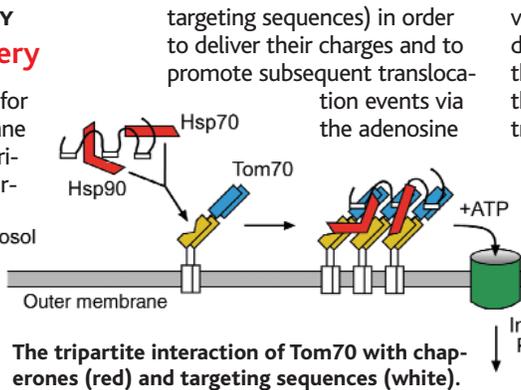


edited by Gilbert Chin

## CELL BIOLOGY Special Delivery

Proteins destined for the inner membrane of the mitochondrion face several hurdles in traveling from the site of their synthesis, which for most of them is the cytosol, across the outer mitochondrial membrane to reach the inner one. They contain internal peptide sequences, which target them to receptors in the outer membrane, and their hydrophobic membrane-spanning segments (which enable them to function as solute transporters) need to be chaperoned, both to avoid aggregation while awaiting translocation and to allow for unfolding and passage through the import pore. Young *et al.* show that in mammalian cells the cytosolic chaperones Hsp90 and Hsp70 bind to the mitochondrial import receptor Tom70 (which recognizes the



The tripartite interaction of Tom70 with chaperones (red) and targeting sequences (white).

targeting sequences) in order to deliver their charges and to promote subsequent translocation events via the adenosine

triphosphate (ATPase) activity of Hsp90. In yeast, only Hsp70 is used in the equivalent reaction, and its ATPase activity is needed for import. — SMH  
*Cell* 112, 41 (2003).

## MICROBIOLOGY Not So Boring Bacteria

Spiroplasma are minimalist (in genetic terms) free-living forms of life, having about the same dimensions as a eukaryotic cilium. How they move about has been a puzzle, as they do not possess external flagella-powered rotary motors, yet are highly active within viscous en-

vironments. These tiny bacteria do not have a rigid cell wall like their larger cousins. Instead, they possess an internal contractile cytoskeleton consisting of protein subunits with no known homologs. Gilad *et al.* and Trachtenberg *et al.* show that the cytoskeleton is organized as a flat but twisted ribbon of seven paired fibrils attached at points to the inner side of the cell membrane, which makes the entire cell adopt a helical shape. The fibrils can rapidly change length by swapping different ring-shaped subunits, which alters the geometry of the ribbon. Changes in helical dimensions cause cell shape changes to drive a linear motor; standing waves can be propagated for forward movement and boring through viscous media. Direction can be reversed easily by switching the handedness of the helix. Generating a "kink" seems to be the favored mode of propulsion, and spiroplasma can also twitch and bend to aid reorientation and rotation. The

next question is how spiroplasma decide which direction to take. — CA

*Mol. Microbiol.* 47, 657; 671 (2003).

## APPLIED PHYSICS Half-Metallic Manganites

Magnetic tunnel junctions control current based on spin rather than electric field. They consist of two ferromagnetic electrodes separated by a thin oxide layer. The amount of current transported across the junction depends only on the relative spin polarization of the two outer layers, much like light traveling through a polarized lens. These simple devices are attractive as magnetic memory elements and as a source of polarized electrons in spintronics applications. However, the main issue hindering progress has been finding a material with a high degree of polarization. Bowen *et al.* present transport measurements of magnetic tunnel junctions with the manganite  $\text{La}_{2/3}\text{Sr}_{1/3}\text{MnO}_3$  as the electrode material. The results suggest an electrode spin polarization of at least 95%, revealing a marked improvement over current magnetic tunnel junction device structures. — ISO

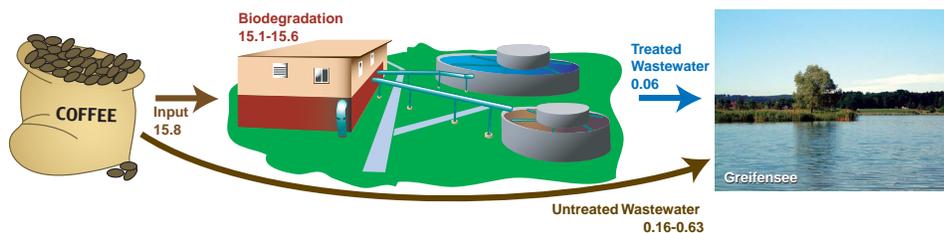
*Appl. Phys. Lett.* 82, 233 (2003).

## ENVIRONMENTAL SCIENCE So What Happens to All That Coffee?

Although many industrialized nations routinely treat wastewater, the capacity of these systems is finite, and thus some wastewater can go untreated, especially during large storms and floods. Buerge *et al.* have followed one proposed marker for domestically produced wastewater—caffeine—by measuring its concentration in water entering and exiting Swiss wastewater plants and in local watersheds. Treatment eliminates 80 to 100% of the caffeine (primarily from coffee), yet caffeine is routinely detected in Swiss rivers and all but the highest Alpine lakes. The authors calculate that if this caffeine were to have been introduced on the days when wastewater systems were overburdened due to rain, then the fraction of untreated wastewater would amount to 1 to 4%. Indeed, for Zürichsee, monthly inputs of caffeine did correlate with fluctuations in precipitation. — PDS

*Environ. Sci. Technol.* 10.1021/es020125z (2003).

