Snapshots of science

January

Particle physics

Nuclear reaction rules out neutrino hypothesis

Neutrinos are among the most abundant elementary particles in the Universe, but they have zero electric charge and interact only weakly with matter, so they are difficult to detect in experiments. The long-held idea that there are only three types of neutrino was challenged in 1996 by evidence suggesting the possibility of a fourth type called the sterile neutrino. Further support for this proposal came in 2011, when the total number (the flux) of antineutrinos — the antimatter counterpart of neutrinos — produced in a nuclear reactor differed significantly from that predicted. A dedicated search ensued. And now, the STEREO Collaboration confirms the flux anomaly, but reports that this discrepancy cannot be explained by the existence of a sterile neutrino, putting to rest one hypothesis and opening the field for others. The search for an explanation continues.

Jun Cao writing in *Nature* **613**, 248–249 (2023).
Original research: *Nature* **613**, 257–261 (2023).

THIERRY FALISE/LIGHTROCKET VIA GETTY

February

Environmental sciences

Extent and drivers of global wetland loss

Wetlands have often been drained or repurposed (pictured) so that the land can be used for human objectives — most notably, in pursuit of productive agricultural land and to accommodate growing urban populations. The history of these environmentally devastating transformations is so long that developing an accurate global picture of the long-term extent of wetland loss has been exceptionally difficult. Fluet-Chouinard *et al.* now provide a comprehensive estimate. They reveal that around 3.4 million square kilometres — equivalent to about 2% of Earth's land surface area — have been lost owing to a broad range of drivers over the past three centuries. This equates to the loss of about one-fifth (21%) of the wetlands that existed in 1700. The findings and resources developed by the authors will inform global policy initiatives, including the United Nations Sustainable Development Goals, which require an understanding of the distribution of wetland change to improve the management of these ecosystems.

Nicholas J. Murray writing in *Nature* **614**, 234–235 (2023).
Original research: *Nature* **614**, 281–286 (2023).

March

Engineering

Hazards help autonomous cars to drive safely

Every year, collisions involving road vehicles kill or seriously injure tens of thousands of people in the United Kingdom alone. Autonomous vehicles could reduce these numbers, but their safety is yet to be guaranteed. Identifying potentially hazardous situations and testing how an autonomous agent will react are crucial parts of the safety-assurance process. But people are not necessarily adept at recognizing situations that would be hazardous for non-human drivers. Feng *et al.* introduce a method that uses artificial intelligence (AI) to validate the AI of autonomous vehicles. The authors' AI agent learnt to ignore the vast set of situations in which vehicle behaviours are benign, and instead built a dense set of test data for safety-critical events. In this way, unimportant scenarios were removed from the data set, decreasing computational complexity and increasing the efficiency and effectiveness of testing.

Colin Paterson & **Chiara Picardi** writing in *Nature* **615**, 594–595 (2023).
Original research: *Nature* **615**, 620–627 (2023).

April

Behavioural ecology

An evolutionary route to warning coloration

Many species have conspicuous coloration that accurately advertises a defence or other characteristics enabling them to escape predation. How can a conspicuous form initially evolve in a cryptic (camouflaged) population? Being conspicuous increases the probability of being discovered by a predator, and because conspicuous prey will initially be rare, predators will not learn to avoid the colour signal, and thus the risk of extinction of the conspicuous form will be high. Loeffler-Henry and colleagues considered the fact that some cryptic animals, when in competition with other members of their species or when under predatory threat, display a bright colour patch (pictured), but only briefly. In an imaginative leap across various subdisciplines, the authors reasoned that species with conspicuous lower (ventral) surfaces but cryptic upper (dorsal) surfaces might provide a pathway through which full-blown conspicuousness could evolve.

Tim Caro writing in *Nature* **618**, 34–35 (2023).
Original research: *Science* **379**, 1136–1140 (2023).

