RESEARCH HIGHLIGHTS

Fast evolver

Proc. Natl Acad. Sci. USA 103, 10334–10339 (2006)

When the Andes mountains were pushed up to near their final height between 2 million and 4 million years ago, it created new habitats for hardy plants. Colin Hughes and Ruth Eastwood of Oxford University, UK, chart how lupins, such as those pictured, took advantage of the opportunity.

They show that one species from the genus *Lupinus*, which arrived in the Andes around 1.5 million years ago, has since diversified into 81 different species. This suggests that each new branch of its phylogenetic tree divides, on average, every 320,000 years — a species diversification rate that makes it the fastest-evolving plant group discovered so far. Only the cichlid fish of East Africa's rift lakes are known to be evolving more quickly.

C. HUGHES

GEOLOGY

Eruption frozen in time

J. Geophys. Res. 111, D12107 (2006)

The timing and magnitude of a medieval volcanic eruption — one of the largest in recent history — have been pinned down by analysis of ice-core records.

The eruption of the South Pacific volcano, Kuwae, in Vanuatu, was probably a single burst in either late 1452 or early 1453, conclude Chaochao Gao of Rutgers State University in New Jersey and her colleagues. They looked at 33 ice cores from Antarctica and Greenland, which reveal the eruption as a spike in sulphate concentration.

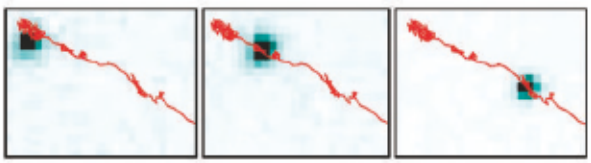
They estimate that the eruption released more sulphate (which cools the climate) than any other event in the past 700 years. The results could serve as a reference to improve the dating of ice-core records.

BIOPHYSICS

Off the tracks

Nano Lett. doi:10.1021/nl060921t (2006)

Motor proteins have been watched as they march along their biomolecular tracks.



AM. CHEM. SOC.

Kinesin proteins are responsible for transporting materials around in cells, guided along protein rods known as microtubules. Giovanni Cappello of the Curie Institute in Paris, France, Maxime Dahan of the Kastler Brossel Laboratory, Paris, and their co-workers filmed them going about their work in living mammalian cells by attaching semiconductor nanoparticles to the motor proteins. The nanoparticles glowed like light bulbs under a fluorescence microscope, allowing the researchers to track each protein's trajectory (pictured below).

The kinesin molecules typically switched between spells of linear motion, when they were attached to microtubules, and random, diffusive motion when they left the tracks.

RNA INTERFERENCE

What a turn-off

Proc. Natl Acad. Sci. USA 103, 10456–10460 (2006)

Neuroscientists have succeeded in turning female mice completely off sex by silencing a single receptor in a specific region of the brain.

Donald Pfaff and Sonoko Ogawa of The Rockefeller University in New York and their colleagues used RNA interference to switch off the oestrogen receptor-α in neurons of the hypothalamic ventromedial nucleus — a region of the brain previously shown to have a role in sexual behaviour. This caused the female mice to angrily reject the advances of males, instead of assuming a receptive posture.

Although genetic mutations can be induced to knock out the receptor completely, this may affect how the mouse's brain develops. Using RNA interference allowed the researchers to study the receptor in normally developed adult mice.

NEUROBIOLOGY

Miraculous recovery

J. Clin. Invest. 116, 2005–2011 (2006)

Brain scans of patients who have been in a minimally conscious state (MCS) for long periods are providing new insights into how nerve cells adapt after a traumatic brain injury.

Researchers led by Henning Voss of the Citigroup Biomedical Imaging Center and Weill Medical College of Cornell University in New York studied the damaged brains of two patients using a technique known as diffusion tensor imaging. One patient had regained the ability to talk after a car accident left him in an MCS for 19 years. The other had remained in an MCS for 6 years.

Although large parts of both brains showed damage, the recovered patient's brain revealed regional changes that correlated with clinical improvements. The authors propose that this could represent the regrowth of nerve fibres.

SCIENCE

ANIMAL BEHAVIOUR

Mice show empathy

Science 312, 1967-1970 (2006)

A mouse watching a cage-mate writhe in pain will writhe more itself, an observation that Jeffrey Mogil and his team at McGill University in Montreal conclude is evidence of rodent empathy.

The researchers tested mice in twos, giving one or both mildly painful shots of acetic acid. If the two were strangers, they behaved as if they were on their own. But if they had lived together for a few weeks, and both got a shot, they both showed more abdominal constrictions, termed writhing, than when given a shot alone. The effect vanished if the roomies could not see one another.

