RESEARCH HIGHLIGHTS

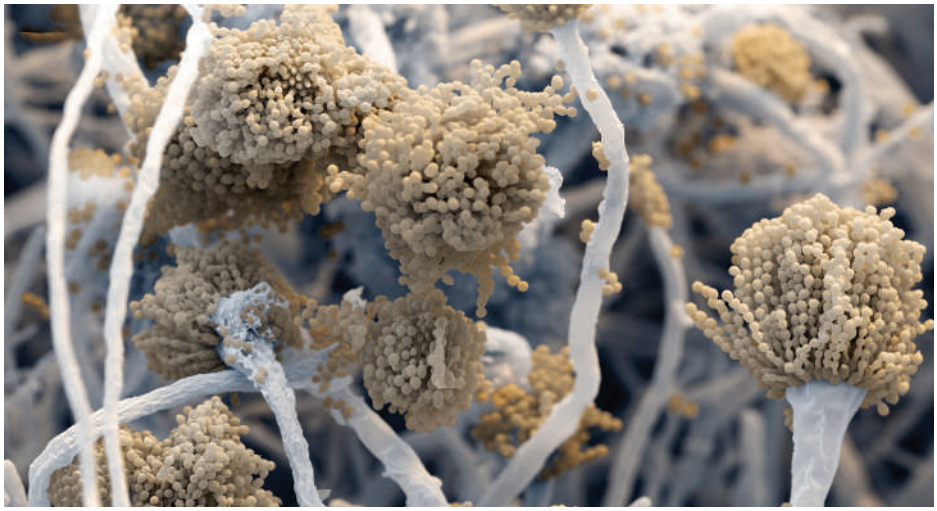
All wrapped up

Cell. Microbiol. doi:10.1111/j.1462-5822.2007.00895.x (2007)

A fungus that causes life-threatening lung infections in people protects itself within a biofilm, researchers at the Pasteur Institute in Paris, France, have found.

Aspergillus fumigatus (pictured) has previously been grown in liquid for study, but Anne Beauvais and her colleagues decided to grow it on a gel exposed to air, to mimic conditions in the lung more closely. They observed that a hydrophobic sheath glued its filaments together.

The existence of this protective film may help to explain why some drugs that have killed the fungus in liquid-based *in vitro* experiments do not always work very well when given to patients.



EYE OF SCIENCE/SPL

CELL BIOLOGY

Torn asunder

J. Cell Biol. doi:10.1083/jcb.200609014 (2007)

A key regulatory protein that sits in animal cell membranes is activated when a neighbouring cell tears a part of it away, new research shows.

The protein, called Notch, is a two-protein complex, part of which is exposed on the cell surface. Removal of the entire extracellular portion frees the intracellular portion of the protein to travel to the nucleus and regulate gene expression.

Gerry Weinmaster and her colleagues at the University of California, Los Angeles, suspect that when a neighbouring cell rips away the exposed part of Notch, it leaves the remaining portion vulnerable to degradation by proteases. Their action could then liberate the inner Notch tail.

STEM CELLS

Personal sperm bank

Dev. Cell **12,** 195–206 (2007)

Mice may have a backup system for producing sperm, report Shosei Yoshida and his co-workers at Kyoto University, Japan. The mechanism may help to ensure that males can make sperm for their entire lives.

The group engineered mice so that undifferentiated sperm cells expressed a fluorescent tag. By observing how the number and location of fluorescent cells changed over time, the group found that mice seem to make sperm from two kinds of cell: 'actual' stem cells, which give rise to sperm-generating cells and renew themselves; and 'potential' stem cells. Potential stem cells normally become sperm without renewing themselves, meaning their fluorescence switches off. When the actual stem cells fail, however, the fluorescence of potential stem cells persists, suggesting that they have become stem cells themselves.

ARCHAEOLOGY

Spicing it up

Science **315,** 986–988 (2007)

Ancient humans domesticated chilli peppers more than 6,100 years ago, according to newly gathered archaeological evidence. In some regions, this means that chilli cultivation even pre-dates pottery.

