RESEARCH HIGHLIGHTS

Carbon lost from lakes

Global Biogeochem. Cycles **21,** GB3002 (2007)
An assessment of the carbon cycles of 41 lakes on five continents has put new global numbers on lakes' contribution to carbon in the atmosphere. The lakes' net carbon emission, at around 86 million tonnes, is roughly equivalent to Spain's annual carbon emissions.

Simone Alin of the University of Washington in Seattle and Thomas Johnson of the University of Minnesota in Duluth compiled available data for primary production, carbon burial and lake–atmosphere gas exchange for lakes (including Lake Malawi, pictured) representing more than two-thirds of the world's total volume of freshwater and saline lakes.

Overall, the lakes lose an order of magnitude more carbon to the atmosphere than they remove through burial of sediments.

T. JOHNSON

BIOTECHNOLOGY

Viral endgame

Proc. Natl Acad. Sci. USA doi:10.1073/pnas.0705362104 (2007)
Viruses could be placed in a 'checkmate' position with a strategy that identifies and blocks off all escape routes for evading antiviral agents by mutation.

Richard Lerner, Sydney Brenner and their colleagues at the Scripps Research Institute in La Jolla, California, engineered bacteria-infecting phages to express the surface proteins of other viruses, such as a strain of influenza. They then exposed the phages to libraries of small molecules or antibodies to identify molecules that blocked the viral protein's interaction. Cycles of mutagenesis create phages in which the viral protein evades the blocker, whereupon new blockers can be found that stop that mutated form. In effect, the likely viral mutations in the wild are thus explored and counteracted in advance *in vitro*, so that the antidotes can be prepared in anticipation.

EVOLUTIONARY BIOLOGY

Interaction over time

Curr. Biol. **17,** 1225–1230 (2007)
Researchers have traced the evolution of a mechanism that controls the growth of more recently evolved plants.

The hormone gibberellin acts by promoting the interaction of two proteins. Nicholas Harberd and his colleagues at the John Innes Centre in Norwich, UK, looked for this interaction in plants that diverged at different points in time.

The proteins are present in the most ancient plant studied, a moss, but don't interact. In spikemosses, which evolved later, the hormone is present and the proteins interact, but they do not control growth. When they looked in the most recently evolved plant, the angiosperm *Arabidopsis thaliana* (or thale cress), they found that the system regulated plant growth.

This suggests that the gibberellin-response mechanism evolved in a step-by-step fashion between around 300 million and 400 million years ago.

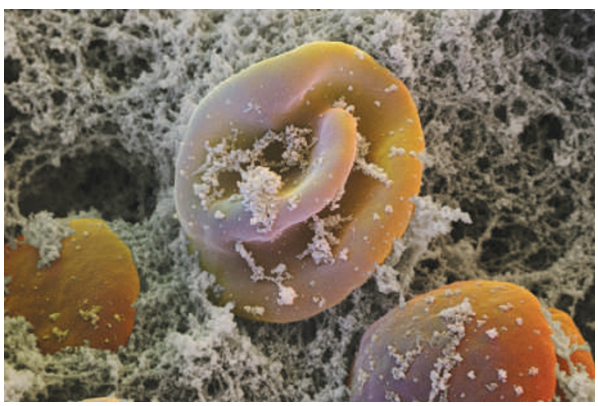
MICROBIOLOGY

Build-up in the brain

Mol. Microbiol. doi:10.1111/j.1365-2958.2007.05837 (2007)
Certain variants of the malaria parasite *Plasmodium falciparum* preferentially accumulate in the brain, researchers have found.

P. falciparum manufactures proteins that make the red blood cells it infects (pictured below) stick to the lining of small blood vessels. In the brain, this can lead to blockages that may ultimately cause the infected person's death.

Jacqui Montgomery of the Malawi-Liverpool-Wel lcome Programme of Clinical Tropical Research in Blantyre, Malawi, and her colleagues compared the expression of *var* genes, which encode such proteins, in parasites taken from the brain, lung, heart and spleen of malaria patients. The team identified a couple of *var* genes that are specifically expressed in the brain and could represent targets for future therapies.



