

# RESEARCH HIGHLIGHTS

## CELL BIOLOGY

### Slug beats puma

*Cell* **123**, 641–653 (2005)

Damage to a cell's DNA activates the tumour suppressor protein p53, which can either initiate DNA repair or trigger cell suicide. A protein called Slug has been found to ensure that p53 acts as a saviour in some tissues by preventing the action of *puma*, a gene that promotes cell death.

After finding this link *in vitro*, researchers led by Thomas Look of the Dana-Farber Cancer Institute in Boston, Massachusetts, showed that mouse mutants unable to make Slug died of bone-marrow failure after exposure to doses of radiation that are not lethal to normal mice. The team suggests that finding a way to boost Slug levels could permit stronger doses of chemo- and radiotherapies to be used without damaging bone marrow.

## MATERIALS

### An aluminium lotus

*J. Am. Chem. Soc.* **127**, 15670–15671 (2005)

A lotus leaf shakes off water because its bumpy, waxy surface makes it super-hydrophobic: water droplets just roll off. Mimicking this effect in synthetic micro- and nanostructured coatings has become commonplace, and could lead to mist-proof windows, self-cleaning surfaces and solid lubricants. But such coverings have tended to be exotic and expensive.

Weimin Liu of the Lanzhou Institute of Chemical Physics in China and his co-workers have recreated the 'lotus effect' cheaply on aluminium and its alloys. They simply spin-coat the metals with a fluorinated hydrocarbon or a hydrophobic polymer and heat them in a vacuum. This produces finely textured surface films that water cannot wet.

## PHYSIOLOGY

### Light clockwork

*Cell Metabol.* **2**, 297–307 (2005)

A study has illuminated some of the pathways through which light resets the body clock and controls the hormonal system.

Researchers headed by Hitoshi Okamura of Kobe University, Japan, investigated how exposure to light influences the activity of the adrenal glands. These organs sit above the kidneys in humans and secrete hormones that are involved in regulating metabolism.

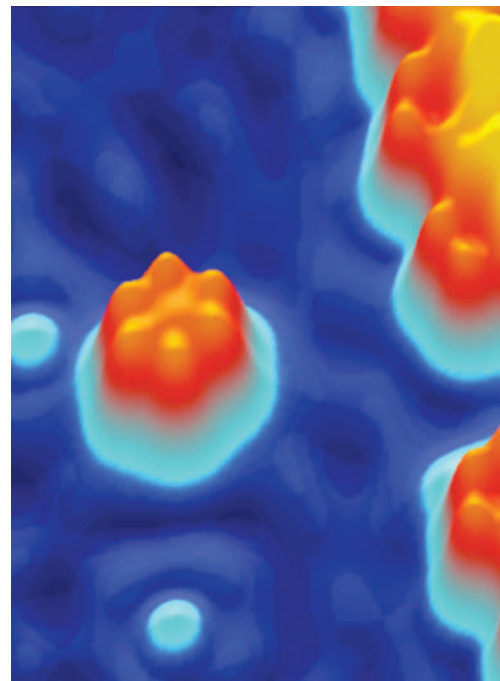
The team's experiments, carried out in mice, reveal that a part of the brain called the suprachiasmatic nucleus directly controls

## Tools of the trade

*Nature Mater.* doi:10.1038/nmat1529 (2005)

Researchers in Europe have designed a dumper truck for nanoscale construction: it's a molecule that can capture, carry and unload up to six atoms at a time.

The molecule consists of a central benzene ring from which six bulky legs protrude (pictured). The legs hold up the ring, creating a cage underneath. Francesca Moresco of the Free University of Berlin, Germany, and her colleagues used the tip of a scanning tunnelling microscope (STM) to drive the molecule over lone atoms on a copper surface. The legs guided the atoms into the central cage where they became trapped until the molecule was lifted from the surface. The team says this approach could be used to assemble nanostructures on insulating surfaces, which are difficult to manipulate using standard STM techniques.



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the activity of the adrenal glands, a process previously thought to be mediated by the brain's pituitary gland. The researchers also found that exposure to light increased expression of the *Per1* gene — believed to be a key player in the circuitry of the biological clock — in the adrenal glands.

## GENOMICS

### Coffee's cousin

*Theor. Appl. Genet.* doi:10.1007/s00122-005-0112-2 (2005)

Two of the world's best-loved crops are more similar than geneticists had previously realized. A new database of

genes from the coffee plant *Coffea canephora* shows that it has an almost perfect gene-for-gene match with the tomato plant *Solanum lycopersicum*.

Of the more than 13,000 genes that make up the coffee genome, almost all have counterparts that perform the same function in tomato, as well as in other solanaceous species, such as potato and aubergine. Researchers led by Steven Tanksley of Cornell University in Ithaca, New York, made the discovery after analysing the genetic sequences expressed in coffee seeds at a range of developmental stages, and comparing them with previously published sequences for other species.

## QUANTUM PHYSICS

### The third man

*Phys. Rev. Lett.* **95**, 200502 (2005)

Encoding information in entangled quantum states — for example, by polarizing individual photons — allows tamper-proof communication between two parties. But this offers more security than some would like. In the cryptography schemes demonstrated by Yu-Ao Chen and his colleagues, a boss wants to retain control over the ability of his two employees to exchange secure information.

