EDITORS' CHOICE

edited by Gilbert Chin

PLANETARY SCIENCE

Cracks in the Shield

Electrons spiraling down from space (carried by the solar wind) into the atmosphere give rise to colorful curtainlike displays that are seen at high latitudes (aurora borealis in the north and aurora australis in the south), usually at night. Spacecraft-based observations have revealed the existence of daytime or dayside auroras, which are caused by protons, another constituent of the solar wind. It has been suggested that protons can pierce Earth's magnetic shield as a result of energy released by "reconnection" between magnetic field lines in the magnetopause (where Earth's atmosphere and the solar wind meet).

Phan *et al.* report on simultaneous observations by five satellites that confirm reconnection as the source of dayside auroral emissions. On 18 March 2002, NASA's IMAGE spacecraft recorded a bright dayside auroral spot. At the same time, ESA's CLUSTER mission, which consists of four spacecraft flying in a triangular pyramidal formation, passed through a jet of energetic solar protons that were colliding with Earth's atmosphere, directly above the bright spot. In the future, observations of dayside auroral spots can be used to monitor the formation and mending of cracks in Earth's magnetic shield. — JFU

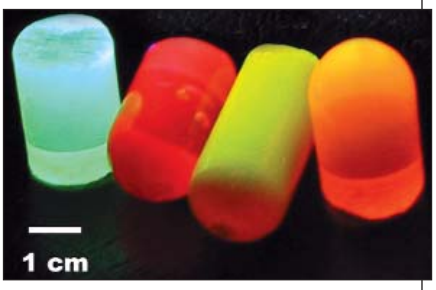
Geophys. Res. Lett. **30**, 1509 (2003).

EARTH SCIENCE

Tidal Meltdown

Water that is produced by basal melting of the Filchner-Ronne Ice Shelf in Antactica is an important component of Antarctic Bottom Water. The rate of this melting has been estimated by oceanographic and by glaciologic methods, but these values disagree. Joughin and Padman used remote-sensing data to evaluate the spatial distribution of melt beneath the Filchner-Ronne Ice Shelf. They found that melt production is 2.5 to 5 times lower than previous glaciological estimates (but similar to existing oceanographic estimates) and that net melt production is dominated by melting at the front of the ice shelf, which is largely a result of tidal mixing. Furthermore, considerable melting occurs at the grounding line, yet much of that melt refreezes at the center of the shelf. These observations emphasize the need to take processes such as tides into account when modeling circulation beneath the ice shelf and when predicting the ice shelf response in future climate scenarios. — HJS

Geophys. Res. Lett. **30**, 1477 (2003).



Four composites containing CdTe nanocrystals of 2.8 (blue-green), 3.3 (yellow-green), 3.6 (orange), and 4.0 (red) nm diameter.

MATERIALS SCIENCE

Protecting and Connecting

Semiconductor nanocrystals or quantum dots consisting of cadmium selenide (CdSe) or telluride (CdTe) are highly fluorescent and thus potentially useful in optical devices and solar cells and as biological labels. A capping ligand or a matrix material is required to stabilize them, but embedding the nanocrystals into a polymer matrix is hard because of incompatibilities between the two materials. Zhang *et al.* overcome this problem by first capping the CdTe nanocrystals with a surfactant that makes the nanocrystals soluble in styrene. A subsequent polymerization step creates a transparent and still fluorescent CdTe-polystyrene composite. Although nonpolymerizable surfactants produced composites that are opaque and have low photoluminescence (due to the phase separation of the nanocrystals), a mixture of methylmethacrylate and styrene as solvent resulted in CdTe-polymer composites with improved long-term transparency. — MSL

Adv. Mater. **15**, 777 (2003).

CELL BIOLOGY

Putting the Squeeze On

The protein actin generates powerful propulsive forces when it polymerizes into filaments in cell motility processes. In an effort to quantify the biophysical characteristics of these forces, Upadhyaya *et al.* and Giardini *et al.* have both used lipid vesicles coated with the bacterial actin-binding protein ActA, which is the molecule that enables the intracellular pathogen *Listeria monocytogenes* to harness actin for its own transport through the cytoplasm of the host cell. The polymerizing actin forms a cometlike tail behind the vesicles, which become deformed into teardrop shapes, round side in front, as they are pushed

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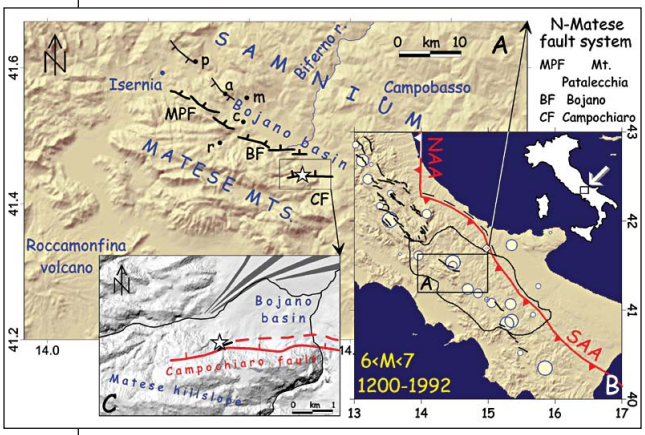


Diagram of the Matese fault system and location of the sanctuary of Hercules (star).

