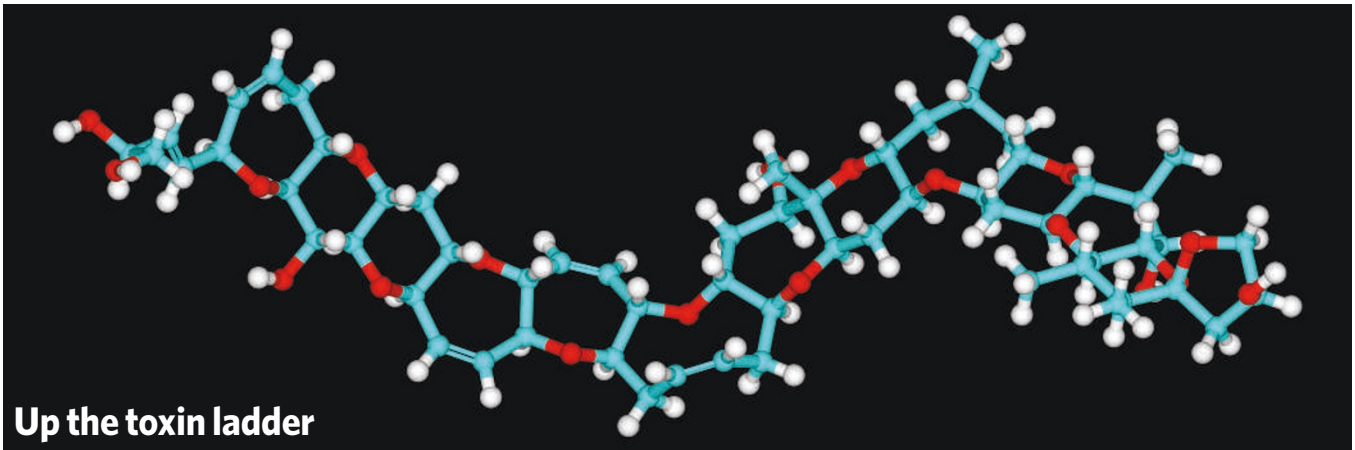
RESEARCH HIGHLIGHTS



Up the toxin ladder

J. Am. Chem. Soc. doi:10.1021/ja063041p (2006)

Chemists have mastered the making of ciguatoxins, the exceptionally large and highly toxic molecules responsible for some forms of seafood poisoning. By increasing the amount of the toxins available to test, this work could help biologists to probe how the toxins work *in vivo* and find drugs to combat ciguatera poisoning.

Ciguatoxins are produced by the dinoflagellate *Gambierdiscus toxicus*, which is eaten by fish and so in turn is consumed by the occasional hapless human. The toxins present a tantalizing challenge to synthetic chemists both because of the molecules' size and their complex 'ladder-like' architecture (pictured).

Masayuki Inoue, Masahiro Hirama and their co-workers at Tohoku University in Japan report the total synthesisis of the two most toxic members of the family: ciguatoxin and 51-hydroxyCTX3C.

ANIMAL BEHAVIOUR

Love songs

Curr. Biol. **16,** 1311–1316 (2006)

Flying mosquitoes may change the whining tone created by their wings to match those of potential mates, say Gabriella Gibson of the University of Greenwich and Ian Russell of the University of Sussex, UK.

The researchers recorded the wingbeat frequencies of pairs of tethered tropical mosquitoes, *Toxorhynchites brevipalpis*. They found that both mosquitoes in an opposite-sex pair alter their wingbeat patterns until their flight tones are the same. By contrast, the noises made by any same-sex pair diverge in frequency. Males, who have more sensitive antennae, make wingbeat adjustments more quickly than female mosquitoes.

BIOPHYSICS

Enzyme fieldwork

Science **313,** 200–204 (2006)

Steven Boxer and his colleagues at Stanford University, California, have devised a way to fit a voltmeter inside an enzyme, making it possible to probe the electric fields that influence the enzyme's structure and catalytic activity.

Boxer's group showed that changes to the electric field inside an enzyme, induced by mutations in the protein, shift the vibrational frequency of a carbon–nitrogen triple bond in a molecule bound in the enzyme's active site.

