New Scientist

WEEKLY 3 January 2026

2026 PREVIEW

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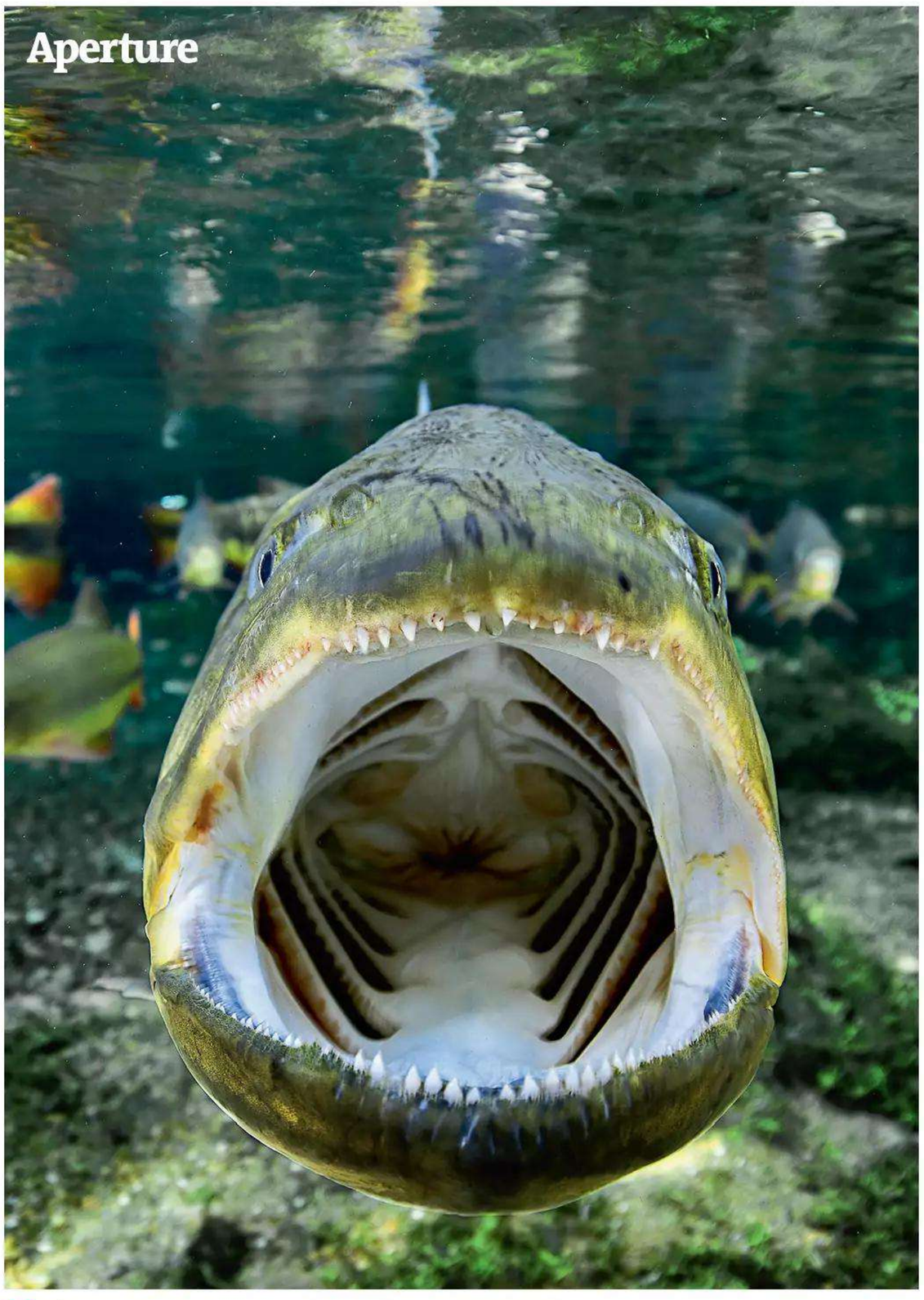

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The shape of things to come

Weight-loss drugs are set to get even bigger in 2026

PLEDGING to lose weight is a common New Year's resolution, particularly after the excesses of the holiday season. In years gone by, that would mean a new January diet, early mornings at the gym and a host of other habits that often prove hard to stick to. Which is why it is no surprise that many people give up after a few weeks.

Today, though, there is another option: weight-loss drugs. Rather than relying solely on changing your habits, you can turn to a regular shot of a GLP-1 agonist, or soon, as we detail on page 6, a pill. (Doctors do still recommend combining these drugs with regular exercise.)

Our Sisyphean annual health drive isn't the only thing GLP-1 drugs are disrupting. Restaurants are creating menus for "Ozempic diners", reducing portion sizes for people who simply aren't as hungry as before. Supermarkets have blamed falling sales on people taking the drugs. Airlines are even eyeing up the possibility of reduced fuel costs, as the weight of the average passenger falls.

Of course, it is unclear how much we can actually attribute these changes to GLP-1 drugs, which are still only taken by a small minority, and how much is down to brands jumping on the latest health trend. Yet with obesity affecting 1 billion people worldwide, rates of use are only set to rise. According to a World Health Organization estimate, fewer than 10 per cent of people who could benefit from GLP-1 drugs will have access to them by 2030, but that is still a sizeable chunk of the population.

"Restaurants are creating menus for 'Ozempic diners', with reduced portion sizes"

Still more advanced drugs are coming down the pipeline (see page 7), and their impact could be even larger. That is before we even turn to the many non-weight-loss uses GLP-1 agonists and related drugs are being trialled for, with studies showing the potential for treating everything from addiction to cataracts.

There are still many unanswered questions around long-term effects, what happens when you stop taking them and how to increase access, but prospects are looking rosy. As we enter the second quarter of the 21st century, weight-loss drugs look set to shape the future. ▮

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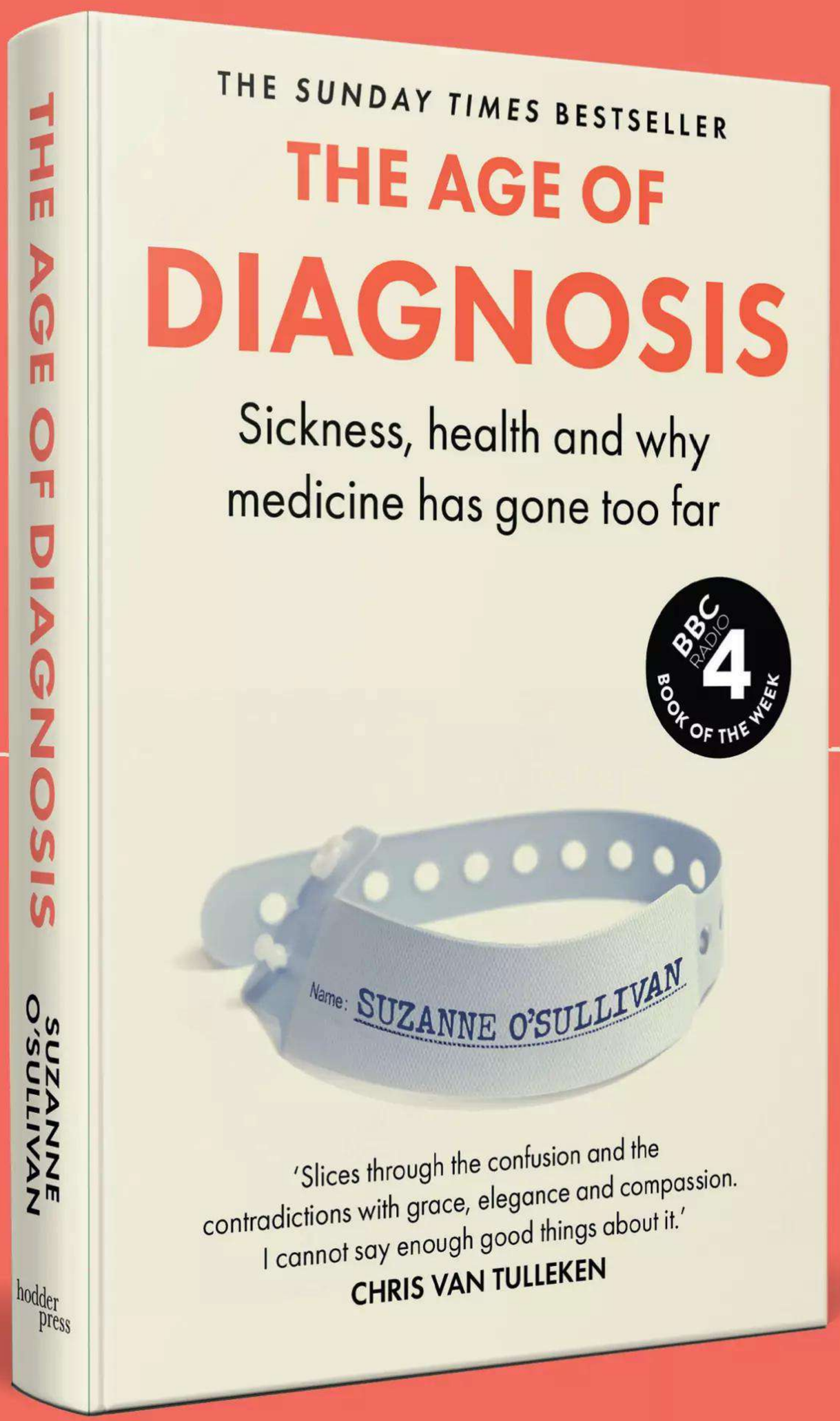


'Brave'
Financial Times

'Outstanding'
Guardian

A moving and eye-opening journey through modern illness from neurologist Suzanne O'Sullivan

A WATERSTONES **'BEST BOOKS OF 2025'**

Preview of 2026

-/AFP VIA GETTY IMAGES; GETTY IMAGES; NASA

THE YEAR AHEAD

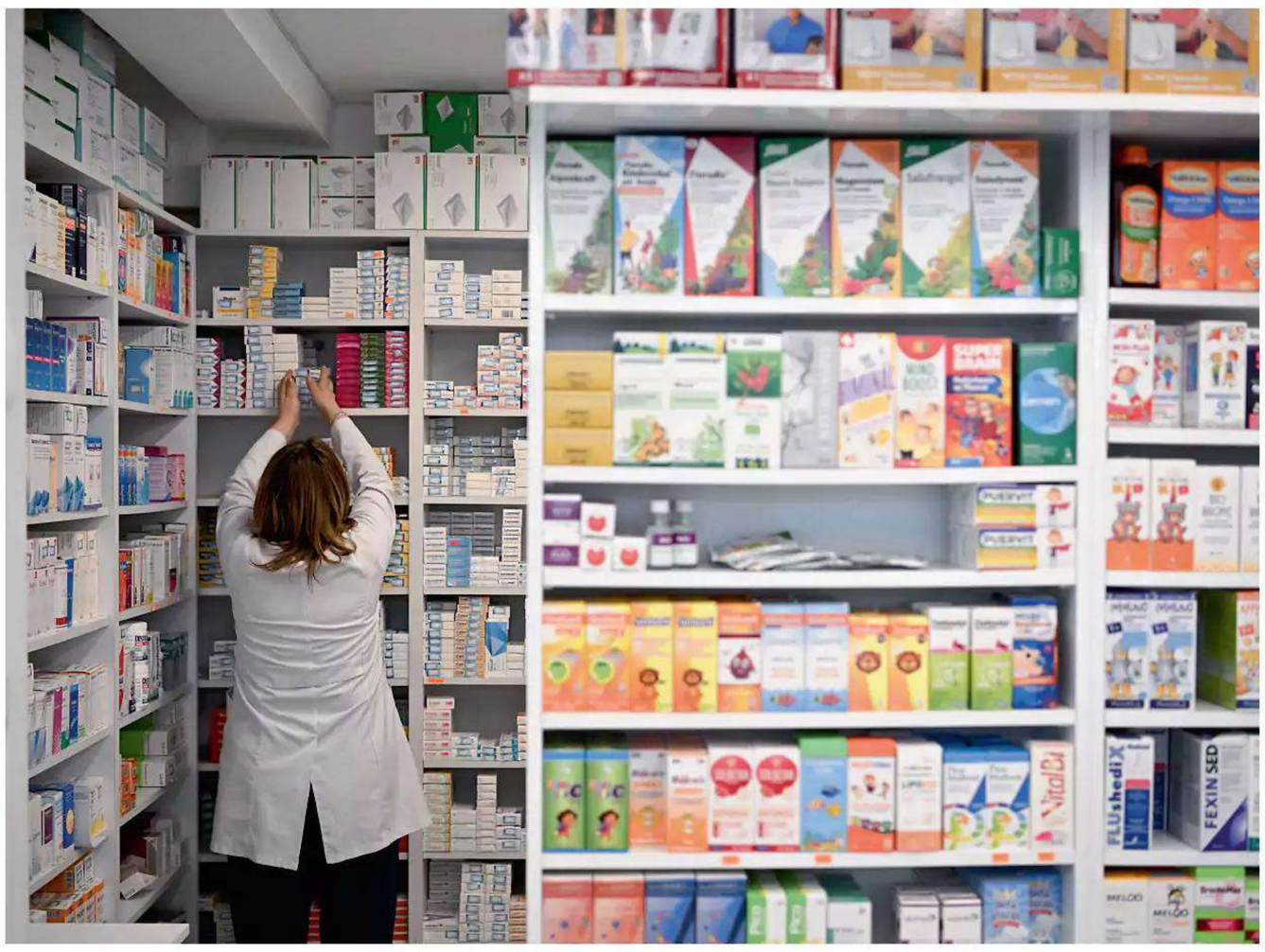
From space missions to medical breakthroughs, welcome to *New Scientist's* round-up of what's to come over the next 12 months

Health

Weight-loss drugs should get cheaper...

Medications like Wegovy are out of reach for most people, but that could soon change

Michael Le Page



ARMEND NIMANI/AFP VIA GETTY IMAGES

Supply for weight-loss drugs has struggled to meet demand

THE blockbuster weight-loss drug semaglutide and its rivals promise to help reverse the global obesity epidemic – if only more of the people who would benefit from these treatments could afford them. But this year could see welcome steps in that direction.

For years, weight-loss drugs were in short supply, but by the end of 2024, manufacturers had caught up with the huge demand. Yet medicines such as semaglutide (sold as Wegovy or Ozempic) remain very expensive, typically costing several thousand dollars for a year's supply.

That price tag puts them beyond the reach of most of the more than 1 billion people around the world who have obesity. Only 3 per cent of eligible people in the US are on weight-loss drugs, and less than 1 per cent elsewhere, according to the financial company Morgan Stanley.

But two key developments are expected this year. One is the approval of a drug called orforglipron in various countries. This works in the same way as semaglutide, by mimicking the action of a hormone called GLP-1, which reduces appetite. But it is a small molecule, meaning that, unlike semaglutide, it can be absorbed through the gut and thus taken in pill form.

3%

How many of those eligible in the US are currently on weight-loss drugs

1%

How many of those eligible in the rest of the world are taking them

"Tablets are cheaper to produce, easier to store and simpler to distribute," says Lora Heisler at the University of Aberdeen in the UK. "In short, pills can provide treatment to more people who need it."

Semaglutide, by contrast, is a large molecule, a kind of protein. Large-molecule drugs are generally much more difficult and expensive to manufacture. They also usually have to be injected, and supplying them in injector pens adds to the costs and complications. These are the reasons why manufacturers long struggled to meet the demand for GLP-1 drugs after they became popular for weight loss.

Confusingly, there is a pill form of semaglutide called Rybelsus, which is approved for type 2 diabetes, and the maker of semaglutide – Novo Nordisk – has applied for approval for a pill form for weight loss.

However, Rybelsus isn't an ordinary pill. It contains semaglutide in combination with a substance called salcaprozate sodium, which neutralises stomach acid and "fluidises" cell membranes, allowing semaglutide to pass through the cells lining the gut and enter the bloodstream. You don't want this happening with partially digested food, so Rybelsus has to be taken at least 8 hours after eating, and people can't eat or drink for half an hour after taking it.

All this is why orforglipron should be cheaper to produce than semaglutide, and why it can be taken without the special requirements for Rybelsus.

The approval of another GLP-1 drug will also increase competition between pharmaceutical companies. The maker of orforglipron, Lilly, has yet to announce pricing, but has indicated it will be cheaper than other GLP-1 drugs.

The only downside is that it seems to be less effective, with people on the highest dose losing around 10 per cent of their weight after 72 weeks, compared with around 14 per cent for semaglutide, though a head-to-head trial will be needed to confirm this.

Expiry date

The second big development is the expiry of semaglutide patents in countries including China, India, Brazil, Canada and Turkey. This means drug manufacturers can start selling generic versions.

Generics have to be approved and meet the same standards as patented versions, but can be much cheaper. "When a medicine loses patent protection, typically generic competition reduces prices by as much as 90 per cent," says Jeremy Durrant at Medicines UK, an association of generic medicine manufacturers.

So, soon a lot more people could have access to these drugs. But in guidelines released in December, the World Health Organization (WHO) recommended that people should get counselling on behavioural and lifestyle changes in addition to the drugs, to maximise the benefits and ensure they persist. "Medication alone cannot solve the global obesity burden," wrote Francesca Celletti at the WHO. ▮

...and further trials might make them even better

WHILE drugs for treating obesity such as semaglutide have been successful (see "Weight-loss drugs should get cheaper", left), the hope is that the experimental treatments on trial soon will prove even more effective.

"We are witnessing an exciting new chapter in obesity treatment that is improving the health and lives of many patients," says Lora Heisler at the University of Aberdeen, UK. "Obesity fuels some of the world's most serious diseases: cancer, heart disease and type 2 diabetes. Even a modest 5 per cent drop in body weight can lower those risks."

The drug semaglutide has turned out to have direct cardiovascular benefits, in addition to the benefits due to weight loss, and may also help treat other conditions, such as drug and alcohol addictions. However, semaglutide can have side effects, including nausea and vomiting, that result in many people discontinuing its use.

In 2023, a drug called tirzepatide (sold as Mounjaro for diabetes) was also approved for weight loss, marketed as Zepbound. Tirzepatide improves on semaglutide by having a dual action: it mimics both GLP-1 and another hormone called GIP, which is involved in regulating energy use and storage. It has similar side effects to semaglutide.

In a head-to-head trial, semaglutide reduced people's weight by 14 per cent, on average, over 72 weeks, whereas tirzepatide lowered it by 20 per cent. Other studies show that lost weight is typically regained if the drugs are discontinued.

Coming up next are more dual-action, and even triple-action, drugs. One that could be approved this year is CagriSema, a combination of a drug called cagrilintide – which makes people feel full by mimicking the action of a hormone called amylin – with semaglutide.

In a trial involving more than 3400 adults, people on CagriSema lost 20 per cent of their weight after 68 weeks, compared with 15 per cent for semaglutide alone and 12 per cent for cagrilintide alone. That suggests it is on a par with tirzepatide, though various trials are continuing.

"There are more promising drugs on the horizon that could produce even greater benefits"

A similar drug called amycretin is also in development. Like CagriSema, amycretin mimics both GLP-1 and amylin, but it consists of a single molecule that can bind to both the GLP-1 and amylin receptors, rather than two molecules.

In a small, early trial of amycretin with just 125 participants, people lost 24 per cent of their weight, on average, after 36 weeks. This suggests it might be better than tirzepatide, but it will be some time before this becomes clearer, with a final-stage trial starting only this year.

Then there is the "triple G" drug retatrutide, which mimics three hormones: GLP-1, GIP and glucagon, which triggers the release of fat stores. In a trial with 338 people, those on the highest dose lost 24 per cent of their weight, on average, after 48 weeks. Again, that is promising, but much depends on the results of the final-stage trials already under way. It is possible that retatrutide could be approved late this year, but it might be later.

The race is on

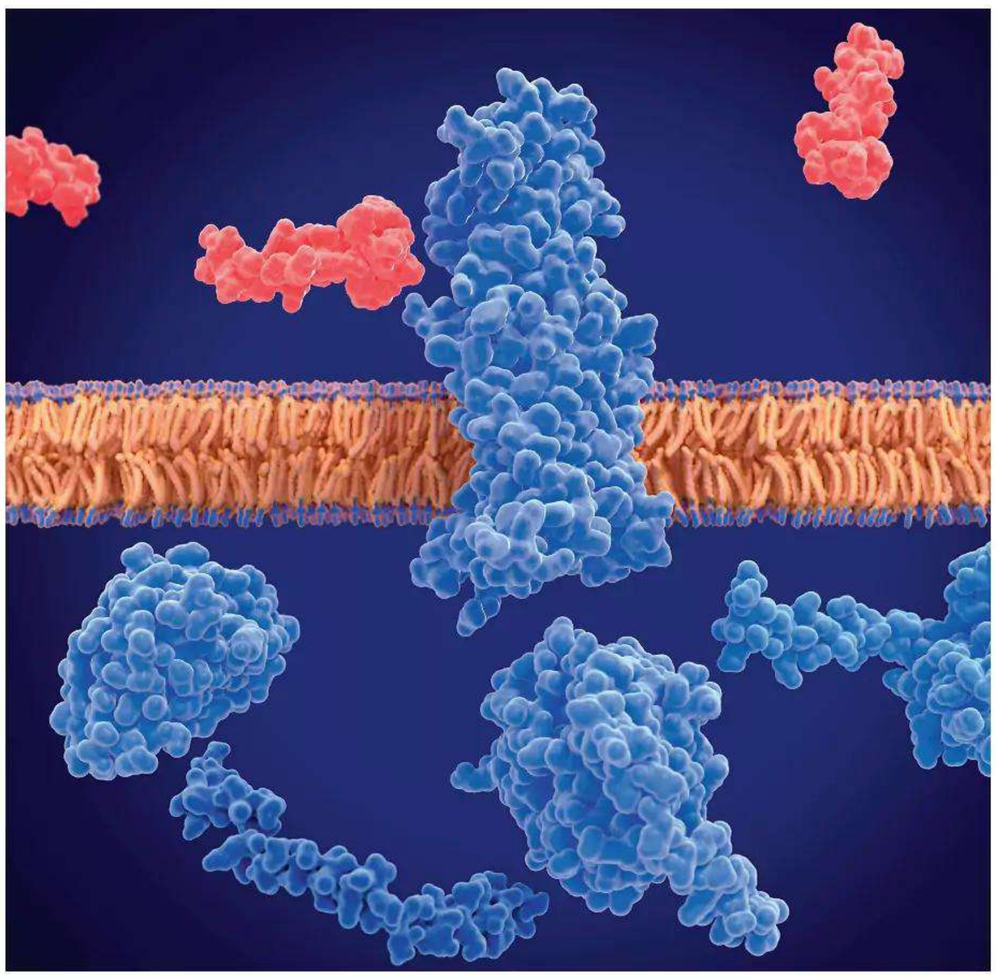
It should be noted that the figures for weight loss from different trials aren't directly comparable because of differences in, say, how participants were selected, as well as duration and dosing. The averages also obscure the wide variation in people's response to GLP-1 drugs: some don't respond at all whereas others see dramatic weight loss.

Beyond this year, more than 100 weight-loss drugs are in development as pharmaceutical companies race to get a slice of the lucrative market. Many target various combinations of the existing four targets – the GLP-1, GIP, glucagon and amylin receptors – but some involve different targets and mechanisms.

Others try to compensate for undesirable effects, such as the fact that some of the weight people shed on GLP-1 drugs is due to muscle loss rather than fat loss. For instance, a trial that finished in 2025 combined semaglutide with bimagrumab, which blocks a receptor that inhibits muscle growth, though the results have yet to be announced.

"What is really exciting is that there are more promising drugs on the horizon that could produce even greater benefit with fewer side effects," says Heisler. ▮ MLP

ALEX RATH/ISTOCK/GETTY IMAGES



JUAN GAERTNER/SCIENCE PHOTO LIBRARY/ALAMY

More drugs are in development, which will bind to GLP-1 receptors in the body (below)

Space exploration

NASA aims to return astronauts to moon

The oft-delayed Artemis II mission will soon have lift-off

Leah Crane

ASTRONAUTS are heading back to the moon for the first time in over half a century. NASA's Artemis II, scheduled to launch no later than April 2026, will take four astronauts in a loop around the moon, setting the stage to put boots on the lunar surface once again.

The mission has been repeatedly delayed from its original planned launch time between 2019 and 2021 due to complications on the ground, but it is looking hopeful that the wait could now be over at last. In September 2025, NASA stated that the Space Launch System (SLS) rocket is "ready to fly crew", and in November, the Orion crew capsule was stacked atop the rocket for a final series of tests. In fact, NASA has even said it hopes to move the launch up to February rather than April, though it is unclear if that will happen.

The four astronauts selected as crew members for the mission are Reid Wiseman, Victor Glover, Christina Koch and Jeremy Hansen. The first three are all NASA astronauts, each of whom has been to space once before, and Hansen is an astronaut from the Canadian Space Agency – this will be his first mission.

"As astronauts, we sign up to be the people to execute and operate the missions because we believe in human space flight; we believe in exploration," says Koch. "To get to fulfil that personal mission in a new way, doing something we haven't done in over 50 years, is just absolutely phenomenal."

"As astronauts, we believe in human space flight; we believe in exploration"

Artemis II will last for about 10 days, beginning with two days orbiting Earth before the spacecraft heads off towards the moon. During those first two days, the astronauts will test out the life support systems, as well as a protocol for meeting up with other spacecraft in orbit, which will be performed with a used-up and jettisoned rocket stage.

First steps

Then, the Orion capsule will fire its main thruster and jet off in a figure-of-eight loop around the moon. It won't enter lunar orbit. Instead, it will circle the moon just once before heading home. The closest approach to the moon will take the capsule about 7400 kilometres from its surface. At the end of the mission, the spacecraft will splash down in the Pacific Ocean.

It is a fairly similar mission profile to the Artemis I mission, which circled the moon in November 2022 as a first flight test of SLS and Orion. But that mission didn't have a crew. Since then, a few changes have been made to the spacecraft: among other things, its navigation and communications systems have been improved, some extra plates have been added to the exterior of SLS to dampen vibrations, and, of course, Orion has been outfitted with all the necessary systems to protect the astronauts.

Nevertheless, this, too, is a test flight. If all goes well, it is meant to set the stage for Artemis III in 2027, when astronauts will finally set foot on the surface of the moon for the first time since humanity's last visit on the Apollo 17 mission in 1972. But concerns about SpaceX's Starship lander, which is meant to ferry the crew to the lunar surface, could see that moment pushed back even further.

