RESEARCH HIGHLIGHTS

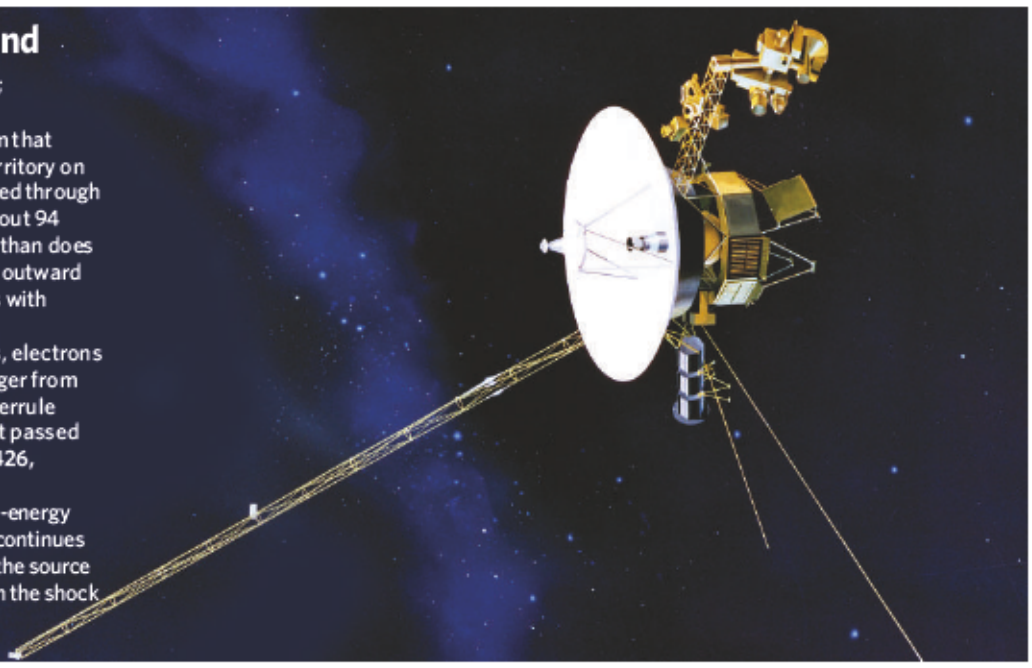
To infinity and beyond

Science 309, 2017–2020; 2020–2024; 2025–2027; 2027–2029 (2005)

Data published last week confirm that Voyager 1 flew into uncharted territory on 16 December 2004 when it passed through the 'termination shock'. Lying about 94 times further away from the Sun than does the Earth, this is where the Sun's outward flow of charged particles merges with interstellar plasma.

The measurements of the ions, electrons and magnetic field around Voyager from four teams of US researchers overrule the previous report that the craft passed this milestone in 2002 (*Nature* 426, 45–48; 2003).

Surprisingly, the number of high-energy cosmic rays detected by Voyager continues to increase. This could mean that the source of these rays lies beyond and not in the shock region as was previously thought.



NASA/JPL

MICROBIOLOGY

Kinky moves

Cell 122, 941–945 (2005)

Video footage of swimming *Spiroplasma* has solved the long-standing puzzle of how these tiny helical bacteria move.

Some researchers believed that *Spiroplasma* travel by rotating their spiral-shaped bodies, like a corkscrew. They thought this because *Spiroplasma* lack the rotating, whip-like extensions called flagella that many other microbes use to move. But high-resolution video microscopy shows their motion to be more snake-like.

Joshua Shaevitz and his colleagues at the University of California, Berkeley, found that *Spiroplasma* move by unwinding their spiral shape from the front, then coiling it back up in the opposite direction. The resulting kinks that propagate along the body of this single-celled microorganism propel it forward.

CELL BIOLOGY

Inner charge

Proc. Natl Acad. Sci. USA 102, 14058–14062 (2005)

A battery that stores electrical charge might build itself from a protein called Sprouty in the cells of mammals and other organisms, report Steven McKnight of the University of Texas Southwestern Medical Center and his co-workers.

Sprouty — so-called because fruitflies with mutant forms of it have excessively branched trachea — is thought to control development by interrupting a cell-signalling pathway that regulates growth factors. While investigating the mechanism by which Sprouty works, McKnight's group noticed that sulphur atoms in the protein bind to iron, forming a complex that can hold and release electrons. The proteins clump into spherical particles 4–5 nanometres across, which might help to insulate the charge. The researchers suggest that such a particle could form the core of an unidentified enzyme.

NEUROBIOLOGY

Drugs to forget

Neuron 47, 795–801; 873–884 (2005)

Two studies raise the prospect of a new treatment for drug addiction by showing, in rats, that it is possible to erase memories of cues associated with cocaine.

IMAGE UNAVAILABLE FOR COPYRIGHT REASONS

The treatments work by interfering with the pathways that reconsolidate a memory after its recall. Although such an approach has been shown to remove memories in other contexts, until now it was suspected that drug-linked memories might be too hard-wired.

In a study by Jonathan Lee of the University of Cambridge, UK, and his colleagues, rats were conditioned to associate a light signal with a cocaine reward. The animals' drug-craving response to light was eliminated by injecting the animals with DNA fragments that block the production of the protein Zif268. In the other study, researchers led by John Marshall of the University of California, Irvine, used drugs that block a biochemical pathway called ERK to erase the rats' preference for a chamber containing cocaine.

