RESEARCH HIGHLIGHTS

Firefly humbled

RUNK/SCHOENBERGER/ALAMY

Nature Photonics doi:10.1038/nphoton.2007.251 (2007)

The most bioluminescently efficient organism, the firefly, is less than half as efficient as previously thought, according to work by researchers in Japan.

Studies almost five decades old that are still authoritatively quoted say that firefly luminescence, produced by the oxidation of luciferin, occurs with an 88% efficiency — that is, the oxidation event produces a photon about 88% of the time. Yoriko Ando at the University of Tokyo and colleagues show that the efficiency in the firefly *Photinus pyralis* is only about 41%.

The team has also examined why firefly luminescence changes between red and yellow-green at a pH of around 6.5. In contrast to conventional theories, that two alternative light emitters exist corresponding to yellow-green and red colours and are converted depending on the pH equilibrium, Ando's team found that the intensity of red luminescence is more or less constant, whereas green is greatly pH-dependent. At higher pH, the green begins to drown out the red light, producing the yellow-green appearance.

ANIMAL BEHAVIOUR

An elephant never forgets

Biol. Lett. doi:10.1098/rsbl.2007.0529 (2007)

Among the mobile elephant societies of Amboseli National Park in Kenya, the ability to keep track of kin may well be adaptive.

Richard Byrne of the University of St Andrews in Fife, UK, and his team tested whether African elephants (*Loxodonta africana*) could remember where specific individuals were. They did this by falsifying the presence of these individuals at unexpected locations using olfactory cues. The team gathered earth containing urine deposits and moved it to both likely and unlikely locations. In general, elephants reached for and sniffed urine more often and for longer if it was from elephants that were walking behind them or kin from far away, behaviour that the team interpreted as indications of surprise that the individual was in an unexpected place.

The differences between interest in urine in expected and unexpected locations were subtle, but the team guesses that each elephant keeps track of the locations of all the members of its group. Such groups can number as many as 30.

MATERIALS SCIENCE

Singled out

Phys. Rev. Lett. **99,** 227401 (2007)

By working in just one dimension, researchers have observed excitons — made up of an electron bound to a 'hole', which describes the absence of an electron — in a metallic system. Excitons are hugely important in semiconductor materials such as light-emitting devices and solar cells, but have never been observed in bulk metals because the charges of free electrons in the metal interfere with exciton formation.

Alex Zettl at the University of California, Berkeley, and his co-workers chose to hunt for excitons in metallic single-walled nanotubes, which are one-dimensional. The work confirms previous predictions that interference by free electrons would be reduced in one-dimensional conductors.

MEDICINE

Mirror mouse

J. Clin. Invest. doi:10.1172/JCI33284 (2007)

A genetic connection has been revealed between heterotaxy, in which the internal organs are positioned in a partial mirror image of their usual arrangement, and primary ciliary dyskinesia (PCD), in which cilia — tiny filamentous projections that extend from certain cell types — function poorly or not at all. Patients with heterotaxy often have heart defects, whereas those with PCD tend to have difficulty ridding their lungs of mucus and in males infertility is common, owing to immobile sperm.

Cecilia Lo, at the National Heart, Lung, and Blood Institute in Bethesda, Maryland, and her colleagues found a mutant mouse with a wrongly structured heart and a recessive mutation in a gene called *Dnahc5*. Patients with mutations in *DNAH5*, the human version of this gene, often have PCD. The researchers showed that 40% of mouse mutants with one copy of the recessive gene also exhibit heterotaxy. They conclude from breeding experiments that *Dnahc5* can cause both conditions, and suggest that many patients with heterotaxy may have undiagnosed PCD, and vice versa.

NANOTECHNOLOGY

Bitty barcodes

F. STÖBER/IMAGEBROKER/FLPA

Nano Lett. 10.1021/nl072606s (2007)

Chemists have created nanowires that encode information in two ways. These could be used to detect disease or, after spraying them onto products or people, as tags for inventory management or espionage.

The nanowires act similarly to a barcode through the variable arrangement of pairs of gold disks spaced along each wire. The disks' paired arrangement, which includes a tiny space between them, amplifies a spectroscopic signal and allows it to be read. Chad Mirkin and his colleagues at Northwestern University in Evanston, Illinois, also added dyes that broadcast a unique spectrum when read by an instrument up to a third of a metre away.

To demonstrate the wires' use as biological detectors, the researchers fused single strands of DNA to the disks that, in solution, seek and bind their complementary target sequence. This could be used to test for diseases such as anthrax.