A lot is resting on the continued success of the Artemis programme, with more missions of increasing complexity planned through the 2030s and an eventual goal of setting up a permanent human presence on the lunar surface. ▮

NASA/KEVIN DAVIS; NASA/FRANK MICHAUX

Left: Assembling the rocket
Below: Artemis II crew (left to right): Reid Wiseman, Victor Glover, Christina Koch and Jeremy Hansen

Climate change

EU carbon border tax will force others to cut emissions

Michael Le Page

High-carbon industries in the EU like cement must now pay for their emissions

JURE MAKOVEC/AFP VIA GETTY IMAGES; BELOW: ALAMY

UNTIL now, countries lagging behind others in cutting carbon emissions haven't faced any downsides, apart from higher energy costs. All international climate agreements are effectively voluntary. But as of 1 January, the European Union is charging a carbon tariff on imported goods that penalises

This tax affects imports and includes the use of fertilisers

climate laggards – the first to be introduced anywhere in the world.

Needless to say, the nations that will be forced to pay these carbon taxes aren't happy about it. Tensions were high in the lead-up to the start of the EU's carbon border tariff, or what it calls a carbon border adjustment mechanism. The trade disputes are likely to continue, but the tax is here to stay – and is the first of many, says Ellie Belton at climate think tank E3G.

"I think we can expect to see carbon border adjustment mechanisms popping up all over the world," says Belton. The UK plans to introduce one in 2027 and Australia, Canada and Taiwan are also considering it.

The EU's carbon border tax is essentially an extension of its carbon pricing. Since 2005, industries in the EU that emit a lot of carbon dioxide have had to pay for the privilege under the Emissions Trading Scheme. This scheme is being extended to cover more sources of emissions, and the current price is around €76 per tonne of CO_2.

This means that, say, steel-makers in the EU have higher costs than those in countries where there is no carbon pricing. The idea of the adjustment mechanism is to restore a level playing field. In other words, the border tariff is set to match the EU's internal carbon price.

With steel from countries that already have carbon pricing, the EU will charge only the difference between the prices. Besides steel, the border tax will apply mainly to iron, aluminium, cement, fertilisers, hydrogen and electricity.

The immediate aim is to ensure that heavy industries don't simply move to other nations where they don't get penalised for pollution, a phenomenon known as carbon leakage. "The EU has been very clear that it will not make any exemptions, because essentially you would then create a pollution haven where the dirtier production would relocate to," says Belton.

On top of this, the policy aims to help limit global warming by effectively forcing other countries to do more to cut carbon emissions. It is already working, says Belton. Some nations, including Brazil and Turkey, are introducing their own carbon pricing schemes specifically because of the EU's carbon border tax.

"I think we can expect to see carbon border adjustment mechanisms popping up all over the world"

A mish-mash of systems

The EU's decision to implement a carbon border adjustment mechanism was finalised in 2023. A pilot scheme began in October 2023, under which companies liable for the charge had to make declarations. Firms have to start paying on 1 January, but the charges are being phased in gradually, with the full amount not kicking in until 2034.

Companies in the UK aren't expected to have to pay the tax because of the country's plan to introduce its own border tax in 2027. Negotiations are under way to make the UK scheme compatible with the EU one.

The ideal situation would be for all nations that introduce carbon border adjustment mechanisms to adopt the same system. This would increase their economic clout, meaning they would have more power to force others to act. It would also ease trade within the unified tariff bloc and reduce administrative costs for those exporting to this bloc. Unfortunately, this is unlikely to happen, says Belton, and it appears that a mish-mash of different carbon tariff systems will spring up around the world. ▮

Nuclear weapons

Russia–US nuclear pact set to end

The expiry of a key treaty means there will be no cap on US and Russian nuclear weapons

Matthew Sparkes

IN FEBRUARY 2026, for the first time in decades, there will be no active treaty limiting the size of the US and Russian nuclear arsenals. Experts are divided on whether the New START treaty genuinely made the world safer, but there is far more agreement on one thing: a replacement is unlikely.

The US and Russia first agreed to place limits on their nuclear weapons and allow each to inspect the other's stockpiles with the START I treaty in 1991, and this was succeeded by New START in 2011. In 2021, Joe Biden and Vladimir Putin agreed to extend the treaty by five years. It is now due to expire on 5 February and talks on a replacement have faltered.

Tension between Russia and the US had already been ratcheting up when the former staged a full-scale invasion of Ukraine in 2022. Just months later, Russia pulled out of weapons inspections, prompting the US to reciprocate. Now, there is talk from both states about a resumption of nuclear testing – a bellicose bit of theatre with no practical purpose. A replacement for New START seems more unlikely now than ever.

Mark Bell at the University of Minnesota says a new treaty that caps US weapons at a similar number to Russia is unlikely to appeal to the US, which fears that it needs enough to deter both Russia and China at once. China has 600 nuclear weapons, far fewer than the 5000-plus that the US and Russia both hold, but it is growing its arsenal rapidly.

Meanwhile, Russia is unlikely to accept a cap that follows this argument and seeks to allow it fewer bombs than the US. And China won't want to be dragged into a new deal if it caps its bombs at current levels, preventing eventual parity with Russia and the US. Treaties are never easy, but this is a knotty starting point, says Bell.

START I and New START have broadly been seen as a success. They certainly aren't perfect, but they are a pragmatic and stabilising influence. But Bell is sceptical about whether they have actually done much to make the world safer. "Did they save both of the superpowers a bit of money? Maybe. Did they provide a forum that was useful for cooperation? Yes. But did they fundamentally change the probability of war? I don't think so," he says.

MIKHAIL SVETLOV/GETTY IMAGES

A Russian nuclear missile on display in Moscow

With or without a treaty, there will always be a real risk of nuclear war, says Bell. In many ways, the threat of mutually assured destruction is our best insurance now that the atom has been split, and it is the unthinkable results of nuclear conflict rather than treaties that prevent wars, he says. "The stabilising effect comes from the danger, and you can't get rid of that. That's a feature, not a bug, of nuclear deterrence," he says.

"It allows for unrestrained competition by leaders who seem to want to rely on nuclear weapons"

But some with insider knowledge are more concerned about the treaty's end. Stephen Herzog is an academic at the Middlebury Institute of International Studies in Monterey, California, but, prior to that, worked on arms control at the US Department of Energy. He told *New Scientist* that the loss of New START makes nuclear war more likely.

"It makes the world a less safe place because of the lack of transparency, because it allows for unrestrained competition by leaders who seem to want to rely on nuclear weapons," says Herzog. "In a situation where Russia is increasingly unpredictable, and in a situation where the administration of the United States is unfortunately increasingly unpredictable, not having a vital, confidence-building and transparency measure that essentially tamps down the arms race is really scary to me."

Kicking the can down the road

There are still some treaties covering nuclear weapons. The ambitious Treaty on the Prohibition of Nuclear Weapons aims to totally eradicate them and is attracting signatories – but notably not from nuclear powers. Several nuclear states have signed the Treaty on the Non-Proliferation of Nuclear Weapons, but that does little to limit the number of bombs in existence. It was only New START that really held the nuclear superpowers to account.

Herzog believes that if Donald Trump and Putin were willing, they could agree to a substantially similar deal immediately. Indeed, there have been suggestions from Putin, which were warmly received by Trump,

that an informal, year-long extension could be agreed. But no negotiations have taken place and such a deal would be, at best, a short-term solution for the problem.

Philipp Bleek at the Middlebury Institute of International Studies says a continuation could be useful if the extra time were used to negotiate a new treaty, but the prospects of longer-term arms control are dim. "The one-year extension might make the Russians feel like they've kicked the can down the road and might make them less likely to engage [in future talks]," says Bleek.

Treaty negotiations are complex tussles involving politicians, militaries and spy agencies, with opportunities to crowbar tiny but potentially vital strategic advantages into the small print, says Herzog. Many key US personnel – weapons inspectors, negotiators and nuclear experts – have been fired, made redundant or encouraged to resign by the Trump administration, he says, which could give Russia the upper hand.

"If we were to go hard to the mat and try and negotiate a new treaty, I think that there are certain things that we probably don't have the staffing and personnel to do," says Herzog. ▮

Space

Satellites to provide sunshine on demand

Alex Wilkins

A CONTROVERSIAL scheme will begin to reflect sunlight to Earth with satellites this year, so dark places can be temporarily lit for visibility or energy production. But astronomers are sceptical about the plan's efficacy and possible scientific consequences.

US company Reflect Orbital, which aims to provide "sunlight on demand", intends to launch its first satellite early this year, beaming sunlight to 10 locations as part of an initial "World Tour". The company then plans to launch thousands of satellites, equipped with mirrors spanning tens of metres, so that light can be reflected to Earth for "remote operations, defense, civil infrastructure, and energy generation".

By 2030, Reflect Orbital says it will have sufficient satellite coverage to beam 200 watts per square metre to solar farms on Earth, equivalent to levels of sunlight at dusk and dawn, so places with less natural sunlight can still generate reliable energy.

But according to specifications of the company's first satellite in filings with the US Federal Communications Commission (FCC), the useful light reflected to Earth will be much less than that.

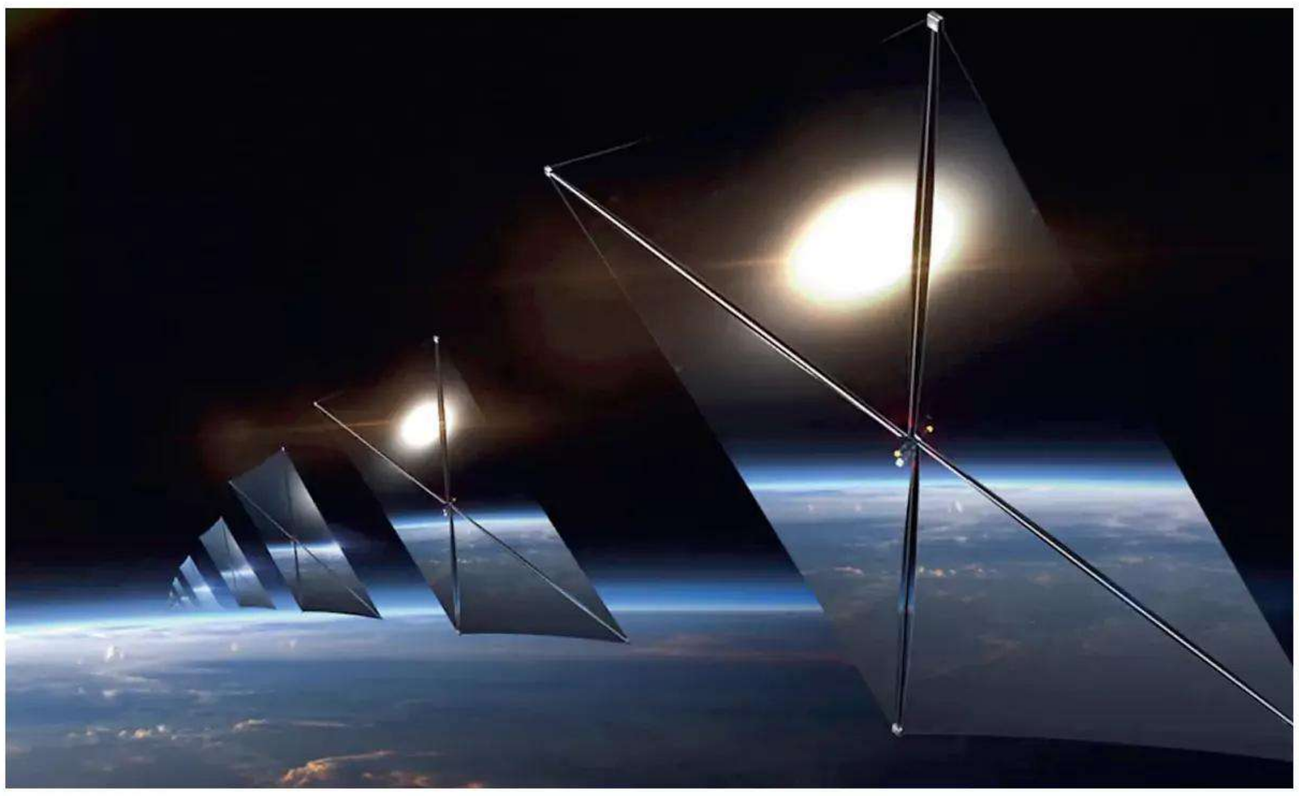
John Barentine at Dark Sky Consulting, a company based in Tucson, Arizona, and astronomers from the American Astronomical Society used the FCC filing to calculate how much power the satellite would generate from solar panels on Earth. "For a single reflector, the amount of light that's delivered at ground level is vastly insufficient to power solar farms," he says.

The level of light would be equivalent to four times the full moon, which over a large surface area wouldn't generate much electricity, says Barentine. To produce more light than this would require satellites with thousands of reflectors in total, which would be extremely expensive to launch and complex to fly in formation.

However, the satellites could pose problems for astronomers by causing momentary flashes of sunlight when their mirrors change position, says Barentine. Some scattering and dissipation of light in the atmosphere, sending it towards unintended locations, is unavoidable, especially if the satellite's reflectors are damaged by micrometeorites and become imperfect reflectors, he says.

Reflect Orbital has contacted scientists to discuss potential mitigations for these issues, says Barentine. Reflect Orbital didn't respond to a request for comment before *New Scientist* went to press. ▮

"Some scattering of light in the atmosphere, sending it to unintended locations, is unavoidable"



REFLECT ORBITAL

An artist's impression of the Reflect Orbital satellites in action

Mental health

We'll learn more about LSD and anxiety

Studies this year could lead to the drug being used as a mental health treatment

Carissa Wong

TWO major trials investigating the potential of the psychedelic drug LSD for reducing anxiety are set to conclude this year. Scientists are feeling positive after the drug's success in an earlier-stage trial, which could mean the treatment will be available in the US as early as 2027.

Generalised anxiety disorder is a common condition where people feel very anxious about lots of different things. It is typically treated with antidepressants and talking therapies, but around half of people don't respond to such treatments.

Other psychedelic drugs like psilocybin and MDMA are already used to treat particularly severe cases of depression and post-traumatic stress disorder in some countries, such as Australia and Switzerland. LSD is increasingly being explored as a mental health treatment, partly because research shows it triggers profound emotional experiences in some people, and it seems to enhance the brain's ability to rewire itself and form new thought patterns.

In 2025, a landmark trial showed that a single, high dose of LSD relieved moderate to severe anxiety for at least three months.

Now, two later-stage trials are building on these results, with findings expected this year. Both are made up of about 200 people with moderate to severe anxiety, who will take either LSD as tablets that collectively add up to a 100-microgram dose or placebo pills. Their anxiety levels will be tracked for up to three months after the dosing day.

Then, in a second 10-month phase of the study, all the participants – including those who were initially on placebo pills – will be offered LSD whenever they self-report their anxiety reaching a certain threshold on a standard scale. This will help determine how long effects last from a single dose, says Dan Karlin at biotech company MindMed in New York, who was involved in the 2025 trial and both of the upcoming ones.

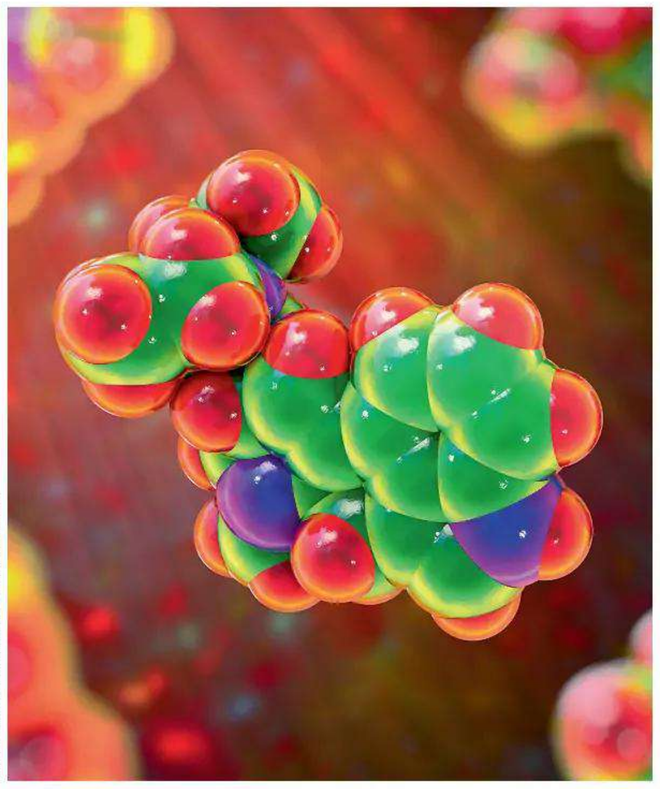
"If the results are positive, LSD could be approved for treating anxiety in the US as early as 2027"

The key difference between the two trials is that the second also has a third group of participants on a 50-microgram dose of LSD. The 2025 trial demonstrated that this dose has mind-altering effects, such as hallucinations, but doesn't reduce anxiety beyond the placebo effect. Including this group should help address a major limitation of most psychedelic trials: that participants can often tell whether they have taken the drug.

Those in the third group may work out that they have taken LSD, but won't know if it was at the dose needed to reduce anxiety, helping disentangle the placebo effect, says Sandeep Nayak at Johns Hopkins Bayview Medical Center in Maryland, who isn't involved in the trials.

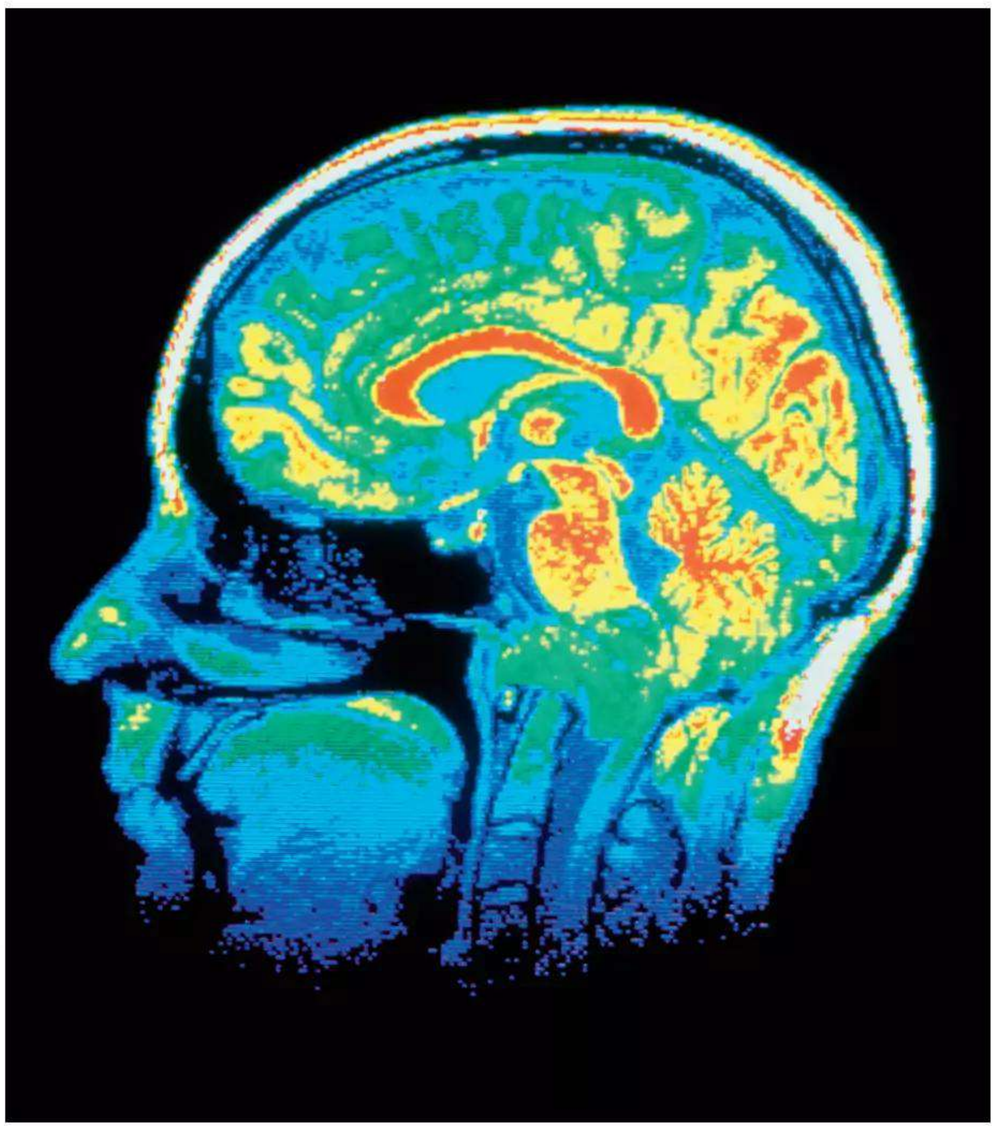
If they both produce positive results, the Food and Drug Administration (FDA) could approve LSD for treating anxiety in the US as early as 2027, paving the way for potential approval in Europe and beyond, says Karlin.

"If the next trials do anything close to the previous one [in 2025], then it should be enough for the FDA," says Boris Heifets at Stanford University.



KATERYNA KON/SHUTTERSTOCK

LSD molecules (right) seem to enhance the brain's ability to rewire itself



CNRI/SCIENCE PHOTO LIBRARY

Side effects

Typically, a 3-to-5-point difference on the anxiety scale used by the team between the placebo and psychedelic groups is considered enough to have a meaningful impact on people's lives, says Nayak.

As the 2025 trial showed a roughly 5-point difference, the next ones stand a good chance of hitting this threshold, although any benefits will have to be weighed up against how long they last and any side effects, he says.

For instance, if the treatment causes transient psychological distress, the FDA may deem that a tolerable side effect, but it probably wouldn't for longer-term distress, says Nayak. The latter wasn't seen in the 2025 trial, however.

But even if the approach wins approval, it will probably take several years before LSD becomes widely accessible for anxiety, says Nayak, and it will probably be used only after standard therapies have failed. This is mainly due to practical difficulties, such as the need for clinicians to monitor people for several hours while they are having a psychedelic trip, he says.

Technology

World's first subsea desalination facility will provide drinking water

Vanessa Bates Ramirez

RUBEN SOLTVEDT/FLOCEAN

The plant, called Flocean One, is being built in Norway

TURNING seawater into drinking water is so costly and energy-intensive that it is untenable in most parts of the world, but a Norwegian company is trialling a new approach that could change that. Flocean will launch the world's first commercial-scale subsea desalination plant this year, and says its system will dramatically cut the cost and energy consumption of the process.

Global demand for water is going up, driven by population growth, climate change and industrial uses like data centres and manufacturing. Meanwhile, fresh water is becoming less abundant due to droughts, deforestation and over-irrigation.

Land-based desalination currently produces about 1 per cent of the world's fresh water supply, with over 300 million people relying on this source for their daily water needs. The biggest plants are in the Middle East, where cheap energy makes it more feasible and water scarcity makes it more necessary.

The leading technology for desalination today is reverse osmosis, whereby seawater is pumped through a membrane with microscopic holes that only allow water molecules through, while salt and other impurities get filtered out. The water has to be pressurised to push it through the filters, which requires vast amounts of energy.

1%

How much of the world's fresh water supply comes from land-based desalination

50%

How much less energy Flocean's subsea plant could use compared with a conventional plant

Flocean's approach is to plunge water-filtering pods deep into the ocean, separate seawater from salt at depth, then pump the fresh water back up to land. By putting reverse osmosis pods deep underwater, the technology leverages hydrostatic pressure – the weight of all the water pressing down from above – to push the seawater through filtering membranes.

Less pumping means less energy consumption, around a 40 to 50 per cent reduction compared with conventional plants, according to the company. Plus, seawater is cleaner once you get below the sunlight zone (which extends to 200 metres below the water's surface), which means the water doesn't require as much pretreatment before it reaches membranes.

"It's fundamentally quite boring down there from a process and engineering perspective," says Alexander Fuglesang, Flocean's founder and CEO. "It's the same salinity, temperature, pressure. It's dark. There's not a lot of bacteria that can cause biofouling." The same hydrostatic pressure that pushes water through the membranes also helps disperse the salty brine by-product, which Flocean says is free of chemicals that might harm marine life.

For the past year, Flocean has been desalinating water at a depth of 524 metres at its test site at Norway's largest offshore supply base, Mongstad Industrial Park. Its commercial facility, called Flocean One, is being built at the same location, and will initially produce 1000 cubic metres of fresh water daily when it launches next year. The operation can then be scaled up modularly by adding more pods.

"Our philosophy is to keep the subsea units the same and scale by multiplication rather than by building ever bigger machines," says Fuglesang. Scaling up will involve engineering trade-offs at the system level, however. Since more modules will share the same power supply and controls, Flocean's engineers need to organise power distribution and the permeate manifold – the mechanism that directs purified water from multiple membranes to a single output line – so that scaling up is as straightforward as possible.

Getting bigger

"This solution could become viable in suitable locations, providing affordable water if costs decline, but it has yet to be proven at large scale," says Nidal Hilal at New York University Abu Dhabi.

Cost reductions will be crucial to scale up the technology further, says Hilal, as it is still much more expensive than obtaining fresh water through conventional methods.

Cleaning and maintaining the membranes will be one of Flocean's biggest costs. Advances in membrane technology will help: Hilal's research group is working on electrically conductive membranes that use electricity to repel salt ions and foulants, keeping themselves clean and boosting throughput.

Flocean One should start producing fresh water in the second quarter of the year. If the technology works as planned, it could help Flocean get the backing to build bigger plants elsewhere. ▮

Energy

US plans nuclear power renaissance

An ambitious government programme aims to fast-track the testing of advanced reactors

Vanessa Bates Ramirez

DESPITE providing nearly a fifth of US electricity generation, nuclear power in the country has stagnated for decades. Regulatory hurdles, public scepticism and cheaper energy sources led to plant closures, moratoriums and a lack of funding for novel nuclear technologies. But spiking electricity demand – driven largely by data centres – is spurring a nuclear revival, and the Department of Energy's Reactor Pilot Program is fast-tracking the testing of advanced reactor designs. Eleven companies are taking part, and the goal is for at least three of them to reach criticality – a state where a nuclear fission reaction becomes stable and self-sustaining – by 4 July.

"It is deliberately a very ambitious deadline," says Leslie Dewan, a nuclear engineer specialising in advanced reactor technologies. "One of the purposes of this pilot is to really flesh out which concepts are executable under real-world constraints."