GENETICS

One too many

Science 309, 2033–2037 (2005)

Geneticists have created the most accurate mouse model yet of Down's syndrome, a condition in humans caused by having an extra copy of chromosome 21. They did this by injecting mouse embryonic stem cells with copies of this human chromosome.

Previous mouse models had extra copies of parts of mouse chromosome 16, which bears many but not all of the same genes as the human 21. This meant that the full syndrome could not be studied.

The new mice show characteristics of

M. WEINZIERL/ALAMY

Down's syndrome, including behavioural changes and heart defects, reports the team led by Victor Tybulewicz of the National Institute for Medical Research, London, and Elizabeth Fisher of the Institute of Neurology, London.

PHYSICS

Feel the force

Nature Phys. doi:10.1038/nphys125 (2005)

A silicon chip that can juggle two blobs of ultracold gas provides a new tool for physicists exploring the quantum properties of Bose–Einstein condensates, and could form the basis of high-precision sensors.

The chip interferometer developed by Peter Krüger at the University of Heidelberg in Germany and his colleagues uses magnetic fields to split a condensate of rubidium atoms. The clouds of atoms are pulled up to 80 micrometres apart, such that there is interference between the quantum matter-waves of the two clouds.

Crucially, this separation does not affect the coherence of the condensates. This means that any changes in the way the two clouds interfere is a sensitive measure of external influences, such as a gravitational field, rather than an effect of the separation process.

MEDICINE

A good shot

J. Exp. Med. 202, 817–828 (2005)

A dose of the drug chloroquine, delivered in conjunction with a vaccine, enhances the response of the immune system's $CD8^+$ T cells. The finding, reported by Vincenzo Barnaba of the University of Rome 'La Sapienza', and co-workers, may represent a strategy to improve the effectiveness of vaccination.

Chloroquine reduces the acidity of the environment into which soluble viral antigens, the key components of many vaccines, enter when they are engulfed by a cell. This may slow the degradation of the antigens so that more are presented to the patrolling cells of the immune system, including $CD8^+$ T cells, which then mediate an appropriate response.

CELL BIOLOGY

Bound by a ring

Cell 122, 849–860 (2005)

Just before a cell divides, its chromosomes, which are organized as pairs of DNA molecules called chromatids, must be pulled apart so that each daughter cell can inherit one chromatid from each pair.

IMAGE UNAVAILABLE FOR COPYRIGHT REASONS

A. TSUMNER/SPL

Until this point, a protein complex called cohesin clamps the chromatid pairs (pictured) firmly together. The cohesin complex has recently been shown to be a large ring structure. Dmitri Ivanov and Kim Nasmyth of the Research Institute of Molecular Pathology in Vienna now show that the cohesin complexes seem to keep chromatid pairs together not by binding them physically, but by trapping them topologically inside their rings.

BIOCHEMISTRY

Stable mate

Nature Chem. Biol. doi:10.1038/nchembio734 (2005)

Although the nitric oxide produced by mammalian tissues is known to regulate cell function, the nitrite produced when it is oxidized was long viewed as biologically inert. Now a study by Martin Feelisch of the Boston University School of Medicine, Massachusetts, and his colleagues shows that nitrite can act as a signalling molecule and a regulator of gene expression.

Rats injected with nitrite showed marked changes in the activity of important enzymes such as cytochrome P_{450}. Nitrite can also set off a molecular cascade inside cells that ultimately affects blood-vessel dilation.

The authors note the similar action of nitrite and nitric oxide, and suggest that the overlap may offer an evolutionary advantage. As the more stable molecule, nitrite may act as a longer-lasting version of nitric oxide.

Corrections

Our Research Highlight 'Diamond geezers' (*Nature* 437, 5; 2005) described a diamond material as "harder than the real thing". This is incorrect: the material is less compressible than diamond, as revealed through measurements of the bulk modulus. The reference for 'Keep your options open' (*Nature* 437, 298; 2005) should have been: *Cell* 122, 947–956 (2005). Apologies for the errors.

JOURNAL CLUB

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A physicist is drawn to wave research in his study of the aurora.

Little delights me more than work that unexpectedly unifies subjects previously thought disparate, particularly when it involves my specialty — the aurora.

Bright aurora, which form rings around the northern and southern magnetic poles, result from the impact of electrons on the upper atmosphere, some 120 km above the Earth's surface. The electrons which originate in the Solar wind or from the ionized layer of the atmosphere — the ionosphere — have somehow been accelerated to high energies.

For years, we focused on quasi-steady electric fields at heights of 1,500 to 10,000 km above the Earth's surface as the cause of the acceleration. More recently, evidence from satellites has suggested that some auroral electrons are accelerated by an entirely separate phenomenon: electromagnetic waves called Alfvén waves, which propagate through ionized gas.

Work in the *Journal of Geophysical Research* (C. C. Chaston *et al.* 110, A02211; 2005) both solidifies this association and adds new wrinkles.

Chaston *et al.* show that regions where European Cluster satellites have measured a high flux of electromagnetic energy directed towards Earth — carried by an Alfvén wave — match up with areas where NASA's FAST satellite, in a lower orbit, has seen accelerated electrons. These electrons have just the type of energy spectra thought to correspond to wave-induced aurora.

Intriguingly, the paper also links the production of these Alfvén waves to surface waves on the magnetopause, which is the bubble that the Earth's magnetic field creates in the Solar wind. Although aurora remain my focus, I am now following wave research more closely.