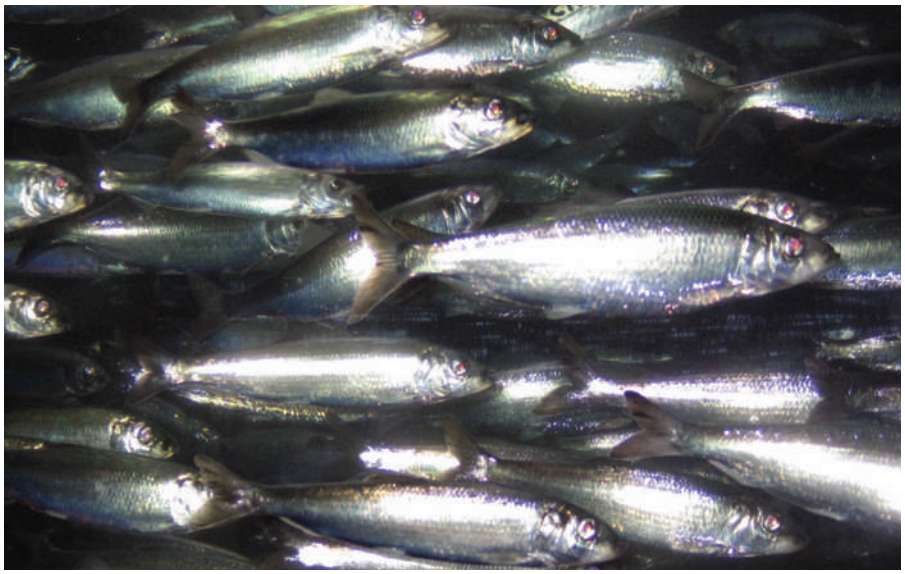
RESEARCH HIGHLIGHTS

School soundings

Science **323,** 1734–1737 (2009)

It is difficult to study what triggers shoaling in sea fish as the conglomerations can be tens of kilometres across and yet are still hard to find in the vast oceans. Nicholas Makris of the Massachusetts Institute of Technology and his colleagues have observed the genesis of an entire giant shoal for the first time, using a low-frequency acoustic technique that can take snapshots of areas up to 100 kilometres across every 75 seconds.

They found that spawning Atlantic herring (*Clupea harengus*) around the Georges Bank in the Gulf of Maine had to reach a critical density of 0.2 fish per square metre to trigger a rapid transition from anarchy to synchronization. After this transition the fish then proceed to migrate in their millions under the influence of a small number of leader fish.



H.BAESEMANN/DPA/CORBIS

MITOCHONDRIAL GENOMICS

Bloody anomaly

Genome Res. doi:10.1101/gr.083188.108 (2009)

Blood-sucking lice are common. Genetically, they are also unusual, say Renfu Shao at the University of Queensland, Australia, and his colleagues. Using information from the Human Body Louse Genome Project, the team found that the mitochondrial genome of the human body louse (*Pediculus humanus*) is splintered into 18 mini-chromosomes.

Chromosome fragmentation seems to have evolved along with blood sucking: the authors found it in human head and pubic lice, as well as in blood-sucking lice of other primates, but not in related lice that feed on other material. The chromosomal break-up may have been advantageous by increasing recombination between mini-chromosomes and introducing genetic variation that helped lice adapt to a bloody mammalian diet.

MECHANOCHEMISTRY

Tug of war

Nature Nanotechnol. doi:10.1038/nnano.2009.55 (2009)

Even the strongest molecular bonds break if yanked hard enough. But studying this effect requires a delicate tugging mechanism that can focus force controllably on individual bonds.

Roman Boulatov and his colleagues at the University of Illinois in Urbana-Champaign have found such a device: a rigid U-shaped molecule, stiff stilbene (pictured right), the ends of which are attached to the molecule under interrogation. Stilbene twists into a strained shape on exposure to light, pulling on its attached molecule. The force generated can be calculated from quantum mechanical principles, and altered incrementally depending on the length of an adjustable linker.

The researchers confirm a direct relationship between the force their probe exerts on a cyclobutene molecule and the rate at which a central bond falls apart.

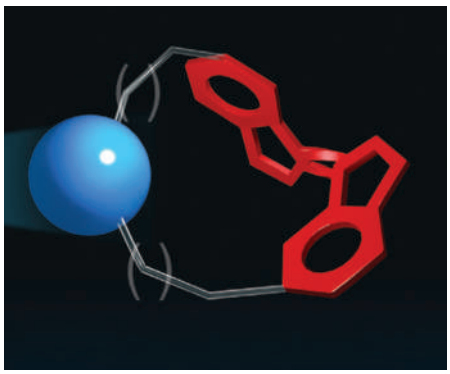
TRIBOLOGY

Brushing problems aside

Science **323,** 1698–1701 (2009)

The joints in human elbows, knees and the like exhibit very little friction even at moderately high pressure — man-made materials can offer nothing as good. Zwitterions might put that right.

Zwitterions are molecules with discrete positive and negative charges in different places. Jacob Klein of the University of Oxford, UK, and his colleagues have created polymer 'brushes' made of zwitterionic phosphorylcholine, in which the multiple positive and negative charges strongly attract water molecules, and attached them firmly to mica surfaces. The result is a system with very low friction when the surfaces move against each other, probably because the water molecules clinging to the phosphorylcholines prevent the brushes becoming entangled. The bound water can exchange freely with other water molecules, which also reduces friction.



This work might have application in biomedical devices where friction is often a problem.

