

Persistent LCMV (green) in the mouse spleen.

## IMMUNOLOGY

## Double Jeopardy

A persistence of infection is a trademark of some viruses, notably HIV and hepatitis B and C viruses, and is in large part the result of an incompletely effective antiviral T cell immune response. Brooks *et al.* provide evidence that a familiar and important regulatory cytokine—interleukin (IL)—10—plays a key role in facilitating viral persistence. Using two strains of the mouse lymphocytic choriomeningitis virus (LCMV), one capable of establishing a persistent infection and the other not, they showed that the levels of IL-10 generated during infection with the former were significantly higher than with the rapidly cleared strain. The T cell responses in the persistently infected animals were also diminished, leading them to ask if IL-10 were directly responsible for allowing the persistence of one strain (and not the other) by dampening virus-specific T cells. Indeed, in mice lacking IL-10, the strain differences were less apparent and, as they also found using blocking antibodies for IL-10, this led to faster viral clearance and signs of improved T cell memory.

Although differential IL-10 expression might explain such effects, it will be useful to understand exactly how the two different strains of virus trigger distinct levels of IL-10 in the first place. Presumably, mechanisms that diminish immunity could influence other ongoing infections, including situations of bacterial co-infection. Although IL-10 was not itself tested in another study by Navarini *et al.*, these authors do report that LCMV increases the susceptibility of mice to co-infection with bacteria. Rather surprisingly, the culprit in this case was the innate antiviral cytokine type I interferon, which induced apoptosis in bacteria-clearing granulocytes. — SJS

*Nat. Med.* **12**, 10.1038/nm1492 (2006); *Proc. Natl. Acad. Sci. U.S.A.* **103**, 15535 (2006).

## MATERIALS SCIENCE

## Turning Water Inside Out

Colloidal particles with appropriate surface properties adsorb strongly at liquid/liquid and vapor/liquid interfaces; hence, they are used as stabilizers for emulsions and foams. Particle surface wettability can be tuned to entrap water in oil, or oil in water, for example, and even to switch between these two regimes. In the case of a vapor/liquid interface, such inversion behavior—the shift from air bubbles dispersed in water, as in a foam, to water droplets dispersed in air—has been explored only recently. Binks and Murakami stabilize a full range of air/water dispersions by adding silica particles 20 to 30 nm in diameter that vary in their wettability, which the authors reduce by lowering the concentration of surface silanol (SiOH) groups via hydrophobic capping. High SiOH content gives rise to stable aqueous dispersions, whereas intermediate particle hydrophobicity leads to air-in-water foams. At the lowest SiOH content, the particles drive a transitional inversion, coating discrete water droplets to stabilize a water-in-air powder. This powder releases water to the skin when sheared by rubbing, suggesting possible applications in cosmetics. The authors further show that varying the ratio of water to air at fixed SiOH content can also force an inversion (in this case formally termed “catastrophic”), giving rise to a soufflé-like

material stickier and more highly aggregated than the water-in-air powder. — MSL

*Nat. Mater.* **5**, 10.1038/nmat1757 (2006).

## MICROBIOLOGY

## Intracellular Demographics

Mathematical models are commonly used to help predict the course of epidemics through a population of organisms. In contrast, Brown *et al.* have absorbed recent findings on intracellular events in salmonellosis to develop a within-organism model. *Salmonella enterica* grows within host phagocytes to varying cell density regardless of cell “permissiveness.” Interestingly, the model hints that apoptosis of host cells has little effect on controlling the spread of infection; rather, the driving force is necrotic bursts that release bacteria to spread into new foci of infection. Comparing attenuated (i.e., vaccine) and virulent strains of salmonellae in the model reveals that an attenuated strain replicates less well than a virulent strain and uses the same number of host cells to do so; hence, the resulting pathology may be rather similar. The model is clearly useful for predicting the effect of combination drug therapy, and it hints that drugs that kill extracellular pathogens might select for “refuge resistance”; that is, the suppression of cell lysis mechanisms. — CA

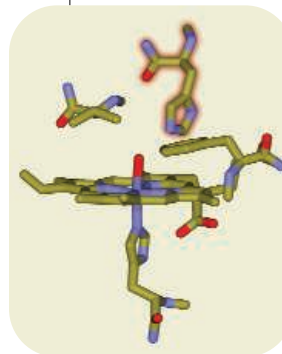
*PLoS Biol.* **4**, e349 (2006).

## CHEMISTRY

## Embedding a Reporter

The nitrile (CN) group can be a useful infrared reporter in proteins because it has a strong stretching vibration near  $\sim 2200\text{ cm}^{-1}$ , a spectral region usually free from interfering absorptions in a biochemical environment. Schultz *et al.* have devised a protocol to introduce the

non-naturally occurring amino acid *para*-cyanol-*l*-phenylalanine (pCNPhe) into proteins during bacterial synthesis, using an orthogonal nonsense suppressor transfer RNA (tRNA) paired with an aminoacyl-tRNA synthetase derived from *Methanococcus jannaschii*. They apply this system to incorporate the pCNPhe reporter in place of a histidine



His<sup>64</sup> (highlighted) in myoglobin was replaced by pCNPhe.

residue (His<sup>64</sup>) near the ligand-binding site of the heme group in myoglobin. When water was bound in the active site, they observed an  $11\text{-cm}^{-1}$  shift in frequency relative to pCNPhe absorption in pure water or buffer solution, a

