RESEARCH HIGHLIGHTS

ORGANIC CHEMISTRY

Ring leaders

Angew. Chem. Int. Edn doi:10.1002/anie.200701551 (2007)

Chemists in the United States report an improved procedure for preparing boronate esters — starting materials for making the many molecules that contain linked aromatic rings.

The preferred route to boronate esters is from readily available aryl chlorides. But existing processes require high temperatures and don't work for all substrates. By changing the catalysts used, Stephen Buchwald and his colleagues at the Massachusetts Institute of Technology, Cambridge, prepared boronate esters from aryl chlorides at room temperature. Their method also works for a wider range of molecules than the previous method.

Finally, they react two aryl chlorides together, through a boronate ester intermediate, to create 'biaryl' compounds. This is the first time that this desirable transformation has been achieved directly from two aryl chlorides.

CHEMICAL BIOLOGY

Smart drops

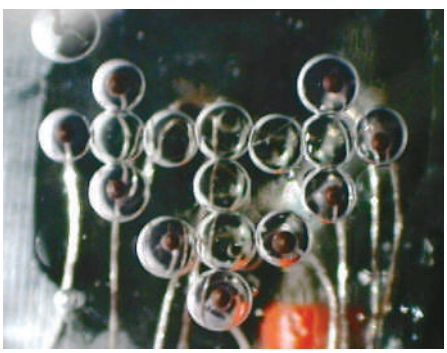
J. Am. Chem. Soc. doi:10.1021/ja072292a (2007)

Artificial cell-like compartments can be linked into networks that act as devices, show Matthew Holden of the University of Oxford and his co-workers.

Each compartment is a water droplet, typically less than 1 millimetre across, surrounded by a lipid monolayer and immersed in oil (pictured below). When two droplets stick together, they are separated by a cell-membrane-like lipid bilayer, which can host membrane proteins such as ion channels that allow communication between the 'cells'.

The researchers created a chain of three droplets containing solutions of different ions with channels in the connecting walls to pump the ions. This acted as a 'biobattery', generating a current. Also, a network of droplets connected through the light-sensitive proton pump bacteriorhodopsin offered an electrochemical light-meter that mimics light-detecting retinal cells.

M. HOLDEN



Assorted fungi

Mycol. Res. **3,** 509–547 (2007)

A concerted effort by 67 researchers based in 13 countries to sort out the taxonomy of fungi has reached its conclusion. The hope is that the new classification, which divides the kingdom Fungi into 195 taxa, will clear up naming confusion in the literature and bring about consistency across online databases.

To devise the classification, David Hibbett of Clark University in Worcester, Massachusetts, and his colleagues sorted through molecular data on different fungal species and examined the history of their nomenclature. Their effort, part of the 'Assembling the Fungal Tree of Life' project, should provoke some changes. For example, the researchers propose that the phylum Zygomycota, which includes the 'sugar' moulds found on fruit, is disbanded and its taxa shared among other groups.

D. HIBBETT

MEDICINE

Brain boost

Lancet **369,** 2097–2105 (2007)

A preliminary gene-therapy trial has improved brain function in patients with Parkinson's disease.

Parkinson's disease causes neuronal degeneration, loss of motor control, and reduced levels of an important neurotransmitter known as GABA. Matthew During of Ohio State University in Columbus and his colleagues placed a gene important for GABA production, called glutamic acid decarboxylase, into a virus. They then injected the virus into a specific region of the brain, on one side only, in 12 patients with Parkinson's disease.

The phase I trial was designed to test safety rather than efficacy, but brain scans and motor-control tests showed that function in the injected side of the brain improved relative to the side that had not received the gene. No patients died or developed new neurological deficits.

CANCER BIOLOGY

To drug the undruggable

EMBO J. doi:10.1038/sj.emboj.7601744 (2007)

An antibody fragment can hit a cancer target that many have been deemed 'undruggable', say scientists in the United Kingdom.

Mutations that activate Ras proteins show up in as many as 30% of cancers, but the difficulty of blocking their protein–protein interactions inside the cell had made them seem intractable targets.

Terence Rabbitts, now at the Leeds Institute of Molecular Medicine, and his colleagues report that an antibody fragment, dubbed iDab#6, jams mutant Ras by blocking a key interaction site. In mice injected with human tumour cells, tumour growth stopped if the cells expressed the antibody fragment.

