E. VAN BOMMEL

University in St Louis, Missouri, and his colleagues tested the models on 14 species, from small bird-like creatures to the large tyrannosaurus. The models, which predict metabolic rates on the basis of anatomy and the energetic cost of walking or running, suggest that the five largest species — each weighing more than 20 kilograms — had a higher metabolic output and were thus warm-blooded. Only the smallest species tested, a 0.25-kilogram *Archaeopteryx*, was deemed to be cold-blooded.

NANOBIOTECHNOLOGY

Magnetic tumour cells

Nature Nanotechnol. doi: 10.1038/nnano.2009.333 (2009)

Cancer can become more deadly when tumour cells spread from one tissue type to another. A technique that uses two kinds of nanoparticle could help to trap and detect these rare cells in the bloodstream, potentially enabling earlier cancer diagnosis, according to Vladimir Zharov of the University of Arkansas for Medical Sciences in Little Rock and his colleagues.

The researchers first inoculated the flank areas of mice with human breast-cancer cells to create tumours, followed later by an injected mixture of magnetic iron nanoparticles and gold-plated carbon nanotubes, each of which could bind to different cancer-cell receptors. The team then applied a magnet to the mouse ear to capture the particle-bound tumour cells, and pulsed the particles with a laser that triggered a photoacoustic signal. The technique detected a rising number of tumour cells in the blood vessels as the primary tumour developed throughout the four-week experiment.

MARINE ECOLOGY

Speedy sponge

J. Exp. Biol. **212,** 3892–3900 (2009)

The marine sponge *Halisarca caerulea* takes up about two-thirds of its body weight in dissolved carbon each day by filtering massive amounts of water, but it barely grows in size.

To work out where the carbon is going, Jasper De Goeij of the Royal Netherlands Institute for Sea Research in Texel and his colleagues collected the sponges from a coral reef (pictured, above) off the Caribbean island of Curaçao in the Netherlands Antilles and stained them with chemicals that reveal actively dividing and dying cells.

They found that some of the sponge's cells divide about every five hours — remarkably fast for a multicellular organism. Most of these fast-dividing cells were from the sponge's filtering chambers. The researchers did not observe much cell death but found that the creatures shed huge amounts of these cells, resulting in the conversion of dissolved carbon into a food source for other reef organisms.

For a longer story on this research, see go.nature.com/t2tgg7

PLANETARY SCIENCE

Cracking Martian ice

Geophys. Res. Lett. **36,** L21203 doi:10.1029/2009GL040634 (2009)

After nearly six months of scraping at the polar regions of Mars, NASA's Phoenix lander in 2008 discovered both ice-cemented soil and slabs of pure ice below the surface. It also found that thermal contractions had cracked the ground surface into polygons. Many on the Phoenix team had attributed the cracking to churning of the surface soil layer caused by seasonal frost cycles.

But by comparing geological features from cold, dry regions of Antarctica to those seen in Phoenix photographs, Joseph Levy of Portland State University in Oregon and his colleagues conclude that sublimation of the deeper slab ice is a better explanation for the cracking. The researchers surmise that the Martian landscape has been chiselled more by the steady loss of massive slab ice from below than by frost action in the surface soil.

REGENERATIVE BIOLOGY

Brainy stem cells

Proc. Natl Acad. Sci. USA **106,** 19150–19155 (2009)

Patients undergoing irradiation for brain tumours often display signs of cognitive dysfunction, owing in part to the loss of healthy neural stem and precursor cells. To investigate possible treatments, Charles Limoli of the University of California, Irvine, and his colleagues injected human embryonic stem cells into the brains of irradiated rats. After four months, the researchers confirmed the cells' survival in the rats' brains and found that the animals performed much better in a place-recognition task compared with irradiated rats that did not receive the transplant.

JOURNAL CLUB

Matt Friedman
University of Oxford, UK

A palaeontologist ponders how biodiversity is spread across the vertebrate tree of life.

Why do some biological groups burst at the seams with many different species, whereas others, despite their deep evolutionary heritage, contain only a handful of members? Many of my old vertebrate-biology textbooks are rife with qualitative scenarios, peddled with surprising degrees of confidence, that explain how species-rich branches can chalk up their success to key evolutionary 'innovations' and how less-diverse ones haven't kept up with changing conditions. What you won't find are details of how these exceptional groups might be identified in the first place.

Michael Alfaro of the University of California, Los Angeles, and his colleagues have now quantified this black art (*Proc. Natl Acad. Sci. USA* **106,** 13410–13414; 2009). They marry statistically explicit models with fossil-calibrated evolutionary trees and counts of living species to ask a basic, but surprisingly unanswered question: precisely which branches of the vertebrate family tree are more or less species-rich than expected given their age?

The authors identify nine groups that show substantial changes from the background tempo of vertebrate evolution: 'living fossils' such as lungfishes are characterized by lower-than-predicted diversity, whereas other branches, such as the perch-like fishes and a subset of mammals, contain vastly more species than expected.

As a palaeontologist, I am intrigued that three of the exceptionally diverse radiations are thought (although not without controversy) to have proliferated following the mass extinction that killed off the dinosaurs, hinting at the far-reaching consequences of this event in structuring the modern vertebrate fauna. Most importantly, these authors establish a clear quantitative framework that can be used to test all those textbook stories. I'm confident that in a few years, my students will learn a much more nuanced picture of vertebrate diversification than I ever did, one that will trace its own roots back to studies such as this.

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