EDITORS' CHOICE

edited by Stella Hurtley

APPLIED PHYSICS

Light-Based Particle Accelerators

Most people own their own particle accelerators. In the back of a television set, electrons are emitted from a cathode and accelerated and maneuvered by electric and magnetic fields toward the phosphor screen. The same principle of electron acceleration is used in large particle accelerators, only on a much grander scale. Reducing the size of accelerators without compromising the need for very high particle energies is a goal for the next generation of accelerators. Because light is an electromagnetic field, schemes are being devised that use light to accelerate electrons.

Zawadzka *et al.* demonstrate that shining femtosecond pulses of intense laser light on a thin film of silver or gold produces an evanescent light field that extends from the surface and can accelerate photo-emitted electrons up to energies approaching 400 electron volts. Although this energy is quite modest compared with those achieved in traditional particle accelerators, calculations show that higher, perhaps even relativistic, energies may be possible by using longer wavelength light pulses or by modulating the film surface to enhance the interaction between the light and the electrons. — ISO

Appl. Phys. Lett. **79**, 2130 (2001).

HYDROLOGY

Good Intensions Gone Awry

Large levees and channel structures, such as wing dams, were built on the lower Missouri and Mississippi rivers during the past century to help to mitigate damage from major floods. Recently, several devastating floods have hit the Mississippi watershed, and these events offer an opportunity to assess the impact of these flood control devices.

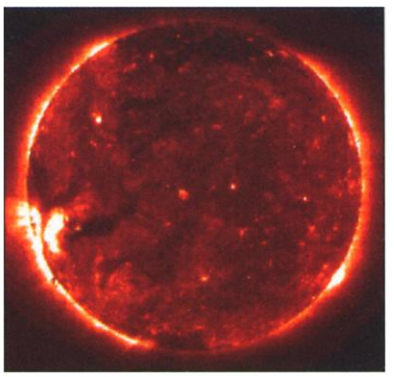
Criss and Shock compared floods in the Mississippi River, which contains many levees and in-channel dams, with floods on several of its major tributaries, which do not. Although the discharge during recent floods on the Mississippi River was equal to that of floods early in the last century before flood control devices were built, the flood stage or height on the Mississippi River increased by up to several meters because the engineered structures constrained the channel. The net effect of these changes is that the potential energy of any flood has increased and the recurrence interval between floods (based on stage height) has decreased. — BH

Geology **10**, 875 (2001).

ASTRONOMY

All Change

Solar coronal holes are regions of low-density and low-temperature material that form where the magnetic field lines are open or at least divergent. An understanding of their evolution is important because they are a source of the solar wind that impacts communications on Earth. Data from the solar and heliospheric observatory (SOHO) have shown that coronal holes with fast solar wind speeds tend to concentrate near the poles during solar minimum (1996 to 1997), whereas coronal holes with lower wind and outflow speeds tend to occur at all latitudes during solar maximum (2000 to 2001).



1996 coronal hole.

Now, Miralles *et al.* have observed the growth of a north pole coronal hole in February 2001, just as the sun was reversing its magnetic polarity and beginning its return to a solar minimum. Spectra of O^{+5} taken with the ultraviolet coronagraph spectrometer on SOHO show that the hole is broadened by a fast perpendicular ion stream flow and that the solar wind speeds are higher than those of solar maximum coronal holes. This solar minimum coronal hole may represent the first observation of the new negative polarity of the Sun. In addition, the timing of the growth of a solar minimum hole coincident with the Sun beginning to flip its magnetic field provides an important dynamic for large-scale solar processes that will need to be considered in models. — LR

Astrophys. J. **560**, rapid release 29 September (2001).

Male butterflies feeding before migration.

ECOLOGY/EVOLUTION

Butterflies in the Wind

Migration is a costly process for flying animals and so birds, bats, and insects have evolved optimal strategies for conserving energy and maximizing distance traveled. Srygley has shown a difference in migrating strategies between the sexes of a butterfly species. On their migration from Colombia to Panama, females of the cloudless sulfur butterfly, *Phoebis sennae*, reduce their flight speed taking advantage of tailwinds. When males travel in tailwinds, however, they maintain their flight speed. The female strategy appears to be to conserve energy, whereas the male strategy is to arrive quickly. For males, early arrival may increase mating opportunities at the breeding grounds, whereas for females, using tailwinds may conserve energy resources for egg production. — AMS

Behav. Ecol. **12**, 607 (2001).

NEUROSCIENCE

Fine Tuning

Synaptic plasticity has been studied extensively because of its potential connection with learning and memory. However, nearly all experiments have hitherto focused on questions concerning changes in the release probability of neurotransmitter or on changes on the postsynaptic side of the synapse, e.g., the number or the sensitivity of neurotransmitter receptors.

