

RESEARCH HIGHLIGHTS

Flower finds its roots

Science doi:10.1126/science.1135260 (2007)
The plant with the world's largest flower (pictured), which spans up to a metre across and stinks of rotting flesh, has found a place in the tree of life almost 200 years after it was first described.

Rafflesia arnoldii is one of a group of parasitic plants termed Rafflesiaceae. With no proper roots, leaves or stems, plants of this group have proved tricky to classify. Even the chloroplast DNA often used to identify plant relationships has failed to provide clues, as many of the marker genes are missing or truncated.

To get round this, Charles Davis of Harvard University Herbaria in Cambridge, Massachusetts, and his team analysed about 11,500 base pairs of mitochondrial DNA from more than 100 species. They show that, surprisingly, the Rafflesiaceae are nestled within the Euphorbiaceae family, in which most species have tiny flowers.



J. HOLDEN

OPTICS

Most sensitive molecule

Optics Lett. **32**, 59–61 (2007)

Researchers have designed an organic molecule that is more sensitive to light than any seen before. Its strong optical response could be put to use in telecommunication systems, for example to build optical switches.

Javier Perez-Moreno of the University of Leuven in Belgium and his colleagues found that linking two different carbon-ring structures through a nitrogen double-bond enhanced the movement of electrons in the molecule when it was struck by light. The measure of this movement, known as the molecule's 'intrinsic hyperpolarizability' was about 50% higher for the new molecule than for the previous record-holder. However, its value still falls short of the theoretical limit by a factor of around 20, leaving chemists with work to do.

IMMUNOLOGY

Opposing forces

J. Exp. Med. doi:10.1084/jem.20061738 (2007)

Researchers have found a protein that safeguards the central nervous system from autoimmune responses.

The protein, known as IL-25, belongs to a family of proteins that regulate inflammation. Daniel Cua and his colleagues at Schering-Plough Biopharma in Palo Alto, California, created mice that lacked IL-25. These mice were more

susceptible to an inflammatory autoimmune disease afflicting the central nervous system, suggesting that IL-25 acts against inflammation.

The findings were a surprise because a closely related protein, known as IL-17, promotes inflammation. However, mice that lacked both proteins did not contract the autoimmune disease, demonstrating that the proteins have opposing roles. The researchers believe that IL-25 acts in other organs as well, and could be a target of future therapies for inflammatory diseases.

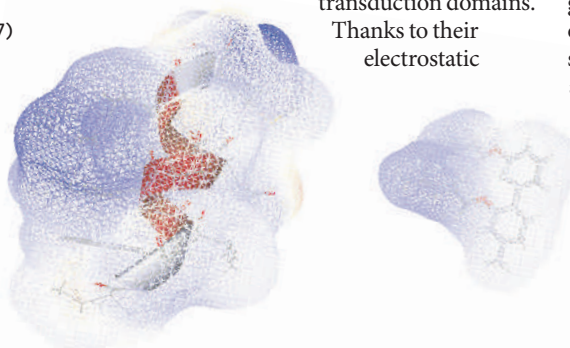
BIOTECHNOLOGY

Delivery service

Nature Methods doi:10.1038/nmeth997 (2007)

The graphic below shows the electrostatic potential of a helical peptide (left) and that of a smaller molecule (right) designed to mimic it: blue and red regions are polar, grey regions non-polar.

The peptide belongs to a class of structural elements known as protein transduction domains. Thanks to their electrostatic



properties, such peptides can penetrate the membranes of cells. Biologists take advantage of this, coupling other molecules such as dyes or drugs to the peptides for delivery into cells. The mimic designed by Gareth Williams and David Selwood of University College London, UK, and their colleagues can also carry molecules through the cell membrane. It should be cheaper to synthesize than a peptide and easier to optimize for different cargoes.

ECOLOGY

Invasion of the wild radish

Proc. Natl Acad. Sci. USA **104**, 549–552 (2007)

For invading forces, there is strength in numbers. That this is also the case for many plants is confirmed by a study of an invasive colonizer, the California wild radish (*Raphanus sativus*).

Ecologists led by Norman Ellstrand of the University of California, Riverside, showed that larger, more genetically diverse plots of the widespread weed produce more seeds and fruit per plant than smaller, more interrelated groups. This conforms to the predictions of the 'Allee effect', whereby individuals in a small group are expected to decline in fitness as a result of the scarcity of mates.

QUANTUM PHYSICS

Dead and alive

Nature Phys. doi:10.1038/nphys507 (2007)

In the famous thought experiment, Schrödinger's cat was constrained by the quirks of quantum physics to being both

half-dead and half-alive at the same time. In practice, the principle of superposition doesn't extend to such large objects, but physicists have succeeded in making hypothetical cats from small groups of photons or atoms.

