RESEARCH HIGHLIGHTS

Slow-speed sprinters

J. Roy. Soc. Interface doi:10.1098/rsif.2007.1095 (2007)

Elephants switch from walking to running at surprisingly low speeds, researchers have found.

John Hutchinson of the Royal Veterinary College in London and his colleagues previously provided some of the first evidence that elephants could run, clocking elephants in Thailand hitting top speeds of 25 kilometres per hour (J. R. Hutchinson *et al. Nature* **422,** 493–494; 2003). A follow-up study, in which elephants in UK safari parks were tagged with motion sensors, now reveals that the animals adopt a running gait once they hit 8 kilometres per hour. Above this speed, elephants use their back legs like 'pogo sticks' to drive their bodies forward over their stiffer forelimbs in a vaulting motion.

A. WOLFE/GETTY

COSMOLOGY

Gone without a trace

Nature Phys. doi:10.1038/nphys654 (2007)

'What happened before the Big Bang?' used to be a silly question, as time and space were thought to have begun there. But some theories of quantum gravity suggest that the Big Bang was a transition rather than a beginning, such that scientists might think about — and perhaps even observe — what went before.

Even so, says Martin Bojowald of Pennsylvania State University, limits will still apply to what we can learn. He shows, for a very simple quantum model of the Big Bang, that some of the conditions 'before' leave no discernible imprint on what comes 'after'. In particular, if the pre-Big Bang Universe was a mass of quantum fluctuations, essentially all information about these would have been lost in the Big Bang itself.

BIOCHEMISTRY

Game of tag

J. Am. Chem. Soc. doi:10.1021/ja070003c (2007)

Chemists have created a new fluorescent tag to label proteins and quantitatively monitor their interactions.

The tag belongs to a class of small molecules called biarsenical multi-use affinity probes (MAPs). These probes bind specific amino-acid sequences and are smaller than the fluorescent proteins commonly used as labels, making them less likely to interfere with protein function or localization.

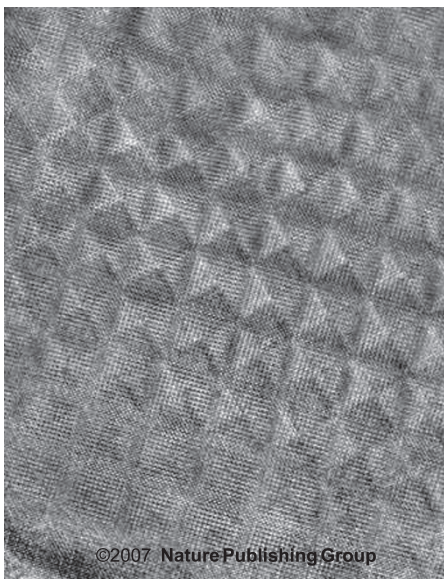
Uljana Mayer and her colleagues at the Pacific Northwest National Laboratory in Richland, Washington, created a MAP that incorporates a red dye named Cy3 and recognizes a different amino-acid sequence to previously available MAPs. The individual probes can be used to simultaneously label different proteins, and interactions between two probes can be used to monitor protein–protein interactions.

MATERIALS SCIENCE

Squared to perfection

Nature Mater. doi:10.1038/nmat1953 (2007)

The geometric pattern shown below is an electron-microscope image of the surface of a crystal of a perovskite mineral. Its repeating structure has "extraordinary perfection", according to Beth Guiton and Peter Davies at the University of Pennsylvania in Philadelphia.



The pattern appears in a perovskite containing lithium and neodymium. The researchers propose that the material phase separates into square lithium-rich regions a few nanometres across, separated by lithium-poor stripes. Bumping up the ratio of lithium to neodymium tunes the pattern's periodicity, increasing the size of the squares.

The team suggests the oxide's surface could serve as a template for the assembly of nanoscale objects such as tubes or wires.

BIOTECHNOLOGY

Film ends badly

Proc. Natl Acad. Sci USA **104,** 11197–11202 (2007)

Bacteria hunkered down inside a biofilm can be targeted by bacteriophages — bacteria-destroying viruses — that have been armed with tools to break through the bacteria's biofilm defences, show Timothy Lu and Jim Collins of Boston University in Massachusetts.

Biofilms can help bacteria to thrive in places they're not wanted, such as in medical devices, by protecting the bacterial cells within a tough matrix of sugars, proteins and other components. These films are hard to remove, or to treat with antibiotics.

Lu and Collins genetically engineered a biofilm-busting enzyme into the genome of phage T7, which targets *Escherichia coli*. The enzyme breaks apart the biofilm matrix, so that the phage can attack the bacteria, hijacking their replication machinery for its own multiplication and then killing the bacterial cells. This offers a strategy for creating armies of phages tailor-made to attack biofilms of different bacterial pathogens.

SCIENCE SOURCE/SPL

MATERIALS SCIENCE

On Earth as it is in heaven

Appl. Phys. Lett. doi:10.1063/1.2752718 (2007)

There's no need to go into space to do microgravity experiments on crystal growth, say researchers. Applying a magnetic field to a sample can have the same effect.

Experiments have been flown on rockets and the International Space Station to study whether reduced gravity makes it easier to grow high-quality protein crystals. Quality is important when determining a protein's structure from its crystal form.