ASTRONOMY

Slow revolution

Astrophys. J. **694,** 130–143 (2009)

Galactic archaeologists have identified a component of the Milky Way's halo that had been predicted but not seen before. The team, led by Heather Morrison at Case Western Reserve University in Cleveland, sifted through stellar velocity data from surveys going back to 1994, and found a group of stars marching to a different beat from the halo's original inhabitants. These stars were probably part of the outer halo and seem to have arrived at their positions more recently.

Some astronomers had theorized that the halo of stars centred on the Milky Way should contain two components. One, roughly spherical, would not rotate. The other, observed now for the first time, flattened into a thick, slowly rotating disk after the Galaxy's formation when stars from the outer halo drifted inwards.

This new component contains stars with eccentric orbits not found in the rapidly rotating main disk.

MARINE BIOLOGY

Deep-sea Methuselahs

Proc. Natl Acad. Sci. USA doi:10.1073/pnas.0810875106 (2009)

The longevity of deep-sea corals has been much debated: radiocarbon dating provides estimates of millennia, but counting growth rings gives ages of only a few hundred years. Brendan Roark at Texas A&M University in College Station, an advocate of the radiocarbon approach, now reports with his colleagues more evidence for extremely long-lived corals.

They show that, in some cases at least, the organic carbon that is acquired by the corals is 'fresh'. It is carbon rapidly transported from the surface ocean to the depths at which the corals live, rather than old sea-floor carbon in which the radioactive carbon-14 has already decayed.

The fresh diet means that the carbon-14 levels in the corals should accurately reflect their ages. On this basis the team estimates members of the black-coral genus *Leiopathes* to be 4,265 years old.

CHEMISTRY

Chemical scissors

Nature Chem. doi:10.1038/nchem.162 (2009)

A synthetic catalyst that mimics the chemical scissors at the heart of bacterial methane digestion can snap strong carbon–hydrogen bonds.

Previous attempts to copy the natural catalyst, which relies on a pair of iron atoms for its activity, produced catalysts that could only tackle relatively weak C–H bonds. The latest version, from Eckard Münck at Carnegie Mellon University in Pittsburgh and his colleagues, works thousands of times faster and breaks the toughest of C–H bonds, such as those in cyclohexane. It picks up electrons supplied by an electric current, and delivers them to the bond to prise the carbon and hydrogen atoms apart.

Although the synthetic di-iron catalyst does not match that of bacteria for speed, it goes one better by being able to break even stronger oxygen–hydrogen bonds.

CLIMATE CHANGE

Much travelled dust

Nature Geosci. doi:10.1038/ngeo474 (2009)

During the ice ages there was much more dust in the air over Antarctica than there is now, but its supply was sometimes rapidly curtailed.

David Sugden of the University of Edinburgh, UK, and his colleagues suggest that an 80,000-year record of the extent of the glaciers in Patagonia, the likely source of the dust, may explain the uneven pattern of dust deposition seen in Antarctic ice cores.

When the glaciers were extended, their sediment-rich discharge flowed out over extensive plains. Here, their dusty sediments would have been easily mobilized by the wind. When the glaciers retreated — as they did on occasion, even in an ice age — they discharged instead into lakes (pictured below), where the sediments simply accumulated. Glacier fluctuations correlate well with the Antarctic dust record.

B. HARRINGTON III/CORBIS

ECOLOGY

Saving songbirds

Ecol. Appl. **19,** 505–514 (2009)

The number of birds killed by crashing into communication towers could be reduced by about 50–70% by simply changing the towers' lighting systems, researchers say.

Millions of night-migrating songbirds collide with these towers each year. Joelle Gehring of Michigan State University in Lansing and her colleagues counted bird carcasses below 21 similar-sized towers in Michigan during two 20-day migration periods in 2005.

Towers with only flashing lights had a mean of 3.7 bird kills per season, whereas towers with both flashing and steadily burning lights had a mean of 13.

As the steady light may attract birds, the team suggests that tower operators turn off those lights or reprogram them to flash.

JOURNAL CLUB

Anthony J. Ryan
University of Sheffield, UK

A chemist welcomes an ingenious advance in plastics technology.

It's a rare joy to come across a communication that is truly concise, with a genuinely surprising but ultimately logical result, and compellingly modest conclusions that could materially benefit our society. Anne Hiltner at Case Western Reserve University in Cleveland, Ohio, and her colleagues take two well established facts — confined polymers form single crystals, and a blend of polymers, when stretched and folded by clever processing, makes very many thin layers — and use them to make something novel: a two-polymer blend with an oxygen permeability 100 times lower than either of its components (H. Wang *et al. Science* **323,** 757–760; 2009).

Plastics are often used in packaging as multilayer coatings. When each layer is thick, the barrier to oxygen is the sum of the properties of its components. The team found that as the layers were stretched, making them thinner, and folded back on themselves to make many layers, the plastic film became an even better oxygen barrier.

When a polymer crystallizes in a confined film it typically makes large pancake-like crystals around 10 nanometres thick and many micrometres across. Using simple mathematical models, the team showed that the improved barrier properties were due to the stretched and folded polymers forming alternating layers of such crystals. The core of each crystal is essentially impermeable to oxygen, which thus has to go across the pancake to find the edge — and at each alternate layer it faces another impermeable core: like a person having to go 1 kilometre sideways to go 1 metre forwards.

This astounding improvement is essentially free and could be incorporated into current packaging materials at little cost, reducing their environmental and energy impact. It makes a cold beer in a biodegradable plastic bottle a distinct possibility — and for me that would be a rare joy indeed!

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