

THIS WEEK IN Science

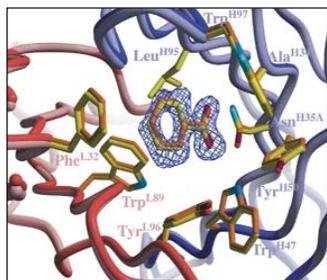
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Dealing in Small Volumes

Although pressure-induced solid-state transformations are important in both geology and materials science, they are difficult to understand at a fundamental level because their kinetics can be highly inhomogeneous, and the role of defects can make transition cycles irreproducible. Jacobs *et al.* (p. 1803) tackled this problem by shrinking the sample size to increase homogeneity and eliminate defects. They studied the transition between in CdSe nanoparticles between the low-pressure tetrahedrally bonded phase and the high-pressure, six-coordinate phase. The activation volumes for the forward and reverse transitions are opposite in sign, which indicates the intermediate has a volume in between that of the four- and six-coordinate phases (rather than greater than both). This finding suggests that directionally dependent nucleation occurs that would be consistent with shearing motion along the crystal planes.

Antibodies That Burn Water?

Recently it was shown that antibodies, upon exposure to light, generate hydrogen peroxide through the conversion of photo-generated singlet oxygen. Wentworth *et al.* (p. 1806; see the news story by Service) now show that this process is catalytic, and that the electron source for this reaction is most likely water—not photo-oxidizable residues such as tryptophan, metal ions, nor chloride ions. Water would be oxidized by singlet oxygen to create H_2O_3 as an initial intermediate. Crystallographic studies with xenon, a binding-site mimic, suggest that singlet oxygen may be bound near conserved Trp and Tyr residues.



Firm Numbers

It might be expected that there will be fewer large business firms than smaller ones. However, the specific distribution of businesses as a function of the number of employees is for addressing questions in economics, such as the relation of firm size and capital and the relative importance of small firms. Economists have generally assumed that there should be some cutoff with firm size and that the distribution is lognormal. Axtell (p. 1818) reanalyzed data for the United States' economy and found that the firm sizes have a Zipf distribution, which means that for each 10-fold increase in firm size, the number of firms decreases by 10, and that this distribution has held over time. Thus, there is no

1800 Galaxies Running Out of Gas

Galaxies that fall into clusters are typically stripped of their cold, neutral hydrogen gas. Zwaan *et al.* (p. 1800) used the recently upgraded Westerbork Synthesis Radio Telescope to search for neutral hydrogen gas of infalling galaxies in older clusters (those at a redshift of about 0.2). They detected hydrogen gas from only one spiral galaxy falling into the Abell 2218 cluster and infer that gas stripping is efficient. This technically challenging detection is consistent with low-density cosmological models.

cutoff at firm sizes as small as 1 or 2 employees.

Moving Mantle After the Shock

Large earthquakes deform the continental crust, but it remains unclear whether this deformation is confined to local shearing or more broadly coupled to mantle flow. Pollitz *et al.* (p. 1814) studied 9 months of postseismic geode-

tic data measured with the global positioning system after the magnitude 7.1 Hector Mine earthquake in California. The observed deformation can be modeled by flow in a relatively low viscosity upper mantle that is coupled to a higher viscosity, stiff lower crust and a more brittle upper crust.

Pumping Uphill

The ABC transporters, one of the largest classes of membrane proteins engaged in active (energetically uphill) transport, contain a cytoplasmically disposed adenosine triphosphate (ATP)-binding cassette linked to what has been predicted to be a bundle of transmembrane helices (see the Perspective by Higgins and Linton). The subgroup of multidrug resistance (MDR) transporters use the energy from ATP hydrolysis to pump a broad spectrum of hydrophobic drugs out of cells. Chang and Roth (p. 1793; see the cover) have determined the crystal structure at 4.5 angstroms of MsbA, a bacterial ABC transporter that has strong sequence similarity with MDR proteins. Two six-helix bundles form an inverted V shape, intramembrane transport chamber. The authors propose that accessibility to this chamber is regulated cyclically via hydrolysis of ATP at the two globular ABC domains.

