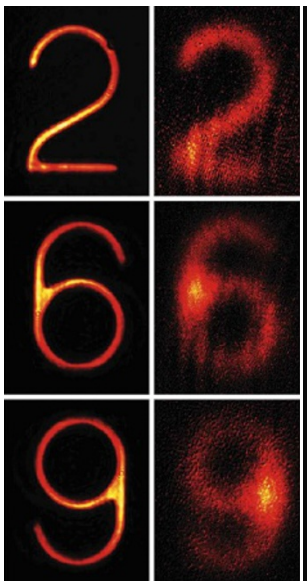
RESEARCH HIGHLIGHTS



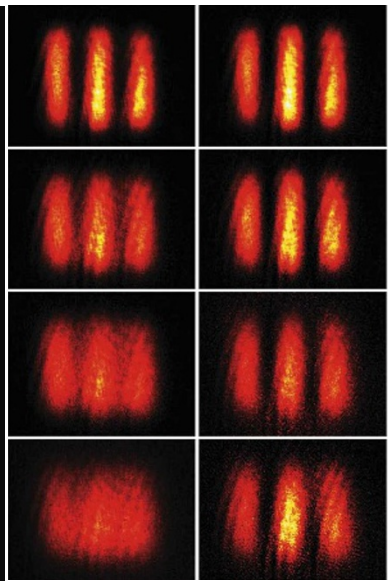
Fuzzy figures

Phys. Rev. Lett. **100,** 223601 (2008)

Capture the complex patterns of photons that make up several numerals in a vapour of rubidium atoms at 52 °C, and those images will degrade as the atoms diffuse (pictured left). But Moshe Shuker of the Technion-Israel Institute of Technology and his colleagues have found a way to store such images and then regenerate the original light beam. The numbers were created by projecting a laser beam through a stencil and exciting the atoms.

Shuker's team stored images comprising sets of three parallel lines for 2, 10, 20 or 30 microseconds (pictured far right and in descending order) using a 'phase shift' technique to counteract the effect of diffusion (shown near right). The technique involves manipulating the phase of the input image, which controls the quantum phases of the atoms. The phases of the atoms that diffuse away from an image's lines are at 180° to one another, and so cancel each other out in the restored image.

Thirty microseconds is a thousand-fold increase over the previous record for delaying an image. The work has potential applications in many fields, including quantum information processing.



M. SHUKER ET AL.

CHEMICAL NANOTECHNOLOGY

Close the gate

J. Am. Chem. Soc. doi:10.1021/ja800266p (2008)

Nanoscale synthetic channels that are opened and closed by a DNA 'switch' have been constructed by a team in China. Such channels could form part of a selective membrane for filtering and purifying water or for mimicking the changeable permeability of biological ion channels.

Yugang Wang of Peking University and his colleagues etched funnel-shaped holes, 5–44 nanometres wide at the narrowest point, into polymer membranes and lined the pores' mouths with single strands of DNA. The DNA in the pore is tightly folded in acidic conditions but unravels into loose chains at pH 8.5. This alters the diameter of the hole and therefore the flux of ions through it.

MOLECULAR BIOLOGY

Sod it

Genes Dev. **22,** 1451–1464 (2008)

Mutations in the *SOD1* gene cause motor neurons to die in amyotrophic lateral sclerosis, also known as Lou Gehrig's disease. Hidenori Ichijo of the University of Tokyo and his co-workers have pinned down why.

The key lies in the system of intracellular membranes called the endoplasmic reticulum (ER). Mutations in *SOD1* seem to affect the system that degrades worn-out pieces of ER, and a surfeit of ER containing misfolded proteins activates a genetic programme that kills the cell.

Ichijo's team found that they could mitigate motor-neuron death and extend the lifespan of *SOD1*-mutant mice by deleting a gene (*ASK1*) that turns on the cell-death programme.

ANIMAL BEHAVIOUR

Token symbolism

PLoS ONE **3,** e2414 (2008)

Apes use and understand symbols but they are not unique in this respect: capuchin monkeys (*Cebus apella*; below) can assign values to tokens that represent different items of food.

Elsa Addessi of the CNR, Italy's national research council, and her colleagues trained five monkeys to associate a particular token — such as a green chip, black plastic tube or a brass hook — with one of three specific types of food. They then gave the monkeys a series of choices, each time between different amounts of two food items or between two types of token.

The value the monkeys assigned to a token was very similar to the value they gave to the food it represented, which suggests that the animals weighed up both real and symbolic options in an equivalent manner.

E. VISALBERGHI

ASTROPHYSICS

Cosmic tiara

Astrophys. J. **680,** 295–311 (2008)

A halo of stars surrounds the Milky Way, but researchers disagree how it got there. One theory proposes that it formed from the same cloud of gas as the galaxy itself; the other says the halo is the remains of several 'dwarf galaxies' that were originally separate from but close to the Milky Way proper. A survey of about three million halo stars weighs heavily in favour of the latter hypothesis.

Eric Bell of the Max Planck Institute for Astronomy in Heidelberg, Germany, and his colleagues compared data from the Sloan Digital Sky Survey with several models. The halo's structure, they say, suggests that it is the remains of several smaller galaxies that were subsumed into the Milky Way after it formed.

ECOLOGY

Dotty diets

Nature Nanotech. doi:10.1038/nnano.2008.110 (2008)

Those who worry about nanotechnology do so partly because of its potential environmental impact. So David Holbrook and a team from the US National Institute of Standards and Technology, in Gaithersburg, Maryland, have tested whether quantum dots (tiny blobs of semiconducting material) accumulate in a simple invertebrate food web.

