

RESEARCH HIGHLIGHTS

Surface surprise

Geophys. Res. Lett. **35**, L04605 (2008)

The efficiency with which photosynthetic phytoplankton removes carbon dioxide from the surface waters around Antarctica is itself dependent on the CO₂ concentration of those waters. This opens up the possibility that a negative feedback system exists, whereby increased plankton growth under high-CO₂ conditions results in proportionally more CO₂ being pumped out of surface waters and into sediments.

Philippe Tortell at the University of British Columbia in Canada and his co-workers found that diatoms — a common type of phytoplankton — normally seen in summer blooms in the Ross Sea were the greatest beneficiaries of this effect, with chain-forming diatoms doing particularly well. The finding may have implications for understanding the biogeochemistry of past ice ages as well as conditions to be expected in the future.

of two substances. On sniffing a given isomer of one substance, the volunteers received a small electric shock. This 'conditioning' process altered the activity of the primary olfactory cortex, a region of the brain that processes smell. Afterwards, volunteers distinguished between the two versions of this substance better (50% of the time) than would be expected by chance (33%). The two versions of the second substance, used as a control, remained impossible to tell apart.

The work shows that humans have a more extensive smell capacity than was thought, but they don't normally need to use it.

IMMUNOLOGY

Antibiotic antibodies

J. Clin. Invest. doi:10.1172/JCI33998 (2008)

The discovery of functional antibodies against strains of *Salmonella* that do not cause typhoid raises hopes that a vaccine can be developed. In Africa, such strains kill up to 24% of infected children in communities in which appropriate antibiotics and blood-culture facilities are available.

Calman MacLennan of the University of Birmingham, UK, and his colleagues noted that *Salmonella* infection in Malawi is more common in toddlers under two years of age than in older children. The researchers report that healthy children over 16 months old produce antibodies that destroy non-typhoidal *Salmonella* as it divides in the blood; younger children do not.

Such strains are susceptible to other immune-system mechanisms when inside cells, but these do not stop the bacteria from proliferating in the blood. This further supports the potential usefulness of an antibody-stimulating vaccine.

NANOMECHANICS

Pulling teeth

Appl. Phys. Lett. **92**, 113103 (2008)

Imagine a tiny cog that spins without its teeth touching a driving rack. Theoretical physicists have worked out that two corrugated racks moving in the same direction on opposite sides of such a cog would cause the cog to turn backwards and forwards repeatedly. This set up might be used to make a low-wear mechanical oscillator, say MirFaez Miri of the Institute for Advanced Studies in Basic Sciences in Zanjan, Iran, and Ramin Golestanian of the University of Sheffield, UK.

The device's moving parts would need to be of nanoscale dimensions because the cog's motion relies on the Casimir force, a quantum-mechanical effect that pulls two surfaces together over very short distances. The Casimir force is highly sensitive to small changes in separation, so the device might also make a tiny position sensor.

INFORMATION SYSTEMS

Web spread

Proc. Natl Acad. Sci. USA **105**, 4633–4638 (2008)

The dissemination of a single piece of news over the Internet has been observed and analysed, revealing many more steps than theoretical models had predicted, and thus greater opportunity for information to be altered.

David Liben-Nowell at Carleton College in Northfield, Minnesota, and Jon Kleinberg at Cornell University in Ithaca, New York, studied variations of two e-mail petitions — one about opposition to the Iraq war and the other concerning government

MOLECULAR BIOLOGY

Hepatic hope

Nature Biotechnol. doi:10.1038/nbt1396 (2008)

There are no approved therapies for the scarring that underlies cirrhosis of the liver. But delivering a small interfering RNA (siRNA) — a molecule that intercepts specific messenger RNAs — to the cells that produce the bulk of this collagen scar tissue could reverse the damage.

This approach worked in rats with liver damage when Yoshiro Niitsu and colleagues at the Sapporo Medical University School of Medicine in Hokkaido, Japan, administered an siRNA in fatty bubbles known as liposomes. These were coated with vitamin A, which tricked the cells into letting the drug in. The siRNA the authors used jams the expression of a crucial protein in collagen production.

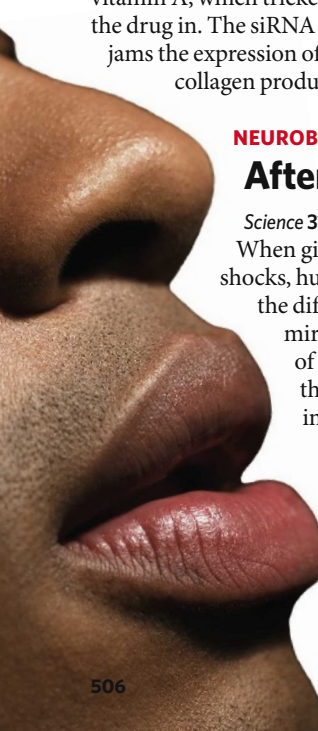
NEUROBIOLOGY

Aftershock

Science **319**, 1842–1845 (2008)

When given small electric shocks, humans can learn to tell the difference between two mirror-image versions of the same molecule that previously seemed indistinguishable.

Wen Li and her colleagues at Northwestern University in Chicago, Illinois, asked people to sniff the right- and left-handed isomers



funding of radio and television. Each recipient added their name before forwarding the petitions to friends. The variations therefore contained different but overlapping lists of names that revealed the paths by which they spread.

Instead of diffusing from person to person like an infectious disease, the two petitions moved around the Internet in similar and surprisingly narrow tree-like patterns, and continued to reach new people even after several hundred steps.