Human Neural Stem Cells

The generative capacity of certain cells found in the adult central nervous system has led to questions of their origin: Are these stem cells set aside during early development, or is their proliferative capacity a result of experimental perturbation? Ourednik *et al.* (p. 1820) addressed this question by transplanting labeled human neuronal stem cells into the developing brain of fetal bonnet monkeys. The transplanted cells both contribute to immediate brain development and also form clusters in the secondary germinal zone. ✕

Cells Hang On for Dear Life

One explanation for why the development of cancer cells is a relatively rare event is that cells that lose their attachment to a substratum and associated integrin signaling often undergo cell death or apoptosis. Puthalakath *et al.* (p. 1829; see the Perspective by Hunt and Evan) now describe a mechanism by which unattached cells may sense changes in the cytoskeleton and initi-

ate the process of apoptosis. A new mammalian Bcl-2 family member called Bmf can promote apoptosis by binding to and inhibiting the pro-survival Bcl-2 proteins. Bmf interacts with dynein light chain 2 and becomes localized to the myosin V motor complex on filamentous actin. In cells in which the actin cytoskeleton was disrupted by treatment with actin-depolymerizing agents or by culture of the cells in suspension (without attachment to a substratum), Bmf was released from its association with the cytoskeleton and freed to interact with Bcl-2. Thus, Bmf appears to function as a sensor that couples alterations in the cytoskeleton to activation of the cell death machinery.

Pass the Cyanide

Increasingly sophisticated genomic technology has made it feasible to consider transplanting entire metabolic pathways, rather than just single genes encoding single enzymes. Tattersall *et al.* (p. 1826) apply this approach to the plant-pest interaction. By transferring the metabolic pathway for synthesis of a cyanogenic glucoside from *Sorghum* into *Arabidopsis*, the latter plant, the normal host for a flea beetle, is rendered less palatable and even deadly. This type of metabolic engineering may be useful for improving the defense arsenal of other plants as well as for experimental study of plant-pest ecology. ✕

Distributed Control in a Nervous System

The limited movement of our jointed limbs requires tight control by the central nervous system. Other animals, like the octopus, have flexible arms with much greater degrees of freedom. Sumbre *et al.* (p. 1845) studied movement generation and control in octopus arms in which the connection between the arm's peripheral nervous system and the brain was severed. Arm extension could be elicited by electrically stimulating the arm's nervous system or by touching the arm's skin. The evoked movements were practically identical to natural reaching movements in normal animals. Control of the complex flexible arms of the octopus appears to be distributed between the central nervous system, which gives the overall direction of a planned movement, and the peripheral system that implements the finer details.



Measure Twice, Cut Once

Genes contain both exons, which encode the amino acid sequence, and introns, which do not. The latter must be removed from the pre-messenger RNA (mRNA) transcript with great exactitude—a single base error may result in premature termination of translation as a consequence of a shift in reading frame. In order to guard against synthesizing truncated and potentially deleterious proteins, a multisubunit complex is used to “mark” the place where exons have been joined. If translation terminates upstream of any such mark, then the mRNA is shunted into a degradation pathway called nonsense-mediated decay (NMD). Kim *et al.* (p. 1832) and Lykke-Andersen *et al.* (p. 1836) now provide the first evidence for physical interaction between components of the mark and those of NMD.

Clues to Lethal Flu

Clues into the molecular basis for the lethality of some outbreaks of influenza A in this century are the subject of two reports (see the Editorial by Layne and the Perspectives by Webster and by Laver and Garman). The 1918 influenza pandemic swept through the United States Army and escaped to slaughter more young adults than did World War I. A reanalysis of the gene sequences by Gibbs *et al.* (p. 1842) indicates that a recombination event between swine and human lineages in the hemagglutinin gene of the virus triggered the pandemic. This event would have meant a change in antigenicity, and owing to the previous demography of flu, the immunologically naïve population was apparently precisely the age group that showed the highest mortality from severe lower respiratory tract oedema and hemorrhage. In 1997, a strain of influenza A transmitted from birds killed 6 of 18 infected persons in Hong Kong. Hatta *et al.* (p. 1840) infected mice with human viral isolates and found that a mutation at position 627 of polymerase 1 and cleavability of the hemagglutinin glycoprotein had the greatest effects on pathogenicity.