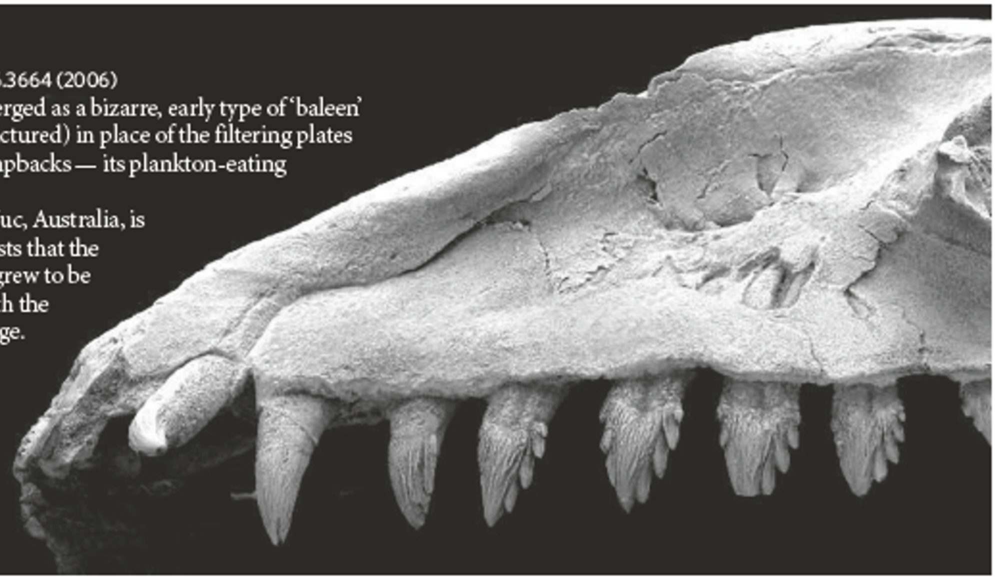
RESEARCH HIGHLIGHTS



R. START/MUSEUM VICTORIA

Nice gnashers

Proc. R. Soc. Lond. B doi:10.1098/rspb.2006.3664 (2006)

A 25-million-year-old fossil has emerged as a bizarre, early type of 'baleen' whale. It has a set of vicious teeth (pictured) in place of the filtering plates used by today's blue whales and humpbacks — its plankton-eating relatives.

The fossil skull, discovered in Jan Juc, Australia, is only 50 centimetres long. This suggests that the species, dubbed *Janjucetus hunderi*, grew to be a few metres in length, compared with the 30 metres that blue whales can manage. Certain features of the skull, such as the way the snout meets the brain case, identify it as a relative of baleen whales (Mysticeti), reports Erich Fitzgerald of Monash University in Clayton, Australia. Predatory species, it seems, evolved alongside filter feeders.

CELL BIOLOGY

Acid bath

Nature Cell Biol. doi:10.1038/ncb1456 (2006)

Researchers think they may be able to explain why cystic-fibrosis patients are extremely vulnerable to severe infection in the lungs, but not elsewhere in the body.

Cystic fibrosis is caused by defects in a membrane protein called CFTR. Deborah Nelson at the University of Chicago, Illinois, and her colleagues have now shown that this protein helps to control pH in the digestive compartment of macrophages that reside in the lungs. Macrophages kill bacteria and other invading pathogens by engulfing them and drowning them in acid.

The team showed that macrophages in the lungs — but not the abdomen — in CFTR-deficient mice were less able to maintain strong acidity, and therefore less able to fight infection.

MICROBIOLOGY

Toxin factory

J. Am. Chem. Soc. doi:10.1021/ja062953o (2006)

Researchers in Germany have pulled off the seemingly impossible task of isolating and culturing an endosymbiotic bacterium on a large scale.

Christian Hertweck and his colleagues at the Leibniz Institute for Natural Product Research and Infection Biology in Jena grew the bacterium *Burkholderia rhizoxina*, which usually lives symbiotically in the cytoplasm of the fungus *Rhizopus microsporus*.

This bacterium produces a toxin known as rhizoxin, which blocks cell division. It causes blight in rice seedlings infected by the fungus, but is also a potent anticancer agent.

