RESEARCH HIGHLIGHTS

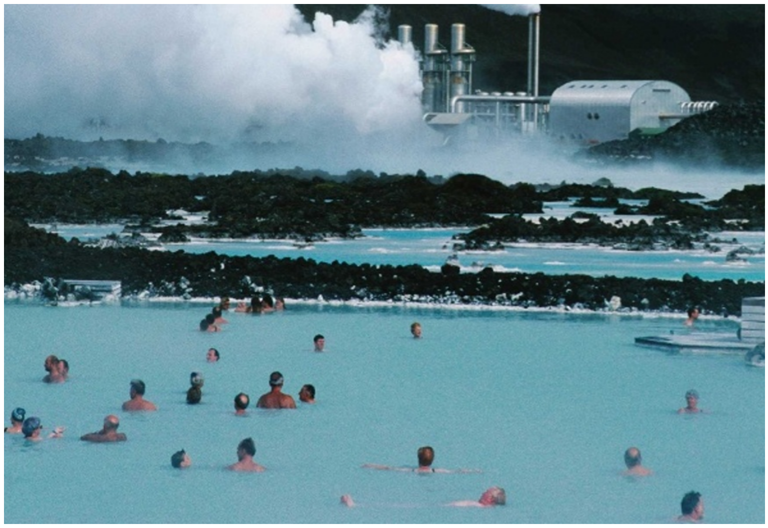
Kissing cousins

Science **319,** 813–816 (2008)

Close inbreeding is typically frowned on by society and geneticists alike. But research in Iceland has shown that pairing up with a third or fourth cousin may actually boost fertility.

Agnar Helgason and his colleagues at deCODE Genetics, a company in Reykjavik, reached this conclusion after analysing genealogical data for 160,811 couples born in a 165-year period starting from 1800. Icelanders remained remarkably equal during this time in both social and economic terms, so the authors assumed that these factors exerted little influence on marital unions.

For example, women born between 1925 and 1949 who married third cousins had, on average, almost one more child, and almost two more grandchildren, than couples who were eighth cousins or even more distantly related. First- or second-cousin marriages had just as many kids as third-cousin unions, but their children died younger and were less likely to reproduce.



D. TELEMANS/PANOS

SYSTEMS BIOLOGY

Critical condition

Proc. Natl Acad. Sci. USA **105,** 1897–1900 (2008)

The idea that life is a self-organized 'critical state' akin to those postulated for physical systems such as avalanches has long been mooted in complexity science. Ilya Shmulevich of the Institute for Systems Biology in Seattle, Washington, and his team have now found a signature of critical dynamics in the gene-expression pattern of immune cells called macrophages.

The team measured the information content of transcriptional activity in macrophages as the cells responded to various stimuli over time. Transcriptional states triggered by different stimuli walk a fine line, they found, becoming neither more nor less like one another as time progresses. This means that the corresponding changes in the cells' information content are poised on a knife edge between order and chaos.

The balance corresponds to a critical state, which the researchers think offers an ideal compromise between stability and adaptability in the cells' responses.

MATERIALS SCIENCE

In and out

Science **319,** 794–797 (2008)

A UK-based collaboration has found a crystal that when cooled contracts in one direction while expanding in another, changing its dimensions by ten times the amount of a typical crystal.

Andrew Goodwin at the University of Cambridge and his colleagues probed silver hexacyanocobaltate ($Ag_3[Co(CN)_6]$), a structure composed of long strings of colbalt, silver, nitrogen and carbon atoms arranged in a lattice. When the crystal cools, silver atoms are drawn together, contracting the compound in one direction. This causes cobalt atoms, which occur between silver atoms along the string, to be pushed apart, expanding the material in the other direction.

The crystal might one day be used to better control systems that experience large temperature swings, such as spacecraft instruments, the authors say.

ENVIRONMENTAL MODELLING

Surprise supply

Environ. Sci. Technol. **42,** 822–830 (2008)

It has long been supposed that cultivated croplands are the largest source of phosphorus, as well as nitrogen, in the Mississippi river. But the latest water-quality model developed by the US Geological Survey suggests otherwise.

