RESEARCH HIGHLIGHTS

COSMOLOGY

The Universe bounces back

Phys. Rev. Lett. **96,** 141301 (2006)

Will physics fit through the pinhole of the Big Bang — the first instants of space and time, when everything fitted into a volume smaller than a quark? This is the challenge for theories of quantum gravity, which pursue the elusive union of quantum mechanics and general relativity.

Abhay Ashtekar and colleagues of Pennsylvania State University argue that one of the most promising theories, known as loop quantum gravity, can preserve the predictability of physics through this singularity in space-time. They say that loop quantum gravity produces a quantum bridge between two large, classical universes: one expanding, the other contracting. Thus the Big Bang could have been a big bounce, as a previously shrinking universe reversed its contraction.

CANCER BIOLOGY

Reading the runes

Proc. Natl Acad. Sci. USA **103,** 5923–5928 (2006)

Data from thousands of patients are needed to identify the genes that influence the outcome of cancer, say researchers.

Early prediction of a cancer's potential for metastasis or relapse would improve treatment. But lists of 'predictive' genes, whose level of expression is thought to correlate with clinical outcome, have been unreliable. Lists from different studies have few genes in common.

Eytan Domany and his colleagues at the Weizmann Institute in Israel devised a mathematical method called probably approximately correct (PAC) sorting to assess the problem. They calculate that data from thousands of patients, rather than the hundreds used in studies so far, are needed to compensate statistically for the weak correlation between individual gene activity and disease outcome.

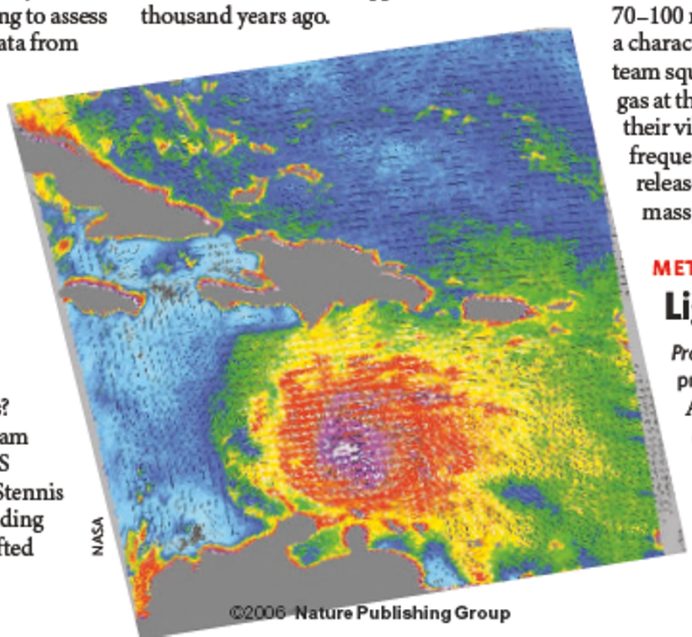
OCEANOLOGY

Ivan the terrible

Geophys. Res. Lett. **33,** L07607 (2006)

Might hurricanes trigger tsunamis? This is the question posed by William Teague and his colleagues of the US Naval Research Laboratory at the Stennis Space Center in Mississippi, on finding that Hurricane Ivan (pictured) shifted around 100 million cubic metres of sediment as it stormed into the Gulf of Mexico in September 2004.

The researchers based their estimate on data from six instruments moored on the sea floor under Ivan's path. They suggest that the accumulation of sediment and shaking of the sea floor caused by a hurricane might trigger an underwater landslide, called a slump, resulting in a tsunami. Geological evidence suggests that just such a slump occurred in the Mississippi Delta several thousand years ago.



