RESEARCH HIGHLIGHTS

CLIMATE SCIENCE

Water, water, in the air

Proc. Natl Acad. Sci. USA doi:10.1073/pnas.0702872104 (2007)

Satellite observations show that the total atmospheric moisture content above the oceans has increased by 0.41 kilograms per square metre per decade since 1988. Statistical analyses now show that this is a climate 'fingerprint' of human greenhouse gas emissions.

The analysis, led by Benjamin Santer of the Lawrence Livermore National Laboratory in California, shows that the observed increases in atmospheric moisture levels are consistent with models that take into account a human-induced greenhouse effect. Furthermore, they could not be fully explained by other proposed causal factors such as increased solar activity or recovery from the 'global dimming' effects of the 1991 Mount Pinatubo eruption.

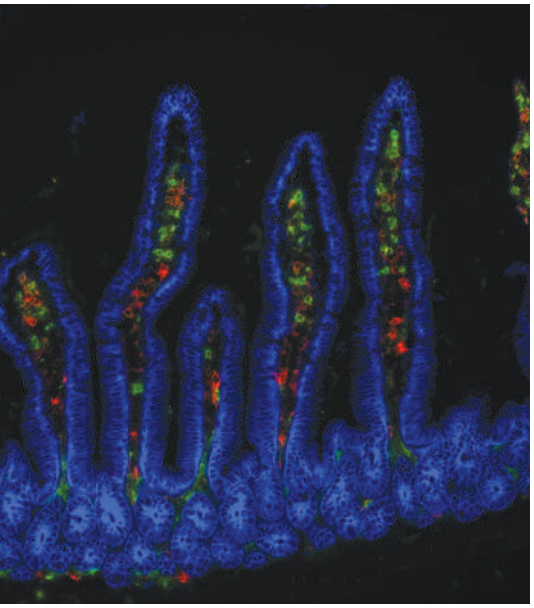
IMMUNOLOGY

A gut decision

Nature Immunol. doi:10.1038/ni1511 (2007)

In the gut, the immune system must attack deadly pathogens such as *Salmonella*, while tolerating the billions of harmless bacteria that live there. Bali Pulendran and his colleagues at Emory University in Atlanta have discovered two types of immune cell in the guts of mice that may help to determine which response a microbe meets.

The cells seem to wage a tug-of-war. On one side are a type of macrophage (stained green in the section of small intestine pictured) that acts to suppress the immune response. On the other, a type of dendritic cell that the team showed turns up mouse defences. Their interplay may be what shifts the overall response of the immune system in the gut. The researchers also suggest that imbalances in the cells' effects could explain inflammatory bowel disease.



The scent collectors

Proc. R. Soc. B doi:10.1098/rspb.2007.0727 (2007)

Researchers have traced how male neotropical orchid bees (pictured) concoct a perfume that they may use to seduce their mates.

The bees collect scents by spitting fatty secretions onto everything from flowers to faeces. The secretions absorb the smell, and are then stashed in pockets on the bees' hind legs. Thomas Eltz at the University of Düsseldorf in Germany and his colleagues isotopically labelled a component of these secretions and added it to the hind-leg pockets of male *Euglossa viridissima*. Four days later, the bees had recycled most of the compound, moving it from the legs to glands in the head.

The researchers note that *E. viridissima* glands and secretions resemble those of bumblebees that spread their own scent, suggesting an evolutionary link between the two behaviours.

T. ELTZ

NEUROBIOLOGY

Cycling in tune

Nature Neurosci. doi: 10.1038/nn1974 (2007)

Auditory neurons, which transmit acoustic information into the brain, need to encode sounds ranging from the very quiet to the very loud. New observations show that the number of one type of receptor at a neuron's surface drops temporarily after exposure to a loud sound, decreasing the neuron's sensitivity to subsequent noise.

William Sewell and his colleagues at the Massachusetts Eye and Ear Infirmary and Harvard Medical School in Boston saw this happening for AMPA receptors. Researchers have previously seen AMPA receptors coming and going in cultured hippocampal neurons. The function of such recycling in a part of the brain associated with learning and memory is not clear, but the researchers suggest that in auditory neurons it may optimize the handling of sound's large dynamic range.

OPTICS

Bumps in the night

Appl. Phys. Lett. **91,** 101108 (2007)

Some nocturnal insects such as moths enhance their vision with an antireflective coating of tiny bumps on their compound eyes. Peng Jiang of the University of Florida in Gainesville and his co-workers offer a cheap route to copying the coating's design.

Antireflective coatings are useful in industry, for example on car dashboards or solar cells. But patterns that mimic the small moth-eye bumps are difficult to make over large areas using standard lithographic patterning methods. Jiang and colleagues' approach is to cover a surface with a layer of 360-nm silica beads, which pack into an ordered array. This acts as the template for a mould made from a soft polymer, from which endless replicas of the bead layer can be made.

CELL BIOLOGY

Out of shape

Cell **130,** 837–850 (2007)

Proteins known as septins form part of a signalling pathway that links a human cell's scaffolding to its DNA-damage response, researchers report.

Ian Macara and his team at the University of Virginia School of Medicine in Charlottesville

found that silencing expression of three septins caused human cells to lose their shape, because their scaffolding of actin fibres broke down. They showed that the effect depends on the interaction of septins with a signalling protein called SOCS7, and that loss of that interaction triggers SOCS7 to recruit another protein, known as NCK, to the cell's nucleus.

