Magnetization jumps in oxide superconductors

SIR—In your report, "New superconductors in perspective"¹, the importance of achieving large critical currents in the high-temperature oxide superconductors (HTS) was discussed for different applications. In particular, it mentioned that the critical current would be substantially improved if oriented single crystals were used instead of polycrystalline ceramics.

Besides the difficulty of having correctly oriented grains with respect to the field direction in every region of the magnet, we would like to mention here another problem we have discovered: at low temperature ($T < 15$ K), large magnetization jumps are observed in the high-field hysteresis curves of large (up to 30 mg) single crystals of $\text{YBa}_2\text{Cu}_3\text{O}_7$. This is illustrated in the figure, where the magnetization of a 27-mg crystal is shown for a field of up to 18 T applied parallel or perpendicular to the c axis.

Such magnetization jumps are not mysterious; they have been observed in conventional superconductors² and are

Magnetization curves for a single crystal of $\text{YBa}_2\text{Cu}_3\text{O}_7$ (27 mg) at 1.2 K, measured every 0.1 T up to 18 T, for a field applied parallel or perpendicular to the c axis.

attributed to the local energy flow following the movement of one or more vortex lines. Because of the low specific heat and conductivity of the HTS³, this energy flow will be transformed into a local increase in temperature, which can precipitate an avalanche of vortex-line penetration (or expulsion) — hence the jump in magnetization. These magnetization jumps look rather periodic because they take place between two envelope curves (unstable and stable magnetization) which are nearly parallel in a field far below the upper critical field H_{c2} . The amplitude of the magnetization jumps depends mainly on the sample size and on the cooling effi-

Diabetes and the potato

SIR—Jerome Rotter and Jared Diamond in their recent News and Views article¹ intriguingly predicted a higher rate of non-insulin-dependent diabetes mellitus (NIDDM) in the present-day population of Ireland by comparison with the descendants of their counterparts who left the country during the famine of 1846–51. Their rationale is that although genes predisposing to NIDDM may be deleterious when individuals have a standard westernized diet, the reverse is true under conditions of severe general malnutrition. Thus, NIDDM genes would have been favoured in the Irish who survived the famine *in situ*, and so were transmitted to subsequent generations, but not among those who emigrated.

Implicit to this line of reasoning is the assumption of a subsistence diet in Ireland before the famine, with resultant negligible selection against NIDDM genes. But all contemporary evidence contradicts this belief², largely because of the notable Irish dietary dependence on the potato.

Using the results of a detailed survey conducted by the Poor Law Commissioners in 1839, the total daily energy value of an average labourer's diet has been calculated³ as 4,720 kcal. This comprised 5.1 kg potatoes, equivalent to 1,007 g carbohydrate, supplemented with 1.8 l buttermilk. Given this diet, it seems inconceivable that there would not have been strong selection against NIDDM genes in the generations *before* the famine, consequently reducing their incidence in the gene pool. If a difference does exist between native-born and overseas Irish in the incidence of NIDDM, the large-scale population disturbances resulting from the famine⁴ seem to offer a more convincing explanation than differential selection.

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iciency (smaller jumps are observed in smaller samples or when the sample is in liquid helium instead of exchange gas). It depends less on the rate of field variation⁴.

The existence of these jumps strongly lowers (by at least a factor of two) the critical currents possible in large single crystals as compared with values observed in small ones. Thus, even if it is now possible to grow large crystals, it would appear necessary to stabilize them thermally (as is done in Nb–Ti wires, for example, by using bundles of small-diameter filaments), as well as trying to improve the numbers and

Optimization methods

SIR—As my recent article "New optimization methods for physics and biology"¹ has created the same unintended impression in two people's minds^{2,3}, I had better add some clarification.

I sought to bring several very different novel optimization methods to your readers' attention. These methods were developed in fields as far apart as spi-glass physics, neural-network modelling and evolutionary simulation. My sole reason for describing them in terms of the travelling salesman problem (TSP) is that this is a well-known problem familiar to many of your readers and it therefore provides a convenient common framework to expose these new ideas. I am well aware that much better algorithms exist for the TSP, as described in Johnson's letter³. Had I been writing a review of algorithms for the TSP I would have discussed these other algorithms and referred to the vast body of work by Johnson and many others.

I am interested, however, in general purpose optimization algorithms suitable for a wide range of applications. These problems may or may not be NP complete: all that is certain is that they have an unknown number of local optima in addition to the global optimum. For such systems the specialized methods developed for the TSP are not applicable. What makes simulated annealing attractive is that it is easy to implement and it often provides reasonably good solutions for diverse problems. As I pointed out¹, this is what engineers and others with practical problems to solve usually require.

May I take the opportunity to correct a more serious omission. The amount of work on genetic algorithms is much larger than I realized. Those interested in a bibliography should contact Professor David Goldberg at the Department of Engineering Mechanics, University of Alabama, Tuscaloosa, Alabama 35486.

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