

RESEARCH HIGHLIGHTS

Selections from the scientific literature

ASTROPHYSICS

Supernova clues from neutrinos

Neutrinos detected by Earth-based observatories could one day help to reveal the sequence of events that occur in supernovae.

When a white-dwarf star becomes too massive to support itself, the internal pressure is thought to trigger a runaway thermonuclear reaction followed by an explosion — known as a Type Ia supernova — but the events involved in the explosion are unknown. Warren Wright at North Carolina State University in Raleigh and his colleagues simulated a supernova and calculated the number of neutrinos it would generate, and the timing of their release, if the star's gravity initially limited the explosion, and the nuclear reaction spread across the star's entire surface before the star exploded.

This would create two distinct neutrino bursts that would be much fainter than the single burst that would be made by a faster explosion, which the team calculated in a previous study published last year. Over time, neutrino observatories searching for supernovae in our Galaxy should be able to use these predictions to tell whether either scenario is accurate, the authors say. *Phys. Rev. D* 95, 043006 (2017)

AGRICULTURE

Pesticide-free farms can pay

It may be possible to curb pesticide use on some farms without lowering yields or cutting profits.

Martin Lechenet and Nicolas Munier-Jolain at the French National Institute for Agricultural Research in



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GENOMICS

Prehistory's female dynasties

One of the first complex societies in North America transferred power through the female line, genomic evidence suggests.

In some of the earliest recorded societies, power was passed down along family lines, but little is known about how prehistoric societies without writing systems transferred power. Douglas Kennett at Pennsylvania State University in University Park and his colleagues examined DNA from nine individuals buried in a crypt at Chaco Canyon in New Mexico (pictured), a major population centre between AD 800 and 1130.

The crypt contained thousands of turquoise and shell artefacts, finely made pottery and musical instruments, suggesting that the people belonged to an elite class. All of them shared identical mitochondrial genomes, which are inherited from the mother. Further analysis confirmed a mother–daughter pair and a grandmother–grandson pair in the crypt, suggesting a matrilineal dynasty.

The findings are consistent with the presence of matrilineal leadership systems in some Native American groups living in the area today. *Nature Commun.* 8, 14115 (2017)

Dijon and their colleagues assessed whether herbicides, fungicides and insecticides are associated with productivity or profitability at 946 arable farms across France. They found that pesticides do not drive yields or income for 77% of the farms, but noted that results varied between crops. Cereal yields, for example, were not adversely affected by decreased pesticide use, but the profitability of potato and sugar-beet crops relied heavily on chemicals.

All farms could change their practices and rely on other technological innovations to

reduce pesticide use while protecting crops from disease, the authors say.

Nature Plants 3, 17008 (2017)

MICROBIOME

Skin cream kills pathogen

A lotion containing specific bacteria kills a pathogen associated with an inflammatory skin disorder.

Atopic dermatitis causes dry, itchy and inflamed skin, and is often marked by high levels of the pathogenic

bacterium *Staphylococcus aureus*. Other bacteria that normally live harmlessly on the skin are known to produce antimicrobial compounds, so Richard Gallo at the University of California, San Diego, and his colleagues set out to investigate whether these bacteria help to combat *S. aureus*. The researchers isolated and sequenced the genomes of a range of *Staphylococcus* species from the skin of both healthy people and those with atopic dermatitis. They found that people with the disorder had

MAURICIO DE PAIVA

lower levels of microbes with antimicrobial activity than did their healthy counterparts.

The team identified several *Staphylococcus* species, and the peptides they make, that specifically kill *S. aureus*. Only the strains with antimicrobial activity were able to lower *S. aureus* levels when applied to people's skin.

Sci. Transl. Med. 9, eaah4680 (2017)

BIOMATERIALS

A super-strong underwater glue

A synthetic adhesive inspired by the sticky proteins made by mussels can bind to wet surfaces more tightly than even live mussels can.

