

# RESEARCH HIGHLIGHTS

## EXOPLANETS

### Explaining the eccentricities

*Asrophys. J.* **702**, 716–723 (2009)

The near-circular orbits followed by the planets in the Solar System are probably not the norm. Many planets travelling around other stars appear to follow an oblong or 'eccentric' path.

In some cases, that apparent eccentricity may be caused by the presence of a second, undetected planet. Timothy Rodigas and Philip Hinz at the University of Arizona in Tucson modelled a range of solar systems. They found that about 4% of the time, a hidden planet far from the star could create the illusion that the closer planet was in a highly eccentric orbit. The effect was much more pronounced for planets with moderately oblong orbits.

The team says that their study could help to explain the apparent abundance of eccentric exoplanets. It could also help researchers to find hidden planets.

## BIOLOGY

### A colourful past

*Biol. Lett.* doi:10.1098/rsbl.2009.0524 (2009)

Reconstructions of extinct species often attribute garish colours to animals on the basis of nothing more than artistic licence. Now Derek Briggs of Yale University and his colleagues have discovered evidence of preserved colour in fossil feathers.

Using a scanning electron microscope, they found neatly organized pigment structures called melanosomes in fossils such as the one pictured below from the Messel Shale in Germany. Owing to the loss of surrounding keratin, which is involved in optical scattering, they could not determine the feathers' exact hue.

But comparison with the melanosomes of modern birds suggest black feathers with a iridescent blue, green or copper sheen.



J. VINTNER

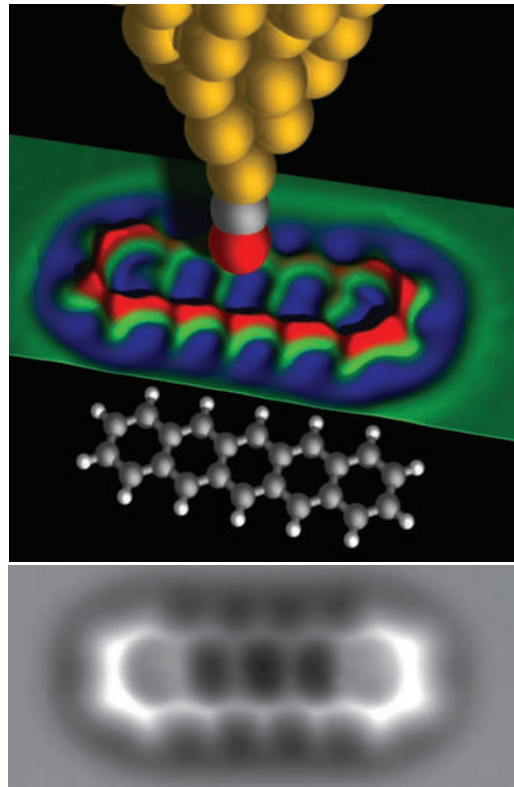
### Seeing the honeycomb

*Science* **325**, 1110–1114 (2009)

Behold pentacene (pictured right), a five-ringed hydrocarbon molecule shown with remarkable clarity thanks to an atomic force microscope with a crucial modification.

Leo Gross and his colleagues at IBM Research in Zurich, Switzerland, placed a carbon monoxide molecule on the tip of the microscope's sensitive detector. The tip scans over the surface and is deflected by its interaction with the atoms in the sample.

Choosing the right molecule for the tip enabled repulsion due to the electronic exclusion principle to dominate over the blurring caused by attractive Van der Waals and electrostatic forces. The improved contrast allowed the researchers to resolve the positions of individual molecules and the bonds between them.



IBM RESEARCH, ZÜRICH

## IMMUNOLOGY

### Killer fat

*Immunity* **31**, 232–244 (2009)

Lipid droplets in a type of immune cell may have a key role in triggering attacks on infected and damaged cells.

Dendritic cells engulf pathogens, chop up their components and display the resulting antigens on their surfaces using the major histocompatibility complex class I (MHC I) molecules. These antigens activate cytotoxic T cells, which seek and destroy infected cells.

Pierre Guermonprez at Rockefeller University in New York and his colleagues found that an enzyme residing on lipid droplet membranes is essential to this pathway. When the researchers eliminated the enzyme in mice, they found defects in the cells' lipid droplets and in their ability to display antigens through the MHC I pathway. The manipulation did not affect the MHC II pathway.

## PAIN

### Deep, deep in your head

*Neuron* **63**, 533–543 (2009)

The placebo effect is more hard-wired into the brain than previously thought.

For decades, scientists have known that sham treatments can relieve pain, and studies

have identified natural opioid pathways as important players. But because the placebo effect seems to be linked to expectation, some have assumed that it occurs mainly through 'higher' brain structures associated with consciousness.

Falk Eippert at the University Medical Center Hamburg-Eppendorf in Germany and his team imaged the brains of volunteers given a sham ointment to relieve a mild burning pain. Half of them had been treated with naloxone, a chemical that blocks opioid signalling. The researchers found that placebo-related brain activity normally occurs in both the prefrontal cortex and more hard-wired areas, such as the amygdala, hypothalamus and parts of the brainstem.

## CHEMISTRY

### Bacterial factories

*Biotechnol. Bioeng.* doi:10.1002/bit.22502 (2009)

Researchers have engineered bacteria to produce useful levels of putrescine, a key ingredient in the production of plastics and industrial chemicals. Putrescine — a natural breakdown product of amino acids that contributes to the characteristic odour of rotting flesh — has historically been manufactured from petrochemicals through environmentally harsh methods.

