RESEARCH HIGHLIGHTS

An allele for endurance

Hum. Genet. doi: 10.1007/s00439-005-0066-0 (2005)

A single gene may help to distinguish which athletes are likely to succeed at different endurance events. The *EPAS1* gene encodes a transcription factor that is activated under low-oxygen conditions.

By comparing 492 elite endurance athletes with a control group, researchers at the University of Sydney, Australia, found that one *EPAS1* allele is more common in athletes such as swimmers and middle-distance runners, who need maximum power for periods of only minutes. Another allele is predominant in those competing in Olympic triathlon and Ironman events, who need sustained performance.

According to Ronald Trent, who led the research, the alleles may differ in how efficiently they 'switch' the body over from using mainly anaerobic metabolism — effective for short, intense energy bursts — to an aerobic energy supply, needed for prolonged periods of exercise.

CANCER

Seek and destroy

Nature Med. doi:10.1038/nm1311 (2005)

Immune cells could one day be used to hunt down and destroy solid tumours such as skin cancers. A team led by Claude Perreault at the University of Montreal, Canada, have adapted a treatment that has already been successful against human leukaemia. They primed T cells from mice with a protein fragment called H7^a, which is found on the surface of all body cells, then injected them into mice suffering from melanoma.

Remarkably, the T cells killed the melanoma cells but did not attack healthy tissue. The team suggest that this is because the abnormal blood vessels inside tumours contain high levels of a protein called Vcam1 that attracts T cells.

PHYSICS

Wave power

Phys. Rev. Lett. **95**, 154501 (2005)

"How do you keep a wave upon the sand?" a nun famously sang in *The Sound of Music*. Xinhua Hu and Che Ting Chan of Hong Kong University of Science and Technology suggest an answer. Their calculations show that shallow-water ocean waves can be focused by an array of regularly spaced pillars on the sea bed. The effect is similar to the manipulation of light waves by arrays of microscopic scatterers in photonic crystals. The pillars act like a refractive medium; if the array has a lens-shaped perimeter, it brings incident waves to a focus. That point, say the researchers, would be an ideal place to put a device that harnesses wave power.

ZOOLOGY

Ancient sex

Proc. Natl Acad. Sci. USA doi:10.1073/pnas.0504031102 (2005)

Placozoans (pictured) are tiny invertebrates with the simplest organization and smallest genomes of any known multicellular animal. This makes them promising model organisms for studying the development of the multicellular state. They are also completely asexual — or are they?

Ana Signorovitch and colleagues from Yale University in New Haven, Connecticut, show, in a selection of genes from ten placozoan isolates, that the overall level of nucleotide variation is similar to the level of variation within any one individual. This is consistent with expectations for a sexual population, but not an obligately asexual one.

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PATHOLOGY

Passing on prions

Science **310**, 324–326 (2005)

Kidney inflammation in prion-infected mice can cause the infectious protein particles to be excreted in their urine — suggesting a mechanism for prion transmission.

The study, by Adriano Aguzzi of the University Hospital of Zurich in Switzerland and colleagues, may explain how prions spread between sheep, causing a disease called scrapie, and give rise to a chronic wasting disease in elk and deer. It also raises concern that urine from humans with variant Creutzfeldt–Jakob disease may contain low concentrations of prions.

CHEMISTRY

Chemical cascade

J. Am. Chem. Soc. doi:10.1021/ja055545d (2005)

Organic synthesis is a slow business if each chemical alteration to a molecule must be followed by a lengthy purification process, so chemists try to design reactions that can happen in a single cascade. A neat example comes from David MacMillan and his colleagues at the California Institute of

Technology in Pasadena.

They show that an imidazolidinone molecule can catalyse two distinct addition reactions — one electrophilic, the other nucleophilic — to build up complex products quickly from simple precursors.

This cascade reaction produces high yields and is also highly stereoselective, so that incoming chemical units preferentially add to just one face of the substrate molecule, rather than producing a random mixture of mirror-image molecules.

CELL BIOLOGY

Breaking tensions

J. Cell Biol. 171, 153–164 (2005)

When epithelial cells become cancerous, they acquire the ability to break down the cell–cell junctions that stick them together, leaving them free to invade other tissues. These junctions are normally maintained by the protein E-cadherin.

Johan de Rooij, now at the Netherlands Cancer Institute in Amsterdam, and his colleagues have investigated a model of this process, in which scattering of cultured canine kidney cells is induced by hepatocyte growth factor (HGF).

They find that HGF does not disrupt E-cadherin function, as had been thought. Instead, the cell–cell junctions are ripped apart by tensions that build up in the cells' internal matrix, the cytoskeleton. The strength of these forces is linked to how tightly the cells adhere to the extracellular matrix, via integrin receptors.

