# BBG HOW TO CHANGE YOUR PERSONALITY Science Focus

Inside the PENTAGON'S UFO FILES How human activity is CHANGING EARTH'S SPIN Which makeup is HARMING YOUR HEALTH?

## SCIENTISTS AND EXPERTS PICK THE BIGGEST BREAKTINGEST BREAKTINGEST OF THE IDEAS THAT WILL SHAPE THE NEXT 25 YEARS

#### IN THIS ISSUE

The terrible ideas we wish inventors had kept to themselves

Tech

— Sleep

How 'cognitive shuffling' can put your mind at ease

#### Psychology

Can you overcome your brain's biggest blind spot?

THE WORLD IS FULL OF WONDERS, AND HIGH-RESOLUTION CAMERAS LET US SEE THEM IN UNPRECEDENTED DETAIL. CHECK OUT OUR FAVOURITE IMAGES CAPTURED DURING THE FIRST 25 YEARS OF THE 21ST CENTURY

WORDS: HAYLEY BENNETT

## BEST. SELFIE. EVER.

2021

Launched in 2011, NASA's Curiosity Rover was sent to search for signs that life could have existed on Mars. It has now spent well over a decade on the Red Planet, carrying out experiments with its onboard laboratory. While Curiosity isn't heading back to Earth any time soon, the take-home message from its Martian campaign is that the planet once had free-flowing water and the kind of chemistry suitable for supporting life, namely microbes. One of Curiosity's most memorable moments came in 2021, when the sixwheeled wanderer took this cheeky selfie while posing on a small outcrop of rock that scientists named Mont Mercou, after the French mountain. It's perhaps not quite the 'moment' that it first appears, though. To create the selfie, scientists had to composite 60 images taken over two days with two cameras – most by using a robot arm like a selfie stick and the remainder using the 'Mastcam' on Curiosity's head.



### MUMMIFIED MAMMOTH V

2022

This is Nun Cho Ga, the only whole baby woolly mammoth to have been discovered in North America (near Dawson City, Yukon) to date. In the Hän language spoken in the region where her mummified remains were found, her name means 'big baby animal'. Nun Cho Ga was preserved in permafrost for 30,000 years before gold miners found her and handed her over to the Tr'ondëk Hwëch'in First Nation and Yukon governments. In 2024, she was moved to the Canadian Conservation Institute to be carefully preserved.

## $\begin{array}{c} \text{LOST IN THE} \\ \text{SHADOWS} \rightarrow \end{array}$

AMERICA (FROM THE DEEP SPACE CLIMATE OBSERVATORY)
2024

A total solar eclipse happens only once every year and a half, and not everyone on Earth experiences a total eclipse each time – only those along a band called the 'path of totality'. This is where the Moon's shadow tracks briefly across Earth. On 8 April 2024, Americans across 13 US states experienced totality. This image of the Moon's shadow was captured by the Earth Polychromatic Imaging Camera (EPIC) housed in the Deep Space Climate Observatory satellite. America, say "Cheese!"





#### OUT OF HIS HEAD $\rightarrow$ SINGAPORE 2017

It's hard to find any sympathy for flies, but try to spare a thought for this ill-fated fellow, who has vacated his skull following colonisation by the parasitic 'zombie fungus'. Cordyceps (*Ophiocordyceps unilateralis*) fungi infect and take over the minds of their insect victims, which are generally ants, but also flies. The fungi don't seem to infect their victims' brains directly; instead, they release mind-controlling molecules to do their bidding. Infection ends with the hapless insect climbing to the fungus' ideal sporing height, where it bursts through the insect's skull.





#### GHOSTS IN THE MACHINE $\rightarrow$ Geneva, switzerland 2017

How do you catch a particle that travels at near-light speed and weighs virtually nothing? That's what this huge, gold, waffle-surfaced box is designed to do. Constructed between 2016–2018 at the CERN facility in Switzerland, the Deep Underground Neutrino Experiment (DUNE) is one of two prototypes for larger, US-based versions being built to detect fundamental particles called neutrinos (also known as 'ghost particles'), which originate from the nuclear reactions occurring within stars. The chamber acts as a Thermos flask for liquid argon, which boils at very low temperatures, so must be held below -184°C (-299.2°F). It contains detectors that can capture traces of the electrons released when neutrinos hit argon atoms. While neutrinos don't interact with much - trillions pass through us every minute with seemingly no effect - the density of atoms in liquid argon makes their interactions easier to sense. When operational, the new full-size chambers (20 times bigger than DUNE's) will hold 72,000 tonnes of argon and be able to detect beams of neutrinos fired from test facilities 1,300km (almost 810 miles) away. Scientists hope the chambers will help them fit neutrinos into the particle puzzle.

#### TOUCHDOWN ON TITAN 个 TITAN (FROM THE HUYGENS PROBE) 2005

"We'll soon be landing in Adiri. The weather is breezy with temperatures of -170°C (-274°F)." We can imagine space tourists one day hearing these words as they prepare to disembark at a spaceport on Titan, Saturn's largest moon. As of now, though, the Huygens probe remains the moon's only visitor from Earth - mainly because getting there is such a chore. Having departed at the end of the 20th century - October 1997 - aboard the Cassini spacecraft (see 'Basking in the Sun's glow', p16), it took the robotic lander until January 2005 to begin its descent to Titan's surface. As it parachuted into the moon's Adiri region, Huygens took a number of photographs, including this one, before making a soft landing in sand and dirty ice. Thanks to the lander's (strictly business) trip, we now know that Titan's atmosphere contains complex organic compounds and its surface is scarred with dried-out rivulets of what may have been liquid methane.

