recognise another ant's smell

"I did not expect it, I have to say," says Knaden. "Because knowing that alkenes are such a minor part [of the ants' scent], we knew that whatever we did with ozone would only change maybe 2 per cent or 5 per cent of the blend."

Daniel Kronauer at the Rockefeller University in New York City says alkenes are crucial for nest-mate recognition, so the aggressive reactions didn't shock him.

Alkenes are involved in other ant behaviours like trail following and communication between larvae and adults. The study found that, when exposed to ozone, adult clonal raider ants (*Ooceraea biroi*) can neglect their larvae, so these ozone-induced changes have the potential to disrupt more aspects of ant life – and the wider ecosystem too. ▮

Chiara Marchisio

Quantum physics

Our universe's quantum secret

Even given a set of possible quantum states for our cosmos, it's impossible for us to determine which one of them is correct, finds **Karmela Padavic-Callaghan**

FROM the vantage point of quantum physics, the universe may in some ways be fundamentally unknowable.

In quantum physics, every object, such as an electron, is matched to a mathematical formula called the wave function. The wave function encodes all the details of an object's quantum state, which means physicists can predict what an object might do in an experiment by combining its wave function with other equations.

But if we accept that the whole world is quantum – and many researchers do – then much larger objects ought to have wave functions, including the whole universe. This is a point of view that was previously argued by, for instance, physics luminaries like Stephen Hawking.

Now, however, Eddy Keming Chen at the University of California, San Diego, and Roderich Tumulka at the University of Tübingen in Germany have shown that complete knowledge of this universal wave function may be fundamentally inaccessible.

"The wave function of the universe is like a cosmic secret that physics itself conspires to keep. We can know enormously much about how the universe behaves, yet remain fundamentally uncertain of which quantum state it is in," says Chen.

Picking the right answer

Previous studies posited the universal wave function's form based on theoretical models of the cosmos and didn't directly address what role experiments and observations could play in determining its details. Chen and Tumulka started with a more pragmatic question: given some set of wave functions that could reasonably represent our universe, could observations enable researchers to pick out the correct one?

The pair started with mathematical results from quantum statistical mechanics, which studies properties of collections of quantum states. Another ingredient in their calculations was the fact that the universal wave function would require a very large number of parameters, or exist in an abstract state with many dimensions.

"The wave function of the universe is like a cosmic secret that physics itself conspires to keep"

Strikingly, upon completing the calculations, the pair had to conclude that the universal quantum state is essentially unknowable (*British Journal for the Philosophy of Science*, doi.org/qpsg).

"Any measurement that's allowed according to the rules of quantum mechanics will give us very limited information about the wave function of the universe. It's impossible to determine the wave function of the universe with any useful accuracy," says Tumulka.

JB Manchak at the University of California, Irvine, says this work helps us better understand the limitation of our very best empirical methods and already has some counterparts in general relativity – Albert Einstein's theory of gravity. At the same time, this may not be surprising, as quantum theory was never conceived as a theory for cosmically large scales, he says.

"The wave function, of a small system or of the entire universe, is a rather theoretical entity. Wave functions are relevant, not because we see them, but because we use them," says Sheldon Goldstein at Rutgers University in New Jersey. He says that this means it may not be a problem that we are unable to choose a single most accurate universal wave function from a narrow set of candidates, because any of the wave functions in the set may have a similar effect when used in further calculations.

Some say if the world is quantum, the whole universe should have a wave function

VICTOR DE SCHWANBERG/SCIENCE PHOTO LIBRARY/GETTY IMAGES

A note of caution

Chen says that he and Tumulka now want to connect their work to large systems that are smaller than the whole universe, and especially to investigations into techniques like "shadow tomography", which are used to determine such systems' quantum states. But the work's philosophical implications matter as well. Specifically, researchers should take it as a note of caution to not overly rely on positivist thinking, or the notion that a statement is meaningless or unscientific if it cannot be tested experimentally, says Tumulka. "Certain things actually exist out there in reality, but we cannot measure them," he says.

This reasoning may also play into the century-long debate on how to make sense of quantum mechanics itself, says Emily Adlam at Chapman University in California. In her view, the new result can be seen as motivation to put more stock into interpretations of quantum equations, such as the wave function, that emphasise relationships between quantum objects and each observer's perspective rather than positing one objective view of reality codified by a single mathematical object. ▮

Health

The doctor on the hunt for people with first-rate faeces

Alice Klein

FAECAL transplants are now commonly used to treat recurrent *Clostridioides difficile* infections, but finding people whose faeces are of sufficient quality to be used in these transplants is a challenge.

"It's actually quite a frustrating activity because only about 1 per cent of people who respond to advertisements for donors are healthy enough," says Elizabeth Hohmann, an infectious disease expert at Massachusetts General Hospital in Boston. "I ask them to keep coming back to donate because they're very hard to find." Over the years, some of her donors have supplied more than 100 of their precious stools.

Hohmann has been in charge of faecal transplants at the hospital for 15 years. It is her job to collect donated stools and turn them into oral capsules, which are then given to people with hard-to-treat gut conditions, like recurrent *C. difficile* infections that cause diarrhoea and haven't responded to antibiotics. The "good" gut bacteria from the donor faeces help to edge out the "bad" bacteria in the recipients' guts, often alleviating their symptoms.

To find donors, Hohmann posts ads online offering $1200 for a month's worth of stool donations. Respondents first undergo extensive screening. Most are let go at the initial phone interview stage because they don't meet certain criteria. For example, they can't be healthcare workers or have recently travelled to South-East Asia, since both increase the chance of picking up drug-resistant gut bacteria. They must also be lean, because in the past, faecal transplants from donors with obesity have led to the development of the condition in recipients.

STEVE GSCHMEISSNER/SCIENCE PHOTO LIBRARY

ELIZABETH HOHMANN

Left: A sample of faecal bacteria. Top: Elizabeth Hohmann with one of her stool donors

Those who pass this initial screening then undergo a battery of tests, including various blood tests to assess their overall health, tests for infections like HIV and covid-19, and a rectal exam to check for bleeding or other abnormalities that may signal gut troubles.

Hohmann says her best donors tend to be exercise enthusiasts with healthy diets. Top-notch stools are generally associated with diets rich in fresh fruit, vegetables and whole grains, with minimal ultra-processed foods, she says. "I know one [faecal transplant centre] was talking about only using vegan donors, but actually the best donors I've had have been omnivores," she says.

A typical donation period lasts two to four weeks. During this time, the donor defecates at the hospital as many times as possible. "Often, they have very regular bowel movements so they come into the hospital at the same time each day and drink a coffee to get things going," says Hohmann. Each stool is caught by a plastic container placed in the lab toilet.

Hohmann immediately converts the fresh stool into capsules. "I put it in a blender with saline, then filter it through graded mesh filters," she says. After several more processing steps, she pipettes the liquid into capsules. "It's not pleasant, but it's something you kind of get used to," she says.

Afterwards, the donors are screened once more to check they haven't picked up covid-19 or other infections since their initial screening. If they have, the capsules must be destroyed and Hohmann has to start again with another donor.

"I keep doing it because, you know, it really does make a huge difference in some people's lives"

Despite these occasional setbacks, Hohmann loves the work because of the transformative results she sees in faecal transplant recipients. She recently had a patient who was so sick he couldn't work. Since taking the stool capsules, he has been able to work 30 hours a week. "I keep doing it because, you know, it really does make a huge difference in some people's lives," she says.

Now that Hohmann is nearing retirement, she is struggling to find a successor. "I keep asking my division: 'Who wants to help out?' Nobody. It's silent," she says. "They hear about the basics of it and they're just totally grossed out." ▮

Faecal transplants could help treat some cancers

As well as helping treat *C. difficile* (see main story), faecal transplants could also boost the effectiveness of some cancer treatments.

Immunotherapy drugs known as checkpoint inhibitors can help the immune system destroy cancer cells, but they don't work for everyone. Prior studies suggest that a faecal transplant from people who respond to these drugs to the guts of those who don't can be beneficial.

Gianluca Ianiro at the Catholic University of the Sacred Heart in Rome, Italy and his team recruited 45 adults with kidney cancer who had started taking the checkpoint inhibitor pembrolizumab plus axitinib, a drug that disrupts tumours' blood supply, within the past two months.

They then randomly assigned the participants to receive either a stool transplant – collected from a man who went into remission from cancer after receiving checkpoint inhibitors – or a saline solution.

Within the transplant group, the participants' cancer was stable for two years, on average, after their first transplant, compared with nine months in the placebo group. What's more, just over half of those in the transplant group saw their tumours shrink, compared with only around a third in the placebo group (*Nature Medicine*, doi.org/qpsr). Carissa Wong

Neuroscience

We're getting closer to being able to grow a brain inside a lab dish

Carissa Wong

A TINY version of the developing cerebral cortex – a brain region involved in thinking, memory and problem-solving – has been grown in a lab dish, with a system of blood vessels that closely resembles the real thing. This clump of cells is one of the most detailed brain organoids created to date, and will deepen our understanding of the brain.

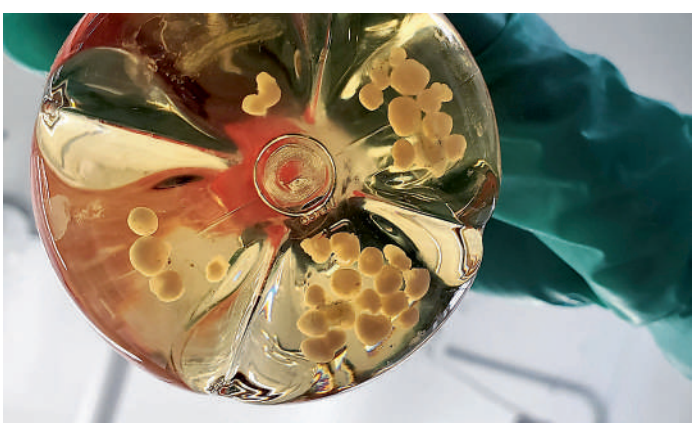
Brain organoids, sometimes called mini-brains, are typically grown in lab dishes by bathing stem cells in a mixture of chemical cues, which coax them to form balls of cells. Since they were first created in 2013, these cerebral structures – whose electrical activity resembles fetal or newborn brains – have provided fresh insights into conditions such as schizophrenia and dementia.

But organoids have one big flaw: they typically start dying after a few months. That's because, while full-sized brains are equipped with a network of blood vessels to transport oxygen and nutrients, brain organoids can absorb these only from the dish in which they are grown, starving the innermost cells. This limits their size and complexity, and how well they resemble the developing brain. "It's a very big problem," says Lois Kistemaker at the University Medical Centre Utrecht Brain Centre in the Netherlands.

To address this, Ethan Winkler at the University of California, San Francisco, and his colleagues grew human stem cells in lab dishes for two months to produce what they call cortical organoids, because they mimic the developing cerebral cortex. Separately, they grew organoids composed of blood vessel cells, and placed two of these at opposite ends of each cortical organoid. A couple of weeks later, the blood vessels had spread evenly throughout the miniature brains.

Crucially, by imaging the organoids, the researchers revealed that the blood vessels had a hollow centre, or lumen, highly similar to that found in the brain (bioRxiv, doi.org/qpsm). "The demonstration of vascular networks with lumens like you would find in actual blood vessels is impressive," says Madeline Lancaster at the University of Cambridge, who first developed brain organoids. "It's a major step."

Brain organoids are grown by bathing stem cells in a mixture of chemicals



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What's more, compared with prior attempts, the vessels in this new experiment seemed to more closely resemble the physical properties and genetic activity of those found in real developing brains, forming an improved "blood-brain barrier", which usually protects the brain from invading pathogens, while enabling nutrients and waste products to pass through, says Kistemaker.

The findings suggest the vessels stand a better chance of transporting nutrient fluid to keep the organoids alive, says Lancaster. "To have truly functional [blood vessels], they would need a way to continuously pump blood through, like the heart does, and it would need to be in a directional manner, so fresh oxygenated blood – or a blood-like substitute – entering, while deoxygenated blood is taken away," says Lancaster. "We are still a long way from that," she says. ▮

Ancient humans

Mapping where Neanderthals and early humans mixed

NEANDERTHALS and *Homo sapiens* were probably interbreeding over a huge area stretching from western Europe into Asia.

We know that early humans (*Homo sapiens*) and Neanderthals (*Homo neanderthalensis*) interbred, but where this happened and on what scale has long been a mystery. Two studies from 2024 based on ancient genomes implied that the most gene flow between *H. sapiens* and Neanderthals happened in a sustained period of between around 4000 and 7000 years, starting about 50,000 years ago. It was thought this probably happened in the eastern Mediterranean region, but the location is hard to pin down.

To investigate, Mathias Currat at the University of Geneva in Switzerland and his team have used data from 4147 ancient *H. sapiens* genetic samples, the oldest being about 44,000 years old, from more than 1200 locations. They assessed the amount of Neanderthal DNA in each sample and used computer simulations to work out how large the geographical zone of hybridisation would have to be to explain the patterns in the DNA.

They found a gradual increase in the proportion of transferred DNA the further you go from the eastern Mediterranean, plateauing after about 3900 kilometres westwards towards Europe and eastwards into Asia (bioRxiv, doi.org/qpxv).

"We were quite surprised to see a nice increasing pattern of introgression proportion in human genomes resulting from what we guess is the out-of-Africa human expansion," says Currat.

"What we see seems to be a single continuous pulse – a continuous series of interbreeding events in space and time," says Currat. "However, we don't know when hybridisation took place in the zone." ▮

Chris Simms

"What we see seems to be a continuous series of interbreeding events in space and time"

Elon Musk is making a big bet on his future vision – will it pay off?

There are reports of a merger between SpaceX, Tesla and xAI. **Chris Stokel-Walker** examines what it all means

ELON MUSK is a busy man, heading multiple billion-dollar companies. While he is a divisive figure, there is no doubt that Tesla and SpaceX have done much to advance the future of electric cars and spacecraft, respectively. But a series of corporate moves suggests Musk has a new vision of the future – and he may be combining all his companies to get there.

First, Musk's electric car company, Tesla, announced that it was halting production of two of its flagship vehicles, the Model S and Model X. The decision doesn't mean Tesla will stop making vehicles altogether, but the factories for these two models will now be repurposed into a facility to produce Tesla's Optimus humanoid robots.

At the same time, Tesla said it would invest $2 billion in xAI, another Musk firm that owns the social media site X and its controversial chatbot, Grok.

Put together, it suggests that Tesla is shifting priorities towards more AI-intensive activities, which is where the next major revelation comes into play. According to reporting by Bloomberg and Reuters, Musk is planning to merge SpaceX with Tesla or xAI – or perhaps even both – as part of a plan to list the space firm on the stock market this year.

So, what could Musk be hoping to achieve through consolidating his business empire? "By merging xAI and SpaceX, Musk is likely looking for resource optimisation across data flows, energy and computing," says Merve Hickok at the University of Michigan. "He had also entertained the possibility of a merger with Tesla to use each [vehicle] as a distributed computing resource."

The calculation appears to be that Tesla's planned future in humanoid robots – Musk said last week that he wants to produce 1 million units of the third-generation Optimus robot per year from his newly converted Tesla factory – will need a lot of computing resources for AI.

"Musk seems to believe combining companies will let him dominate the future of AI"

Interaction with a built-up environment alongside people, as humanoid robot adherents hope will happen, requires specialist AI models to crunch through lots of data.

But the generative AI revolution is already stretching energy supplies to their limit. Musk's xAI was recently censured by the US Environmental Protection Agency for breaching legal limits of power generation for its Colossus data centre in Memphis, Tennessee.

He has also previously spoken about the need to put data centres in space: at the recent World Economic Forum in Davos, Switzerland, Musk called the idea a "no-brainer" and said full-scale deployment was possible within two or three years. It should be noted that others are less bullish on these proposals, as a host of technical difficulties need to be solved first.

Those objections aside, getting data centres into orbit means launching them – and SpaceX is one of the most reliable suppliers of rockets and launches to the private and public sectors, as well as being experienced in satellite orbits, thanks to its Starlink internet arm.

"SpaceX is putting grids of satellites up in space – they already have 9000 – and those grids are about internet distribution," says Robert Scoble, a technology analyst at Unaligned. "xAI is doing internet distribution and news, but they are really about building new kinds of AI models to run our cars, our humanoid robots, and our lives." He says that "adding these two together makes a lot of sense".

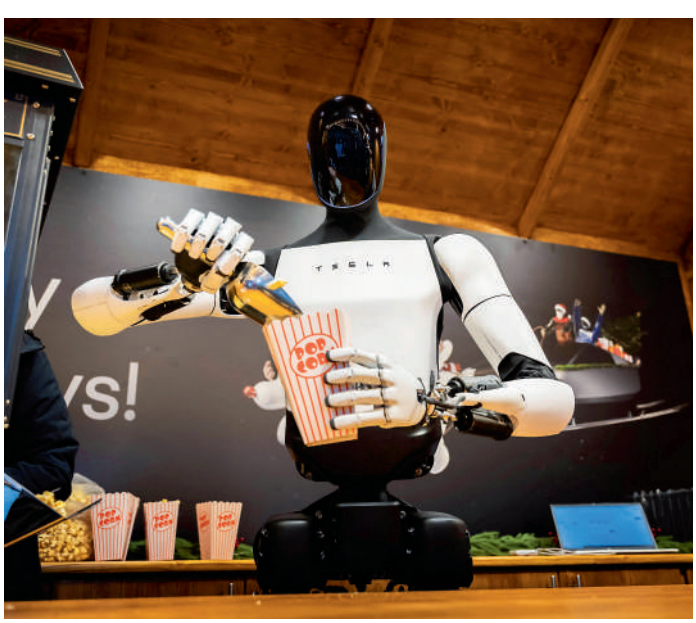
In other words, Musk seems to believe that combining SpaceX, Tesla and xAI will let him dominate the future of AI in a way that will be difficult for competitors like OpenAI, Google and Microsoft to match. None of the three companies responded to a request for comment, nor did Musk himself.

A defensive move?

However, not everyone agrees that's what is behind the plans. "They all lack the economics, with the exception of Tesla, which is heading in the wrong direction, to fund their growth," says Edward Niedermeyer, author of *Ludicrous: The unvarnished story of Tesla motors*. He sees the decision as a "defensive" move designed to shore up their futures – and to engage a wider range of financing from public investors.

