RESEARCH HIGHLIGHTS

Male eggs laid last

Proc. Natl Acad. Sci. USA **103,** 14406–14411 (2006)

House finches (*Carpodacus mexicanus*, pictured) have a smart strategy to spare their chicks from parasites. Females whose nests are infested with mites lay female-bearing eggs first and male ones last. Male chicks then grow faster than the females.

The strategy helps to ensure that reproductive output is damaged as little as possible by the infestation, say researchers led by Alexander Badyaev of the University of Arizona in Tucson. Male chicks are more vulnerable to being killed by mites, so laying them last and giving them more of a growth spurt minimizes their time in the nest while allowing them to grow to full fledging size in a shorter time.

A. BADYAEV

CANCER BIOLOGY

Breaking and entering

Genes Dev. doi:10.1101/gad.1451806 (2006)

To spread, or metastasize, around the body, cancer cells must escape from their site of origin. Doing so requires crossing the basement membrane, a specialized barrier of connective tissue.

Stephen Weiss and his colleagues at the University of Michigan, Ann Arbor, have identified three enzymes that allow tumours to degrade proteins in the basement membrane, opening a hole through which cancer cells can escape. Expression of any one of the three enzymes is enough to chew through the barrier.

Once the hole is there, tumour cells squeeze through, amoeba-style. Knowing the enzymes that puncture the basement membrane could enable future cancer therapies to target this process.

PHYSICS

Silicon success story

Phys. Rev. Lett. **97,** 116101 (2006)

Researchers at Vanderbilt University in Nashville, Tennessee, have unpicked one of the reasons why silicon has been so successful in electronics.

When silicon is heated to temperatures above 800 °C, its surface layer becomes oxidized, turning into silicon dioxide. The interface between the silicon and the insulating oxide layer is exceptionally smooth, which is essential to making high-performance electrical devices.

Leonidas Tsetseris and Sokrates Pantelides modelled the oxidation process. They found that the random deposition of oxygen, which might be expected to give a rough interface, is counteracted by relaxation processes (such as diffusion of the oxygen) activated by the high temperatures.

ENVIRONMENTAL SCIENCE

Storm surge

Science doi:10.1126/science.1129116 (2006)

Hurricanes seem to be the main factor in replenishing inorganic sediments along the US Gulf Coast. This finding will have to be taken into account in plans to restore the region's wetlands by diverting rivers into the marshes — an effort meant, in part, to increase sedimentation rates.

The results come from a team led by R. Eugene Turner, of Louisiana State University in Baton Rouge, which walked, boated and helicoptered along the ravaged shoreline after Hurricanes Katrina and Rita hit Louisiana and Texas last autumn. Mud samples revealed the huge amounts of inorganic sediments left by the storms — 227 times the amount introduced by one river diversion built for wetland restoration.

The health of marshes depends on many factors, however, and river diversions may bring other benefits.

SCIENCE

IMMUNOLOGY

To the root of the problem

Cell **126,** 1121–1133 (2006)

A molecule called RORγt helps to promote inflammation and might be targeted by new drugs to fight autoimmune diseases such as multiple sclerosis and rheumatoid arthritis.

A certain population of immune cells, called Th17 cells, is known to promote inflammation and be a key driver of autoimmune disease. RORγt directs the development of these cells, say Daniel Cua at Schering–Plough BioPharma in Palo Alto, California, Dan Littman at the Skirball Institute of Biomolecular Medicine in New York and their colleagues. They found that mice lacking RORγt are resistant to autoimmune disease and have fewer Th17 cells.

RORγt triggers the production of inflammation-provoking cytokines and may normally help to control the numerous bugs in the gut.

NEUROSCIENCE

Insight into Alzheimer's

Science 10.1126/science.1132341 (2006); *Science* **313,** 1781–1784 (2006)

Two studies give new insight into the biology of β-amyloid, the protein that forms clumps in the brains of Alzheimer's patients.

One team studied an enzyme called β-secretase, which is targeted by current drug therapies. It is needed for β-amyloid to form, but its normal function was unknown.

The team found that it is essential for the formation of myelin, a fatty insulating substance, around peripheral nerves.

In a separate study, researchers suggest that there might be different 'strains' of β-amyloid with different biological properties. They injected diseased brain extracts into unaffected mouse brains, causing β-amyloid clumps to form. The pathology that develops depends on both the source of the agent and the host into which it is injected.

GEOSCIENCE

Modelling Earth's interior

Geophys. Res. Lett. **33,** L18301 (2006)

Satellites have been used to probe the electrical conductivity of Earth's interior. Researchers analysed data from three geomagnetism satellites to model how Earth's conductivity varies with depth — information that can help constrain the properties of the mantle.

The model resembles those created using data gathered by ground-based observatories, report Alexei Kuvshinov and Nils Olsen of the Danish National Space Center in Copenhagen. Their result is less noisy than previous models based on satellite data because they used data collected over a longer time period, totalling five years.