Previous mussel-mimicking adhesives were strong when dry, but less effective underwater. Jonathan Wilker and his colleagues at Purdue University in West Lafayette, Indiana, created a polymer with some of the same structural elements as the sticky protein threads that mussels make to attach themselves to rocks and other surfaces.

Previous adhesives had catechol chemical groups attached to a synthetic polystyrene backbone, but the new material incorporates these groups into the backbone, as mussels' adhesive proteins do. This may explain the polymer's high degree of stickiness underwater, the authors say.

ACS Appl. Mater. Interfaces <http://doi.org/bz8n> (2017)

EVOLUTION

How humans adapt to arsenic

People living in Chile's Atacama Desert have different versions of a gene that allow them to cope with the region's naturally high levels of arsenic.

Arsenic from rocks seeps into the desert's scarce water sources, exposing people in the Camarones Valley to levels 100 times higher than the safe

limit of 10 micrograms per litre set by the World Health Organization. Mauricio Moraga at the University of Chile in Santiago and his colleagues compared the DNA of 50 people from this region with that of 92 individuals from other areas of the country that have lower levels of arsenic. They identified mutations that increased the efficiency with which the arsenic methyltransferase enzyme processes the element, and found these to be more common in the people of the Camarones Valley.

Nearly 70% of the Camarones people carried the most protective variant, considerably more than in other populations. These people have evolved over just 7,000 years under natural selection to tolerate arsenic, the authors say.

Am. J. Phys. Anthropol. <http://doi.org/bz4s> (2017)

NEUROSCIENCE

Predicting smell from structure

Algorithms can predict a molecule's odour on the basis of its chemical structure.

Pablo Meyer at IBM's Computational Biology Center in Yorktown Heights, New York, and his colleagues, asked 49 people to smell hundreds of molecules (**pictured**) and rate them on intensity, pleasantness and 19 other descriptors, such as 'fruit', 'musky' and 'bakery'.

The researchers gave these ratings, along with information on the substances' chemical structures, to 22 teams of computational scientists, who competed to

build the best predictive, machine-learning algorithms. After initially developing and training their algorithms on a partial data set, the teams tested their algorithms' abilities to predict people's perception of the remaining molecules.

Across all models, 'garlic' and 'fish' were the best-predicted attributes, at about 70% accuracy. Such tools could be used by the flavour and fragrance industry to formulate products, the authors say.

Science 355, 820–826 (2017)

ANTHROPOLOGY

Skulls show migration history

A study of skulls of early people in South America suggests that there were multiple waves of migration into the New World more than 10,000 years ago.

Wide variation in the skull shape of modern South American people has triggered debate over whether this results from rapid changes after the arrival of people in the region, or from successive migrations that introduced diversity. Noreen von Cramon-Taubadel at the University at Buffalo in New York and her colleagues compared the shape of Palaeoamerican crania (**pictured**) from the Lagoa Santa site in Brazil with those from modern populations. The team used the data to develop a model of ancestry, and found that the most recent common ancestor of the Palaeoamericans and contemporary Native American groups lived outside the Americas.



This adds weight to the theory that people moved into the Americas at many different times from northeast Asia across the Bering land bridge. *Sci. Adv.* 3, e1602289 (2017)

ECOLOGY

Alien species on the rise

The number of new instances of non-native species documented is increasing around the globe — growth that shows no sign of slowing.

The introduction of alien species can disrupt ecosystems and even cause local extinctions. Hanno Seebens at the Senckenberg Biodiversity and Climate Research Centre in Frankfurt, Germany, Franz Essl at the University of Vienna and their colleagues assembled a data set of 45,813 records, dating back to the 1500s, detailing the first arrival of an alien species. They show that such 'first records' have increased in the past 200 years, from an average of 7.7 per year between 1500 and 1800 to a record 585 in 1996. The rise in these records in the past 200 years was found in all taxa, with the exception of mammals and fishes, in which rates have declined in recent decades.

Alien numbers will probably continue to rise for years to come, despite efforts to curb them.

Nature Commun. <http://doi.org/bzw2> (2017)

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