D. SCHARF/SCIENCE FACTION/GETTY

NEUROBIOLOGY

Release from helplessness

Neuron **55,** 289–300 (2007)
Researchers report that a protein called ΔFosB may help mice to cope with repeated stress.

When mice experience recurrent, inescapable stress, some simply stop trying to get away. This behaviour, called 'learned helplessness', is relieved by antidepressants and is used to model depression and post-traumatic stress disorder.

Now, Eric Nestler of the University of Texas Southwestern Medical Center in Dallas and his colleagues have found that ΔFosB is expressed by neurons that contain a pain-signalling peptide called substance P, in a brain region called the periaqueductal gray. Overexpressing ΔFosB in stressed mice diminishes stress-induced release of substance P, and reduces learned helplessness.

MATERIALS SCIENCE

Water pores

J. Am. Chem. Soc. doi:10.1021/ja073067w (2007)
Specially designed lipids can polymerize to create a three-dimensional network of pores perfectly tailored to filter salts out of water, researchers in the United States have found. The hope is that such 'nanofilters' could be used for desalination in regions where fresh water is scarce.

The nanofilter developed by Douglas Gin, Richard Noble and their colleagues at the University of Colorado in Boulder has uniform pores that have an effective size of just 0.75 nanometres — around three times as big as a water molecule. This means that water can flow through but larger ions get blocked.

BIOTECHNOLOGY

Pick up a prion

Nature Methods doi:10.1038/nmeth1066 (2007)
A new assay may prove quicker than existing techniques for detecting prions — the proteins responsible for brain diseases such as scrapie in livestock and Creutzfeldt–Jakob disease in people.

Currently, researchers monitor the ability of a sample of tissue or neural fluid to convert normally folded prion protein from brain tissue into the infectious, misfolded aggregates characteristic of disease. But the assay takes weeks to reach optimal sensitivity.

Ryuichiro Atarashi and his team at the Rocky Mountain Laboratories in Hamilton, Montana, instead tested samples against prion proteins produced by bacteria. These proteins can be engineered to carry probes that make it easy to monitor the structural changes that occur in the protein when aggregates form. The assay, tested on samples from hamsters with scrapie, takes three days or less.

CELL BIOLOGY

Quick change

Cell **130,** 77–88 (2007)
Our cells may be poised to change fate, reports a team led by Richard Young of the Whitehead Institute for Biomedical Research in Cambridge, Massachusetts.

Young's team looked in embryonic stem cells and two types of adult cell for chemical signals usually found close to genes that are being actively transcribed. They found these signals near about three-quarters of protein-coding genes in all the cell types. This was a surprise, because less than half of these genes were turned into the complete mRNAs needed to make proteins.

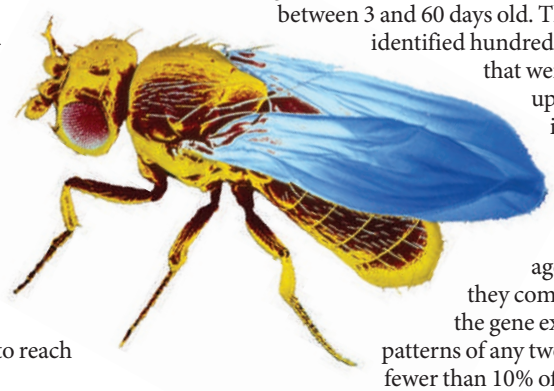
Although the cellular machinery initiates transcription at many genes, it only finishes transcribing some. This may allow the cell to quickly change fate under certain conditions by extending to completion the transcription of key genes.

GENETICS

Time waits for no fly

Genome Res. doi:10.1101/gr.6216607 (2007)
Whether you look at brain, gut, muscle or fat, ageing exacts its toll on an animal's body. Now a study of fruitflies (pictured below) has found that gene expression follows different ageing patterns in different body tissues, with little overlap.