Their culture yielded high concentrations of rhizoxin, and other chemically related compounds that were up to 10,000 times more potent than rhizoxin as anticancer drugs *in vitro*.

HYDROGEN STORAGE

Quick release

Angew. Chem. Int. Edn doi:10.1002/anie.200601434 (2006)

Hydrogen-fuelled engines would be a boon for the local environment, producing an exhaust that is only water. But we lack a suitable, safe way to store the explosive gas. Andrew Weller at the University of Bath, UK, and his colleagues suggest a new approach.

The team prepared clusters of rhodium atoms that reversibly bind molecules of hydrogen. Unlike other hydrogen-storage systems, the clusters hold the gas at ambient temperature and pressure. The hydrogen could be released within milliseconds — either by applying a current, or adding a chemical. However, the amount of hydrogen that can be stored in a given volume of material is, for now, below a practical level.

NASA, METI & ERDSAC

CANCER BIOLOGY

Partners in crime

Cell 126, 489–502 (2006)

A key protein involved in breast cancer has an accomplice, say researchers. The finding helps to explain how the tumours become invasive.

Just under a third of breast cancers contain extra copies of a signalling protein called ErbB2, which promotes cell division. Now Filippo Giancotti of the Memorial Sloan-Kettering Cancer Center in New York and his colleagues have found that another protein, β4 integrin, can boost the signal from ErbB2.

The two proteins club together to promote the activity of genes that disrupt cell and tissue structure, and increase cell division. Targeting β4 integrin could improve the efficacy of drugs such as Herceptin that block ErbB2 activity, the researchers suggest.

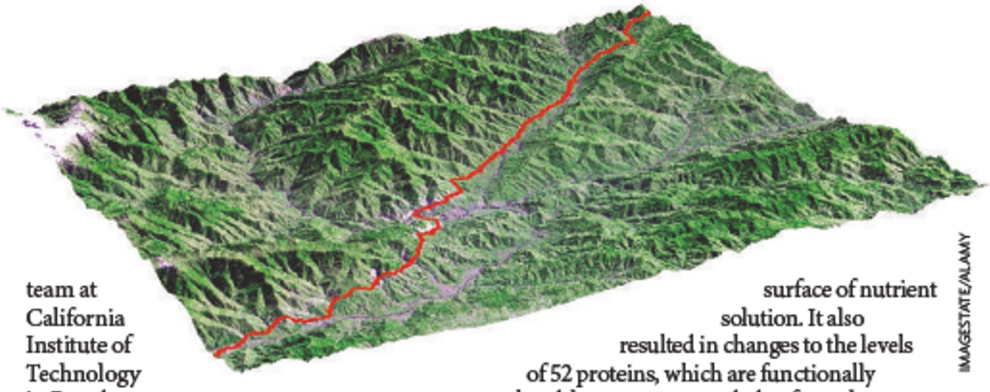
NEUROSCIENCE

Fathering changes brain

Nature Neurosci. doi:10.1038/nn1753 (2006)

It's not clear how it happens, or why — but male marmosets respond to becoming fathers by growing new bits of neuron.

A team led by Elizabeth Gould of Princeton University, New Jersey, compared brain tissue from marmoset fathers to that from adult males living in mating pairs without offspring.


IMAGESTATE/ALAMY

Male marmosets carry an infant for as much as 70% of its first month of life.

Both first-time and experienced fathers had a higher density of dendritic spines — which branch out to form connections between neurons — in their prefontal cortex than did non-fathers. Increased expression of a certain vasopressin receptor hints that the hormone may play a role in this structural change.

MATERIALS SCIENCE

Shrink to fit

Science doi:10.1126/science.1132195 (2006)

An ion wrapped in a crowd of solvent molecules will distort to squeeze into a pore smaller than itself. This, say Yury Gogotsi of Drexel University in Philadelphia, Pennsylvania, and his colleagues, may provide a strategy to optimize energy storage in carbon materials riddled with holes.

Porous carbon materials soaked in electrolytes are used as supercapacitors, which store energy in charged ions adsorbed to the surface. Contrary to expectations, Gogotsi's team found that such a material's capacitance increases suddenly if the pore width is shrunk below the size of the electrolyte ion's solvation shell. The effect is caused by the distortion of the shells, which pushes their enclosed ions closer to the carbon surface, increasing the number of ions per unit area.

