RESEARCH HIGHLIGHTS

Now hear this, or not

PLoS One doi: 10.1371/journal.pone.0005413 (2009)

Although many mammals can hear very high frequencies, other vertebrates are less au fait with ultrasound.

Victoria Arch, of the University of California, Los Angeles, and her colleagues now report that a frog from Borneo, Huia cavitympanum, is the first non-mammalian vertebrate discovered to communicate with calls purely in the range above 20 kilohertz, which is about the upper limit of human hearing. This species had been known to produce these ultrasonic calls, and when playing them back in the field, the team found that male frogs nearby increased the frequency of their calls in response.

On examining the frog's brain and ears, the researchers showed that its hearing was most sensitive above 20 kilohertz.

T. ULMAR GRAFE

NEUROGENETICS

Psychosis genes exposed

Science **324,** 605 (2009)

Scientists in Germany have provided the first evidence that genetic risk for psychotic illnesses is linked, at least in part, to abnormal connections between different brain areas.

Andreas Meyer-Lindenberg of the University of Heidelberg and his colleagues studied 115 healthy people with or without a particular variant of the gene *ZNF804A*. The variant has been identified in genome-wide association studies as possibly conferring a small risk for developing schizophrenia or bipolar disorder. The authors performed brain imaging while volunteers carried out cognitive tasks relevant to these disorders.

The team found that although the risk gene does not influence the strength of activation in various brain areas, connectivity between some areas is either reduced or increased in risk-gene carriers — in a pattern reminiscent of that seen in patients.

VIROLOGY

HIV at the gates

Cell **137,** 433–444 (2009)

HIV enters human cells through a more complex pathway than previously predicted.

Researchers had long thought that HIV binds to cell-surface receptors, and then fuses directly with the cell membrane, dumping its dangerous payload into the cell within about 10 minutes.

Gregory Melikyan and his colleagues at the University of Maryland School of Medicine in Baltimore show that successful infection includes an additional step, in which the virus becomes enveloped by membrane and internalized by the cell through a process called endocytosis. Thirty minutes to an hour can pass before the virus fuses with the internalized membrane and delivers its genetic material.

The findings may necessitate re-evaluation of drug candidates meant to block HIV's entry into cells.

For a longer story on this research, see http://tinyurl.com/d5nuze

DNA REPAIR

Chemo's modus operandi

PLoS Biol. **7,** e1000091 (2009)

The chemotherapeutic 5-fluorouracil has been a first-line treatment for diseases such as colorectal cancer for decades, even though it's not clear exactly how the drug works.

In cells, 5-fluorouracil is converted into several metabolites that mimic the natural RNA base uracil. The metabolites inundate the cell, some becoming incorporated into RNA and even DNA in dividing cells. Uracil in DNA activates a family of DNA-repair proteins devoted to removing it, but the unnatural 5-fluorouracil triggers incomplete repair, causing an accumulation of strand breaks in the DNA and eventual cell death. Primo Schär of the University of Basel in Switzerland and his colleagues examined mouse and human cells responding to the drug and identified thymidine DNA glycosylase (TDG) as the uracil-removing protein responsible for the breaks. Without TDG activity, cancer cells become more resistant to the drug.

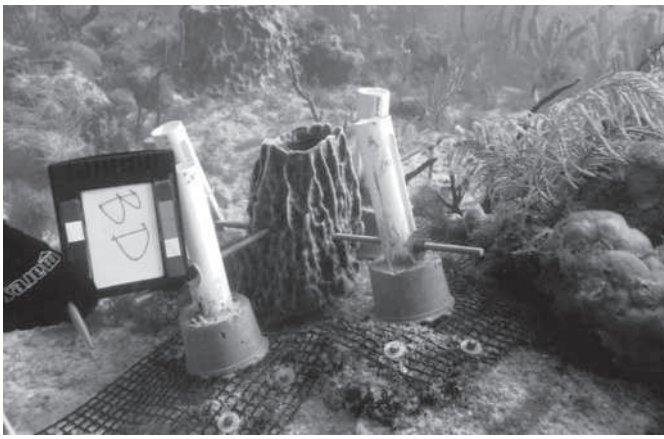
CONSERVATION

Reef repair

Restor. Ecol. **17,** 192–195 (2009)

Some large marine sponges, such as the barrel sponge *Xestospongia muta*, can live for hundreds of years. But when dislodged from the reefs they inhabit by storms, ship groundings or fishing lines, these organisms have little chance of reattaching naturally. Steven McMurray and Joseph Pawlik of the University of North Carolina in Wilmington have stumbled across a new method of reattaching them that could be useful in conservation efforts.

The duo skewered sponges with two perpendicular steel rods, then secured the rods to bases made from PVC piping, concrete and mesh that had been nailed to the reef's limestone bed (pictured below). The method, designed for temporary experiments, surprised the researchers by helping half of the 40 transplanted sponges to reattach, despite three passing hurricanes. The apparatus was removed once attachment was complete.



S. MCMURRAY, UNIV. NORTH CAROLINA, WILMINGTON

MATERIALS SCIENCE

Conductors with a twist

Nature Mater. **8,** 421–426 (2009)

Discotic liquid crystals are flat-cored organic molecules that stack in twisting, electron-conducting columns. They are used in photovoltaics and field-effect transistors. The best discotic species currently in use make stacks with a twist angle of 30°, but calculations show 60° to be optimal for conduction.

