RESEARCH HIGHLIGHTS

Damp feeling

EMBO J. doi:10.1038/sj.emboj.7600668 (2005)
The bacterial flagellum has revealed an unexpected talent: it can sense wetness. The signal it produces is relayed to genes that control the injection of virulence factors, such as toxins, into the bacterium's host cell.

The flagellum is a whip-like protein with a well-known role in helping bacteria to swim. Its extra function was discovered by Rasika Harshey of the University of Texas at Austin and her colleagues, who observed that *Salmonella typhimurium* (pictured) failed to sprout full-length flagella in dry environments.

Such environments cause problems with the secretion of the filament protein that makes up the flagellum. This causes a cascade of molecular events inside the cell that ultimately affects gene regulation.

IMAGE UNAVAILABLE FOR COPYRIGHT REASONS

BDS/SPL

PARTICLE PHYSICS

Lattice work

Phys. Rev. Lett. **94,** 172001 (2005)
A promising method of calculating the interactions between fundamental particles has passed an important test. It successfully predicts the mass of the charmed B meson.

The method, unveiled early last year, is an improved version of lattice quantum chromodynamics. Researchers can now make precise predictions of particle properties using less computing power.

An international team of theorists used the method to predict the mass of the two-quark charmed B meson to be 6,304 ± 20 mega-electronvolts. This tallies with a measurement of the particle's mass made at Fermilab's Tevatron accelerator in Batavia, Illinois, which is being prepared for publication.

CHEMISTRY

Homeric electrons

Angew. Chem. doi: 10.1002/anie.200500541 (2005)
A cunning metal-oxide cluster molecule acts as a Trojan Horse by carrying electrons into reactions, reports a group led by Leroy Cronin from the University of Glasgow, UK.

The colourless tungsten complex $[W_{18}O_{56}(SO_3)_2(H_2O)_2]^{8-}$ contains two pyramid-shaped sulphite groups that usually act as passive structural components. But when the complex is heated to about 400 °C, the sulphites reconfigure to form extra bonds to oxygen atoms within the cluster. This turns them into tetrahedral sulphate groups, and releases two electrons.

It is the first example of a polyoxometallate compound containing embedded electron-releasing groups. Such molecules may have useful catalytic or electrochemical properties.

PLANT DEVELOPMENT

Surviving the split

Plant Cell doi:10.1105/tpc.105.032185 (2005)
Short pieces of RNA that play a key role in plant development have been doing their job since before the evolution of flowers, say Michael Axtell and David Bartel of the Whitehead Institute in Massachusetts.

They used microarrays to measure the accumulation of 63 microRNAs and other RNAs that silence genes in *Arabidopsis thaliana*, a plant of the mustard family. They applied the same probes to species of wheat, pine (*Pinus resinosa*, pictured), fern and moss.

Despite the fact that these plants diverged hundreds of millions of years ago, they contain some of the same microRNAs acting on similar target genes.

IMAGE UNAVAILABLE FOR COPYRIGHT REASONS

CELL BIOLOGY

Go one better

Nature Methods doi:10.1038/nmeth764 (2005)
Enzymes that play a diverse range of roles in cellular function can sometimes be studied by creating a single mutation in their sequence. And when one mutation doesn't work, two might, says a team headed by Kevan Shokat of the University of California, San Francisco.

Five years ago, Shokat's group discovered a way to target specific protein kinases by changing their structure: substrates or inhibitors target the kinase of interest after a simple mutation removes a 'gatekeeper' amino acid from in front of one of the binding sites. Unfortunately, the mutation can destroy an enzyme's activity, thwarting attempts to study its function. Now the team has found that a second mutation can rescue activity.

MATERIALS

No flat batteries

Adv. Mater. **17,** 1230-1233 (2005)
Betavoltaic batteries create current from the electrons (β-particles) that are produced by a radioisotope when its neutrons decay to protons. They tend to be inefficient, but a design that may improve their performance has emerged from Philippe Fauchet's team at the University of Rochester, New York.

Conventional designs pass tritium gas over flat electron collectors. Fauchet's group fill a porous silicon block with the radioactive gas instead. This has a greater surface area for electron collection, boosting the current by a factor of ten. The team estimates that almost

J BRANDENBURG/MINDEN PICTURES/FLPA

every β-particle in the battery contributes to the current. Using radioisotopes with long half-lives could produce low-power batteries that last for decades — ideal for satellites.

CHEMICAL BIOLOGY

Ironing out bugs

Nature Chem. Biol. **1**, 29–32 (2005)

The bacteria responsible for tuberculosis and plague both need iron to become virulent in humans, and both produce iron-sequestering compounds, known as siderophores. So drugs that block siderophore synthesis could provide a line for antibiotic attack.