EARTH SCIENCES

Satellite maps fault line

Earth Planet. Sci. Lett. doi:10.1016/j.epsl.2006.06.025 (2006)

Researchers have found a way to use readily available satellite photographs to measure the ground deformation caused by large earthquakes.

Geophysicist Jean-Philippe Avouac and his team at California Institute of Technology in Pasadena, analysed the 7.6-magnitude earthquake that hit Kashmir on 8 October 2005. The team compared before and after images from the Earth-observation satellite Terra. After compensating for distortions caused by the imaging system and the mountainous terrain, they mapped a surface rupture (see graphic above) over 75 kilometres that had an average offset of 4 metres .

Avouac hopes that the new technique, which yields detailed displacement data along an entire fault, can be coupled with on-the-ground measurements to create more realistic models of how earthquakes unfold.

EVOLUTIONARY BIOLOGY

A wrinkly mutant

Nature Genet. doi:10.1038/ng1867 (2006)

A study carried out at Oxford University, UK, by Christopher Knight and his colleagues has mapped how a mutation in a single gene can have knock-on effects in many different proteins. Biologists know that some such effects can be good, others bad — showing how an organism must compromise to adapt to its environment.

The mutation in *Pseudomonas fluorescens* lets the bacteria, which would usually just float around, thrive in wrinkly mats on the surface of nutrient solution. It also resulted in changes to the levels of 52 proteins, which are functionally related, but were not needed to form the mats. Pathways involving these proteins are already implicated in some of the bad effects of the wrinkly mutation, such as impairment of the bacteria's ability to process some nutrients.

CHEMISTRY

In and out of the mix

Science 313, 958–960 (2006)

Chemists have created an elegant surfactant to stabilize emulsions such as those formed by oil droplets in water. The molecule's surfactant properties can be turned on and off, and it is inexpensive, non-toxic and simple to use.

Designed by Philip Jessop of Queen's University in Ontario, Canada, and his colleagues, the surfactant has a hydrocarbon tail attached to a chemical group known as an amidine. The amidine switches from a neutral, oil-soluble state to a charged, hydrophilic state on reacting with carbon dioxide and water. The molecule then prefers to sit with its tail in an oil droplet and its head in water, stabilizing the emulsion. Bubbling air through the mix returns the amidine to its neutral state, breaking up the emulsion.

Such a surfactant could find application in the oil and polymer industries, which often need to recover material from emulsions formed in an earlier processing stage.

JOURNAL CLUB

Lora Hooper
University of Texas Southwestern Medical Center, Dallas, USA

A pizza-loving microbiologist is grateful to have her gut microbes on her side.

When I started working in gut biology about 10 years ago, we knew that microbial cells outnumber human cells in the gut by a wide margin. But we had very little good information about exactly which microbes were there or what they were doing.

So I was delighted when David Relman's group at Stanford University published a paper in which they used state-of-the-art molecular techniques to get a better fix on the microbial make-up of the human gut (P. Eckburg *et al. Science* 308, 1635–1638; 2005). They showed that in the human gut, representatives of three different kingdoms of life (Eucarya, Bacteria and Archaea) coexist.

Karen Nelson's group at The Institute for Genomic Research in Rockville, Maryland, has recently gone even further to provide insight into exactly why we offer a safe haven to our gut microbes (S. Gill *et al. Science* 312, 1355–1359; 2006).

By analysing the DNA sequences present in the collective genomes of the human gut microbiota, her group revealed that a lot of microbial effort goes into breaking down complex carbohyrates in our diet that we can't digest by ourselves. We humans clearly profit from microbial help in extracting dietary energy that would otherwise be lost.

Interestingly, there is even evidence of inter-kingdom collaboration between Archaea and Bacteria in determining which polysaccharides are broken down first (B. Samuel & J. Gordon *Proc. Natl Acad. Sci. USA* 103, 10011–10016; 2006).

I always remind myself that my gut microbes are in it for themselves, but I'm glad they're cooperating for my benefit. I just wonder whether they know what to do with my pizza-rich diet.