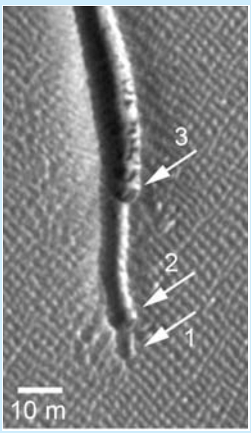
References

1. M. Haider, S. Uhlemann, E. Schwan, H. Rose, B. Kabius, K. Urban, *Nature* **392**, 768 (1998).
2. P. E. Batson, N. Dellby, O. L. Krivanek, *Nature* **418**, 617 (2002).
3. O. L. Krivanek, M. F. Chisholm, V. Nicolosi, T. J. Pennycook, G. J. Corbin, N. Dellby, M. F. Murfitt, C. S. Own, Z. S. Szilagyi, M. P. Oxley, S. T. Pantelides, S. J. Pennycook, *Nature* **464**, 571 (2010).
4. J. C. Meyer, A. Chuvilin, G. Algara-Siller, J. Biskupek, U. Kaiser, *Nano Lett.* **9**, 2683 (2009).
5. C. Jin, F. Lin, K. Suenaga, S. Iijima, *Phys. Rev. Lett.* **102**, 195505 (2009).
6. N. Alem, R. Erni, C. Kisielowski, M. D. Rossell, W. Gannett, A. Zettl, *Phys. Rev. B* **80**, 155425 (2009).
7. K. Suenaga, Y. Sato, Z. Liu, H. Kataura, T. Okazaki, K. Kimoto, H. Sawada, T. Sasaki, K. Omoto, T. Tomita, T. Kaneyama, Y. Kondo, *Nat. Chem.* **1**, 415 (2009).
8. O. L. Krivanek, N. Dellby, M. F. Murfitt, M. F. Chisholm, T. J. Pennycook, K. Suenaga, V. Nicolosi, *Ultramicroscopy* (in press).
9. M. Kuwabara, W. Lo, J. C. H. Spence, *J. Vac. Sci. Technol. A* **7**, 2745 (1989).

lily grain in panel a, for example, has an elongated aperture that allows harmomegathy to proceed somewhat like the way in which one makes a cone by connecting the edges of a disk that has had a slice removed. Strictly followed, that process yields vertices with high concentrations of bending energy; in reality the lily grain stretches a little at the vertices and ends up looking like a US football. The other grains illustrated in the figure have built on the same simple physics—avoid stretching and kinks—to achieve more intricate but equally effective harmomegathic responses. (E. Katifori et al., *Proc. Natl. Acad. Sci. USA* **107**, 7635, 2010.) —SKB

Water-carved gullies on Mars. Carved into many Martian dunes are narrow, sinuous channels. Studies of their morphology and laboratory simulations suggest that the likely origin of the gullies is surface or near-surface water ice that melts and forms a flowing slurry of sandy debris. Dennis Reiss and colleagues at the University of Münster's Institute for Planetology report new evidence for such transient liquid water. Their observations rely on data from the High Resolution Imaging Science Experiment, a camera on the *Mars Reconnaissance Orbiter* that provides nearly 10 times the resolution of the camera aboard the earlier *Mars Global Surveyor*. Armed with 23 sequential HiRISE images of the Russell crater dune field in Mars's southern hemisphere over two successive Martian years (spanning November 2006–May 2009), the researchers uncovered signs of multiple flow events that, as seen in this image, deepen and widen the channels. They also observed gullies lengthening over the course of the early Martian spring. Factoring in near-IR reflectance data, which tracked the melting of frozen carbon dioxide, and calculations of daily springtime temperature profiles at the surface, they discount dry flows and CO_2 flow mechanisms; they instead conclude that the gully changes are best explained by the seasonal melting of small amounts of water ice. (D. Reiss et al., *Geophys. Res. Lett.* **37**, L06203, 2010.) —RJF



Cement is denser than it's cracked up to be. When chemically modified with water in a process called hydration, cement morphs into the durable binder that holds gravel, sand, and other additives together to form concrete—the most used manmade material in the world. The main constituent of hydrated cement is $CaO\text{-}SiO_2\text{-}H_2O$ (called C-S-H) in the form of nanoscale colloidal aggregates, the size, shape, and packing of which are crucial to the ultimate strength and stability of concrete. The solid C-S-H nanoparticles are generally thought to be analogous to the claylike minerals tobermorite and jennite, mixed with calcium hydroxide. But new neutron-scattering studies by Jeffrey Thomas and Hamlin Jennings of Northwestern University and Andrew Allen of NIST in Gaithersburg, Maryland, show that C-S-H has a higher-than-expected atomic packing density. The mass density of solid C-S-H is roughly 10% higher than that of a mixture of its widely used mineral analogues with the same composition. The result has important implications for the modeling of cement paste. (See, for example, PHYSICS TODAY, November 2009, page 23, where that model's starting point is dry tobermorite.) The researchers also investigated the composition and density of C-S-H cured at elevated temperatures and with various additives. In particular, they found that curing the cement at 80 °C led to a lower atomic packing density. Such atomic packing variations suggest the possibility to control chemical shrinkage and the associated cracking of concrete. (J. J. Thomas, H. M. Jennings, A. J. Allen, *J. Phys. Chem. C* **114**, 7594, 2010.) —SGB

Maglevs for ships. Several approaches have been devised for suppressing the rolling motion of ships at sea. Active systems that position a movable mass to provide a countering torque can rapidly damp the rolling, but the inherent friction not only is noisy but also produces constant wear. Researchers from the Korea Institute of Machinery and Materials recently demonstrated that the technology employed to reduce friction in magnetically levitated trains can do the same for ships. Indeed, their antirolling device is essentially a maglev train car on a short track that runs side to side across the ship's midline. For the demonstration, the team built a 118-kg, small-scale model with the cross-sectional shape of a twin-hulled catamaran. A C-shaped, 4-kg mass—the "train car"—wrapped around a 1-m-long rail along the top of the model; electromagnets at the bottom of the mass faced the rail from underneath and provided the levitating force. Mounted in the rail was a linear motor, like those used to propel maglev trains (and some roller coasters). Whereas the more common rotary motors produce torque, linear motors produce linear forces. In the researchers' setup, as the motor controller received signals from a tilt sensor on the ship, it quickly moved the mass to the appropriate position to damp the rolling motion. In tests, the model ship's free oscillations were suppressed within 4 seconds. Though it is more expensive than conventional alternatives, the researchers think maglev antirolling technology could have broad potential, from pleasure boats to oceanographic research vessels. (C. H. Park et al., *Rev. Sci. Instrum.* **81**, 056102, 2010.) —RJF