Researchers led by Sige Zou at the National Institute on Aging in Baltimore, Maryland, did a genome-wide screen of fruitflies aged between 3 and 60 days old. They identified hundreds of genes that were turned up or down in seven different tissues as the flies aged. When they compared the gene expression patterns of any two tissues, fewer than 10% of the changes were in the same genes.



J. BURGESS/SPL

PALAEONTOLOGY

When dinos hit puberty

Biol. Lett. doi:10.1098/rsbl.2007.0254 (2007)
Many dinosaurs hit puberty before they reached adult size, according to a new study.

Gregory Erickson of Florida State University in Tallahassee and his colleagues studied seven fossilized dinosaurs that were brooding when they died. The specimens' body sizes indicate that they followed a growth and maturation pattern more akin to that of modern crocodilians than their other descendants, birds.

Birds reach their full size long before sexual maturation. The discovery hints that this life-history trait may have emerged relatively recently, and no earlier than the first true bird, *Archaeopteryx*.

JOURNAL CLUB

Jon Kleinberg
Cornell University, Ithaca, New York

A computer scientist wonders how much information is really good for us.

I am interested in understanding how groups of people or computer systems work together to solve complex problems. This is relevant in real-life situations that demand collective problem-solving, ranging from scientific research to military operations, so we hope to learn about the underlying mechanisms through experiment.

Stanley Milgram's famous 'six degrees of separation' studies form one such set of experiments. In these, participants were asked to help send a letter to a far-away stranger by forwarding it to a friend they thought might know the target. That this strategy often succeeded hints at how people lacking a global picture of the social network they inhabit can still jointly solve a difficult search problem.

One of the interesting questions here is how a group's ability to solve a problem is affected by the amount of information available. I expected that if people had a global view of the system, rather than just a local one, their effectiveness at solving the problem would increase.

A fascinating experiment (M. Kearns *et al. Science* **313,** 824-827; 2006) shows that this isn't always so. The researchers posed a task in which they deliberately varied how much information was revealed to participants about what others in their group were doing.

For certain settings of the problem, giving participants a global view significantly slowed down progress. People faced with too much information in a time-pressured setting became `overloaded', and this impaired the group's function.

As we consider designing tools to help people work together effectively, we should remember that increasing everyone's situational awareness might not always lead to improved performance.

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

analysis were carried out by one person using traditional methods it could take weeks.

EARTH SCIENCES

Leaks and flows

Geophys. Res. Lett. **34,** L13612 (2007)

Ocean circulation in the southern hemisphere is characterized by swirling basin-wide currents, known as gyres, contained within the Indian, Pacific and Atlantic Oceans. Now scientists have discovered a 'supergyre' that connects the three basins.

Ken Ridgway and Jeff Dunn of CSIRO Marine and Atmospheric Research in Hobart, Australia, determined flow patterns from temperature and salinity profiles collected since 1950. They found that, in a region south of Tasmania, Pacific waters 'leak' into the Indian Ocean. There is a similar but weaker connection south of Africa between the Indian and Atlantic Oceans.

Models have suggested that the ocean basins are linked, but until now the connecting element had escaped observation. The supergyre seems to be an essential component of the global ocean circulation system.

CELL BIOLOGY

Age: nothing but a pathway

Science **317,** 803–806 and 807–810 (2007)

A molecular pathway that regulates stem cells leads a double life as an usher of old age, two teams have found.

Toren Finkel at the National Heart Lung and Blood Institute in Bethesda, Maryland, and his co-workers examined a strain of mice, known as Klotho, that ages prematurely. The team found that the klotho protein these mice lack keeps the Wnt pathway in check. Wnts are a family of proteins known to stop stem cells from differentiating.

Thomas Rando, at Stanford University School of Medicine in California, and his team noticed the same counterintuitive role for Wnt when they connected the veins and arteries of young and aged mice, so that blood flowed freely between the two. Under these conditions, muscle stem cells in young mice showed signs of fibrosis — a hallmark of old age. Activating Wnt signalling in young mice had the same effect.