Now Chao-Yang Lu and Jian-Wei Pan of the University of Science and Technology of China in Hefei report the biggest photonic cat yet, made by entangling the properties of six photons. This six-photon state is technically known as a Greenberger–Horne–Zeilinger state. The team also produced another kind of six-photon grouping, known as a cluster state. Each will provide new opportunities for testing ideas in quantum communication and computing.

CANCER BIOLOGY

Wrong number

Cancer cell 11, 25–36 (2007)

A study of the role of aneuploidy — an abnormal number of chromosomes — in cancer has reached the surprising conclusion that aneuploidy can inhibit tumorigenesis.

Many tumour cells have an abnormal chromosome number, but the question of whether this property plays an active role in tumour initiation or progression has remained under debate. Don Cleveland of the University of California, San Diego, and his colleagues found that reduction in the motor protein CENP-E, which helps to separate chromosomes during cell division, generated aneuploidy in mice. In these mice, the rates of some types of cancer did increase, but liver tumours were diminished in size. Aneuploidy also delayed tumour onset in mice lacking a tumour suppressor gene.

CELL BIOLOGY

Rapid response

Mol. Cell 24, 853–865 (2006)

Noise may help cells to cope with stress, say James Collins of Boston University, Massachusetts, and his colleagues.

Working in yeast, they tinkered with the promoter region of a gene to vary how strongly the gene was transcribed. This changed the amount of noise in the expression of the gene. When the cells were subjected to a transient environmental stress, such as an antibiotic, populations with more variable levels of gene expression tended to survive better than those with steadier expression levels. The team suggests that having more variation makes it more likely that some of the cells will find a satisfactory response to the stress. Some genes may have evolved to be prone to noisy expression, they speculate.

BIOPHYSICS

Water in slow motion

Proc. Natl Acad. Sci. USA doi:10.1073/pnas.0601639104 (2006)

Water is mysteriously sluggish inside cells of the extremely halophilic Dead Sea archaea *Haloarcula marismortui*, report Giuseppe Zaccai of the Laue-Langevin Institute in Grenoble, France, and his colleagues.

Using neutron scattering, they found that about three-quarters of the intracellular water in these organisms has a diffusion coefficient 250 times lower than that of bulk water. The idea that cell water is 'different' from bulk water is old and controversial, but it seems that in this salt-loving extremophile it may be true. Why? The researchers aren't yet sure, but suspect that proteins and high concentrations of potassium ions in the cells may somehow conspire to alter the water's liquid-state structure.



NEUROSCIENCE

Bats' brains differ to rats'

Nature Neurosci. doi:10.1038/nn1829 (2007)

A study of bat brains casts doubt on the prevailing theory of how the hippocampus, a brain region concerned with navigation and memory, does its job.

Researchers had based their models of how hippocampal cells function in mammals on observations of rats. But Nachum Ulanovsky and Cynthia Moss at the University of Maryland in College Park report that the brain waves generated by hippocampal cells are different in bats to in rats.

In freely roaming rodents, the hippocampal brain waves, or theta rhythms, are continuous and are assumed to be essential for remembering spatial information. But in bats using echolocation, rather than movement, to explore their surroundings, the theta rhythms appeared in short intermittent bouts. The researchers suggest that theta-wave behaviour may be tailored to a species' mode of navigation.

M. DURHAM/MINDEN PICTURES/FLPA

JOURNAL CLUB

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A cold-matter physicist is amazed by atoms' ability to divide themselves up equally.

Imagine having a box containing an even number of objects, N . You want to divide them into two boxes, each of which contains exactly $N/2$ objects. Sounds easy, right?

But let's complicate things a bit. Let's suppose you can't count the objects, nor look at them. Will you still be able to make the split fairly?

A collaboration of researchers from the Massachusetts Institute of Technology and Harvard University, both in Cambridge, recently showed that it's possible to do so for atoms. They divided into two equal halves a Bose-Einstein condensate of 1 million sodium atoms (G.-B. Jo *et al. Phys. Rev. Lett.*, in the press; preprint at <http://arxiv.org/abs/cond-mat/0608585>).

Bose-Einstein condensates are a novel state of matter that forms at a temperature close to absolute zero. They behave like quantum entities with pronounced wave-like properties. These are properties that I exploit in my own work with condensates, and they also underpin the atom division.

The Cambridge team stored their matter waves in microfabricated magnetic traps, made out of thin wires. The researchers changed the currents in the wires to split slowly the one potential well that was holding the atoms into two.

In a non-interacting gas, this splitting process would probably give a skewed distribution of atoms, and the distribution would be different every time. In this case, the quantum interactions favour a system in which each well contains exactly $N/2$ atoms.

In fact, the evidence suggests that the splitting is accurate to within 50 atoms. I find that truly remarkable from a fundamental point of view. More practically, this dividing of atoms could also be useful in building novel atom interferometers and atomic clocks.