

RESEARCH HIGHLIGHTS

Flights of fancy

Proc. R. Soc. B. doi:10.1098/rspb.2009.0182 (2009)

Biologists believe that some butterflies send mixed signals. Wings with brightly coloured topsides attract mates, for example, whereas camouflaged undersides protect against predators.

Jeffrey Oliver of Yale University and his colleagues compared the rates of wing-pattern evolution in 54 species of the genus *Bicyclus* (pictured, *Bicyclus anynana*). Because eyespots are evolving at different rates on the upper and lower surfaces of *Bicyclus* wings, the team concludes that markings on different parts of the wings are probably used for different purposes and suggest this separation of signals allows butterflies to be simultaneously attractive to mates and safe from predators.



W. PIEL

ECOLOGY

Equality in dirt

Glob. Biogeochem. Cycles

doi:10.1029/2008GB003250 (2009)

Soil is the same all around the world — at least in terms of its capacity to break down certain nutrients. Davey Jones of Bangor University in Gwynedd, UK, and his colleagues reached this conclusion after analysing soil samples collected at 40 locations around the globe, from the Arctic to the equatorial zone to Antarctica.

The researchers found that all of the soil samples contained similar concentrations of amino acids. And, when maintained at the same conditions, microbes resident in the different samples all broke down amino acids at roughly the same rate. The results suggest that even though global ecosystems are complex and distinct, soil microbes are similar in their ability to convert amino acids into smaller molecules.

QUANTUM DOTS

Pillars progress

Appl. Phys. Lett. 94, 121102 (2009)

The interplay between a photon and a quantum dot — a semiconducting blob of atoms — held inside a small cavity creates a device that can act as a qubit, the data-carrying building block of quantum computing.

Materials scientists would like to study information transfer between many such solid-state qubits. However, current construction techniques can create only a few unpredictable cavities and dots, thwarting attempts to build regular arrays.

Adrien Dousse and his colleagues at the Laboratory for Photonics and Nanostructures

in Marcoussis, France, have now used laser-guided etching to create, in one process, a dozen pillar-shaped cavities less than 3 micrometres wide, each containing an accurately tuned and positioned quantum dot. The technique could be scaled to create an assembly of identical qubits.

ATMOSPHERIC SCIENCE

Bolt from the storm

Nature Geosci. doi:10.1038/ngeo477 (2009)

Although forecasters can anticipate hurricane trajectories fairly well, successful prediction of storm intensification lags behind. Lightning may provide the warning needed to predict that a tropical cyclone is about to become more powerful.

Colin Price of Tel Aviv University and his colleagues compared data from the World Wide Lightning Location Network with data on all 58 category-4 and category-5 tropical

cyclones that occurred between 2005 and 2007. In all but two storms, peak lightning activity preceded peak hurricane intensity by roughly one day.

The researchers say that they don't know the exact mechanism, but note that lightning serves as an indicator of the kind of in-storm convection that can lead to vortex intensification.

ASTRONOMY

Slow and steady

Astrophys. J. 694, 1171-1199 (2009)

Most nearby galaxies in the Universe are massive and filled with middle-aged stars, but how and when the galaxies formed is a topic of hot debate.

To estimate galactic ages, Edward Taylor of Leiden University in the Netherlands and his colleagues studied 7,840 galaxies using the Multiwavelength Survey by Yale-Chile (MUSYC), which in total covers one square degree of the southern sky. They looked at the age of stars in galaxies as far away as 10 billion light years, and discerned that about one-fifth of large galaxies formed within the Universe's first 4 billion years; 50% of the galaxies had formed by the time the Universe was 7 billion years old, about half its current age.

The new survey data suggest that massive galaxies develop at a slower, steadier rate than previously believed.

BIOPHYSICS

DNA made for walking

Science 324, 67-71 (2009)

Researchers have designed a DNA molecule that can 'walk' for two-and-a-half steps in a predetermined direction along a DNA track.



GETTY

Nadrian Seeman at New York University and his colleagues created a 49-nanometre-long track of bound DNA strands with loops, and a single-stranded DNA 'walker' molecule. The walker ratchets itself along when its front 'leg' binds to the next loop on the track, triggering a reaction that frees the back leg. Chemical analyses showed the walker took a step 74% of the time.

The team is exploring other chemical reactions besides base-pair binding to drive the walkers. If such constructs can be designed to carry cargo, they could be used to build molecular complexes, the researchers say.

IMMUNOLOGY

Inflaming the problem

Nature Immunol. doi:10.1038/ni.1722 (2009)

A common genetic mutation may contribute to a painful autoimmune disease by interfering with the production of the anti-inflammatory protein IL-10.

The mutation, in a gene called *NOD2*, is associated with up to half of all cases of Crohn's disease in the West, but how it contributes to the disease has been controversial, in part because mice with the mutation have normal IL-10 production. Xiaojing Ma at Weill Medical College of Cornell University in New York and his colleagues found that cells from patients with Crohn's disease who have the mutation produce less IL-10.

