RESEARCH HIGHLIGHTS

Tundra and lightening

J. Geophys. Res. **110,** G01004 (2005)
Global warming will cause parts of the Arctic to absorb up to three-quarters more sunlight than they do at present, say US researchers.

Climate scientists expect rising temperatures to cause shrubs to grow in Arctic areas that are covered in snow for much of the year. This could increase warming, because darker vegetation absorbs more solar radiation than snow. So researchers from the US Army Cold Regions Research and Engineering Laboratory and Colorado State University measured the radiation reflected from different Arctic surfaces at five sites in Alaska — the Niukluk River is shown here. They estimate that a tundra-to-shrub transition would cause an increase in absorption of 69 to 75%, depending on the latitude and time of year.

S. DOUGLAS

NEUROSCIENCE

Conscious connections

Science **309,** 2228-2232 (2005)
Consciousness fades when we fall asleep, but the brain remains active. Giulio Tononi and his colleagues at the University of Wisconsin, Madison, go some way to resolving this paradox. Using equipment that allows the human brain to be stimulated and monitored at the same time, they show that during deep non-rapid-eye-movement sleep, which occurs at the beginning of the night, neuronal firing in the brain is unable to spread across the cortex. In contrast, effective connectivity persists during quiet wakefulness; activity in one cortical area is transmitted to other areas of the brain.

DRUG DISCOVERY

Cravatt makes twin ties

Nature Biotechnol. doi:10.1038/nbt1149 (2005)
Drug developers screen libraries of small molecules to find useful biological effects, but it is not easy to identify these molecules' targets. Small molecules often bind their protein targets only weakly, making it hard to isolate the complexes from living cells.

Benjamin Cravatt of the Scripps Research Institute in La Jolla, California, and his co-workers get round this by adding a probe containing two reactive groups to the molecules that are to be screened. One reactive group attaches to the protein when the molecule binds, holding the two together. The other reacts with a fluorescent label, allowing the trapped protein to be identified.

The researchers used their method to find a compound that inhibits proliferation in breast-cancer cells and to identify its enzyme target.

ANIMAL BEHAVIOUR

Smells fishy

Nature Chem. Biol. doi:10.1038/nchembio739 (2005)
Researchers working on strategies to control the invasive sea lamprey, *Petromyzon marinus* (pictured), have characterized the chemicals that act as a migratory cue for the creatures.

The larvae give off a pheromone that adults detect at concentrations as low as a single milligram in five Olympic-size swimming pools of water. The chemical draws the adults to suitable spawning sites upstream. Peter Sorensen, Thomas Hoye and colleagues of the University of Minnesota found three components — the most active of which is similar to the antibiotic compound squalamine, produced by sharks.

The team hopes that a fake pheromone could act as bait to help rid the North American Great Lakes of these parasitic fish, which arrived from the Atlantic a century ago.

MOLECULAR EVOLUTION

Sense and sensitivity

Proc. Natl Acad. Sci. USA **102,** 14338–14343 (2005)
Not all proteins evolve at the same rate, and those that evolve most slowly are often also those that are most highly expressed. Why?

Allan Drummond of the California Institute of Technology in Pasadena and his co-workers studied recent gene-chip data from yeast. They verified that expression rate is a good predictor of evolution rate for yeast proteins, then used the genome-wide data to compare explanations for rate variation. They conclude that evolution rate varies because highly expressed proteins incur translation errors more often — so their folding behaviour needs to be relatively insensitive. Resilient sequences are rare, leaving little opportunity for evolution to tinker with them.

PHYSICS

In phase

Phys. Rev. Lett. **95,** 127205; 127206; 127207 (2005)
As if superfluids weren't strange enough, quantum theory also predicts the existence of supersolids — crystalline structures that, like superfluids, will flow with zero viscosity.

Last year, researchers thought they might have detected the phase in helium-4 (*Nature* 427, 225–227; 2004). Now three papers, from groups in Europe, India and California, describe a system that could create supersolids for study. They calculate that pouring certain kinds of superfluid into an optical lattice that holds the atoms in a triangular pattern will force them into a supersolid phase when the lattice is partially filled.

D. HANSEN

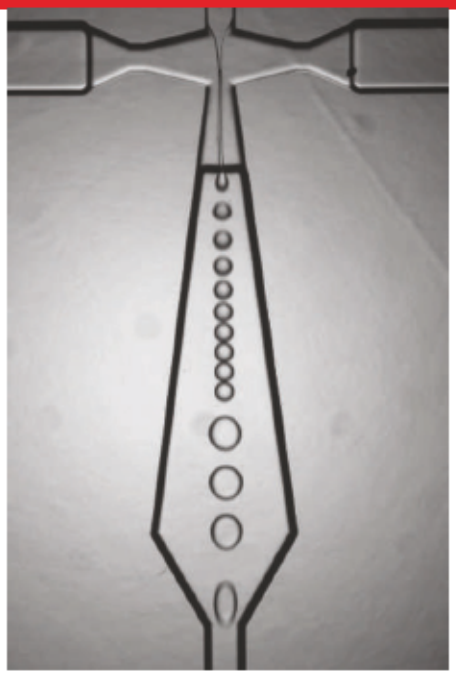
NANOTECHNOLOGY

Crystal balls

J. Am. Chem. Soc. doi:10.1021/ja051381p (2005)

A steady stream of nanodroplets is pictured (right) flowing through a microreactor designed by a team led by Richard Mathies of the University of California, Berkeley.