In a gravitational field, a crystal growing in solution creates a convection plume, because the buoyancy of the protein solution changes as the material precipitates out. This may affect the crystal's quality. Elias Vlieg of Radboud University Nijmegen in the Netherlands and his colleagues show that a magnetic-field gradient can suppress this potentially perturbing convection as effectively as microgravity, by acting on a protein's diamagnetism.

MEDICAL RESEARCH

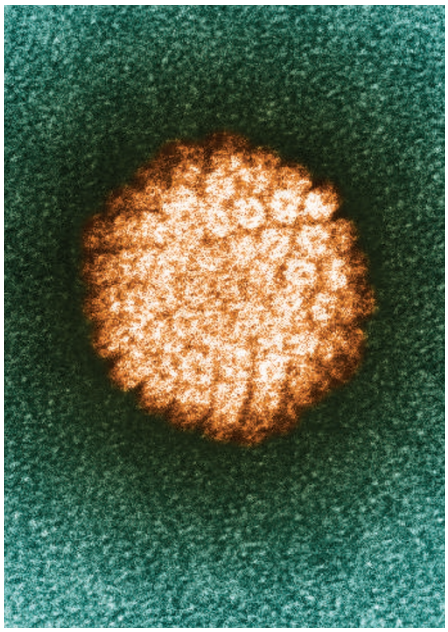
Spermicide aids infection

Nature Med. doi:10.1038/nm1598 (2007)

Ingredients found in spermicides and vaginal lubricants can affect the transmission of genital human papillomavirus (HPV), the sexually transmitted infection to blame for almost all cases of cervical cancer, researchers have found.

John Schiller and his colleagues at the National Cancer Institute in Bethesda, Maryland, studied how HPV infects cells in a mouse model. The team used a pseudovirus (as human HPV is not readily available) tagged with fluorescent markers.

They found that the presence of the



spermicide nonoxynol-9 increased infection rate, possibly because the chemical damages the genital tract's inner layer. In contrast, carrageenan, a molecule found in many lubricants, inhibited infection, suggesting it might be used as a microbicide .

IMMUNOLOGY

Innate immunity to TB

J. Clin. Invest. **117,** 1988–1994 (2007)

A study of almost 200 people who had been exposed to tuberculosis (TB) has revealed a previously unappreciated facet of the immune system's defences against the disease. Researchers led by Adrian Martineau and Robert Wilkinson of Imperial College London found that TB immunity is boosted by high levels of neutrophils, a type of white blood cell.

These cells, which are part of the innate immune system, may be a more significant factor in TB resistance than the adaptive immune system — the target of vaccines such as the BCG.

The study shows that neutrophils produce proteins such as cathelicidin LL-37 and lipocalin 2, that defend against the TB bacterium *Mycobacterium tuberculosis*. Black Africans in the study had lower average neutrophil levels than south Asian or white volunteers — but as LL-37 production can be boosted by vitamin D supplements, this might offer another way to combat the disease.

NEUROSCIENCE

Dazed and confused

Nature Neurosci. doi:10.1038/nn1931 (2007)

Scientists at the University of Maryland, Baltimore, have identified a population of neurons that may contribute to impaired decision-making in drug addicts.

Thomas Stalnaker and his colleagues trained cocaine-addicted rats to associate different odours with either a reward or a punishment. When they reversed the associations, they found that cocaine-addicted animals were slower to adapt than healthy animals.

The researchers then monitored neural activity in a brain region involved in learning and conditioning, known as the basolateral amygdala, from implanted electrodes. This revealed a group of neurons that responded to the cues and that showed altered firing patterns in healthy animals — but not in cocaine-treated mice — when the cues were switched.

Inactivating the basolateral amygdala of addicted rats restored their ability to change their response to the cues.

JOURNAL CLUB

Allan Balmain
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A cancer geneticist delves into family matters.

A mystery lies at the heart of a small family of growth signalling enzymes (K-Ras, H-Ras and N-Ras), which are widely mutated in human cancers. In culture, all three enzymes have similar functions, but different *ras* genes are associated with cancers in different tissues.

My laboratory, for instance, noted more than 25 years ago that skin cancers show activation of H-*ras*. Others have demonstrated that lung, colon and pancreatic cancers show activation of K-*ras*, whereas N-*ras* is the oncogene of choice in melanomas and some leukaemias.

What determines this intriguing specificity? Are the enzymes' functions somehow modified in certain tissues *in vivo*? Or is it regulation of the genes, affecting where and when they are expressed, that matters?

We may get some answers by following the lead of an elegant study (N. Potenza *et al. EMBO Rep.* **6,** 432–437; 2005). In this work, the authors knocked out K-*ras* in mice, but simultaneously replaced the gene with its close relative H-*ras*, doctored to have the regulatory elements of K-*ras*. Mice can survive without the H-*ras* or N-*ras* genes (or even both of them) but usually die if K-*ras* is deleted. These mice, despite lacking K-*ras*, were viable and lived to a ripe old age.

This important observation provides novel opportunities to probe the mechanisms of cancer initiation. Are the mice lacking K-*ras* now resistant to the lung and pancreatic cancers that are normally linked to K-*ras*? If yes, this would indicate a true requirement for the K-Ras protein in lung-cancer development; if not, the focus would switch to regulation.

A straw poll of Ras cognoscenti suggests that opinion is for now divided, but my group and others are working on this mouse model, and hope to have answers soon.

Discuss this paper at **http://blogs.nature.com/nature/journalclub**