

RESEARCH HIGHLIGHTS

Mercuric swallows*Science* 320, 335 (2008)

High levels of mercury in rivers present a broader threat to ecosystems than previously thought, according to Daniel Cristol and his colleagues at the College of William and Mary in Williamsburg, Virginia. They found that mercury that entered the headwaters of the Shenandoah River in Virginia between 1930 and 1950 has accumulated not only in aquatic animals and the creatures that eat them, but also in birds that exclusively gobble terrestrial insects and spiders.

Blood samples from 12 out of 13 species of terrestrial-feeding birds breeding near the river contained notably higher levels of mercury than samples the team collected from the same species at uncontaminated sites. But whether aquatic insects venturing onto land or historical floods that deposited the pollutant are responsible for its spread remains unclear.



R. PATEL

CONDENSED-MATTER PHYSICS**Unblinking dots***J. Am. Chem. Soc.* 130, 5026–5027 (2008)

Quantum dots are semiconductor nanocrystals that emit light, making them suitable for such things as medical imaging, but their usefulness is undermined by a tendency to blink or even go out when their surface chemistry is disrupted. Encasing quantum dots in a thick alloy shell renders their optical behaviour much more robust, write Jennifer Hollingsworth and her colleagues at Los Alamos National Laboratory in New Mexico.

The team slowly grew many thin layers of cadmium sulphide, zinc sulphide and cadmium zinc sulphide on cadmium selenide quantum dots that were 3–4 nanometres in size until the particles reached 15–20 nanometres across. This altered the colour of the emitted light and increased the fraction of time for which the dots glowed, an improvement that should facilitate new applications in biology and optoelectronics, the researchers say.

PHYSIOLOGY**Feeling the air***Cell* 133, 223–234 (2008)

The process by which mice adapt to low oxygen levels is mediated at least in part by their skin, report Randall Johnson at the University of California, San Diego, and his colleagues.

When they knocked out the ability of mouse skin cells — but no other cells — to make a protein associated with adaptation to hypoxia, the researchers found that an adaptation

mediated by the kidneys was greatly reduced. It seems that, normally, when oxygen levels are low, the protein alters blood flow from the skin to the kidneys and encourages the production of erythropoietin (EPO). This tells the body to build red blood cells — a useful response to low oxygen availability.

The work demonstrates a new drug-based mechanism for stimulating EPO production, as well as an intriguing role for skin as an independent environmental oxygen sensor, the authors say.

NANOTECHNOLOGY**Stencilissimo***Nano Lett.* doi:10.1021/nl080033t (2008)

Engineers at the University of Cambridge, UK, and the Nokia Research Centre in the same city have stenciled two- and three-dimensional patterns onto the surface of a silicon wafer using silicon oxide nanowires as a mask.

Andrea Ferrari and his co-workers first attached the nanowires to the surface of a silicon wafer with nickel leads. They then

etched the wafer chemically, which left extremely thin lines of silicon under the nanowires.

Were the nanowires to be arranged in preset patterns — a task that might be achieved with microfluidic techniques — the etching process would carve nanoscale-circuits into crystalline silicon.

EVOLUTION**Darwinian chips***PLoS Biol.* 6, e85 (2008)

Researchers in California have demonstrated computer-controlled natural selection of an RNA molecule in real time.

Brian Paegel and Gerald Joyce of the Scripps Research Institute in La Jolla took an RNA molecule that can chemically stitch itself to other RNA fragments and reproduce itself as a result. They then loaded this catalyst and some suitable RNA fragments into a chip that can hold minute volumes of liquid, and connected this to a computer. The computer diluted the growing population and resupplied the RNA fragments at ever lower concentrations.

Over time, the system created a selection pressure for more efficient RNA catalysts. After 500 dilutions, the RNA catalyst had accumulated 11 mutations, and performed 90 times faster than the original catalyst.

MICROBIOLOGY**A misunderstood microbe***Science* 320, 382–385 (2008)

The flagellar filaments of *Campylobacter jejuni*, a major cause of bacterial diarrhoea worldwide, are composed of seven protofilaments. The same anatomical



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parts contain 11 protofilaments in all other bacteria studied so far.

Edward Egelman of the University of Virginia in Charlottesville and his colleagues uncovered this break from tradition when they examined the species' flagella filaments using electron cryo-microscopy. They propose that *C. jejuni*'s unusual filament structure arose from a minor change in a region of the protein that is responsible for the helical symmetry of flagella filaments.

MOLECULAR BIOLOGY

Arsenic's action

Nature Cell Biol. doi:10.1038/ncb1717 (2008); *Nature Cell Biol.* doi:10.1038/ncb1716 (2008)

Arsenic trioxide, a poison familiar to readers of Agatha Christie, has been used to treat acute promyelocytic leukaemia since 1992, although how it works has never been fully explained.

Two studies have now pin-pointed RNF4, a member of a family of enzymes called ubiquitin ligases, as the reason why the drug destroys PML-RAR α , a protein produced in patients with this cancer.

