Snapshots of science

Atmospheric science

Jet stream stops shifting as ozone layer recovers

The discovery of a hole in the springtime atmospheric ozone layer over the Antarctic in the mid-1980s revealed the threat posed by human-made ozone-depleting substances (ODSs). The Antarctic ozone hole, which resides at altitudes of around 10–20 kilometres, has also affected atmospheric circulation all the way down to the surface in the Southern Hemisphere — most notably, by shifting the summertime jet stream polewards. The production and use of ODSs was banned by the Montreal Protocol of 1987 and its subsequent amendments. Atmospheric ODS concentrations are therefore decreasing, and the first signs of ozone-layer recovery have emerged. Banerjee *et al.* report that the hole-associated circulation effects have paused since ozone recovery started. A cessation of the circulation trends has been noted previously, but Banerjee and colleagues are the first to formally attribute it to the effects of the Montreal Protocol.

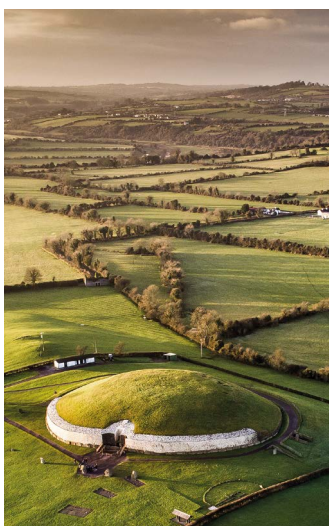
Alexey Yu. Karpechko writing in *Nature* **579**, 500–501 (2020).
Original research: *Nature* **579**, 544–548 (2020).

Ancient DNA

Incest uncovered at elite prehistoric Irish burial site

Cassidy *et al.* examined the social structures of farming communities, focusing on the people buried in passage tombs. The most famous Irish passage tomb is the enormous monument at Newgrange (pictured). It was built using sophisticated engineering to ensure that, at the end of a long, stone-lined passage, a burial chamber is lit up by the rays of the rising Sun on the shortest day of the year. Ancient DNA from human remains found there reveals a rare and unexpected incidence of incest. A man buried in the chamber of Newgrange around 5,000 years ago was the offspring of a first-degree incestuous union: his parents were either siblings or parent and child. This finding led the team to speculate that the elite associated with this magnificent monument practised incest as a way of maintaining a dynastic bloodline.

Alison Sheridan writing in *Nature* **582**, 347–349 (2020).
Original research: *Nature* **582**, 384–388 (2020).



Ecology

Satellites could soon map every tree on Earth

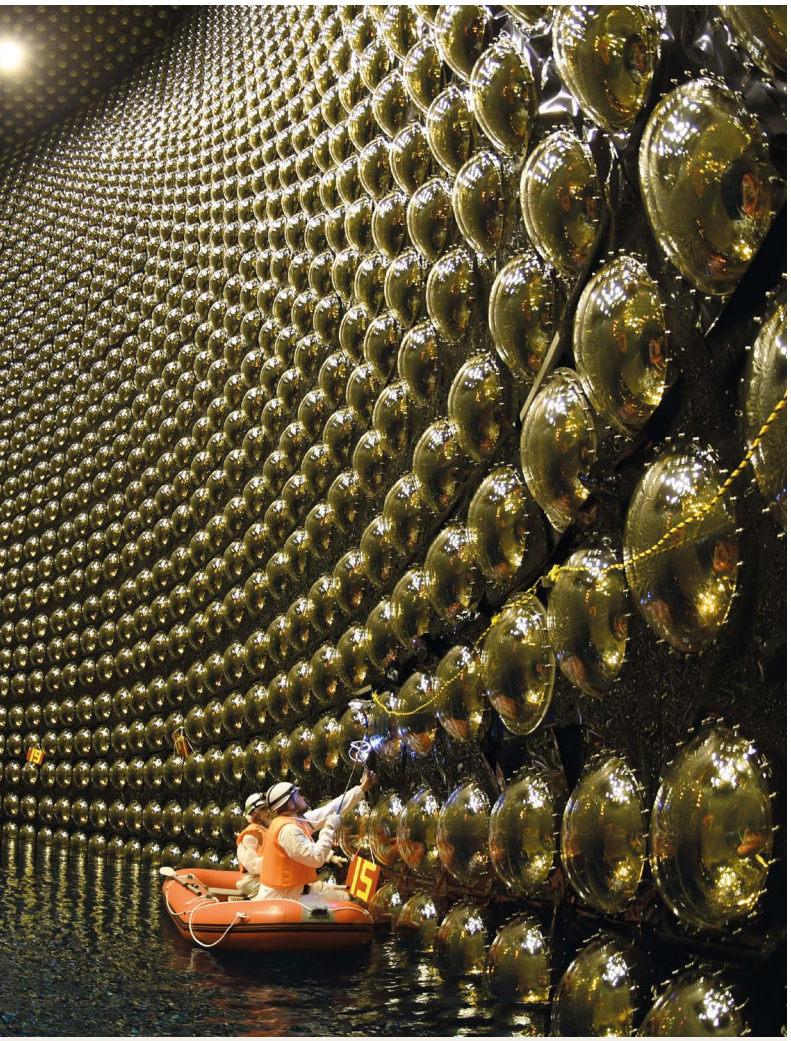
Brandt *et al.* report their analysis of high-resolution satellite images covering more than 1.3 million square kilometres of the western Sahara and Sahel regions of West Africa. The authors mapped the location and size of around 1.8 billion individual tree canopies; never before have trees been mapped at this level of detail across such a large area. Commercial satellites have begun to collect data capable of capturing ground objects measuring one square metre or less. This places the field of terrestrial remote sensing on the threshold of a fundamental leap forward: from focusing on aggregate landscape-scale measurements to having the potential to map the location and canopy size of every tree over large regional or global scales. This advance will undoubtedly drive fundamental changes in how we think about, monitor, model and manage global terrestrial ecosystems.