That public investor cash will be vital, reckons Niedermeyer, because the rate at which Musk's companies are reportedly running through cash is significant: the cost of training and then running AI models is expensive, as many AI companies are discovering.

"It has to burn just insane amounts of cash," says Niedermeyer – and so Musk may be hoping that putting all of his eggs into one readily investable basket will make his vision attractive enough for people to part with their funds. If not – or if his envisioned future fails to come to fruition – it may all come crashing back to Earth. ▮



CHRISTOPH SOEDER/DPA/ALAMY

Optimus – Tesla's humanoid robot – may be more of a priority moving forwards

To read more about Elon Musk's plans, turn to page 20

Health

Why only some get ill from EBV

Most people will catch the Epstein-Barr virus at some point in their lives, but only a few become seriously unwell. The reason may have something to do with our genetics, reports **Michael Marshall**

ABOUT 1 in 10 people carry genetic variants that make them particularly vulnerable to the Epstein-Barr virus (EBV), a ubiquitous pathogen that is increasingly being linked to conditions like multiple sclerosis and lupus. The finding, which comes from a study of more than 700,000 people, may help explain why EBV causes severe illnesses in some people while leaving most of us virtually unharmed.

"Almost everyone is exposed to EBV," says Chris Wincup at King's College London, who wasn't involved in the research. "How come everyone is exposed to the same virus and that virus causes autoimmunity, yet the majority of people don't end up with an autoimmune condition?" This study offers an answer, he says.

Epstein-Barr virus was first described in 1964, after researchers found particles of it in a type of cancer called Burkitt's lymphoma. We now know that more than 90 per cent of people are infected by EBV at some point, because almost everyone produces antibodies against the virus.

In the short term, EBV is the main cause of infectious mononucleosis, also known as mono or glandular fever, which usually resolves after a few weeks. In some cases, EBV seems to contribute to severe long-term autoimmune conditions, in which the immune system attacks the rest of the body. A 2022 study, for instance, offered strong evidence that it is the ultimate cause of multiple sclerosis, in which the protective sheaths around nerves are damaged, leading to difficulties with walking.

"Why is it that humans, at a population level, respond so differently to the same viral infection?" says Caleb Lareau at the Memorial Sloan Kettering Cancer Center in New York.

To find out, Lareau and his colleagues examined health data from more than 735,000 people from the UK Biobank study and a US cohort called All of Us. Participants had their genomes sequenced – crucially, this was done using blood samples. When EBV infects, it actually leaves a copy of itself in some cells in blood, says Lareau. This means the human genomes in the studies' samples contained copies of the EBV genome.

90%
Proportion of people infected with EBV at some point in their life

10%
How many people have genetic variants that make them vulnerable to EBV

The researchers found that some people had much more EBV DNA than others: 47,452 of the studies' participants (9.7 per cent) had more than 1.2 complete EBV genomes for every 10,000 cells (*Nature*, doi.org/hbmrq3). This means that while most participants had largely cleared the virus after infection, this group hadn't.

Next, the team tried to determine why these people were more vulnerable to EBV. "Were there certain differences in their genome that predisposed them to have higher levels of EBV?" says team member Ryan Dhindsa at Baylor College of Medicine in Houston, Texas. "We found that there were 22 different regions of the genome that were associated with higher levels of EBV," he says. "Encouragingly, many of those genomic regions that popped up had already been previously associated with different immune-mediated diseases."

The strongest associations were with genes that encode the major histocompatibility complex, a set of immune proteins that play a big role in distinguishing between the body and invading pathogens. "There were certain people who had different variants in their major histocompatibility complex," says Dhindsa. Further experiments suggested that these variants affected the body's ability to detect EBV infection.

"This virus does something to our immune system, and it does something persistent and permanent to our immune system in some people," says Ruth Dobson at Queen Mary University of London. When the viral DNA persists, it may keep gently nudging the immune system, eventually triggering it to attack the body, she says.

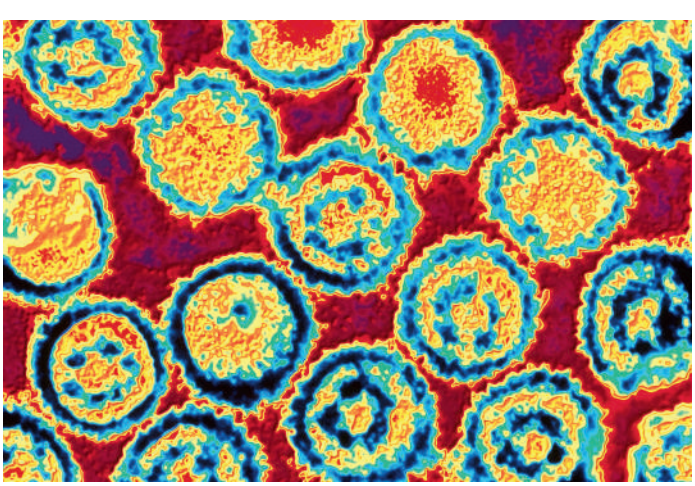
Finally, the genetic variants that were associated with high levels of EBV were also associated with many other traits and conditions – notably, a greater risk of autoimmune conditions such as rheumatoid arthritis and lupus, adding to the evidence that the virus is involved in causing them.

A radical step

The team also found an association between having these variants and malaise or fatigue. This was intriguing, because some studies suggest that EBV could be a causal factor for myalgic encephalomyelitis, also known as chronic fatigue syndrome (ME/CFS). Due to the huge sample size, "we can say with confidence that that signal is there", says Dhindsa. "But at this point, we don't exactly know what the relationship is."

For Wincup, a key benefit of the results is identifying exactly which parts of the immune system are disrupted by persistent EBV. Those components could then be targeted by specific treatments.

Another possibility is vaccination. So far, only experimental vaccines have been developed. This would be a radical step, says Wincup. "Many people see EBV as a quite benign illness," he says. However, the conditions it is associated with carry a huge toll for a significant number of people. "So how benign is it?" ▮



PASIEKA/SCIENCE PHOTO LIBRARY

Epstein-Barr virus is linked to conditions, such as lupus and multiple sclerosis

Quantum computing

Complex time crystal shows the promise of quantum computers

Karmela Padavic-Callaghan

A TIME crystal more complex than any made before has been created in a quantum computer. Exploring the properties of this unusual quantum setup strengthens the case for quantum computers as machines well suited for scientific discovery.

Typical crystals have atoms arranged in a specific repeating pattern in space, but time crystals are defined by a pattern that repeats in time instead. A time crystal repeatedly cycles through the same set of configurations and, barring deleterious influences from its environment, should continue indefinitely.

This indefinite motion initially made time crystals seem like a threat to the fundamental laws of physics, but throughout the past decade researchers have made several of them in the lab. Now, Nicolás Lorente at Donostia International Physics Center in Spain and his colleagues have used an IBM superconducting quantum computer to make an unprecedentedly complex time crystal (*Nature Communications*, doi.org/qpmb).

While most past studies focused on one-dimensional time crystals, which can be compared to a neat line of atoms, the researchers set out to create a two-dimensional version. They used 144 superconducting qubits arranged in an interlocking pattern roughly like a honeycomb. Each qubit played the role of a particle with quantum mechanical spin, which is a key component of quantum materials such as magnets, and the team could control how nearby qubits interacted.

Varying these interactions over time is what gave rise to the time crystal, but the team could also program the interactions to have a particular pattern of strengths.

Being able to reach this new level of complexity allowed the team not only to create a time crystal more complex than any produced before now, but also to start mapping out the features of the whole qubit system to obtain its "phase diagram" – a map that shows all the possible states the system can take.

Jamie Garcia at IBM, who wasn't involved in the research, says this experiment may be the first in many steps that could eventually lead to quantum computers helping to design new materials based on a fuller picture of all the possible properties a quantum system can have, including those as odd as time crystals.

The equations that the researchers used as a blueprint for making the time crystal were complicated enough that conventional computers can't use them for simulations without having to make approximations. At the same time, all existing quantum computers suffer from errors, so the researchers had to use those conventional methods to check the quantum computer's work. This back-and-forth between conventional methods and quantum approaches could sharpen our understanding of many complex quantum models for materials going forward, says Garcia. ▮

"This experiment could lead to quantum computers helping to design new materials"

To read more about quantum computers, turn to page 41

Zoology

Polar bears thriving despite sea ice loss

Alec Luhn

GEIR WING GABRIELSEN/NORWEGIAN POLAR INSTITUTE

AS SEA ice disappears in Norway's Svalbard archipelago, the fastest warming place on Earth, polar bears have been getting fatter – but scientists don't expect it to last.

The northern Barents Sea, which stretches between Svalbard and Russia's Novaya Zemlya in the Arctic Ocean, has been heating up seven times faster than the globe as a whole. The sea ice around Svalbard lasts two months less in winter and spring than it did two decades ago. Bears now have to swim 200 to 300 kilometres between hunting grounds on the ice and snow dens on the islands where they give birth.

But the average size and weight of the Svalbard bears have increased since 2000. "We should think about this as good news for Svalbard," says Jon Aars at the Norwegian Polar Institute.

Polars bears are split into 20 populations across the far north. While numbers are declining in parts of Alaska, Canada and Greenland, the Barents Sea population is thought to be stable or perhaps even growing. Starting in 1995, Aars and his colleagues tranquilised 770 bears with dart guns, then measured their length and, to estimate weight, their girth at the chest.

Svalbard's polar bears are gaining weight while the ice melts – for now

Trend analysis showed this body condition decreased until 2000, then increased until the end of observations in 2019 (*Scientific Reports*,doi.org/qpqt).

In the spring, when ringed seals give birth to pups on the sea ice, polar bears hunt them to build up stores of fat for the ice-free months. Aars and his colleagues believe the shrinking ice area may be making these seals easier to find.

The approximately 250 bears that remain on the islands when the ice recedes may be hunting more harbour seals, which are spreading to Svalbard as the climate warms.

These "local bears" are ransacking duck and geese colonies for eggs, and have also been seen chasing down reindeer from a growing population.

However, "it will be very difficult to support a reasonable population of polar bears if sea ice disappears," says Jouke Prop at the University of Groningen in the Netherlands.

"There will be a threshold, and... polar bears in Svalbard will be negatively affected by continued sea ice loss," says Aars. ▮

Space

A dark matter map has revealed some never-before-seen structures

Leah Crane

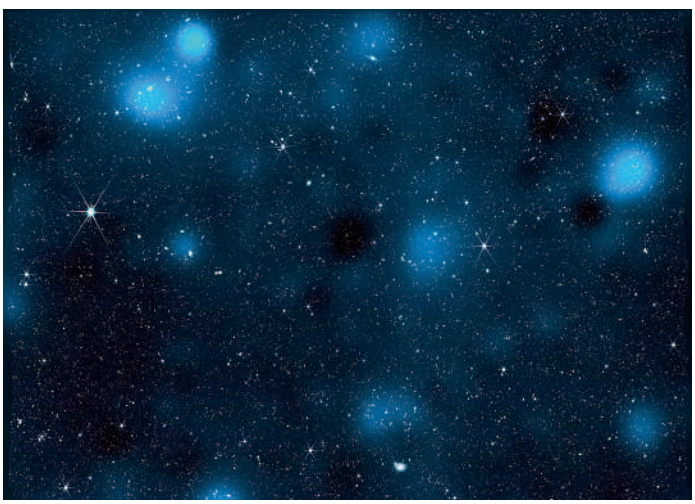
SCIENTISTS have created the best ever map of dark matter using subtle distortions in the shape of about 250,000 galaxies. It could help us understand some of the biggest mysteries in the cosmos.

Dark matter is extraordinarily hard to map because, true to its name, it doesn't emit any light that we can detect. It only interacts with regular matter through its gravitational pull, so that is what researchers use to figure out where it is. Jacqueline McCleary at Northeastern University in Massachusetts and her colleagues used the James Webb Space Telescope (JWST) to do so, examining an area of sky slightly bigger than the full moon.

"Not only is this an observational coup, but in turn it's going to enable a lot of other analysis"

"It is a very high-resolution picture of the scaffolding of this little corner of the universe," says McCleary. The resolution of the map is about twice as high as previous ones made with the Hubble Space Telescope, and includes structures much further from Earth.

NASA



In this new map of dark matter's distribution, the brighter the blue circle, the higher the density of dark matter

The researchers examined the shapes of about 250,000 galaxies – but it isn't their intrinsic shape that is interesting. "Those galaxies are basically the cosmic wallpaper," says Liliya Williams at the University of Minnesota, who wasn't involved in the analysis. Instead, what's important is how the gravity of dark matter between the telescope and the "wallpaper" warps the light of the galaxies, in a process called gravitational lensing: the further the average shape of the distant galaxies is from circular, the more dark matter lies between them and us.

By analysing these differences in shape, the researchers mapped out huge clusters of galaxies, along with the filaments of the cosmic web that connects them. Some of these structures didn't match up with anything we had previously seen while observing regular, or luminous, matter, indicating that they must be dominated by dark matter (*Nature Astronomy*, doi.org/hbmjbw). "To identify many of these structures over a wide field, gravitational lensing is one of very, very few techniques, and definitely the best," says Williams.

Because dark matter makes up about 85 per cent of the total matter in the universe, it is crucial to the evolution of not only galaxies and galaxy clusters, but also the cosmos as a whole. Building a map of its distribution could help us nail down how it behaves and what exactly it is made of, says Williams.

"Not only is it an observational coup, but in turn it's going to enable a lot of other analysis – cosmological parameter constraints, the connection between galaxies and their dark matter haloes and how they grow and evolve over time," says McCleary. These cosmological parameters include the strength of dark energy, the mysterious force causing the universe to expand at an accelerating rate.

For now, it appears the map matches our current standard model of the universe, known as lambda-CDM, but there are many in-depth investigations of the data yet to be done that are certain to provide new insights, says McCleary. "Although at a glance it's a match for lambda-CDM, I'm not giving up yet – I'm withholding judgement until our analysis is finished." ▮

Huge dark matter cloud may be lurking near our solar system

Not only have scientists created the best ever map of dark matter (see main story), but we have also spotted what seems to be an enormous dark matter cloud next to our solar system.

Our best cosmological models hold that galaxies are embedded in tenuous dark matter clouds called haloes, with smaller sub-haloes studded throughout. But dark matter doesn't emit light, so these are hard to find.

To spot this one, Sukanya Chakrabarti at the University of Alabama in Huntsville and her colleagues used pairs of rapidly spinning neutron stars called pulsars. With a pair of them, we can use changes in their orbits around one another to measure the acceleration that occurs when a massive object is nearby.

Dark matter interacts with regular matter via gravity, so if a dark matter sub-halo is near a pair of pulsars, it should stretch their orbits slightly. That is exactly what Chakrabarti and her colleagues found a little more than 3000 light years from our solar system (*Physical Review Letters*, doi.org/qpxx).

They analysed the extent of the pull and found that it must come from an object about 60 million times the mass of the sun, whose location doesn't match any known objects made of regular matter. LC

To halt measles' resurgence, we must fight the plague of misinformation

Measles is one of the most contagious viruses on the planet. So why are so many children not being vaccinated against it, asks **Michael Le Page**

WHEN I read the 1998 study falsely claiming there was a link between the measles, mumps and rubella (MMR) vaccine and autism, I was shocked. Shocked by how bad the paper was, shocked that it was published in a high-status journal and shocked that journalists reported it so uncritically. And back then, I didn't even know the study was fraudulent.

Nearly three decades later, the consequences are still reverberating around the world. Due to low vaccination rates driven at least in part by the anti-vax movement, fuelled by that fraudulent paper, six countries have lost their measles-free status, according to the World Health Organization (WHO), including the UK (for the second time), Spain and Austria. Meanwhile, the US is battling its worst outbreak in many decades, and could have potentially lost its own measles-free status soon, had it not withdrawn from the WHO.

Measles is one of the most contagious viruses on the planet. It causes severe complications in around 1 in 5 children, including breathing difficulties, deafness, blindness and brain swelling that can lead to permanent brain damage. Globally, measles killed about 95,000 people in 2024.

It also kills off some of the immune cells that protect us against other infections, lowering people's immunity for around five years, so its true toll is even higher. Measles isn't an infection that you want to take chances with.

Luckily for us, it has a weakness: the virus first infects immune cells and travels to the lymph nodes, before spreading more widely around the body. This convoluted route means there are far more opportunities for our immune system to intercept it before people become infectious than with respiratory viruses that mainly infect the cells lining our noses and throats.

Going backwards

This is why the measles component of the MMR vaccine is so effective. It is also clear beyond any doubt that children are much better off being vaccinated than not, and that there is no link with autism. Numerous studies show this, but the one I found most convincing is the fact that when the MMR vaccine was withdrawn in Japan, it made no difference at all to the incidence of autism.

But because the measles virus is so contagious, at least 95 per cent of children have to be vaccinated to ensure each infected person will infect fewer than one other person on average, meaning the virus can't spread. Put another way, if only a small proportion of parents fail to vaccinate their children, measles can make a comeback.

> "Governments in Europe and beyond need to get more serious about promoting sound science"

Globally, the picture isn't too bad – but it could be better. The proportion of children getting a first dose of a measles vaccine rose from 71 per cent in 2000 to 84 per cent in 2010. It then levelled out and dropped a bit during the covid-19 pandemic, but has since recovered. The WHO estimates that between 2000 and 2024, 60 million deaths globally were averted by measles vaccination.

But in rich countries, we are going backwards. After the false claims made in 1998, MMR uptake levels fell to as low as 80 per cent in England and Wales. By 2013, uptake was back above 90 per cent, but it has been slowly falling ever since. According to a report last year, this latest decline in the UK is due in part to it becoming harder for parents to get their children vaccinated – an issue that needs to be urgently addressed.

But the resurgence of the anti-vaxxers in many countries is definitely part of the problem, with the issue now closely linked to right-wing extremism and promoted on certain social media platforms. I did a quick search for "mmr measles" on Bluesky and didn't spot a single anti-vax post in the top results. When I repeated this search on X, many of the results were anti-vax nonsense.

When the billionaire owners of social media platforms are in cahoots with the habitual liar who leads the richest country in the world, and who has made an anti-vaxxer health secretary, it is hard to know how to combat all this disinformation.