The reactor designs being developed range from molten salt and high-temperature gas reactors to fast reactors, sodium-cooled designs and pressurised water systems. One of the companies that is thought to be furthest along is California-based Valar Atomics, which is developing a 100-kilowatt high-temperature gas reactor (HTGR) called the Ward 250.

HTGRs run on tiny particles of uranium coated in layers of carbon and ceramic. The coatings turn each particle into a self-contained fuel unit that won't melt even at extremely high temperatures, providing a built-in safety shield to prevent radioactive leakage.

Fuel particles are loaded into graphite blocks, which form the reactor's core and have channels for helium gas to flow through. The fuel's fission reaction heats the helium, and that heat boils water to create steam, which turns a generator to produce electricity. The helium then flows back to the reactor to be reheated.

Valar broke ground on the Ward 250 in September 2025, making it the second company to start construction (the first was Texas-based Aalo Atomics, which broke ground in August). Valar was the first to achieve cold criticality, a self-sustaining fission reaction with no heat output. This was done at a government test facility under tightly controlled conditions, and while it validates core physics and provides useful data, says Dewan, "it's not the same thing as having their own integrated test reactor built and operated at power".

"I view this as the start of the interesting data-gathering period, it is by no means the finish line"

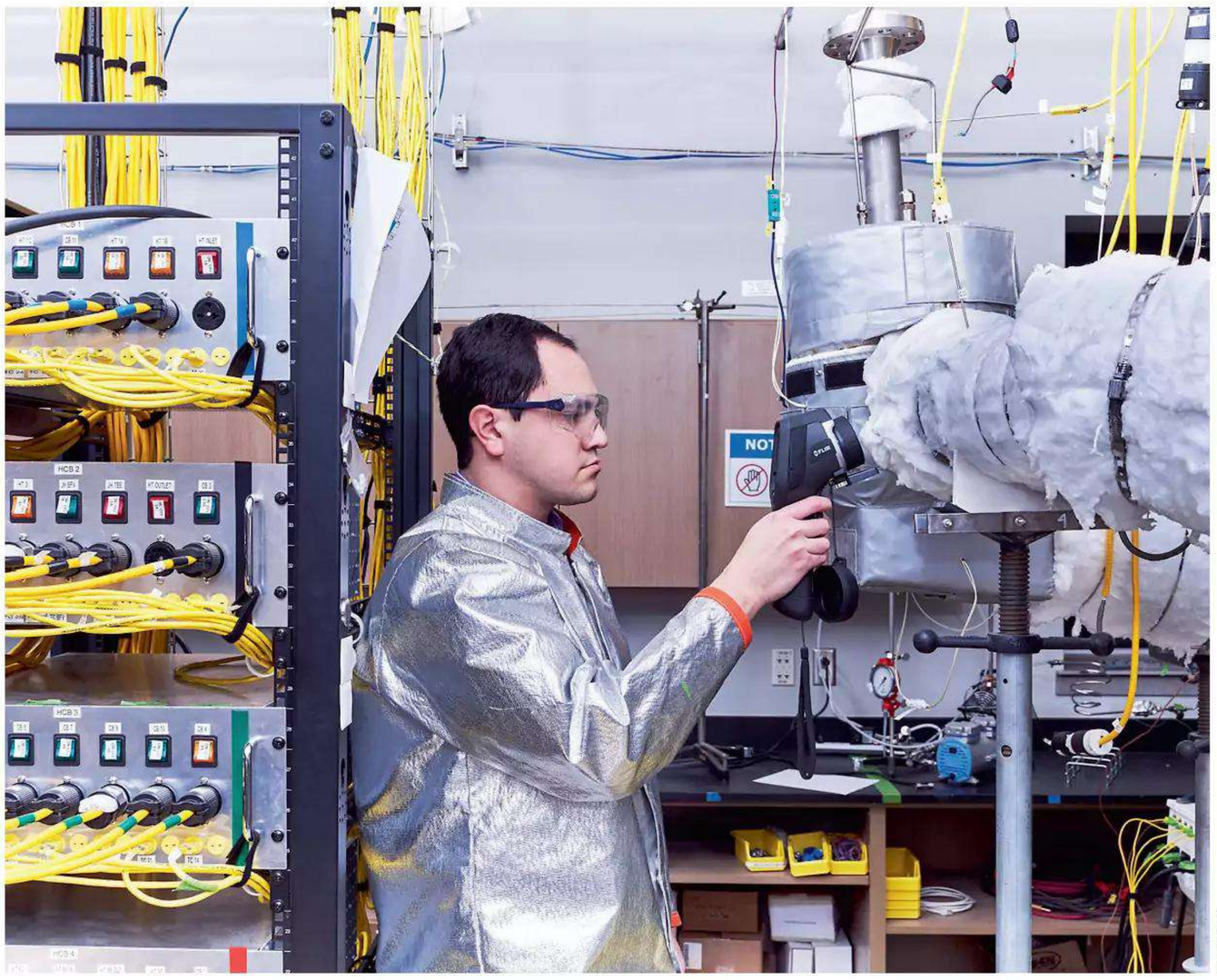
Molten salt reactors, Texas-based Natura Resources' design of choice, work in a very different way, but are also thought to be inherently safe. Uranium is mixed into molten salt, which heats up with the fuel's fission reaction. Pumps move the liquid salt through a heat exchanger, where it transfers heat to another loop that makes steam or drives a turbine. If the salt overheats, it expands and melts an emergency "freeze plug" that drains the fuel into a safe tank, where it can't sustain a chain reaction.

"Molten salt reactors operate at atmospheric pressure, so any type of accident would be confined to the site itself," says Dewan. "Even if it loses all electric power, even if there aren't any operators on site, it would be able to coast to a safe stop."

Although Natura hasn't broken ground yet, it secured a construction permit from the Nuclear Regulatory Commission to build a 1-megawatt research reactor. The company has had a "very positive" relationship with the NRC, says Dewan, but "molten salt is corrosive and at high temperatures it's radioactive, so the material challenges are not to be underestimated".

Given the criticality deadline is only six months away, Valar, Natura and the rest will need to work at an unprecedented pace. Though, this is just one of the hurdles for them to clear.

"The real proving points will be things like: can you take the reactor up to power and down again in a controlled way; can you operate at design temperature for thousands of hours; can you demonstrate that the materials and fuel are behaving as expected; and can you do all of that reliably enough that the NRC and future customers will trust the design?" says Dewan. "I view this 2026 date as the start of the interesting data-gathering period, by no means the finish line." ▮



NATURA

The company Natura Resources is working on a reactor using molten salt

Solar system

Space missions set out to uncover the secrets of the solar system

Alex Wilkins

THE mysteries of two neighbouring planets may soon start to be unravelled, with the launch of a spacecraft that will eventually bring a chunk of a Martian moon to Earth and the descent of another craft into Mercury's orbit.

Understanding the origins of Mars's moons Phobos and Deimos, and how they came to be orbiting the planet, can hopefully tell us a bit about the evolution of Mars in general and its history, says Emelia Branagan-Harris at the Natural History Museum in London.

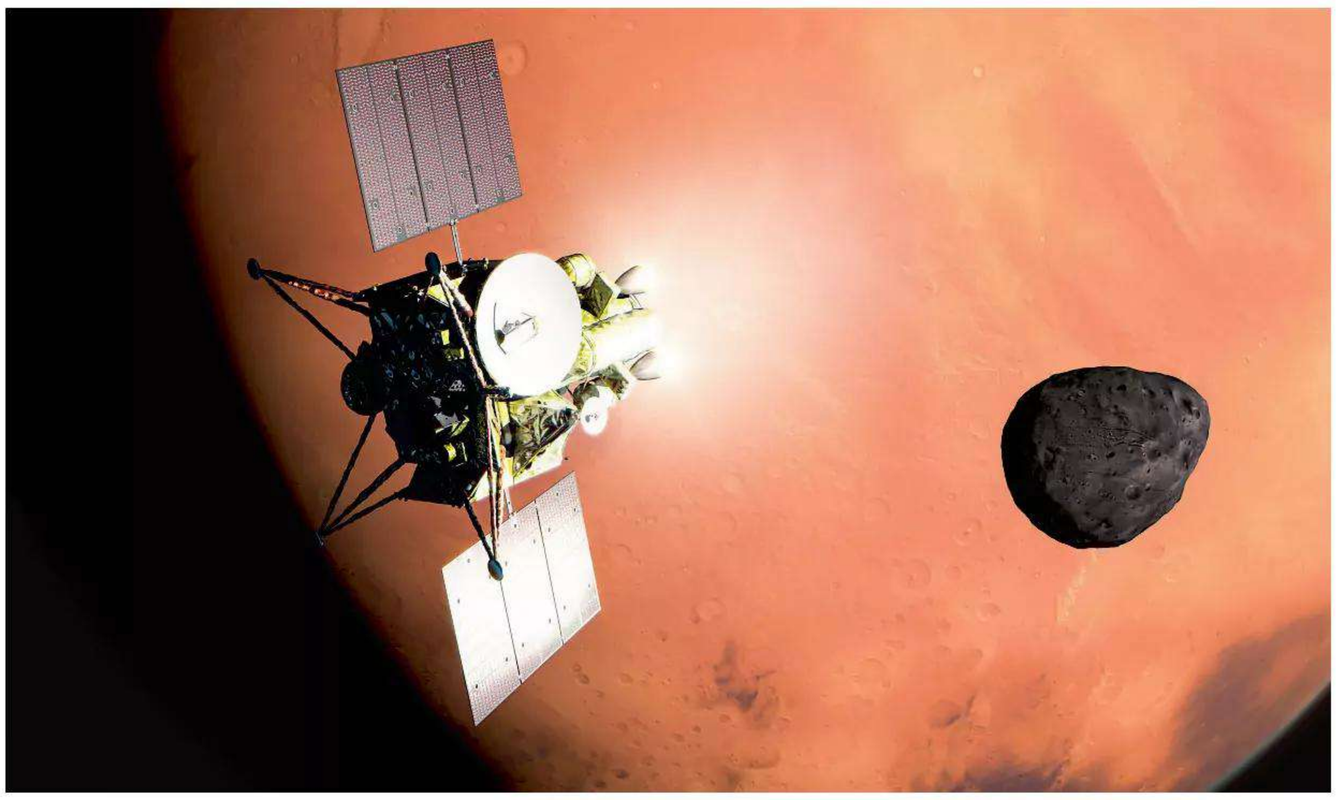
There are two competing hypotheses for how these moons came to orbit Mars: the Red Planet could have captured them as a pair of asteroids, which were either conjoined and later separated or closely orbited each other, or they could have been produced from an asteroid smashing into Mars itself, like how Earth's moon formed.

So far, we have limited evidence for either scenario, but the Japan Aerospace Exploration Agency (JAXA)'s Martian Moons eXploration spacecraft, which will launch sometime after April, should be able to definitively rule out one scenario or the other, says Branagan-Harris. The spacecraft is equipped with a raft of cameras and spectrometers it can use while orbiting the moons, which it is scheduled to reach in 2027, as well as a rover that it will deploy to the surface of Phobos to collect samples.

If the observations find abundant carbon-rich molecules and water, this could suggest that the asteroid capture theory is correct. But if they are absent, then we might need to wait for the samples to return to Earth for analysis, which is currently scheduled for 2031.

These samples will consist of rock both from Phobos's surface and from several centimetres into the ground. Once we can test the material itself, we can see whether it shows signs of melting in the past and infer whether it came from a collision with the Martian surface.

Regardless of Phobos's origin, it orbits close enough to Mars that it might contain well-preserved samples from the planet at an earlier time in its history. "There's a potential there that Phobos could have pieces of ancient Mars from back when it had liquid water, so we'd be learning a lot about the history of Mars as well," says Branagan-Harris.



JAXA

A spacecraft scheduled to launch this year will orbit the moons of Mars

From Mars to Mercury

We may also begin to learn Mercury's secrets this year, as the BepiColombo mission descends into orbit around the solar system's innermost planet.

BepiColombo consists of a pair of spacecraft from both the European Space Agency (ESA) and JAXA. The Mercury Planetary Orbiter (MPO) and the Mercury Magnetospheric Orbiter (Mio) are attached to a parent spacecraft, the Mercury Transfer Module (MTM).

Since launching in 2018, the MTM has flown by Mercury six times, using the planet's gravity to slow its descent until it can easily slot into orbit, a technique invented by the mission's namesake, physicist Giuseppe "Bepi" Colombo.

The mission has collected important scientific data, such as clues about the solar wind and high-resolution images of Mercury's surface. But its most powerful instruments, such as a pair of X-ray spectrometers on ESA's MPO, haven't yet been used because their view has been obscured by the MTM.

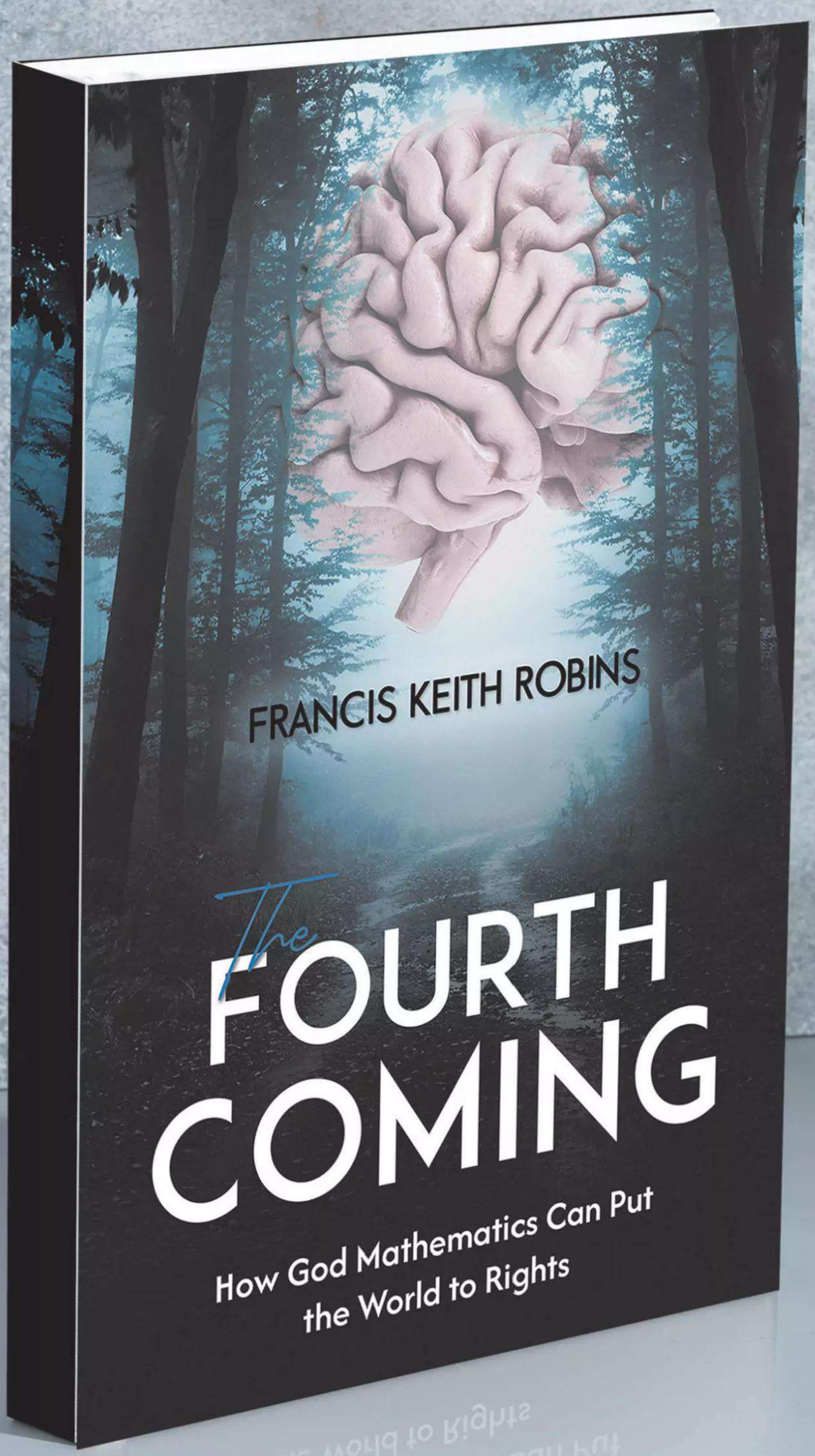
"If you can understand how the planets came to be, you can understand the whole solar system"

In September, MPO and Mio will detach from the MTM and begin their descent into orbit, which is expected to be complete by November, letting them finally set their eyes on the planet.

Charly Feldman at the University of Leicester, UK, worked on one of the MPO's instruments. "It's been building for a very long time, so whilst it is incredibly exciting, it's also a little bit nerve-wracking."

As well as imaging Mercury's magnetic environment in far more detail than any previous mission, Mercury's surface will be extensively mapped and analysed, using tools like the MPO's spectrometers. "It will be taking the first X-ray images of a surface of another planetary body," says Feldman.

This could help us solve mysteries such as the unexpectedly high amount of X-rays coming from the planet's night side, facing away from the sun, which previous missions measured. It can also measure X-rays coming from the planet's sun-facing side, which will allow scientists to work out what Mercury's surface is made of, which can then tell us about how the planet evolved. "If you can understand how the different planets have come to be as they are, you can understand the dynamics of the whole solar system," says Feldman. ▮



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Good heavens!

Stargazing has many mental health benefits, says **Michael Brooks**, who is determined to get to grips with the constellations this year

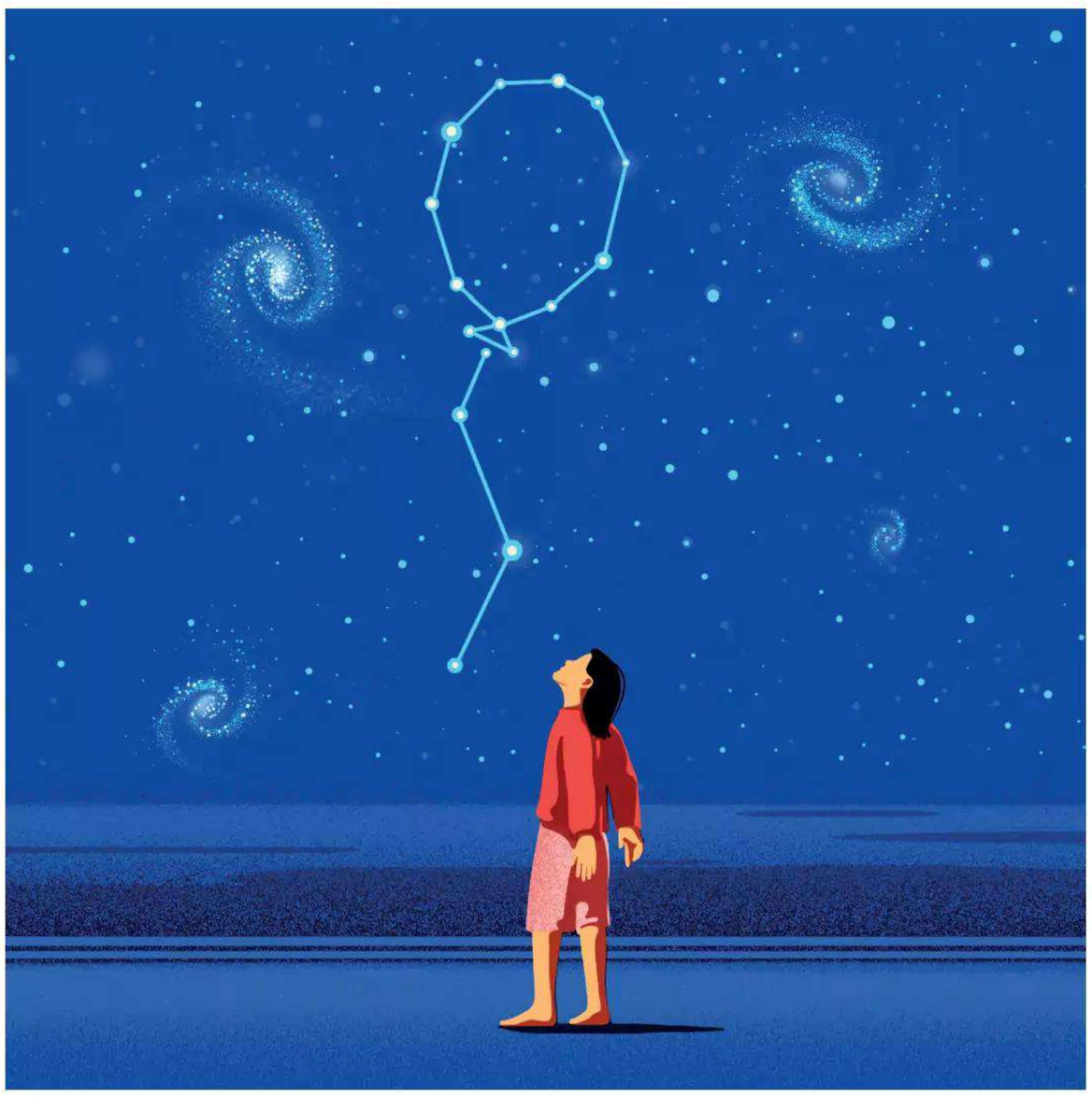
FOR me, this year is going to be all about self-care via the stars.

It has been 20 years since I first felt palpable envy at someone being able to navigate the night sky. In 2006, I was at a conference in La Jolla, California, reporting for *New Scientist*. Among the delegates was astrophysicist Neil de Grasse Tyson. One evening, as we were all having an al fresco dinner, he took out a laser pointer and gave us a tour of the visible constellations. I was mesmerised, and impressed by the ease with which Tyson wandered through the heavens. I made myself a promise: when I got home, I was going to become a stargazer.

It didn't happen. I still haven't learned to spot much beyond Orion and the Plough, or Big Dipper. Maybe I can blame the streetlit skies of my neighbourhood, but I can also blame the fact that, even then, I was older than is ideal. A love for the night sky is best developed in childhood. Those who start young, guided by a parent or family friend, tend to have a lifelong affinity with the heavens. And, crucially, they also tend to have better mental health.

Connecting with the cosmos is good for us. Research shows it is associated with various positive aspects of mental health, as well as improved general happiness. It even makes us more generous.

The love for looking up on a dark night is known as noctcaelador, from the Latin for "night", "sky" and "adore". The phrase was coined in 2003 by William Kelly, a professor at George Fox University in Portland, Oregon, in a paper investigating attitudes towards stargazing. Participants reported that they "strongly enjoyed watching the night-sky" and that they experienced an "improved mood from watching the night-sky".



ADRIÀ VOLTÀ

Last year, Kelly published further research showing that noctcaelador is related to a personality trait known as openness to experience, which is especially achievable in childhood.

That fits with research into the experiences of Generation Z lovers of the night sky. Members of Gen Z were born between the mid-1990s and the early 2010s, and are the first "digital natives". Holly Brenna McNiven published an exploration of noctcaelador in Gen Z last year as part of her master's degree project at the University of Wales Trinity Saint David. She found that many of those who reported a love for the night sky – which was associated with positive well-being – can trace their noctcaelador back to childhood experiences of astronomy.

Her study involved only 29 young people, who were recruited via astronomy clubs, so it is hard to say how representative they were of their generation. What we can say is that sharing a love of the stars with younger people can ensure that the love goes on. McNiven reports developing an affinity for the night sky through stargazing with her parents, and the majority of her participants also "noted memories linked to learning and socialising with neighbours, teachers, friends and family members".

I'm a little sad that I didn't get that star-love instilled in me as a child, but there's still time. And these days, I don't even need clear or dark nights – good news when light (and other) pollution means most of the world's population no longer has access to a star-strewn sky. After all, who needs clear skies when there's a growing gaggle of astronomers on TikTok ("SpaceTok", for the initiated)?

They are mostly Gen Z, though, so I'm not sure SpaceTok is for me. Being a little older, I am thankful that, on cloudy evenings, you can still connect with the cosmos through books. I have a copy of Brian May's new *Islands in Infinity*, which presents stereoscopic photographs of galaxies. And for Christmas, I got Nigel Henbest's *Stargazing 2026*, a guide to this year's sights for those who choose to look up. I just need to invest in a laser pointer and I could soon be giving Tyson a run for his money. ▮

Michael Brooks is a science journalist and author specialising in physics

Future Chronicles

Super size me

We journey to the near-future with Rowan Hooper to discover that by the 2030s, botanists had worked out how to grow hybridised superplants to help feed the world

Rowan Hooper is *New Scientist*'s podcast editor and the author of *How to Spend a Trillion Dollars: The 10 global problems we can actually fix*. Follow him on Bluesky @rowhoop.bsky.social

In Future Chronicles, he explores an imagined history of inventions and developments yet to come.

IN Roald Dahl's novel *James and the Giant Peach*, magic crystals cause a withered peach tree to produce a spectacular, juicy, house-sized peach. How nice would it be, people thought, if we could grow massive fruit in real life – perhaps without also spawning giant insect pests and having to endure villainous aunties.

By the mid-2030s, botanists had figured out how. Scientists found ways to produce oversized fruits and vegetables using genetics, and improved on James's peach: they created crops and trees that grew not just a single species, but a variety of delicious and nutritious foods.

The Fruit Salad Tree, a tree producing multiple kinds of fruit which itself sounds like something from a Roald Dahl story, was produced commercially in the early 2020s. Grafting had been used for thousands of years to produce hybrid plants, and fruit salad trees are made by grafting branches of one tree, say a russet apple, to that of another variety of apple, say a golden delicious. Other varieties can be added, so that a single tree produces a range of different apples. In 2013, one man made a tree producing 250 different varieties of apple. Similar fruit salad trees were made with citrus fruits (growing lemon, lime, oranges and grapefruit). Yet another type produced plums, peaches, nectarines and apricots.

And then there were tomtatoes – you say pomatoes – made by grafting the roots of a potato plant to the leaves and stem of a tomato plant.

In all these examples, the hybrid is built up from closely related plants. Tomatoes and potatoes, for example, belong to the same genus, *Solanum*, which also includes aubergines (or eggplants). Indeed, potatoes themselves evolved from a hybridisation event involving a tomato some 8 million years ago. So it is a simple matter to make a thriving hybrid of closely related plants through grafting.

With some careful gene editing and plant breeding, by the early 2030s it became possible to make a plant able to grow fruits from different families, resulting in trees growing, for example, bananas, citrus, apples and peaches. Farmers and private growers could order the combination that most suited their tastes.

"In homage to Roald Dahl's story, scientists created a peach variety that grew fruit the size of large suitcases"

Horticulturalists also turned their hand to *Brassica oleracea*, the species that produces, in different varieties, cabbage, kale, broccoli, cauliflower and Brussels sprouts. It was a relatively simple matter to make a hybrid that produced all these vegetables on different parts, in a sprawling hedge.

