of applying a magnetic field in their experiment. But, for many workers in this area, a sine qua non for establishing a new superconductor is the observation of the Meissner-Ochsenfeld (MO) effect — when an element or compound enters the superconducting state, magnetic flux that previously permeated the sample is suddenly excluded. Also, in certain superconductors, applying a magnetic field of sufficient magnitude can suppress superconductivity, and this is exactly the effect seen by Shimizu and colleagues. Although they also hold observation meated the sample is suddenly excluded. Nevertheless, their demonstration of this suppression is nevertheless an important pointer.

Another indication of the onset of superconductivity is a drop in electrical resistance, which Shimizu et al. observed. This, however, is a slightly indeterminate procedure, as can be seen from the authors' data, and future experiments may well lead to some minor revisions of the transition temperature they have measured. Nevertheless, the evidence seems compelling that a superconducting state in lithium has been attained. As the authors note, the reported transition temperature makes lithium (for now) the element with the highest superconducting transition temperature — with, so to speak, not ad-electron in sight.

Although it may be regarded as a simple element in atomic terms, in structural terms lithium in its condensed state at high pressures is complex. It seems to be the case (and indeed it was predicted7) that, under pressure, lithium takes on structures quite unlike the familiar body-centred-cubic phase, including structures that have an even number of atoms in the unit cell. How this structural complexity connects with the theory of superconductivity is an intriguing question, for perhaps one of the most difficult theoretical problems in the field of condensed-matter physics is accurately predicting superconducting transition temperatures. Nevertheless, general arguments (based on the density of states, the strength of the electron–phonon interaction, the scale of the Coulomb pseudopotential, and so on) can bolster the expectation that a state of significant superconductivity will occur, and did in fact make a strong case for lithium8.

But calculations7 of lithium's transition temperature seem to come up with a value that is a factor of four or so above Shimizu and colleagues' measurement. In a way, this discrepancy could be seen as a propitious opportunity — the pressure experiments on lithium and on other light-element systems may at last offer the prospect for systematic studies of the behaviour of the dynamic electron–electron interaction and in particular of the Coulomb pseudopotential, the manifestation of direct electron–electron repulsion that generally works against electron pairing (unlike the electron–phonon interaction, which in lithium probably promotes it).

It may be that the early Matthiass rule should simply be rephrased to read that single-band, rather than single-valence, elements are in general not favoured for superconductivity, for there is accumulating evidence that structures resulting in multiple bands are predominant among superconductors. If structural anisotropy in layered structures is a route to higher-temperature superconductors, as Ginzburg and Kirzhnits have suggested and as seems to be the case with the superconducting latecomer MgB2.