Niall P. Hanan and **Julius Y. Anchang** writing in *Nature* **587**, 42–43 (2020).
Original research: *Nature* **587**, 78–82 (2020).

Particle physics

Matter–antimatter symmetry violated

L TO R: KEN WILLIAMS; KAMIOKA OBSERVATORY/INSTITUTE FOR COSMIC RAY RESEARCH/UNIV. TOKYO; BENJAMIN FABIAN



The T2K Collaboration reports possible findings of the violation of particle–antiparticle mirror symmetry (also known as CP symmetry) by particles from the lepton group. Leptonic CP violation can be searched for using neutrinos. Neutrinos come in three 'flavours' determined by their associated charged lepton (an electron, a muon or a tau particle), and can change from one flavour to another as they travel. If CP symmetry is conserved, the oscillation probability for muon-to-electron neutrino conversion would be the same as that for muon-to-electron antineutrino conversion. In the T2K experiment, neutrinos (or antineutrinos) that have travelled 295 kilometres through Earth are detected by the underground detector at the Kamioka Observatory in Japan (pictured). The experiment measures the oscillation probability of muon-to-electron neutrino conversion. The results exclude CP conservation at a 95% confidence level, and could be the first indications of the origin of the matter–antimatter asymmetry in our Universe.

Silvia Pascoli and **Jessica Turner** writing in *Nature* **580**, 323–324 (2020).
Original research: *Nature* **580**, 339–344 (2020).

Virology

Latent HIV gets a shock

HIV can hide out in a 'latent' form in viral-reservoir cells, undergoing little or no transcription and thus remaining undetected by the immune system. 'Shock and kill' treatments aim to reverse this latency and increase viral gene expression (shock), rendering the viral-reservoir cells vulnerable to elimination (kill) by the immune system. Two groups describe interventions in animal models that cause perhaps the most robust and reproducible shock reported so far. Nixon and colleagues used a drug called AZD5582, which can activate the transcription factor NF-κB — a major instigator of HIV-1 gene expression. McBrien *et al.* combined two immunological interventions — antibody-mediated depletion of $CD8^+$ T cells (immune cells that reduce levels of viral transcription) and treatment with a drug called N-803 that activates HIV-1 transcription. In addition to the advances they make, the studies showcase the conceptual and technical challenges associated with pharmacological latency reversal.

Mathias Lichterfeld writing in *Nature* **578**, 42–43 (2020).
Original research: *Nature* **578**, 154–159 (2020); *Nature* **578**, 160–165 (2020).

Neuroscience

Engineering a picky eater

The fly *Drosophila sechellia* feeds exclusively on the toxic noni fruit (*Morinda citrifolia*). What makes this species such a picky eater compared with its generalist relatives? Auer *et al.* cracked the case using the genome-editing tool CRISPR–Cas9. One class of sensory neuron that expresses the odorant receptor 22a (Or22a) protein is more abundant in *D. sechellia* than in other fly species — the group showed that small changes in Or22a's amino-acid sequence have contributed to *D. sechellia*'s partiality for noni. They also identified several other evolutionary changes that might contribute to this apparently simple behavioural shift. Even tiny flies that love stinky fruit can provide powerful insight into how brains evolve to shape complex behaviours.