Grafting was all very well, but it was time-consuming and expensive, as each individual plant had to be made to order, by hand. The real breakthrough came in the mid 2030s, when botanical geneticists were able to make hybridised superplants that could be grown from seed. That meant far more people had access to the convenience of multiple harvests from a single plant.

PolyPlants, as they became known, heralded a new way of treating crops and food trees. People became more relaxed about gene editing as they saw the benefits it could give. Fruits were engineered to produce extra nutrients and vitamins. This built on work in 2022 that had made tomatoes engineered to produce extra amounts of antioxidant pigments called anthocyanins, which have a longevity-enhancing effect. Other adjustments made by gene editing created PolyPlants better able to resist fungal disease, salt water, drought and insect attack. Engineering of the root microbiome customised the mycorrhizal fungi for each component of the crop and boosted production and growth.

Extensive gene editing became even more important as global temperatures increased and traditional crops failed. PolyPlants designed to survive climate extremes helped provide food security around the world.

Genome analysis had identified clusters of genes that contributed to the size of the edible component of food plants. A method adapted from grafting allowed the gene editing of plants that had otherwise eluded direct engineering, such as avocado, coffee and cocoa. These advances allowed the creation of plants producing oversized fruit.

In homage to Roald Dahl's story, scientists created a peach variety that grew fruit the size of large suitcases. Traditions sprung up around the supersized fruit trees. Feast Days were held when fruit ripened and children were encouraged to gorge themselves on delicious giant peaches, cherries and strawberries.

Crops and trees that produced oversized, ultra-nutritious food weren't just fun to feast on. They were crucial in providing vital nutrition to many parts of the world where food scarcity was a problem and food security a growing risk. ▮

This column appears monthly. Up next week: Chanda Prescod-Weinstein

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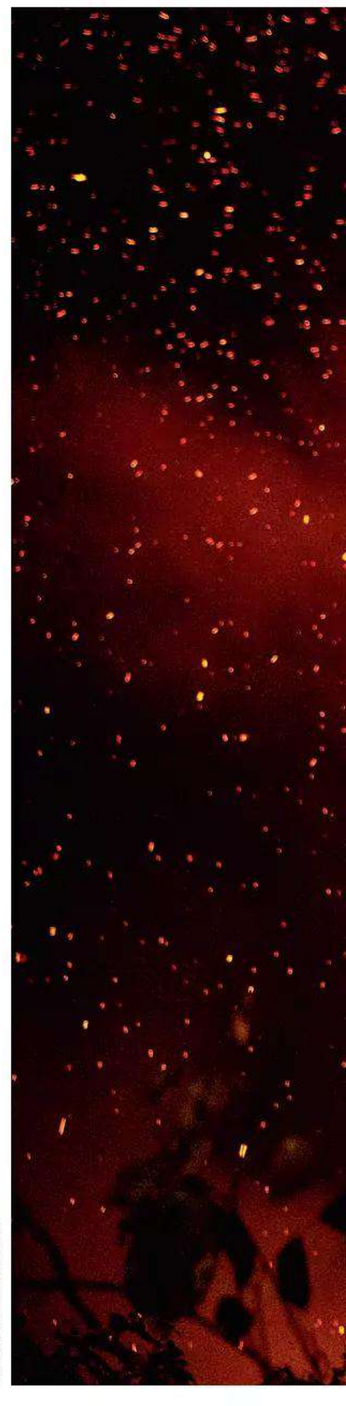


LALO DE ALMEIDA

Fire and water

Science Museum

HOW can these four pictures be images of the same region? What force could possibly transform the Pantanal – a tropical wetland straddling Brazil, Bolivia and Paraguay, full of jaguars, howler monkeys, caiman, marsh deer and a vast number of fish and birds – into a fire-ravaged wasteland?

The 200,000-square-kilometre wetland – the world's largest – is used to alternating dry and wet seasons. But climate change, deforestation and intensive farming have made a grim parody of its natural wet and dry cycles. In 2020, a record-breaking wildfire burned over a quarter of the region's vegetation cover. The last major fire season was in 2024.

The plight of the fragile ecosystem has captured the attention of two photographers, Lalo de Almeida and Luciano Candisani. Their radically different images are showcased in Water Pantanal Fire, a free exhibition opening on 6 February at London's Science Museum, and running until the end of May.

Candisani's photographs focus on water and the region's freshwater life. At top near left is a dorado in the Olho D'Água river in 2013, while at bottom far left is an aerial view showing how life was burgeoning in the main drainage channel of the Baía do Castelo, a floodplain lake, in 2018.

De Almeida, a documentary photographer, has focused on the fires that devastated the region and on how it has been affected by climate change. At top far left is a marsh deer escaping a forest fire in Poconé, Mato Grosso, in 2020. At bottom near left are volunteer firefighters gathering at the Jofre Velho ranch during 2020's catastrophic blaze.

Simon Ings

It's 2026 – time to turn the page

Clear out your shelves: a bumper crop of new books on slowing ageing, climate hope, space exploration and more is ready to fill them, finds **Alison Flood**

LOTS of science books will be published over the course of the coming year – tonnes, in fact. After spending last month wading through the books and publisher catalogues that came into our offices, I have decided on the science books that I am most excited about, arranged in categories so it is easy to find what you love throughout the year. Of course, if you are a bit of an omnivore like me, you could end the year an expert in everything from spotting psychopaths to very, very huge numbers.

PLAINPICTURE/MICHIRU NAKAYAMA

Space

Let's start at a grand scale, with environmental historian Dagomar Degroot's ***Ripples on the Cosmic Ocean***. He considers how the solar system shaped humanity, whether that's Martian dust storms sparking stories about aliens, or comet impacts on Jupiter inspiring the first planetary defence strategy. Degroot also looks at human impact on the cosmos, calling for "interplanetary environmentalism" (lovely phrase).

We go from grand to even grander, as astrophysicist Emma Chapman's ***Radio Universe*** reveals how we use radio waves to explore the distant universe. Chapman follows one on a journey from Earth into the wider Milky Way, passing black holes and pulsars.

New Scientist columnist Chanda Prescod-Weinstein also takes us on a journey in ***The Edge of Space-Time***, drawing on poetry and culture to explain theoretical physics and the quantum nature of space-time.

Health

There are two strands to 2026's health titles I am most excited about. The first is using science to make yourself healthier. In ***The Age Code***, health journalist David Cox explores nutrition science and how to use it to slow biological ageing. Surgeon, clinical research director and self-confessed recovering alcoholic Charles Knowles reveals ***Why We Drink Too Much***, and writer Bill Gifford tells us how we can use heat to improve our health in ***Hotwired***. We evolved, Gifford argues, to exist in sweltering conditions, and temperature extremes can expand our physical and mental limits.

"Naomi Klein and Astra Taylor collaborate to tell the story of the rise of the far right in their new book"

Aside from self-improvement, we have a phalanx of investigative writers probing what is really going on in the health industry. Celebrity doctor Xand van Tulleken promises to expose "the world of wellness to find a healthy way of living" in ***Make Me Well***.

Science journalist Deborah Cohen's ***Bad Influence*** looks at the world of internet medicine, from Ozempic influencers to AI-powered diagnoses, while Reuters columnist Aimee Donnellan brings her experience writing about business (including big pharma) to bear on GLP-1 drug Ozempic in ***Off the Scales***. Then there is journalist Alev Scott's ***Cash Cow***, which tears into the fertility industry and how the "maternal body" has been commodified.

Maths

In the world of maths, we are thinking big this year, as two top mathematicians get stuck in. Richard Elwes's ***Huge Numbers*** is a look at how counting higher and higher has shaped human thought, while Ian Stewart's ***Reaching for the Extreme*** goes to the edges of mathematics to look at the biggest, smallest and prickliest of our mathematical conundrums.

Technology and AI

The Emergent Mind by computational neuroscientist and experimental psychologist Gaurav Suri and psychology professor Jay McClelland is out to explain emergence, where complex systems arise as a result of the interactions of simpler systems.

The pair apply this to the human brain – and to AI – in a book that would be nicely complemented by Tom Griffiths's ***The Laws of Thought***. Here, the head of Princeton University's AI Lab shows how we use maths to describe thinking, looking at the ideas underlying modern AI, and how these differ from the ones about human minds.

Sticking with AI, sociologist James Muldoon's ***Love Machines*** explores how our relationships are being changed by our interactions with tech, from chatbots to attempts to "resurrect" dead loved ones.

I also won't be missing Naomi Klein and Astra Taylor's ***End Times Fascism and the Fight for the Living World*** in which the journalist and activist collaborate to tell the story of the rise of the far right, and what they call a "new, apocalyptic alliance of religious fundamentalists, billionaire Silicon Valley tech kings and ethno-nationalists". Luckily the duo aren't only investigating the situation, they are also telling us how we can resist it.

Two other tech books also caught my eye: the first is ***Little Blue Dot*** by investigative reporter Katherine Dunn, the story of the Global Positioning System. GPS was conceived as a military system, but daily life now depends

on that blinking blue dot on our screens. And at a different scale, YouTuber and top construction influencer (yes, really) Fred Mills picks 10 megaprojects and looks at how they will transform the world in ***Mega Builds***.

Environment

Writer and activist Rebecca Solnit offers us hope with her new book ***The Beginning Comes After the End***. She talks about the revolution in human thinking over the past 50 years, and the changes we have seen around race, gender, sexuality, science and the environment. The old world is still fighting back, but Solnit reminds us the power to make change is within our reach. So does environment journalist Fred Pearce in ***Despite It All*** – a former *New Scientist* staffer, he has written a "handbook for climate hopefuls", telling us it isn't too late, that things can change for the better. His reasons for (cautious) hope include nature's ability to thrive in unexpected places and humans reaching "peak stuff".

Another shot of hope in a burning world comes from biology professor Dave Goulson's ***Eat the Planet Well***, on our toxic food system and how to solve it. And in ***The Surge***, journalist Jeevan Vasagar considers rising flood waters over history – timely, given 150 million people will live below the high tide line by 2050. Here, the hope lies in the groundbreaking engineering solutions he shares.

Nature

Climate change is everywhere, including in ***Where the Earth Meets the Sky***, the story of conservation biologist Louise K. Blight's time studying penguins in Antarctica. She shows how global warming is altering this remote corner in her intriguing insight into working in the Antarctic wilderness.

The world that marine biologist Ruth Searle explores in ***The Intertidal Zone*** is a little warmer, but equally fascinating – a hugely dynamic and fragile ecosystem where land meets sea, constantly reshaped by humans.

Zoologist Jo Wimpenny is out to have some fun in ***Beauty of the Beasts***, a defence of "nature's least loved animals" (snakes, wasps, crocodiles and the like) and why we should champion them amid catastrophic biodiversity loss.

And who could resist biologist Lixing Sun's dive into the "weird and wonderful" science of reproduction in ***On the Origin of Sex***?

Meanwhile, just how profoundly animals have shaped human brains over millennia is revealed in ***Animate*** by Michael Bond, another former staffer at *New Scientist*.

Psychology

Homing in on our brain yields welcome surprises this year. I love ***Art Cure***, in which psychobiologist Daisy Fancourt draws on neuroscience, psychology, immunology, physiology, behavioural science and epidemiology to show how the arts can improve our health and well-being. (I totally agree!)

"Celebrity doctor Xand van Tulleken promises to expose 'the world of wellness' in *Make Me Well*"

Elsewhere, two books by neuroscientists take on the techno-social change we are facing more directly, with Hannah Critchlow discovering how to become more resilient in ***The 21st Century Brain*** and Paul Goldsmith explaining in ***The Evolving Brain*** how our "ancient" minds evolved for a very different world than the one we inhabit, and what we need to thrive now.

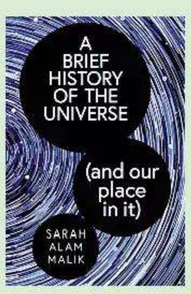
Leanne ten Brinke is out to improve our lives more specifically in ***Poisonous People***, as the psychopathy expert wants to help us identify the psychopaths, narcissists, manipulators and sadists in our lives and learn how to take evasive action.

There are also plenty of opportunities to examine how our brains work to build complex people and societies. In ***A World Appears***, writer, academic and activist Michael Pollan explores the mystery of why we are conscious from scientific, philosophical, spiritual, historical and psychedelic perspectives.

Elsewhere, other psychologists are hard at work: Paul Eastwick looks at the science of attraction, sex and relationships in ***Bonded by Evolution***, while Melissa Maffeo's ***Science of the Supernatural*** uses neuroscience and psychology to explain alien abductions and psychic readings.

Clearly, it is time to clear out our bookshelves to make way for this year's rich new treasures! ▮

THE BEST OF THE BEST: FOUR TOP PICKS FOR 2026

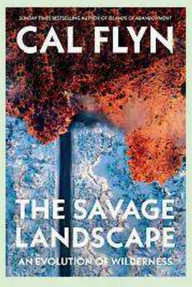


A Brief History of the Universe (and Our Place In It) by Sarah Alam Malik

Particle physicist Sarah Alam Malik explores discoveries that changed our perception of the cosmos, from the Babylonians tracking the skies on clay tablets to the Copernican revolution.

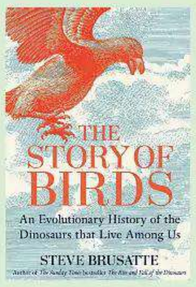
I Am Not a Robot by Joanna Stern

***Wall Street Journal* technology reporter Joanna Stern (pictured) spent a year using AI to do almost everything and to replace almost everyone, just to see what happened. A brilliant, and terrifying, idea.**



The Savage Landscape by Cal Flyn

***Islands of Abandonment* by Cal Flyn was a highlight of 2021 for me. In her new book, she travels deep into isolated wilds, exploring the nature of wilderness and how to protect wild places.**



The Story of Birds by Steve Brusatte

Palaeontologist Steve Brusatte turns to the evolutionary history of the birds, the "dinosaurs among us". Penguins the size of gorillas? Ducks weighing more than cows? I'm in.

Get set for sci-fi gold

On the horizon are Ann Leckie's latest, Neil Jordan's debut and more from Adrian Tchaikovsky. Exciting times, says our sci-fi columnist **Emily H. Wilson**

I MAY have to eat my hat later, but I reckon 2026 is shaping up to be an excellent year for science fiction. With eight months of books announced, the table is already loaded with delightful offerings.

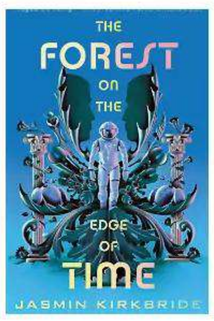
In January, we welcome new books from two big hitters. There is Peter F. Hamilton's ***A Hole in the Sky***, the first in an ark ship trilogy, and a change of pace for the author, who made his name with sprawling, science-heavy, brain-warping books. This one is short and straightforward, written from the point of view of a teenage girl. Hamilton hopes his current fans will enjoy the book, which is aimed at a younger audience.

The novel is also a change in terms of its publishing schedule, since all three books will be published this year – the second in June, the third in December. It will be interesting to see how that works for readers.

JOBY SESSIONS/SFX MAGAZINE/FUTURE VIA GETTY IMAGES

Adrian Tchaikovsky's *Children of Strife* will be a highlight of March

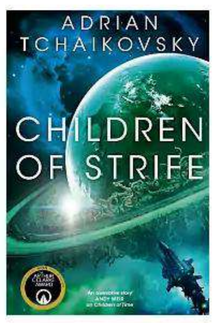
Our second big arrival is ***Vigil***, a new novel from George Saunders, who won the 2017 Booker prize for *Lincoln in the Bardo*. *Vigil* isn't sci-fi, but it has a claim to be climate fiction, because it centres on the death of an oil tycoon, and it certainly sounds speculative.



In February, expect ***The Forest on the Edge of Time*** by Jasmin Kirkbride, which is pitched as "time-travel climate fiction", and ***The Rainseekers*** by Matthew Kressel, about a group of people who travel to witness the first rain on Mars.

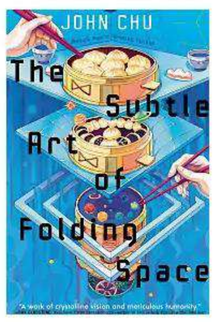
There's also ***After the Fall*** by Edward Ashton, billed as "part-alien invasion story, part-buddy comedy... part-workplace satire". Which is cool if it works.

The highlight in March (for me, at least) will be the fourth book



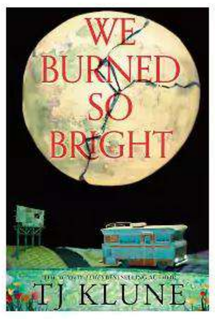
in Adrian Tchaikovsky's *Children of Time* series, this one entitled ***Children of Strife***, which will feature at least one uplifted mantis shrimp. I'm in.

Other notable releases in March include ***The Library of Traumatic Memory***, the first work of sci-fi from film director and writer Neil Jordan, and ***Jitterbug*** by Gareth L. Powell, described by its publisher as an action-packed adventure featuring a crew of bounty hunters in a devastated solar system.



In April comes ***The Subtle Art of Folding Space***, a debut attracting excitement because its author, John Chu, has won big awards for his short stories. We should also see ***The Photonic Effect*** by Mike Chen, marketed as "a page-turning space opera", featuring a galactic civil war.

But that's not all. ***The Radiant Dark*** by Alexandra Oliva is also due out (*Arrival* meets *Wild Dark Shore*", say its publishers), as is ***The Language of Liars*** by S. L. Huang ("science fiction about linguistics and consequences") and ***Ode to the Half-Broken*** by Suzanne Palmer (described as "hope-punk sci-fi").



Then there's ***We Burned So Bright*** by TJ Klune. He's an author I have never read, but know that I should. This one is about "an older gay couple on an end-of-the-world road trip".

The highlight of May will surely be ***Radiant Star***, a new work from Ann Leckie set in her magnificent Imperial Radch universe. But let's not forget an eighth *Murderbot* book, ***Platform Decay***, from the marvellous Martha Wells.

We can also expect ***The Republic of Memory*** by Mahmud El Sayed, described as an ambitious work of

"All of Peter F. Hamilton's trilogy will be published this year. It will be interesting to see how that works for readers"

Arab Futurism, and ***Not With a Bang*** by Temi Oh, billed as a family drama perfect for fans of Emily St John Mandel's *Station Eleven*.

In June, we can look forward to ***Sublimation*** by Isabel J. Kim, "an immigrant story like no other", and ***The Traveler*** by Joseph Eckert, which tells the story of a reluctant time traveller and his son. Also due out that month is ***Dead But Dreaming of Electric Sheep*** by Paul Tremblay, billed as a "genre-bending near-future tech nightmare... as bitingly funny as it is horrifically believable".

Last but not least, August will see the publication of ***The Infinite State*** by Richard Swan, another bestselling author (his books include the *Empire of the Wolf* trilogy). This one is apparently "a thrilling tale of survival" and "a blistering science fiction epic".

I am excited to get stuck in. ▮

Emily H. Wilson is the author of *The Sumerians* trilogy. She is currently working on her first science-fiction novel

Editor's pick

Taking a different view of human exceptionalism

15 November, p 25

From Shirley C. Strum
University of California, San Diego, US

I am a scientist who has studied wild baboons in Kenya for over 50 years. While I agree with much of what Christine Webb says in her book, *The Arrogant Ape*, looking at humans through what I call my "baboon glasses", constructed over decades of research, shows just how exceptional humans are.

Recently, the weight of human infrastructure (concrete, glass, timber, metals, etc.) equalled the weight of all life on Earth. Because of this, I reach a different conclusion to Webb. We shouldn't look to any non-human animal to find the origins of the best and worst human behaviours. These are of our own (human) making. Our muddle today is because humans are exceptional.

Cats and dogs aren't accessories

6 December, p 22

From Ingrid Newkirk
People for the Ethical Treatment of Animals, Washington DC, US

Eddie Clutton makes excellent points in condemning "fur babyism", which reduces a dog or cat to a toy, accessory or infant. They aren't any of these things – they are individuals of a species different from our own, in ways that we ignore to their detriment, e.g. crating them for our convenience, flattening their faces for a "look" so they can barely breathe, declawing them to save our furniture or reprimanding them for natural behaviours.

Weighing up the odds of alien life

6 December, p 30

From Bryn Glover
Ripon, North Yorkshire, UK

Michel Brahic tells us that the formation of the last universal common ancestor from a soup of chemicals was "an extremely unlikely event, with a probability estimated at less than 1 in a billion".

He then goes on to speculate that life elsewhere in the universe, if it exists, could be based on even more unlikely events. Surely, in the face of such massive adverse odds, if life has happened elsewhere, then it is most likely to be a duplication of what has happened here.

Understanding the psychology of driving

22 November, p 19

From Angela Crabtree
Reading, Berkshire, UK

Anthony Laverty's article "Running out of road", struck a chord with me as someone who hasn't had a car for most of my adult life and who now has a little Corsa that's about 15 years old. I think the psychology of driving is something that needs a lot more research, perhaps with an aim to making us less car-centric.

People change when they drive and become arrogant, aggressive and completely ignorant to the fact that they aren't the best drivers in the world. For walkers and cyclists, it makes for high risk, and for small cars it's intimidating at times. I'm not a car hater, and I do enjoy driving, but like it is often said, driving is a privilege, not a right.

Concern over the limits of medical research

29 November, p 13

From Ruth Samuels, Bishop's Stortford, Hertfordshire, UK

Am I alone in finding highly distressing the report into how to achieve successful pup delivery in oxytocin-deprived mice? Many of these mice and their pups are reported to have died without the assistance of an experienced mouse midwife. Pain and distress must have accompanied these deaths.

While experiments using non-human animals may be required for medical research, there appears to be no such justification in this case. Proving that oxytocin-deprived mouse mothers and their pups need and attract the assistance of an experienced cage companion seems not to equal the distress likely to have been caused.

A better formula for setting goals

15 November, p 28

From Joe Black
Santa Rosa, California, US

Working towards more than one goal usually means missing both. A better formula is: your major goal is what you really want to be, and be remembered for. Periodically rededicating yourself to that lifetime goal often pulls you through tough times. That goal is your own, private matter.

As you grow and learn in your career, you might adjust or refine the goal, i.e. to be the best (title) in (location). Everything else is an objective, or perhaps minor goal. These are usually specific, measurable accomplishments, rewards, financial security, etc.

Listening out for the sound of the caves

22 November, p 34

From Grace Bedell
Toronto, Ontario, Canada

I accept that ancient peoples may have selected sites for social and spiritual purposes because of unique soundscapes, but, for cave art, what if sound was mostly important to help find the right place? For an artist, tall ceilings would be good so smoke from a large light-giving fire would gather high up, allowing clear sight for painting and comfortable breathing; tall Victorian ceilings had the same purpose.

To find such height, the length of reverberation could be used as a proxy measurement by the artist. A dim torch would be useless for assessing this. Ancient peoples may have had a strong appreciation for sound signals and some people who are blind are said to have improved echolocation, so discovering this method may not have been difficult.

An answer to the simulation mystery?

13/20 December, p 54

From Tim Rafferty
Aargau, Switzerland

I very much enjoyed Miriam Frankel's article "Do we live in a simulation?". But she inadvertently hints at an interesting theory and then ignores it. Just assume, as others have, that this is a simulation designed entirely as a time machine to study humanity. After setting the "internal" clock of the simulation to run many times faster than any external clock, the observers could see how, from an initial condition, this particular set of events would play out.

But they would only need to simulate our ability to observe the universe, not manifest every aspect of it until that point "in time" when the "thing" met with our observation. This deals with the "no computer or power source could be big enough to cope with the load of simultaneously simulating everything" problem.

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For the record

Andrea Halpern is a professor of psychology at Bucknell University, Pennsylvania (6 December, p 46)

And breathe...

The best thing you can do for your health this year is learn to put your body into safe mode. **Caroline Williams** is your guide

SIMBIE YAU

IT HAPPENS every new year. Party time is over, and it is time to brace yourself for the predictable onslaught of health advice. Most of it will involve doing more of something that you already know is good for you. More exercise. More cooking from scratch. More wholesome, mindful hobbies. It is no wonder so many of us fall off the wellness wagon before the month is out. No matter how sage the advice, who has the time and energy to do more of anything? If this sounds familiar, it might come as good news that scientists have come up with a more appealing alternative — one that still promises to increase your chances of staying healthy for longer, but involves doing less, not more.

Or, more precisely, that involves perfecting the art of doing, physiologically speaking, as little as possible. This unusual, yet deeply effective, twist on the New Year's resolution hinges on mastering a physiological state that many of us spend few of our waking hours in. It is called deep rest – a way of being in which signals between the body and brain align on one fundamental fact: that all is well and there is absolutely nothing to worry about.

In essence, it is the polar opposite of stress. Deep rest is a state where the body can take a break from fighting and fleeing, instead regrouping and catching up with some much-needed maintenance and repair. And while it might take some trial and error to find your personal off switch, the evidence is accumulating that the payoffs could be huge: healthier ageing, reduced risk of disease and more energy to spend on something other than maintaining an ambient panic response.

Alexandra Crosswell is a psychologist at the University of California, San Francisco, who, along with a group of her colleagues, proposed the idea of deep rest in early 2024. She is aware the term may sound familiar to some. Andrew Huberman, a Stanford neuroscientist turned wellness influencer, has widely promoted what he calls "non-sleep deep rest" on his podcast and social media channels. But, says Crosswell, the two aren't quite the same. "The difference between how we define deep rest and how Huberman describes non-sleep deep rest is that his is a relaxation practice and ours is a psycho-physiological state," says Crosswell. "Deep rest is beyond relaxation – it's a coordinated shift of the whole nervous, endocrine and immune system into an overall state of safety signalling."

It is a truth, universally acknowledged, ›

STUART FREEDMAN/IN PICTURES VIA GETTY IMAGES IMAGES

A moment of calm can do wonders for your health and well-being

that if one thing could transform human health, it would be an antidote to stress. Problematic stress is a centuries-old issue that people have been complaining about since at least the industrial revolution. The things that generation struggled with – the cost of living, the pressures of work and family and an unsettling change in the pace of life – are still as relevant today as they were then. What's new is that these very human concerns are layered on top of an underlying current of unease fuelled by 24-hour access to awareness of global crises, many of which seem frighteningly out of our control. There are signs that all of this is taking a serious toll.