Further experiments revealed that NCK also collects in the nucleus of cells exposed to DNA-damaging stresses such as ultraviolet light, helping to stop the cells' growth. Macara says that many details of how and why the link operates remain to be explored.

CANCER BIOLOGY

Alternative remedy

Cancer Cell **12,** 230–238 (2007)

New research challenges the long-held idea that antioxidants fight tumours primarily by preventing DNA damage. Tests involving vitamin C and another antioxidant, *N*-acetylcysteine, suggest that they inhibit tumour growth by destabilizing the protein hypoxia-inducible factor 1 (HIF-1). This protein stimulates blood-vessel development and glucose metabolism in tumours.

Chi Dang of Johns Hopkins University School of Medicine in Baltimore, Maryland, and his colleagues found that *N*-acetylcysteine reduced tumour growth in mice and in human cell cultures without affecting the frequency of genome rearrangements due to DNA damage. They also found that both *N*-acetylcysteine and vitamin C increased the degradation of HIF-1. The researchers confirmed the link with the finding that tumours expressing a mutant form of HIF-1 that resists degradation were less affected by the two antioxidants than those expressing a normal form.

J.J. MITCHELL/REUTERS

PHYSICS

Going up

Phys. Rev. Lett. **99,** 104501 (2007)

The aerodynamic lift of supersonic aircraft could be boosted by roughening the undersurface of their wings, Guang Lin and his colleagues at Brown University in Providence, Rhode Island, suggest.

The researchers' computational models predict that the amount of lift generated by an aerofoil wing over which air flows at supersonic speeds increases when the wing's bottom edge has a randomly rough surface. This offers a theoretical validation of an idea that emerged from experiments in the 1990s.

The effect is caused by complex reflections of the shock waves generated at the wing surface, and the increase in lift can be comparable to that produced by a smooth aerofoil. But the authors stress that any attempt to exploit the effect in aircraft (should there be a successor to Concorde, pictured, for example) would have to balance the gain in lift against the increased drag the roughness causes.

METHODS

Dot to dot

J. Am. Chem. Soc. doi:10.1021/ja073527l (2007)

Carbon nanoparticles can be used in a technique known as multiphoton imaging to light up the inside of cells, researchers report.

Ya-Ping Sun and his colleagues at Clemson University in South Carolina found that carbon particles coated in large organic molecules emit light when excited by two infrared-wavelength photons. Multiphoton spectroscopy benefits from using these long wavelength photons because they can penetrate tissue more deeply and are less damaging to biological material than shorter wavelength light. The team tested the particles in human cancer cells. Carbon-based imaging agents are non-toxic and are unlikely to bioaccumulate.

IMMUNOLOGY

Collateral damage

J. Clin. Invest. doi:10.1172/JCI31344 (2007)

A type of therapy being tested against HIV may carry a risk of boosting coronary artery disease, if results from a mouse study hold true in humans.

Previously, researchers have shown that a protein known as programmed death 1 (PD-1) is displayed at high levels on T cells in patients with HIV. PD-1 seems to interact with partner proteins PD-L1 and PD-L2 to exhaust the body's response to the virus, so scientists are testing whether blocking this interaction could help patients to fight HIV.

But Andrew Lichtman and his team at the Brigham and Women's Hospital and Harvard Medical School in Boston, Massachusetts, have found that if mice with high cholesterol lack PD-L1 and PD-L2, they have larger plaques in their arteries with more T cells than do mice with high cholesterol that have both proteins.

JOURNAL CLUB

Eörs Szathmáry
Collegium Budapest, Hungary, and The Parmenides Foundation for the Study of Thinking, Munich, Germany

A theoretical biologist recommends thought-provoking reading on the origin of translation and the genetic code.

As Francis Crick and his co-workers once noted, "the origin of protein synthesis is a notoriously difficult problem". Our best hopes of resolving this problem begin, in my opinion, in an RNA world.

The RNA-world hypothesis holds that RNA emerged before DNA and proteins, neatly separating the origin of life from that of the genetic code and its translation. The question then becomes: how did RNA evolve to make proteins?

In a recent paper, Yuri Wolf and Eugene Koonin of the National Institutes of Health in Bethesda, Maryland, present one scenario (*Biol. Direct* **2,** 14; 2007).

They rightly call attention to studies that suggest that protein-based aminoacyl-tRNA synthetases, which are involved in the first steps of assembling amino acids into proteins, are relatively late evolutionary inventions. This forces us to accept the idea that protein synthesis is older than such synthetases.

Before the evolution of synthetases, the only agents that could conceivably have marshalled amino acids are RNA enzymes, or ribozymes. Wolf and Koonin share my view that the recruitment of amino acids was driven by selection for enhanced catalytic activity, and that the ancestor of the large ribosomal RNA that catalyses protein synthesis in today's cells — a molecular 'fossil' — was a catalyst that linked only two amino acids.

I am less happy with these authors' suggestion of a relatively late switch from peptide-specific proto-ribosomes to those that could use an external template such as mRNA to synthesize peptides with arbitrary sequence — but they may well be right.

They lay out an evolutionary sequence that is more complete than the scenario I once proposed. I highly recommend this well-written, thought-provoking paper.

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