Richard Alexander at the agency's headquarters in Reston, Virginia, and his colleagues think that animal manure on pasture and rangeland accounts for 37% of the phosphorus moving into the river. This then travels onwards into the shallow coastal waters of the Gulf of Mexico, where it contributes to a hypoxic 'dead zone' in summer. By comparison, corn and soya bean cultivation account for only 25% of phosphorus discharged into the Mississippi, but 52% of nitrogen pollution.

That the distribution of pollution sources is more diverse than was previously supposed suggests that managing runoff in the Midwest may be more complicated than thought.

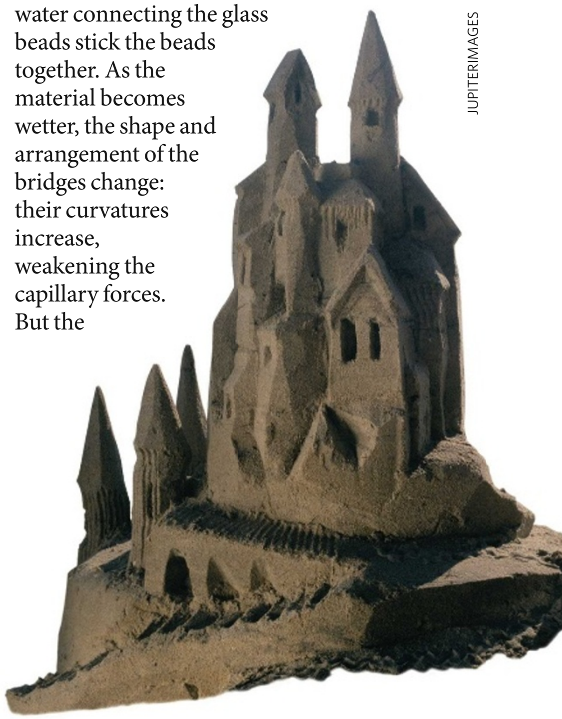
GRANULAR PHYSICS

Built on sand

Nature Mater. doi:10.1038/nmat2117 (2008)

The recipe for a sandcastle (pictured below) — just add water — is surprisingly insensitive to precise quantities. But why? Because two effects roughly balance each other in sand of almost any wetness, reseachers report.

Taking X-ray cross-sections of small glass beads of varying wetness allowed Stephan Herminghaus of the Max Planck Institute for Dynamics and Self-Organization in Göttingen, Germany, and his co-workers to monitor structural changes in 'sand' as they altered the water content of the mixture. Capillary forces in 'bridges' of water connecting the glass beads stick the beads together. As the material becomes wetter, the shape and arrangement of the bridges change: their curvatures increase, weakening the capillary forces. But the



JUPITERIMAGES

bridges reach more of the beads' surfaces, which helps the particles stay together. These opposing effects cancel out, so the sand's stiffness remains more or less constant whether a cupful or a bucket load of water goes into the castle.

ONCOLOGY

Melanoma mystery

Cell doi:10.1016/j.cell.2007.12.032 (2008)

Researchers have identified a protein that seems to underlie the paradoxical activity of a cancer-causing gene called *BRAF*. This gene can lead to melanoma but also causes pigment-producing skin cells to stop dividing and die.

The research group, led by Michael Green of the University of Massachusetts in Worcester, screened the entire human genome for other genes that could explain the mystery. They turned up 17, each of which could trigger *BRAF*'s killer activities. To their surprise, they found that a secreted protein, IGFBP7, is produced in cells with permanently activated *BRAF* genes, and acts to mute other signals induced by *BRAF* telling the cells to divide rapidly. Injecting IGFBP7 into mice with human melanomas slowed the growth of the tumours. The authors propose that loss of IGFBP7 allows *BRAF* to revert to its cancer-causing ways.