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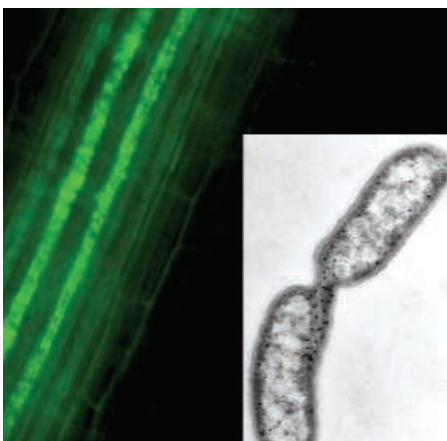
change consistent with increased water polarity in the binding pocket. Changes in the observed CN stretching frequency were also consistent with the bent conformations of Fe(II)-bound NO and O<sub>2</sub>, as well as the linear CO-Fe(II) complex. — PDS

*J. Am. Chem. Soc.* **128**, 10.1021/ja0636690 (2006).

## BIOTECHNOLOGY

## Keeping the Fix In

The endophyte *Azoarcus* sp. strain BH72 resides within the roots of rice and other grasses. In return for supplying the plant with fixed nitrogen (diatomic nitrogen that has been converted into biochemically tractable forms such as ammonia), it is presumed to benefit from a shel-



*Azoarcus* in a rice root.

tered and predictable habitat. Krause *et al.* have sequenced its genome and compared it to that of a free-living relative, the strain EbN1. They find the expected suite of nitrogen-fixing and -metabolizing enzymes along with a large set of transporters for dicarboxylic acids (though not of sugars) and chelated iron. On the other hand, the low-stress lifestyle appears to have led to the loss (or non-acquisition) of type III and IV secretion systems as well as a paucity of virulence and pathogenic components. Similarly, there are only a small number of mobile elements, in comparison to its independent cousin. How these characteristics might be harnessed in agronomic efforts to enhance rice cultivation, and perhaps that of other cereals, is not yet clear, but it's a start. — GJC

*Nat. Biotechnol.* **24**, 10.1038/nbt1243 (2006).

## PSYCHOLOGY

## Theorizing Takes Time

The human ability (commonly referred to as a theory of mind) to formulate inferences about

the mental states, such as beliefs and intentions, of others is a fundamental item in our social cognitive skill set. Apperly *et al.* have asked whether the component reasoning processes operate in an automatic fashion, in the background as it were, and yield output that can be summoned effortlessly when needed. Using the canonical Maxi type of false-belief task (which some might argue has attained a mythic status), they required that participants report the final positions of objects, both their actual locations as well as where female actors believed them to be. In comparison to keeping track of the physical objects, participants required more time to infer where the actors thought they were located; though if explicitly forewarned to monitor belief states, they were equally fast at specifying actual and supposed locations. Does this mean that we do not automatically maintain a running tally of who believes what? Not quite—there may be an unconscious pre-processing of evidence into candidate belief states, where the final step of asserting which one to act on is taken only on demand. — GJC

*Psychol. Sci.* **17**, 841 (2006).

## APPLIED PHYSICS

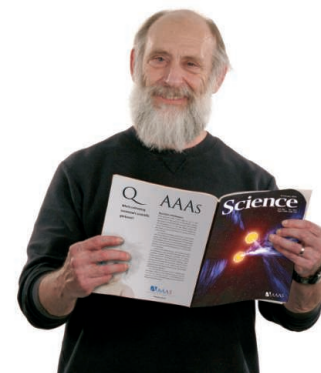
## Scaling Superconductive Memories

Superconducting electronic systems offer great potential to improve the speed of conventional computers through low power dissipation and switching times on the order of picoseconds. One problem, however, has been to develop small-sized memory storage elements that are also compatible with large-scale integration. For instance, data storage in these systems has generally been based on harboring magnetic flux in a superconducting loop, and those loops tend to be several micrometers in diameter.

Held *et al.* propose the design of a memory element based on a ferromagnetic dot coupled to a superconducting Josephson junction. Because the critical current of a Josephson junction is magnetic field-dependent, the magnetization of the dot can be switched to modulate the field in the junction either below or above a critical value. The data, 0 or 1, are thus stored as the magnetization direction in the dot and can be read out as the critical current of the Josephson junction. Preliminary experiments using a Permalloy (Ni<sub>81</sub>Fe<sub>19</sub>) dot demonstrate the principle of operation and also show nonvolatile storage capability at room temperature. The authors note that optimization of the device should reduce the relatively high (~100 mA) applied currents required to switch the dot magnetization. — ISO

*Appl. Phys. Lett.* **89**, 163509 (2006).

## Who's opening the pipeline to new discoveries?



“ I started out as a plumber in the Bronx, New York. My father was a plumber. He wanted me to go to college to learn engineering so we could go into business together.

But I was no good at engineering and switched to physics. I got hooked, and quickly knew that I wanted to be a physicist. I had to break it to my father. He didn't know what a physicist was, so I said – like Einstein.

Well, I may not be Einstein but I did become a physicist. It appeals to my curiosity.

I'm a member of AAAS because I believe in what it does for science and scientists. A big part of that work is in education. I think its efforts to bring on the next generation of scientists are vital for our future. ”

Dr. Leonard Susskind is a professor of physics at Stanford University. He's also a member of AAAS.

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