Over a series of experiments, they put bacteria (*Escherichia coli*), rotifers (*Brachionus calyciflorus*) and ciliates (*Tetrahymena pyriformis*) in flasks with carboxylated and biotinylated quantum dots, which may find a use in computing and solar cells.

The nanomaterials could only stick to clumps of bacterial cells — aggregates too large for ciliates to gobble. However, ciliates took up quantum dots directly from the media, retaining the biotinylated dots for more than twice as long as the carboxylated ones. Rotifers, which eat ciliates, thus consumed quantum dots, but emptied the dots from their guts fast enough to avoid accumulating them.

NEUROSCIENCE

Wide awake

Nature Neurosci. doi:10.1038/nn.2140 (2008)
When it comes to neuronal activity, researchers often assume that what holds for anaesthetized subjects holds for those that are fully awake. This simple inference is misguided, Jason Kerr of the Max Planck Institute for Biological Cybernetics, in Tübingen, Germany, and his colleagues have found.

They recorded how pairs of neurons behave in unmedicated rats and how they behave in the same rats when dosed with ketamine. The neuron pairs that generated the strongest correlations in their discharges before the animals were anaesthetized were not those that were most strongly correlated when the rats were drugged.

This means that care must be exercised when extrapolating measurements of firing patterns across populations of brain cells in the anaesthetized to the wakeful.

MOLECULAR BIOLOGY

Shaping up

Science **320,** 1471–1475 (2008)
How does ubiquitin, a regulatory protein that labels other proteins for destruction, bind to so many different structures? By shuffling between arrangements until it finds the best option, according to Bert de Groot of the Max Planck Institute for Biophysical Chemistry in Göttingen, Germany, and his team.

Forty six of the arrangements were already known from X-ray crystallography of ubiquitin recognition complexes. The researchers followed ubiquitin's structure over pico- to microseconds in various solutions and from many angles, showing that all these conformations are likely to be adopted in living cells.

This work adds to evidence that many confirmations of the same protein often exist in dynamic equilibrium before a binding partner comes along, a model that is at odds with the 'induced fit' hypothesis.

ENVIRONMENTAL MONITORING

Arsenic detectives

Proc. Natl Acad. Sci. USA doi: 10.1073/pnas.0710477105 (2008)
Dissolved arsenic was discovered in the groundwater of the Bengal Basin of Bangladesh and India more than twenty years ago. With deeper wells, safe drinking water might be provided for more than 90% of this region, according to an analysis by Holly Michael and Clifford Voss of the US Geological Survey (USGS) in Reston, Virginia.

The release of arsenic into the basin's groundwater is mainly caused by reduction of iron oxyhydroxides, which tends to take place near the surface. Most wells in the area pump from the contaminated zone, even though the polluted groundwater rarely reaches deeper than 100 metres.

J. HOLMES/PANOS

The USGS model of groundwater flows in the basin suggests that water taken from depths of 150 metres or more will not, in most areas, be tainted by arsenic for a millennium.

MOLECULAR BIOLOGY

Cancer's instigators

Cell **133,** 994–1005 (2008)
Some primary tumours stimulate the spread of cancer by releasing a protein called osteopontin, studies in mice suggest.

Robert Weinberg of the Whitehead Institute for Biomedical Research in Cambridge, Massachusetts, and his colleagues implanted tissue from vigorously growing human breast tumours into mice. They then injected tumour cells that normally grow slowly. The fast-growing tumours spurred the enlargement of the 'responder' tumours via osteopontin, which has been previously linked to poor prognosis in several human cancers. Blocking osteopontin's action may yield useful cancer treatments.

JOURNAL CLUB

John P. Quinn
Queen's University, Belfast, Northern Ireland

A microbiologist learns that all marine creatures must suffer for the greed of a few.

Phosphate is an essential nutrient for all forms of life. Demand for it tends to outstrip supply to such an extent that it limits the overall productivity of many ecosystems, including vast tracts of the seas. I study the curious strategies by which creatures obtain sufficient phosphate for life as they know it.

Some microorganisms, for instance, keep a phosphate store for when times are hard. They scavenge for the nutrient in their surroundings with high-affinity uptake systems and then produce polyphosphate, an insoluble polymer that packs hundreds of phosphate subunits into a single strand. Strands of polyphosphate then form intracellular granules that can be broken down by cellular enzymes when they are needed.

This kind of 'luxury' uptake was recently the focus of a study by Ellery Ingall of the Georgia Institute of Technology in Atlanta and his colleagues. Diatoms — unicellular, silica-walled algae — accumulate phosphate during summer blooms to levels far beyond their immediate needs. Indeed, polyphosphate produced by plankton accounted for 7–11% of the total phosphate in the surface waters of Effingham Inlet, a fjord on Vancouver Island, Canada (J. Diaz *et al. Science* **320,** 652–655; 2008).

This self-indulgent behaviour seems to have far-reaching consequences. Decaying plankton eventually sink to the ocean floor, where they spill unused polyphosphate onto the sediment surface. Notably, Ingall and his team found that soluble phosphate was not released at this point. Instead, polyphosphate molecules seeded the precipitation of minerals called apatites, a process that took only a few years. So diatom greed may ultimately lower the ceiling on marine productivity by locking away the oceans' most hard-to-come-by nutrient. That is important as well as curious.

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