The researchers, at the Hefei National Laboratory for Physical Sciences at the Microscale in China, use quantum optics to carry out two different protocols that enable

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this. In both cases, the employees can establish a secret key for decoding encrypted data only with their boss's cooperation. These three-party protocols are made possible by the team's mastery of four-photon entanglement.

#### PALAEOBIOLOGY

### Dung grasses up dinosaurs

*Science* **310**, 1177-1180 (2005)

Grasses have come to dominate habitats across the world since the dinosaurs' rule. Yet, because the earliest unequivocal grass fossils came from some 10 million years after the end of the dinosaurs' era, the two were never thought to have met.

Now we have proof that they did. Researchers led by Caroline Strömberg from the Swedish Museum of Natural History in Stockholm have discovered silica structures characteristic of grass in fossilized dinosaur droppings from 65 million years ago. The dung is suspected to have come from titanosaur sauropods (pictured right). Although grass was not a major part of the dinosaurs' diet, the team suggests it may have been important for early mammals that had teeth similar to today's grazers.

#### CELL BIOLOGY

### In miniature

*Nature Struct. Mol. Biol.* doi:10.1038/nsmb1019 (2005)

The enzyme telomerase plays an important role in cells, stitching short stretches of DNA on to the ends of chromosomes to stabilize them. But study of the telomerase from yeast, a model organism, has been hindered because the enzyme contains a large RNA component that misfolds in the test tube.

Thomas Cech and his colleagues at the University of Colorado in Boulder have now put together a miniature version of the RNA unit, Mini-T, that makes reconstitution of the active enzyme possible. Mini-T functions well in yeast cells, although such cells are less fit than those with the normal enzyme.

This system will allow cell biologists to characterize the yeast telomerase mechanism by adding back bits of the RNA unit, in addition to Mini-T, to see what happens.

#### MICROFLUIDICS

### Air-breathing for energy

*J. Am. Chem. Soc.* doi:10.1021/ja054599k (2005)

US researchers have developed an air-breathing microfluidic fuel cell that could prove cheaper than conventional alternatives, while rivaling their performance.

Microfluidic fuel cells, because they handle small volumes of fluid, can use the principle of laminar flow to separate the fuel and its oxidant, whereas conventional cells must use a physical barrier — a costly membrane — to control the interaction of the two fluids.

But researchers exploring this approach found that the cell's power output was limited by the rate that dissolved oxygen, the oxidant, could diffuse through the cell. Led by Larry Markoski of INI Power Systems in Cary, North Carolina, and Paul Kenis from the University of Illinois at Urbana-Champaign, the team now reports that using an electrode that is permeable to atmospheric oxygen overcomes the problem.

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#### TECTONICS

### Plate spinning

*Geology* **33**, 857-860 (2005)

A novel explanation for the spinning of tectonic plate fragments — seen where one plate sinks beneath another — has emerged from real-time measurements of the motion.

Laura Wallace of the Institute of Geological and Nuclear Science in New Zealand and her colleagues used a global positioning system to characterize the rotation of microplates, with millimetre accuracy, at five subduction zones. These rotations occur in the upper plate, they conclude, when a buoyant mass such as an island or undersea ridge blocks the downward flow of the lower plate. The collision creates the fragments, then the pieces are set spinning by the torque that the lower plate exerts as its unblocked regions continue to subduct. The researchers suggest that this mechanism may also trigger the stretching of the upper plate that sometimes causes it to split — a phenomenon known as backarc rifting.

## JOURNAL CLUB

**Ronald Breaker**

**Yale University, New Haven, Connecticut**

### A biochemist speculates on the battle between proteins and RNA to control the cell.

The 'RNA world' theory about life's origin argues that RNA alone ran the metabolism of the first cells. As a supporter of this theory, I like to think that some of the rare RNA molecules, such as ribozymes, that persist in cells today are direct descendants of ancient RNA organisms.

If so, these molecules have survived billions of years of stiff evolutionary competition from proteins, which dominate the machinery of modern cells. This is testament to the power of RNA.

But I have to confront the reality of evolution. If RNA is so good, why have protein enzymes driven ribozymes, their 'RNA world' counterparts, to the brink of extinction?

RNA molecules are known to have deficiencies: they have limited chemical complexity, for example, and are notorious for spontaneously self-destructing. Also, Watson and Crick taught us that each nucleotide has a complementary partner, which means that ribozymes at high concentrations could experience antisense catastrophes as molecules bind to others with matching sequences.

Researchers at the Whitehead Institute in Cambridge, Massachusetts, recently added another deficiency to the list. They showed that existing ribozymes have a difficult time evolving new activity (E. Curtis & D. Bartel *Nature Struct. Mol. Biol.* **12**, 994-1000; 2005). Proteins, however, can yield new catalysts with only a few mutations. The fitness landscape in which ribozymes evolve seems to be much more jagged.

I still believe that RNA is a functionally powerful polymer, but these new findings lead me to suspect that ancient organisms had a bumpy evolutionary ride until proteins emerged to pave the road ahead.

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