Delivering the genetic material to express iDab#6 in human patients would be a challenge, but the team's characterization of the Ras–antibody interaction may also help small-molecule drug development.

CELL BIOLOGY

Numbing the pain

Neuron **54,** 905–918 (2007)

Intense pain can switch off the ion channels that sense it by flipping a molecular toggle,

researchers report. The ion channel TRPV1 regulates the flow of ions such as calcium into nerve cells in response to heat and acidity, mediating the feeling of burning pain. Rachelle Gaudet and her colleagues at Harvard University in Cambridge, Massachusetts, determined the structure of a TRPV1 region that protrudes into the cell, known as the ankyrin-repeat domain. They found that it binds to one or other of two signalling molecules: ATP or the calcium sensor calmodulin.

The channel responded to repeated stimulation when bound to ATP, but its response was deadened by calmodulin. The team proposes that the high intracellular calcium levels that follow channel stimulation favour calmodulin binding and thus channel desensitization.

BIOCHEMISTRY

A new last resort

J. Am. Chem. Soc. doi:10.1021/ja068602r (2007)

The arms race between antibiotics and bacteria has yielded bugs that are impervious to vancomycin, the antibiotic 'of last resort'. Now, researchers have found a simple way to create vancomycin-like compounds that are up to 40 times more potent than their predecessor.

Vancomycin comprises a loop of three amino-acids with two attached sugars. Jon Thorson of the University of Wisconsin-Madison and his colleagues produced eight vancomycin variants by adding various glucose molecules containing 'lipid-like' hydrocarbons to vancomycin's amino-acid backbone.

Biological activity against vancomycin-resistant bacteria was highest when the hydrocarbon was attached at the third or fourth carbon of the glucose molecule. The method provides a way of generating libraries to optimize antibiotics for targeting resistant pathogens.

CELL BIOLOGY

Act in two parts

Science **316,** 1749–1752 (2007)

Researchers have unpicked a mechanism of actin's dual function in cells.

Actin is a major component of a cell's cytoskeleton and a regulator of gene expression. These functions are linked through a protein known as MAL that binds actin and that normally shuttles between a cell's nucleus and cytoplasm.

When a cell is preparing to divide, actin assembles into cytoskeletal polymers. The resulting drop in free actin levels causes MAL to accumulate in the nucleus, where it promotes the expression of growth-related genes.

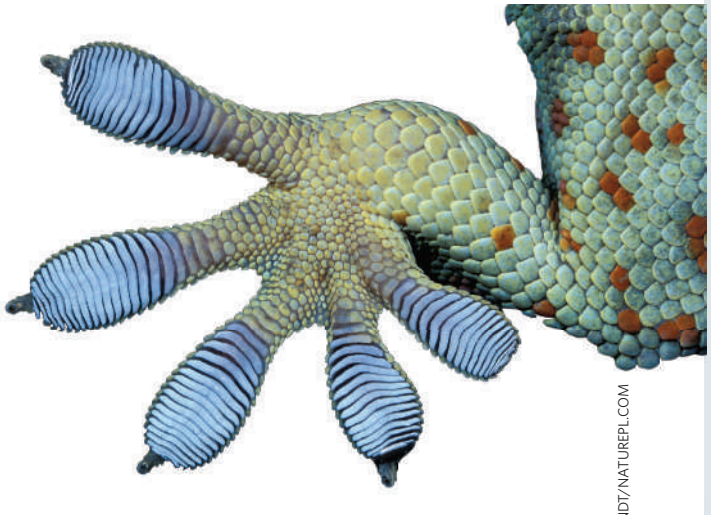
Richard Treisman and his colleagues at Cancer Research UK's London Research Institute show that MAL accumulates in the nucleus because its export to the cytoplasm requires it to be bound to nuclear actin. The team also shows that actin binding to MAL in the nucleus inhibits gene expression.

MATERIALS SCIENCE

Geckos outstuck

Proc. Natl Acad. Sci. USA **104,** 10792–10795 (2007)

A reuseable adhesive tape four times stickier than gecko feet has been made by Ali Dhinojwala at the University of Akron, Ohio, and his colleagues.



