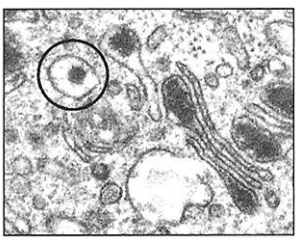
EDITORS' CHOICE

edited by Gilbert Chin

CELL BIOLOGY

Megavesicles on the Move

Debate about the mechanisms of cargo transfer across the Golgi complex has been intense. Do cargo molecules travel through vesicular carriers, which bud from the cisternal rims of one Golgi cisterna and fuse with the next, or do whole cohorts of Golgi membrane cisternae mature and progress en bloc from the cis to trans face of the organelle?



Huge cargo-carrying vesicles.

One of the key results in favor of cisternal progression has been the observation of the transport of cargoes that simply are too large to fit inside a standard 70- to 90-nanometer transport vesicle. But Volchuk *et al.* have generated huge cargoes—up to 400 nm protein aggregates—and were able to observe their transport in megavesicles that appeared to pinch off from Golgi cisternal rims as they rapidly traversed the Golgi complex. Therefore, at least in this instance, vesicular transport is sufficient to allow transport of large cargoes across the Golgi complex; nevertheless, cisternal progression may be important for some cargoes in certain cell types. — SMH

Cell **102**, 335 (2000).

ASTROPHYSICS

Endless Expansion?

A few years ago, astronomers determined that distant supernovae were receding from the center of the universe much faster than before. The cause of this accelerating expansion of the universe remains unclear. An antigravitational repulsive force caused by an increasing density of vacuum energy has been fingered as a likely culprit; as the distance between objects grows, the density of matter decreases, allowing the increasing density of vacuum energy to dominate and eventually to produce cosmic loneliness.

Barrow *et al.* start their calculations with a homogeneous and isotropic universe with no curvature and then consider the changes in expansion rate over time when two forms of matter, a perfect fluid and a quintessence field, are allowed to evolve. They find that it is possible for the density of vacuum energy to decrease over time and for the density of matter to increase, leading to a deceleration of the expansion. Thus, there may yet be opportunity to observe and to interact with our extragalactic neighbors during the next few billion years. — LR

Mon. Not. R. Astron. Soc. **316**, L41 (2000).

GEOPHYSICS

Triggering a Big Quake

In 1998, a magnitude 8.1 earthquake ruptured about 178 kilometers of oceanic crust from east to west within the Antarctic Plate, off the coast of Antarctica in the Indian Ocean. This event was the largest ever recorded within an oceanic plate and the most tectonically isolated, being far from any plate boundary or seismically active region. In addition, the orientation and motion along the fault plane did not match with the generally northeast-to-southwest trending fracture zones and their related seismicity within this area of the seafloor.

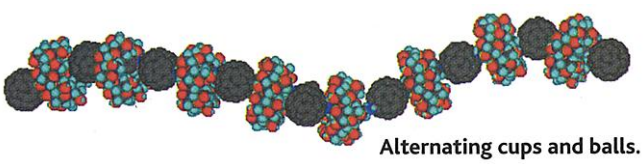
Kreemer and Holt have tried to ascertain the cause of this uncommon event with models of the vertical stress field and the horizontal strain field. The strain field model indicates that the event probably is not related to diffuse deformation from the Australian-Antarctic-Pacific Plate triple junction or an unrecognized microplate within the Antarctic Plate. The stress field model reveals that deglaciation of the nearby Antarctica ice cap may have triggered this event. Three other groups publishing in the same issue have reached similar conclusions on the basis of other data. Understanding the triggering processes that led to this extremely energetic, yet isolated rupture will help to improve our understanding of more complex tectonic regions, such as southern California, where triggering of the Hector Mine earthquake by the Landers earthquake has been suggested. — LR

Geophys. Res. Lett. **27**, 2297 (2000).

CHEMISTRY

Sugar Coating Fullerenes

Potential applications in biology and medicine have motivated attempts to make fullerenes soluble in water, but success has been limited. Now, Samal *et al.* have succeeded in synthesizing water-soluble fullerene polymers that consist of cyclodextrin



Alternating cups and balls.

moieties linked to C_{60} molecules via amine units, thus forming a chain of alternating cyclodextrin and C_{60} molecules. The cyclodextrin units encapsulate the amines and prevent multifunctionalization of the fullerenes, although it is still not known if chain branching occurs. The polymer appears to retain the useful properties of free C_{60}; preliminary experiments show that the molecule cleaves DNA oligomers in the presence of light. — JU

Chem. Comm. **2000**, 1373 (2000).

NEUROSCIENCE

Division of Labor in the Dendrite

An important part of brain growth and maturation in mammals occurs during the first weeks of postnatal development. This can be seen in the extensive change in size and dendritic arborization of neocortical neurons during this period, but large parts of this process are incompletely understood. Zhu used morphological and electrophysiological methods to study the maturation of layer V pyramidal neurons in the rat.

The apical dendrite of these neurons lengthened and thickened, displaying more than a fivefold increase in size at postnatal day 2. This change was accompanied by a switch from high to very low electrical input resistance of dendrite and cell body. Consequently, the apical tuft of the dendrite and the soma became more and more electrotonically isolated from each other.