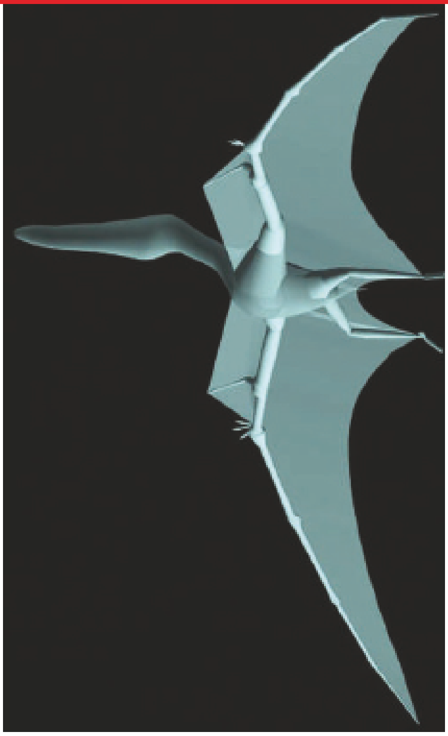
ASTRONOMY

Watch this asteroid

Icarus 178, 281–283 (2005)

Fortunately for us, the asteroid known as 2004 MN4 will pass close enough to Earth to allow some spectacular observations, without hitting the planet. In work that tells astronomers what to watch for, Daniel Scheeres of the University of Michigan in Ann Arbor and his colleagues predict that the asteroid's close pass will dramatically alter the way it tumbles.

Uncertainty about this asteroid's orbit created an Earth-impact scare that made headlines in December last year. But its closest approach, in April 2029, is now expected to leave roughly 30,000 km of space between it and us. This should be near enough for the rotational changes induced by Earth's gravity, simulated by Scheeres *et al.* to be visible using ground-based telescopes.



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BIOMECHANICS

Winging it

Proc. R. Soc. Lond. B doi:10.1098/rspb.2005.3278 (2005)

Pterosaurs (pictured) possessed a unique extra wrist bone called the pteroid. This either pointed forwards and supported a membranous forewing, or, as an opposing theory suggests, was tucked away, alongside the arm. Researchers provide data to inform this long-running debate by testing the two wing shapes in a wind tunnel.

Matthew Wilkinson and colleagues from Cambridge University, UK, made scale models of pterosaur wings with and without a forewing supported by a pteroid bone; more lift was obtained with the forewing. They claim that this settles the argument, and explains how even the largest pterosaurs could take to the air.

SPINTRONICS

Caught on a jewel

Nature Phys. doi:10.1038/nphys141 (2005)

Impurities in diamond may dismay the jeweller, but they excite the information engineer. A defect called a nitrogen-vacancy centre, created by impurities in the diamond, has an electron spin that could be used to encode data, possibly for quantum computing.

David Awschalom and his colleagues at the University of California, Santa Barbara, have developed an instrument that combines magnetic and optical probing to measure the spin of a single nitrogen-vacancy defect. By monitoring this site, they are also able to detect interactions with neighbouring impurities, including 'dark' spins, which are invisible to conventional detection by photoluminescence.

JOURNAL CLUB

Bob Behringer
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A grain of a good idea, introduced by a material scientist.

Imagine a handful of sand. With a bit of force, you can push it around. But what is the nature of the deformations occurring within the sand, and how do they lead to its macroscopic behaviour?

For some time now, I have been fascinated by the behaviour of granular materials. These materials share a common feature with disordered molecular solids, foams and other many-body systems: they exist in jammed states, which deform irreversibly when a finite force is applied.

Craig Maloney and Anaël Lemaître, then both at the University of California, Santa Barbara, published two papers in *Physical Review Letters* addressing how the deformation happens (93, 195501 and 016001; 2004).

Their work uses numerical and physical modelling of the microscopic behaviour of particles from which granular-type materials are made. They consider deformations of granular matter using shear transformation zone theory, an approach that had previously been applied only to molecular solids.

Several testable predictions emerge from their observations, including that plastic (irreversible) changes in the material structure should alternate with elastic (reversible) deformation, and that the elastic constants will show unusual behaviour. These predictions can be put to careful experimental test.

And here is where the idea becomes really appealing. Granular experiments of the type performed by my group (T. S. Majmudar & R. P. Behringer *Nature* 435, 1079–1082; 2005), unlike molecular studies, can directly access the particle dynamics. If this approach proves valid, granular materials may well inform us about processes at the molecular scale.