What's clear is that this goes way beyond vaccines, with climate science being another crucial area where lies can crowd out the truth. Governments in Europe and beyond need to get more serious about controlling the infosphere and finding ways to promote sound science. No less than the future of humanity is at stake. ▮

ROBIN UTRECHT/SHUTTERSTOCK

A large number of children need to be vaccinated to stop measles from spreading

6
How many countries have just lost their measles-free status

60 million
Number of deaths the measles vaccine has prevented since 2000

Michael Le Page is a reporter at *New Scientist* specialising in genetics and biomedicine

Palaeontology

A treasure trove of Cambrian fossils

Nearly 9000 fossils from 153 species, 60 per cent of which are new to science, provide a window into marine life during the Cambrian Period, finds **James Wong**

AN EXTRAORDINARY 512-million-year-old fossil site has been discovered in southern China, preserving in vivid detail almost an entire ecosystem from a time shortly after Earth's first mass extinction event.

The fossils date from the Cambrian Period, which began 541 million years ago. The early Cambrian saw an explosion of diversity in animal life which gave rise to most of the major groups alive today.

But this flourishing came to a halt with the Sinsk event around 513.5 million years ago, when oxygen levels in the ocean fell, killing off several animal groups.

Han Zeng at the Nanjing Institute of Geology and Palaeontology in China and his colleagues began finding fossils at a quarry in the mountainous region of Huayuan County in Hunan Province in 2021.

So far, they have excavated nearly 9000 fossils from 153 species, nearly 60 per cent of which are new to science (*Nature*, doi.org/qpm8). The team has christened this ancient ecosystem the Huayuan biota and says the site may be superior to the most famous Cambrian fossil site, the Burgess Shale in Canada.

The assemblage consists of 16 major groups of animals that are thought to have lived in the deep ocean and appear to have been less impacted by the Sinsk event.

"Our previous knowledge of the Sinsk extinction event only came from the fossil record of skeletal animals such as archaeocyathid sponge reefs, trilobites and small shelly fossils," says Zeng.

The Huayuan biota also consists of many different species of soft-bodied animals. "We found that the extinction mainly destroyed the shallow-water environment, and the deep-water environment at the edge of the continental shelf, where the Huayuan biota is situated, was less affected," says Zeng.

> **"The diversity of species and quality of preservation vaults this into the top tier of Cambrian fossil sites"**

Most of the fossils found are arthropods, related to today's insects, spiders and crustaceans. The fossils also include molluscs, shelled creatures called brachiopods and cnidarians, which are relatives of jellyfish.

An 80-centimetre-long arthropod named *Guanshancaris kunmingensis* is the largest animal recovered from the quarry and would have been the predator at the top of the pile in the Huayuan ecosystem.

Another arthropod, *Helmetia*, is one of two genera that were previously found only in Canada's Burgess Shale but have now been found at Huayuan, which was then, as now, "halfway across the world," says Zeng. "This indicates that early animals were able to spread over a very long distance, which was most likely made by the transportation of animal larvae in ocean currents," he says.

Zeng says the reason for the exquisite preservation found at the site is that the animals were buried very quickly under a slurry of fine mud. The soft parts of animals are preserved in extraordinary detail, including walking legs, antennae and tentacles, respiratory organs such as gills, the pharynx and guts in many animals and even eyes and neural tissues.

Joe Moysiuk at Manitoba Museum in Canada says the diversity of species and quality of preservation "vaults Huayuan into the top tier of Cambrian fossil sites."

We know that the Sinsk event in the mid-Cambrian saw major declines in some groups of sponges, trilobites, and others, he says, but we have very little information about its impact on most animal groups.

"Discoveries like the Huayuan biota give us critical snapshots of this soft-bodied biodiversity during the Cambrian, filling in missing frames in the proverbial tape of Earth's history," says Moysiuk.

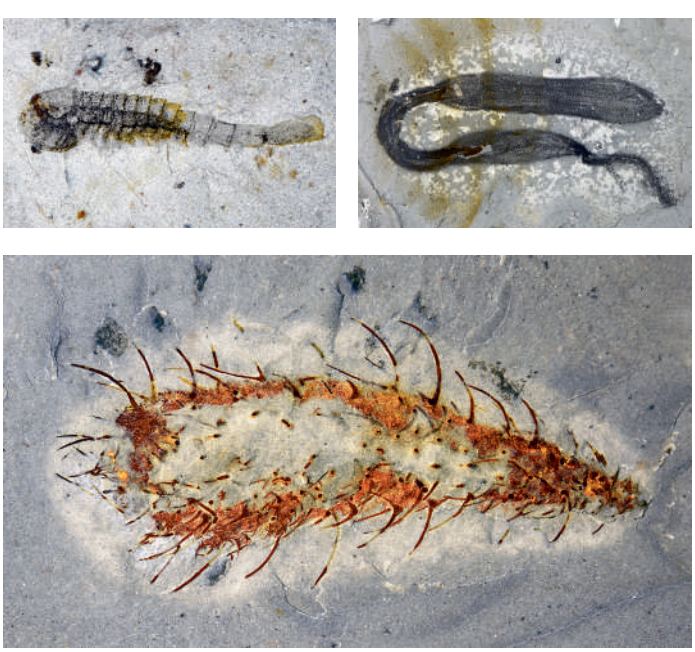
A fishy absence

Tetsuto Miyashita at the Canadian Museum of Nature in Ottawa says the two most famous Cambrian fossil sites to date are the 520-million-year-old Chengjiang biota in China and the 508-million-year-old Burgess Shale in Canada.

"But it's like comparing Bach's court ensemble and the Beatles – we need to understand where the differences come from before knowing what story they tell us on the whole," says Miyashita. "A new biota like this is important because it helps palaeontologists tease apart the effects of geography, mass extinction and ocean depths and chemistry."

One important group is conspicuously absent from Huayuan. "Where are the fish?" says Miyashita. "Were they undergoing a pinch globally and very rare, or was there any other ecological reason that we don't find fish chasing after so many species of soft-bodied animals?"

Zeng says his team hasn't yet sifted through all of the fossils. "There will be new species coming out. Fish may be there, and we shall wait and see," he says. ▮



HAN ZENG

Top left: A fuxianhuiid arthropod with gut preserved; top right: Leptomitus, a sponge; bottom: *Allonnia*, a cactus-like animal

Environment

Amazon is getting drier as deforestation starves 'flying rivers'

Alec Luhn

DEFORESTATION has reduced rainfall over the Amazon, suggesting the rainforest could reach a catastrophic tipping point sooner than expected.

Satellite observations and rain gauge measurements show that the amount of rain falling in the southern Amazon basin declined by 8 to 11 per cent between 1980 and 2019. Tree cover in that part of the Amazon shrank by 16 per cent in roughly the same period, mainly because the forest was slashed and burned for beef cattle ranching.

The northern Amazon basin has suffered far less deforestation and saw only a slight increase in precipitation, which wasn't statistically significant.

While a recent study linked deforestation to drier weather within 300 kilometres, the new research found this connection across a basin more than 3000 kilometres wide. That shows destroying rainforest can also hurt nearby ranches and soy farms, says Dominick Spracklen at the University of Leeds, UK.

"Some people in agribusiness might see a bit of forest as wasted land [they] could go clear," he says. "That bit of forest is working really hard to maintain regional rainfall that our bit of agriculture is benefitting from."

Global warming has also been drying the Amazon rainforest, with extreme drought leading to record wildfires in 2024. But atmospheric modelling by Spracklen and his colleagues showed deforestation caused 52 to 75 per cent of the decline in rainfall (*Nature Communications*, doi.org/qpj4).

Large sections of the Amazon rainforest have been slashed and burned

MICHAEL DANTAS/AFP VIA GETTY IMAGES

Prevailing winds transport moisture from the Atlantic Ocean that falls as rain over the Amazon. Evaporation and transpiration by plants return three-quarters of that water to the atmosphere. Further downwind, it falls as rain again and returns to the atmosphere for half a dozen cycles or more, fuelling "flying rivers" that carry moisture across the entire rainforest.

If an area of forest is razed, more than half of the rainwater in that area runs off into streams and begins flowing back to the ocean. That starves the flying rivers of moisture and reduces rainfall. It also diminishes the atmospheric instability that leads to storm cloud formation, the team found.

With fewer trees to slow it down, the wind blows faster and carries more moisture out of the region.

Unlike past research, the study marries both data and modelling to explain how deforestation weakens rainfall, says Yadvinder Malhi at the University of Oxford. "The atmosphere becomes smoother; in some ways it glides. The moisture can travel further out... because there's less friction on the ground," he says.

Scientists are concerned the combined effects of heat, drought and deforestation could push the Amazon to a tipping point that sees it transform into a savannah, but there is uncertainty on how close this is to happening. Spracklen and his colleagues found that climate models underestimate the impact of deforestation on rainfall by up to 50 per cent, which suggests this tipping point could be reached much sooner than expected. ▮

Health

Menstrual pad may help women track their fertility

AN AT-HOME test built into a menstrual pad could give women insights into their fertility without the need for repeated blood tests.

For many women, their fertility is a mystery until they try to conceive. Clinical tests can offer insights by measuring levels of anti-Müllerian hormone (AMH), a common marker of "ovarian reserve" – a rough indication of the number of eggs remaining. AMH levels decline with age, so high levels indicate a plentiful egg supply. A below-average level can signal a diminished egg reserve or early menopause.

Traditionally, AMH is measured using a blood test in the clinic or via a finger-prick test at home. In both cases, the sample must be sent to a lab for processing.

Now, Lucas Dosnon at ETH Zurich in Switzerland and his colleagues have developed an easy-to-use test that provides immediate results using menstrual blood (medRxiv, doi.org/qpjr).

The test is a lateral flow assay (similar to a covid-19 test) that uses tiny, gold-coated particles covered with antibodies that bind specifically to AMH. When the test is dipped in menstrual blood, the interaction of the hormone and particles creates a visible line on the test strip. The darker the line, the higher the AMH.

When the researchers used their approach to test menstrual blood containing known concentrations of AMH, the results closely matched those obtained from lab-based tests.

"This test could enable frequent screening of ovarian health for many purposes"

The team has also integrated the test into a menstrual pad, which would allow AMH levels to be measured passively during a period. This could provide insights into ovarian reserve over time, potentially revealing trends that would be missed by a single test.

"We believe that this work could be transformative for women's health," says Dosnon, who suggests the test could enable frequent screening of ovarian health for many purposes, including during IVF or for detecting fertility conditions other than declining ovarian reserve. ▮

Helen Thomson

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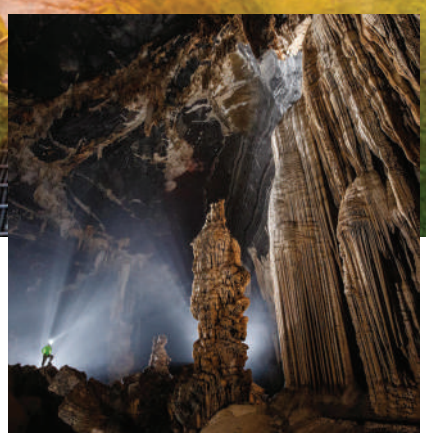

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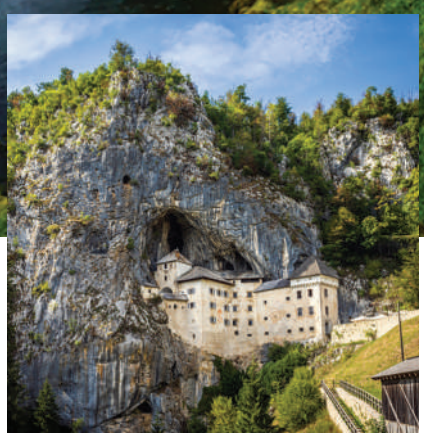

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Views

Comment

Getting the full picture

Clinical research is still failing Black and other underrepresented communities – but we can change that, says **Drews Adade**

HOW can I trust that my information will be safe? That's the question I hear as a young Black doctor working in clinical research when I speak to Black African and Caribbean communities about joining genetic studies. You don't have to search far to find mistrust – or the reasons for it.

Take the infamous Tuskegee syphilis study, where Black men were left untreated so doctors could watch the disease progress, even after a cure existed. Or the cHenrietta Lacks, whose cells were taken without consent, then used in research worldwide, making millions for companies while her family couldn't afford healthcare. Black people have long been treated as experimental objects.

SIMONE ROTELLA

Working in research, I understand that good healthcare relies on good data. Black people – and many other groups including people of non-European ancestry, older adults and those with complex health needs – are underrepresented in clinical research. To truly understand disease, we must study all the groups it affects, so we can build tests and treatments that work for all of us.

In the coming years, healthcare systems plan to put genetics at the centre of patient care. This is precision medicine, using genetic information to tailor prevention and treatment to each individual, rather than giving us all the same standard approach. Doctors could predict your personal risk for a disease and choose treatments more likely to work for you.

But work by institutions such as the University of Exeter, UK, and Queen Mary University of London shows a big gap remains in our understanding of genetics in non-European individuals and how this relates to disease. This research shows that some Black individuals have a genetic deficiency which can affect the accuracy of standard tests used to diagnose and monitor type 2 diabetes, leading to a delay in diagnosis. We need more Black people in research, but first we need to rebuild trust.

Current research often accidentally excludes people in its design. If your study recruitment materials only come in English, you have already lost people. If you only recruit during weekday office hours, you have excluded shift workers. If you only work through hospitals and universities, you have neglected where communities actually gather – churches, barber shops, community centres. Social context matters, and traditional research sometimes misses this.

Academic institutions are increasingly realising that different communities need different approaches. It takes a balance of cultural sensitivity and scientific care. It is about giving the community power, about how the science behind the research translates to actionable change in the community whether through policy change or improved access to care. I have also noticed that representation in research matters. When people see themselves in the researchers, like me, it builds trust. Both sides understand, on a personal level, why the research is important.

How do we fix this? Researchers need to talk to communities from the start, not just show up asking questions. The organisations funding research need to factor community involvement and training in the research budget, as we know that involving patients and communities in research is increasingly recognised as an effective way to boost participation of underrepresented groups and thus improve population health. Most importantly, researchers need to give something back through health programmes, jobs or facilities, to show they are not just taking data and disappearing.

And for everyone who wants to take part in research, please do. There are many ways: joining a clinical trial or simply filling out a questionnaire. Every piece of information counts.

Dr Drews Adade is a clinical research fellow in London

Field notes from space-time

Not so boldly going As Elon Musk and Pete Hegseth talk about wanting to make *Star Trek* real, long-time fan **Chanda Prescod-Weinstein** says they have misunderstood the heart of the show

Chanda Prescod-Weinstein is an associate professor of physics and astronomy at the University of New Hampshire. She is the author of *The Disordered Cosmos* and the forthcoming book *The Edge of Space-Time: Particles, poetry, and the cosmic dream boogie*

Chanda's week

What I'm reading
I loved Fara Dabhoiwala's What is Free Speech? The history of a dangerous idea.

What I'm watching
I'm loving Gina Yashere and Kerrice Brooks in Star Trek: Starfleet Academy.

What I'm working on
Figuring out how to get through the day while the US government attacks its own population.

This column appears monthly

TO LIVE in the US at this moment is to live through a series of strange juxtapositions. I prepare myself for how to respond if the construction workers at my house get stopped by government agents; I need to think about what I would like to eat for dinner. I tell my spouse to pick up some veggies from the grocer; I worry he will be stopped by US Immigration and Customs Enforcement on the way home. I am supposed to do science, to write about how the universe is exciting; I spend part of my day reading about children being held in detention camps. NASA's funding survived an attempted cut; NASA decimated its workforce in 2025, and they are probably not coming back.

The week this column publishes, NASA may launch an astronaut on a journey around the moon – humanity's first in decades. This is a stage of the Artemis mission, which will eventually land people on the moon. In the long term, Artemis is widely understood to be a stepping stone on the journey to placing humans on Mars. At a SpaceX event with Pete Hegseth, head of the US Department of Defense (which the administration wishes you would call the Department of War), Elon Musk pitched sending humans to other planets as an important part of getting us to the *Star Trek* universe. We are supposed to be excited and to think that all of these missions are bringing us a step closer to spacefaring utopia.

What a delightful idea. If only it were true. As a *Trek* convention-attending fan, I can tell you that not only do these men not understand the franchise, but they have never really seen it. Otherwise, they would know that, in the *Trek* universe, the 2020s were a terrible era in human history. The Bell Riots, which take place in a fictional 2024, involve an uprising of poor and discarded people against an authoritarian government that runs a society of extreme wealth inequality. In *Trek*, the world must survive another world war in which soldiers are given a drug to enable their participation in atrocities.

The similarities between fact and 30-year-old fiction are striking. In the *Trek* scenario, the men telling us about their militarised, corporate plans for space are the baddies, not the ones who will get us to utopia. Not only do those citing *Trek* today misunderstand their place in the narrative, but they also don't understand what *Trek* is really about. Space travel is the setting, but that isn't the heart of the franchise's story, which is about humanity bettering itself through cooperating with each other, reckoning with hard philosophical questions and imagining a socialist-inspired socioeconomic system – where everyone's needs are taken care of.

"In the *Star Trek* scenario, the men telling us of their militarised, corporate plans are the baddies"

Will going to Mars do that for us? There is an alternate timeline where maybe going to Mars is part of our journey toward appreciating "infinite diversity in infinite combinations", which is the basis for the alien Vulcan species' world view. Already, we have successfully sent multiple uncrewed missions to Mars and learned so many amazing things – that Mars once had the conditions for the formation of life, and liquid water may still be somewhere on the planet, and that Mars has terribly unpredictable weather, due in part to its rather thin atmosphere.

Another lesson our remote explorations of Mars have taught us is that it's cold, dry and, by human standards, an awful place to live. So, even in the scenario where sending a crewed mission to Mars emerged from a united and peaceful humanity, we would still have to reckon with the reality that Mars is trying to kill us. We can't breathe there, and, even if we could change the chemical make-up of the atmosphere, the dirt would still be dangerous. If you are like me, when you are in a dusty room, you have a bit of an allergic reaction, full of sneezing. That's a cakewalk compared with what Mars dirt would do to the human body. It has got just enough silica in it to do serious damage to human lungs, causing an illness similar to the black lung disease that miners often have.

You might be thinking, "Well, it's not like we plan to inhale the dirt!" But Mars has enormous dust storms that kick up dirt all the time. Any astronaut on the surface can expect to get it all over their suit, all the time. It will be hard to keep the dust out of habitats. The resources required to make building a settlement on Mars survivable are enormous. It would, literally, be a heavy lift to launch them off Earth's surface and out of our planet's gravitational pull.