GENETICS

The long and the short of it

Genes Dev. doi:10.1101/gad.1595107 (2007)

Short interfering RNAs (siRNAs) silence gene expression, regulating various cellular processes. Different types of naturally occurring siRNA exist, but the hallmark of these sequences is their short length of 20–31 nucleotides. Researchers now report that the model plant *Arabidopsis* also expresses long siRNAs (lsiRNAs) of 30–40 nucleotides.

Hailing Jin, from the University of California, Riverside, and her colleagues find that lsiRNAs share many features with other plant siRNAs, but differ in two aspects. Creation of lsiRNAs requires a unique set of proteins, and one lsiRNA seems to mediate the degradation of its target mRNA sequences by a mechanism that is unusual for plants. The lsiRNAs identified by the team are mainly induced in response to bacterial infection and under certain growth conditions.

ASTRONOMY

Galactic dust-busting

Astronom. J. **134,** 2385–2397 (2007)

Inside galaxies, stray dust blocks starlight and creates difficulties for astronomers. Most observations require a correction to compensate, but there have been relatively few measurements of dust in galaxies far from Earth.

Now Benne Holwerda of the Space Telescope Science Institute in Baltimore, Maryland, and his colleagues have used pairs of galaxies to gain a better understanding of far-away dust. Using the Sloan Digital Sky Survey, an archive of almost a quarter of the sky, the team selected 83 cases in which one galaxy was partially obscured by another (pictured, below). By comparing the exposed and obscured parts of the background galaxy, the team measured exactly how much light was absorbed by dust in the foreground galaxy.

The team looked at galaxies as far away as 2 billion light years, and is now working on extending the survey to even greater distances. The findings will aid a wide range of astronomical observations.

NASA/STSCI

CHEMISTRY

Special delivery

Nature Chem. Biol. doi:10.1038/nchembio.2007.56 (2007)

Salinosporamide A is a chlorinated natural product from a marine bacterium that is being tested in clinical trials for its cancer-beating properties. Bradley Moore, at the University of California, San Diego, and his colleagues have discovered an enzyme, SalL, that delivers chloride to a precursor of salinosporamide A by a unique enzymatic pathway.

Chlorine normally works its way into natural products by an oxidative mechanism. But in this case the researchers have identified a nucleophilic substitution that involves the breaking of a carbon–sulphur bond and the formation a carbon–chlorine bond. A biological methylating agent is highjacked by SalL to do this. Subsequent reactions of metabolite intermediates form salinosporamide A. The authors suggest that this enzyme opens up fresh possibilities for engineering metabolic pathways to create new chlorinated products.

NEUROBIOLOGY

Uncomfortably numb

Neuron **56,** 880–892 (2007)

During stressful situations, it pays to be able to cut out distractions. Now, researchers have found the mechanism that enables the stress hormone noradrenaline to block pain.

Pankaj Sah and his colleagues at the University of Queensland in Australia have found that in rats, noradrenaline prevents communication between a pain-sensing region of the brain called the parabrachial nucleus, and a portion of the central amygdala, a region that links emotion with sensory experience.

Axons from the parabrachial nucleus extend into the central amygdala. The researchers showed that noradrenaline acts on receptors in the parabrachial nucleus, leading to a reduction in the number of sites at which neurotransmitter is released into the central amygdala.

JOURNAL CLUB

Paul Mulvaney
University of Melbourne, Australia

A nanoscientist says block co-polymers may unblock nanotechnology.

One of the great drivers of the nanotechnology revolution has been the dream of molecular assembly. Essentially, this means using molecular or chemical forces to self-assemble smart or functional structures that could be integrated into electronic or optical devices.

Thomas Russell and his colleagues have recently provided a superb example of the way the field may be heading (B. Kim *et al. Small* **3,** 1869–1872; 2007).They took a diblock polymer — one that self-assembles into micelles — known as poly(styrene-b-4-vinylpyridine) and forced it to form microdomains by tuning the micelle structure through solvent exchange. This led to hexagonally ordered templates with periods of about 45 nanometres.

They then transferred these polymer templates by reactive ion etching to aluminium surfaces and fabricated regular pores by anodic oxidation at 4° C. The resulting hexagonal, close-packed pores are just 12 nanometres across, with nearest-neighbour spacings that should be tunable over a range of about 10–50 nanometres. The ordering extends over an area several micrometres square.

Particularly elegant is the seamless combination of colloid chemistry with more conventional 'top-down' processing. These wet chemical methods should be cheaper and more scalable than more conventional cleanroom-based techniques. What is particularly exciting about this approach is that the diblock structure can be readily tuned to provide a range of surface topologies and so a wide variety of potential templates. These could drastically simplify the fabrication of periodic, sub-wavelength structures for plasmonics-based applications such as optical circuitry.

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