Unlike other systems, this set-up works even at high temperatures, and was used to create cadmium selenide nanocrystals at temperatures between 240 and 300 °C. Precursors containing cadmium and selenium are introduced into bubbles of octadecene squirted into an inert carrier fluid. The size of the bubbles, each just a few billionths of a litre in volume, is controlled by varying the injection rate of the liquids into the reactor.



ACS

BACTERIOLOGY

Hard to stomach

Lancet 366, 1079–1084 (2005)

A virulent strain of the *Clostridium difficile* bacterium that has emerged in hospitals in Canada has been characterized by Michel Warny of Acambis in Cambridge, Massachusetts, and his colleagues.

Patients who have taken antibiotics to cure another illness sometimes suffer as resistant strains of the bacterium flourish in their gut. Between 1991 and 2003, the number of people killed by a *C. difficile* infection within a month of its diagnosis increased from 4% to 13% in a region of Quebec. Warny's group identify the epidemic strain as NAP1/027, and link its virulence to elevated production of toxins.

ASTROPHYSICS

Peering into the past

Preprint astro-ph/0509303 at http://arxiv.org (2005)

The satellite telescope Swift is looking out for the long gamma-ray bursts produced by the violent deaths of stars. A good proportion of these bursts should come from very early stars, say Volker Bromm of the University of Texas, Austin, and Abraham Loeb of Harvard University in Cambridge, Massachusetts.

Using star formation rates, the researchers calculate that about 10% of the bursts seen by Swift will come from stars that exploded during the first billion years of the Universe's existence.

They add that some of them may even come from the first ever stars. Little is known about these bodies, which are thought to have been massive and metal-free. But to release a burst of gamma rays, they would have to have existed as binary systems in which one star stripped away the outer layer of its dying mate.

CHEMISTRY

Attack on anthrax

Angew. Chem. Int. Edn 44, 2–5 (2005)

It was recently discovered that *Bacillus anthracis* spores display a unique carbohydrate on their surface. Because vaccines made from synthetic carbohydrates have shown some potential in treating other diseases — including cancer and malaria — this tetrasaccharide has piqued interest as a candidate for a small-molecule anthrax vaccine.

Daniel Werz and Peter Seeberger, both of the Swiss Federal Institute of Technology in Zurich, report the first chemical synthesis of this tetrasaccharide. They designed the synthetic scheme so that it could be easily tweaked to modify the carbohydrate's structure — meaning that, if necessary, it should be easy to synthesize and test analogues of the natural compound.

SYNTHETIC BIOLOGY

Flak jackets

J. Am. Chem. Soc. 127, 13213–13219 (2005)

No one could expect building a living cell from scratch to be easy. But one difficult hurdle has been overcome by Jack Szostak and his co-workers at the Harvard Medical School in Boston, Massachusetts.

The team is aiming to make 'protocells' by filling vesicles made from fatty acids with ribozymes, which combine genetic and enzyme-like functions.

The problem has been that the metal ions that ribozymes typically need to function cause the fatty acids to precipitate. Now the team has found that a mixture of myristoleic acid and its glycerol ester will make vesicles that are not only immune to metal-induced precipitation, but are also permeable to magnesium ions.

JOURNAL CLUB

Günter Theißen
University of Jena, Germany

Dog domestication inspires an evolutionary biologist to reflect on the evolution of complex life.

There are some who believe that living organisms are so complex that they must have been created by an 'intelligent designer' — arguably just another term for God. Meanwhile, others argue that evolutionary biology can already fully explain how complex organisms emerged.

In my view, clarifying how complex organisms evolve remains one of the greatest challenges of biology. Rather than intelligent design, however, we need more intelligent research, such as that presented by John Fondon and Harold Garner (J. W. Fondon & H. R. Garner *Proc. Natl Acad. Sci. USA* 101, 18058–18063; 2004).

We have learned in recent years that changes in the genes that control the development of organisms can bring about major evolutionary transitions. But it has not been clear how the usually slow accumulation of random mutations could account for the fast and coordinated morphological changes seen in the fossil record.

Fondon and Gardner's study suggests a striking solution. Their research links the differing shapes of dog breeds to variation in the number of repeats of short DNA sequences in certain developmental control genes. Changes to repeat length occur much more often than other kinds of mutation, explaining how evolution can sometimes be very rapid. Also, the identified repeats encode amino acids that, ultimately, modulate the activity of genes involved in limb and skull development, explaining the effects on morphology.

I am optimistic that the authors have uncovered a crucial mechanistic detail of how genes link development to evolution. I eagerly await further analyses telling us whether this trick in dogs also works in other organisms.