RESEARCH HIGHLIGHTS

DRUG DEVELOPMENT

Drift off quickly

Nature Med. doi:10.1038/nm1544 (2007)

A novel sleep-inducing agent has been developed that acts by blocking the actions of brain peptides called orexins.

Orexins promote wakefulness, and people with narcolepsy — a condition causing daytime sleepiness and sudden loss of muscle tone — have low orexin levels.

François Jenck of Actelion Pharmaceuticals in Allschwil, Switzerland, and his colleagues report that their new compound, code-named ACT-078573, reduced alertness in rats, dogs and humans. Human subjects receiving the drug fell asleep more quickly than those receiving the placebo, but none of them experienced loss of muscle tone.

THEORETICAL CHEMISTRY

Sextuple bondage

Angew. Chem. Int. Edn doi:10.1002/anie.200603600 (2007)

In a covalent bond, two atoms share a pair of electrons, knitting together the respective electron orbitals. Two electron pairs are shared in a double bond.

But no-one knew for sure how high a bond could go. Björn Roos of the University of Lund in Sweden and his colleagues have now computed that the maximum number of electron pairs that two atoms can share is actually six.

The best example of such a sextuple bond is that between two tungsten atoms, which bond each other in a complex embrace involving six pairs of electrons.

BIOCHEMISTRY

Receptor finally bagged

Science doi:10.1126/science.1136244 (2007)

The elusive receptor that allows cells to take up vitamin A has finally been identified, after a 30-year hunt.

Vitamin A is required for many biological functions, such as vision and immunity. It is carried through the blood bound to retinol-binding protein, RBP.

Hui Sun and his colleagues at the University of California, Los Angeles, devised a strategy to stabilize the binding of RBP to its cell-membrane receptor, and purify the complex. Using mass spectrometry, they identified the receptor as STRA6 (pictured below in retinal cells; green), a widely expressed protein of previously unknown function.

S. XIAO

Ancient embryos

Geology 35, 115–118 (2007)

Palaeobiologists in China and the United States have identified what may be fossilized embryos (pictured) captured, 600 million years ago, in an early stage of development.

The microfossils, candidate embryos of an as-yet unidentified species, were discovered in southern China. Shuhai Xiao of Virginia Polytechnic Institute in Blacksburg and his colleagues used microfocus X-ray computer tomography imaging to virtually peel back the outer envelope surrounding the embryos, thus exposing them. The embryos comprised several hundred cells or more arranged in three clockwise coils.

This arrangement suggests that the parent might be a tubular coral-like animal, the authors say.

ASTROPHYSICS

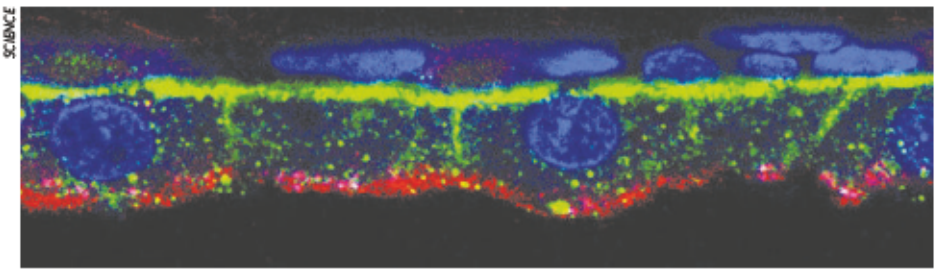
Timed burst

Astrophys. J. 655, L25–L28 (2007)

Gamma-ray bursts (GRBs) — explosions of powerful radiation from deep space — are typically classified as being 'short' or 'long'. But that may be a bad way of doing things.

Bing Zhang of the University of Nevada, Las Vegas, and his colleagues based that conclusion on an analysis of an unusual GRB. The spectral features of the burst, sighted on 14 June 2006 by the Swift satellite, were typical of a short GRB, but lasted for around 100 seconds. Short bursts normally last less than 5 seconds.

Based on the GRB's origin and spectral features, the team concluded that it, like most short GRBs, came from the collision of two compact stars. The team suggests reclassifying GRBs into Type I and Type II.



SCIENCE

ATMOSPHERIC SCIENCE

Corn monitor

Geophys. Res. Lett. doi:10.1029/2006GL027 (2006)

Trails of carbon dioxide from fossil fuels can be tracked by analysing the leaves and husks of corn.

Fossil fuels contain no carbon-14, so CO_2 from burning coal, gas and oil dilutes levels of this radioisotope in the atmosphere.

Diana Hsueh of the University of California, Irvine, and her colleagues reasoned that because carbon in corn is derived from atmospheric CO_2 during photosynthesis in a single growing season, the level of carbon-14 in the plants could be a useful marker of CO_2 release by fossil fuels.

They surveyed samples of corn across North America, unexpectedly finding that levels of fossil-fuel-derived CO_2 were lowest in the western mountain states — perhaps because emissions get blown away from the mountains, or are lifted too high for the corn to incorporate.

IMMUNOLOGY

Sunny response

Nature Immunol. doi:10.1038/ni1433 (2007)

The Sun warms the skin — and may help to protect us from getting sick, report Hekla Sigmundsdottir and Junliang Pan of Stanford University, California, and their co-workers.