GEOPHYSICS

Herculean Displacement

Italy's archaeological treasures trace not only the waxing and waning of human culture but also natural events such as earthquakes. The displacement of the wall of the Coliseum and the rotation of the Colonna Antonina in Rome are well-known examples of earthquakes deciphered through archaeoseismology. Some of the more damaging and large-magnitude earthquakes occur in the Apennine Mountains.

Galli and Galadini inventoried damage to the sanctuary of Hercules built during the 4th century B.C. in the southern Apennines by the Samnites (before their subjugation by the Romans). Floors warped by fault scarps and walls offset by fault displacements were associated with a Matese fault system earthquake, which occurred in 290 B.C. Additional damage was correlated with historically recorded earthquakes in 346, 1456, and 1805 A.D. Adding the offset from the previously unrecognized 290 B.C. event yields a slip rate of 0.9 mm per year between 290 B.C. and 1805 A.D.; this high rate is symptomatic of an active fault system that bears watching. — LR

Geophys. Res. Lett. **30**, 1266 (2003).

CREDITS: (LEFT) GALLI AND GALADINI, *GEOPHYS. RES. LETT.* **30**, 1266 (2003); (RIGHT) ZHANG *ET AL.*, *ADV. MATER.* **15**, 777 (2003)

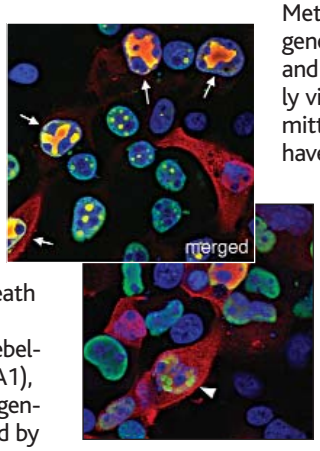
forward. The deformation provides an estimate of the compressive forces on the side of the vesicle and the retractive forces at the rear, which combine to produce a net propulsive force of a few nanonewtons on a vesicle 5 μm in diameter, or about 10 piconewtons per filament. — SMH

Proc. Natl. Acad. Sci. U.S.A. **100**, 4521; 6493 (2003).

BIOMEDICINE

A Stabilizing Partner

A number of human neurodegenerative diseases are caused by genetically encoded expansions of polyglutamine tracts in the disease-causing proteins. These mutant proteins form intraneuronal aggregates that may arise from aberrant stabilization of the proteins, but the mechanism by which this occurs and how the stabilization is linked to neuronal death remain unclear.



14-3-3 (red) colocalizes with S776-ataxin (above, green) in nuclear inclusions (arrows) within COS1 cells (DNA, blue), but not with A776-ataxin (below, green).

Studying spinocerebellar ataxia type 1 (SCA1), an inherited neurodegenerative disease caused by polyglutamine expansion in ataxin-1, Chen *et al*. found that ataxin-1 interacts with and is stabilized by 14-3-3 proteins, a family of phosphopeptide-binding proteins previously shown to regulate many forms of cellular signaling. The binding of 14-3-3 promoted the accumulation of ataxin-1 in neurons and required phosphorylation of ataxin-1 at serine-776 by Akt, a protein kinase implicated in neuronal survival pathways. Both 14-3-3 and Akt modified ataxin-1 neurotoxicity in a fly model of SCA1. That serine-776 plays a critical role in the pathogenesis of SCA1 was also documented by Emamian *et al*. in a related mouse study. Further dissection of these molecular interactions may help identify drug targets for these devastating disorders. — PAK

Cell **113**, 457 (2003); *Neuron* **38**, 375 (2003).

NEUROSCIENCE

Sex, Drugs, and Rock and Roll

Methamphetamine and some of its congeners are popular as artificial stimulants and can have neurotoxic effects, primarily via the elevated release of neurotransmitters and oxidative stress. Brown *et al*. have examined another effect of methamphetamine, which is an increase in body and brain temperatures. In male rats, they find that temperatures can rise by almost 4°C and that hyperthermia lasts for hours. The brain warms before the body, indicating a neurally triggered rather than a movement-driven pathway. The warming was enhanced by the introduction of a female rat into the cage, leading to one fatality at the highest drug dosage. In the context of earlier work that demonstrated a potentiation by loud music of methamphetamine-induced repair responses in brain glial cells, it appears that environmental factors can influence the potency of drugs of abuse. — GJC

J. Neurosci. **23**, 3924 (2003).

HIGHLIGHTED IN *SCIENCE'S* SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT

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Of Macrophages and Muscle

One function of the cytokine interleukin 4 (IL-4) when released by T cells is to stimulate macrophage fusion. Horsley *et al*. show that IL-4 is also a fusion-stimulating signal for nascent myotubes and that it promotes myotube growth by enhancing fusion of myoblasts to existing myotubes. The c2 isoform of the transcription factor NFAT (nuclear factor of activated T cells) is activated in nascent myotubes just after fusion. In myoblasts lacking NFATc2, myotube size and nuclei number could be restored to wild-type levels by application of IL-4. Furthermore, IL-4 expression and secretion were increased during the period after initial myotube formation and were absent in the NFATc2-deficient myotube cultures. Finally, in a coculture fusion assay, the myotube-released IL-4 stimulated the IL-4 receptor–expressing myoblasts to fuse with existing myotubes. — NG

Cell **113**, 483 (2003).

CREDITS: CHEN *ET AL.*, *CELL* **113**, 457 (2003)

Protecting and Connecting

Science **300** (5625), 1477.
DOI: 10.1126/science.300.5625.1477c