The chilli is a relatively recent addition to cuisine in most of the world, however. Before Columbus's travels in the fifteenth century, the spicy peppers of the genus *Capsicum* were limited to the Americas.

To trace the chilli's history in the Americas, anthropologist Linda Perry of the Smithsonian National Museum of Natural History in Washington DC and her colleagues analysed starch grains preserved on cookware and stone tools from several archaeological sites. They found some grains identical to those produced by modern domesticated peppers — showing that ancient humans not only cultivated staple crops such as maize and yam, but also farmed for flavour.

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QUANTUM PHYSICS

Not so firm

Nature Physics doi:10.1038/nphys539 (2007)

New doubts about whether physicists have seen evidence for 'supersolid' flow are raised by Philip Anderson of Princeton University, New Jersey.

In a theoretical paper, he suggests that experiments involving a rotating block of helium-4 did not detect supersolidity — a quantum effect whereby atoms in a solid move en masse without viscosity — as claimed, but rather measured the influence of a novel form of vortex liquid.

Vortex liquids occur when whirlpools pepper the quantum wavefunction of a material and are quite well studied in some systems. Anderson suggests that the type of vortex liquid that he predicts might also explain certain puzzling features of high-temperature superconductors.

MATERIALS SCIENCE

Heavyweight lightweight

Adv. Mater. doi:10.1002/adma.200601748 (2007)

Carbon nanotubes can be made into a low-density material known as an 'aerogel', report Arjun Yodh and his colleagues at the University of Pennsylvania in Philadelphia.

Such materials are extremely porous, ultra-light and extra-strong — and a carbon nanotube aerogel is good at conducting electricity to boot.

To make the aerogel, the researchers freeze-dried carbon nanotubes out of a liquid suspension, leaving a network of filaments with a high ratio of surface area to volume. The

properties of this network could be readily manipulated by tweaking the freeze-drying process, or by adding a polymer to reinforce the structure. The resulting material could be useful for making electrodes or in chemical and thermoelectric sensors.

INFECTIOUS DISEASES

HIV's route of entry

Immunity doi:10.1016/j.immuni.2007.01.007 (2007)

Most new HIV infections in women occur as a result of sexual intercourse, so researchers are working to find agents, such as microbicides, that prevent HIV from infecting the body through the vagina.

To pinpoint the virus's targets, Julie McElrath and her colleagues at the Fred Hutchinson Cancer Research Center in Seattle, Washington, performed experiments on live vaginal tissue removed from women during surgical repair procedures and hysterectomies. They show that two types of immune cell in the vagina — $CD4^+$ T cells and Langerhans cells — are vulnerable to attack by HIV, indicating that microbicides and vaccines will have to block the virus from entering both these cell types to be effective.

ORGANIC CHEMISTRY

Better by design

J. Am. Chem. Soc. doi:10.1021/ja067870m (2007)

Most chemists would be happy just to show that they can synthesize some naturally occurring compound, but Kazunori Koide and his colleagues at the University of Pittsburgh, Pennsylvania, have gone one better. Having completed a concise synthesis of FR901464, a compound that shows anticancer activity *in vitro* and in mice, they then prepared a more potent analogue.

Their approach used a reaction known as cross metathesis, which had rarely been exploited near the end of the synthesis of complicated molecules. The gamble worked, but the researchers then found that FR901464 degrades quite quickly. To address this issue, they prepared a version of the compound in which a hydroxy group (OH) was replaced with a methyl group (CH_3).

This analogue was more stable than the original and was 100-fold more active in cancer cell antiproliferation assays.

ECOLOGY

Pest control

Proc. R. Soc. Lond. B doi:10.1098/rspb.2006.0415 (2007)

Devil's gardens in the Amazon are tracts of forest dominated by just one species of tree, *Duroia hirsuta*. Local legend holds that the stands are tended by evil spirits, but Megan Frederickson and her colleagues have previously shown the gardeners to be ants (*Nature* **437,** 495–496; 2005), which dwell in the tree stems and kill other plants.

