of either a hearty feast or a severe famine (the two cases are mathematically symmetrical in the model). The solid line marks the critical population at which wear-and-tear and use-it-or-lose-it are equally likely to be selected. Above the line, wear-and-tear prevails; below, use-it-or-lose-it. But how strongly a population feels that preference depends on the number of generations that have elapsed: The smaller the number, the farther a population must be from the critical line before one principle wins.

In his lab experiments, Savageau saw evidence for use-it-or-lose-it but not wear-and-tear. By applying their quantitative model, Gerland and Hwa could see why that might be the case. *E. coli* lives for a few hours; their mammalian hosts for a few decades. A mammal's gut therefore hosts up to 10^5 generations of *E. coli*. Given a typical colony size is also about 10^5, Savageau's bacteria-infected hosts were squarely in the use-it-or-lose-it region of Gerland and Hwa's phase diagram.

Besides quantifying gene regulation, the model might help pharmacologists understand and combat the resistance of bacteria to antibiotics. One strain of *E. coli*, called mar, is resistant to tetracycline, an otherwise potent antibiotic, thanks to the working of two transcription factors.

Charles Day

References

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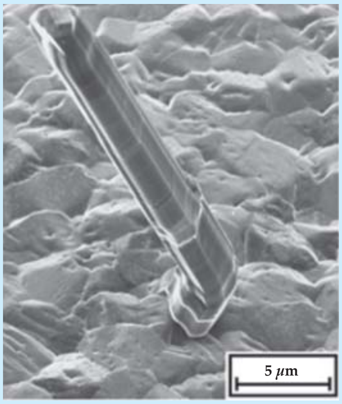
2. M. A. Savageau, *Proc. Natl. Acad. Sci. USA* **71**, 2453 (1974).

150-km radius of Beijing, the average 2008 AOT value was more than 14% lower than the previous years. But what would it have been without the mandated emissions reductions? To answer that question, the researchers used a neural network approach: With data from the preceding six summers, they trained a model to predict AOT as a function of relative humidity, wind velocity, and precipitation. The model then predicted that within a 500-km radius of the city, AOTs in 2008 would have been 10%–14% higher than the actual observed values; the model was less accurate when larger regions were analyzed. Although the magnitude of the reductions was lower than expected, the emissions restrictions did have a statistically significant local impact. (J. Cermak, R. Knutti, *Geophys. Res. Lett.* **36**, L10806, 2009. Photo by Michael Silverman, 6 August 2006.) —JNAM

How tin whiskers grow. Late Stone Age metal smiths added a little tin to copper to usher in the eponymous Bronze Age; over the ensuing five millennia, many new combinations and applications of the two metals have appeared. Today, for example, a thin tin coating on a copper substrate often works like solder to interconnect electronic components of various kinds, such as are found in medical devices and satellite equipment. Unfortunately, micron-sized tin whiskers (see figure) sometimes arise spontaneously and can short out the equipment, with great technological and economic repercussions. After decades of widespread effort, the actual mechanism underlying such whisker growth has only now been elucidated. Led by Eric Mittemeijer, a group from the Max Planck Institute for Metals Research in Stuttgart, Germany, working with the Robert Bosch company and Argonne National Laboratory in Illinois, examined growing whiskers and their crystallographic environment. Using Laue diffraction measurements made at Argonne's Advanced Photon Source, the researchers noted that at the Cu–Sn interface, Cu_6Sn_5 develops along the tin grain boundaries and is most pronounced directly beneath a whisker's root. That observation, coupled with residual strain measurements, led the team to propose that deep penetration of Cu_6Sn_5 into the 3-μm-thick tin layer induces in-plane compressive strains near the Cu–Sn interface and in-plane tensile strains nearer the surface. Out-of-plane and in-plane strain gradients—not the strains themselves—then provide the driving force that leads to whisker growth by transporting Sn atoms to the whisker nucleation site as a strain-relief mechanism. (M. Sobiech et al., *Appl. Phys. Lett.* **94**, 221901, 2009.) —SGB



Cosmic-ray electron spectrum. Last fall, the ATIC balloon collaboration reported a tantalizing peak near 500 GeV in its measured spectrum of high-energy cosmic-ray electrons (PHYSICS TODAY, January 2009, page 16). The peak suggested that 500-GeV dark-matter particles of the kind predicted by extra-dimensional extensions of standard particle theory might be annihilating each other in nearby accumulations of dark matter to produce energetic electron–positron pairs. Now NASA's recently launched *Fermi Gamma-ray Space Telescope* has measured the electron spectrum out to 1 TeV with much higher statistics (see the figure). Designed primarily to record high-energy gammas, *Fermi* can also detect electrons. The data show no narrow spectral feature near 500 GeV, nor anywhere else; but above 100 GeV there is a growing excess over the predictions of a conventional diffusive model of electrons from very distant astrophysical sources. The positron spectrum measured by the orbiting PAMELA magnetic spectrometer showed a similar excess above 10 GeV. (Neither ATIC nor *Fermi* can distinguish electrons from the much rarer positrons.) Taken together, the *Fermi* and PAMELA results suggest that our local galactic neighborhood harbors either an undiscovered astrophysical electron–positron source (most likely a pulsar) or a dense concentration of unidentified, heavy dark-matter particles. Much should be revealed when the *Fermi* collaboration reports electron spectral data beyond 1 TeV and the spectrum of the diffuse gamma-ray background out to 1 TeV. (A. A. Abdo et al., *Fermi* collaboration, *Phys. Rev. Lett.* **102**, 181101, 2009; O. Adriani, PAMELA collaboration, *Nature* **458**, 607, 2009.) —BMS