The group exposed dendritic cells — a type of immune cell — to a form of vitamin D that is made in the skin after exposure to sunlight. The vitamin stimulated dendritic cells, as well as T cells (another type of immune cell), to convert the vitamin D into a chemically active form. This active form then spurred T cells to stud their surfaces with a specialized homing molecule that guides T cells towards the skin.

The authors suggest that through this mechanism, sunlight triggers the immune system to protect the skin with T cells, which may help to block pathogens and repair damage caused by the Sun.

NANOMECHANICS

Good vibrations

Nature Nanotechnol. advance online publication doi:10.1038/nnano.2006.208 (2007)

Nanoscale vibration sensors sensitive enough to detect their own thermal quivers have been built by scientists at the California Institute of Technology in Pasadena.

Microscopic cantilevers, like miniature springboards, are commonly used to sense motion and mass. But bouncing light off the cantilever to detect its displacement won't work for devices far smaller than the wavelength of light.

One alternative is to detect bending via piezoresistance — a change in electrical conductivity caused by a shape change — in a thin coating. Michael Roukes and his colleagues show that for nanoscale cantilevers, semiconductors are no longer the best piezoresistive materials.

They use gold films instead, giving sensors that work for very high frequency vibrations and that can detect mass changes of less than 10^{-18} grams.

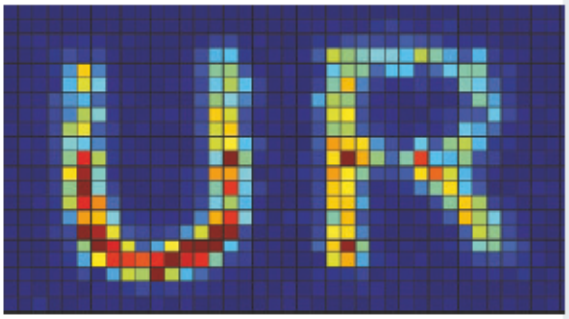
OPTICS

Hold that photon

Phys. Rev. Lett. 98, 043902 (2007)

Information imprinted in a light beam is easy to transmit but harder to process or store. So today's telecommunications involve the cumbersome interconversion of data encoded optically and electronically.

But Ryan Camacho and his colleagues at the University of Rochester in New York have shown that an image — such as the



'UR' pictured above — recorded in light pulses can indeed be 'stored' after a fashion. Light passing through caesium gas is slowed down massively, delaying a pulse by up to 10 nanoseconds and thus allowing it to be 'held onto' for longer than normal.

AMERICAN PHYSICAL SOCIETY

The trick works even for beams so dim that a single 2-nanosecond pulse may contain less than one photon, while still encoding an image of several hundred pixels. The technique might enable huge amounts of information to be stored within just a few photons.

CELL BIOLOGY

GATA keep it in check

Cell 127, 1041–1055 (2006) and *Nature Cell Biol.* 9, 201–209 (2007)

The transcription factor GATA-3 may underlie the development of a type of breast cancer that is hard to treat, researchers suggest.

Two groups have independently shown that GATA-3 is required for the formation and maintenance of mammary glands.

When the *GATA-3* gene was suppressed during development, the mammary gland failed to mature, leading to a build-up of immature cells less likely to express receptors for the hormone oestrogen.

The scientists suggest that GATA-3 loss may perhaps be the cause of some cases of oestrogen-receptor-negative breast tumours, which have notoriously poor prognoses.

JOURNAL CLUB

Andrew Watson
University of East Anglia, UK

An oceanographer describes a missing piece of the climate puzzle.

Most school students know that increasing atmospheric carbon dioxide raises global temperatures. But I've always been fascinated by the other half of the climate–CO_2 connection: why, in the past, have increasing temperatures driven up atmospheric CO_2?

That CO_2 and temperature are locked in a powerful, positive-feedback embrace is obvious from ice-core evidence. But if we add up all the mechanisms that we know about, we fall short of explaining the rise in CO_2 levels seen at the end of glaciations.

Upwelling in the Southern Ocean may be the missing piece. Today, this process brings deep CO_2-rich water rapidly to the surface, where it vents carbon to the atmosphere. If upwelling was shut down during glaciations, we could fit the data better.

It has been suggested that sea ice might have blocked the air–sea transfer of CO_2 during times of glacial maxima (B. B Stephens & R. F. Keeling *Nature* 404, 171–174; 2000).

There is good evidence that sea ice was extensive in the region, but any upwelling would have melted that ice, because the rising water has a temperature above freezing point. So the sea ice is evidence that the upwelling itself was absent. What stopped it?

One recent paper (J. R. Toggweiler *et al. Paleoceanography* 21, PA2005; 2006) argues that the critical factor was a shift to the north of the westerly wind belts that drive the upwelling. I and a colleague propose a subtler connection, a change in the balance of surface heat flux, that would also reduce the upwelling to near-zero (A. J. Watson & A. C. N. Garabato *Tellus B* 58, 73–87; 2006).

The theories are convergent in many respects, but make distinct predictions that we can test against new proxy evidence. This problem will be solved pretty soon, I think.