RESEARCH HIGHLIGHTS

Best-laid plans

Proc. R. Soc. B doi:10.1098/rspb.2006.3676 (2006)
When your offspring take as long as 17 years to mature, choosing where to lay your eggs is crucial. Louie Yang of the University of California, Davis, studied how cicadas pick their spot.

Cicadas lay their eggs in incisions in tree branches (pictured); the nymphs, once hatched, live underground. To find out what attracts the insects to certain trees, Yang planted 32 red oak saplings in a forest in Virginia. Each tree received different levels of natural light, and was fed with different amounts of nutrients.

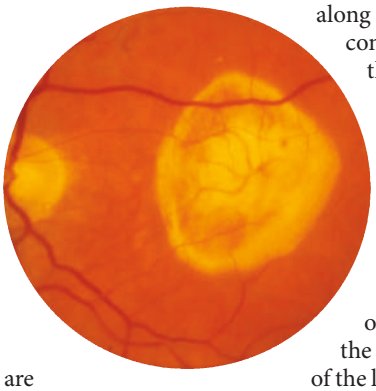
Yang observed that insects from the 2004 brood of periodical cicadas chose their trees by light levels, rather than nutrient availability. He speculates that this is because sunlit sites have richer underground environments, dense with roots on which the nymphs can feed.

ROYAL SOC.

GENETICS

Retinas at risk

Nature Genet. **38,** 1049–1054; 1055–1059 (2006)
Susceptibility to age-related macular degeneration, the most common cause of blindness in the elderly, may be boosted by a number of different changes in one of the genes implicated, report two research groups. The results could be used to screen for those who are at risk.



Earlier studies had linked the chance of developing this disease of the retina (pictured right) to one protein-altering change in an immune-system gene called complement factor H.

Gonçalo Abecasis and Anand Swaroop at the University of Michigan, Ann Arbor, and their colleagues found a further 20 single-letter changes in this gene that are associated with disease risk, but lie outside protein-coding regions. The second team, led by Mark Daly and Johanna Seddon of Harvard Medical School, Boston, confirmed one of these variants in a different sample of people, and also found links between two other genes and the disease.

CHEMISTRY

X marks the spot

J. Am. Chem. Soc. doi:10.1021/ja061112e (2006)
Cross-shaped fluorescent molecules could be turned into powerful sensors for metal ions that play important roles in the cell, such as calcium and magnesium.

Uwe Bunz and his co-workers at the Georgia Institute of Technology, Atlanta, designed the molecules to undergo a dramatic colour change on binding to a metal ion. The trick lies in the layout of the molecule's orbitals, between which electrons flit when the molecule fluoresces.

The cruciform shape allows the two important orbitals to be arranged along separate axes. In a conventional fluorophore, the binding of a metal ion can affect both the relevant orbitals; in this criss-cross arrangement it affects only one. This exaggerates the change in the energy gap between the two orbitals, meaning that the shift in the colour of the light emitted is more pronounced than in a conventional fluorophore.

MOLECULAR BIOLOGY

Pumping ions

J. Mol. Biol. doi:10.1016/j.jmb.2006.07.006; doi:10.1016/j.jmb.2006.07.081 (2006)
Scientists think they may have identified a novel mechanism in a protein that regulates the flow of ions across cell membranes.

The 'chloride pump' CLC-ec1, a membrane protein that helps to control cellular pH, normally exchanges two chloride ions for one proton. However, it can be 'uncoupled' in such a way that chloride alone flows through.

In two back-to-back papers, Christopher Miller from Brandeis University in Waltham, Massachusetts, and Raimund Dutzler from the University of Zürich, Switzerland, and their colleagues report crystal structures of mutant proteins that are permanently uncoupled.

These findings suggest that protein movement requires chloride to occupy the same active site on the pump that protons use. This is surprising because other exchange transporters studied so far have mutually exclusive binding sites for their ions.

P. PARKER/SPL

CELL BIOLOGY

Muscle building made easy

J. Cell. Biol. **174,** 677–687 (2006)
Researchers at the University of Virginia in Charlottesville have found that microRNAs can promote the differentiation of some kinds of stem cell into specific cell types.

miRNAs are snippets of RNA that suppress the expression of certain genes by interacting with messenger RNA (mRNA). Anindya Dutta and his group looked at how genes were switched on and off when certain miRNAs were put into muscle stem cells, or myoblasts. They showed that gene regulation by miRNAs encouraged the stem cells to lengthen and stop dividing, as happens when the cells differentiate.

Dutta's team also found hints that some of the miRNAs function by cutting up the target mRNA. Most miRNAS in animals are thought to work by attaching to mRNA and blocking its translation, while leaving the mRNA intact.

GENE THERAPY

T cells target cancer

Science doi:10.1126/science.1129003 (2006)

In the first successful use of gene therapy to treat cancer, scientists have modified the T cells of cancer patients to recognize melanomas. The result: in 2 of 17 cases, tumours shrank and the patients remained disease-free for more than a year.

T cells recognize their targets via specific receptors. Steven Rosenberg and his colleagues at the National Cancer Institute in Bethesda, Maryland, cloned two T-cell receptors that recognize melanoma tumours. They then extracted T cells from melanoma patients, inserted the gene that would cause them to express the melanoma-targeted receptor, and put the engineered cells back into the patients.