### Caffeine fluxes (in mg per person per day) into and around treatment plants in the Greifensee region.



## BIOTECHNOLOGY Passing a Blood Test

Almost all of us have undergone one of the basic laboratory procedures: a measurement of blood chemistry, sometimes referred to as an SMA (sequential multiple analyzer)—12 test for the 12 components (cholesterol, glucose, etc.) analyzed. Unlike experimental measurements under optimized conditions, real-life quantitation of the critical electrolyte  $\text{K}^+$  should be independent of other variables such as pH and  $\text{Na}^+$ . Another desirable quality for a  $\text{K}^+$  sensor would be a highly

CONTINUED ON PAGE 629

CREDITS: (TOP) YOUNG *ET AL.*, *CELL* 112, 41 (2003); (BOTTOM) ILLUSTRATION: DEBRA J. MORGENEGG/SCIENCE; (PHOTO) MICHELE MARCONELLI

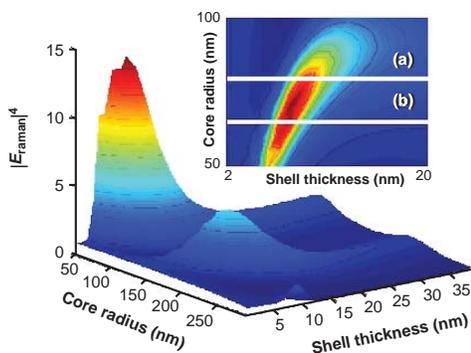
sensitive fluorescent readout, which would require placing both the excitation and emission wavelengths outside those of the endogenous chromophores in whole blood. He *et al.* describe the synthesis of a molecule that passes these tests; it contains a fluorophore (absorbing at 470 nm; emitting at 540 nm) linked to a  $K^+$ -binding ( $K_d \sim 5$  mM) crown ether derivative. In the absence of  $K^+$ , the fluorescence is quenched via intramolecular electron transfer, which is nullified when the tertiary amine binds  $K^+$ . Similarly, He *et al.* have designed a  $Na^+$  sensor ( $K_d \sim 80$  mM) that fluoresces in a pH- and  $K^+$ -independent manner. — GJC

*J. Am. Chem. Soc.* 10.1021/ja0284761 (2003);  
*Anal. Chem.* 10.1021/ac0205107 (2003).

## APPLIED PHYSICS

### The Core-Shell of the Matter

In vibrational spectroscopy, the Raman effect, which generally is rather weak, can be enhanced by means of surface plasmons when molecules are adsorbed on the surface of rough silver films. Although the enhancement can be by several orders of magnitude, its variability has limited the easy quantification of spectra. Jackson *et al.* studied the surface-enhanced Raman scattering (SERS) of nanoparticles in which a dielectric silica core is surrounded by a silver shell, a geometry that can enhance the local electromagnetic field. Experimental studies on cores ranging from 65 to 79 nm and shells



### Calculated changes in Raman response with core-shell geometry.

with a thickness of 5 to 20 nm show an apparent SERS enhancement of  $10^6$  for *para*-mercaptoaniline molecules adsorbed in aqueous solutions. Because of the reabsorption of signal by nearby core-shells, the actual enhancement is  $10^{12}$ , or comparable to that seen for colloidal silver. The changes in calculated Raman response (as  $|E_{\text{Raman}}|^4$ ) with changes in core-shell geometry follow

those seen experimentally; thus, the enhancement is not due to other factors (localized plasmons and molecular resonances) proposed to contribute to SERS. — PDS

*Appl. Phys. Lett.* **82**, 257 (2003).

## BIOCHEMISTRY

### The Downside of 24/7

Chromosomal translocations can result in the fusion of parts of genes; the fusion protein, as in the classic example of BCR-ABL, can exhibit an inappropriately unrestrained tyrosine kinase activity that leads to cellular transformation and the development of cancer. Known oncogenic gene fusions involving plasma membrane receptor tyrosine kinases, in essence, subtract the receptor portion and add a dimerization-inducing domain, acting as if ligand were present all the time. Charest *et al.* describe a fusion protein, FIG-ROS, that was found in a human glioblastoma. FIG acts to localize the tyrosine kinase portion of the plasma membrane protein ROS to the Golgi apparatus, which is a necessary prelude for it to exert its transforming potential. — GJC

*Proc. Natl. Acad. Sci. U.S.A.* **100**, 916 (2003).

## ENVIRONMENTAL SCIENCE

### Chesapeake Bay Watch

Eutrophication of lakes, bays, and estuaries caused by the addition of nutrients derived from human activities is a serious environmental problem. The Chesapeake Bay, one of the most productive and important ecosystems in the continental United States, has been seriously affected by nutrient excess and remains at great risk for the foreseeable future.

In order to establish a history of the anthropogenic contribution to primary productivity there, Colman and Bratton have measured the biogenic silica content of well-dated Chesapeake Bay sediments from the past 1500 years. Because diatoms are the major primary producers in the bay, biogenic silica is a good proxy for productivity in the overlying water column. Comparison of sedimentation and productivity before and after European settlement shows that both sediment and biogenic silica fluxes in Chesapeake Bay waters have increased by factors of 4 to 5 since settlement. These results quantify the range of changes that have occurred in response to human activity and should be useful in the design of nutrient and suspended-sediment targets for restoration of the bay. — HJS

*Geology* **31**, 71 (2003).