I think trying to settle Mars is probably a terrible idea. And that's OK, because we have got a pretty awesome planet already: Earth. We aren't taking very good care of it, but that could change. For me, that's what *Star Trek* is all about. Not the promise of a high-tech future where we escape our world, but rather one where we learn to respect the incredible spaceship that is our home planet. ▮

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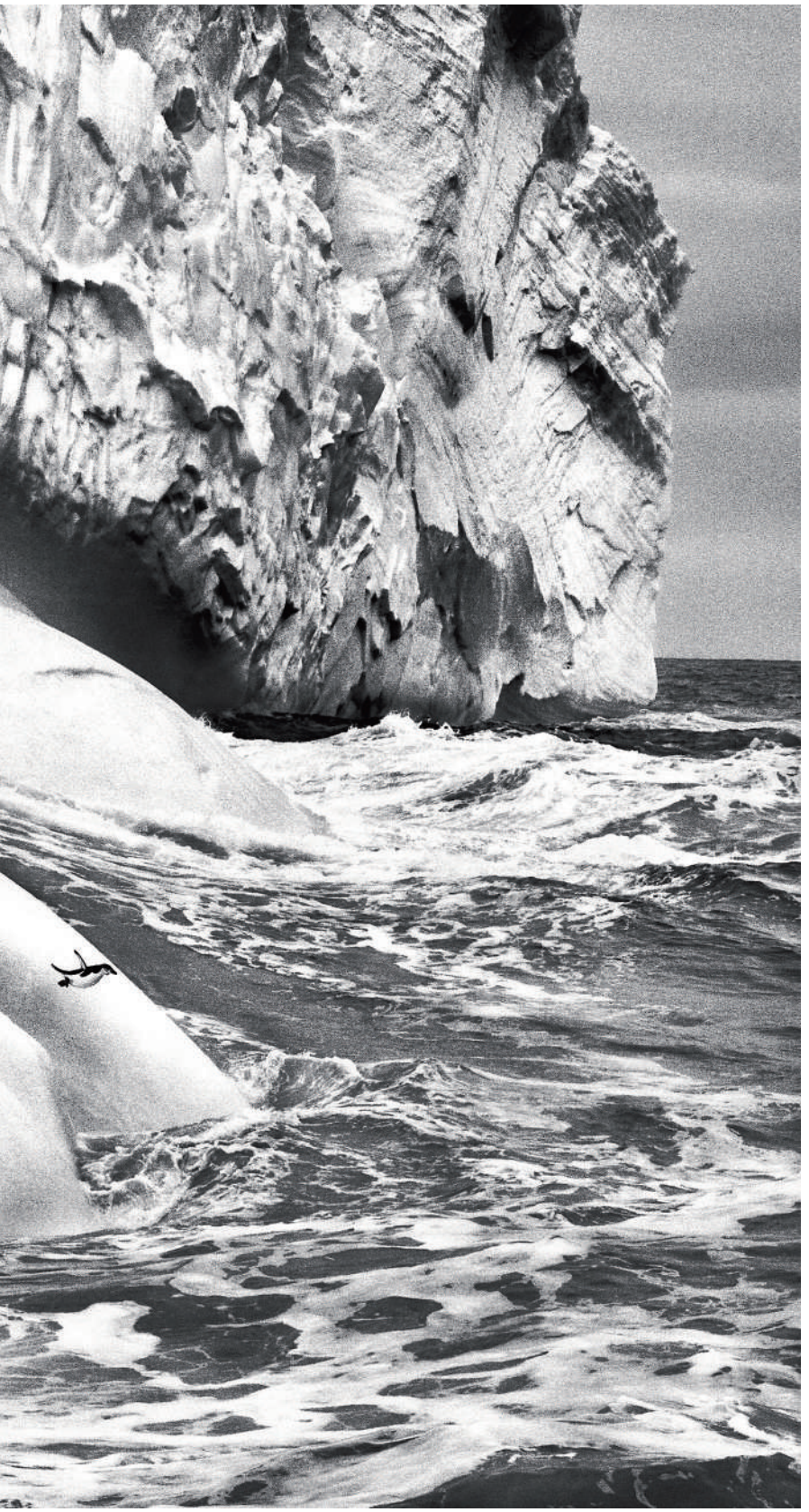

Diving in

Sebastião Salgado
Prestel

SEBASTIÃO SALGADO became famous for his portraits of humans struggling to survive in a violent world. He took astonishing photographs of the attempted assassination of US President Ronald Reagan, covered conflicts in Rwanda and the Balkans, and documented the lives of labourers and migrants in years-long, globe-spanning projects.

But after photographing the Rwandan genocide, Salgado became depressed, retreating to his family farm in Brazil. Dismayed by the environmental destruction he found, he began restoring the Atlantic rainforest there, which eventually inspired him to return to photography. The Genesis project followed, to capture "what was pristine and hadn't been destroyed" on the planet, as Selgado said in a 2024 interview, from the mountains of Alaska to the Indigenous peoples of the Amazon. These travels turned him into an environmentalist, he said in another interview.

Glaciers, published this month following Salgado's death last year, collects 65 of the black-and-white shots of glaciers and other ice the photographer took for Genesis. The images are seemingly timeless, freeze-frames of the big and small movements of the coldest regions. In the one shown here, a parade of penguins dive off an iceberg into the seas off the South Sandwich Islands in 2009.

But of course, the images aren't timeless, as every year Earth loses 1000 glaciers, and the number is rising. On our current warming trajectory, about four-fifths of glaciers will disappear by 2100, including almost all in western Canada, the US and the Alps.

Alec Luhn

On the thinnest of ice

An unexpectedly moving book makes a strong case for putting the Arctic at the heart of our fast-changing world, says **Elle Hunt**

Book

Frostlines

Neil Shea

Picador (UK, 12 February)

Ecco Publishing (US, available now)

KATIE ORLINSKEY

A herd of caribou outside Anaktuvuk Pass, Alaska, in the spring migration

IN SO far as those of us further south consider the Arctic at all, we tend to think of it as a monolith: an expanse of white, with walruses and a few polar bears. Some may even imagine penguins, in fact to be found at the other pole, illustrating the remoteness of these extreme landscapes and their otherworldly foreignness.

But a new book argues that we neglect the Arctic at our peril – not least because of its importance to our rapidly heating planet. In his first book *Frostlines: A journey through entangled lives and landscapes in a warming Arctic*, journalist Neil Shea brings together his findings from two decades of reporting, mostly for *National Geographic*.

In this lyrical, unexpectedly moving work of narrative non-fiction, Shea brings the wonders of the Arctic to life for readers who will never journey there, while mounting a persuasive case for why we must at least cast our minds northwards.

He begins *Frostlines* with a startling image from his first trip to the Arctic back in 2005, camping on the sea ice at Canada's Admiralty Inlet. Looking out to the open water from an ice floe, Shea was treated to a mass gathering of narwhals, the males brushing their tusks against each other in a what is thought to be a display of sexual dominance, while being swarmed by fish, birds and other wildlife.

That spectacle of "all those lives converging, colliding... stories that could never fit into any magazine" instilled in Shea a fascination for the Arctic. For all his misgivings about the limits of the written word, Shea quickly and effectively extends his passion to the reader through vivid imagery and enviable encounters with wildlife.

On Ellesmere Island, Shea befriends a population of white wolves that have never learned to fear people – one even steals his inflatable pillow from his tent. Deep in Alaska's Kobuk Valley National Park, he camps among vast herds of caribou and becomes "neighbourly" with a brown bear.

"Melting ice is making the Arctic attractive, as evidenced by President Trump's threats against Greenland"

It would have been possible to focus this book on the Arctic wilderness and wildlife alone; Shea writes beautifully about both. But to do so would have been to sell this complex, unique region short, and play to our generally vague preconceptions of it. Instead, Shea aims for a more granular picture, even if it is a more uncomfortable one.

That area between the North Pole and the Arctic circle is far from a homogeneous expanse of snow, encompassing eight modern states with 4 million residents. Some 400,000 are Indigenous people, belonging to dozens of distinct tribes and speaking many different languages and dialects.

In his lively portraits of the people he spends time with, Shea vividly conveys the realities of daily life across this region, as well as the increasingly existential challenges of an Arctic warming three or four times more rapidly than anywhere else on Earth.

Some of Shea's Inuit interviewees are eager to share the changes they have witnessed over mere decades, and their efforts to protect their communities and traditional way of life. Others are more reluctant and even resentful, having seen so many Westerners over the years come, ask questions, take notes and leave.

Shea finds that "no one wants to talk about climate change" while camped on top of a frozen lake and otherwise at the mercy of nature for survival. Yet the consequences are already at hand, unbalancing the Arctic's fragile ecosystems and opening it up to further threats.

Melting ice is allowing more ships to access the Arctic and making it an attractive territory, as evidenced by US President Donald Trump's threats against Greenland. Meanwhile, the Ukraine war has closed other areas off. *Frostlines* concludes with Shea on the Norway-Russia border, where migrants make life-threatening bids to find refuge and not even reindeer can cross freely.

As remote and removed as the Arctic may seem, Shea reveals it to be both a part of our familiar modern world and a region increasingly endangered by our activities. We are more connected to the ice than we might think, and the people and animals that live in the Arctic don't have the luxury of ignoring the worsening cracks. ▮

Elle Hunt is a writer based in Norwich, UK

A new world order

An epic exploration of the cosmos reflects a changed landscape around science in the 21st century, finds **Alison Flood**

Book

A Brief History of the Universe

Sarah Alam Malik

Simon & Schuster (UK, 12 February)
William Morrow (US, 5 May)

IN 1988, Stephen Hawking published *A Brief History of Time*, an exploration and explanation of cosmology by the renowned physicist that became an unlikely, and huge, bestseller. Shameful admission: I set out to read an updated edition as a curious, literature-studying teenager, and struggled. I never finished it.

Thirty-eight years later, particle physicist Sarah Alam Malik is here to help with her own exploration of cosmology, with a nod to Hawking in her title: *A Brief History of the Universe (and our place in it)*.

Hawking started with Aristotle arguing for a geocentric model of the universe in 340 BC. Malik opens her brief history earlier, around the 7th century BC, as the Babylonians track the movements of the sun, moon and stars in "astronomical diaries" written in cuneiform. But we are soon into Aristotle and Ptolemy, and then the flourishing of astronomical knowledge in the Islamic world in the 6th century AD.

Since this is a brief history, by page 47 we have dashed through Galileo Galilei and his discovery of Jupiter's four moons and Isaac Newton watching his apple fall, to arrive at Albert Einstein and general relativity. From there, we canter through galaxies and black holes to the eventual heat death of the universe. From the macro to the micro: "The cosmos's building blocks have turned out to be no less wondrous than the cosmic structures they created," writes Malik, taking her readers through the discoveries that led to quantum mechanics and the unveiling of the subatomic world.

She gets less deep into the nitty-gritty of the physics than Hawking, painting with a broader brush and focusing a little more on bringing the people she's writing about to life. This ranges from Dmitri Mendeleev, the youngest in a family of over a dozen children in a small Siberian town, coming up with the periodic table while visiting a cheese factory, to Fritz Zwicky positing dark matter in the 1930s, but being so disagreeable the idea didn't catch on for four decades.

Malik, writing decades later than Hawking, captures a more diverse cast of characters. These range from the Islamic astronomers of the Middle Ages to women like Vera Rubin, who overcame widespread misogyny to carry out groundbreaking work on galactic rotation curves.

Not only is the tone different, but she takes us inside developments Hawking couldn't have included back in 1988 – for example, the Large Hadron Collider (on which Malik worked) and the Higgs boson. Some of the audience wept during the announcement of its discovery, she writes, in one of the book's many delightful anecdotes.

This is indeed a "brief history of the universe", but what lies inside the brackets, "and our place in it", is just as important. It is a book about our discovery of the universe, how we stood on the shoulders of giants to get this far, and what may come next. It is full of awe – "It remains a marvel of human existence that we can comprehend worlds far removed from our own" – and humility – "Humanity has written and rewritten the story of the universe many times, and each era has, for the most part, believed the story of its time."

The book was at its best journeying deep into space and the quantum – unsurprising, given Malik's field (dark matter). Chapters on life's origin, its future and machine intelligence felt slighter.

Much of what Malik recounts will be familiar to *New Scientist* readers, but she is a warm, clear writer who covers an awful lot in a small space (my edition is just 223 pages). I think 18-year-old me might just have made it through this one – and then have been ready for Hawking.

No tour of the cosmos is complete without a description of black holes

MARK GARLICK/SCIENCE PHOTO LIBRARY

New Scientist *recommends*

Michael Dalton
Assistant magazine editor
London

You wait decades for another sequel to Danny Boyle's virus-based horror classic *28 Days Later* and then two come along. Hot on the heels of last year's *28 Years Later*, **28 Years Later: The Bone Temple** picks up almost straight after the provocative final scene of its predecessor, which introduced us to a murderous gang led by Sir Lord Jimmy Crystal (Jack O' Connell).

Indeed, the humans are the major threat this time, with the "infected" primarily represented by Samson (Chi Lewis-Parry), so called by Ian Kelson (Ralph Fiennes, pictured), with whom he has an unlikely friendship.

As these two stargaze and dance to Duran Duran (really), Kelson learns more about the virus and starts to develop a cure. But the characters are on a collision course, coming together for a truly heavy-metal finale.

While it can be a tough watch, there's humour and humanity amid the horror. If the third *28 Years Later* film succeeds, this may go down as one of the great movie trilogies.

SONY PICTURES

The TV column

Peeling it off In *The Beauty*, mysterious deaths of models are linked to a new drug and a sexually transmitted infection, both of which kill as they beautify. But if you want great body horror, this isn't the place to look, concludes **Bethan Ackerley**

Bethan Ackerley is a subeditor at *New Scientist*. She loves sci-fi, sitcoms and anything spooky. Follow her on X @inkerley

PHILIPPE ANTONELLO/FX; BELOW: 20TH CENTURY FOX/ALBUM/ALAMY

Bella Hadid smoulders terrifyingly as Ruby in *The Beauty*

THE intentions and limitations of *The Beauty* (Disney+/FX), the new series from TV titan Ryan Murphy and collaborator Matthew Hodgson, are on full display in its first scene. Amid the models strutting down a catwalk in Paris, one face is more smouldering than the rest – literally. The unfortunate Ruby (Bella Hadid) is drenched in sweat, so desperate for water she kills the fashionistas for their water bottles. Cornered, gasping with thirst, she spontaneously combusts.

This may grab you – or not. But it is what audiences have come to expect of Murphy (think *Glee* and *American Horror Story*). His schlock and awe should have been perfect for *The Beauty*'s glossy, gruesome plot, in which two FBI agents investigating deaths in Europe's fashion capitals uncover a lucrative drug and a sexually transmitted infection, both with glamorising yet lethal effects. In practice, the series is a muddle.

One thing Murphy's shows have long shared with body horror is that they hinge on whether they find the truth buried in their tastelessness. But the only truth that *The Beauty* peddles is the futility of climbing the infinite ladder of our beauty standards. So while it occasionally thrills with its gory transformations, including that catwalk carnage, *The Beauty*'s social commentary is (sorry) skin-deep, manifesting mostly in cheap swipes at Ozempic users.

Between that and its aesthetic misfires, the series rarely captures the transgressive spirit that makes body horror so special. Worse, it feels unoriginal, not because it's an adaptation of a popular comic book series, but because it has nothing but obviousness to offer.

To see what *The Beauty* could have been, consider *The Fly*, a masterpiece from David Cronenberg that, despite its very different plot, covers remarkably similar ground to *The Beauty*. Scientist Seth Brundle (Jeff Goldblum) is struggling to make his experimental teleportation pods work for living creatures. After becoming romantically involved with reporter Ronnie Quaife (Geena Davis), late-night insecurity prompts him to test his machine, accidentally hybridising himself with an errant fly.

Jeff Goldblum as Seth Brundle in David Cronenberg's *The Fly*

The Fly is is a staggeringly original love story about the limits of intimacy, which uncovers remarkable truths. The slow transformation never quite destroys the love between Seth and Ronnie. *The Fly* cleverly splices romance and stomach-turning horror without diminishing either, while subtly speaking to themes from the price of ego and gender dysphoria to mania and the AIDS epidemic.

The Beauty also touches on these topics – one character pleads that years of PrEP should help him fight off the strange new infection, while a transgender woman about to medically transition fears the beautifying drug will stop her from doing so. The show even contains a scene where a character slowly pulls off their fingernails, just as Seth does when he realises that something has gone wrong.

But whenever *The Beauty*'s producers toy with richer material, they do so in the most didactic way possible. Not so Cronenberg, who lets the resonances of Seth and Ronnie's story speak for themselves. The lesson is that while we remake the flesh in awful, astonishing ways, the real horror lies in failing to imagine anything new at all.

TV

The Beauty

Ryan Murphy and Matthew Hodgson

Disney+/FX

Bethan also recommends...

Film

The Substance

Coralie Fargeat

Full disclosure: I'm not sure I liked this film very much. But it simply must be watched, even just for the scene in which fading star Elisabeth Sparkle (Demi Moore) first takes the titular drug and her back splits open, revealing a younger, more beautiful version of herself. The Substance *achieves what* The Beauty *botches, and with a lot more vim and vigour.*

Editor's pick

Why you should treat life like a science experiment

10 January, p 43

From Simon Ward, Lutterworth, Leicestershire, UK

Congratulations to Grace Wade for succeeding in her New Year's resolution to run a half-marathon last year.

I'm a little sceptical about some of the claims derived from countless PR-fodder surveys about New Year's resolutions, but it does seem to ring true that our tradition of setting big, long-term goals at the start of January isn't always that effective.

Perhaps it is just a case of different approaches working for different people? For what it's worth, my current favourite approach is the Tiny Experiments method developed by neuroscientist Anne-Laure Le Cunff: ditch linear goals, and treat life more like a science experiment. Develop a hypothesis, put it to the test, evaluate the results, adapt and go again. Essentially, embrace trial and error, and don't feel bad about the failures – it's all valuable data!

Expressing individuality as part of the crowd

24 January, p 20

From Sam Edge, Ringwood, Hampshire, UK

The behaviour described in *The Lonely Crowd* does indeed seem very applicable to modern social media, as Annalee Newitz argues. However, it's been very common for at least a century.