#### HEAD IN THE CLOUDS → 11,000M (36,000FT) ABOVE THE PACIFIC

2016

Santiago 'The Storm Pilot' Borja has received many plaudits for the pictures he takes from the cockpit of his Boeing 767 passenger plane. He initially tried taking photos of mountains and cities, but realised they were too small to appreciate from the air. So he switched to taking photos of the weather instead, often using lightning to illuminate the scenery. Although he uses relatively long exposures, his photos aren't blurry: the lightning works as a fast flash. This atmospheric image focuses on an 'overshooting top' – a patch of cloud where strong updraughts in a thunderstorm have caused a protrusion from the top of a cumulonimbus. They're small in meteorological terms, measuring around 15km (about nine miles) across. Textbook examples appear as distinct spots in infrared satellite imagery. Overshooting tops are important in meteorology because they mark the location of the most severe conditions in storms.

#### CENTRE OF ATTRACTION SAGITTARIUS A\* (FROM EARTH)

2022

We first stared into the astronomical abyss in 2019, when the international team of scientists working at the Event Horizon Telescope (EHT) captured an image of M87\*, a supermassive black hole in the centre of a galaxy 53 million light-years from Earth. Three years later, the EHT team used its global array of telescopes to produce this composite image of Sagittarius A\*, the supermassive black hole that lies 26,000 light-years away at the centre of the Milky Way – our home galaxy. In this image and the image of M87\*, it's not the black holes we see, but the glowing gases swirling around them. Even though it's considerably closer, it was much harder to get a clear shot of Sagittarius A\* because of its lower mass. At 'only' 4 million times the size of the Sun, it's a baby compared to M87\*, which is a whopping 6.5 billion times bigger than the star at the centre of our Solar System. This size discrepancy means the gases swirl around Sagittarius A\* within minutes, as opposed to days at M87\*, making for a changing pattern of brightness that's difficult to image. EHT scientists are now working to produce the first movie of a black hole, after the 15m-wide (49ft) Africa Millimetre Telescope in Namibia was added to the array.





"ALTHOUGH THEY LOOK SMOOTH AND CONTINUOUS, THE RINGS ARE ACTUALLY FORMED FROM BILLIONS OF PIECES OF ICE AND ROCK"

#### BASKING IN THE SUN'S GLOW SATURN (FROM THE CASSINI SPACECRAFT) 2006

NASA launched its Cassini spacecraft from Cape Canaveral, Florida, in 1997. Seven years later, it reached Saturn, its primary destination, having travelled 3.4 billion kilometres and taken in the sights of Jupiter along the way. Upon its arrival at Saturn, the spacecraft embarked on a grand tour of the ringed planet's many moons, including Titan (where it dropped off the Huygens lander – see p10), Dione, Enceladus and Rhea. In total, Cassini collected 453,000 images during its mission, including this stunning portrait of Saturn, taken as the planet occulted the Sun. Saturn's rings were discovered over 400 years ago by Galileo, but, backlit like this, they appear brighter and perhaps more beautiful than we've ever seen them. Although they look smooth and continuous, they're actually formed from billions of pieces of water ice and rock – some as small as grains of rice, some as big as mountains. With the information Cassini was able to gather, scientists were able to learn more about where this material comes from. For instance, we now know that many of the icy chunks in the E-ring – one of the fainter, outer rings – were vented from Enceladus.



#### RECORD-BREAKING RESOLUTION NORTH CAROLINA, USA

NORTH CAROLINA, USA 2023

This is a slice through a brain scan that's 64 million times sharper than any ordinary magnetic resonance imaging (MRI) machine is capable of producing. The full, 3D version – unveiled in 2023 on the 50th anniversary of the invention of magnetic resonance imaging – allowed scientists to view mind-boggling details of the circuitry inside a mouse's brain. It's the result of four decades of work at Duke University's Center for In Vivo Microscopy. Researchers there plan to use ultra-high-resolution scanning to study brain tumours and get to grips with what's really going on in neurodegenerative conditions like Alzheimer's disease.









PLUTO, UP CLOSE PLUTO (FROM THE NEW HORIZON'S SPACECRAFT) 2015

When NASA launched its New Horizons spacecraft in 2006, Pluto was still a planet and the only one in the Solar System that remained completely unexplored. Later that same year, however, Pluto lost its full planet status as the International Astronomical Union officially designated it a 'dwarf planet'. This may have downgraded the importance of the mission, but it didn't change its trajectory. New Horizons was already past Mars and well on its way towards Jupiter, taking advantage of a gravity assist by the gas giant to knock three years off its journey time. Finally, in July 2015, the spacecraft passed within an astronomical hair's breadth – 12,553km (7,800 miles) – of Pluto, using its telescope to take the photo above. Prominent in the centreright of this image is the Solar System's biggest glacier, Sputnik Planitia, first spotted by the Sputnik 1 satellite in 1957 and measuring around 1,000km wide (621 miles). Thanks to data from the flyby, scientists were able to conclude that Pluto is bigger than they thought, although it's not actually size that determines planetary status. The issue for Pluto is that its gravity isn't strong enough to have cleared 'its neighbourhood' of other objects.

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