It was already known that arsenic trioxide attaches several copies of SUMO, a signalling molecule, to PML-RAR α , and that this addition prompts the destruction of PML-RAR α . Ronald Hay of the University of Dundee, UK, Hugues de Thé of the University of Paris and their respective colleagues have shown that the SUMO chains are recognized by RNF4, which directs PML-RAR α to an organelle called the proteasome, where PML-RAR α is chewed up.

PALAEONTOLOGY

Amphibious origins

Proc. Natl Acad. Sci. USA **105**, 5786–5791 (2008)
Isotopes in the teeth of elephants' extinct relatives are adding weight to the arguments of researchers who think that the Eocene proboscideans from which elephants evolved lived in freshwater.

Alexander Liu at the University of Oxford, UK, and his colleagues measured the oxygen isotopes in enamel taken from the teeth of two late-Eocene genera, *Barytherium* and *Moeritherium*. These genera are closely related 'sister taxa' of modern elephants. The isotopic composition of their teeth matched those of many other aquatic and semi-aquatic mammals, making a case for elephants and sirenians — that is, manatees and dugongs — sharing an amphibious ancestor that lived about 50 million years ago.

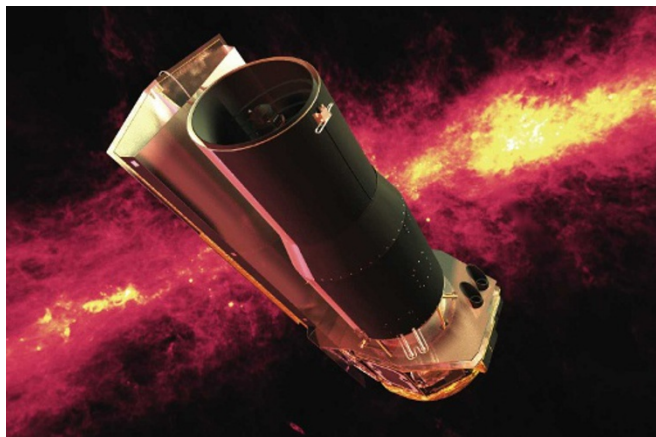
CRYSTALLOGRAPHY

Probing a crystal

Phys. Rev. Lett. **100**, 145502 (2008).

A way to distinguish molecular left- and right-handedness (chirality) has been demonstrated using the SPring-8 synchrotron X-ray source in Harima, Japan.

Yoshikazu Tanaka of the RIKEN SPring-8 Center in Sayo, Japan, and his co-workers have found that the instrument's bright beams of circularly polarized X-rays create disparate diffraction patterns for the two chiral forms of quartz. Normal X-ray diffraction gives identical patterns for both versions. When the angle at which the circularly polarized beam hits the crystals varies between the chiral forms, the intensity at which it is reflected differs. The method can directly ascertain chirality when measuring the rotation of polarized light cannot.



NASA/JPL-CALTECH

ASTRONOMY

Galactic adolescence

Astrophys. J. **677**, 943–956 (2008)

The Spitzer Space Telescope (picture above) has detected about 2,600 ancient galaxies undergoing a growth spurt. These galaxies are about ten billion light years from Earth and hidden from ground-based telescopes by their own silicate dust, which reddened their light in the same way that our atmosphere reddens sunsets.

Arjun Dey of the National Optical Astronomy Observatory in Tucson, Arizona, and his collaborators used the Spitzer to detect the infrared glow of the galaxies, finding a subset of galaxies that formed hundreds or thousands of stars per year and that had fast-expanding black holes at their centres.

The team believes that this rapid growth lasted for 100–200 million years — a mere blip in galaxy evolution — and that these far-off galaxies went on to resemble the massive galaxies close to our own.

JOURNAL CLUB

Vijay Kuchroo
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An immunologist muses about inflammation through cell interactions.

I spend my lab hours trying to understand what prompts T cells — a type of white blood cell — to specialize. Some T cells produce soluble molecules that rattle the immune system into an inflamed state; other cells generate molecules that calm the system back down.

Upon infection, cells such as macrophages — another type of white blood cell — produce soluble molecules called interleukins that direct the fate of the responding T cells. An emerging curiosity in the field is which interleukins make certain T cells become pro-inflammatory, and which cause other T cells to become anti-inflammatory. This decision is crucial for determining whether an immune response induces or suppresses inflammation.

Recently, investigators have turned their attention towards an interleukin known as IL-27. This is produced by activated macrophages and was initially thought to induce IFN γ , a signalling molecule that activates macrophages even more.

But work by Nico Giraldi and his colleagues at Genentech in South San Francisco, and other groups, has recast IL-27 as a molecule that primarily directs T cells to suppress inflammation. In a paper published in March, Giraldi's team confirmed that IL-27 acts in this way because it causes CD4+ and CD8+ T cells to make the anti-inflammatory IL-10, and does not work through an alternative pathway (M. Batten *et al.* *J. Immunol.* **180**, 2752–2756; 2008). Mice with *Listeria* infections or autoimmune tissue inflammation in their brains and spinal cords generated fewer IL-10-producing T cells when they lacked an IL-27 receptor. Whether an analogous interaction occurs in humans is not known, but, if it does occur, this research could become medically useful.

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