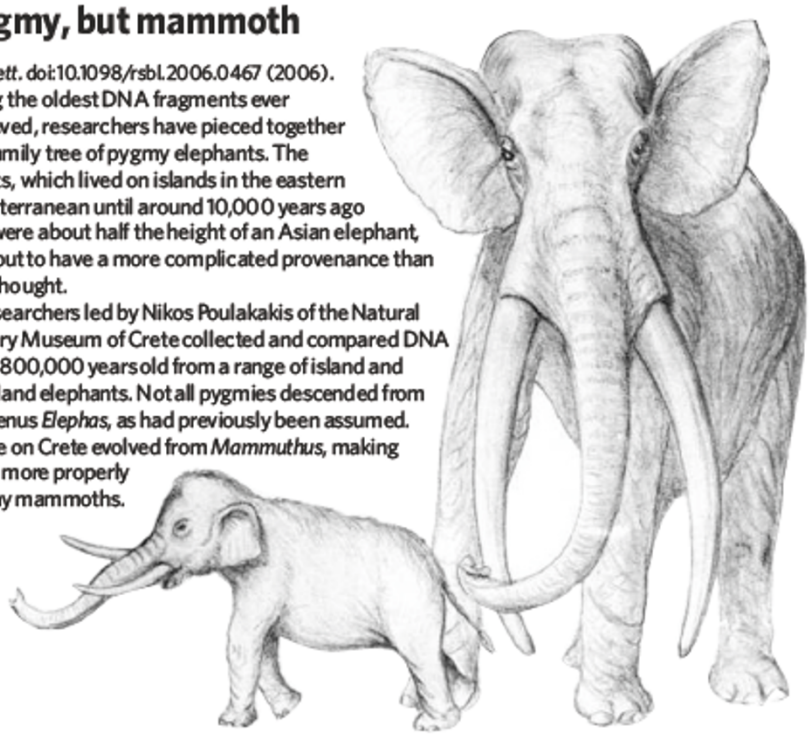
NASA

Pygmy, but mammoth

Biol. Lett. doi:10.1098/rsbl.2006.0467 (2006).

Using the oldest DNA fragments ever retrieved, researchers have pieced together the family tree of pygmy elephants. The beasts, which lived on islands in the eastern Mediterranean until around 10,000 years ago and were about half the height of an Asian elephant, turn out to have a more complicated provenance than was thought.

Researchers led by Nikos Poulakakis of the Natural History Museum of Crete collected and compared DNA up to 800,000 years old from a range of island and mainland elephants. Not all pygmies descended from the genus *Elephas*, as had previously been assumed. Those on Crete evolved from *Mammuthus*, making them more properly pygmy mammoths.



N. POULAKAKIS

MEASUREMENT SCIENCE

Small scale

Nano Lett. **6,** 583–586 (2006)

Researchers in the United States have fine-tuned a sensing technique to measure mass with zeptogram (10^{-21} g) resolution. In principle, this should make it possible to weigh tens of atoms or a single molecule.

To make the measuring device, a team of scientists at the California Institute of Technology used silicon carbide beams just 70–100 nanometres in width that vibrated at a characteristic, very high frequency. The team squirted streams of xenon and nitrogen gas at the beams and recorded the change in their vibrational frequency. Comparing the frequency shift to the quantity of gas released yielded a reliable measurement of mass to the zeptogram scale.

METHODS

Lighting the way

Proc. Natl Acad. Sci. USA doi:10.1073/pnas.0509881103 (2006)

A new optical technique can concentrate and steer clusters of biomolecules such as proteins in solution.

Developed by Dean Hafeman of Protein Discovery in Knoxville,

Tennessee, and his colleagues, the technique uses a laser spot to concentrate charged biomolecules into an area measuring about 1 mm across. The laser is shone onto a photoconductive electrode, which sits below a conductive fluid layer containing the biomolecules, sandwiched by a second electrode.

The electric field created by the laser spot forms a trap which carries the molecules as the laser moves. The team demonstrates the process — which they call photo-electrophoretic localization and transport — by dragging a packet of proteins about half a millimetre per minute.

MOLECULAR BIOLOGY

Slide and jump

Nature Struct. Mol. Biol. doi: 10.1038/nsmb1086 (2006)

The action of an enzyme that attenuates the infectivity of HIV has been shown to have an intriguing asymmetry.

APOBEC3G, which is encapsulated in HIV, helps stop the virus infecting certain cells. It does this by mutating the single-stranded DNA copied from the virus's RNA. Specifically, the enzyme converts a cytosine nucleotide from the end of a CCC triplet into a uracil nucleotide.

Myron Goodman and his colleagues at the University of Southern California in Los Angeles looked at why the mutations predominantly appear on the same end of the triplets. They show that APOBEC3G can slide and jump along single-stranded DNA in both directions to reach its target, but that it only catalyses mutations when moving in one direction.