To develop a more sustainable process, Sang Yup Lee and his colleagues at the Korea Advanced Institute of Science and Technology in Daejeon, Republic of Korea, boosted putrescine production in *Escherichia coli*. Their method involved inactivating the metabolic pathways that use and degrade putrescine, and amplifying the production of an enzyme that makes it from its precursor, ornithine. In high-cell-density cultures, the bacteria can produce up to 24.2 grams of putrescine per litre in about 32 hours.

#### CANCER BIOLOGY

### Cilia's dual role

*Nature Med.* doi:10.1038/nm.2011; doi:10.1038/nm.2020 (2009)

Cilia, the thin filaments that protrude from many mammalian cells, can both inhibit and exacerbate tumour formation in mice.

Cilia are essential for proper functioning of the hedgehog signalling pathway, which has been found to go haywire in various cancers. Jeremy Reiter of the University of California, San Francisco, and his colleagues deleted genes for cilia formation in two mouse models of skin cancer, each carrying a mutation in the hedgehog pathway. Tumours did not grow in mice with one mutation, but were accelerated in mice carrying the other.

Arturo Alvarez-Buylla, also at the University of California, San Francisco, and his colleagues found similar results modelling brain cancer in mice. In addition, they showed that some types of human brain cancer have cilia, whereas others do not, suggesting that cilia could aid in diagnosing cancer type.

#### GENETICS

### Y-rated

*Curr. Biol.* doi:10.1016/j.cub.2009.07.032 (2009)

DNA sequencing of the human Y chromosome suggests that humans carry 100–200 genetic mutations not seen in their parents. This direct measurement of the human mutation rate should help researchers to refine evolutionary dating and better understand the source of genetic disease.

Yali Xue and Chris Tyler-Smith of Wellcome Trust Sanger Institute in Hinxton, UK, and their colleagues sequenced the Y chromosome of two men in China separated by 13 generations. Four mutations had cropped up during that time. Extrapolating out to the 6-billion-odd base pairs of the complete human genome, that translates to roughly one mutation per 30 million base pairs per generation on average.

For a longer story on this research, see <http://tinyurl.com/nv9u59>

#### MICROBIOLOGY

### Resistance is futile

*Clin. Infect. Dis.* 49, 869–875 (2009)

Antibiotic resistance in pathogens can be reversed by rolling back the total amount of the drug consumed, but it increases as soon as consumption rises again.

During a seven-month period in 2001–02, the use of ciprofloxacin, a popular antibiotic, was restricted in Israel because supplies were being stockpiled in case of a bioterrorist attack. Michal Chowers and her colleagues at Tel Aviv University in Israel measured the ciprofloxacin sensitivity of the bacterium *Escherichia coli* from urine samples before, during and after this period.

A near 50% drop in ciprofloxacin use reduced the percentage of samples containing resistant bacteria from 12% to 9%. But resistance surged as soon as people started popping the pills again.



C. KREBS/CORBIS

#### FOOD CHEMISTRY

### Bee-devilled by corn syrup

*J. Agric. Food Chem.* 57, 7369–7376 (2009)

Dangerous levels of toxins that can form in high-fructose corn syrup and endanger domesticated honeybees can now be easily predicted and eliminated.

Blaise LeBlanc, while at the US Department of Agriculture in Tucson, Arizona, and his colleagues measured the rate of formation of hydroxymethylfurfural (HMF), a heat-generated contaminant found in high-fructose corn syrup, honey and other foods. Over a 35-day period, they tracked HMF content in several brands of syrup stored at different temperatures. They also established the concentration at which HMF becomes toxic to caged bees.

Although temperatures of around 32 °C had little effect, those of 40 °C and above caused the HMF content to rise markedly. The rate of the increase can be precisely predicted from pH and other variables, the scientists say. HMF formation was lower in syrups of higher pH, and adding bases to syrup reduced levels of the toxin.

## JOURNAL CLUB

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### A microbiologist wonders what turns us on.

An Internet search for the words 'pheromone attractant' pulls up products ranging from human aphrodisiacs to control measures for the Colorado potato beetle.

But sexual chemistry is not only important to humans and beetles, it is also relevant to many fungi. Fungal peptide pheromones are often released by one mating type to attract a partner of the opposite sex, thereby initiating the programme of sexual differentiation. This signalling is often highly specific so that pheromones attract only potential partners and not unwanted suitors.

Work by Joseph Heitman and his colleagues at Duke University in Durham, North Carolina, provides a new spin on pheromone signalling in fungi (Y.-P. Hsueh *et al.* *EMBO J.* 28, 1220–1233; 2009). While studying the fungal pathogen *Cryptococcus neoformans*, the authors became curious about the function of an uncharacterized pheromone-receptor-like gene.

It turns out that this gene, *CPR2*, encodes a constitutively active receptor that stimulates downstream mating events in both the presence and absence of pheromones. During sexual differentiation, expression of *CPR2* is upregulated and supplements the activity of conventional pheromone receptors. A single amino-acid substitution in the Cpr2 protein, in a transmembrane domain that is highly conserved among pheromone receptors, was shown to be responsible for constitutive signalling activity.

This demonstrates that the sexual lifestyles of unicellular organisms can be much more complicated than they first seem. Furthermore, constitutively active receptors have been implicated in many signal-transduction processes in mammalian cells. It remains to be seen whether sexual activity in more complex organisms also involves signalling components that are continuously turned on.

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