Every generation thinks they're being more individual by "rebelling" and becoming a flapper, teddy boy, mod, biker, rocker (that was me), punk, skin head, goth or whatever. This always involves dressing the same as all the others in your new-found group, liking the same music, doing the same things and having the same opinions. All this while insisting to everyone that they are asserting their individuality.

In defence of practising effective altruism

24 January, p 28

From Thomas White, Sydney, Australia

I was saddened to see effective altruism included in "The 5 worst ideas of the 21st century". The idea in question is simply that when we give, we should try to do so thoughtfully, using evidence and reasoning to help others more effectively. In a century where many bright-sounding ideas have soured, from the gig economy to wellness optimisation, criticising the notion of giving more consciously is a strange choice.

The mystery of the missing meteorite lives on

Letters, 24 January

From Ian Smith, Chipping Norton, Oxfordshire, UK

I, too, am sceptical of the existence of a giant iron meteorite in the Sahara desert, but the two letters published on this question miss the point that Gaston Ripert didn't just see the object from a distance. He climbed over it and indeed brought back a sample that is clearly a rare type of meteorite. This makes the whole episode far more intriguing than "man fooled by mirage" or "man fooled by painted rock", unless he was spinning a yarn, which his personality suggests is unlikely. The mystery remains...

Which one came first: bread or beer?

13/20 December 2025, p 46

From Hazel Beneke, Banksia Beach, Queensland, Australia

Did bread or beer come first? Michael Marshall claims it is still undecided. But his evidence doesn't go back far enough. Grindstones with traces of grain, found at Cuddie Springs in New South Wales, have been dated to 30,000 years ago. And with evidence for occupation at Madjedbebe in the Northern Territory dating back to 65,000 years ago, it is likely that the starch residue on artefacts there is even older. Whether the seed at these sites were fermented or not is another matter.

More musings on our relationship with nature

10 January, p 19

From Gary Trethewey, Cherryville, South Australia

I am somewhat mollified that Richard Smyth has aired some unpalatable but necessary facts on our relationship with nature. Some say they are nature lovers, but only the bits of nature with bike paths, horse riding or 4WD tracks, and with trees removed to see the view. I so often find that people's expressed love of nature is based on fantasies, and that much actual nature is avoided because it is uncomfortable. Connect with nature by all means, but connect with the realities, not the children's fantasies.

Passing chess down through the generations

10 January, p 13

From Michael Smithson, St Albans, Hertfordshire, UK

I read with interest your article "Is it checkmate for the standard version of chess?". As the great-grandson of the mathematician Frank Morley, who started his life as an avid chess player at age 10, I was introduced to chess by my grandfather, his youngest son.

As a youngster, I experimented with hexagonal chess boards, played Chinese chess and Go, and I developed a quad-game board where standard chess (and draughts), Chinese chess, Japanese chess (Shogi) and Go could all be played. I am now introducing chess to my 7-year-old grandson, Francis Morley Michael. While we have so far stuck to playing on a standard chess board, the games are anything but the standard version. It is checkmate against me every time as Francis makes up his own rules and gobbles up all my pieces.

Hopefully, by age 10, he will play by standard, or fairer, rules, or something completely different that allows the game of chess to be more enjoyable for players of different rankings.

How to approach an era of water bankruptcy

24 January, p 8

From Carl Hinton, Northampton, UK

Calling the current water crisis "water bankruptcy" is more than a metaphor; it is an accurate diagnosis. Like financial collapse, it results not from a single dramatic failure but from countless routine decisions that quietly overspend a finite resource. What stands out is not a lack of knowledge. The science is clear, and has been for some time. The problem is behavioural: evidence accumulates faster than willingness to act on it. If this is truly an era of water bankruptcy, the open question is whether societies can change course before the costs become unavoidable.

A theory on why we might have junk DNA

10 January, p 12

From Nathaniel Hellerstein, San Francisco, California, US

I speculate that part of the reason for junk DNA is to make it difficult for viruses to manipulate our genomes. A side effect of this is that it will be difficult for us to manipulate our genomes.

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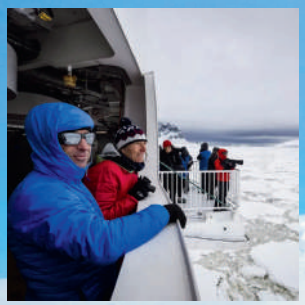

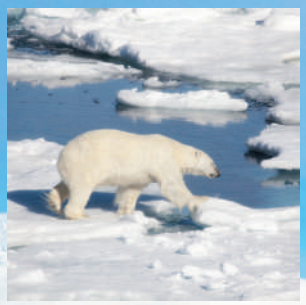

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Body, heal thyself

Tapping into the secret signals our organs send to each other could help us repair tissues and slow ageing, discovers **Claire Ainsworth**

AT FIRST glance, it might not seem like people have much in common with deer. But a strange discovery about how their antlers regenerate is lifting the lid on the unseen ways that our bodies work, too.

Biologist Chunyi Li, who has long studied deer in north-east China, noticed something odd that happened when the animals regrew their antlers each year. This regrowth coincided with healthier-looking animals that showed much faster healing of their wounds and less scarring, leading him to suspect that the regenerating antlers somehow promoted regeneration in the wider body.

Li's hunch was confirmed last year when he and his colleagues at Changchun Sci-Tech University in Jilin, China, found that the growing antlers release messages that tell other parts of the body to shift into regenerative wound-healing mode – evidence of a hitherto-hidden communication network that connects distant organs.

This finding doesn't apply only to deer. In recent years, researchers have discovered a web of chatter among the human body's organs and tissues, even those we once thought were dull and inert. We now know that your fat and brain tissue converse to influence the speed at which you age, your skeleton sends information packets to the pancreas to control metabolism, and much more.

By tapping into these communication networks, we may be able to develop radical new ways to boost our health and slow ageing – and some clinical trials of this approach are already under way.

These ongoing findings are emerging from the new field of inter-organ communication, which is building on the old physiological idea that organs function together as a greater whole.

We have long known that information is transmitted around the body via nerve networks and hormones, but what is extraordinary about these latest discoveries is the growing diversity of ways in which organs and tissues "talk" to each other to coordinate their action. Indeed, inter-organ communication is now seen as critical machinery for controlling metabolism, ageing and overall health.

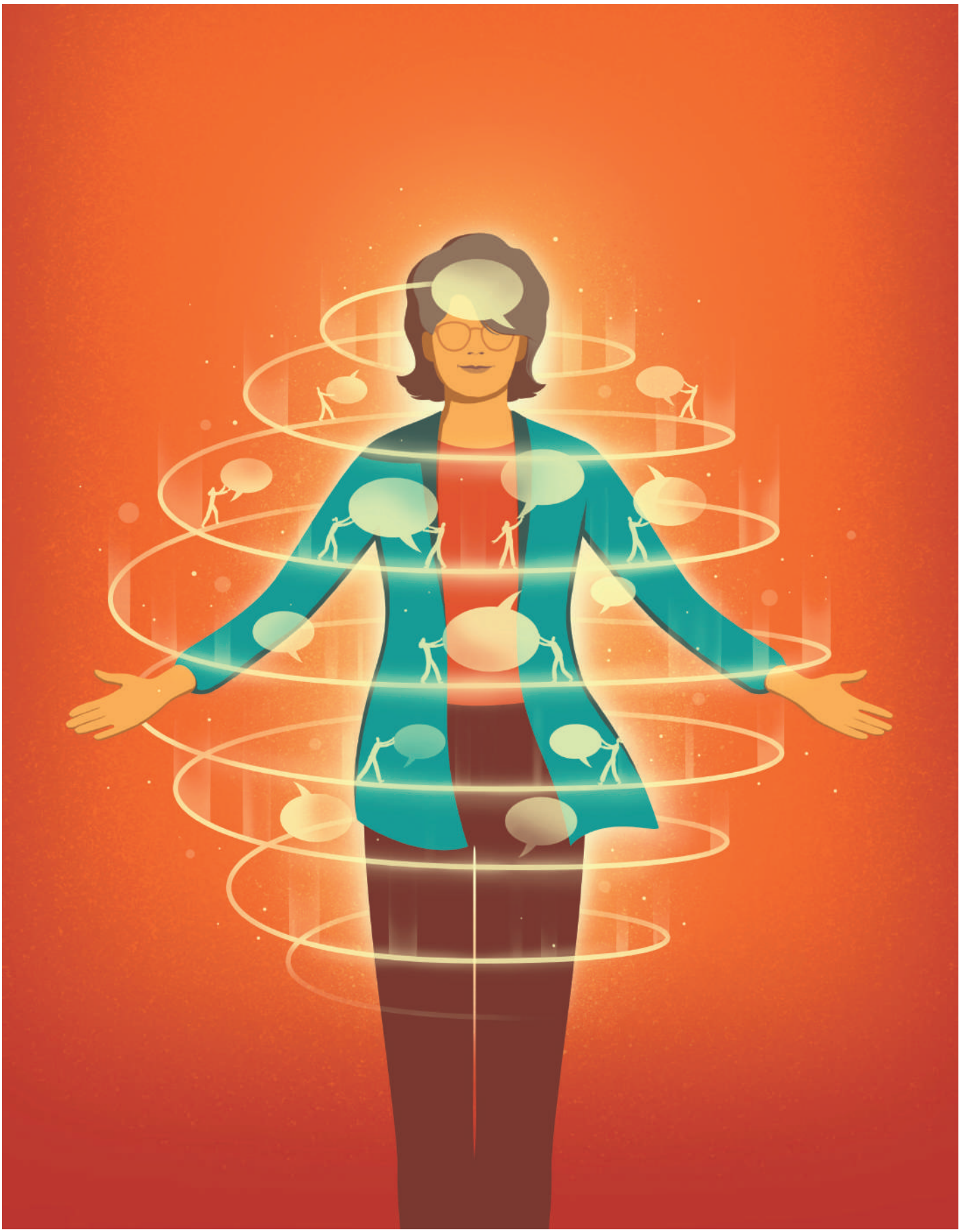
"I think we'll suddenly see that organs are communicating in ways we didn't know about," says Irene Miguel-Aliaga at the Crick Institute in London. "And then if we find that, then we can see what goes wrong in disease."

> // YOUR FAT AND BRAIN TISSUE CONVERSE TO INFLUENCE THE SPEED AT WHICH YOU AGE

The first clues that there might be more to some organs and tissues than first supposed arose in the mid-1990s, when researchers discovered that fat, or adipose tissue, makes a hormone called leptin, which helps control appetite and the body's energy balance. This transformed our perception of fat: once seen as passive storage tissue, it is now thought of as a dynamic, vital organ.

Since then, it has emerged that pretty much every organ or tissue is chipping in. One of the biggest surprises is bone, long thought of as a lifeless mechanical scaffold. In fact, we now know that bone functions as a sophisticated "endocrine" organ, secreting a hormone called osteocalcin that influences metabolism, male fertility and exercise performance. It even reaches the brain, where it reduces anxiety, improves spatial memory and enhances cognition. Boosting falling levels of osteocalcin may one day offer a way of tackling age-related decline in muscle and brain function.

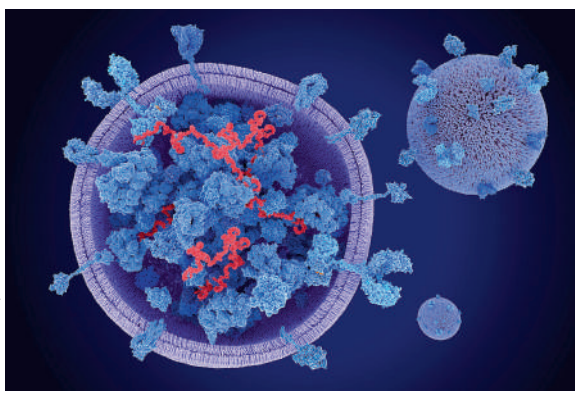
The skeleton has its fingers in so many pies because the energetic cost of running it is exorbitant. To repair tiny fractures caused by mechanical stress, bone is constantly being broken down by cells called osteoclasts, and in turn constantly rebuilt by cells known as osteoblasts. "Bone health has to be connected to energy metabolism in a way that bone can grow, but not at the expense of the other organs and function," says Gerard Karsenty at Columbia University in New York. This is ›



DAVIDE BONAZZI

CHRIS HOWES/WILD PLACES PHOTOGRAPHY/ALAMY

Messages sent between different organs by extracellular vesicles (below) are involved in the ageing process



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why it has such a powerful influence on so many other organs and tissues. And, importantly, other organs talk back.

One such organ is fat, which talks to bone via leptin. Back in 2002, it was discovered that fat sends signals to the brain, which responds in part by increasing nerve activity in the sympathetic nervous system, whose tendrils reach many organs, including bone. There, its nerve endings send signals to osteoblasts, reducing bone building and increasing bone destruction. This means that leptin signals from fat are a major regulator of bone mass.

A study from 2018 showed that these signals can be jammed with existing blood-pressure drugs known as beta-blockers, which inhibit stress hormones like adrenaline released by the sympathetic nervous system. So these drugs might be a cost-effective way of preventing bone loss in women after menopause and in older people more generally. Two clinical trials investigating this are currently under way.

Osteoporosis isn't the only condition that could benefit from intervening in inter-organ signalling: ageing itself could be a target. This springs from the surprising discovery in 2013 that a small region of the brain known as the hypothalamus appears to integrate conversations from multiple organs, and so acts as a high-order controller of ageing and, in turn, longevity.

Longevity controller

Shin-ichiro Imai at Washington University in St Louis, Missouri, whose team was one of the two that made the discovery, thinks of this orchestration as an entire interconnected system that maintains a stable function, or "robustness". When this robustness falters, it results in ageing and physiological decline. "We need to integrate all the different pieces from all the different layers, like a molecular layer, cellular layer, tissue, organ layer, to understand the whole system," he says.

Imai and his colleagues have put many of these pieces together. For example, in 2024, they showed that a particular subset of neurons in the hypothalamus of mice talks to adipose tissue through the sympathetic nervous system, triggering the release of an enzyme essential for producing NAD+, a molecule that is vital to cellular metabolism and associated with longevity. When the researchers stimulated these neurons in old mice, the mice lived longer than control mice that didn't receive this stimulation.

"This is the first demonstration in mammals that manipulation of specific neurons really delays ageing and extends lifespan," says Imai. Moreover, the 2024 study concluded that "these findings clearly demonstrate the importance of the inter-tissue communication... in mammalian aging and longevity control".

Other organs, including skeletal muscle and the small intestine, also converse with the hypothalamus. For instance, in unpublished work, Imai and his colleagues have identified the hormone used by skeletal muscle to communicate with this brain region.

Each of these communication pathways operates independently but synergistically to maintain the overall system's robustness, says Imai, which we can tap into in turn. So, rather than someone taking supplements to boost NAD+ in the hope of slowing down the ageing process – a strategy whose efficacy is still being investigated in humans – Imai proposed a new approach last year, which he terms "inter-organ communication management". This would involve interventions to strengthen each of these brain-organ conversations simultaneously "as an anti-ageing preventative measure", he says. "We are working to translate this idea to humans."

To do this, we need to fully understand all the different communication systems that organs use to send messages around the body. We now know that organs use a bewildering smorgasbord of languages to communicate, not just the well-known routes of hormones and nerve action. These include metabolites, small molecules carrying information about energy status and cellular health, and new signalling molecules, such as those produced when skeletal muscles contract that act on many other tissues, including the brain and liver.

New types of these messengers are constantly being uncovered, thanks to advances in analytical technologies. For instance, in January, researchers showed how a type of body fat called beige fat regulates blood pressure via a protein it produces called QSOX1, which helps control the stiffness of blood vessels. And a study from November last year found that cancer cells manipulate inter-organ signalling – in this case, via nerves – to undermine the immune response against them.

But one of the most exciting discoveries in the field of inter-organ communication is the way that many of these factors are shunted around the body in mysterious bubble-like blobs known as extracellular vesicles (EVs), which our cells constantly shed. When they were first spotted in cells in the 1980s, researchers assumed the cells were just spitting out junk. But we now know there

Our skeleton has a powerful influence on other tissues

MICHAEL HEISE/UNSPLASH

is a whole constellation of EVs of varying sizes, carrying a range of cargoes, from large vesicles bearing mitochondria (the energy engines of the cell) to smaller ones known as exosomes that carry tiny fragments of RNA called microRNAs, which can influence gene activity in recipient cells.

Here, too, new varieties of EVs are continually being unearthed, such as the discovery last year of particularly massive ones dubbed "blebbisomes", which function as mobile communication centres. At the opposite end of the spectrum are the tiny exomeres and supemeres, both discovered in 2021, which aren't encased in membrane. Plus, there are oncosomes, produced by cancer cells. All are emerging as important players in health and disease.

In a 2022 study, for instance, Saumya Das at Harvard Medical School and his colleagues showed that heart cells and a type of cell from connective tissue called a fibroblast communicate via EVs to limit the amount of scarring in heart failure. But EVs can cause problems, too. In 2023, Das and his team showed that EVs produced by the heart can make their way to the kidneys and cause damage by delivering harmful microRNAs – damage that could potentially be prevented by therapeutic intervention.

> // MANY OF THESE MESSAGES ARE SHUNTED AROUND THE BODY IN MYSTERIOUS BUBBLE-LIKE BLOBS

'Zombie' cells

Obesity, too, exerts some of its effects on the body via EVs. These can communicate with multiple organs, crossing the blood-brain barrier to talk to immune cells in the brain called microglia, which are involved in brain inflammation. "We're looking at the whole connection between obesity and dementia," says Das. Fat also talks to the liver via EVs, which are emerging as an important factor in a form of liver disease caused by metabolic dysfunction. And fat-derived EVs also seem to play a role in the development of heart arrhythmias in obesity.

Recent studies also show that EVs are implicated in neurodegenerative conditions such as Alzheimer's disease and Parkinson's, transporting microRNAs and pathological proteins from the brain to peripheral organs. This helps explain the progression of these conditions beyond the nervous system.

We are even finding that these once-mysterious blobs play a pivotal role in ageing. A key factor in ageing is the accumulation of senescent, or "zombie", cells, which promote inflammation and damage in tissue, leading to age-related decline. Senescent cells release EVs that, like sparks from a wildfire, trigger senescence in other cells, even in distant organs. Senescent cells in the lungs of people with chronic lung disease emit EVs that trigger senescence in distant blood vessels, for example. This probably contributes to what is known as the "multimorbidity of the elderly", the fact that older people usually have several chronic conditions, such as heart disease combined with muscle wasting and kidney disease.