IMMUNOLOGY

No pain, no heartache

J. Clin. Invest. doi:10.1172/JCI27540 (2006)

There may be a way to get the pain-relief benefits of the drugs called COX2 inhibitors without the cardiovascular problems that can result from long-term use.

Such drugs are thought to relieve pain and inflammation by suppressing COX2-derived prostacyclin (PGI2) and prostaglandin E2 (PGE2). Working in mice, Garret FitzGerald at the University of Pennsylvania School of Medicine, Philadelphia, and his colleagues show that disabling COX2 also causes blood-pressure and clotting problems.

They found that disabling a third protein in the pathway, microsomal PGE synthase-1 (mPGES-1), might be one way around this problem. It lowers the activity of PGE2 and still combats pain — but it boosts that of PGI2 and apparently dodges the cardiovascular problems.

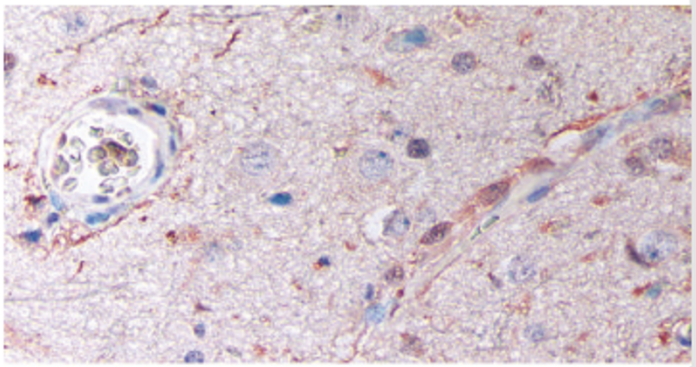
CANCER BIOLOGY

Stemming tumour growth

Cancer Cell **9**, 287–300 (2006)

Researchers hoping to stop the growth of gliomas, an aggressive form of brain cancer, have narrowed in on a promising target.

Howard Fine of the National Cancer Institute in Bethesda, Maryland, and his colleagues showed that a growth factor



B. SEVER

associated with the cancer, stem-cell factor, aids the tumours' spread by promoting the formation of new blood vessels, a process known as angiogenesis. Drugs targeting stem-cell factor might slow this. The picture above shows tumour cells surrounding blood vessels.

MATERIALS SCIENCE

Sink or swim

Macromolecules doi: 10.1021/ma060006u (2006)

Magnetic particles with collapsible polymer coats could be useful in catalysis, say researchers from the University of Düsseldorf in Germany.

Annette Schmidt and her colleagues made round magnetite particles that bristled with long-chain polymers and added them to methanol. Below a critical temperature, the particles precipitated, because their polymer chains crumpled close to the surface. Above it, the chains straightened out, helping the particles to disperse though the liquid. The researchers suggest this thermoresponsive system could be used to disperse catalyst-carrying particles during a reaction, then collect them up afterwards.

JOURNAL CLUB

Shahid Naeem
Columbia University, New York

An ecologist ponders the pendulum of natural history's paradigm.

The central paradigm of natural history has been stuck for 200 years, ever since Georges-Louis Leclerc de Buffon lost out to Carl Linnaeus.

Buffon championed an encyclopaedic approach to classifying nature, but his 36-volume attempt to study all aspects of all species, *Histoire Naturelle, Générale et Particulière*, often got fundamental things such as species relationships wrong.

In contrast, Linnaeus generally got species relationships right, by focusing on homologous, or structurally similar, traits. The homologous trait of feathers correctly flocks birds together, for example, whereas the functional trait of wings would erroneously group birds with bats and bees.

When Darwin later identified common descent as the rational basis for homology's success, it seemed the pendulum of natural history's paradigm was fixed.

But natural history based on homology has led to a biotic inventory that cannot predict the consequences of biodiversity loss, because it lacks information on species' functional traits. We need to know what species do, not who they are related to.

So when my graduate student pointed out a paper by Brian McGill of McGill University in Montreal and his colleagues (B. J. McGill *et al. Trends Ecol. Evol.* **21**, 178–185; 2006), I was fascinated to hear the echo of my lament among community ecologists.

McGill *et al.* claim that 50 years of concentrating on population dynamics has created a field that cannot predict species distributions. To fix this, they argue for an approach centred on functional traits.

This paper will, I'm sure, be widely read and debated. When the pendulum of a paradigm stops, someone needs to give it a nudge.