The researchers measured the frequency shift for an inhibitor of the human enzyme aldose reductase, but say the technique should be applicable to many other enzymes. In this case, the observed changes in field strength matched the predictions of computer simulations that included movements of the enzyme's side chains.

CELL BIOLOGY

Death bottled up

Cell **126,** 163–175; 177–189 (2006)

Mitochondria (pictured below) appear to use their membrane folds as bottles for a protein — cytochrome *c* — that can boost programmed cell death. Sequestering the protein protects the organelles' host cells from an untimely end.

That mitochondria release cytochrome *c* to amplify apoptosis was already known; the papers from Bart De Strooper of the Flanders Interuniversity Institute for Biotechnology in Leuven, Belgium, and Luca Scorrano of the Dulbecco-Telethon Institute at theVenetian Institute of Molecular Medicine, Padova, Italy, and their colleagues explored how this happens.

They show that a soluble form of the protein OPA1 seals cytochrome *c* inside pocket-like folds of the inner mitochondrial membrane. The plug seems to be maintained by the enzyme PARL, which cleaves a membrane-bound form of OPA1 to produce the soluble form. The authors suggest that the actions of other cell-death activators might disrupt the OPA1 stopper, releasing cytochrome *c*.

ISM/SPL

GENETICS

Buffering disease

Nature Genet. doi:10.1038/ng1844 (2006)

A person's susceptibility to genetic disease may be influenced by a class of genes that buffer against the effects of mutations, suggest researchers in Europe.

Andrew Fraser of the Wellcome Trust Sanger Institute in Cambridge, UK, and his colleagues used RNA interference to investigate the interactions between about 65,000 pairs of genes in the worm *Caenorhabditis elegans*. They produced a map of these interactions and found six 'highly connected' genes that together interacted with a quarter of all the other genes tested. If one of these six genes was disabled, the effects of mutations in many

other genes became worse.

All six genes regulate gene activity by affecting the structure of chromatin, the combination of DNA and proteins that makes up chromosomes

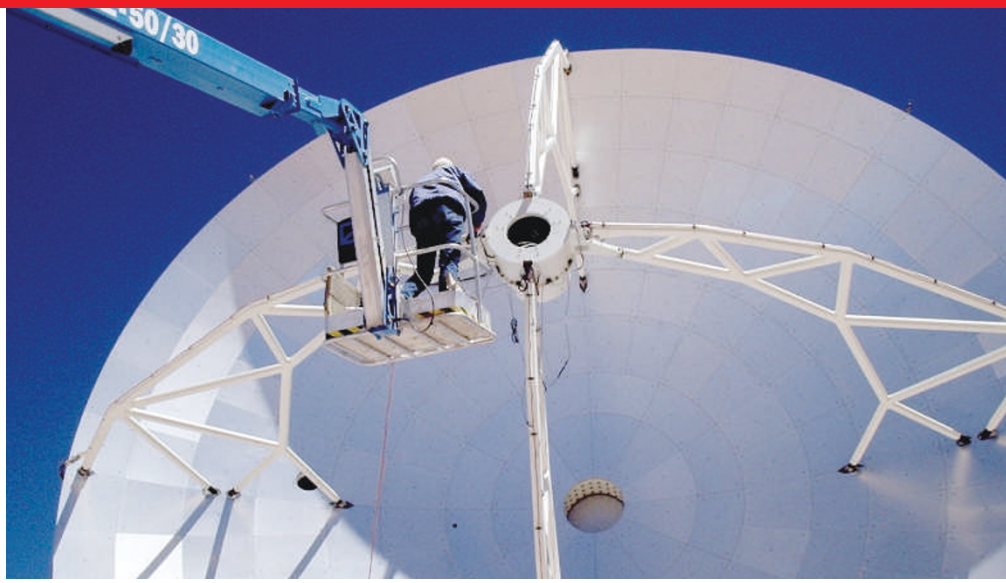
ASTRONOMY

View from the APEX

Astron. Astrophys. **454,** L13–L118 (2006)

Perched at an altitude of 5,107 metres in the Chilean Andes, the Atacama Pathfinder Experiment, APEX, is a 12-metre telescope that began scanning the southern skys in 2005. Its first observations and a description of the instrument have now been published in a special package of 26 letters.