The same could be done for other planets, the researchers point out, providing a new tool for planetary exploration.

CHEMISTRY

Speed search

Chem. Comm. doi:10.1039/b609138e (2006)

Chemists have borrowed the idea of 'cultural evolution' to speed up the algorithms that determine crystal structures from X-ray diffraction patterns.

Current evolutionary algorithms start with trial crystal structures, then randomly mutate properties such as the position of the atoms. The structures that best match the X-ray patterns are then mutated and 'mated' to optimize the fit with the data. Such algorithms therefore follow the principles of genetic evolution.

Cultural evolution introduces the idea that past behaviour constricts that of future generations, a phenomenon seen in fashion. Maryjane Tremayne and Samantha Chong from the University of Birmingham, UK, applied this concept to crystal-structure searches. They showed that restricting the limits between which the crystal parameters vary after each trial generation doubles the speed with which the genetic algorithm reaches its solution.

MATERIALS SCIENCE

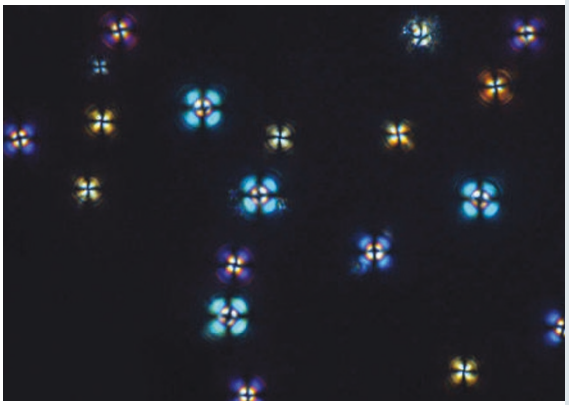
Liquid-crystal sensors

Nano Lett. doi:10.1021/nl061604p (2006)

Liquid-crystal droplets wrapped in polymers could provide a tool to track changes in biological systems, researchers suggest.

Nick Abbott of the University of Wisconsin, Madison, Frank Caruso of the University of Melbourne, Australia, and their colleagues showed that the polymer coat slows the liquid crystals' response to a chemical that changes the orientation of its molecules, suggesting that the coats can be used to influence such interactions. The orientation change is easily tracked because it alters how the droplets look under polarized light (pictured below).

Abbott and Caruso suggest that the interaction of biological molecules with the droplets' coating, which could be engineered to contain enzyme substrates, may also change the structure of the liquid-crystal core, turning the droplets into sensors.



AM. CHEM. SOC.

BIOTECHNOLOGY

Switch for yeast's cell cycle

Angew. Chem. Int. Edn **45,** 6322–6325 (2006)

A light-controlled switch that operates on the cell cycle of budding yeast, *Saccharomyces cerevisiae*, will pave the way for novel experiments, report researchers from the University of Chicago, Illinois.

Conventionally, researchers synchronize *S. cerevisiae* for cell-cycle studies by adding the pheromone α-factor, which stalls the yeast cell on the brink of the division process. To restart the cycle, they wash the pheromone away.

Stephen Kron and his colleagues redesigned α-factor to eliminate the imprecise washing step. They swapped one amino acid in the pheromone for a chemical group that can be cleaved by ultraviolet light. Adding this α-factor analogue to *S. cerevisiae* arrested the yeast's cell cycle; brief exposure to ultraviolet light restarted it.

JOURNAL CLUB

Sossina Haile
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A materials scientist argues for an alternative to hydrogen fuel.

Much has been said about the 'hydrogen economy' as a way to a clean, sustainable and geopolitically sound energy future. But hydrogen is not an energy source, merely an energy carrier. The fact that hydrogen does not produce greenhouse gas emissions at the point of use hardly renders it a clean and sustainable fuel, and as an energy carrier it is, for several reasons, a poor choice.

Now let us imagine a more sensible future, one in which a carbon-free energy source generates easily transported hydrocarbon fuels, using water and carbon dioxide as chemical inputs. For example, a chemical process might generate alcohols via artificial photosynthesis. Clean and efficient use of that fuel can, in principle, be achieved using solid oxide fuel cells, which offer about twice the efficiency of combustion engines while producing zero emissions of regulated pollutants.

But solid oxide fuel cells don't normally work well when operated directly on hydrocarbon fuels. The culprit is the nickel in the anode, the very element used to catalyse electrochemical conversion of fuels. When hydrocarbon fuels are used, nickel-containing electrodes tend to become clogged with carbon, a process known as 'coking'.

Some progress has been made in finding nickel-free electrode compositions, but the power densities achieved from such reformulated fuel cells have remained low — until this year.

In April, researchers at the University of Texas, Austin, reported that the double perovskite $Sr_2MgMoO_{6-\delta}$ shows exceptional activity for electrochemical conversion of methane (Y.-H. Huang *et al. Science* **312,** 254–257; 2006). This gives me hope that, with greater attention to alternative anodes, our world can reach the goal of sustainable energy.