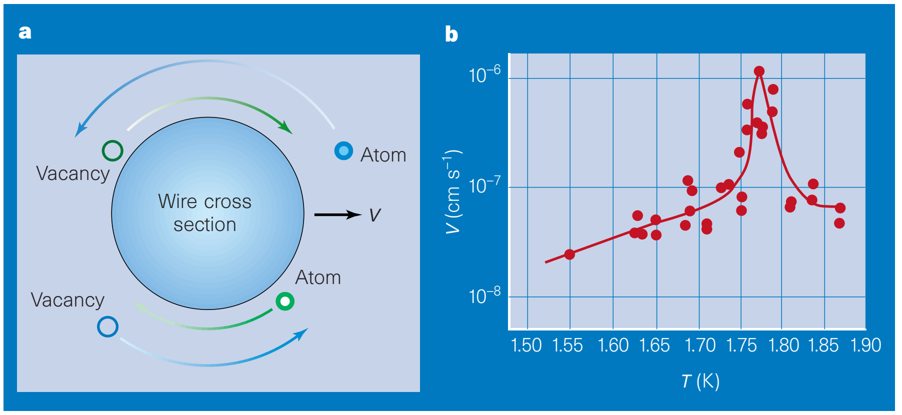

Figure 1 **Superdiffusion in solid helium.** a, **Migration of crystal vacancies, and counterflow of atoms, around a stress-imposing wire in a solid crystal of helium, which allows the wire to move.** b, **Velocity of the wire as a function of temperature as observed by Polturak *et al.*[1], showing a peak at the temperature where 'superdiffusion' of atoms and vacancies occurs. This peak coincides with the temperature at which helium changes crystal structure, and is much larger than any such effect seen in metals (note that the ordinate scale is logarithmic).**

softening of a particular kind of crystal vibration, or mode in the phonon spectrum[7]. Polturak's group thinks the same process causes the helium effect. The extraordinary magnitude of the peak in Fig. 1b is associated with the very low formation energy for crystal point defects in helium (~ 1 meV) compared with b.c.c. metals (~ 1 eV). This low formation energy for He suggests that both the concentration and the mobility of point defects, such as vacancies, might be greatly enhanced near the peak. Computer simulations by Polturak *et al.*[3] suggest that the point defects responsible for the very fast diffusion may in fact be a type of interstitial structure in the crystal lattice rather than vacancies.

The acceleration of vacancy creep under a small stress (also called superplasticity by metallurgists) at a phase-transformation temperature is a well-established fact, but in metals the magnitude of such acceleration is nothing like that observed in helium. Polturak and colleagues[2] have evidence that the presence of ^{3}He enhances superdiffusion in ^{4}He by further reducing the point defect formation energy. So in isotopic mixtures, the magnitude of the diffusion peak at the transition temperature is even greater than that shown in Fig. 1b.

The significance of these studies in helium is the unprecedented degree of enhancement of point defect concentration and mobility at a phase transformation. These findings are also relevant to melting theory, in that a very high density of point defects combined with a softened phonon mode can lead to melting, by reducing the shear resistance near the transition to the point where the solid becomes mechanically unstable. In their latest work[3], the authors suggest a feedback mechanism in which the point defects in helium soften the phonon (vibrational) spectrum, and this in turn enhances diffusion and creates more point defects. This feedback mechanism, and a very high density of point defects to begin with, are crucial ingredients in producing a mechanical instability sufficient to generate melting: both are missing in rival theories of melting, of which there have been many over the years. □

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1. Berent, I. & Polturak, E. *Phys. Rev. Lett.* **81,** 846–849 (1998).
2. Berent, I. & Polturak, E. *J. Low-Temp. Phys.* **112,** 337–354 (1998).
3. Polturak, E. *et al. Physica B* (in the press).
4. Schuster, I. *et al. Europhys. Lett.* **33,** 623–628 (1996).
5. Guyer, R. A. in *Encyclopedia of Physics* 2nd edn (eds Lerner, R. T. & Trigg, G. L.) 486–494 (VCH, New York, 1991).
6. Haskel, D. *et al. Phys. Rev. B* **47,** 14032–14043 (1993).
7. Petry, W. *et al. Phys. Rev. B* **43,** 10933–10947 (1991).

errata In J. Bland-Hawthorn's article "Clues to galaxy formation" (*Nature* **400,** 220–221; 1999) the image in Fig. 1 was not produced by the Virgo Consortium and was not published in ref. 12 as stated. The image should have been attributed to G. Kauffmann, J. M. Colberg, A. Diaferio & S. D. M. White, *Mon. Not. R. Astron. Soc.* **303,** 188–206 (1999), as part of the GIF project (http://www.mpa-garching.mpg.de/~jgc/sim_gif.html).

The source of the cichlid images used in the graphic accompanying Tom Tregenza and Roger K. Butlin's "Speciation without isolation" (*Nature* **400,** 311–312; 1999) should have been acknowledged as a photograph taken by Michael K. Oliver. The photograph of the species concerned, *Dimidiochromis compressiceps,* and others can be viewed at *The Cichlid Fishes of Lake Malawi, Africa* http://www.connix.com/~mko/

Daedalus

The insect plane

Aviation engineers look with envy on birds and especially insects. Their flapping wings lift and propel them far more efficiently than the fixed wings of aircraft. One reason is their ability to exploit the subtleties of stalling.

If the angle of attack of a wing is increased, it ultimately stalls, with sudden, disastrous loss of lift. No fixed-wing aircraft dare risk stalling. But an insect with oscillating wings can exploit an intriguing loophole in the laws of aerodynamics. Accelerated at a high angle of attack into the stalling regime, a wing takes a short while to stall. And until it does, it generates enormous lift. By speeding into stall and out again at each flap, an insect wing develops amazingly high average lift.

So Daedalus is inventing a non-steady-state aircraft wing. A conventional wing could never be made to flap, of course. But it might be covered with a flexible elastic fabric, and this could be flapped by a system of rapid repeated inflation and collapse. It might even be made to flap spontaneously in the slipstream, as a flag does in the wind. But the ideal solution is simpler still. Instead of flapping the wing or its surface, Daedalus plans to flap the airflow around it.

Cunningly, he will generate this non-steady airflow from a non-steady propulsive source, a pulse-jet of the type used to power the old V1 missile. Its primitive motor drew in air through a one-way valve, and mixed it with petrol vapour in its combustion chamber. When the chamber was full, a spark ignited the mixture. The valve closed, directing the propulsive blast out through the tail-pipe. The valve then opened and the cycle repeated. So Daedalus's new 'pulse-wing' aerofoil has a leading edge enclosed in cunningly shaped ducting, which acts as a long, thin pulse-jet combustion chamber stretching the length of the wing.

Each time the chamber fires, a sheet of hot gas blasts from the ducting, entraining the airflow round the wing. It speeds it up dramatically, and veers it upwards to put the wind into brief extreme stall, thus creating a sudden pulse of enormous lift. The craft is both propelled and held aloft by repeated pulses. To minimize noise and vibration, Daedalus hopes to drive his pulsed wing in a continuous, distributed manner. Each explosion will spread from the wing root out to its tip, by which time another explosion will be starting at the root.

David Jones