Klaus Müllen and Denis Andrienko of the Max Planck Institute for Polymer Research in Mainz, Germany, and their colleagues have synthesized a new molecule with a 60° twist. This doubled electron mobility, and through molecular dynamics simulations, the authors show that removing defects in the stacking structure could push that value higher.

COSMOLOGY

No ring or reason

Astrophys. J. **696,** 694–700 (2009)

A new study raises questions about the ring of dark matter reported to exist inside a galaxy cluster.

The cluster, called Cl0024+17, is actually thought to be two merging clusters, and some suggest that the ring was caused by their collision. To test the idea, John ZuHone, now at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts, and his colleagues simulated cluster collisions under varying conditions. They could not produce a ring unless the dark-matter particles had circular orbits.

Because such orbits are unlikely to occur in galaxy clusters, the results suggest that the ring report is questionable, says ZuHone.

PLANT PHYSIOLOGY

Gifts from grafts

Science **324,** 649–651 (2009)

Plants grafted together exchange genetic information, suggesting a new and surprising mechanism for gene transfer between organisms.

Grafting is commonly used in cultivation and can occur naturally when shoots or roots from different trees come into contact, but grafting was not thought to involve any mixing of genetic material. To test this, Sandra Stegemann and Ralph Bock of the Max Planck Institute for Molecular Plant Physiology in Potsdam-Golm, Germany, grafted together two transgenic tobacco plants expressing different antibiotic-resistance genes.

The resistance genes were frequently exchanged between cells across the graft site. However, transfer only occurred when the genes were carried in the chloroplast genome, not when a resistance gene was inserted into the nuclear genome. Because the genetic exchange was limited to the graft site, the genes would only be passed to offspring of shoots formed at that site.

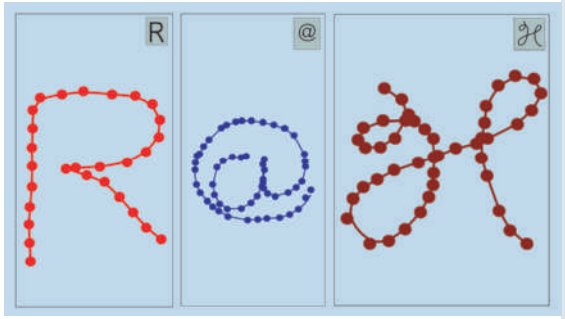
STRUCTURAL BIOLOGY

A virus laid bare

PLoS Biol. **7,** e1000092 (2009)

Mimivirus was once mistaken for a bacterium owing to its shape and great size. Michael Rossmann of Purdue University in West Lafayette, Indiana, and his colleagues have now revealed the structure of this largest of known viruses. Enzymatic scrubbing of long fibres that extend from the viral capsid gave the researchers a new view. They reconstructed the icosahedral shape of the virus using cryogenic electron microscopy and atomic force microscopy.

Mimivirus is not as symmetrical as many other large, double-stranded DNA viruses, in part because of a 'starfish' feature that appears on one side. This feature may allow the virus to deliver its genome into host cells.



ACS

NANOTECHNOLOGY

The helix that delivers

Nano Lett. 10.1021/nl900186w (2009)

For nanomedical applications such as delivering drugs or performing microsurgical procedures at specific places in the body, the ability to navigate bodily fluids with a high degree of control is crucial.

With this in mind, Ambarish Ghosh and Peer Fischer of the Rowland Institute at Harvard produced screw-like glass structures 1–2 micrometres long by nanofabrication. Depositing a thin layer of a ferromagnetic material on one side of each helix allowed the authors to direct the screws' motion with rotating magnetic fields. The duo even used the swimmers to spell out the initials of their institution (pictured above).

The microswimmers can carry chemicals and push loads, and could be used as probes in rheological measurements difficult to perform by other techniques.

JOURNAL CLUB

David Kirchman
University of Delaware, Lewes

A microbial ecologist learns something new from an old-fashioned study.

What could be easier than learning about an organism simply by watching how it varies over time in its natural habitat? You'd think this would have been done long ago for marine bacteria, which are important in many biogeochemical processes, including the carbon cycle; in fact, they're the organisms running the biosphere. But it's not easy to follow microbes in the open ocean, far from the lab and beyond the reach of standard techniques.

Craig Carlson at the University of California, Santa Barbara, and his colleagues took on this challenge for the most abundant group of marine bacteria: SAR11. They examined variations in SAR11 over several years in the Sargasso Sea, where the group was first discovered nearly 20 years ago (C. A. Carlson *et al. ISME J.* **3,** 283–295; 2009). Sequencing and other data had previously revealed that SAR11 bacteria are diverse and can account for almost 50% of microbes in a given marine environment; however, we still knew little about their natural history.

So Carlson's group looked to address a basic question: how do different members of SAR11 vary with depth and over time? They examined 13 years' worth of DNA samples, viewed 3 years' worth of preserved cells under the microscope, and then analysed the microbial data in light of what is known about SAR11's environment. Three SAR11 'ecotypes', they say, flourish differently at various depths and over a yearly cycle, which starts in spring, when deep mixing stops and photosynthesis speeds up.

The authors make good use of new genomic data from a lab-grown representative of SAR11 (*Pelagibacter ubique*) to understand Sargasso Sea populations, but the study's insight comes from the old approach of patiently watching organisms over time in their natural habitat.

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