X-ray crystallography has now been used to image non-crystals. X rays have long been used to determine the structure of crystalline objects: The periodic arrays of atoms or molecules produce diffraction patterns with discrete peaks that, when analyzed by Fourier transformation algorithms, provide a map of the sample's structure with approximately angstrom resolution. In the new experiment-performed at Brookhaven National Laboratory's National Synchrotron Light Source by Jianwei Miao and David Sayre (both of State University of New York at Stony Brook), and their colleagues- x rays were directed onto a micrometer-sized array of letters spelled out with 100 nm gold nanoparticles (top image). That manifestly noncrystalline object produced a continuous (rather than discrete) diffraction pattern (middle), which was then oversampled and put through an iterative algorithm to reconstruct the image (bottom) with a resolution of about 75 nm. The researchers believe their method can be applied to imaging small biological cells or even large subcellular objects. (J. Miao et al., *Nature* 400, 342, 1999.) -pfs

A linear decelerator for neutral molecules has been demonstrated by a group in The Netherlands led by Gerard Meijer (University of Nijmegen). It provides a new way to cool molecules for subsequent trapping and study. Previous methods for obtaining cooled molecules either depended on a cold background gas and magnetic fields or were restricted to those molecules that could be formed from previously chilled trapped atoms. For their demonstration, the researchers constructed a 35 cm long "Stark decelerator" that contains a succession of 63 pulsed electric fields and is designed to slow down any neutral molecule with a permanent dipole moment (a permanent separation of electric charge within the molecule). Thus it can handle virtually any asymmetric molecule. When a precooled mixture of carbon monoxide in xenon gas entered the decelerator, each CO molecule experienced the Stark effect; at every electric field, the molecule's internal energy shifted upward, accompanied by a loss of some kinetic energy. After passing through all 63 stages, a subset of the CO molecules was slowed from 225 m/s to 98 m/s, with an equivalent temperature of 30 mK. This technique promises to be useful for cold molecule physics, a field that is "expected to bloom in the next decade," says Meijer, who also told us the group has now slowed molecules to 54 m/s. (H. L. Bethlem, G. Berden, G. Meijer, *Phys. Rev. Lett.* 83, 1558, 1999.)-bps

Acoustic time-reversal mirrors (TRMs) can characterize rough surfaces. In one TRM technique, an echo is detected by an array of transducers, whereupon each signal at each transducer is reversed in time and rebroadcast (last in, first out) back along the incoming path. The resulting cacophony of signals amazingly converges into a single pulse of sound located at the source of the echo. (See the article "Time Reversed Acoustics" in Physics Today, March 1997, page 34.) Now, in exploring the robustness and limits of the technique, Mathias Fink (University of Paris VII) and his colleagues have found that, by moving the TRM before the signals are retransmitted, they could determine both the root-mean-square height and the surface-height autocorrelation function of rough surfaces. The second of these statistical measures has been particularly difficult to determine, requiring either point-by-point mapping of the surface, which is slow, or a less accurate double-echo technique without the strong correlations introduced by time reversal. Among the applications for this technique are measuring arterial walls in vivo, exploring the sea floor, and determining the interfacial roughness between two solids. (J. H. Rose et al., J. *Acoust. Soc. Am.* 106, 716, 1999; P. Roux et al., J. Acoust. Soc. Am. 106, 724, 1999.) -sgb

A new model of epilepsy. The onset of an epileptic seizure is marked by a transition from the customary uncoordinated (perhaps even chaotic) firings of neighboring neurons into a state of synchronous firings, whose organizing principle is not yet known. In recent years, brain imaging techniques have shown that the staging area for some of the most intractable forms of epilepsy is in a region of the hippocampus. Now, researchers at Indiana University-Purdue University at Indianapolis have created a hybrid model of a portion of the brain. First, they describe a hippocampal subnetwork of neurons with three biologically inspired coupled ordinary differential equations. Then they connect about 1200 such subnetworks into a spatially extended lattice of coupled ODEs whose rules are governed by potassium diffusion. Epilepsy is a "dynamical disease," arising not from any structural or chemical abnormality, but rather from the temporary excursion of a critical parameter outside of some acceptable window of behavior. Knowing what this parameter is could lead to new therapies. From analyzing the results of their model calculations, the IUPUI scientists suspect the mystery parameter may be the speed of communication among the synchronized neurons. (R. Larter, B. Speelman, R. M. Worth, *Chaos* 9, 795, 1999.) -pfs