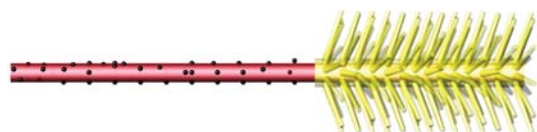


rough surface topography, crustal deformation, and mantle upwelling (upward arrows) more accurately than do standard geological models. The upwelling identifies spots of potential earthquakes or volcanism. (L. Liu, D. Hasterok, *Science* **353**, 1515, 2016.) —RMW

MICROMOTORS SWIM TOWARD AND AWAY FROM THE LIGHT

Since the first molecular motors were synthesized in the late 1990s, the catalog has expanded to include self-propelling micromotors that roll, walk, or swim. Building such devices is challeng-



ing enough, but controlling their direction of motion has also proved difficult. Now chemist Baohu Dai and his colleagues at the University of Hong Kong have created a tree-shaped micromotor that exploits the motion of charges inside and outside the device to swim toward or away from a light source. Each device is about 10 μm long and consists of titanium dioxide nanowires (yellow in the illustration) sprouting from one end of a silicon wire (pink). Ordinarily the microswimmers succumb to Brownian motion (see the article by Dean Astumian and Peter Hänggi, *PHYSICS TODAY*, November 2002, page 33). But the randomness is overcome when the miniature trees are immersed in an aqueous solution of hydrogen peroxide and illuminated with 365 nm UV light. That combination spurs a redox reaction in which the rod end serves as the cathode and consumes electrons and protons that are supplied by the dissociation of H_2O_2 on the branched (anode) end. While the electrons travel through the silicon wire, the protons migrate in the surrounding solution, dragging fluid in one direction so that the motor is propelled in the opposite direction. Dai and colleagues demonstrated that they could alter the swimmers' direction of motion either by tailoring the surface charge of the silicon wire beforehand or by illuminating one side of the

TiO_2 tree to produce a torque. The motors may find use as micro-sized pumps. A potential future experiment would be to monitor the collective behavior of many of the devices. Bathing a swarm of microswimmers in light would cause their ion gradients to overlap and result in complex interactions between individuals that may resemble the chemical-fueled communication and motion of slime molds. (B. Dai et al., *Nat. Nanotechnol.*, in press, doi:10.1038/nnano.2016.187.) —AG

A PULSAR'S CHANGING MAGNETIC FIELD

The Vela X-1 binary consists of a massive blue star and a spinning neutron star. The pair are close enough that the neutron star's gravity draws in material from its companion's powerful wind. Because of the neutron star's intense magnetic field, the material is funneled onto the star's poles. In the process, the material gets so hot that it emits x rays, which are pulsed because the magnetic and rotation axes are misaligned. NASA's *Swift* has been monitoring Vela X-1 since the orbiter's launch in 2004. That long train of data has given Valentina La Parola of Italy's National Institute for Astrophysics and her colleagues the opportunity to investigate changes in the neutron star's magnetic field. Specifically, they tracked a cyclotron absorption line at around 54 keV; the line arises, as in the quantum Hall effect, from the quantization of energy levels in a strong magnetic field. The researchers found that shifts in the line's energy were positively correlated with fluctuations in x-ray luminosity. Two mechanisms could account for the correlation. When the wind is strong and more material falls onto the poles, the luminosity rises and the x-ray-emitting region is pushed down into a region of higher magnetic field. Alternatively, the higher the luminosity, the more radiation pressure slows the infalling material and the smaller the line's Doppler redshift. La Parola also found that since 2004 the line's energy and, therefore, the magnetic field at the poles have been steadily dropping, independently of changes in luminosity. Distortion or displacement of the field lines by piled up material is a possible cause. (V. La Parola et al., *Mon. Not. R. Astron. Soc.* **463**, 185, 2016.) —CD

HOW TO DETECT OIL SPILLS UNDER SEA ICE

As petrochemical companies prospect for oil in the crust beneath the Arctic Ocean, the threat of oil spills looms. Compounding the threat is the possibility of a spill happening underneath sea ice, where it could spread unseen. To meet the challenge of detecting such spills, Christopher Bassett of Woods Hole Oceanographic Institution and his collaborators are investigating the feasibility of using autonomous underwater vehicles equipped with sonar.

Given that seawater, crude oil, and ice have different acoustical properties, the approach might seem straightforward. It isn't. The resulting ice contains a network of brine channels and a water-ice interface with small dendritic structures. If an oil spill occurs underneath growing ice, the oil gets trapped under the ice and be-

tween the finger-like structures to form a complex multilayer system. Bassett and his colleagues re-created that process in a tennis-court-sized tank of seawater (shown here) at the Cold Regions Research and Environmental Laboratory in Hanover, New Hampshire. Specifically, they grew six patches of ice and pumped in adjustable amounts of Alaskan crude oil from below. A cart equipped with six transducers ran on rails beneath each patch in turn to record the echoes of acoustic pulses of various frequencies and bandwidths.

The researchers found that the channel with the highest nominal frequency (500 kHz) and the largest bandwidth (370–590 kHz) was best able to resolve oil layers thinner than 1 cm, but at the cost of



lower penetration and less sensitivity to ice's complex structure. By contrast, the channel with the lowest nominal frequency (100 kHz) and the smallest bandwidth (75–130 kHz) could resolve only thick layers of oil, but it could detect oil that had been newly encapsulated by an underlayer of ice. (C. Bassett et al., *J. Acoust. Soc. Am.* **140**, 2274, 2016.) —CD PT