Empathy has previously been considered an attribute of primates alone. Of course, the empathetic response does not indicate that the mice consciously felt sorry for one another — only that they respond to each other's pain.

NANOTECHNOLOGY

Bridging the gap

Nano Lett. 6, 1092-1095 (2006)

Mechanical switches in electrical circuits work by introducing a gap, a behaviour that Marc Bockrath of the California Institute of Technology in Pasadena and his colleagues have replicated at the nanoscale.

The researchers bridged two electrodes with a multiwalled carbon nanotube. Applying a high voltage broke the tube, which put the system into an 'off' state. But the broken ends, the researchers found, could be reunited by charging them. This set up an electrostatic repulsion between the concentric walls of the nanotube, causing the inner tubes to telescope out. The gap was then bridged and the ciruit switched on. For

double-walled tubes this switching proved reversible, so it could potentially be used to store information bits in a rewritable memory chip.

PLANETARY ATMOSPHERES

Mystery gas

Geophys. Res. Lett. 33, L12301 (2006)

If Earth's volcanoes are a good analogue for those on Mars, researchers will have to look elsewhere for the source of the red planet's mysterious methane.

The detection of methane in the martian atmosphere two years ago led to speculation that it might be produced by some form of life. But non-living sources are possible too — one of the alternatives being martian volcanoes, such as the massive Olympus Mons, a 'shield' volcano that was active until 2 million years ago.

Mauna Loa in Hawaii is Earth's largest shield volcano, which Steven Ryan of the Mauna Loa Observatory and his co-workers have now scanned for evidence of methane emission. In data stretching back to 1987, there is no sign of any methane accompanying the volcanic carbon dioxide.

PHYSIOLOGY

Ants take it in their stride

Science 312, 1965-1967 (2006)

Ants, those notorious picnic-crashers, will march long distances in search of food. But how do they find their way home again?

Matthias Wittlinger of the University of Ulm, Germany, and his colleagues show that Saharan desert ants, *Cataglyphis fortis*, use a pedometer to count their strides. The authors allowed a group of ants to march from their nest to an experimental food site. Then, the ants were captured and the researchers either shortened the ants' legs by amputation or elongated them by gluing on stilts made of pig bristles. Both types of altered ants misjudged the distance home — the ants on stumps undershot while the ants on stilts (pictured left) went too far. Further work on the accuracy of the ant pedometer is planned.

GENETICS

C. difficile made easy

Nature Genet. 38, 779-786 (2006)

The complete genetic sequence of the troublesome bacterium *Clostridium difficile*, decoded in new work, provides clues to understanding the bug's virulence and emerging drug resistance.

C. difficile can cause diarrhoea, which, in the worst cases, leads to death. Researchers led by Julian Parkhill of the Wellcome Trust Sanger Institute in Cambridge, UK, sequenced the 4.3 million base pairs of the circular chromosome of *C. difficile* strain 630, and its smaller plasmid. The chromosome contained an unusually large proportion of mobile elements (11%), which differed in strains extracted from different hosts. They also identified genes associated with antibiotic resistance and virulence factors.

JOURNAL CLUB

Morgan Sheng
Massachusetts Institute of Technology, Cambridge, USA

A neuroscientist looks at life and death in the brain.

In the mammalian brain, the subject of my research, the same 'use it or lose it' philosophy guides both the life and death of neurons and the strengthening or weakening of the communication junctions between them (the synapses). Recent work suggests there might be a reason for the parallel.

During brain development, more neurons are born than are needed. Those that compete successfully for limited amounts of growth-sustaining neurotrophic substances, such as brain-derived neurotrophic factor (BDNF), survive.

Synapses are likewise formed in excess during development, and the 'poorly connected' are eliminated, probably also through competition for trophic factors. Active neurons and synapses tend to win out over inactive ones.

In my lab we study the mechanisms by which some synapses grow bigger and stronger and others are weakened and lost. We already knew that BDNF, in addition to enhancing neuronal survival, promotes the strengthening of synapses.

But Bai Lu and colleagues (N. Woo *et al. Nature Neurosci.* 8, 1069-1077; 2005) have uncovered a new twist. They show that the precursor of BDNF (proBDNF) acts in diametric opposition to BDNF.

BDNF promotes stronger synapses by acting on the receptor TrkB. Woo and his co-workers find that proBDNF weakens synapses by acting on a distinct receptor, p75NTR. This receptor has previously been implicated in cell death, whereas TrkB has well-known pro-survival activity.

Thus, two different products of the same gene — proBDNF and BDNF — acting on two different receptors elicit opposite outcomes. This leaves me wondering whether neuronal survival and synaptic plasticity are different aspects of similar underlying mechanisms.