I. ARNDT/NATUREPL.COM

Gecko feet stick to surfaces using pads covered with rod-like protrusions called setae, which split at their end into smaller filaments known as spatulas, just a few nanometres thick. These fine hairs penetrate every crevice on a surface, then stick via van der Waals forces.

Carbon nanotubes, which are strong and stiff, have previously been identified as candidate hairs for a synthetic gecko pad; now Dhinojwala and his team have marshalled them into pillar-like clusters with square cross-section, copying the hierarchical organization of setae. One square centimetre of tape covered with these structures can support nearly 4 kilograms.

JOURNAL CLUB

Achim Müller
University of Bielefeld, Germany

A chemist finds beauty in molecules that resemble an early model of the Solar System.

Since Plato's time, people have been fascinated by the beauty of highly symmetrical objects. The symmetry of the C_{60} buckyball surely contributed to scientists' tremendous interest in this spherical molecule. Indeed, I was convinced that the discovery of C_{60} would induce a rush among chemists to search for other symmetrical structures.

That rush may not have happened, but scientists have still turned up some surprising highly symmetrical structures. A recent report from researchers at Xiamen University in China (X.-J. Kong *et al. J. Am. Chem. Soc.* **129,** 7016–7017; 2007) describes a cluster in which beauty cages beauty; it consists of an icosidodecahedron of nickel ions, having 20 triangular faces and 12 pentagonal faces, inside of which sits a dodecahedron of lanthanum ions.

The team describes the magnificent structure as 'Keplerate', a term that I and my colleagues first used around ten years ago to describe structures that contain Platonic and Archimedean solids (regular polyhedra, and polyhedra with two types of face, respectively) one inside another, like Russian dolls. It honours Johannes Kepler, who in the sixteenth century developed a model of the cosmos in which "the radii of the successive planetary orbits are proportional to the radii of spheres that are successively circumscribed around and inscribed within the five Platonic solids".

Another recent report found these same shapes — the icosidodecahedron and dodecahedron — in Keplerate-type arrangements in quasicrystals (H. Takakura *et al. Nature Mater.* **6,** 58–63; 2007). Such crystals are still poorly understood. I hope that future work will correlate these materials' properties with their beauty.

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

Jersey Medical School in Newark found that mutant mice lacking AC5 lived, on average, 30% longer, weighed less, and exhibited less age-induced heart stress and bone loss. Mutant mice also produced more of the antioxidant enzyme superoxide dismutase.

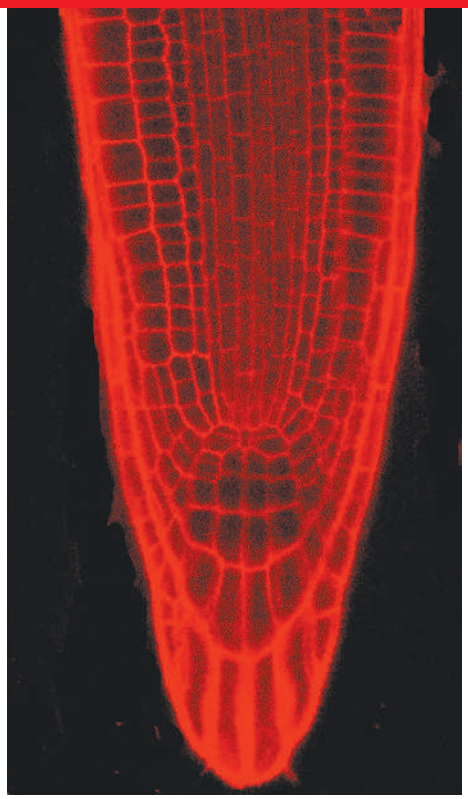
BOTANY

At the root of it all

Science **312,** 507–510 (2007)

In plants, ethylene responds to environmental signals such as being touched. Now, ethylene has also been discovered to relay these signals to the very heart of the root's stem-cell production factory.