CONSERVATION BIOLOGY

Embattled bats

J. Mammal. **89**, 18–24 (2008)

Six colonies of Brazilian free-tailed bats (*Tadarida brasiliensis*) in the southwestern United States may have plummeted from 54 million members to 4 million since 1957, according Margrit Betke at Boston University in Massachusetts and her colleagues. This is bad news for humans, because the bats eat the moth *Helicoverpa Zea*, the larva of which is one of North America's most destructive farm pests.

The team used heat-sensitive video cameras to pick out the creatures' warm thoraxes in the dark to record colonies emerging en masse from caves. Because fast-moving bats occlude one another only briefly, comparing sequential video frames allowed the authors to produce a reliable census.

The 1957 study was much less accurate as it relied on human observers, but massive population decline due to guano mining and heavy DDT use in the 1960s seems likely.

PHYSICS

Record breaker

Nature Phys. doi:10.1038/nphys919 (2008)

The record for the most bits of information transmitted in a single flicker of light has been beaten by researchers at the University of Illinois at Urbana–Champaign.

Light can transmit quantum information twice as fast as zeros and ones can move through classical electronic devices. This is due to a process called entanglement, whereby the spins of a pair of photons are manipulated. But the capabilities of light-measuring instruments have limited rates to 1.585 bits per photon.

Julio Barreiro and his colleagues achieved an average rate of 1.63 bits per photon by further entangling the photon pairs, using a corkscrew motion of light known as its orbital angular momentum. Perfect measurement of this method could result in rates as high as 2.81, they say.

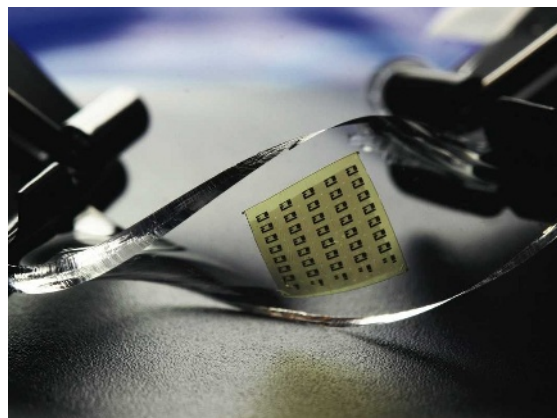
ECOLOGY

Carbon conundrum

Proc. Natl Acad. Sci. USA doi:10.1073/pnas.0800568105 (2008)

As atmospheric carbon dioxide concentrations rise, soya-bean plants defend themselves less well against some beetles, find May Berenbaum and her colleagues at the University of Illinois at Urbana–Champaign.

The researchers studied Japanese beetles (*Popillia japonica*) and soya-bean plants (*Glycine max*) in open-air laboratories in which the percentage of CO₂ in the air can be controlled. Crops grown in CO₂ concentrations of 550 parts per million — roughly twice the pre-industrial level — had reduced expression of genes involved in defensive signalling. Faced with lower levels of compounds that normally deter them, the beetles ate more soya-bean leaves.



MATERIALS SCIENCE

Bendy electronics

Science doi:10.1126/science.1154367 (2008)

Stretch them, fold them, unfold them, and flexible new integrated circuits (pictured above) still perform as well as rigid ones. They can be used to build logic gates, amplifiers and transistors.

The devices are made from arrays of unbroken silicon crystal nanoribbons, through which electrons flow rapidly. These are printed on an ultrathin layer of a polymer, on a substrate covered with 'sacrificial' glue that is later dissolved. The product is then transferred onto a stretched sheet of poly(dimethylsiloxane), another polymer, which makes the circuits stretchable when the strain is released.

Authors John Rogers of the University of Illinois at Urbana–Champaign, Yonggang Huang of Northwestern University in Evanston, Illinois, and their colleagues propose using the bendy circuits in wearable health monitoring equipment.

SCIENCE

JOURNAL CLUB

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A chemist looks at DNA-based molecular logic.

Logic gates — AND, OR and NOT gates — are used in all manner of electronic devices, for example computers, in which they are connected in huge arrays. Several research groups, including my own, have designed and built molecular logic gates since the early 1990s. But the usefulness of our efforts has been limited because linking these gates in series has proved difficult.

Recently, Reza Ghadiri and his colleagues at the Scripps Research Institute in La Jolla, California, constructed a full set of logic gates that release a single-stranded DNA sequence when provided with the correct combination of single-stranded DNA inputs (B. M. Frezza *et al.* *J. Am. Chem. Soc.* **129**, 14875–14879; 2007).

This means that the output of one gate can be the input for another, and that the gates can be 'wired together' into multi-level circuits using the solution containing the DNA as a communication medium.

The gates work as follows. When a single strand of DNA pairs with a longer strand, an 'overhang' of unpaired DNA is left. If another complementary strand then comes along that is the same length as the longer strand, the overhang provides a foothold, allowing the new strand to push the shorter one off and form a full-length hybridized pair. Ghadiri *et al.* attached the DNA to beads so that different gates could be kept apart until the correct input was ready. They also added a fluorescent part to the final output signal to make the result easy to monitor.

This may not seem like much of an achievement to a computer buff. Nevertheless, I think the principle that this paper describes could pave the way to more useful molecular logic gates. In the meantime, the simple molecular logic gates that are available can serve in real-life applications such as identification tags for small micrometric objects. Semiconductor identification devices are too big for this purpose.

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