Still, there is a long way to go before we fully understand the variety of EVs within the body and their precise roles. But this work underlines the idea that no organ is an island. "You really cannot think of [diseases of these organs] as siloed," says Das. For example, the leading type of heart failure was long believed to concern the heart only. "But the more you look at it, it's a systemic disease," says Das. "It has obesity, it has liver dysfunction, it has kidney dysfunction, it even has dementia." This may explain why GLP-1 drugs, although originally designed to aid weight loss and treat diabetes, are now being used to successfully treat heart failure.

This all raises the question of why our organs need to speak so many different languages. One possibility is that the location of the conversation matters. "Maybe there's ›

DANNY GREEN/2020VISION/NATURE PICTURE LIBRARY/ALAMY

Antler regrowth in deer seems to trigger better wound healing

a spatial logic to this communication, and then for that reason it matters what organ is next to what organ," says Miguel-Aliaga. In 2024, she and her team found that, in fruit flies, adjacent organs influence each other's shape by secreting specific substances, and that changing their geometry can make them function differently.

"We really don't understand this spatial specificity very well. But I think it's going to be important because I think it'll add a layer of information in between the organ and organism level that we still don't know about," says Miguel-Aliaga. "Potentially, it's a language in itself."

One reason why this kind of communication system might be useful is that it offers yet more versatility in targeting particular messages to specific "audiences" of tissues and organs.

> // RESTORING GOOD COMMUNICATION COULD PERHAPS MAKE HUMANS BETTER AT REGENERATION

Some signals, such as conventional hormones, are broadcast body-wide like a national radio show. Others could be locally confined, with organs whispering to each other like next-door neighbours over a garden fence.

Scar-free healing

While we don't yet know for sure why so many languages are needed, their existence highlights the complexity of coordinating a collection of organs in space and time into a whole organism. And it suggests that, while we thought we already knew everything about what our organs do, they are each likely to have a range of extra functions that we haven't yet discovered.

Restoring good communication – local, organ-wide and body-wide – could also help us understand more about regeneration and perhaps how to make humans better at it. Experiments linking the blood systems of both young and old mice have revealed the presence of signals that can rejuvenate some tissues and extend lifespan. And studies of animals that excel at regeneration are starting to show that, in many cases, it is a process involving coordinated responses from different tissues and organs, even those remote from the injury.

Amputating an axolotl's leg, for instance, triggers a body-wide reaction. The cells at the injury site revert to a more embryonic-like state, called a blastema, which gives them the flexibility to regenerate the limb – something mammals can't do. At the same time, cells in the opposite limb and in organs such as the liver, heart and spinal cord also start dividing. Intriguingly, although mice don't have the same reaction, if you damage a muscle in one limb, stem cells in the opposite limb enter an "alert" state that means they can respond to injury faster. This is triggered by a signal in the blood.

Li's work on deer antlers reveals similar principles, showing that both local conversations between neighbouring tissues and body-wide communication are involved in this spectacular act of regeneration. Applying extracts of blood from deer that are regenerating their antlers to wounded rats makes the rats' wounds shift to a regenerative form of healing that repairs them almost scar-free. Li and his team are now working on a formula to test this in humans.

Indeed, the challenge ahead for this field is to translate discoveries into new therapies, but this is beginning to happen. For instance, an ambitious project across five research centres in Germany was kick-started last year to investigate the role of faulty inter-organ communication in the irreversible muscle loss linked to conditions such as cancer and chronic obstructive pulmonary disease. Certain metabolites associated with these conditions can reprogram immune cells, which then promote muscle wastage. The project aims to identify these metabolites, with the ultimate goal of developing therapies that target them. And in the US, the National Institute on Aging has also identified inter-organ communication as a research priority.

It took four decades of patient observation for Li to discover the secret of the deer's mysterious annual rejuvenation. It turns out our own bodies have been just as cryptic, with our organs talking between themselves without us noticing. Now that we are learning to listen, we can find ways to turn their conversation to our advantage. ▮

Claire Ainsworth is a science journalist focusing on biology and biomedicine

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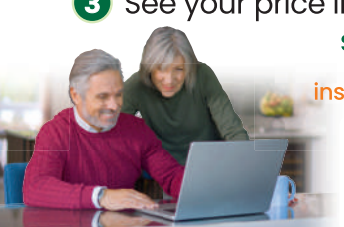

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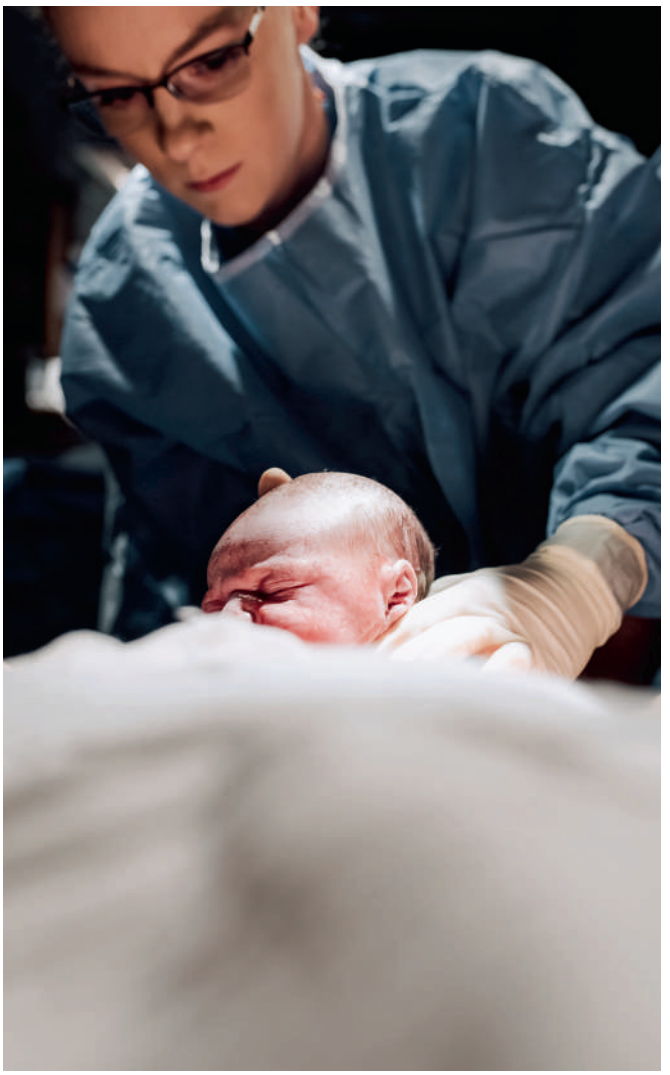
The childbirth conundrum

Some argue we're evolving to become wholly dependent on C-sections and other serious medical interventions. But a surprising new understanding of the pelvis tells a different story, finds **Colin Barras**



MEGAN MATTIUZZO

THE female pelvis may become too narrow for vaginal childbirth, meaning that caesareans could become the only option for delivering babies. At least, that's the claim made by a research team last year. Their calculations suggest that in Australia, Mexico and Poland, the average female pelvis is now 4.2 centimetres narrower than it was in 1926. If the trend continues, they wrote, surgery may be the only way for our species to continue.

Untangling whether this bold and controversial claim has merit means exploring one of human evolution's most famous – and most eyebrow-raising – hypotheses: the obstetrical dilemma. The idea is that an evolutionary battle has been raging over the female pelvis for millions of years, with the structure being simultaneously under pressure to be narrower to assist with walking on two legs and wider to make childbirth easier.

The new claim is based on an updated version of the dilemma, which argues that modern medical technology allows women to give birth no matter the shape of their pelvis. This, it is suggested, has redrawn the battle lines in a way that allows for the narrowing of hips. In the past, a narrow birth canal or a too-large baby would have probably proved fatal for mother and infant in childbirth. But because caesareans reduce this evolutionary pressure, the genes that code for narrow hips can be passed on.

Things, of course, are rarely so simple. Over the past 15 years, some researchers claim to have found evidence against the hypothesis, while others offer evidence in its favour. Yet more have broadened it out to incorporate surprising factors, from the advent of farming through to changes in our modern diet. The big question is, have their efforts brought us any nearer to explaining why childbirth is often so difficult – and to predicting whether it will become even more so in future?

Childbirth is notoriously painful. It is also potentially dangerous, claiming tens of thousands of lives each year. Countless more women are left with life-changing injuries, including pelvic organ prolapse. "It's astonishing that in 2026, with all our medical technology, maternal and fetal mortality and morbidity rates are still so high – including in wealthier countries," says Nicole Webb, a palaeoanthropologist at the Senckenberg Research Institute and Natural History Museum in Germany. This seems to make little

Scientists have long wondered why giving birth can be difficult and painful

sense. After all, childbirth is critically important for the survival of our species. "As an evolutionary biologist, it is difficult to reconcile the fact that the very process that enables our reproductive fitness can also hinder it," says Webb.

For decades, the obstetrical dilemma has been the go-to explanation for why childbirth is such a risky process. Although the roots of the idea can be traced back to the early 20th century, it was first properly described only in 1960, in an article published by the late physical anthropologist Sherwood Washburn. Curiously for such an influential idea, it didn't appear in an academic journal, but in the pages of a popular science magazine, *Scientific American*, where it was mentioned only briefly in an article primarily concerned with the role of tools in human evolution.

Here, Washburn suggested that our ancient ancestors evolved a narrower pelvis – and by association a narrower birth canal, the vertical opening running through the pelvis – to allow for more efficient walking on two legs. Then, however, our ancestors also underwent selection for larger brain size. This created a problem – Washburn's signature obstetrical dilemma – because large-brained adults begin life as large-brained babies, and babies with heads above a certain size can't fit through a narrow birth canal.

For Washburn, evolution solved this dilemma by delivering babies at an earlier stage of development, when they were somewhat smaller – although not too much so, given that survival rates fall as birthweight drops. ›

CAROL GUZY/ZUMA PRESS WIRE/SHUTTERSTOCK

This solution had profound knock-on effects, he wrote, because those babies were then far more immature at birth and so required much more maternal care. Consequently, new mothers became helpless themselves, reliant on the males in the social group to hunt and provide for them. This, wrote Washburn, fundamentally shaped how humans organise socially, with a firmly patriarchal slant.

Given this conclusion, the obstetrical dilemma isn't the most enlightened of hypotheses. In fact, many researchers now question the assumption that ancient women were incapable of hunting or becoming powerful members of society. Still, the basic idea that the female pelvis is shaped by these two competing factors is accepted by lots of people working in the sphere of evolution, despite being frustratingly ambiguous. Even today, for example, there is no consensus on whether "efficient" walking should be measured in terms of the energy needed to move, or simply in terms of how easily – and, in particular, how quickly – someone can get from point A to point B.

Shaping the pelvis

All this means that testing the obstetrical dilemma is difficult. Gathering the necessary data is challenging, as this ideally includes detailed pelvic measurements of a large number of individuals whose behaviour and medical history are then tracked through time. Last year, though, Marianne Brasil, an anthropologist and biologist at Western Washington University in Washington state, and her colleagues explored the dilemma with a sample of more than 30,000 people – both male and female – using data from the UK Biobank, a biorepository that contains medical and lifestyle information from a large cohort of people living in the UK. The researchers found that people with larger birth canals had slower self-reported walking speeds, in line with the obstetrical dilemma.

But Anna Warrener at the University of Colorado Denver sees problems with that conclusion. Not only are self-reported walking speeds potentially unreliable, she says, but Brasil and her colleagues had to use the low-resolution X-ray scans contained within the UK Biobank to measure birth canal size. These scans provide only a face-on, two-dimensional picture of the pelvis, whereas the birth canal is – obviously – three-dimensional. Brasil concedes that this was a limitation of the study.

A further issue is that the obstetrical dilemma assumes that the shape of the pelvis is controlled only by walking efficiency and childbirth capacity. Over the past 15 years, that assumption has been challenged.

Some researchers say that pelvic floor health is also important, to take one example. A narrower pelvis might offer better support for the internal organs – and for the fetus during pregnancy. In line with this idea, Brasil and her colleagues found that individuals in the UK Biobank with wider birth canals were more likely to experience pelvic organ prolapse.

Researchers, including Brasil, think this could influence the evolution of the pelvis. The argument is that women who develop pelvic floor problems during their first experience with childbirth may be unwilling or unable to go through the process again, and so contribute fewer genes to the next generation.

On top of these potential additional complexities, there is a broader problem with the obstetrical dilemma: if, as Washburn suggested, it was solved millions of years ago, why is childbirth so hard for many women today? A decade ago, theoretical biologist Philipp Mitteröcker at the University of Vienna in Austria and his colleagues suggested an explanation. They argued that the key to the mystery is to remember that natural selection works at the level of populations. "It doesn't optimise individual health," he says.

At the population level, he says, there has been selection to ensure that the average female pelvis is large enough for childbirth. But because pelvic shape varies naturally across a population, some women inevitably develop a pelvis that is simply too narrow for vaginal childbirth. So, while such childbirth is possible – if painful – for most women, it is simply impossible for others, with terrible and even potentially fatal consequences, says Mitteröcker.

In their study, Mitteröcker and his colleagues then threw yet another variable into the mix: our sophisticated human culture. Over the past few centuries, medics have developed obstetrical instruments and procedures that can help deliver even uncomfortably large babies – and, since the mid-20th century, caesareans have become increasingly available for the safe delivery of babies who won't fit through the birth canal.

Mitteröcker and his colleagues argued that these cultural inventions may have relaxed the selective pressure on women to grow

Medical interventions, such as regular screenings , have led to improved maternal mortality rates

"SOMEONE WITH GENES FAVOURING A WIDE PELVIS MAY DEVELOP A NARROW ONE IF THEY EXPERIENCE A VITAMIN D DEFICIENCY DURING CHILDHOOD"

a large pelvis. A mathematical model the team developed suggests that, since the 1950s, there may have been a 20 per cent increase in the number of women with a pelvis too narrow for childbirth. "Everybody thinks in terms of thousands or millions of years when talking about evolution," says Mitteröcker. "But to increase or decrease certain body dimensions, that can go pretty fast."

His view is far from accepted, however. Others are sceptical that we would see so much change over such a short period. "I would expect that it would take, very likely, much more than a few hundred years, especially with our relatively long lifespans," says Brasil. Things become murkier still when you consider that childbirth itself has become a divisive topic in mainstream society, and the obstetrical dilemma – even if unintentionally – could filter into the debate.

One of the issues here, Warrener wrote in a 2023 paper, is that childbirth became increasingly medicalised during the 20th century. To some, it has become over-medicalised. To counter this trend, there are now advocates for "natural" childbirth without medical help – some extreme versions of which have been linked with baby deaths. This general trend, wrote Warrener, can leave pregnant women in a difficult position: expressing doubts about any medical intervention might mean being called "ignorant" by some in society, but if they ultimately need medical assistance during birth, they may be labelled a "failure" by others.

For Webb, though, the obstetrical dilemma hypothesis is valuable here because it can help women contextualise any problems they may experience during childbirth. "I think one should be able to say that there are evolutionary forces at play that can explain birth difficulty," she says. "We want to empower women to know that if you can't give birth naturally, it's not your fault."

"A NARROWER PELVIS MIGHT OFFER BETTER SUPPORT FOR THE FETUS DURING PREGNANCY"

ZEPHYR/SCIENCE PHOTO LIBRARY

Some believe the female pelvis is shaped by two competing factors: walking upright and larger-brained babies

A caesarean-only future?

Which brings us back to the study on the remarkable narrowing of pelvises in Australia, Mexico and Poland, and the suggestion that evolutionary forces will eventually leave no woman able to give birth without surgical intervention. Mitteröcker is convinced that the study, conducted by Maciej Henneberg at the University of Adelaide in Australia and his colleagues, has identified a real trend, and that the team is correct to tie it to changes in medical care during childbirth. "To show this in three different populations in three different countries is, I think, convincing," says Mitteröcker. Webb, too, says that the researchers are on to something with their results.

But neither Mitteröcker nor Webb thinks this will lead to a caesarean-only future. This is partly because any selective pressure for women to develop a narrower pelvis is probably weaker today than it was in the past. For instance, walking efficiently was vital for early humans on the savannah, but it is less important for modern humans, whose lives are far more sedentary. Even Henneberg is softening his initial bold claim: "I understand the scepticism," he says. He adds that he really meant to imply that "practically all" births could require medical assistance with tools and techniques such as forceps or vacuum extraction, as well as just caesareans.

As we have seen, some researchers, including Brasil, take this scepticism further questioning whether new medical practices would prompt evolutionary change on a timescale of decades. But if such changes would take longer to register, how else could we explain the pelvic narrowing ›

INDRANIL ADITYA/NURPHOTO VIA GETTY IMAGES

Modern diets may be contributing to continued difficulties with childbirth

"THE SWITCH TO FARMING LEFT WOMEN WITH SMALLER BIRTH CANALS, BUT LARGER BABIES TO DELIVER"

that Henneberg and his team reported? Some researchers think it is worth considering one final factor: diet.

Although there is now strong evidence that pelvic proportions are heritable, as implied by the obstetrical dilemma, we also know that genetics isn't the whole story. Even someone with genes favouring a wide pelvis may develop a narrow one if they experience a vitamin D deficiency during childhood, for example.

Diet more generally also influences pelvic development. Jonathan Wells, an anthropologist and paediatric nutritionist at University College London's Great Ormond Street Institute of Child Health, says this suggests that the advent of farming roughly 12,000 years ago was a watershed moment in the history of childbirth. Abandoning the hunter-gatherer lifestyle led to a diet richer in carbohydrates and calories. This is generally agreed to have contributed to a worsening of health that restricted growth during childhood, while also, strangely enough, promoting fetal growth during pregnancy. The result, Wells and his colleagues argue, is that farming left women with smaller birth canals, but larger babies to deliver, leading to greater childbirth difficulties.

Wells speculates that the link between diet and childbirth may even help explain one of the greatest mysteries of recent human evolution. About 7000 years ago, some humans developed the ability to digest dairy milk well into adulthood. This "lactase persistence" then spread through many populations over just a few millennia. "It was like wildfire," says Wells. "People have long been wondering why."