The researchers also cloned two receptors that, *in vitro*, recognize other tumour types, opening the door for future clinical studies.

CHEMISTRY

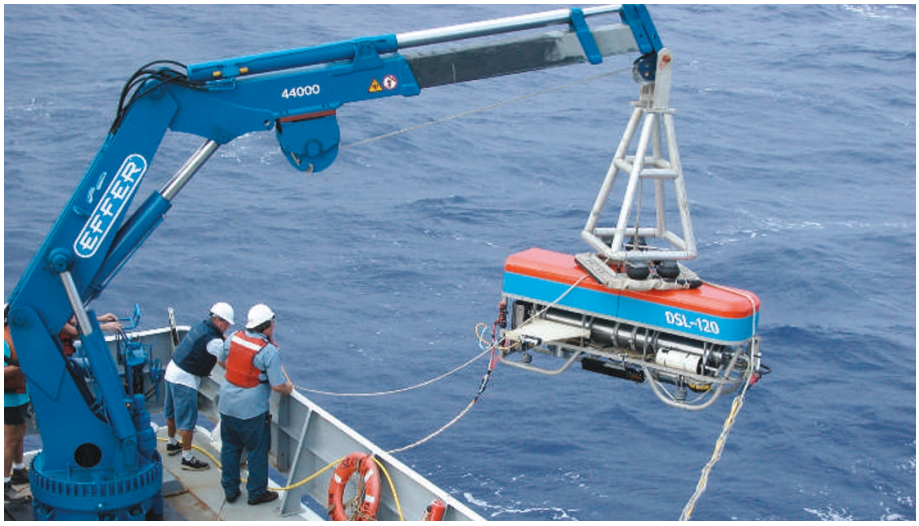
Sweet trick

Science **313,** 1291–1294 (2006)

Some enzymes that attach sugars to molecules during chemical synthesis have been found to have another sweet trick — they can remove sugars too.

Jon Thorson from the University of Wisconsin–Madison and his colleagues show that certain glycosyltransferase enzymes can catalyse reversible reactions in both directions. These reactions can be driven to add, remove or exchange sugar structures as desired.

This surprising discovery reveals glycosyltransferase catalysis to be a versatile tool for the synthetic chemist. To illustrate the point, the researchers report the efficient synthesis of more than 70 variants of the anticancer compound calicheamicin, each of which has slightly different sugar groups attached.



W. SAGER/TAMU

MATERIALS SCIENCE

Locked up in chains

Nature Mater. doi:10.1038/nmat1726 (2006)

The origin of the bright light produced by blue and green light-emitting diodes is something of a mystery: the nitride semiconductors used to make the diodes contain relatively large numbers of crystal defects, and experience with similar alloys suggests that this should hamper their light-emitting potential.

Now a study suggests that the answer lies with chains and tetrahedra of indium and nitrogen atoms that form in the alloys fortuitously. Shigefusa Chichibu of the University of Tsukuba, Japan, and colleagues show that charge carriers in the alloy, which generate the light emission, are trapped by these chains and thus prevented from interacting with the crystal defects.

GEOPHYSICS

Not-so-quiet zone

Geology **34,** 789–792 (2006)

A putative 'quiet' period in Earth's magnetic history may not have been that quiet after all.

Previous studies suggested that the world's oldest ocean crust was marked by few of the magnetic-field reversals that pepper modern oceanic crust.

But researchers led by Maurice Tivey of the Woods Hole Oceanographic Institution in Massachusetts argue otherwise. They combined measurements from deep boreholes in the Pacific's crust with those obtained by towing a magnetometer (pictured above) close to the ocean floor.

The researchers say they have found evidence for reversals in the polarity of Earth's magnetic field as far back as 170 million years ago, during the Jurassic period. That period seemed quiet, they say, because the polarity changes were of low amplitude and occurred rapidly, making them difficult to detect.

JOURNAL CLUB

Thomas A. Moore
French Atomic Energy Commission, Saclay, France, and Arizona State University, USA

A biochemist seeks to better plants' photosynthetic powers.

Photosynthesis uses sunlight to oxidize water, then recycles the electrons removed in this process to reduce carbon dioxide to energy-rich carbon compounds. If this process could be driven at a rate that matched humans' fuel consumption, we would have a sustainable energy loop. Photosynthesis in plants is not very power efficient; our hope is that artificial photosynthesis might lend a hand.

To do so, light must be used to produce both powerful oxidizing and reducing species. Photoexcited dyes can perform the trick, provided their oxidation and reduction energy can be captured and directed to do chemical work.

Electron injection into the conduction band — a high-energy level — of titanium dioxide semiconductor electrodes captures the reducing potential of the excited dye. Unfortunately, things have not been so positive on the oxidizing side — we lack a means to couple the oxidizing potential of a photoexcited dye to water oxidation.

One hope, by analogy with the reducing side, is that the oxidation potential of a photoexcited dye can be captured (through a process known as hole injection) in the lower-energy level of a semiconductor, called the valence band.

Magnus Borgström of Uppsala University, Sweden, and his team recently did this, reporting dye-sensitized hole injection in a porous nickel oxide electrode (M. Borgström *et al. J. Phys. Chem. B* **109,** 22928–22934; 2005).

Although their work was geared towards the development of solar cells, I believe that demonstrating the generation of oxidation potential in an electrode holds promise for artificial photosynthesis. The challenge remains to couple the electrode to water oxidation.