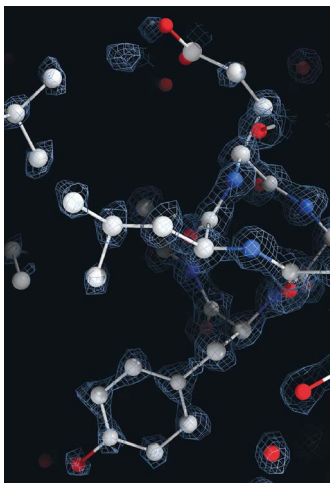
Jessica L. Zung and **Carolyn S. McBride** writing in *Nature* **579**, 345–346 (2020).
Original research: *Nature* **579**, 402–408 (2020).

Astronomy

A fast radio burst in our own Galaxy

Three papers published in *Nature* report the detection of a phenomenon called a fast radio burst (FRB) coming from a source in our Galaxy. Intriguingly, the FRB was accompanied by a burst of X-rays. The discovery was made and understood by piecing together observations from multiple space- and ground-based telescopes. The name 'fast radio bursts' is a good description of what they are: bright bursts of radio waves with durations roughly at the millisecond scale. First discovered in 2007, their short-lived nature makes it particularly challenging to detect them and to determine their position on the sky. This FRB is the first for which emissions other than radio waves have been detected, the first to be found in the Milky Way, and the first to be associated with a stellar remnant called a magnetar — proving that magnetars can drive FRBs.

Amanda Weltman and **Anthony Walters** writing in *Nature* **587**, 43–44 (2020).
Original research: *Nature* **587**, 54–58 (2020); *Nature* **587**, 59–62 (2020); *Nature* **587**, 63–65 (2020).



MARK HERZIK

Structural biology

Cryo-electron microscopy reaches atomic resolution

A founding principle of structural biology is that, once researchers can directly observe macromolecules in enough detail, it should be possible to understand how their 3D structures confer their biological functions. Writing in *Nature*, Yip *et al.* and Nakane *et al.* report the sharpest images yet obtained using a method termed single-particle cryo-electron microscopy (cryo-EM), enabling the location of individual atoms in a protein to be determined for the first time. Each team used hardware that tackled distinct aspects of cryo-EM imaging that had previously limited the resolution attainable. With these technologies, the increased signal-to-noise ratio of cryo-EM images will expand the technique's applicability. Perhaps the melding of these technologies will enable the determination of cryo-EM structures at a resolution beyond even one ångström — an achievement that might once have seemed impossible.

Mark A. Herzik Jr writing in *Nature* **587**, 39–40 (2020).
Original research: *Nature* **587**, 157–161 (2020); *Nature* **587**, 152–156 (2020).

Immunology

Interferon deficiency can lead to severe COVID

Zhang *et al.* and Bastard *et al.* shed light on a key factor that affects whether life-threatening COVID-19 develops. The studies implicate deficiencies in interferon proteins, specifically, type I interferons (IFN-I). Such deficiencies might arise through inherited mutations in genes encoding key antiviral signalling molecules, or by the development of antibodies that bind to and 'neutralize' IFN-I. How does a defective IFN-I response lead to life-threatening COVID-19? The most direct explanation is that IFN-I deficiencies lead to uncontrolled viral replication and spread. However, IFN-I deficiencies might also have other consequences for immune-system function. Individuals with genetic mutations in the IFN-I-induction pathway would benefit from therapy that provides interferon. Furthermore, people who have neutralizing antibodies to IFN-α and IFN-ω might benefit from therapy that provides other types of interferon, such as IFN-β and IFN-λ.

Eric Meffre and **Akiko Iwasaki** writing in *Nature* **587**, 374–376 (2020).
Original research: *Science* **370**, eabd4570 (2020); *Science* **370**, eabd4585 (2020).

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Stem cells

Fight or flight turns hair white

The relative contribution of stress to greying of the hair is not known. Hair colour is determined by cells called melanocytes, which are derived from melanocyte stem cells (MeSCs) located in a part of the hair follicle called the bulge. Zhang *et al.* report that noradrenaline — a neurotransmitter molecule involved in the 'fight or flight' response to stress — is released from neurons of the sympathetic nervous system that innervate the bulge. MeSC proliferation and differentiation increase markedly under extreme stress or on exposure to a high level of noradrenaline, resulting in mass migration of melanocytes away from the bulge and leaving no remaining stem cells to replace them, thus causing greying. Beyond the development of anti-greying therapies, Zhang and colleagues' work promises to usher in a better understanding of how stress influences other stem-cell pools and their niches.

Shayla A. Clark and **Christopher D. Deppmann** writing in *Nature* **577**, 623–624 (2020).
Original research: *Nature* **577**, 676–681 (2020).