A new dilemma

A few years ago, he and his colleagues said childbirth might have been a factor. A dairy-rich diet is more nutritious, promoting skeletal growth – including the bones defining the birth canal. As such, being able to digest dairy milk may have translated to fewer women dying in childbirth, he says, meaning that consuming dairy spread as a practice, because it brought a dramatic boost to communities.

Researchers are still exploring the connection between diet and childbirth, but some societies seem to have long been aware of the link. Last year, Wells and his colleagues published a study exploring dietary food choices during pregnancy in Madagascar. They discovered that cultural taboos on the island discourage pregnant women from eating too much bread or other carbohydrate-rich food precisely because islanders are aware that the foods promote fetal growth and make childbirth harder.

Unfortunately, such local knowledge might be losing its power in today's connected world. Ultra-processed foods that are high in calories but low in important nutrients are now widely available, contributing to a global rise in obesity. Wells thinks this might help explain why death during childbirth remains a real risk in low-income countries. Because processed foods are cheaper than healthier foods and readily available, women might struggle to eat a nutritious diet, which Wells says has exacerbated childbirth difficulties in these countries, leading to what he has dubbed a new obstetrical dilemma.

Even if he is correct, however, there may still be a positive message here: if it ever proves possible to reverse obesity trends by improving diets, childbirth may become easier for many women in low-income countries. "You're not going to see changes overnight, but a healthier diet could actually contribute to better childbirth outcomes," says Wells.

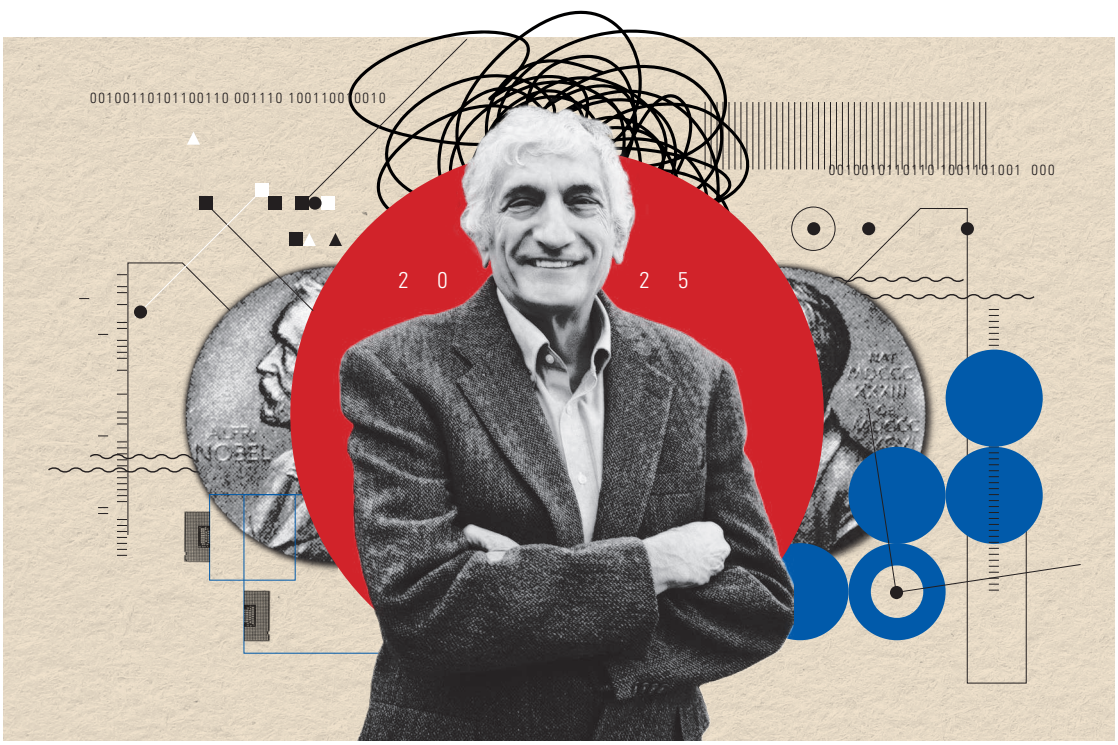
The obstetrical dilemma was introduced almost 66 years ago in a few brief lines buried in a popular science article. Since then, Washburn's hypothesis has been defended by some and rejected by others. But in the past 15 years, it has also evolved into a much grander idea that incorporates all manner of other variables, including pelvic floor health, medical technology and even junk food to explain why childbirth continues to be difficult and potentially dangerous.

We now know that Washburn's idea wasn't the final word on the subject, but merely the starting point for an investigation that has expanded in strange and unexpected directions – even if some recent claims, like the eventual end of childbirth without medical intervention, are on the shakier side. Grappling with why delivering human babies is so fraught for so many comes with no neat answers. Exploring it, though, illustrates the profound ways that childbirth has shaped our evolution – and continues to do so. ▮

Colin Barras is a science writer focusing on life sciences

"We are excited about how we can change the way quantum computers are built"

Nobel prizewinner **John Martinis** has already revolutionised quantum computing twice. He tells Karmela Padavic-Callaghan his radical plan to overcome the technology's next big sticking point



RYAN WILLS FOR *NEW SCIENTIST*

JOHN MARTINIS is a hardware guy. He prefers the nitty-gritty of doing physics in the lab over the idealised world of books. But you couldn't write the quantum computing history books without him: he was central to two of the most pivotal moments in the field. And he is hard at work chasing the next one.

It started in the 1980s, when Martinis and his colleagues ran a series of experiments to probe the edges of what was known about quantum effects – for this work, he won a Nobel prize last year. Back when he was a graduate student at the University of California, Berkeley, we knew that subatomic particles were subject to quantum effects, but the question was whether the world of quantum mechanics could extend to larger scales.

Martinis and his colleagues built and studied circuits made from a mix of superconductors and insulators where, it turned out, many charged particles within the circuit behaved as if they were a single quantum particle. This was macroscopic quantumness, and it laid the foundation for building some of today's most powerful quantum computers, including those ›

"We've had a surprising amount of pushback and scepticism"

currently championed by IBM and Google. In fact, Martinis's work set in motion the trend of tech giants using quantum bits, or qubits, made from superconducting circuits – the most widely used qubits in the world today.

The second time Martinis shook up the field, he was leading the team of Google researchers who built the quantum computer that achieved "quantum supremacy" for the first time. For nearly five years, it was the only computer in the world, quantum or otherwise, that could verify the output of a random quantum circuit. It was later bested by classical computers.

Now, on the cusp of turning 70, Martinis thinks he can score another historic win with superconducting qubits. In 2024, he co-founded QoLab, a quantum computing company that, he says, will take a radically new approach to attempting to create what everyone in the field has been chasing: truly practical quantum computers.

Karmela Padavic-Callaghan: You made waves early in your career with some really fundamental work. When did you begin to understand that your experiment could lead to a new technology?
John Martinis: There was a question about whether a macroscopic variable could evade quantum mechanics, and me being young and just learning quantum mechanics made it seem like that's something we needed to test. Maybe, if you were older, you just assumed that quantum mechanics would work. But as a young student it sounded like a fantastic experiment to do a fundamental test of quantum mechanics.

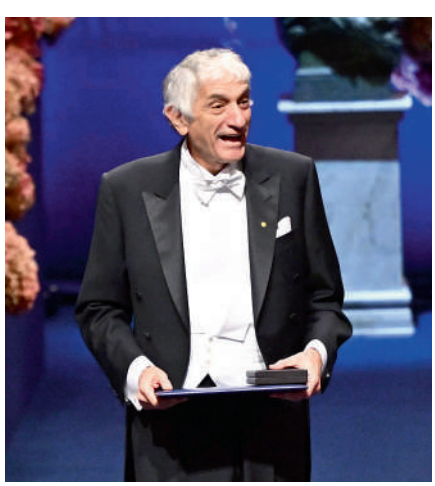
The first thing we did was set up a very crude and fast experiment using the technology of the day. When we took the data, the experiment was an utter failure. But we were able to fail fast, so it didn't matter. In the end, it was an experiment where you had to understand microwave engineering. You had to understand the noise, there's a lot of technical things we had to do, but [success] happened pretty fast after that.

For the first 10 years after that, we were taking this experiment and building quantum devices. Then, the theory of quantum computing advanced a lot, I would say especially the Shor algorithm [which factors large numbers for breaking cryptography], then error-correction [algorithms] soon after. That provided a firm foundation for the field. People could now imagine building something. Because of that, funding became available.

How did funding change the research and, ultimately, the technology?
Things have really changed since the 1980s. Back then, people hadn't even tested whether a single quantum system could be manipulated and measured properly. It's interesting where things have gone in the last 40 years. Quantum computing has grown into a huge field! The proudest thing about all of this is how so many physicists are now employed to understand the quantum mechanics of these superconducting systems and to build quantum computers.

You had a hand in the earliest days of quantum computing. How does that help you understand where the field is going now?
Having been part of the field the whole time, I understand the fundamentals of the physics.

John Martinis won the Nobel prize in physics last year



ANDERS WIKLUND/EPA/SHUTTERSTOCK

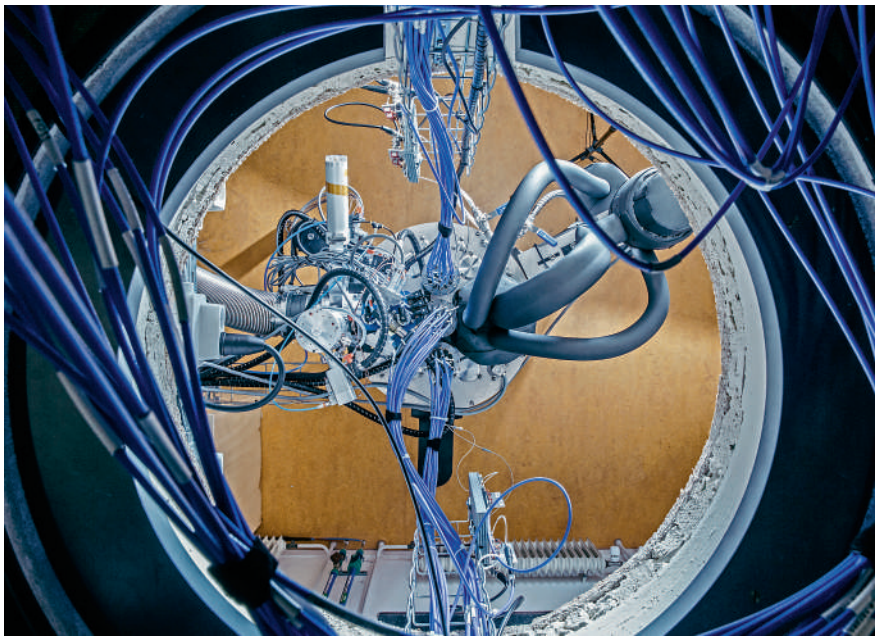
I built the first microwave electronics for [quantum devices] in our group at the University of California, Santa Barbara, and then at Google, I built my own cryostats [devices that keep superconducting quantum computers chilled to the extremely cold temperatures they need to operate]. I was involved in fabrication of every element. I think a lot of people, if they haven't been through all that, they'll just be optimistic that we'll keep forging on ahead. I know where all the problems are. If you want to build a very complicated computing system, it's all systems engineering, and I think I have an advantage in that I understand the basic physics of everything pretty well.

How do you think quantum computing hardware has to change to make quantum computers useful and practical? What changes are you betting on as the start of the next breakthrough?
After leaving Google, I thought about a quantum computer as a whole system and rethought all the fundamentals of what it is that we actually have to build and make better. QoLab is based on that, with fairly dramatic changes in how we build the qubits [in terms of manufacturing techniques] and how you put together the whole thing, especially the wiring.

What we realised is that you have to think about building quantum computers in a totally different way to make the technology reliable and to bring down the cost. It's hard, and hard for people to understand. We've had a surprising amount of pushback and scepticism, but from my experience doing physics for many decades, this means that we have a good idea.

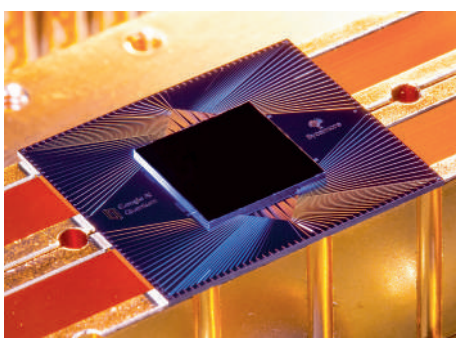
We sometimes hear that to make an error-free quantum computer that is truly useful, it will need a very large number of qubits, in the millions. How do you get there?
In terms of where we're looking to make the biggest disruption, it is in manufacturing and, in particular, in manufacturing quantum chips, which is also the most difficult part. If you look at what everyone is doing – Google, IBM, Amazon and many other companies – they are using manufacturing techniques that are from, I don't know, something like the 1950s or 60s. I don't know [any other industry that] builds real circuits these days with those methods. So, our view is, if you want to make a million qubits and make them reliable, you want to do something else.

We feel very excited about how we can fundamentally change the way these devices are built. And we have an architecture for the chips that can help get rid of all the wires.



MATTIA BALSAMINI/CONTRASTO/EYEVINE

Cryostats are used to keep quantum computers cold



ERIK LUCERO

Making quantum chips is the most difficult part

If you look at a picture of [superconducting] quantum computers, it's just a jungle of wires and microwave components. I want to put all that stuff in a chip and be able to scale that up. In superconducting qubits, the big problem is the wiring problem, and we're working to solve that.

Do you think there will be a clear winner in the race for a practical quantum computer in, say, five years?

There are a lot of different ways in which people are trying to build a quantum computer and, given that the systems engineering constraints are very difficult, I think it's good to approach this problem in many different ways. I think it's good that a lot of different ideas are funded, because then the chance of people having a breakthrough is better. But as I think about those constraints, and there are lots of them, I would generally say that a lot of the projects are being a little bit, I'll just say, naive about what it really takes to meet them, such as managing costs or producing devices at scale. On the other hand, I'm sure many research teams have ideas for getting through some of their design problems that they aren't talking about publicly.

And QoLab's business plan is, I think, a little bit different, maybe even unique, in that we're embracing collaboration because we feel we need all the expertise. We're working with hardware companies that know how to scale and know how to do sophisticated manufacturing.

If someone gave you a very large and error-proof quantum computer tomorrow, what would be the first thing you would try?

I'm really interested in using a quantum computer to solve problems in quantum chemistry and quantum materials. There are some recent papers on using it to help [extract more useful information from] nuclear magnetic resonance (NMR) experiments in chemistry and I really like that as an initial application. This quantum problem is hard to solve on a classical supercomputer because of the basic difficulties of quantum mechanics. But that is, of course, fundamentally solved with a quantum computer – you're just mapping a quantum problem into a quantum computer. I can get excited about that, in part because I like to have definite ideas on how to build [a device] and people have developed definite algorithms to do [applications like enhancing NMR].

A lot of people would maybe think about doing something with, let's say, optimisation problems and quantum artificial intelligence. For me, that is more of a "try it and see if it works". The theory behind materials applications and chemistry applications is much more definite. We know how big the [quantum computer] has to be. That machine is something I think we can build, both in terms of size and execution speed.

Some of the potential uses for quantum computers were mathematically determined more than 30 years ago. Why haven't they become reality yet?

You can abstract away the behaviour of a qubit and imagine how to build a quantum computer, and this is great, because then you can have computer scientists, mathematicians and theorists thinking about it. But the real problem here is that real qubits have noise sources [such as heat from external wires, or impurities in the qubit's own material], and problems that are physical things. A lot of big quantum computing efforts are run by theorists, which is fine, but the real system is way more complicated, as is what you have to do to build the hardware that can work properly.

In [my graduate advisor] John Clarke's group, I got trained to understand noise. This kind of background was really beneficial for me and people I worked with, because we were thinking about qubits in this very physical way, trying to get rid of physical noise mechanisms that make chips unreliable. This is what happened with the quantum supremacy experiment; [some of the noise comes from the fact that] you have these "two-level states" that are in your device and you kind of operate it to avoid them. You can get it to work, but it's a real pain in the neck, and just makes it hard to scale. My hope is that we [now] get rid of that effect or reduce it. You have to go into the details of qubit design to understand that.

The problem is, you have to have both the hardware and the ideas for applications, and I think we need to make the hardware much better across the field. So, that's what I'm focusing on. ▮

Karmela Padavic-Callaghan is a reporter at *New Scientist* focusing on physics, materials science and quantum technology.

The back pages

Debunking gardening myths

By any other name

It's a truism that weeds love poor soil, but is there anything to it? And what is a weed, anyway? **James Wong** investigates

James Wong is a botanist and science writer, with a particular interest in food crops, conservation and the environment. Trained at the Royal Botanic Gardens, Kew, in London, he shares his tiny flat with more than 500 houseplants. You can follow him on X and Instagram @botanygeek

ONE of the most common claims in traditional gardening lore is that weeds only grow in poor soil. Improve the fertility of your plot, and the weeds will disappear. If true, this simple trick could save gardeners hours of work, just by adding plant food. That's an attractive offer – so let's take a look at the evidence.

First, what do we actually mean by the word "weed"? Rather than a closely related group of plants, "weed" is really a catch-all term for any species growing where humans don't want it. If this sounds arbitrary or culturally constructed to you, that's because that's exactly what it is.

Many notorious weeds in some contexts live secret double lives as prized plants in others. Take the dandelion. It is easily the most common species on weedkiller packaging in the UK. Yet in Singapore, where dandelions are considered exotic, I've seen seeds selling for nearly $100 on online auctions.

In fact, all five of the most invasive plant species identified in a recent global study were originally introduced as garden plants. This blurs the neat distinction between "weed" and ornamental plant, arguably to the point where the word itself begins to lose much of its meaning.

What many commonly cited weeds do have in common is a vigorous growth habit. Their ability to establish quickly, reproduce readily and tolerate a wide range of conditions is precisely what allows them to appear where they aren't wanted. These traits often make them the first plants to colonise disturbed ground or neglected soil – places where other species struggle to gain a foothold. But tolerating poor conditions isn't the same as preferring them.

HEATHER DRAKE/ALAMY

In fact, many classic weeds actively favour rich soils. Stinging nettles, for instance, are strongly associated with nutrient-dense ground. Dandelions also thrive where nitrogen is abundant, not where fertility is low.