Now Frederickson and Deborah Gordon, both of Stanford University in California, ask what stops the gardens, which can include as many as 600 trees spread across 1,000 square metres, from growing even bigger. They suggest that the advantage conferred by the ants is offset by the concentration of leaf-eating creatures in the gardens.

By painstakingly photographing the leaves of *D. hirsuta* trees inside and outside the gardens, they estimate that trees inside gardens lose around three times as much leaf area per year as those outside.

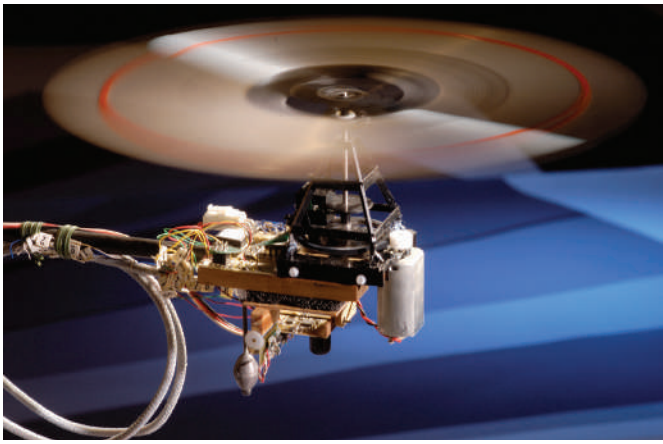
INSECT BEHAVIOUR

Fly by eye

Curr. Biol. doi:10.1016/j.cub.2006.12.032 (2007)

A miniature helicopter that flies using data from just two camera pixels can mimic the way insects pilot themselves in flight, say researchers at the Biorobotics Laboratory of France's Centre National de la Recherche Scientifique in Marseille.

Nicolas Franceschini and his colleagues have designed their helicopter (pictured) to navigate by monitoring the apparent motion of objects on the ground as it flies over them. The idea that insects might rely on such 'optic flow' to control their flight is fairly well accepted, but Franceschini's team has put the concept on a firmer footing. The researchers present a control scheme that can reproduce a range of insect behaviours.



H. RAGUET/ CNRS PHOTOTHÈQUE

In this scheme, when the helicopter changes its ground speed, it keeps the optic flow constant by adjusting its altitude. The simple model can explain why insects descend in a headwind and take a straight path towards the ground to land.

JOURNAL CLUB

Harold Tobin
University of Wisconsin-Madison, USA

A geophysicist wonders how and why faults behave in so many different ways.

I'm involved, with colleagues, in a project of the Integrated Ocean Drilling Program (IODP) to drill deep into the Nankai Trough subduction zone off southwestern Japan — a site of numerous great earthquakes and tsunamis.

Major unknowns in the generation of tsunamis include how far earthquake fault slip can propagate up towards the sea bed and what factors control how that slip stops in accretionary wedges — the submarine mountain ranges created as sediment and rock are scraped off the sinking plate.

My research focus is on faults in such wedges, which are generally thought of as aseismic, or incapable of earthquakes. By drilling into the wedge faults at Nankai Trough, we hope to learn how aseismic faults give way with depth to the seismic faulting associated with tsunamis.

Recently, a new kind of slow-motion earthquake was observed in this wedge (Y. Ito & K. Obara, *Geophys. Res. Lett.* **33,** L02311; 2006). Suddenly, wedges don't seem so aseismic after all.

These 'very-low-frequency' earthquakes, some as large as magnitude 4.4, have previously gone unrecognized because their seismic waves don't show up in the frequency range in which earthquakes are normally detected.

By chance, the quakes were detected exactly where my IODP team plans to start drilling later this year. We hope to install sensors deep in the subsurface to record the earthquakes up close and to measure pore fluid pressure and strain in the rock. We'll also collect samples for laboratory studies of the frictional properties of the rock.

Taken together, the *in situ* and sample data should yield insight into the processes responsible for these slow-motion quakes. This might help us to understand the aseismic–seismic transition.