Inside the root tip (pictured right), a group of four cells known as the quiescent centre (QC) gives rise to all the cells in the tissue systems of the root. Liam Dolan at the John Innes Centre in Norwich, UK, and his colleagues, compared wild-type *Arabidopsis thaliana* (thale cress) with mutants that had defective synthesis of ethylene. They found that ethylene promotes cell division in the QC to create further stem cells. But it does not induce them to differentiate. The latter task is more closely associated with the hormone auxin, and the two chemicals work in concert to orchestrate root growth.



ASTROCHEMISTRY

Anions in space

Astrophys. J. **664,** L43–L46 (2007); *Astrophys. J.* **664,** L47–L50 (2007)

Astronomers using a 100-metre radio telescope have found the largest negatively charged molecule yet in space. According to the researchers, the discovery of octatetraynyl anion (C_8H^-) and three other anions in the past year offers intriguing evidence for a suite of chemical reactions and products not yet observed — including molecules similar to amino acids and other precursors of life.

A team at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts, spotted the compound in the dark molecular cloud TMC-1 in the constellation Taurus. And researchers at the National Radio Astronomy Observatory in Charlottesville, Virginia, have found it in the halo of IRC+10 216, a dying star in Leo.

SEX DETERMINATION

Old sperm sires sons

Biol. Lett. doi:10.1098/rsbl.2007.0196 (2007).

Older sperm are more likely than fresh sperm to produce males, at least in lizards. The discovery comes from a species in which females store sperm after copulation for later use, and it may explain why this species' sex ratio skews towards males as the reproductive season progresses. Sperm stored in the females' reproductive tract often outcompetes sperm from more recent inseminations.

A team of zoologists, led by Mo Healey of the University of Wollongong, Australia, set up breeding pairs of a small lizard called the Australian painted dragon (*Ctenophorus pictus*) in the laboratory. Stored sperm produced 55% sons, whereas fresh sperm sired only 32%.

NANOTECHNOLOGY

The look and feel of nano

Nature Nanotechnol. **2,** 407 (2007)

Ozgur Sahin of Harvard University and his colleagues have developed a specialized atomic-force microscope (AFM) that 'feels' a surface's softness. Existing AFMs create images by passing a vibrating cantilever with a sharp tip across a material. Sahin's team used a T-shaped cantilever that twisted as it vibrated up and down. The twisting changed in response to the material's softness, providing more detailed information than conventional tools allow.

Sahin says the technique shows promise for a variety of nanotechnology and biotechnology procedures, such as probing the mechanical properties of proteins and DNA.

Correction

In the Research Highlight 'Assorted fungi' (*Nature* **447,** 1034; 2007) there was an error in the reference. The correct details are: *Mycol. Res.* **111,** 509–547 (2007).

JOURNAL CLUB

Paul Kenrick
The Natural History Museum, London, UK

A palaeobotanist finds answers to the origin of roots in the genes of a living moss.

Roots have been called the hidden half of plant diversity. Confined mainly to the subterranean, their unseen influence extends well beyond the plant that they sustain to form an integral component of soil ecosystems and a significant link in the carbon cycle.

In my research, I use fossils to piece together how the fundamental organs and basic lifecycles of plants evolved, and roots are one of the key systems. The fossil record shows that roots were an early innovation in the colonization of the land, and that they evolved remarkably rapidly, developing a diversity of forms comparable to those of the aerial shoots, stems and leaves. Comparative morphology is good for documenting how roots evolved, but are there any underlying molecular developmental similarities among the rooting structures of early plants?

An elegant piece of recent research shows that a similar transcription factor encoded by the gene *ROOT HAIR DEFECTIVE 6* regulates root-hair development in the flowering plant *Arabidopsis thaliana* and rhizoid development in the moss *Physcomitrella patens* (B. Menand *et al. Science* **316,** 1477–1480; 2007). Because flowering plants and mosses diverged more than 400 million years ago, this surprising result implies that the cells with a key role in nutrient acquisition and anchorage in most land plants share a molecular developmental pathway that is very ancient indeed.

More surprising still is the notion that these genes are expressed in both haploid and diploid plants — that is, those whose cells have one or two sets of chromosomes, respectively. Many plants cycle between haploid and diploid forms during their lifecycles. Menand *et al.* propose that genes expressed in early haploid plants were turned on in many tissues during the evolution of plants with diploid phases. Pending further testing, this interesting model is plausible for components of the vascular system, cortex, epidermis, shoot and root.