Furthermore, the mutation prevents activation of a protein called hnRNP-A1, which normally binds to a region near the IL-10 gene and stimulates its expression. The authors suggest that the altered *NOD2* protein functions differently in humans and mice.

DEVELOPMENT

The trouble with alcohol

Dis. Model. Mech. doi:10.1242/dmm.001420 (2009)

Excess alcohol consumed during pregnancy starves embryos of retinoic acid, causing deformities such as small head size and missing brain structures.

Abraham Fainsod at the Hebrew University in Jerusalem and his colleagues had previously developed a laboratory frog model of the effects of alcohol. Given alcohol, the frog embryos recapitulate some of the developmental defects of fetal alcohol syndrome.

Fainsod and Hadas Kot-Leibovich now show that alcohol competes with vitamin A, a precursor of retinoic acid, for an enzyme called RALDH2. Increasing RALDH2 levels allows the embryos to tolerate higher doses of alcohol.

CHEMISTRY

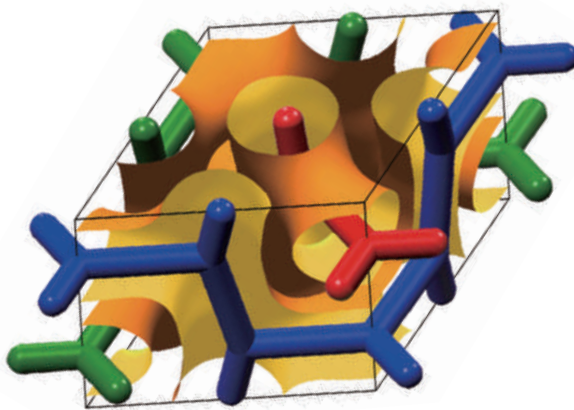
Three in one

Nature Chem. doi:10.1038/nchem.166 (2009)

The most complicated porous nanomaterial ever made is reported by Jackie Ying at the Institute of Bioengineering and Nanotechnology in Singapore, Xiaodong Zou at Stockholm University and their colleagues.

Made from silica, the material has three separate but interwoven continuous porous channels (pictured below). Until now, scientists have only managed to construct mesoporous silica materials containing at most two independent pore systems.

The authors generated the intertwined porous material using a specially designed template made from a positively charged surfactant. The structure contains both ultrashort and ultralong silica channels, and could be used as a molecular sieve to separate different molecules at different rates.



GEOLOGY

Flooding on the Silk Road

Geology 37, 243–246 (2009)

Increased flooding in northwestern China along a section of the old 'Silk Road' trade route is due to accelerated glacier melting, indicating that climate warming is affecting arid communities and their water resources.

Jian Sheng Chen of Hohai University in Nanjing, China, and Chi-yuen Wang of the University of California, Berkeley, analysed oxygen and hydrogen isotopes in the unusually high spring upwelling in a portion of the Hexi Corridor that abuts the Badian Jaran Desert. They traced the water's origin to glaciers four kilometres above sea level in the Qilian Mountains, 40 kilometres away.

The researchers suspect that earthquakes starting in 2003 are responsible for releasing stored groundwater. They also estimate that, at current melting rates, most of the Qilian Mountains' glaciers could disappear by 2050, ultimately depleting the valley aquifer.

JOURNAL CLUB

Michael Heckenberger
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An archaeologist looks at South America's early complex societies.

What leads to the rise and fall of civilizations? In coastal Peru, early urban societies based on maritime fishing thrived from 5,800 to 3,600 years ago. Daniel Sandweiss at the University of Maine in Orono and his colleagues report that climate and environmental changes were critical to the rise of these societies (D. H. Sandweiss *et al. Proc. Natl Acad. Sci. USA* 106, 1359–1363; 2009). They find that environmental shifts are well recorded in coastal geological features, which correlate to high Andes glacial cores, notably in the sixth millennium BP, when small urban centres also emerged in southwestern Asia — the 'cradle of civilization'. But as the Peruvian coastal embayments disappeared, around 3,600 years ago, so too did the societies that depended on them.

This paper particularly interested me as our work in the southern Amazon has revealed integrated towns and villages thriving several millennia later on similar resources as the early Andeans — fish, fruit and tubers. Although not as marked as coastal Peru, climatic fluctuations recorded in glacial records, notably the 'Medieval Warming' around 1100–1300 AD, coincided with the emergence of these small territorial polities.

The early complex societies of South America prompt debate over what constitutes urbanism and 'civil society' in its earliest and most minute forms, and make us reconsider the traits and typologies developed from classical civilizations and Western experience. Notably, in some South American cases, corporate labour and civic organization were not based on agricultural intensification and administration of crop surpluses.

Whether we call them urban or not, these societies show unique properties of self-organization and dynamics of the relationship of humans with natural systems.

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