

RESEARCH HIGHLIGHTS

First breath

PLoS Genetics doi:10.1371/journal.pgen.0010010 (2005)

A class of birth defects that affect the diaphragm has been linked to a faulty gene by Kate Ackerman of Harvard Medical School and her colleagues. The gene seems essential to lung development.

One in 3,000 babies are born with diaphragm defects, which often prove fatal because of associated lung problems. In mice, Ackerman's team found that mutations in the *Fog2* gene caused diaphragmatic defects and disrupted the development of lungs grown *in vitro* (pictured). They also identified a *Fog2* mutation in a human baby with defects in both organs.



PILOS/K. ACKERMAN ET AL.

MOLECULAR BIOLOGY**DNA unpacked**

Cell 121, 873–885 (2005)

DNA is normally packed into a dense structure called chromatin, which is stabilized by histone proteins. When a particular gene needs to be activated, nearby histones are chemically modified; this allows the DNA to be transcribed. Such changes can include the addition of acetyl and methyl groups by enzymes.

A team led by Robert Roeder of The Rockefeller University, New York, provides evidence that these modifications do not occur independently, but in coordinated combinations. They isolated a stable complex of molecules, which included both methyltransferase and acetyltransferase enzymes. The complex acts as a molecular machine to control gene transcription.

BIOTECHNOLOGY**Stocky in stature**

Science doi: 10.1126/science.1113373 (2005)

The key to high-yield rice is an enzyme involved in the plant's reproduction, find researchers led by Makoto Matsuoka of Nagoya University in Japan.

Although regions of the rice genome associated with enhanced seed production were identified after the genome was first sequenced, how such sequences work was not understood. By studying transgenic plants, Matsuoka's team has discovered that one such region suppresses levels of the enzyme cytokinin oxidase, which regulates levels of a hormone involved in seed production. The team cross-bred plants with this genetic trait

with a stocky rice variety, to produce a plant (pictured below) that is heavy with seeds, but not so tall that it falls over in storms.

MICROBIAL GENETICS**Saints and sinners**

Nature Biotechnol. doi:10.1038/nbt1110 (2005)

Many bacteria of the genus *Pseudomonas* are pathogens, including *P. aeruginosa*, which infects cystic fibrosis patients, and the fruit canker agent *P. syringae*. By contrast, the soil-dwelling *P. fluorescens* protects plants from pathogens and frost.

To find out how the saint differs from the sinners, researchers led by Joyce Loper from the Agricultural Research Service in Oregon and Ian Paulsen of The Institute for Genomic Research in Rockville, Maryland, sequenced the complete *P. fluorescens* genome. At 7.1 million bases, it is larger than the genomes of its less benign cousins and stuffed with gene clusters for chemicals harmful to pathogens, a third of which were previously unknown.

**SOLID-STATE PHYSICS****Spin under strain**

Phys. Rev. Lett. 94, 236601 (2005)

Future electronic devices could rely on the control of electronic spin, rather than charge, which means the discovery that mechanical forces can change a spin's orientation may have practical use. Scott Crooker and Darryl Smith of the Los Alamos National Laboratory in New Mexico used a standard optical technique called Kerr microscopy to picture spin flow in a semiconductor. The researchers measured the spins' response to electric, magnetic and mechanical forces, and found that a mechanical strain changed the spin independently of the electric field applied.

NEUROBIOLOGY**Clearing the mind**

Nature Genet. doi:10.1038/ng1591 (2005)

Brain cells use motor proteins called dyneins to ferry harmful proteins to their doom, report researchers led by David Rubinsztein of the Cambridge Institute for Medical Research, UK. This explains why protein clumps characteristic of certain kinds of motor-neuron disease form when mutations impair the dynein machinery.

The group studied the effect of such mutations in a mouse model of Huntington's disease. Mice with impaired dynein function developed the disease more quickly than mice with the Huntington mutation alone. The researchers suggest that this is because dynein propels packages of the harmful protein — in this case, mutant huntingtin — along the intracellular skeleton towards lysosomes, where they are destroyed.