According to a 2022 survey of over 3000 US adults, more than a quarter of respondents said stress made it difficult to function in daily life. Meanwhile, chronic stress has been linked to soaring rates of everything from depression and anxiety to cardiovascular disease, high blood pressure, infectious diseases and some cancers. It is a major factor in the epidemic of tiredness and fatigue and is linked to accelerated ageing and an increased risk of all-cause mortality from middle age onwards. Yet despite an overwhelming consensus that too much stress is bad for our health, it has proved difficult to pin down exactly why, which has made it difficult to know how to go about fixing the problem. The big picture is clear enough and, arguably, pretty obvious.

"Deep rest involves perfecting the art of doing, physiologically speaking, as little as possible"

Stress is draining because, whether the threat is physical or psychological, mounting a stress response requires a huge investment of the body's resources. In experiments, a short bout of psychological stress increased volunteers' energy expenditure by up to 67 per cent above their resting metabolic rate. Other studies suggest that about a third of this energy is spent on fuelling the rise in heart rate, with the rest accounted for by the cost of producing stress hormones and inflammation. Once the stress hormones are circulating in the body, they have knock-on effects on the cell's metabolism.

Human cells that are chronically exposed to stress hormones in the lab have been found to burn through energy 60 per cent faster, age faster and die younger. The whole process gobbles up so much energy that, while an active stress response is on the go, the body takes a break from less urgent processes like digestion, reproduction, maintenance and repair. The stress response is an example of a process called allostasis, or "stability through change". Allostasis is different from the more familiar process of homeostasis, which describes how we regain balance after one or more biological processes have been knocked off course by environmental change.

In allostasis, though, the adjustments don't happen after change, but in advance, based on the brain's predictions about what is likely to happen next (like identifying a possible incoming threat) and how best to adapt (like by flooding your system with hormones as part of the fight or flight response.) "Your brain is predictively regulating your body," says Lisa Feldman Barrett, a neuroscientist at Northeastern University in Boston. "Your body is [then] sending signals back to your brain about the sensory conditions of the body and the sensory consequences of allostasis."

Recently, a group of neuroscientists, including Feldman Barrett, have argued that allostasis isn't just a side project for the brain; rather, it is its main function and number one priority. In this view, thinking, feeling and action all work in service of allostasis, helping the brain reach its goals by motivating us to do whatever is necessary to balance the books and stay alive. This new view of the brain puts

“If one thing could transform human health, it would be an antidote to stress”

The stresses of modern life leave many of us depleted

JIE ZHAO/CORBIS VIA GETTY IMAGES ; ABOVE: MARIO TAMA/GETTY IMAGES

a spin on the challenge of tackling the epidemic of stress, says Karen Quigley, also at Northeastern University, who, along with her colleague Feldman Barrett, proposed the idea in a 2025 paper in the journal *Neuron*.

“If you start from the biology and try to understand this important and critical role for a brain managing its energy budget, then you start to think about concepts like stress slightly differently,” says Quigley. Thinking of toxic stress as allostasis gone awry helps explain why the expense of chronic or repeated stress takes its toll on our health. Allostatic states, like stress, are supposed to be temporary.

In short bursts, the investment is worthwhile when you need to run, fight or think your way out of a crisis. But given that most modern threats aren’t actually likely to lead to your demise, much of the time, the investment is metabolic overkill. And given that daily hassles are a part of life – a survey of US adults reported an average of three or more stressful events a day – there is often little time to recover before the next thing hits the fan. The result is tension, fatigue and an increased risk of poor health, as the body continues to sideline maintenance and repair in a misguided attempt to be ready for anything.

Ironically, there is some evidence that constantly being in “a little bit on” state makes the body less efficient at responding to acute stress, so when we actually need our fight-or-flight system, it’s as worn out as we are. In better news, the fact that allostatic states are temporary by nature raises the possibility that if we can find the right bodily switch, we can change the signal, and the accompanying allostatic state, to one where all is well and biological bankruptcy isn’t an immediate concern.

Restore and revive

“It may be that you can create a ‘system reset’ partly by enhancing signals that current resources are sufficient,” says Quigley. This is where the idea of deep rest comes in. Crosswell and her colleagues set out to explore why contemplative practices like prayer, chanting, meditation, yoga and qigong (a practice involving flowing, coordinated movements) have positive effects on physical health and mental well-being, reducing self-reported levels of stress and improving markers of physical health such as blood pressure and inflammation.

Bringing together a team of researchers spanning neuroscience, physiology and cellular metabolism, the idea was to identify the special sauce in these practices. They concluded that the beneficial effects of contemplative practices come from the way they put a spanner in the physiology of the stress response. “These practices put the organism in a state of lower energy demand,” says Martin Picard, a mitochondrial psychobiologist at Columbia University who collaborated with Crosswell on the research. When the brain gets the memo, he says, it starts to be generous with its resources. “Instead of wasting your energy making cortisol and speeding up your heart rate, you have this energy pool that’s available for restoration,” he says. Studies suggest that contemplative practices do indeed reduce energy consumption.

Research dating back to the 1970s found that during transcendental meditation, metabolic rate dropped by 40 per cent compared with when the same volunteers were sitting quietly without meditating. Studies of regular yoga practitioners have also found that they consume up to 15 per cent less energy at rest than non-practitioners and have lower resting heart rate and blood pressure and lower levels of circulating stress hormones. ›

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Breathing your way to deep rest

Smartphones and watches, with their constant flurry of updates and notifications, seem like the antithesis of a calm, stress-free existence. But for anyone keen to find their own deep rest state, they do have their uses.

One marker of stress regulation that comes as standard in most smart watches is heart rate variability (HRV) – a measure of the tiny variations of the time between successive heartbeats that is used as a marker of overall physiological stress, and of how efficiently the body is managing its resources. Different devices use slightly different measures, and what counts as healthy varies by age, but a higher HRV is generally considered healthier. An HRV below 25 millisends (ms), for example, has been linked to a greater risk of cardiovascular disease and depression.

A tried and tested way to boost HRV is via resonance breathing biofeedback, in which slow breathing at around 6 breaths per minute causes two of the body's key heart-rate regulating reflexes to synchronise so that each boosts the activity of the other. The net result is a boost to the parasympathetic (rest and digest) arm of the nervous system. Some research suggests that if practised regularly, HRV biofeedback trains the body to recover more efficiently after stress.

Take heart

While HRV biofeedback works best when both blood pressure and heart rate are measured in the lab, apps exist that offer breathing exercises based on real-time measurements of HRV. I spent four-weeks self-experimenting using one such app, combined with a chest-mounted heart rate monitor. In week one I logged my baseline average HRV. During week two, I did 20 minutes of resonance breathing biofeedback a day, and in the third week, I took a break from daily training. For the final week, I returned to training.

The results were clear: during the biofeedback weeks, my average daily HRV, measured on my Apple Watch, came in at between 55 and 60 ms (at the healthy end of normal for my age), more than 10 ms above the just-about-healthy baseline I established in week one. The effects seemed to spill over during my week off, with my average HRV staying higher than average, before returning to the high 50s in my final week of training.

This was encouraging, but the training is quite time-consuming. So I was keen to try an even easier alternative. According to its website, the Nurosym vagus nerve stimulator has been shown to significantly increase HRV and improve other markers of stress. The device attaches via a clip to the hard flap of cartilage at the front of the ear, where a branch of the vagus nerve runs close to the surface. I used the device (lent to me by the company) three times, for up to 20 minutes, at the same time of day as I had previously done my breathing practice.

The results were… mixed. The stimulation either led to no change in HRV, a slight decrease (55 ms before, 48 ms after), or a very slight increase (45 ms before, 48 ms during, 51 ms after). Confused, I contacted Julian Koenig, a psychobiologist and member of the international consensus group on transcranial vagus nerve stimulation research.

He points out that my results are about as consistent as what has been found in various studies on the subject. Yet while results vary, the study the company refers to on its website, published in 2022, is something of an outlier in the field in showing an increase in HRV with stimulation.

"That's why we did [a] meta-analysis," says Koenig. So far, he says, the published results of the consensus group's ongoing "live" meta-analysis have shown "no effects on heart rate or HRV" during short-term stimulation. And while there is still much to learn about what, if anything, these devices can do for health, he says that "if the goal is to increase HRV, deep breathing is one of the best and cheapest options".

Flotation tanks can be one way to take time for yourself

ANYA SEMENOFF/THE DENVER POST VIA GETTY IMAGES

VCG/VCG VIA GETTY IMAGES

"With deep rest, you're moving away from worrying about the future into this present moment"

Mindful practices like qigong can help you enter a state of deep rest

As to what exact mechanism is behind the effect, Crosswell and her colleagues speculate that one thing these interventions have in common is – by accident or design – that they tend to involve slow, deep breathing. Deep breathing, particularly at or around 6 breaths per minute, activates stretch-sensitive sensors in the chest, which activate parasympathetic activity in the vagus nerve (see "Breathing your way to deep rest", left). The parasympathetic nervous system controls the so-called rest-and-digest response, which is the polar opposite of fight or flight. When parasympathetic activity is high, heart rate, blood pressure and other signs of arousal are low, and the body gets on with all the internal housekeeping that it has been keeping on hold.

The shift to parasympathetic dominance, combined with the meditative element of these practices, might be enough to persuade the brain that there is no longer any threat, and to stand down, says Crosswell. "With prayer and mindfulness and other deep rest practices, you're moving your mind away from worrying about the future into this present moment," she says. Assuming that the here and now feels safe, this adds a second positive signal for the brain to factor into its budgeting – what Crosswell calls a "present moment sufficiency mindset" or "that right now, I have all the energy I need".

A 2025 study on using a mindfulness intervention seems to back up this idea that deep rest makes a measurable difference. Those who did 10 sessions of an hour-long mindful breathing and stretching-based practice had higher levels of healthy metabolic markers in the blood and lower levels of those associated with disease risk. A comparison group whose participants underwent relaxation training showed no such changes.

Find your calm

This precise prescription wouldn't work for everyone, however; for some, meditation might evoke a stress response, for example. Different options include paced breathing, particularly hitting those apparently crucial 6 breaths per minute, or simply spending time with a loved one who makes you feel safe.

As social creatures, our brains are wired to factor in how much support we have to deal with life's ups and downs. Its power as an antidote to stress may even explain why close, supportive relationships are linked to better health and longer lifespan, says Quigley. "Humans are really critical allostatic supports for one another," she says. "Social support is an important allostatic regulator."

A good way to super-charge social support – or to mimic it if you don't happen to have a loved one to hand – involves activating skin-based sensory nerves that are thought to have evolved to solidify social bonds. Known as C-tactile afferent fibres, these fire most enthusiastically when stroked slowly and gently at close to body temperature. Experiments into the effects of this "affective touch" have shown that it not only feels pleasant and calming to people of all ages, but it also leads to a drop in heart rate and other markers of parasympathetic activity, even when applied during a stressful experience. Research suggests that a soft-bristled brush stimulates these nerves almost as well as a loving caress from an actual human. A team of researchers at Cornell University in New York state are even trialling a wearable device that has shown promise in early tests as a stress-buster.

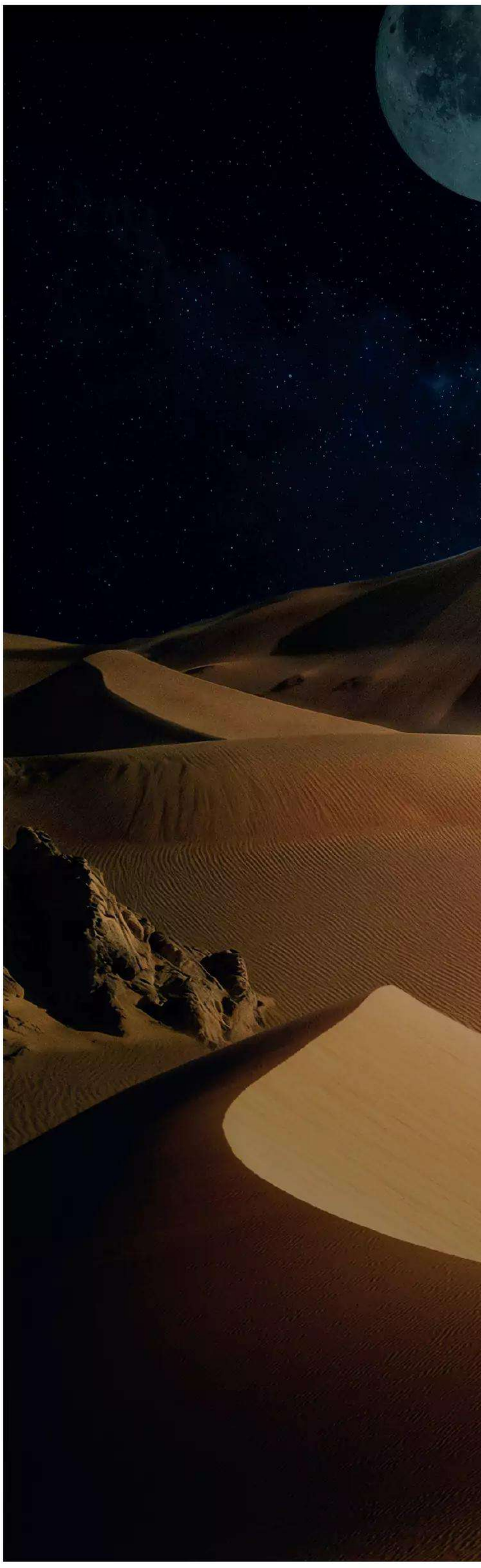
But the paramount message, says Crosswell, is that there is no single route to deep rest. Some people find meditation more stressful than calming, while others find affective touch ticklish or rage-inducing. What's important is to seek out something that makes you feel warm, safe and calm from the inside. The ultimate state of deep rest, of course, is sleep, a time when the energy savings of being still and breathing more deeply allow the body to flush out the brain and make repairs to the body. It is possible that, for anyone short on sleep, adding deep rest to waking hours could help make up the shortfall.

As for how much you need to neutralise the effects of stress, the answer is: it varies. "I wish I could say how many minutes is enough," says Crosswell. Even so, with growing evidence that deep rest is a state worth making time for, the best advice right now is to find where you feel safe and spend as much time in it as possible, basking in the knowledge that you are investing in your long-term health. ▮

Caroline Williams is a science writer specialising in neuroscience, psychology and health. Her most recent book is *Inner Sense*

The mystery of the missing meteorite

A soldier returned from the Sahara desert in 1916 with a wild story about a gigantic meteorite. Over 100 years of hunting yielded nothing – but now the puzzle may have been solved, finds **Alex Wilkins**



IT ALL started with an overheard conversation between some camel herders. The year was 1916, and Gaston Ripert, a French army captain, had been injured and sent to recover in the small town of Chinguetti in Mauritania. It was a lonely, dusty place on the edge of the Sahara.
So when Ripert heard local people talk of a colossal block of iron out in the undulating expanse of dunes, he was intrigued. They referred to it as the "iron of God".

He persuaded one man to guide him to this fabled iron and what followed has passed into legend. After an arduous overnight camel ride, Ripert arrived at what appeared to be an enormous metal edifice – some 100 metres wide in his estimation – partly buried in the dunes, its side polished by the sand to a mirror finish.

Ripert brought back a piece of rock from the site, and when it was analysed after the war, it was found to be genuine meteorite. That caused a sensation and prompted meteoriticists the world over to wonder if the iron of God itself could also be from space. If so, it would be an astonishing find, a meteorite far more massive than any found before.

Over the past century, a rotating cast of adventurers, scientists and treasure hunters attempted to retrace Ripert's footsteps, but all came back empty-handed. Hope of success was ebbing away. But in the past few years, two identical twins – one an astrophysicist, the other an engineer – have taken up this challenge. "As far as anyone knows, this meteorite could exist," says Stephen Warren. "It could be under a sand dune." And thanks to the twins' work, we may now be as close as we have ever been to finding the truth.

Meteorites have fascinated humans for centuries, with some ancient cultures venerating and even worshipping them. Modern scientists are just as captivated, because, as well as being objects of wonder, meteorites can reveal the deep history of our solar system. They come in all sizes, from tiny specks of cosmic dust to boulder-sized rocks. The largest known single piece of space rock on Earth today is the Hoba meteorite, which is about 2.7 metres wide and still lies where it fell in Namibia. That is partly why Ripert's tale inspired such interest: his iron of God would have been thousands of times larger.

From the start, his story had an aura of mystery around it. The man who agreed to ›

JULIEN PACAUD

take Ripert to see the iron, one of the local village heads, did so on the condition that he kept the location secret. Ripert later wrote that they travelled "blind", which has been interpreted to mean he had no map or compass and was perhaps blindfolded. They travelled overnight by camel for 10 hours, arriving at the fabled rock as a new day dawned. By the first shards of morning light, Ripert saw a vast cliff face that was 40 metres high, 100 metres long and "strongly polished by windblown sand", as well as a longer side that had been buried under the dunes, making its third dimension "impossible to estimate".

There are scientific reasons to think this is more than just a story. Ripert examined the huge iron closely and described seeing "metallic needles sufficiently thick so that I could not break them or remove them". These needles later became an important and puzzling piece of the mystery, because what Ripert described sounds eerily similar to real observed properties of a rare class of meteorites called mesosiderites. These meteorites are made of iron encased in a delicate layer of silicate mineral. This means that after a long period on the ground, the mineral layer gets eroded, leaving needles of the hardier metal. This was discovered long after Ripert's journey into the desert, so it isn't a detail he could have intentionally fabricated.

And there's an even stronger piece of evidence for the story's veracity. Ripert said he climbed on top of the iron mass and there found a smaller rock. He brought this back with him, and in 1924 it was analysed and confirmed to be a meteorite by the mineralogist Alfred Lacroix at the French Academy of Sciences in Paris. It turned out to be a mesosiderite, which adds weight to the story of the strange needles. This, coupled with testimony of Ripert's honourable character from friends and colleagues, meant that scientists at the time were captivated by the finding and had little doubt that the larger meteorite existed. Lacroix, when presenting the finding, said: "If, in effect, the dimensions given by M. Ripert are exact, and there is no reason to doubt them, the metallic block constitutes by far the most enormous of known meteorites."

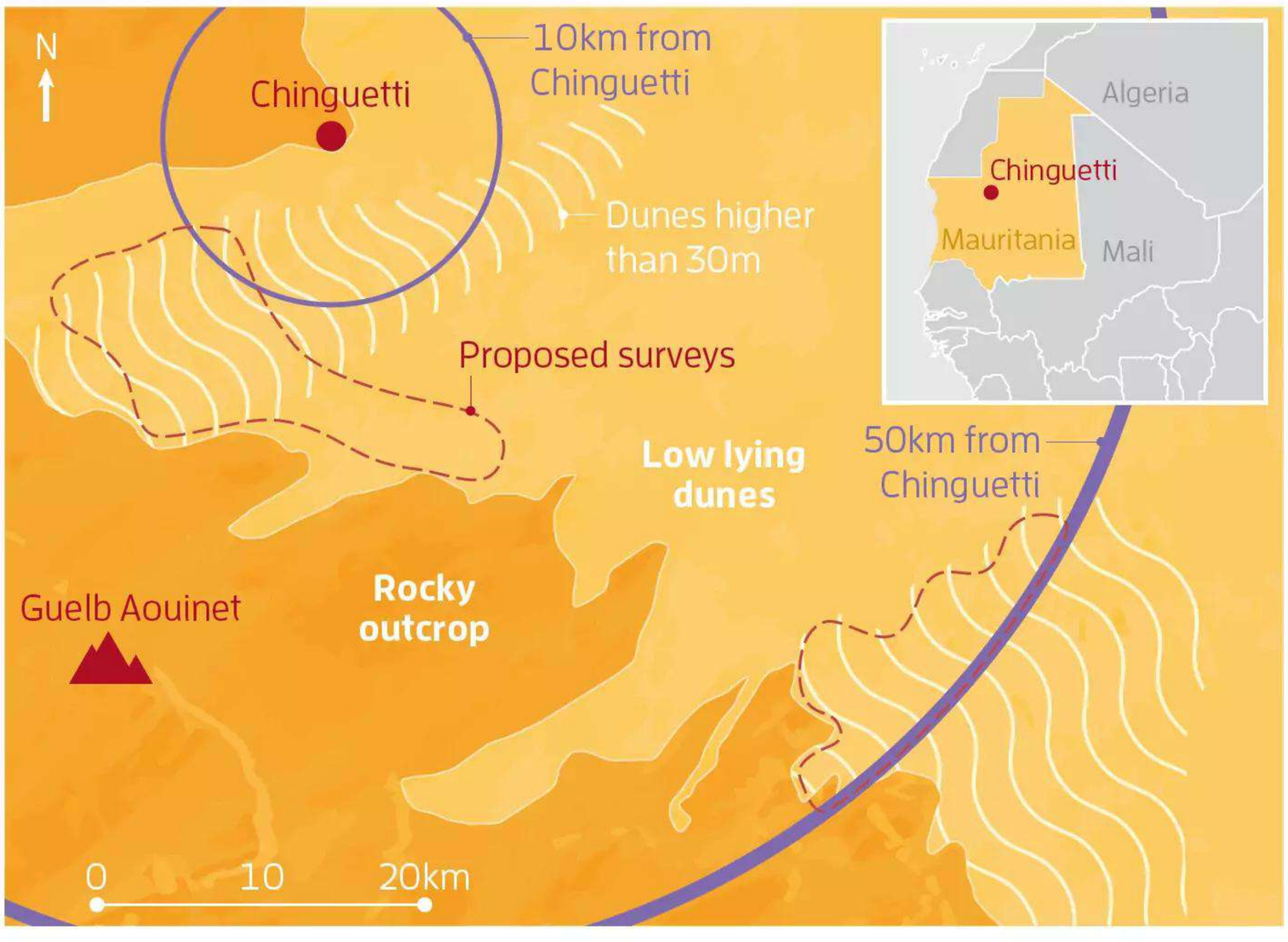
Lacroix divided the smaller meteorite into fragments for analysis, and today the largest piece is kept in the collection of France's National Museum of Natural History. It takes only a quick glance at this specimen to see why Ripert would have immediately noticed the rock. There are large, shiny chunks of what look to be pure metal surrounded by tiny clumps of irregular rock. This feature is a consequence of how scientists believe mesosiderites form, where one asteroid smashes into the pure iron core of another.

"A meteorite the size of a building shimmering in the sun would be a magnificent sight"

A meteorite the size of a building shimmering in the sun would be a magnificent sight, and it wasn't long before scientists began asking a simple question: where was it? Ripert's notes from the trip, which were passed to Lacroix, gave scant information on its location, understandably enough, given that he was travelling blind. Ripert did estimate it was 45 kilometres south-west of Chinguetti and just to the west of a local water hole. The captain had led a camel corps during the first world war, and knew the position of the sun, so these clues at first seemed reliable. But the first people who went looking for the treasure in the desert came back with nothing to show for their trouble. And when astronomers then began communicating with Ripert by letter, his story seemed to shift. The direction may

An unearthly treasure map

Researchers Robert and Stephen Warren narrowed down the possible location of the giant Chinguetti meteorite. The man who originally found it said it took a 10-hour camel journey to reach, which the researchers say means it must be at least 10 km and no more than 50 km from the town where he started. It must also now be hidden by dunes at least 30 metres deep. This led the researchers to propose two unsearched areas of dunes (outlined in red) where the treasure could be.



actually have been south-east, he wrote, and the meteorite could now be buried by migrating dunes.

In the early 1930s, a man named Theodore Monod entered the fray. Monod was a naturalist, explorer and former priest who dedicated a large part of his life to unravelling the Chinguetti mystery. Monod's work ethic and stamina were legendary – he made months-long desert expeditions by camel cataloguing the flora and fauna of the Sahara. His scientific acumen, too, was renowned. He discovered one of the earliest remains of a neolithic person, and later accompanied August Piccard in his prototype submarine, the bathysphere. "He was very honest, and very strict," says meteoriticist Brigitte Zanda at France's National Museum of Natural History. "He viewed science as a calling, as a faith in some way. He thought the Sahara was his diocese."

Monod set out on his first expedition in 1934 from Senegal towards Chinguetti. When he reached the town, he tried retracing Ripert's steps by piecing together clues from his letters and tracking down officials and locals with whom Ripert may have had contact. But the locals professed not to know about this "iron of God", and Monod found nothing.

The iron of God

Monod continued to work obsessively on the problem in the following decades, revisiting the area several times. By the 1990s, nearing the end of his life and almost blind, he was sick of the puzzle, says Zanda, and he concluded that Ripert must have mistaken an isolated nearby rocky hill, or butte, called Guelb Aouinet for an enormous meteorite. Zanda, who accompanied Monod on one of his last expeditions, thinks this improbable, given that Ripert had a degree in natural sciences and knew something of geology. "When you see the butte," says Zanda, "I just don't believe [that's what Ripert saw]. It doesn't make sense."

In the early 2000s, two young planetary scientists, Phil Bland and Sara Russell, took up the search for the iron of God. Both were curious, if sceptical, about its existence, but they had new tools that could be applied to the search that made a fresh hunt seem worthwhile. Plus, it was the adventure of a lifetime. "Chinguetti itself is this incredible town, almost a novelistic picture of a desert oasis with these old, old buildings and ruins

GRANITE PRODUCTIONS

Left: Sara Russell (far left) and Phil Bland (second from left) with local guides during their desert expedition

Below: A piece of the meteorite that Gaston Ripert brought back from the desert

that are partly consumed by the desert," says Bland, who until recently was based at Curtin University in Australia.

Together with a Channel 4 documentary film crew, the pair travelled by camel to a spot in the desert where a pilot called Jacques Gallouédec had claimed he had seen something interesting, and they took with them a scientific instrument that no previous searches had seriously used: a magnetometer, which can detect metallic objects buried under the sand. Like so many before them, they found nothing. But Russell, based at London's Natural History Museum, says the pair realised at the time that their scientific approach, applied in a systematic way, was the path forward. "We thought that's maybe the only way we can really show that it doesn't exist," says Russell.

The magnetometer wasn't the only new trick the scientists had up their sleeves. In 2003, Bland and a colleague ran calculations on a supercomputer to find the biggest possible asteroid that could survive an encounter with Earth's atmosphere, and an impact with Earth itself. Even in the most optimistic scenarios – involving unlikely angles and skipping stone-like trajectories along Earth's oceans – the largest possible meteorites that could survive intact were around 10 metres across, a far cry from the 100-metre-long rock that Ripert claimed to have seen. "Even for 10 metres, you've really got to be turning all the dials to make that come out right," says Bland.