May

Cell biology

Phosphate-storing organelle discovered in fruit flies

Without inorganic phosphate (P_i), our cells would have no DNA, no ATP molecules to store energy and no phospholipids to form membranes. However, researchers do not fully understand how phosphate is metabolized or stored in animal cells. Xu *et al*. made the intriguing observation that, if they prevented P_i intake into the gut cells of fruit flies (*Drosophila melanogaster*), there was a large increase in the proliferation of gut-progenitor cells. They therefore looked for a gene that might encode a phosphate sensor or transporter, and thereby couple P_i deficit to proliferation. The researchers identified one such gene, which they named P_i-sensitive XPR1 orthologue (*PXo*), and demonstrated that the PXo protein is present in previously uncharacterized organelles found in absorptive cells and some progenitors. When P_i is low, these 'PXo bodies' are engulfed by organelles called lysosomes that contain degradative enzymes, allowing P_i to be released and used by the cell.

Emily Strachan & **Irene Miguel-Aliaga** writing in *Nature* **617**, 677–678 (2023).
Original research: *Nature* **617**, 798–806 (2023).

June

Ancient DNA

Onset of farming in northwest Africa traced

The shift in human cultures from hunter-gatherer lifestyles to those based on the cultivation and husbandry of domesticated plants and animals is known as the Neolithic or agricultural transition. How Neolithic lifestyles spread into northwest Africa has been unclear. Simões *et al*. describe human genomic data from three previously unsampled archaeological sites in Morocco, dated to between 7,600 and 5,700 years ago — around the time when farming became established in the region. The research points to a more complex and dynamic pattern of human migration and admixture than previously recognized in Morocco. After a prolonged period of at least 7,000 years of continuity and isolation, the genetic and cultural landscape of Morocco changed drastically between 7,500 and 5,700 years ago, with the arrival of Neolithic groups and lifestyles from both Europe and the Levant (an area bordering the eastern Mediterranean that encompasses the land bridge between western Africa and Eurasia).

Louise Humphrey & **Abdeljalil Bouzouggar** writing in *Nature* **618**, 460–461 (2023).
Original research: *Nature* **618**, 550–556 (2023).

LUIZ A. ROCHA, CALIFORNIA ACADEMY OF SCIENCES

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July

Environmental science

Collaborations uncover extent of plastic pollution

Plastic pollution evokes powerful images of injured marine life tangled in plastic ropes (pictured). Researchers report global evidence that plastics contaminate coral reefs and freshwater lakes — some of which are far away from the human populations that create such pollution. Nava *et al*. looked specifically at plastics that were larger than 250 micrometres by sampling the surface-water outflow of 38 lakes and reservoirs in 23 countries. Plastics were found in all water bodies sampled by the authors, and 94% of these plastics were smaller than 5 millimetres — making them microplastics. Pinheiro *et al*. compiled data to quantify debris larger than 5 centimetres on coral reefs in 84 distinct ecosystems in both coastal and offshore regions around the globe. The authors documented widespread contamination by debris (in 92% of ecosystems), most of which (88%) was composed of plastic.

Kara Lavender Law & **Chelsea M. Rochman** writing in *Nature* **619**, 254–255 (2023).
Original research: *Nature* **619**, 317–322 (2023); *Nature* **619**, 311–316 (2023).

August

Ecology

A drowned future for coastal ecosystems

Humans have gravitated towards coastlines for millennia and depend on coastal ecosystems such as tidal marshes, mangroves and coral reefs for fisheries, storm protection and recreation. Saintilan *et al*. shed light on what the future under climate change might mean for these ecosystems. The authors find that the thresholds beyond which sea-level rise would lead to widespread 'drowning' of coastal ecosystems might be much lower than were previously thought. The boundaries of the safe operating space of coastal ecosystems — in which the risk of catastrophic ecosystem collapse remains low — might be rapidly approaching. Saintilan and colleagues' findings remind us how profoundly necessary it is to achieve the Paris climate agreement's goals through global actions. In a warming world with rapidly rising seas, combining local and global efforts and taking immediate actions would be our best hope to save coastal ecosystems.

Qiang He writing in *Nature* **621**, 44–45 (2023).
Original research: *Nature* **621**, 112–119 (2023).