RESEARCH HIGHLIGHTS

GETTY IMAGES

Stereo smell

Science **311,** 666–670 (2006)

Rats can take an 'olfactory snapshot' of the world in a single sniff, according to research by Upinder Bhalla of the National Centre for Biological Sciences in Bangalore, India, and his colleagues. Their work shows that the rodents can smell in stereo. By contrasting differences between the timing and intensity of smells reaching their two nostrils, the rats determine the direction from which an odour emanates.

The researchers trained thirsty rats (Rattus norvegicus, pictured) to drink from a water spout on either their left or right, depending on the direction from which a puff of odour had been delivered. They found that the rat needed just 50 milliseconds to make its decision.

OPTICS

Longest laser

Phys. Rev. Lett. **96,** 023902 (2006)

A fibre-optic system that could dramatically cut signal power losses in telecommunications has been created by a group led by Sergei Turitsyn and Juan Diego Ania-Castañón at the University of Aston in Birmingham, UK.

The team placed reflectors at each end of an optical fibre and pumped photons into the system. This excited atoms in the fibre and produced another, longer-wavelength set of photons. Because these photons were contained by the reflectors, they acted as a laser amplifier, boosting signals passing through the fibre.

The Aston group showed that there was minimal variation in signal power over 75 kilometres. The device may qualify as the longest laser ever built.

MATHEMATICAL BIOLOGY

Nature by numbers

Bot. J. Linn. Soc. **150,** 3–24 (2006)

Just how mathematical is nature? Answers to this question invariably invoke the idea that the optimal arrangement of leaves or petals in a plant (phyllotaxis) is related to the Fibonacci series, generating groupings of 2, 3, 5, 8 and so on.

But after a critical look at the data, Todd Cooke of the University of Maryland, College Park, concludes that the example may owe more to 'Pythagorean mysticism' than to hard evidence. The spiral patterns in structures such as pine cones and sunflower seed heads do seem to relate to the Fibonacci sequence, but contrary to common belief, they don't correspond to optimal packing. Also, increases in the number of leaves on a growing stem do not follow the Fibonacci sequence, as would be expected if it was fundamental to phyllotaxis.

QUANTUM PHYSICS

Everything is illuminated

Phys. Rev. Lett. **96,** 037402 (2006)

In today's computers, information is encoded in units known as 'bits'. Each bit can take one of two possible electronic states, '0' or '1', switched by a voltage.

The potential of a quantum computer, however, depends on its quantum bits, or 'qubits', sometimes being in both the 0 and 1 states at once. Now, Stefan Stufler of the University of Paderborn, Germany, and his co-workers show how the much more complex state of a qubit can also be set by a simple voltage.

The team used the absence and presence of charges in a speck of semiconductor, known as a quantum dot, to represent a qubit in states 0 and 1, respectively. Charges were created by illuminating the dot with two short laser pulses. The researchers showed that the voltage applied across the dot controlled the mixture of states in the qubit.

STRUCTURAL BIOLOGY

Pulling power

Proc. Natl Acad. Sci. USA **103,** 1244–1247 (2006)

For proteins whose structures resist analysis by conventional means, such as crystallography or computer simulation, Hendrik Dietz and Matthias Rief of the Technical University of Munich, Germany, introduce a brute-force approach.

They inserted chemical groups that can be crosslinked at selected locations in a protein, and used these to connect several of the proteins into long chains. When the chain was pulled taut with the tip of an atomic-force microscope, the portions of protein between the crosslinks unfolded one by one, causing the length of the polyprotein chain to increase in steps. From measurements of the change in length, the initial separation of the crosslinking groups in the folded protein could be calculated. Repeating this for different pairings of three crosslinking groups allowed the relative positions of the inserted groups to be determined by

triangulation. Measurements made on the structure of green fluorescent protein agreed closely with crystallographic data.

CELL BIOLOGY

Riveting toxin

EMBO J. doi:10.1038/sj.emboj.7600959 (2006)

Like many toxins produced by bacteria, aerolysin causes cell death by inserting itself into the cell membrane, creating a channel through which vital ions leak. While studying the insertion of aerolysin, Gisou van der Goot of the University of Geneva, Switzerland, and her colleagues discovered that this toxin uses a novel mechanism to anchor itself in the membrane.

The team identified a short stretch in the aerolysin protein that comprises five hydrophobic amino acids. These form a tip that drives insertion of the toxin into the cell's lipid membrane. Once the tip reaches the aqueous inside of the cell, its hydrophobicity causes it to turn back on itself, fixing aerolysin into the membrane like a rivet. Similar stretches in other toxins suggest that this mechanism may be general. The picture (right) is a top-down view of seven aerolysin proteins assembled into one channel.