By this time, it was also possible to analyse meteorites to find out the levels of various radioactive isotopes inside them. When rocks are in space, they are bombarded by cosmic rays, which can change the balance of these isotopes, but the rays only penetrate so deep. For this reason, measuring the isotopes in any meteorite allows scientists to estimate the size of the parent space rock it came from. In 2010, Bland, Russell and several colleagues applied this idea to the meteorite that Ripert brought back with him. "If it was really a part of a big meteorite, we would have found really low concentrations of these isotopes," says Kees Welten at the University of California, Berkeley, who led the analysis. But the results went exactly the other way. "What we found was that the concentration was pretty normal for a meteorite of a metre-size or so."

For many, that seemed final. Science had spoken and Ripert's mammoth meteorite ›

CHIP CLARK/SMITHSONIAN NATIONAL MUSEUM OF NATURAL HISTORY

What did Gaston Ripert see?

We can't know what it was that Ripert saw in the desert on that fateful morning in 1916, but it is possible to distil four logical possibilities.

1. HE MADE THE WHOLE THING UP

The history of science is littered with frauds and fabulists. Given the bold claim, it is possible that Ripert was simply a liar. But according to letters and character references from scientists and people who knew him, Ripert was reputedly an honest and honourable man. He won the French Legion of Honour, the country's highest military accolade, and was entrusted with high military posts in Senegal and the Ivory Coast for decades. Ripert never seemed to gain anything from his story, either.

2. RIPERT MISTOOK SOMETHING ELSE FOR A HUGE METEORITE

What if the captain did see something, but it wasn't what he thought? The hot conditions of the desert may have given him an "imagination overheated by the Saharan sun", as Jean Bosler, a geologist who exchanged letters with Ripert, argued. Then again, Ripert was no fool. He had multiple degrees in natural sciences and mathematics and was a keen amateur geologist, sending rock samples back to France from his various postings around Africa. This means he would have been familiar with the properties of meteorites, says Brigitte Zanda at the French National Museum of Natural History, and is unlikely to have simply made a mistake.

3. HE WAS TELLING THE TRUTH AND WE'VE MISSED SOMETHING

Despite the strong scientific evidence against it and the Warrens' exhaustive search (see main story), there are always what-ifs. Perhaps the area Ripert travelled to that night wasn't anywhere near where he later said it was. If so, the meteorite might be out there in a location no one has thought to search. It could also be significantly smaller than Ripert estimated and thus more difficult to find.

4. RIPERT WAS TELLING ONLY PART OF THE TRUTH

A year after the nighttime camel trip, the man who guided Ripert died, possibly from poisoning. Does this betray a hint of an otherwise secret intrigue? Perhaps. What we can say confidently is that talk of Ripert's honour overlooks the fact that he apparently broke the vow he gave his guide to keep the iron of God's location secret. That allows an intriguing final possibility: what if Ripert did see the meteorite but deliberately misled people as to its exact whereabouts? Maybe in his mind, this messy compromise kept his promise to keep its location secret, while simultaneously revealing at least its existence to the wider world.

GRANITE PRODUCTIONS

Gaston Ripert claimed to have seen a giant meteorite in the Sahara

couldn't have existed, at least not as he described it. Except, that conclusion raises nagging questions about what to make of Ripert's tale (see "What did Gaston Ripert see?", left). Did the captain make it all up, and if so, for what possible gain? For some, the lack of a convincing motive for him to invent his story leaves open a chink of hope that maybe, just maybe, the science was missing something.

Intriguingly, Ripert himself can speak to us from down the years on this point. In a letter to Monod in 1934, he wrote: "I know that the general opinion is that the stone does not exist; that to some, I am purely and simply an impostor who picked up a metallic specimen. That to others, I am a simpleton who mistook a sandstone outcrop for an enormous meteorite. I shall do nothing to disabuse them, I know only what I saw."

The iron of God began to cast its spell on Robert Warren back in 2018, when he was working as an engineer in Mauritania for a multinational oil company. One day, he was idly browsing for a weekend adventure when he stumbled across the Wikipedia page for the town of Chinguetti and the rich history of its eponymous meteorite. "I was completely hooked at that point," says Warren.

At first, Warren spent evenings on Google Earth to see whether he might spot the meteorite sticking out of the sand. But as he read more about previous searches, he realised that despite Russell and Bland's work, no one had ever conducted a systematic magnetometer survey of what was hiding beneath the dunes.

Before he could do that, however, he wanted to visit Chinguetti. In 2022, he organised a small expedition into the desert retracing Ripert's footsteps, partly with a faint hope of finding the meteorite, but principally to gather as many clues as possible that would, by a process of elimination, narrow down the search area. He also gathered existing satellite data for the region around Chinguetti that, among other things, revealed the depth of the dunes. To piece all the information together, Robert decided to enlist the help of his twin brother Stephen Warren, an astrophysicist at Imperial College London.

For all their similarities, Robert and Stephen have deep differences. "He's a scientist who's worked all his career in an area with absolute gobs of data, and so he likes certainty," says Robert of his brother, who usually specialises in hunting distant galaxies. Stephen, in his

MOHAMED NATTI

The town of Chinguetti is on the very edge of the desert

own telling, says his years of research experience means that he has "developed an intuition for how to approach things, and I'm much more sceptical than [Robert]". But he also admits that his brother has "enormous enthusiasm and energy, and he's very bold as well". Putting all the pieces of evidence together, the twins eventually deduced that there were only two feasible locations (see "An unearthly treasure map", page 34).

Just before Christmas 2022, the Warrens returned to the desert to explore the first of those two locations, an area of dunes south of Chinguetti known as Les Boucles. They took a magnetometer and walked the dunes, taking readings every 50 metres. "This experience of going off into the desert was quite amazing," says Stephen. "It's a beautiful landscape. There's nobody else there. We were doing an exciting experiment. We were hopeful that we would detect it."

But still, nothing. Both brothers had known from the start that their chances were slim. So why bother looking at all? Here was somewhere that the twins agreed: the scientific consensus is a messy thing, and all pieces of evidence need to be taken into account. The isotope studies seemed to make Ripert's story seem untenable. Yet balance against that Ripert's lack of incentive to lie, his reputed good character, the description of the strange needles and the existence of the smaller meteorite itself, and the verdict becomes less certain, says Stephen. "Unless evidence is convincing, I'm open-minded."

They had one last roll of the dice. In the early 2000s, the Mauritanian government had surveyed the area with an aeroplane magnetometer while looking for mineral deposits and compiled a detailed dataset that wasn't publicly available. Robert tried asking the government several times, but received no response, and so he resorted to using his old connections in the oil industry to contact people high up in the government.

End of the hunt?

Finally, in May 2025, Robert's perseverance paid off, and the data came through. Working by himself with an unfamiliar dataset over a vast area took weeks, looking for any sign of a tiny magnetic field spike that could indicate buried treasure, but eventually, he had his conclusion. In August, in an email to *New Scientist*, Robert wrote: "We got exactly the data we needed to see if the meteorite is there or not, and the answer is that it is not."

After searching for this desert treasure for more than seven years, it was a devastating blow. "I was completely crushed," says Robert. "I kept looking at the data, going, what have I missed?" But it was clear – the meteorite did not exist in the area Ripert had described. It remains possible that Ripert may have seen something smaller, says Stephen, but it can't be the monster so many have hoped for. "That's a rather unsatisfactory conclusion, isn't it? Because then it still might be there. It still would be the biggest meteorite in the world by a factor of 10,000 or something. But life's like that. It's not black and white, it's not cut and dried."

For his part, Bland can appreciate why the twins felt the urge to investigate against all the odds. "I absolutely understand why [the Warrens] didn't really take no for an answer," he says. "If you think you've got a different approach, then go for it. So much of science is actually exploration."

Where does that leave us? We now know beyond reasonable doubt that Ripert's story can't be literally accurate. But every scientist who has worked on the iron of God mystery has been left with an unsatisfactory aftertaste. What really went on during that fateful day in 1916? If Ripert was a fantasist, where did he get his bona fide meteorite, which, after all, is of an extremely rare type? "We have to accept that we don't have the answer to everything," says Zanda. "I think we have to live with it unless something really happens. It might have happened with what the Warren brothers did. Well, it didn't."

But perhaps a thicket of messy, hard-to-explain evidence is exactly where scientists should expect to find themselves. After all, it's only rarely that something clicks, confusing lines of evidence slot into place and we see something new. Mysteries and inexplicable clues are the fuel that powers the scientific engine.

The great explorer and naturalist Monod himself seems to have thought this way. Zanda recalls standing with him on top of the Guelb Aouinet, the rocky outcrop that he thought Ripert might have mistaken for a meteorite. "Do we ever have to abandon all hope?" Monod said to her, as they gazed over the dunes. "Is it not perhaps a good thing that by refusing to give in to the evidence, the dreams that lie half awake in us all may persist?" ▮

Alex Wilkins is a news reporter at *New Scientist* focused on physics, space and technology

A deeper connection

Kama muta is the emotion you never knew you had. **David Robson** reveals how to get more of its benefits in your life

DAN HALL/KINTZING

YOU are holding your newborn in your arms and gazing into their beautiful eyes; you are waiting in an airport for a family member to return from a year-long trip and suddenly see them walking towards you; or you are sitting in a sports stadium as your team holds its trophy after years of struggle. In each case, you feel a profound sense of connection swell up inside you, your skin breaks out in goosebumps and your eyes fill with tears.

Sound familiar? You may not know the term, but that feeling is "kama muta", a newly named emotion that is of increasing interest to psychologists. It marks some of the most important moments in our relationships with our family, friends and the wider community. By consciously seeking out opportunities to provoke this feeling (see "Oh, what a feeling!", right), you could imbue your life with greater meaning and enhance your sense of social connection.

It all began in 2012, with a conversation between Alan Fiske, an anthropologist at the University of California, Los Angeles, and his colleagues Thomas Schubert and Beate Seibt, both now at the University of Oslo in Norway. Why, they wondered, do we start crying at films with happy endings? Until that point, psychologists had mostly focused on tears as a sign of sadness.

The informal discussion soon morphed into a serious academic enquiry, beginning with lengthy interviews and questionnaires about people's strong emotional reactions to positive events. Soon, the team found a cluster of characteristics. Firstly, the descriptions were often given in terms of motion, such as being "moved", "stirred", "transported" or "elevated". Secondly, it was accompanied by specific physical sensations, including teary eyes, goosebumps, a brief pause in breathing and warmth in the chest. Thirdly, and perhaps most importantly, it seemed to be triggered by the intensification of some kind of social relationship.

This feeling may arise in many different contexts – when a parent cares for their child, as two lovers reunite or two friends share their secrets. To get a feel for the full range of experiences, the researchers cast their nets far and wide. One of their students attended Alcoholics Anonymous meetings, for instance, and found the feeling often arose from the unconditional acceptance offered by other members.

Moved by love

"Instead of feeling alone and totally miserable about who you are and what you've done, you find this terrible moment in your life connects you intimately with other people," says Fiske.

This reaction can also arise during religious devotion such as prayer, where someone may feel a strong connection with a deity. It is a

Kama muta may have evolved to make sure we care for those who matter most to us

common response to communal events like sports matches, where you may feel enormous admiration or pride for your team after a struggle for victory, or a memorial where you give thanks to the people who sacrificed their lives for your country.

As rich as the English language may be, we simply don't have a single term to cover these experiences. As a result, we often fail to recognise the shared characteristics of the emotion across different situations. "That's the radical argument that we're making," says Fiske. "That it is the same emotion."

He and his colleagues borrowed a term from Sanskrit: *kama muta*, which means "being moved by love". "The Sanskrit phrase just seemed so poetic," says Fiske.

He sometimes describes it as the feeling of "love igniting" and says it may have evolved to ensure that we care for the people who matter most to us. In prehistory, our social ties would have been essential for our survival, after all, ›

Oh, what a feeling!

Like all emotions, kama muta comprises many elements, including physical sensations, mental interpretations of what we are feeling, and the motivation to act in a certain way. To measure people's experiences of kama muta, researchers use the Kama Muta Multiplex Scale.

Try out our quiz inspired by the research, by watching a video of a kitten, for example, or something else in anthropologist Alan Fiske's kama muta video playlist. Or try looking at photos of loved ones or having a meaningful conversation with a friend. Then, to work out whether you felt kama muta, rate how accurate the following responses are, for you, on a scale from 0 (not at all) to 6 (a lot).

▶ SECTION 1

Did you experience...
- Moist eyes
- Tears
- Goosebumps or hair standing up
- Chills or shivers
- A warm feeling in the centre of your chest
- Some feeling in the centre of your chest
- Feeling choked up
- A lump in the throat
- Difficulty speaking
- A smile.
- Feeling buoyant or light
- Feeling refreshed, energised, or exhilarated

▶ SECTION 2

Did you feel...
- An incredible bond
- An exceptional sense of closeness
- A unique kind of love springing up
- An extraordinary feeling of welcoming or being welcomed

▶ SECTION 3

Did you feel...
- The urge to tell someone how much you care about them
- Like you wanted to hug someone
- The urge to do something extra nice for someone
- More strongly committed to a relationship

▶ SECTION 4

Did you...
- Have positive feelings

▶ SECTION 5

On the whole, did you feel the experience...
- Was heartwarming
- Moved you
- Touched you

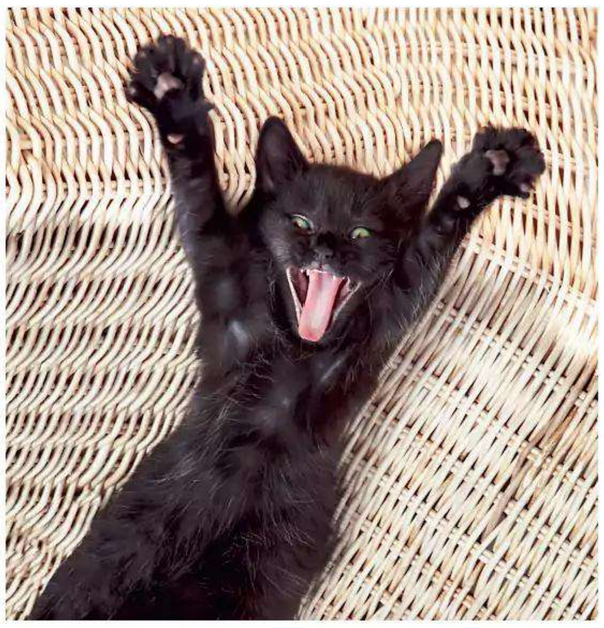
There is no definitive number that means you felt or didn't feel kama muta, but the researchers say that the higher you score on all these sections, the stronger your experience of kama muta.

"Social connection is a huge factor in human health and survival"

ANDREW CHIN/GETTY IMAGES

Shared moments, such as being at concerts (above), and watching videos of kittens (below) can both provoke kama muta

“Kama muta marks some of the most important moments in our relationships”



E+/GETTY IMAGES

and emotions that strengthened those bonds would have offered us a distinct advantage.

Social connection is a huge factor in human health and survival today. Like other “self-transcendent” emotions, such as awe, kama muta may help us to gain more perspective on our lives, which improves our overall well-being.

Thanks to our extraordinary capacity for empathy, we can experience kama muta vicariously, by watching videos of others – and this seems to translate across cultures. During one study by Fiske and his colleagues, participants from the US, Norway, China, Israel and Portugal were shown videos, such as a clip from a documentary film where a lion is reunited with its former carers. Sure enough, these short films depicting intense moments of connection were considerably more likely to trigger kama muta than those showing more mundane social situations.

Power of music

These experiments suggest kama muta may have important consequences, such as increasing people’s motivation to build and maintain relationships. After feeling the emotion, participants give higher ratings to statements such as “I felt more strongly committed to a relationship” and “I wanted to hug someone”, for instance.

People often experience kama muta during concerts, thanks to the beauty of the music and the feeling of unity. “People will walk up to strangers in the lobby and say: ‘Excuse me, but can I hug you?’ ” says Fiske. Taylor Swift fans may not be surprised: during the record-breaking Eras tour, it was common for Swifties to exchange friendship bracelets with the people around them.

Some people are especially prone to feeling kama muta, and this seems to be related to their empathic concern. But in everyday life, we might all learn how to cultivate more of the emotion by lending a more attentive ear to the people around us.

“When people are listened to well, they tend to feel more comfortable with their listener, and they may end up self-disclosing more and also self-reflecting more,” says Kenneth DeMarree, a psychologist at the University at Buffalo in New York state. This, he suggests, promotes the rapid development of a relationship, which should trigger the feeling of kama muta.

DeMarree recently put this to the test in a series of collaborations with conversation experts at the University of Haifa in Israel. In one study, the researchers set up a Zoom call between two strangers, one of whom was asked to share a personal experience with the other person. In another, they were asked to recall a conversation from the past or imagine one in the future.

In each case, a sense of attention and acceptance resulted in those familiar feelings of love igniting. When the listening was higher quality, the participants felt more kama muta. Plus, it turns out, it didn’t make a difference whether they were the one listening or being listened to. “The simple conversations that we engage in on a daily basis have the potential to really foster meaningful connections, if we listen well,” says DeMarree.

There are many other ways to experience kama muta, even if you are alone. Reading or watching love stories may be an obvious choice, but watching cute cat videos seems to do the trick, as your heart goes out to a vulnerable creature that needs your protection.

Actively and deliberately cultivating the emotion can transform your view of yourself. In the past, we might have deliberately suppressed the feeling. “You might think, ‘oh God, I’m not going to get emotional’,” says Fiske. “But knowing about this emotion and that everyone feels it, that licenses you to savour it.” ▮

David Robson is a science writer specialising in the extremes of the human brain, body and behaviour

CoLab

New Scientist

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ONLINE EVENT

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Head of research and development, ViiV Healthcare

Dr. Babafemi Taiwo
Head of early development, ViiV Healthcare

Dr. Sally Hodder
Professor of medicine, West Virginia University

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The back pages

Debunking gardening myths

Keeping in touch

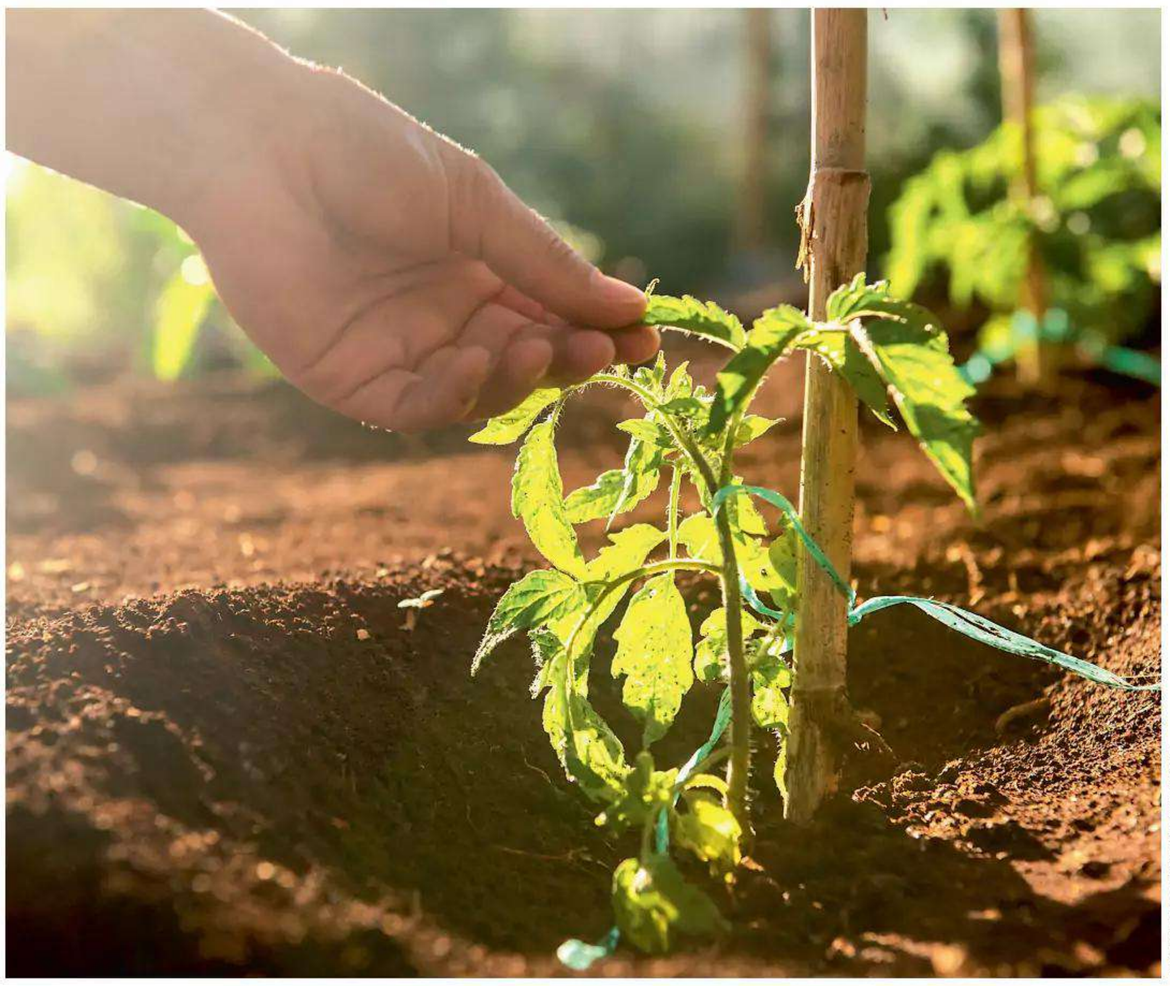
If you're worried about your seedlings getting long and leggy, try a bit of home thigmomorphogenesis, advises **James Wong**

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

IF YOUR windowsills are anything like mine, they are filling up with the first batches of seed sowings for the year ahead. The challenge is that seedlings raised in the cosseted environment of the great indoors are notoriously prone to growing long and leggy, often collapsing just a few weeks after sprouting. But could a colourful old-school technique help keep our gardening hopes for 2026 alive and well? Here's the science behind why stroking your plants isn't quite as mad as it sounds.

Plant propagation is often a balancing act. Starting tender seedlings under glass, away from temperature extremes, harsh wind and the constant threat of pests and diseases, greatly boosts their early survival. Yet this lack of environmental stress can have unintended consequences. Etiolation – where plants grow tall but fragile – is a common issue for indoor plants, including those in commercial nurseries. Once outdoors, these specimens are far more likely to physically collapse. With billions of dollars at stake worldwide, it's no surprise that commercial growers have spent decades searching for effective, scalable solutions.

Chemical growth regulators are one answer, helping produce sturdier, more compact plants. However, many of these substances aren't available to home gardeners. Fortunately, research has shown that mechanical stimulation – simply rubbing, shaking or stroking seedlings – is also remarkably effective at reducing etiolation. This is all down to a phenomenon called thigmomorphogenesis, where plants alter their growth patterns in response to forces such as touch, wind, rain or vibration, by growing thicker stems, more supportive tissues and an overall shorter, stockier stature. Although scientists are still unravelling exactly how plants sense and translate these signals at the cellular level, numerous studies demonstrate that mechanically stimulated seedlings are not only structurally sturdier, but also more resilient to threats like pests and drought.



MICHAEL SIMONS/ALAMY

This has been demonstrated across a range of popular garden species, from tomatoes and lettuce to petunias and marigolds. Experiments using fans, vibrating benches or even a sheet of paper brushed across the foliage have shown these interventions can reduce excessive stem elongation by 20 to 50 per cent.

But here's the best part: while commercial producers have been using machines to deliver this kind of physical stimulus since the 1970s, it is easy to replicate at home. Trials have shown that gently stroking seedlings as little as 10 times, just once a day, is enough to trigger the effect. You can do this with an old envelope, a soft feather duster or even your hands. Not a bad payback for the 10 seconds a day it will take, and all backed by solid science. ▮

Debunking gardening myths appears monthly

Next week
The science of exercise

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

Feel brighter this winter with **Advanced Multi+**

Winter is one of the hardest times to stay energised and well. Even with good food and an active lifestyle, many of us find our energy dipping, digestion feeling off-balance, or simply not getting enough essential nutrients to feel our best.

Advanced Multi+ from FutureYou Cambridge is a next-generation multivitamin for those who value quality, consistency and long-term wellbeing. It brings together your daily essentials with specialised ingredients scientifically shown to support health and vitality – in one simple daily step.