IMAGE COURTESY OF M. A. SHIKARI AND M. MATSUOKA

ANIMAL BEHAVIOUR

The buzzword*Curr. Biol.* **15**, 447–448 (2005)

Bumblebees take cues from each other when faced with unfamiliar flowers, report Ellouise Leadbeater and Lars Chittka from Queen Mary, University of London.

They released bees (*Bombus terrestris*, pictured) into a box containing two unfamiliar types of flower, and noted which type each bee selected. In subsequent trials, the bees were most likely to forage on flowers of the type they first chose, and usually only tried a flower of the unfamiliar variety if it was already being fed on by another bee. Because bees forage in unpredictable habitats, taking a lead from a fellow bee might maximize their nectar haul, the researchers suggest.

GENOMICS

Islands of stability*Genome Res.* doi:10.1101/gr.35774.05 (2005)

Comparing the sequences of different mammalian genomes can illuminate the regions that have functional importance, because such elements tend to be conserved from one species to the next.

Arend Sidow of Stanford University in California and his colleagues demonstrate a powerful approach to performing such a comparison. They lined up sequences taken from the genomes of 29 different mammals and counted the number of substitutions of single bases that appeared along their length. Segments which carried fewer substitutions than expected by chance were considered to be 'constrained' and deemed likely to have some vital function. The team's technique, dubbed 'genomic evolutionary rate profiling',

identified constrained regions that varied from 3 to 1,000 base pairs in length.

CHEMISTRY

Cleaning up*Anal. Chem.* doi:10.1021/ac050460g (2005)

Chemists are being offered a new and improved version of the detergent they use to wash proteins from cell membranes for study. The new detergent molecule collapses to prevent it interfering with mass spectrometry measurements.

Researchers led by Richard Caprioli of Vanderbilt University in Nashville designed the detergent to fall apart after an acid treatment. A fragment is left behind that binds the membrane protein into a solid matrix ready for analysis. When the technique was applied to the entire contents of a cell, it revealed many more proteins than were recovered with a commercial detergent.

FLUID DYNAMICS

Slip and slide*Phys. Rev. Lett.* **94**, 244501 (2005)

When a liquid flows over a surface, the traditional model says that the molecules of the liquid that are closest to the surface stay still, rather than sliding past. But experiments have suggested that surfaces are more slippery than this, particularly if the forces between the surface and liquid are weak.

The lingering confusion has been cleared up by Liliane Leger and colleagues at the Physics of Organized Fluids Laboratory, Paris. They used an optical technique to measure the velocity of two organic liquids, squalane and hexadecane, flowing over different surfaces. Not only do the liquids 'slip' even when the solid-liquid interactions are strong, but the amount of slip is also found to depend on molecular shape: branched molecules slip less.

IMAGE
UNAVAILABLE
FOR COPYRIGHT
REASONS

S. HOPKIN/ARDEA.COM

JOURNAL CLUB**Dian J. Seidel**

National Oceanic and Atmospheric Administration, Silver Spring, Maryland

Follow the ups and downs of a boundary in the atmosphere with a climate scientist.

In introductory meteorology courses, we learn that the tropopause is the boundary between two layers of the atmosphere: the troposphere, where weather occurs, and the stratosphere above. I was

once content to think that the tropopause had little more geophysical importance than political borders on land. Not any more.

A recent series of path-breaking papers propose that the global tropopause is a sensitive indicator of human-induced climate change. From its first airing in the *Journal of Geophysical Research* (B. Santer *et al.* **108**, 4002–4024; 2003), this tantalizing idea sparked the interest of the broader climate-science community, and rekindled my own

research in the tropopause.

We expect the troposphere to warm and the stratosphere to cool in response to increases in greenhouse gases. And simple thermodynamic principles predict that the tropopause will rise. In support, Ben Santer and his colleagues detected an upward trend in the height of the tropopause in model-generated 'reanalyses' of atmospheric observations spanning the past few decades.

Motivated by Santer's work, and in collaboration with Bill Randel of

the National Center for Atmospheric Research in Boulder, Colorado, I am using data from weather balloons called radiosondes to study the structure and variability of the tropopause, particularly in extratropical regions. In winter, near the jet streams, for example, there can be multiple tropopause levels. Before we confidently rely on the tropopause to tell us about the climate, we need to understand its complexity and behaviour. Fortunately, we're making progress on this front.