ASTRONOMY

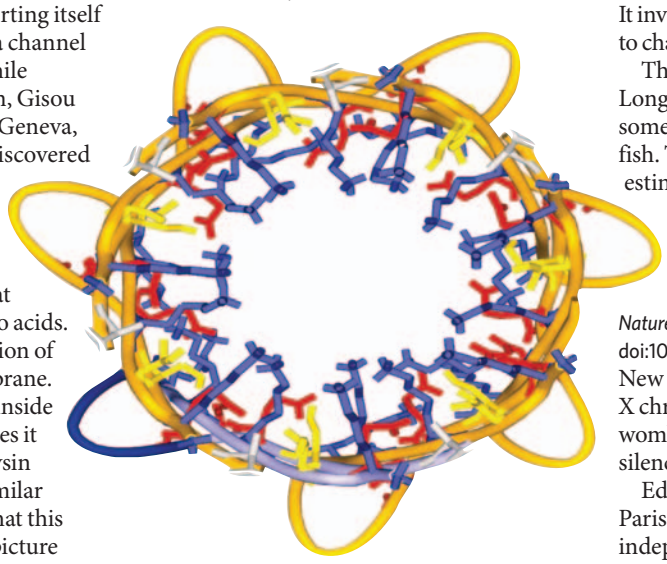
A wee wobble

Astron. Astrophys. **447,** 361–367 (2006).

The search for planets outside our Solar System was recently boosted by a relatively new method based on the gravitational lensing of light by a star–planet system. The technique found a planet about 5.5 times the mass of Earth (*Nature* **439,** 437–440; 2006).

But there's still plenty of life in the more established Doppler technique, which finds planets by measuring the wobble that they induce in the orbit of their parent star.

Stephane Udry and his colleagues at the High Accuracy Radial velocity Planetary Search (HARPS) project at La Silla, Chile, report that they have found a planet with a mass 14 times that of Earth. The planet orbits its star once every 15.6 days at a distance of just 17 million kilometres.



I. IACOVACHE/UNIV. GENEVA

ECOLOGY

Plenty more fish in the sea

Science **311,** 660–663 (2006)

Vast shoals of fish have been monitored in real time across many tens of kilometres using a novel remote-sensing technique.

The technique, developed by Nicholas Makris of Massachusetts Institute of Technology in Cambridge and his colleagues, uses acoustic reflections to detect the position and population density of shoals of fish. The new technique sees much further than conventional fish-finding sonar because the researchers use a trick to reduce the rate at which the sound intensity drops with distance. It involves using the sea surface and sea floor to channel low-frequency sound waves.

The researchers tested the method off Long Island in New York State, detecting some shoals containing tens of millions of fish. The technology should help to improve estimates of fish populations, says Makris.

GENETICS

X marks the spot

Nature Cell Biol. doi:10.1038/ncb1365 (2006); *Science* doi:10.1126/science.1122984 (2006)

New observations hint at how women's two X chromosomes may exchange signals in the womb before one of the chromosomes is silenced forever.

Edith Heard of the Curie Institute in Paris, France, and her collaborators and, independently, a group led by Jeannie Lee at the Howard Hughes Medical Institute in Boston, Massachusetts, tracked the movement of X chromosomes in embryonic mouse cells using fluorescent labelling. They saw that regions of the chromosomes known to be involved in X inactivation drew close to each other during the first few days of development. The researchers say this could allow signals to be passed between the chromosomes. When parts of these regions were deleted, the pairing did not happen and X inactivation was disrupted.

JOURNAL CLUB

Sun Kwok
University of Hong Kong, China

An astronomer is bugged by the scarcity of one of life's vital elements in space.

The idea that we are a product of the stars dates back to the 1950s. Then, astronomers realized that most chemical elements in the Universe are made by nuclear reactions in the stars.

Unsurprisingly, the elements that are most common in living things, including oxygen, carbon and nitrogen, are also among the most cosmically abundant. But there is one fascinating exception.

Phosphorus is important in biochemistry: it is involved in energy transfer and membrane structure, for example. The relative abundance of phosphorus in the human body is several orders of magnitude greater than in the Solar System, where it is only the seventeenth most common element.

So, how did phosphorus concentrate on Earth, ultimately becoming part of us?

This conundrum is discussed by Enrique Maciá of the Complutense University of Madrid, Spain (E. Maciá *Chem. Soc. Rev.* **34,** 691–701; 2005). He reviews the synthesis of phosphorus and measurements of its abundance, and speculates that the element preferentially condenses into solids, becoming incorporated into comets that deliver phosphorus to Earth.

That provides a mechanism for the element's arrival, but what about the forms in which it floats round space? We have detected many molecules containing carbon, nitrogen and oxygen in the interstellar medium and around stars. The only known phosphorus-bearing astrophysical molecules are phosphorus mononitride and carbon monophosphide.

Motivated by this apparent paradox, I am, with others, searching for other phosphorus-containing molecules using the satellite Odin and ground-based telescopes. We hope that such detections will shed light on phosphorus's journey from the stars to Earth.