ASTRONOMY

Blasts from the past

Astrophys. J. **664,** 1000–1010 (2007)

Short gamma-ray bursts have been a feature of the Universe for longer than some observations have suggested, say Edo Berger of the Observatories of the Carnegie Institution of Washington in Pasadena, California, and his colleagues.

In seconds, these bursts release energy comparable to the Sun's output over its entire lifetime. Berger's team detected nine such events and estimate that up to two-thirds of this type of burst happened more than six billion years ago. They also estimate higher energies for these ancient bursts than have been reported for more recent bursts.

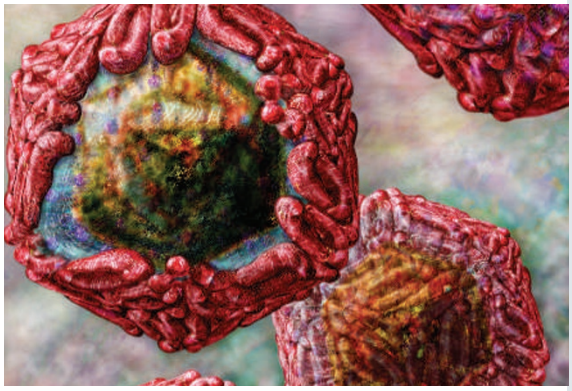
Such observations should help astronomers to work out what causes the explosions: today's best guess is that they result from the merger of two neutron stars, or a neutron star and a black hole.

VIROLOGY

Killer mutation

Nature Genet. doi: 10.1038/ng2097 (2007)

A single mutation may be responsible for the recent increased virulence of the West Nile virus (pictured below). Since 1996, the virus has caused regular outbreaks of severe and even lethal encephalitis in humans. Previously the mosquito-borne, bird-infecting virus had caused only mild infections in humans.



R. KIGHTLEY/SPL

Aaron Brault of the University of California, Davis, and his colleagues analysed the genomes of 21 strains of West Nile virus from around the world. They identified a single base alteration in a gene encoding a helicase enzyme that had arisen independently in at least three strains associated with human outbreaks. Engineering this mutation into a less virulent strain made the virus more lethal to birds, but whether the mutation is associated with increased virulence in humans remains to be determined.

Correction

The Research Highlight 'When dinos hit puberty' (*Nature* **448,** 391; 2007) wrongly implied that modern crocodilians are descended from dinosaurs. Both groups derived from archosaurs.

JOURNAL CLUB

Martyn Poliakoff, University of Nottingham, UK

A champion of environmentally friendly chemistry encourages attempts to identify reactions ripe to be turned 'green'.

The aim of 'green chemistry' is to make the design, production and use of chemicals more sustainable. This means that, unusually for an academic discipline, industrial implementation is an inherent goal.

Research groups in this field, including mine, strive to reduce waste by identifying selective catalysts, alternative solvents or renewable feedstocks that could lead to new industrial processes.

But how do we choose which reactions to try to green? Some targets are obvious; the reactions are notoriously inefficient. However, many chemical manufacturers are understandably reticent about the shortcomings of their processes.

It was therefore particularly refreshing to find a paper that results from the collaboration of seven pharmaceutical companies and highlights key research areas for green chemists (D. J. C. Constable *et al. Green Chem.* **9,** 411–420; 2007). The paper describes several classes of reaction that, if 'greened', would significantly lessen the pharmaceutical industry's effect on the environment.

For example, the paper asks that researchers develop methods to carry out oxidations safely in non-chlorinated solvents (chlorinated solvents are non-flammable but toxic); or to find ways to tame the fearsome reactivity of fluorine so that fluorination occurs selectively.

Another clear message is that new strategies for using solvents could lead to substantial reductions in waste. Could reaction vessels be cleaned out at the end of a process without using organic solvents?

This paper is a great start, but I think the authors have been too conservative. They could have asked for more, such as catalysts that can trigger two or more reactions in sequence. We need really tough challenges to intrigue academic chemists and bring new blood to the task of greening chemistry.

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