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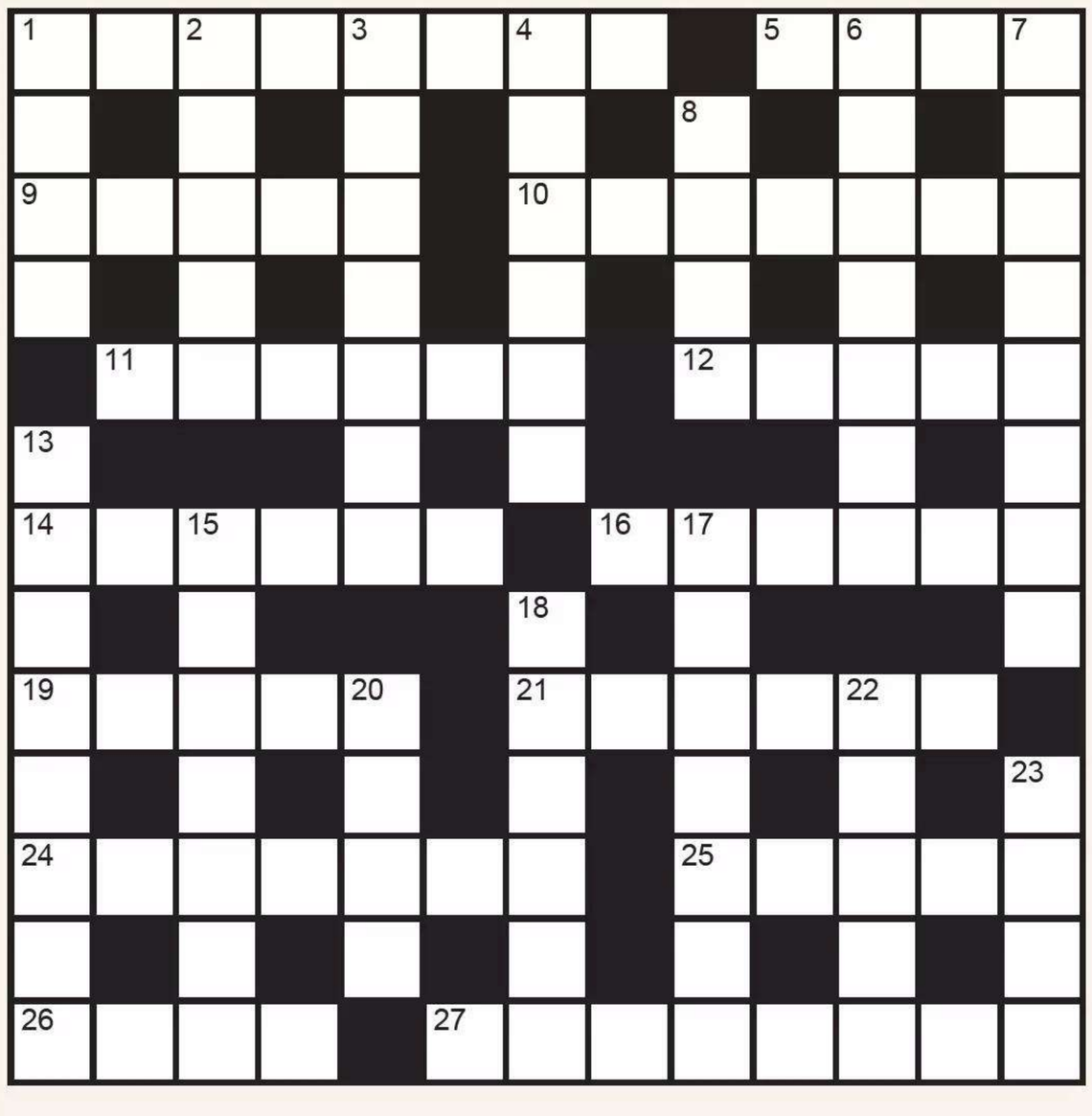
Cryptic crossword #178 *Set by Rasa*



Scribble zone

Quick crossword next week

ACROSS

1 Before reprimand, snatch back hospital chart (3,5)
5 Fuzzy logic avoiding current overload (4)
9 Rate geometrical art encountered in retro exhibition (5)
10 Plots effect size after second science class (7)
11 Ahead of time, clean crude surgical instrument (6)
12 Antigua now protects stuff in caves (5)
14 Apologetic guards addressing having dropped sun for planetarium model (6)
16 Make over a thousand floorboards, one day? (3,3)
19 Loudly appreciate frugal type (5)
21 Cheese tools in a container at school (6)
24 Cut out reversed part of a table formatting mark (7)
25 Rhenium and calcium, on reflection, might ultimately form new substances (5)
26 Carries out woodland females (4)
27 Force tip of rivet into invention (8)

DOWN

1 Spa club hours (4)
2 Peculiar degree, Latin dance (5)
3 Scoundrel found after core crashes happen again (7)
4 Lost Pete's first-rate old coin (6)
6 Wild gambol around university results in lower back pain (7)
7 Georgia nearly cussed at Kansas factory (8)
8 Quickly take in cold embrace (4)
13 Am pseudo-excited for computer accessory (8)
15 Go around Tesla enthusiast, perhaps, headed north (7)
17 Infiltrate one semicircle of intestines (7)
18 One slanting, pointed stick (6)
20 Real roe, oddly hard to come by (4)
22 Fur on tail of Bengali mammal (5)
23 Shock smarted endlessly (4)

Our games are now playable online
newscientist.com/games

Quick quiz #333
set by Tom Leslie

1 What type of cell comes in various kinds including CD8+ and CD4+?

2 A recent excavation in Suffolk, UK, found evidence of fire lighting dating back how many years?

3 What type of cosmological structure is Cassiopeia A, in which researchers recently found evidence of unusually high levels of chlorine and potassium?

4 A dinosaur skin sample recently provided evidence that the giant creatures were as colourful as birds. To which iconic dinosaur genus did the sample probably belong?

5 Which country has the highest level of solar energy generation per capita?

BrainTwister
set by Christopher Dearlove

#107 Prime products

What are the first 12 prime numbers?

Consider the product of the first *N* prime numbers, then add 1. What is this value when *N* = 1? Repeat for *N* = 2, 3 and 4.

What is the first value of *N* for which the result isn't a prime?

Answers on page 47

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?

Garry Trethewey
Leigh Creek, South Australia

The answer is: a bit under 1400 kilometres in diameter, and no. But it's a lovely exercise in googling and back-of-the-envelope calculations.

First, let's see how much water there is in oceans. The US Bureau of Reclamation says 1.37 billion cubic kilometres. And how much water is there in the atmosphere? About 13,000km^3. The oceans hold over 100,000 times as much water as the atmosphere, so atmospheric water is negligible.

Now, lets calculate the size of the sphere that would fit 1.37 billion km^3. First, we need to calculate the size of the cube, which is the cube root of 1.37 billion. This equals a cube 1110 km on each side. For the volume of the sphere, Google provides lots of radius-to-volume calculators, not the other way around, so we must guess a radius, then adjust it up or down until we find the approximate volume. In round figures, lets start

"The state of water on Earth, something that we tend to take for granted, is highly unusual within the universe"

with a cube of 1000km across, so a 500km radius. We get about 500 million km^3, far less than the 1.37 billion km^3 we found earlier. Trying a radius of 700km, we get 1.436 billion – close enough for our back-of-the envelope calculation. Double that (diameter is radius multiplied by 2) to get a ball 1400km across.

Next, could it exist in space by itself? As we know, the temperature at which water evaporates decreases with lower air pressure. You can't get a good cup of tea on Mount Everest. How much air pressure would be around our water ball? Consider the moon, which is about 2.5 times the diameter, so 2.5^3, or 15, times the volume of our water ball. Thus, if the moon were made of water, it would be about 15 times the mass of our ball.

But the moon isn't water; it's rock, which is about 3.3 times the density of water, so let's say about 50 times the mass of our water ball. Even with that mass the moon hasn't got enough gravity to hold on to an atmosphere, so water, or even ice, evaporates quickly.

Our water ball, much smaller, would do the same. It couldn't form in space by itself, and if some super-techno flying saucer people put it in space, it wouldn't last long.

GUY BELL/ALAMY

This week's new questions

Pillow talk **What is it about the human physiology that leads us to use pillows, and does anyone know when we first came up with the idea?** ***Paul Bethel****, London, UK*

Tied in knots **Why do jewellery chains put in a box together become so tightly knotted on themselves, and each other, that it is impossible to unknot them?** ***Pat Critchley****, London, UK*

What leads humans to use pillows and when did we come up with the idea?

(59°F); air pressure is one atmosphere (101,325 pascals); gravity is 1*g*. These are sometimes known as Goldilocks conditions – just right for maintaining water that life, as we understand it, can use.

Over a billion cubic kilometres of water deposited in intergalactic space would experience zero gravity in an almost perfect vacuum at a temperature of -270.3°C (-454.5°F). Under these conditions, it would explode: freezing and subliming (vaporising) at the same time. Eventually, the individual molecules of water would end up about a metre apart, as are most particles in intergalactic space.

Caffeine conundrum

I am in an arid desert with a flask of caffeinated coffee. Should I drink it, or will its diuretic effects speed my demise?

Simon Maxwell
University of Edinburgh, UK

Drink the coffee. In a desert, dehydration is your biggest enemy, and any fluid intake is better than none. While caffeine is often labelled a diuretic, its effect is modest and works by blocking adenosine receptors, which indirectly increases urine production. However, in extreme heat and water scarcity, your body activates powerful water-conserving mechanisms – such as increased secretion of antidiuretic hormone – to retain fluid. These override the mild diuretic action of caffeine. In fact, research shows that for habitual coffee drinkers, the diuretic effect is negligible. The water in the coffee far outweighs any extra loss. So don't worry: the coffee will help you survive, not hasten your demise.

Pat French
Longdon upon Tern, Shropshire, UK

Were you able to accumulate all of Earth's water – ice, liquid and vapour, plus all the water physically and chemically combined with mineral and organic substances – you might reach 1.4 billion cubic kilometres. If somehow you could store it under Earth surface conditions, it might form a sphere of roughly 700-kilometre radius.

However, these conditions would be unlikely. The state of water on Earth, something that we tend to take for granted, is highly unusual within the universe. On our planet's surface, water can exist in its three natural states: solid, liquid and gas, all held in place by gravity. Earth's average surface temperature is about 15°C

Conrad Jones
Llansteffan, Carmarthenshire, UK

My advice would be to drink the

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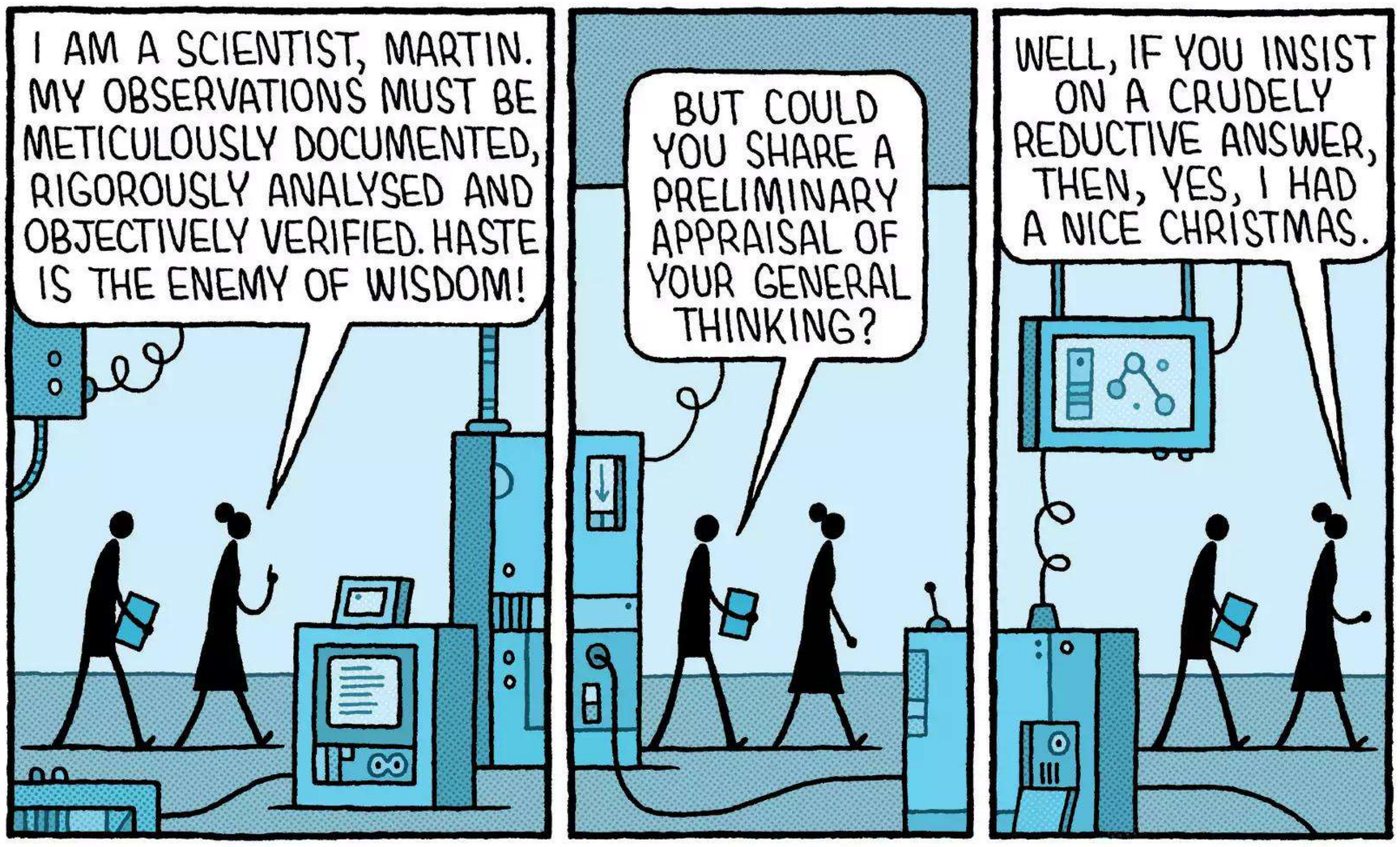
Tom Gauld
for New Scientist



coffee, then use the flask to collect whatever urine is produced, and reprocess it (drink it) later. That would delay your demise, certainly more than if you hadn't drunk the coffee, and probably also more than if you had drunk it only once and watered the desert with your urine instead.

Robert Checchio
Dunnellen, New Jersey, US
I'm probably going to die eventually from dehydration, so I might as well drink the coffee while I'm able to enjoy it.

Tyre change

What are the pros and cons of using carbon dioxide in tyres? (continued)

Tom Lawrence
Athens, Georgia, US
The use of carbon dioxide in tyres is an interesting question on the potential to sequester carbon in a product that will stay out of the global vapour environment.

For any rubber produced using natural trees as the source, we

"In extreme heat and water scarcity, your body activates water-conserving mechanisms to retain fluid"

must consider the production process and its impact on the environment. Assuming the rubber trees are left in place, the overall impact won't be that large, but still somewhat negative in terms of carbon emissions due to harvesting, etc. But the carbon sequestered into producing that rubber will be taken out of the atmosphere and introduced in solid form for many years.

We must also really consider the chemical process that produces synthetic rubber for tyres. The one I am most familiar with starts with the production of acetylene gas from limestone and then a chemical change to produce synthetic butyl rubber. In that process, there is (I believe) a kilogram-per-kilogram based release of CO_2 emissions per mass of rubber product produced.

Does the question focus on the overall life-cycle carbon impact of producing tyres? That would include the carbon sequestration of the trees that produce the rubber, as well as the carbon released in the production of synthetic rubber. CO_2 that is introduced in either of these processes will probably get eventually released into the atmosphere as fugitive emissions.

Crack the case

What is the best way to pack a suitcase to get the most clothes into it? Is it with as few folds as possible? Or is it to roll the clothes up tightly? Is there any mathematical basis behind the answer? (continued)

Keith Macpherson
Clevedon, Somerset, UK
It's all very well advising using a vacuum pump to compress clothes, but to repeat the process for the return journey, one would have to include the pump in the suitcase, which would probably take up more room than is gained. ▮

Answers

Quick quiz #333 *Answers*

1 T-cells
2 400,000
3 A supernova remnant
4 *Diplodocus*
5 Australia

Cryptic crossword #178 *Answers*

ACROSS 1 Bar graph, **5** Clog, **9** Tempo, **10** Schemes, **11** Lancet, **12** Guano, **14** Orrery, **16** Red oak, **19** Saver, **21** Kitsch, **24** Pilcrow, **25** React, **26** Does, **27** Friction

DOWN 1 Bath, **2** Rumba, **3** Reoccur, **4** Peseta, **6** Lumbago, **7** Gas works, **8** Chug, **13** Mousepad, **15** Revolve, **17** Enteric, **18** Skewer, **20** Rare, **22** Coati, **23** Stun

#107 Prime products *Solution*

The first 12 prime numbers are 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31 and 37.

For $N = 1$ to 4, the products of the first N primes plus one are 3, 7, 31 and 211.

The first non-prime number in this sequence is when $N = 6$, where $(2 \times 3 \times 5 \times 7 \times 11 \times 13) + 1 = 30{,}031 = 59 \times 509$.

Madness remastered

Happy New Year! Well, unless you're reading this online on the evening of publication, in which case it's still only 30 December, unless you're in a different time zone, in which case it might be New Year's Eve, but not quite New Year yet. There we are, starting the year as we mean to go on: tying ourselves in knots over an unnecessary detail.

With the new year naturally comes thoughts of resolutions and fresh starts, of a brand-new you. Go ahead and have that mid-life crisis! There's no time like the present.

For real freshness, you could try watching the remastered version of *Mad Men*: the seminal television drama about advertising executives in the 1960s blithely telling everybody how to be happy while simultaneously making an absolute hash of their own lives. The new version is in 4K, which ought to mean the cinematography is clearer and more vibrant than ever before.

Except that they have made a hash of it. The mistakes are encapsulated by one pivotal scene, in which Roger Sterling (John Slattery) returns to the office after a heavy lunchtime's drinking and spectacularly vomits all over the carpet. In the remastered version, the framing of the shot is slightly different, revealing two crew members crouched on the floor operating a vomit-dispensing hose.

Feedback would be less inclined to tease if this were a new phenomenon, the result of path-breaking remastering technology, but it is nothing of the kind. Back in the mists of time in 2014, when David Bowie was still alive, those clever people at Fox decided to remaster the paranormal classic *Buffy the Vampire Slayer*. In the process, they changed the shape of the shots from the original 4:3 ratio to a more widescreen 14:9.

You guessed it: sometimes crew and equipment wandered into the frame, while on other occasions, shots were cropped in weird ways that reduced the focus on the characters. They also forgot to apply the filters used to make scenes look like night when they were shot in the day, resulting in vampires walking around in bright sunlight.

Something similar happened when *The Simpsons* was brought onto Disney+. Earlier seasons were shot in 4:3 and cropped into widescreen. Of course, *The Simpsons* is stuffed with visual gags, and careless cropping removed many of them, hence the 2019 Vulture headline "16 Cropped Simpsons Jokes You Can't See on Disney+". They included guest stars going missing from shots, and a removal van labelled "CLUMSY STUDENT MOVERS" being unceremoniously cropped.

Still, it could have been worse. Feedback is both old and nerdy enough to remember our dismay upon going to the cinema in 1997 to see the remastered "special edition" of *Star Wars*. This featured a lot of new digital visual effects, many of which sat oddly against the original analogue effects. It also, and at this remove we really are sorry to harp on about this, changed the logic of a key scene in which Han Solo escapes a bounty hunter who has him cornered at a table. In the original version, Han slyly shot the bounty hunter under the table. In the new version, the bounty hunter shoots first but somehow misses at point-blank range. Feedback has been baffled by this for 29 years.

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

Text to speech, ish

New year, new recurring items in Feedback. Don Allen writes in to tell us of an SMS message that was sent to his landline and automatically translated into speech by some unidentified piece of software. (Don headed his email "More AI stupidity", but we aren't actually sure AI was involved in this.) The resulting verbal message was: "Your order number five billion, twenty-seven million, eight hundred and thirty-nine thousand, nine hundred and fifty-one is ready for collection."

As Don says: "Just as well I was only expecting one order." We wonder if other readers have had similarly bizarre messages through the medium of automated text-to-speech transcription.

A shorts interlude

With apologies, we must address some lingering business from 2025. In November, we described a study that sought to compare the hygiene benefits of tight swimming briefs – which are mandated in public swimming pools in France – versus loose swimming shorts.

The study suggested that tight briefs might lead to fewer microbes being released from the digestive tract, "due to their elasticity exerting external pressure on the gluteal muscles, thereby reducing contact between the rectum and the fabric."

Gaëlle Ribault writes in "as a French person" to offer an alternative justification. "As I've always understood it, the rationale for the interdiction of shorts in swimming pools is that they risk being worn in multiple other settings, thus being exposed to many sources of dirt and microbes," she says. In contrast, no self-respecting person would wander around town in briefs, because, as Gaëlle drily puts it, they "lack discretion". At minimum, one would wear something over them, thus reducing the chances of external contamination.

This does, we must admit, make more sense than the muscle thing.

Moan and groan

Lastly, in response to our item on the social psychology of dad jokes, Michael Cousins wrote in as follows. "When does a joke become a Dad joke? When it's fully groan." He adds: "I'm here all week."

URGENT MEDICAL RESPONSE

MEDECINS SANS FRONTIERES
DOCTORS WITHOUT BORDERS

HELP SUPPORT OUR MEDICAL TEAMS TODAY

Al-Shifa hospital in Gaza City is one of many health facilities in Gaza that have been severely damaged or destroyed since the start of the war. Photo: Nour Alsaqqa/MSF

NADIA EID IS PART OF THE MSF MEDICAL TEAM IN GAZA

The level of destruction here is hard to describe. Gaza is in mountains of rubble.

Most people in Gaza don't have access to clean water. They don't have access to food or sanitation. Even though a ceasefire was declared on October 10, almost no one got to go back to their houses because those houses no longer exist. People are still living in tents. The situation is catastrophic.

There are many people who are not only living in these inhumane conditions but have also sustained life-changing injuries from explosions or gunshots. I feel so much for the children who have lost limbs, who have amputated legs or arms. They need ongoing treatment and care, but the health system has almost collapsed.

A lot of hospitals and clinics have been directly targeted in the bombardments. MSF teams are currently working at healthcare centres and hospitals across Gaza, but many are either constructed from tents or are using tents as additional wards.

We are seeing hundreds of patients on a daily basis, but each day at our health centres there are more people than we can treat and some have to be turned away.

It's very difficult for us that we have to face this, but this is the reality. People need care now and it will take years to rebuild Gaza's medical facilities.

We don't know what will happen next. I hope we will actually reach the end of this war. But even if that happens, the suffering continues.

MSF has over 1,000 staff in Gaza providing medical care, managing supplies and working on clean water and sanitation. But right now, it's not enough. We don't have the resources to treat every patient. The humanitarian response here must be massively scaled up. More help is urgently needed.

"MSF's ability to act quickly and decisively in emergency situations is made possible by individual donors giving what they can"

Dr Jennifer Hulse, MSF Emergency Doctor

WE CAN'T MISS A LIFE-SAVING MOMENT

Right now, MSF teams are working in volatile crisis zones around the world. From rapidly changing conflicts to sudden natural disasters, our teams are on the ground, providing essential medical care.

Whether it's the few vital seconds that stop a major haemorrhage, or the race to contain an outbreak of deadly disease, our teams know that a moment lost can mean a life lost.

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£190	could pay for emergency splints to immobilise injured limbs for 22 patients
£84	could cover the cost of an MSF surgeon working in a hospital for one day
£50	could pay for 50 IV bags which provide life-saving fluid and blood during surgery

THANK YOU

MSF UK receives no government funding. It's your support that enables us to provide medical care where it's needed most.

DONATE NOW
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Or search MSF QUICK to make an online donation

YES, I would like to support MSF's medical teams

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Your support is vital to our work and we would like to keep you informed with first-hand accounts from our staff and patients about the lifesaving impact your support is having, from combatting epidemics to providing emergency surgery.

We won't allow other organisations to have access to your personal data for marketing purposes and we won't bombard you with appeals.

By supporting MSF, you will receive our magazine Dispatches, event invitations and occasional emergency appeals with requests for donations by post. You can change how you hear from MSF UK by emailing **uk.fundraising@london.msf.org** or calling **020 7404 6600**. Visit our privacy notice for more: **msf.org.uk/privacy.**

Please fill in this form, place in an envelope and return postage free to: **FREEPOST RUBA-GYZY-YXST, Médecins Sans Frontières (MSF), Bumpers Way, Bumpers Farm, Chippenham, SN14 6NG.** Alternatively, you can phone **0800 055 79 84** (open 8am–10pm seven days a week) or make your donation online by searching **MSF QUICK.**

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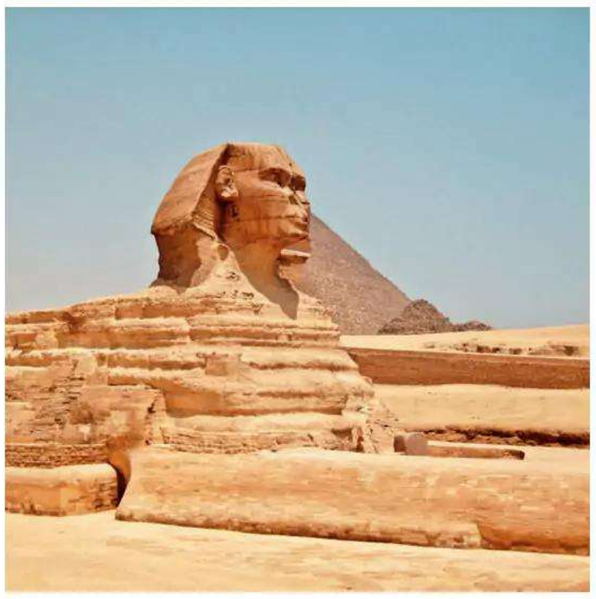
Science history and innovation



Scientific pioneers of the ancient world, Cairo and Alexandria: Egypt

13 March 2026 | 7 days

Step into the world of one of history's most advanced civilisations where astronomy, engineering, and architecture reached astonishing heights. Explore Egypt's scientific legacy, from the iconic pyramids and the Sphinx of Giza to the cutting-edge exhibits of the newly opened Grand Egyptian Museum.

The science of the Renaissance: Italy

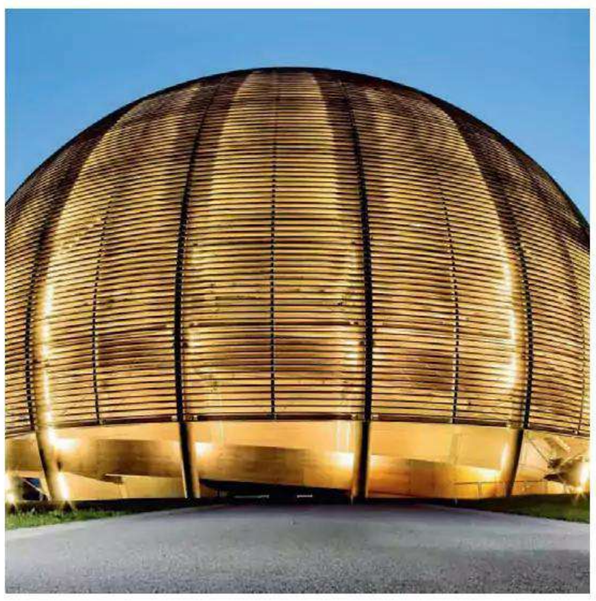
16 April 2026 | 6 days

Discover the spirit of Renaissance innovation in Florence, Pisa and Bologna. Explore fascinating scientific collections, historic observatories and anatomical theatres that reveal how Renaissance thinkers combined observation, experimentation and creativity to unlock the secrets of nature.

Walking Hadrian's Wall and Roman innovation: England

23 June 2026 | 7 days

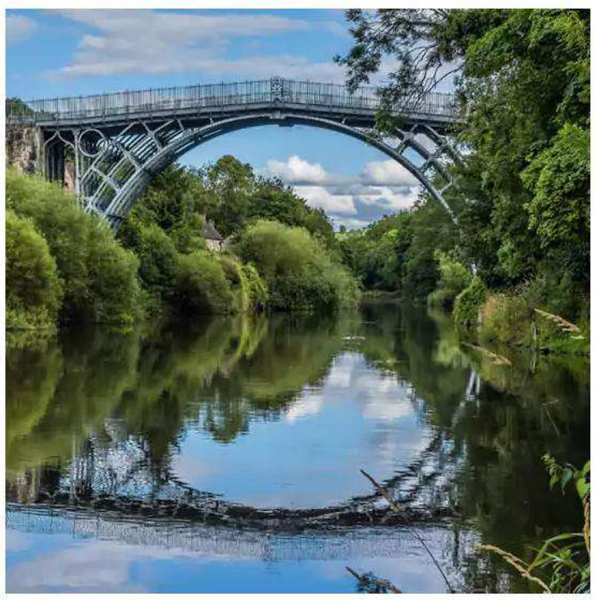
Follow in the footsteps of the Romans on this immersive walking tour along Hadrian's Wall, one of Britain's most iconic, ancient landmarks and a UNESCO World Heritage Site. Discover the intriguing geology of Northumbria and its impact on the construction of the wall, and visit forts, towns and museums that bring Roman Britain vividly to life.