The APEX (pictured right) gathers far infrared and longer wavelength light. So far, its results include the first ever detection of the fluoromethylidynium ion (CF^+) in space, consistent with theories of interstellar chemistry. The telescope is paving the way for the Atacama Large Millimeter Array (ALMA), which will consist of about 50 telescopes of the same size, under construction in the same area.



APEX

AIDS RESEARCH

Cutting HIV

PLoS Med. **3,** e262 (2006)

Male circumcision could slash the number of fresh HIV infections in sub-Saharan Africa by some 2 million, and reduce deaths by 300,000, over the next decade.

The estimate follows the first randomized, controlled trial of male circumcision. This showed that the practice cuts HIV transmission from women to men by around 60% (B. Auvert *et al. PLoS Med.* **2,** e298; 2005).

Now Brian Williams of the World Health Organization in Geneva, Switzerland, and his colleagues have used mathematical models to predict the health impact of extending circumcision to all men in the region.

In the second decade, this simple practice could prevent 3.7 million additional infections and 2.7 million deaths, the researchers estimate.

COMPUTING

Dot gain

Appl. Phys. Lett. **89,** 013503 (2006)

The conventional circuitry of a computer chip might one day be replaced by tiny components known as quantum cellular automata (QCA).

Mladen Mitic and his colleagues at the University of New South Wales in Australia have brought this idea a step closer to reality by building a QCA cell from four nanoscale blobs, or quantum dots, of silicon.

A QCA cell stores information by switching between two states — quantum dots do this by swapping electrons with each other. It is expected that such QCA cells, suitably configured, could run a computer algorithm because their states will switch through interactions with their neighbours.

Previous QCA cells have used dots made from metals or semiconductors. By using silicon, this team have made a cell that is compatible with existing microchip technology.

EVOLUTION

Rise of the radish upstarts

Evolution **60,** 1187–1197 (2006)

Everyone wants their offspring to do well in life, but not at their own expense. Evolutionary biologists studying California's wild radishes (*Raphanus*) have found that one hybrid of two radish species has been so successful in some regions of the state, that it has driven both of its parents to extinction.

Such swamping of existing species by new hybrids is difficult to observe in the field, explain Subray Hegde of the University of California, Riverside, and his colleagues, because it can happen within just a few generations.

The researchers used greenhouse breeding experiments and genetic comparisons to confirm that California's wild radishes, now an important weed species, are indeed the product of a fruitful union between two previous species, *Raphanus raphanistrum* and *R. sativus*.

JOURNAL CLUB

Albrecht W. Hofmann
Max Planck Institute for Chemistry, Mainz, Germany

A geochemist suspects that Earth's oldest rocks may have been hidden away.

One of the greatest puzzles in Earth science, and one I find particularly fascinating, is rooted in the deepest part of the mantle. Just outside the liquid core there exists an irregular layer, some 200 kilometres thick, that has baffling seismic properties.

Seismologists and mineral physicists have pinned their hopes of explaining this D-double prime (D″) layer to a high-pressure mineral phase first reported in 2004, known as post-perovskite. But some geochemists, including this one, favour another model.

Last year, researchers made the surprise discovery that terrestrial rocks are richer in a certain isotope of neodymium, ^{142}Nd, than are meteorites, the bricks from which Earth was built (M. Boyet & R. Carlson *Science* **309,** 576-581; 2005). One way to reconcile the results is if Earth contains a hidden reservoir deficient in ^{142}Nd that balances the measured excess — and maybe D″ is it.

The isotope ^{142}Nd is produced by decay of the relatively short-lived ^{146}Sm, a now-extinct isotope of samarium. Crust concentrates Sm slightly less efficiently than it does Nd, so a primordial crust that formed early in Earth's history, when there was still plenty of ^{146}Sm around, would have a lower Sm/Nd ratio than the mantle and ultimately, therefore, a lower ^{142}Nd abundance.

Boyet and Carlson suggest this primordial crust was subducted and stored at the base of the mantle, providing the reservoir deficient in ^{142}Nd and giving rise to D″.

I like this model because it lets geochemists have a mantle with separate layers, which helps to explain some other peculiarities of Earth's composition. Previously, this idea seemed to fly in the face of seismic images showing Earth's mantle to be thoroughly mixed, except for D″, that is.