SPECTROSCOPY

Surface glance

J. Am. Chem Soc. doi:10.1021/ja710099c (2008)

By combining a spectrographic technique with a pulsed laser, researchers have developed a way to probe molecular interfaces such as biological membranes in real time.

To access very thin layers that are constantly moving, Jens Bredenbeck and his co-workers at the FOM Institute for Atomic and Molecular Physics in Amsterdam, the Netherlands, added a non-resonant laser pulse to two-dimensional infrared spectroscopy, which can be used to measure the properties of molecules in solution. The modification deletes the response from the bulk of a sample, leaving only information from molecules of interest — in their experiment, a thin layer of fatty alcohols in water.

Nuclear magnetic resonance spectroscopy has also been used to look at biological membranes, but it requires samples to be solid. The technique allows the molecular structure and behaviour of membranes in solution to be studied with femtosecond resolution.

IMMUNOLOGY

Primitive immunity

Nature Immunol. doi:10.1038/ni1562 (2008)

The kidneys and gills of lampreys — which, along with hagfish, are the only living jawless vertebrates — contain lots of cells that produce antibodies, researchers have found.

Max Cooper and his colleagues of the University of Alabama at Birmingham studied cells that carry antigen-binding molecules on their surfaces. The levels of these cells surged when anthrax spores were injected into the lampreys, but not when the creatures were injected with bovine serum albumin, to which more 'evolved' immune systems react.

After proliferating, the cells, which are thought to represent ancient B lymphocytes, differentiate and secrete a soluble, antibody-like protein, showing that lampreys are among the most primitive forms of life to express an adaptive immune response.

POPULATION ECOLOGY

Tabling more birds

Biol. Lett. doi:10.1098/rsbl.2007.0622 (2008)

Households that regularly sprinkle a few breadcrumbs and nuts on a bird table during winter are probably having a massive impact on bird breeding success in spring.

Gillian Robb and Stuart Bearhop at Queen's University Belfast in Northern Ireland and their team paired ten patches of deciduous woodland according to ecological and landscape features. They then simulated garden feeding (pictured below) in one of each pair by hanging wire mesh peanut feeders from trees from the start of November until early March. On average, birds at the supplemented sites laid their eggs earlier and raised nearly one extra surviving chick per nest than those in the unsupplemented sites, even though clutch sizes were the same.

PHOTOLIBRARY

JOURNAL CLUB

John Shepherd
Tyndall Centre for Climate Change Research, NOC, Southampton, UK

An oceanographer sees potential in accelerating rock weathering to soak up carbon dioxide from the air.

With CO_2 emissions increasing by more than 2% per year, rather than decreasing by the 3% or so needed to effectively mitigate climate change, I am not surprised that many scientists are seeking alternative solutions to simply cutting greenhouse-gas outputs.

Various geoengineering schemes have been proposed — such as fertilizing the oceans with iron, a limiting resource for planktonic algae that take CO_2 from the atmosphere — but these are unlikely to sequester large amounts of carbon in the long-term and may have serious ecological side effects. The thermodynamics of enhancing geochemical weathering look feasible, but the reactions are too slow to be really practicable.

Geochemists and engineers at Harvard University in Massachusetts and Pennsylvania State University recently suggested a kinetically preferable idea. They propose using the electrolysis of sea water to produce sodium hydroxide and hydrochloric acid, in a variant of the well-known industrial 'chloralkali' process, (K. Z. House *et al. Environ. Sci. Technol.* **41,** 8464–8470; 2007).

Sodium hydroxide could either be used to scrub CO_2 directly from the air, producing sodium bicarbonate, which is neutral and could be discharged into the sea, or be pumped directly into the ocean, increasing sea water's alkalinity and so its ability to absorb CO_2. The hydrochloric acid could be neutralized fairly easily, because it reacts rapidly with both carbonate and silicate rocks.

The scheme House *et al.* outline looks promising if it were operated using a solar or geothermal electricity source near a supply of basic rocks. A mid-ocean volcanic island would be good. And the environmental consequences of the scheme's discharges should be less severe than those of the ocean acidification that humans are already causing.

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