CERN and Mont Blanc, dark and frozen matter: Switzerland and France

27 April 2026 | 6 days
5 October 2026 | 6 days

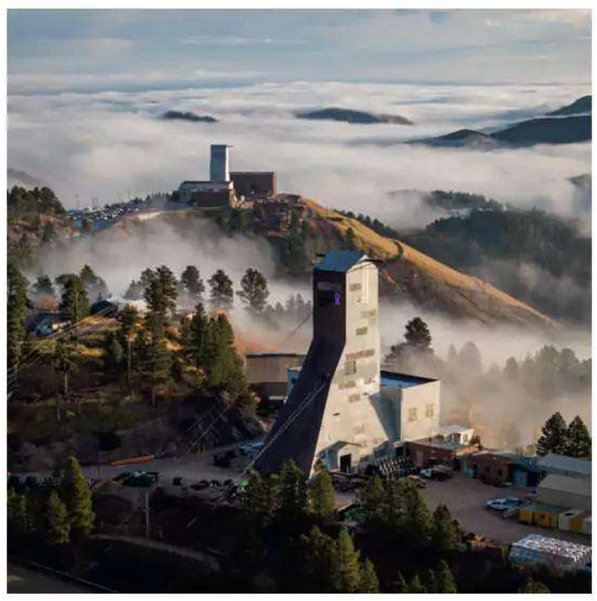
Uncover the rich scientific and historical significance of CERN, the world's premier hub of particle physics, where researchers unlock the secrets of matter, energy and the cosmos. Joined by CERN physicist Darren Price, gain rare insider access, from private lectures to guided tours of the facility's groundbreaking experiments.



Canals and the Industrial Revolution: England

10 May 2026 | 7 days

Discover the scientific and engineering brilliance behind the Birmingham Canal Navigation, a 160-kilometre network that transformed the Industrial Revolution. Explore the ingenious hydraulic systems, locks, aqueducts and junctions that enabled the transport of millions of tonnes of cargo.



SURF and the Black Hills, ancient and dark matter: US

21 September 2026 | 5 days

Explore the cutting-edge world of particle physics at the Sanford Underground Research Facility (SURF) in South Dakota. Go behind the scenes of groundbreaking experiments taking place 2 kilometres underground as scientists chase elusive neutrinos, probe dark matter, analyse biology in extreme environments and explore nuclear fusion.

Find out more **newscientist.com/tours**

Geology and glaciology

A geological journey through ancient landscapes: Vietnam

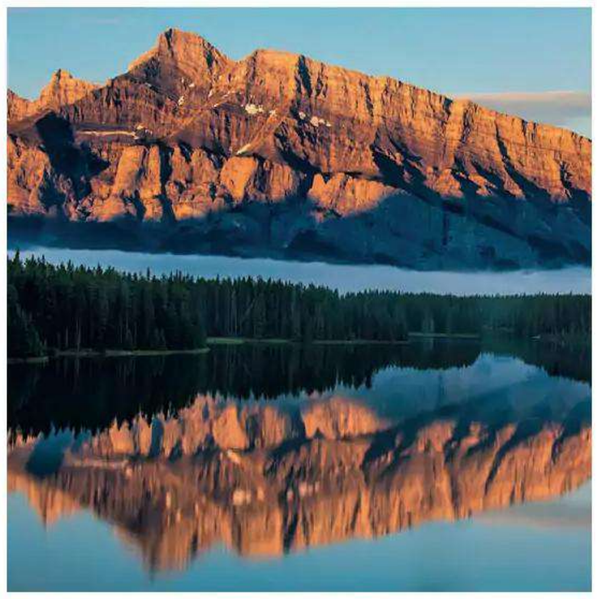
11 April 2026 | 13 days

Explore Vietnam through the lens of geology and discovery. Embark on a fascinating expedition where science, culture and conservation intersect, revealing the powerful natural forces that have carved the country's dramatic terrain and shaped the lives of its people. Accompanied throughout by geoscientist Dr Amy Gough.

Retracing Charles Darwin's travels across north Wales

27 April 2026 | 6 days

Journey through the dramatic landscapes of Eryri (Snowdonia) National Park, following Charles Darwin's early tours of Wales. From his birthplace in Shrewsbury to the volcanic and glacial valleys of Snowdonia, discover how the region's geology shaped both the land and Darwin's scientific training.



Geology and dinosaurs in Lake Louise, the Rockies and the Badlands: Canada

15 June 2026 | 7 days

Be awed by the phenomenal scenery and geology of the majestic Rocky mountains west of Calgary and the otherworldly Alberta Badlands to the east and discover the geological processes that created them. Delve into 420 million years of history and find out how geology influenced the development of Alberta.

Land of fire and ice: Iceland

2 August 2026 | 6 days
17 October 2026 | 8 days

Experience Iceland like never before on this immersive tour accompanied by a volcanologist who will reveal the hidden stories and powerful forces shaping the landscape. Their expertise will transform every stop into a fascinating lesson in geology and volcanology, bringing the island's dramatic landscapes vividly to life.

Caves, geology and gentle walking: Croatia and Slovenia

29 September 2026 | 8 days

Discover Slovenia's breathtaking underground wonders on a gentle walking tour. Explore vast underground rivers and awe-inspiring chambers filled with stalactites and stalagmites to gain a unique window into the geological history of the region. See remarkable karst landscapes, a treasure trove for geologists.

Glaciology and geology: South Island, New Zealand

8 November 2026 | 9 days

Embark on a breathtaking scientific journey through New Zealand's South Island – a landscape shaped by glaciers, forged by tectonic forces and defined by striking geological contrasts. Traverse the glacially carved fjords of Milford Sound and marvel at the surreal limestone formations of Peaknik's Pancake Rocks.

Small ship cruises and marine biology

Alfred Russel Wallace expedition cruise: Indonesia

22 January 2027 |Í 13 days

Set sail on a remarkable expedition through some of the world's most enchanting and biodiverse islands, where the legacy of Alfred Russel Wallace comes alive amid stunning landscapes and extraordinary wildlife, sailing aboard a luxurious 22-berth schooner. Explore lush islands, encounter incredible wildlife and ecosystems.

Human origins, archaeology and wildlife: Scottish isles cruise

26 May 2026 | 12 days

Discover early human civilisations and beautiful wildlife among the wild isles of Scotland aboard a state-of-the-art expedition vessel, the Greg Mortimer. Visit the windswept Hebrides, inhabited for more than 8000 years, and the islands of Orkney and Shetland, where ancient Neolithic, Bronze Age and Viking sites conjure the lives of peoples long gone.

Arctic expedition cruise with Dr Russell Arnott: Svalbard, Norway

17 June 2026 | 12 days

This is no ordinary cruise exploring Svalbard's wild beauty – it is a carefully designed scientific expedition that blends discovery with adventure. Delve into the region's unique ecosystems, witnessing glaciers, wildlife and Arctic waters up close, all guided by marine biologist and oceanographer Dr Russell Arnott.

Marine conservation cruise exploring Darwin's Galapagos: Ecuador

24 August 2026 | 8 days

Discover the unparalleled biodiversity of the Galapagos Islands, a volcanic archipelago that inspired Charles Darwin's theory of evolution. Sail aboard the intimate Solaris yacht, accommodating just 15 guests, exploring the pristine islands of Isabela, Fernandina, Santiago, Rabida and Chinese Hat.

Spirit of Antarctica expedition cruise: Antarctic Peninsula

7 December 2026 | 12 days

Join an extraordinary voyage to Antarctica, Earth's southernmost continent, where science, adventure and discovery converge in one of the most remote and awe-inspiring places on the planet. Accompanied by Rowan Hooper from *New Scientist* and marine biologist Dr Russell Arnott.

Baja whale watching adventure: Mexico

11 March 2027 | 6 days

Discover one of the planet's greatest wildlife phenomena as gray whales complete their epic migration into Baja California's protected lagoons. This journey brings you face-to-face with cutting-edge marine biology, conservation science and the remarkable recovery story of a species once pushed to the brink.

Find out more newscientist.com/tours

Nature

Yellowstone wolf & wildlife winter safari: US

5 January 2027 | 7 days

Step into Yellowstone's pristine winter wilderness, where wolves patrol the Lamar valley and bison carve trails cross snow-draped plains. With special access to areas of the park reserved just for our group, you'll enjoy rare opportunities to observe wildlife in peace and solitude, far from the crowds.

Insect and ecosystems safari: Sri Lanka

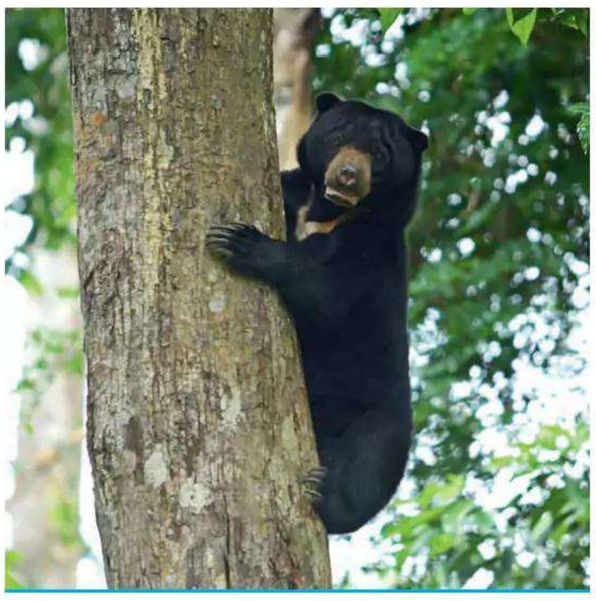
30 March 2026 | 11 days

Explore Sri Lanka's natural world on a science-rich expedition through its varied ecosystems, led by entomologist Dr Tim Cockerill. Discover endemic insects, rare birds and elusive wildlife on private walks, night safaris and safaris in Udawalawe and Sinharaja national parks, while learning about the ecological forces that shape these extraordinary habitats.

Alaskan brown bear, ecology and wilderness adventure: US

9 August 2026 | 6 days

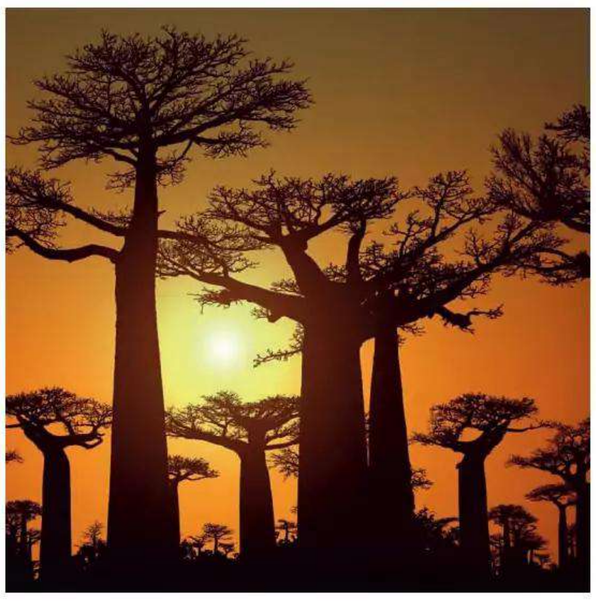
Venture into the wild heart of Alaska for an unparalleled encounter with brown bears in their natural environment. From a secluded fly-in bush camp surrounded by Lake Clark National Park, observe these apex predators at remarkably close range – from grazing in lush meadows to fishing for salmon in tidal streams.



The science of rainforests and wildlife: Malaysian Borneo

24 August 2026 | 10 days

Immerse yourself in the wild wonders of Malaysian Borneo, where lush rainforests, winding rivers and dramatic landscapes teem with life. Journey through the Kinabatangan river, Tabin rainforest and the pristine Danum valley – some of the planet's richest and most biodiverse habitats.



An expedition through unique ecosystems: Madagascar

5 September 2026 | 16 days

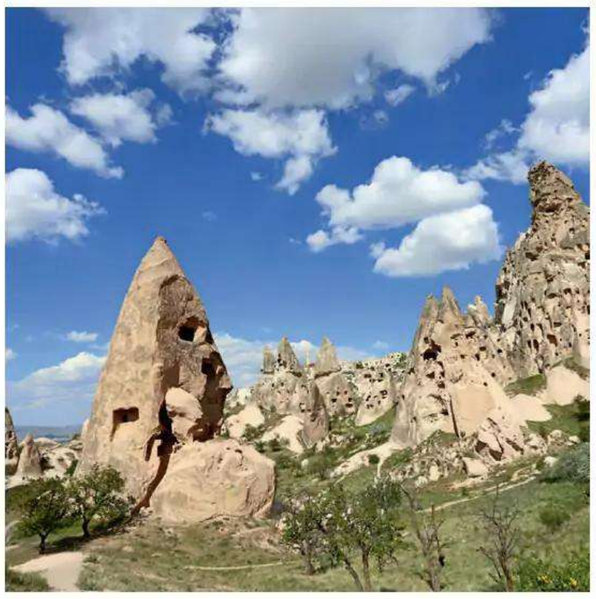
Immerse yourself in Madagascar's diverse and unique ecosystems, a living laboratory of evolution and biodiversity that includes 23 species of lemur. Explore the country's rich flora and fauna, which have evolved in isolation, leading to unique adaptations and species found nowhere else on Earth.

Churchill polar bear adventure: Canada

14 October 2026 | 6 days

Venture to one of the most extraordinary wildlife destinations on Earth – Churchill, Canada – the world's best place to see polar bears in their natural habitat. With expert guidance, explore the behaviour of polar bears and gain insight into the delicate Arctic ecosystems on which they depend.

Archaeology and palaeontology



Human origins: Neolithic and Bronze Age Turkey

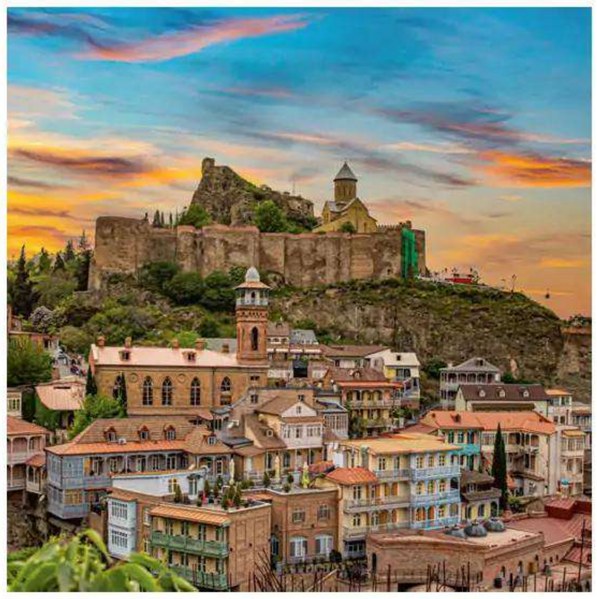
21 May 2026 | 12 days
9 September 2026 | 12 days

Embark on a fascinating journey through Turkey, a land where human history and archaeology converge in spectacular landscapes. Explore the enigmatic ruins of Göbekli Tepe and Çatalhöyük, marvel at the monumental statues of Mount Nemrut and descend into Cappadocia's extraordinary underground city of Kaymakli.

Uncovering Vesuvius, Pompeii and ancient Naples: Italy

17 April 2026 | 6 days

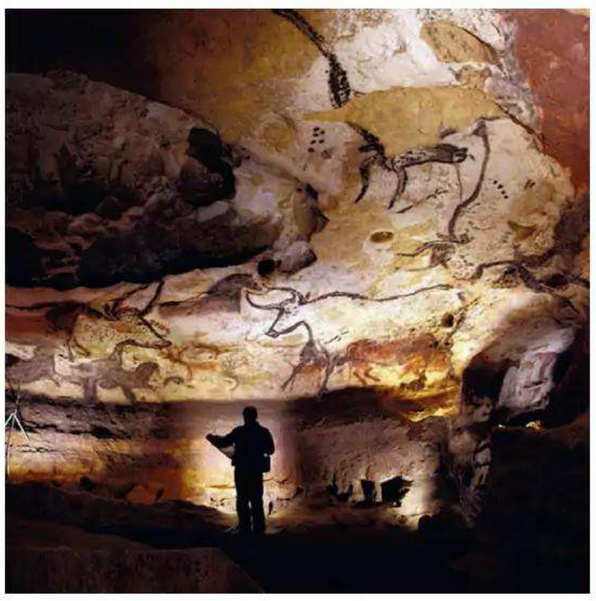
Step into a world where history, archaeology and volcanology collide on a thrilling journey through Naples, Pompeii, Herculaneum and the slopes of Mount Vesuvius. Guided by expert volcanologist Christopher Kilburn, this tour offers a rare opportunity to see visit these legendary sites with expert volcanologist Christopher Kilburn.



Archaeology exploration across the Caucasus: Georgia and Armenia

3 August 2026 | 12 days

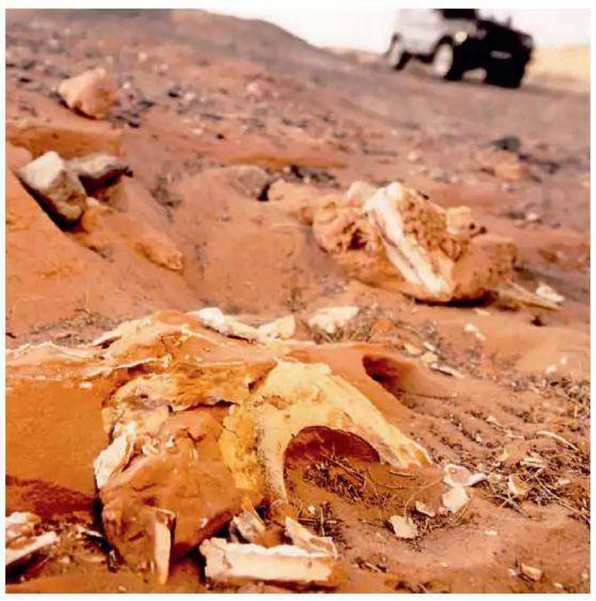
Join a captivating journey through Georgia and Armenia. Explore ancient archaeological sites, medieval churches, monasteries and prehistoric monuments, along with spectacular natural surroundings. Gain an understanding of these beautiful countries through a series of talks from tour expert, Ian Colvin.



Neanderthals, human origins and cave art: France

15 August 2026 | 9 days
12 September 2026 | 9 days

Trace the footsteps of our ancient ancestors on a captivating journey across southern France, where prehistoric art, archaeological wonders and dramatic landscapes bring human history vividly to life. Discover the sites that have revolutionised our understanding of human evolution, cognition and culture.



Dinosaur hunting in the Gobi desert: Mongolia

22 August 2026 | 15 days

Step into the lost world of the dinosaurs on an unforgettable expedition across the vast Gobi desert, one of the globe's most celebrated palaeontological landscapes. Join a small, expert-led team for hands-on fossil prospecting and excavation at some of Mongolia's most iconic sites.

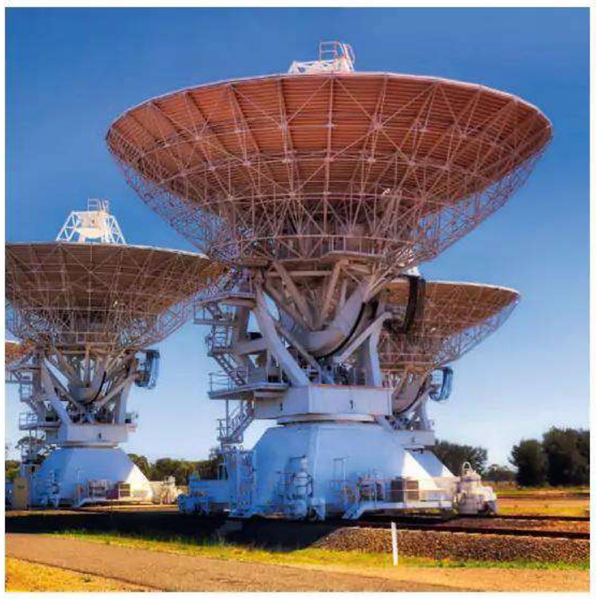
Mycenaean and Peloponnesian archaeology: Greece

28 September 2026 | 8 days

Join this interactive tour offering a unique opportunity to get "behind the ropes" at Mycenae, one of Greece's most significant historical and archaeological treasures.

Find out more **newscientist.com/tours**

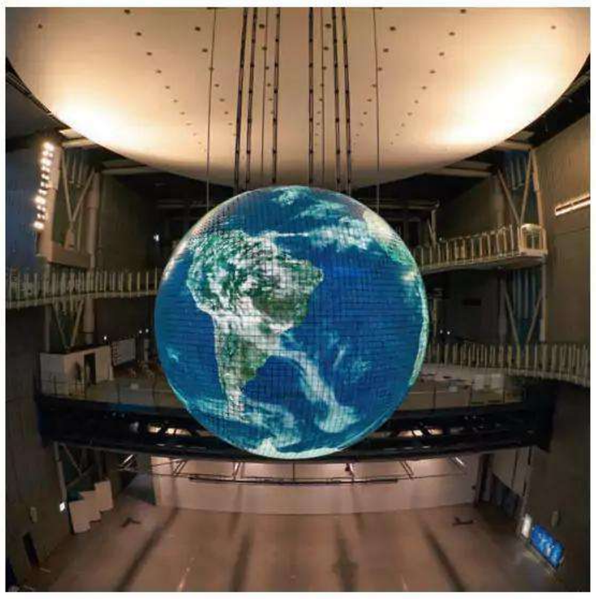
Astronomy



Astronomy and radio telescopes in New South Wales: Australia

29 April 2026 | 8 days

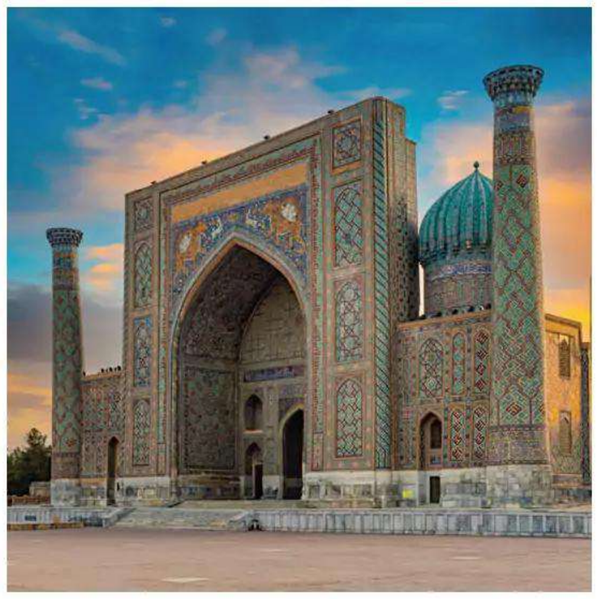
Experience an unforgettable journey through eastern Australia alongside renowned astrophysicist Jonathan Bland-Hawthorn. Step inside legendary observatories like the Parkes "Dish", the Australia Telescope Compact Array and the Anglo-Australian Telescope at Siding Spring, nestled within the breathtaking Warrumbungle Dark Sky Park.



Stargazing and space science in the land of the rising sun: Japan

5 September 2026 | 14 days

Discover Japan through the lens of astronomy with Jamie Carter, from advanced research centres to skies that inspire both science and tradition. Visit world-class facilities like JAXA's Tsukuba Space Center, Nobeyama Radio Observatory and Tanegashima Space Centre, then stargaze under the pristine skies of the Japanese Alps.



Astronomy and culture through Silk Road cities: Uzbekistan

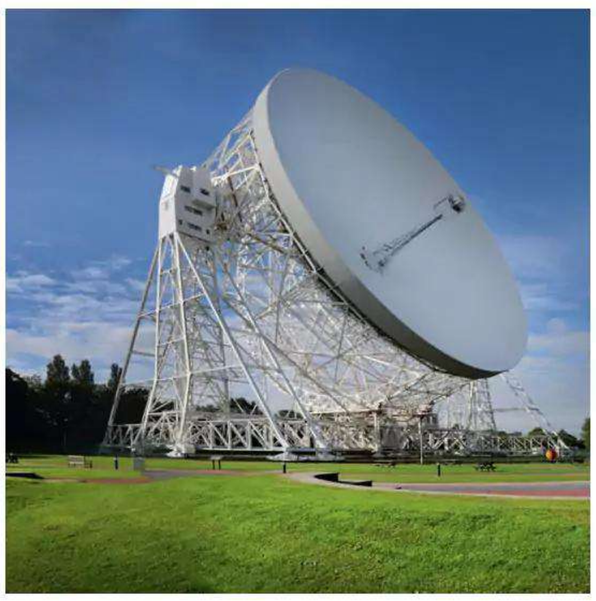
11 September 2026 | 14 days

Embark on a fascinating journey through Uzbekistan, where the rich history of astronomy intertwines with vibrant cultures and vast landscapes. Explore the pivotal role the Silk Road played in astronomy, the historical trade route that facilitated the exchange of scientific knowledge and astronomical advancements across Eurasia.

The history and future of space exploration: US

11 September 2026 | 9 days

Take off on a quest through the past, present and future of space exploration across the US. From the first pioneering rockets to iconic missions, space stations and the emerging commercial space tourism industry, this tour takes you behind the scenes of the US's most famous space centres and museums.



Mysteries of the universe: England

11 September 2026 | 3 days

Spend an inspiring weekend with some of the brightest minds in science as you dive into the mysteries of the universe. Hear from leading astronomers, astrophysicists and cosmologists, who will reveal the latest discoveries in galaxy formation, black hole research and the frontiers of space exploration.

The world capital of astronomy: Chile

1 October 2026 | 13 days

1 March 2027 | 13 days

Journey to Chile, the world's astronomy capital, on an astronomy adventure led by space scientist Martin Griffiths. Witness cutting-edge research into the origins of stars, planets and galaxies, all under the Atacama desert's clear skies. Explore dramatic desert landscapes and vibrant local culture, making this both a scientific and cultural adventure.