Researchers from Cornell University and the Memorial Sloan-Kettering Cancer Center in New York have devised a molecule that binds to and inhibits enzymes involved in siderophore synthesis. The compound successfully reduces the growth of both *Mycobacterium tuberculosis* and *Yersinia pestis* under iron-poor *in vitro* conditions.

CANCER

To catch a kinase

Nature Genet. doi:10.1038/ng1571 (2005)

In order to divide and spread, many cancers rely on faults in enzymes called protein kinases, which means mutant kinases are potential drug targets. Humans have 518 known kinase genes, and a team headed by Mike Stratton of the UK Sanger Institute has screened the DNA sequences of all these genes in 25 cases of breast cancer.

The team found the number of non-inherited mutations in the cancer cells ranged from none to dozens. The pattern of changes in some cases suggests there is an underlying mutation mechanism that has not been seen before.

NONLINEAR PHYSICS

Black magic

Phys. Rev. Lett. **94**, 184503 (2005)

The bizarre black disc pictured right is a magnetic fluid deformed by solitons — localized packets of energy that have a stable shape.

Each spike is a soliton, about a centimetre high, that rises from the surface of a suspension of iron oxide particles. Created by Reinhard Richter at Germany's Bayreuth University and Igor Barashenkov at the University of Cape Town in South Africa, the structures are held aloft in the ferrofluid by a constant magnetic field.

The solitons seem to keep their shape because of the nonlinearity that the spike creates in the surrounding magnetic field. Similar mechanisms have previously been observed only in one-dimensional solitons. Other surface solitons, which are confined in two dimensions, need energy to sustain their structure.

QUANTUM DOTS

Light boxes

Science **308**, 1158–1161 (2005)

Put a nanoscale blob of semiconductor inside a cavity that contains light and it is possible to probe the fundamentals of quantum mechanics by looking at how this 'quantum dot' and the light interact. Sounds straightforward, but research has been hindered by construction problems — it's hard to put the dot in the cavity, and difficult to design the cavity to trap the right wavelength of light.

An encouraging approach for building these systems in semiconductors comes from researchers at the University of California,

APS

Santa Barbara, and the Swiss Federal Institute of Technology in Zurich. They grew a dot in a sandwich of layers, then drilled holes around it to define a 'photonic crystal' that acts as cavity walls. They tuned the wavelength by varying the size of the holes.

DEVELOPMENTAL BIOLOGY

The right slant

Cell **121**, 633–644 (2005)

One of the biggest questions in developmental biology is how embryos that begin as uniform balls of cells end up asymmetric. Experiments in mice provided a clue when researchers discovered that hair-like cilia protruding from embryonic cells in mice rotate, somehow setting up a flow in the surrounding fluid that defines the left–right axis.

A team led by Nobutaka Hirokawa of the University of Tokyo supplies another piece of the puzzle by showing exactly how the cilia's movement sets up the directional flow. The researchers found that the cilia rotate around an axis tilted 40° backwards. The same rotation was observed in rabbit and medakafish embryos, suggesting that the mechanism, previously studied only in mice, defines asymmetry in other vertebrates.

JOURNAL CLUB

Thomas F. Stocker
University of Bern, Switzerland

A climate physicist describes plans to monitor the disaster scenario that Hollywood turned into a blockbuster film.

Soon after the opening credits of *The Day After Tomorrow*, a couple of buoys floating in the Atlantic Ocean register plummeting water temperature. The film gets into full swing as the Gulf Stream shuts down, which takes hours. Days later, ice blankets northern Europe and the United States.

Events would not unfold as fast as the film suggests, but widespread freshening of the Atlantic caused by more rain and melting ice could weaken the north-flowing part of the Gulf Stream. If the current stopped completely, Europe would suffer without the warmth it brings.

Some researchers entertain 'dreamlike scenarios' of such climate turmoil, but I am reassured that others are asking relevant questions: what signs would there be of an imminent shutdown, and where in the Atlantic might we be able to detect them?

The most precise recipe comes from the *Journal of Marine Research* (J. Baehr *et al.* **62**, 283–312; 2004). The authors use a computer model to show that temperature and salinity data from moorings along a latitude of 26° N, combined with measurements of surface winds and estimates of current strength off Florida, could give the strength of the Atlantic current system to within 10% — and predict its fate.

"We still know very little about ocean currents."

I think investment in such an array would be worth while, even if today's widespread freshening turns out not to be a harbinger of disaster. In 1984, my predecessor at Bern's Physics Institute, Hans Oeschger, proposed that flips in circulation patterns could trigger abrupt climate change, but we still know very little about ocean currents. An Atlantic array would allow modelling groups such as mine to improve our predictions by quantifying the natural variability of the ocean circulation for the first time.