Engel *et al.* examined whether the strength of inhibitory synapses could be regulated through changes in the metabolism of the neurotransmitter GABA. By interfering with the activity of the major degradative and synthetic enzymes for GABA, they could increase or decrease both the size and frequency of miniature GABAergic postsynaptic currents. They conclude that the machineries for filling vesicles with neurotransmitter, for vesi-

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SOURCE: (BOTTOM) ROBERT B. SRYGLEY, PH.D./DEPT OF ZOOLOGY OXFORD/ SMITHSONIAN TROPICAL RESEARCH INSTITUTE; (TOP) COURTESY OF THE EIT CONSORTIUM

cle release, and for postsynaptic response do not work at maximal load and can thus be finely tuned through changes in presynaptic GABA concentration. This would give the nervous system additional flexibility when varying synaptic strength. — PRS

J. Physiol. **535**, 473 (2001).

BIOMEDICINE

Malignant Loss of Balance

Multiple myeloma is a generally incurable bone marrow cancer of unknown cause characterized by uncontrolled growth of plasma cells. One of its most prominent clinical features is severe bone destruction caused by overproduction of osteoclasts —the cells that resorb bone during bone remodeling. The interaction between the tumor cells and the marrow stroma is important during osteoclast production, but the underlying molecular mechanism has been unclear.

Pearse *et al.* show that multiple myeloma deregulates osteoclast production by disrupting the balance between TRANCE, a tumor necrosis factor–related cytokine responsible for osteoclast generation, and its inhibitor, osteoprotegerin (OPG), in the marrow stroma. In mice, TRANCE antagonists reduced myeloma-induced bone destruction and, unexpectedly, also inhibited tumor progression. Thus, bone destruction and tumor cell survival seem to be interdependent processes in multiple myeloma. Therapies that target the TRANCE-OPG cytokine axis are already being developed for treatment of osteoporosis and other bone disorders, and these findings may open up new possibilities for the treatment of multiple myeloma. — PAK

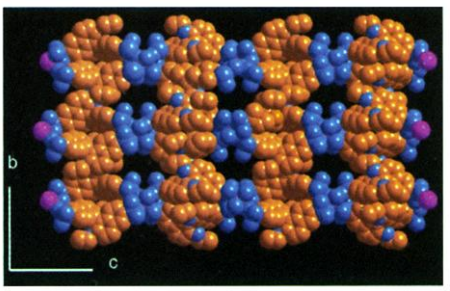
Proc. Natl. Acad. Sci. U.S.A. **98**, 11581 (2001).

CHEMISTRY

Twisted Frameworks

Molecule-scale porosity has typically been associated with inorganic materials such as zeolites. Recently, much progress has been made in synthesizing metal-organic frameworks that resemble zeolites not only in porosity but also in thermal and hydrolytic stability. An additional feature of metal-organic frameworks is that their more rational synthesis should allow for greater tailoring of their properties.

Evans *et al.* precipitated lanthanide salts with chiral binaphthalene ligands bearing



Space-filling model viewed down the asymmetric channels.

two phosphonate groups. The resulting compounds crystallized in a chiral lamellar structure with large (~12 angstrom) asymmetric channels. After the removal of included water molecules, the crystals could be used for separations of racemic mixtures of organic molecules. Although separation efficiencies are still modest (~10% enantiomeric excess), the controlled route of synthesis should allow rational improvement in these materials for chiral separations and for asymmetric catalysis. — PDS

J. Am. Chem. Soc. 10.1021/ja0163772.

HIGHLIGHTED IN *SCIENCE*'S SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT

Science's stke www.stke.org

Egg's Allurin Ways

Sperm-binding proteins on the inner layers of the extracellular matrix of vertebrate eggs are well known. However, sperm attractants in the outer jelly area have been detected in bioassays but have not been isolated. Now Olson *et al.* have purified a sperm chemoattractant from the egg jelly of *Xenopus* eggs. The protein, which they name allurin, has sequence similarity to members of the CRISP (cysteine-rich secretory protein) family. The new results add to the notion that CRISP family members escort or guide sperm on their voyage all the way from the testes to the egg. One CRISP protein, TPX-1, functions to promote adhesion of sperm to Sertoli cells in the testes. During maturation in the epididymis, sperm bind to another set of CRISP proteins, the acidic epididymal secretory glycoproteins, or AEGs. And finally, they encounter the new CRISP member, allurin, the first to be identified in the female reproductive tract. It is possible that receptors on the surface of the sperm sense a gradient in the concentration of allurin, or allurin-like molecules, which then guides the sperm to the egg. — LBR

Proc. Natl. Acad. Sci. U.S.A. **98**, 11205 (2001).

CREDITS: EVANS *ET AL., J. AM. CHEM. SOC.* 10.1021/JA0163772