During the same period the ion channel composition in the dendritic plasma membrane underwent a change from mainly sodium-dependent to the complex calcium- and

CONTINUED ON PAGE 1111

SOURCE: (LEFT TO RIGHT) VOLCHUK *ET AL.*, *CELL* **102**, 335 (2000); SAMAL *ET AL.*, *CHEM. COMM.* **2000**, 1373 (2000).

sodium-dependent mature pattern. As a result, large suprathreshold synaptic inputs in the distal part of the dendritic tree of adult layer V pyramidal neurons can be nonlinearly amplified and can subsequently trigger axonal action potentials.

These findings may have important consequences for information processing on the cellular and network level during the development and maturation of the brain. They also may be valuable for the interpretation and comparison of data from laboratories that use preparations from different developmental stages. — PRS

J. Physiol. **526**, 571 (2000).

MICROBIOLOGY

The Power of Polyphosphate

Inorganic polyphosphate (poly P) is a linear chain of hundreds of phosphate residues linked by high-energy phosphoanhydride bonds. It can be found in all cells, but its functional role has remained elusive. Rashid *et al.* show that poly P is essential for the virulence of *Pseudomonas aeruginosa*, a Gram-negative bacterium that causes serious infections in cystic fibrosis patients and in immunocompromised individuals. Like other pathogenic bacteria, *P. aeruginosa* forms biofilms, sessile three-dimensional aggregates of bacteria that are especially resistant to antibiotics. *P. aeruginosa* lacking polyphosphate kinase (PPK), the enzyme that synthesizes poly P from ATP, was found to be defective in biofilm formation and showed greatly reduced virulence in mice. PPK has not yet been detected in mammalian cells, and it may prove to be an attractive new target for antimicrobial therapies. — PAK

Proc. Natl. Acad. Sci. U.S.A. **97**, 9636 (2000).

IMMUNOLOGY

Arthritis—Another Treatment in the Pot?

The beneficial effects of taking marijuana for debilitating diseases such as multiple sclerosis remains a vigorously debated issue. Evidence for the ability of some constituents of marijuana to influence the immune system, however, does exist. In fact, it is to a nonpsychoactive component of cannabis—cannabidiol (CBD)—that some of these effects can be attributed; CBD has been reported to show anti-inflammatory properties, including the down-regulation of lymphocyte and macrophage function.

Extending these studies, Malfait *et al.* report that oral administration or injection of CBD significantly reduced inflammation in a mouse model of joint disease bearing a similarity to human rheumatoid arthritis. To this end, the cannabidiol appeared to evoke its anti-arthritic effects in two ways: by inhibiting T-cell responses normally induced in the arthritis model upon priming with collagen, and through a direct effect on the inflammatory pathways that lead to the eventual damage of joint tissue. Although the mechanisms by which CBD influences the immune system remain obscure, this study may open up new avenues in the search for effective treatment of chronic inflammatory disease. — SJS

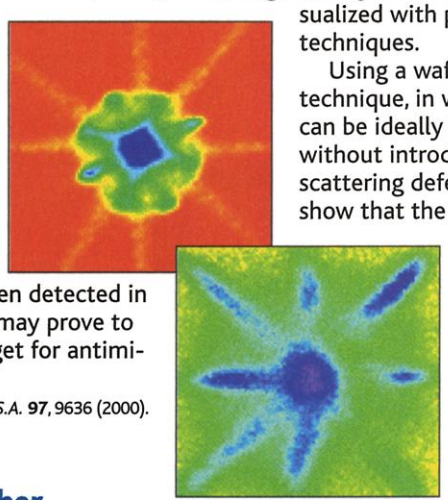
Proc. Natl. Acad. Sci. U.S.A. **97**, 9561 (2000).

PHYSICS

Phonon Management

Impurities and defects within crystals are effective scatterers of acoustic phonons, the quantized units of lattice vibration of the crystal. The symmetry of the crystal itself can result in elaborate, but predictable, patterns of phonon propagation through the crystal, and these can be visualized with phonon imaging techniques.

Using a wafer direct-bonding technique, in which two wafers can be ideally bonded together without introducing phonon scattering defects, Msall *et al.* show that the resultant phonon trajectories at the interface can be engineered by introducing a twist angle between the crystal orientations in the wafers. These trajectories first were simulated computationally and then determined experimentally. The agreement between the data demonstrate that such a technique may prove useful for phonon lensing or for applications requiring phonon management in which heat must be dissipated or directed in particular directions. — ISO



Phonons encountering a 40° twist in Si (upper) and a 20° twist in GaAs (lower).

CREDIT: MSALL *ET AL., PHYS. REV. LETT.* **85**, 598 (2000).

Phys. Rev. Lett. **85**, 598 (2000).

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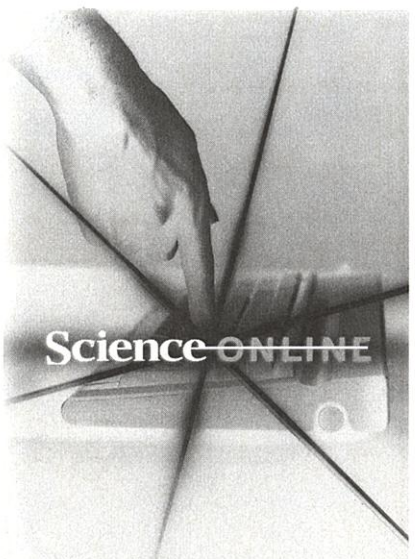

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