So where did the idea that weeds signal infertility come from? Like many gardening myths, this contains a kernel of truth. Improving soil fertility can allow a wider range of plants to grow, reducing the competitive edge of the most resilient pioneer species. This effect was demonstrated in the farmlands of 20th-century Europe, when synthetic fertiliser use increased. Vigorous grasses were finally able to outcompete troublesome weeds such as cornflowers and poppies – to the point where some of these species are now on the brink of extinction in the UK. The great irony is that these exact same plants are now highly fashionable wildflowers.

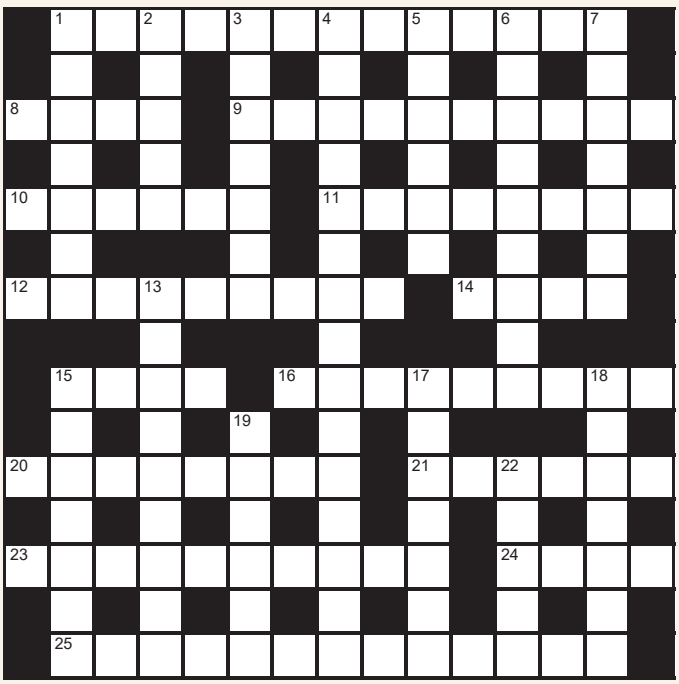
So where does this leave us? With our views about plants constantly shifting, it seems fair to say that weeds aren't so much reliable indicators of soil quality as they are reflections of human whims and preferences. ▮

Debunking gardening myths appears monthly

Next week
The science of exercise

These articles are posted each week at newscientist.com/maker

Quick crossword #201 *Set by Richard Smyth*



Scribble zone

Cryptic crossword next week

ACROSS

1 Irregular, ragged cloud type (13)
8 Landmass east of Europe (4)
9 Study of materials at low temperatures (10)
10 Four-sided shapes (6)
11 Developing dentition (8)
12 Exactly (9)
14 Waste orifice (4)
15 Conduit; tube (4)
16 Ludwig ___, Austrian mathematician (9)
20 Disconnecting switch (8)
21 Mineral, FeS_2 (6)
23 Protrusion of the thyroid cartilage (5,5)
24 Basic input/output system (4)
25 Saccharides found in rice and bread (13)

DOWN

1 Bobby ___, chess grandmaster (7)
2 Siren; warning (5)
3 IT experts (7)
4 Field of study that may involve X-ray diffraction (15)
5 Metal with attractive qualities? (6)
6 La (9)
7 SI units of time (7)
13 PET or nitrile rubber, say (9)
15 Junior academic (7)
17 Highest phase of a vehicle's transmission (3,4)
18 ___ oxide, laughing gas (7)
19 Prefix meaning "layer" or "sheet" (6)
22 *I*, ___, Isaac Asimov story collection (5)

Quick quiz #338
set by Michael Dalton

1 What is the name of SpaceX's mega-constellation of satellites that beam internet to the ground?

2 Bubble-net feeding is a hunting trick used by which marine animal?

3 Omar Yaghi was part of the team that won last year's Nobel prize in which category?

4 In what year was the Schrödinger's cat thought experiment first devised?

5 Two pests – the cotton bollworm and corn earworm – have interbed in which South American country?

BrainTwister
set by Howard Williams
#112 Pronic numbers

A sequence of numbers starts 0, 2, 6, 12, 20, 30, ...

Can you calculate the next two numbers in the sequence?

There are multiple ways to describe this sequence. Find one, and use it to calculate the 50th entry in the sequence.

Calculate 5^2, 15^2 and 25^2, and compare the answers with the terms in the sequence. What do you think 95^2 might be?

Answers to this week's puzzles on page 47

Loud and proud

Why are MRI machines so noisy, and what stops us making them quieter?

Guy Inchbald
Upton on Severn, Worcestershire, UK
MRI stands for magnetic resonance imaging. The technique relies on the rapid switching of powerful electromagnets to scan your body. One set of coils creates a powerful, static magnetic field. A second set varies its strength rapidly up and down like a switch to superimpose variations on the main field, and in this way it controls the focus of the scan. These coils aren't as powerful, but the variations are sufficient to generate strong mechanical forces on them. They are firmly fixed to the structure of the scanner, so they repeatedly push against it, making it vibrate.

The structure, in turn, pushes repeatedly on the air, which we hear as the buzzing sound. Anything that would quieten the buzz would either affect the magnetic field or block the hole we fit in, or both. Developers actually rewrote the scanning software to make the MRI machines sound less horrible.

"Anything that would quieten the buzz of an MRI machine would affect the magnetic field or block the hole we fit in, or both"

When I was scanned once, the staff offered me headphones and piped-in music, but I refused because I wanted to hear what the programmers had achieved. I quite liked it, in a modernist, atonal kind of way – it was certainly preferable to a bit of Arnold Schoenberg.

Jackie Jones
Brighton, UK
I don't think MRI scanners are designed to be loud. It must be a by-product of their workings and therefore may be impossible to silence. But, having had lots of MRI scans, it just takes getting used to the noise. Even after removing my hearing aids and wearing earplugs and headphones, it is still loud. I now think of it as being in a modern music concert, as it is interesting how the frequency and volume of the noise changes, so I just lie there and enjoy it.

BIOSPHOTO/ALAMY

Why don't orcas attack and eat humans when given the opportunity?

This week's new questions

Peaceful predators **As they are top predators, why don't orcas attack and eat humans when they have ample opportunity to do so?** ***John Still****, Portpatrick, Dumfries and Galloway, UK*

Not my fault **From an anthropological perspective, why does it seem that people dislike taking responsibility for their mistakes?** ***Marianna Hostick****, Newquay, Cornwall, UK*

Pinch of salt

Is the concentration of salt in the oceans gradually increasing? Will there come a point when plant and animal life in the oceans will no longer be able to tolerate it? (continued)

Alex Thomas
University of Edinburgh, UK
Short answer: no, not by enough to make the whole ocean inhospitable.

The ocean is salty because the elements that make up salt (mostly sodium and chlorine, but also sulphur, magnesium, calcium and a host of other elements) are added to the ocean by the weathering of rocks and condensation of volcanic gases. These elements are added alongside water in rivers and rain. The water is recycled via evaporation and precipitation, but the dissolved salts get left behind in the ocean. This is why the sea is saltier than the rivers that flow into it, containing, on average, 34.7 grams of salt per kilogram of water.

You might think this would mean the ocean is constantly accumulating salts and is therefore getting saltier over time. Salts are, however, removed by a range of processes. Calcium is removed by incorporation into the shells of marine organisms. Magnesium and sodium are removed by chemical reactions with hot volcanic rocks at mid-ocean ridges. Chlorine is removed at the slowest rate, as seawater gets trapped in the spaces between sediment grains of the seafloor, and this gets buried and eventually subducted into the deep Earth.

While uncommon in the modern ocean, there have also been periods in Earth's past where regions of the ocean became isolated and evaporation could then allow salts such as gypsum and halite to precipitate, removing sodium, calcium and sulphur from the ocean. The important things to note are that these removal processes are slow, because the elements that make up salts are so soluble in water, and removal rates are also proportional to the concentration in the ocean.

So, if the concentration of salts were to go up for any reason, the removal processes would eventually increase, which would lead to the overall content of salts in the ocean staying relatively constant.

Mike Follows
Sutton Coldfield, West Midlands, UK
In a warming world, it is tempting to imagine that the oceans are becoming saltier. While this is broadly true in the tropics, the opposite is happening in polar regions, where melting ice dilutes seawater. Overall, these effects largely balance out, resulting in little net global change in average ocean salinity.

Salt is composed of charged ions. Over geological time, the weathering of rocks has steadily supplied dissolved ions (such as sodium and chloride) to the oceans, alongside inputs from

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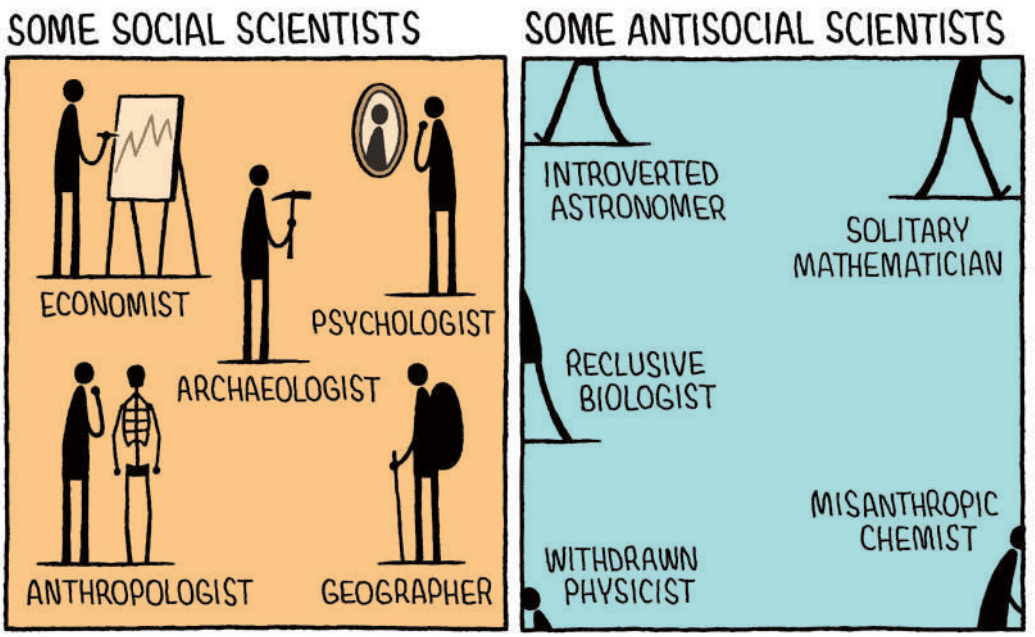
Tom Gauld
for New Scientist



hydrothermal vents. At the same time, other processes remove salt from seawater. One important pathway involves marine organisms that incorporate ions into their shells or skeletons. When they die, their remains sink to the ocean floor and may ultimately be buried at subduction zones. As a result, average ocean salinity has remained close to about 35 g of salt per kg of seawater for hundreds of millions of years.

Life is generally able to adapt to changes in salinity, even relatively rapid ones, and many species already tolerate extreme conditions. For example, brine shrimp (*Artemia*) can thrive in salt concentrations five to 10 times higher than those of normal seawater.

Even a mass extinction that severely reduced the number of species that incorporate ions into their shells, such as molluscs, corals and coccolithophores, would only slow the long-term removal of ions from seawater. It wouldn't cause a rapid or dramatic increase in ocean salinity, as the ocean salt budget changes only over very long geological timescales.

"Life can generally adapt to changes in salinity, even relatively rapid ones, and many species already tolerate extreme conditions"

Water world

If all the water on Earth's surface and in the air were put into a ball, how large would the sphere be? Could it exist in space by itself? (continued)

Derek Bolton
Sydney, Australia
The response from Garry Trethewey concludes that a 700 km-radius ball of ice in space would evaporate away. He appears to have assumed the context of Earth's orbit, but the original question doesn't mention any nearby star. Iceball comets can last for billions of years, only losing mass on approaching the sun. So the question becomes, at what radius from the sun could such an iceball survive?

There may also be some confusion between evaporation and boiling. Respondents mention air pressure, but that is relevant only to boiling. For evaporation, what matters is saturation vapour pressure (SVP).

Regardless of any other chemical species present, there needs to be enough water in the ball to produce a partial pressure (the component of atmospheric pressure that is due only to its water molecules) that exceeds the SVP at the ambient temperature. At 33 Kelvin on Enceladus, the SVP is a mere 0.00001 pascals.

At our iceball's radius, that only requires an atmosphere of 10,000 tonnes of water, a tiny fraction of what is available. And that atmosphere can remain because at this temperature, the typical velocity of a water molecule in the atmosphere is around 200 metres per second, while escape velocity from the iceball is 520 m/s.

Answers

Quick quiz #338

1 Starlink

2 Humpback whales

3 Chemistry

4 1935

5 Brazil

Quick crossword #201

ACROSS 1 Fractocumulus, **8** Asia, **9** Cryogenics, **10** Rhombi, **11** Teething, **12** Precisely, **14** Anus, **15** Pipe, **16** Boltzmann, **20** Isolator, **21** Pyrite, **23** Adam's apple, **24** BIOS, **25** Carbohydrates

DOWN 1 Fischer, **2** Alarm, **3** Techies, **4** Crystallography, **5** Magnet, **6** Lanthanum, **7** Seconds, **13** Copolymer, **15** Postdoc, **17** Top gear, **18** Nitrous, **19** Strato, **22** Robot

#112 Pronic numbers

The next numbers are 42 and 56.

The sequence is made up of the product of two consecutive integers, 0 × 1, 1 × 2, etc. It is also the cumulative totals of even integers, 0, 0+2, 0+2+4, etc. The series can also be generated by adding each integer to the square of itself, 0^2+0, 1^2+1, etc. The 50th entry would be 49 × 50 = 2450.

The squares of 5, 15 and 25 are 25, 225 and 625, which are the first, second and third numbers in this sequence with 25 appended. This means the square of 95 will be the 10th number in the sequence (9 × 10 = 90) with 25 appended, which is 9025.

Caped crusaders

It has been some time since Mrs Feedback was pregnant, but she still remembers the bother of trying to get a seat on public transport while having a belly the size and shape of a volleyball. Other passengers couldn't always be counted on to give up their seats.

But what if Feedback had snuck onto the bus, dressed as Batman? To our surprise and bafflement, this might have made a difference. Researchers led by Francesco Pagnini tried this experiment on the Milan metro system, in a study published in *npj Mental Health Research* in November 2025.

On 138 occasions, a female team member wore a prosthetic bump and got onto a train, accompanied by an observer. In some of these trials, a third experimenter also boarded, in a Batman costume. The get-up included "the characteristic cape, logo, and pointed cowl, making it easily recognizable", although they did leave out the mask "to avoid potentially scaring passengers".

Feedback has looked at the photo of the costume in the paper and we can say with confidence: nobody was going to be scared. It looks like the costume George Clooney wore in *Batman and Robin*, and that wouldn't frighten anybody.

Anyway, passengers offered their seats to the "pregnant" woman 67 per cent of the time when Batman was present, compared with 38 per cent when he was absent. The implication, the team says, is that "unexpected events can promote prosociality". Notably, the passengers often didn't consciously notice Batman: 44 per cent of those who gave up their seats in the presence of the Caped Crusader reported not having seen him.

It occurred to Feedback that maybe Batman, being a social justice warrior of long standing, primed passengers to think about concepts like fairness and decency. The researchers also thought of this, but they point out that experiments on social priming have often failed to replicate, priming being one of the phenomena that fell foul of the "replication crisis" in the social sciences. Hence their focus on the unexpectedness of Batman.

Extrapolating, the team suggests "psychologists may consider ways to integrate 'positive disruptions' into daily life", such as "artistic or theatrical interventions in public spaces" that would "momentarily break routine and engage individuals more deeply with their environment and community". This all reminds Feedback of the concept of "nudging" people into better behaviour, which, like social priming, has generally failed to replicate. In any case, it would seem to require an awful lot of costumes.

Maybe this says something about the places Feedback has lived, but we would barely look twice if someone got on the train dressed as Batman. We would just assume they were going to their local comic convention. Maybe the Milan cosplay scene is less vibrant than elsewhere.

Twisteddoodles *for New Scientist*

Got a story for Feedback?
Send it to feedback@newscientist.com
or New Scientist, 9 Derry Street, London, W8 5HY
Consideration of items sent in the post will be delayed

Read me

Feedback has remarked previously on the phenomenon of academics using pop culture references in paper titles, or otherwise writing whimsical titles in the hope of persuading us to read their work. It's a delicate line to walk, but when it hits, it hits. Full marks, then, to Rebekah White and Anna Remington for their 2018 study titled "Object personification in autism: This paper will be very sad if you don't read it".

It explores how often autistic and non-autistic people personify non-living objects and how this affects their emotional lives. At first, Feedback thought we didn't do this – our vacuum cleaner remains resolutely nameless – but then we remembered that we have tended to name our cars (we are currently driving Kitty, having sold Carol because she was rubbish) and our bicycles.

Clearly, we aren't alone. When the paper was shared on social media recently, one user responded: "Well, we just had a serious discussion about whether the robot vacuum was a boy or a girl and what their name could be." Feedback can answer that: put a brown floppy hat and some big black eyebrows on it, and name it after the iconic *Mario* baddie, the Goomba. That will rhyme with at least one brand.

Another said: "I always take one more croissant or bun from the counter if it's the last one left after I've taken the amount I need. Otherwise, the poor thing will worry and be upset that no one needs it..." Feedback does that too, but for different reasons.

Reviewer 2 strikes again

Before an academic can get a paper published, they must first run the gauntlet of peer review, in which other researchers critique their work (often anonymously). Academics therefore talk about "reviewer 2" in the same way that the rest of us talk about Satan, Pol Pot or people who talk in the quiet carriage of trains.

Historian Andre Pagliarini took to social media to report a particularly egregious instance of peer review: "a first: in rejecting an article I submitted to a journal, reviewer 2 noted I failed to engage the work of one Andre Pagliarini".

As others were quick to point out, this is a "damned if you do..." situation, because if Pagliarini had included more citations to his own work, he would either be accused of self-promotion or have his paper rejected for lack of novelty.

Feedback found ourselves mentally uttering the same line that others wrote in response: "But doctor, I am Pagliarini." And if you don't get that joke, tough luck, because Feedback has run out of room to explain it.

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