These questions must be answered before caspase inhibition can be considered as a target for anti-Alzheimer's drugs. The road to treatment and prevention of Alzheimer's disease is, therefore, still very long. But treatment of other neurodegenerative diseases — such as Huntington's disease — may be available much sooner, because the mechanism of neuronal cell loss is better understood, and it can be mimicked in animal models. □

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Earth science

Excursions in geomagnetism

C. G. Langereis

The intensity of Earth's magnetic field varies on timescales varying from seconds to many tens of millions of years. Secular variation in the field, in terms of 100–1,000 years, can be estimated from historical records. But identifying variation on longer timescales requires continuous palaeomagnetic records from much deeper in the past, and in 1996 Guyodo and Valet[1] provided an analysis of 17 palaeointensity records going back 200,000 years. They integrated them into the so-called 'Sint-200' composite curve, which has since served as a standard. But it still covers only a comparatively brief period of Earth history.

As described on page 249 of this issue[2], Guyodo and Valet have now produced a new 'stack' of globally distributed records. They have analysed 33 records of relative palaeomagnetic intensity spanning the past 800,000 years, and have constructed the Sint-800 composite; the age models of all the records (which had already been normalized with appropriate correction factors) were refined by applying the same reference curves, thereby increasing the correlation between them. The much longer time span of Sint-800 allows insight into the longer-term behaviour of the geomagnetic field — in particular, into the putative effect of climate on magnetic intensity, and into the nature and occurrence of short 'excursions' during the past 780,000 years. This is the period known as the Brunhes Chron, during which the polarity of Earth's magnetic field is as it is now; the excursions are departures from the dipole field that are considerably larger than those seen in secular variation, and sometimes even attain opposite polarity.

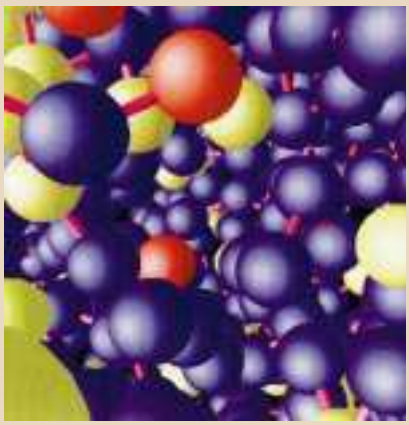
For some time there was speculation as to a causal relationship between Earth's magnetic field and phenomena such as climate variation and faunal extinctions. For instance when, in the 1970s, records of climatic change became available, it was proposed that change in magnetic intensity

Statistical physics

Glasses go critical

Why is polystyrene brittle but polyethylene rubbery? At room temperature, the first is a glassy material whereas the second is more like a highly viscous fluid. At least, that's the easy answer. But what, exactly, is a glass? Phenomenologically, it is a liquid that has 'jammed up' — cooled without freezing until translational molecular motion is arrested. But the transition from liquid to glass poses a deep theoretical problem; indeed, the deepest and most interesting in solid-state theory, according to Philip Anderson in 1995. Elsewhere in this issue (*Nature* 399, 246–249; 1999), Sharon Glotzer and co-workers establish a link between this transition and the critical phenomena familiar from equilibrium statistical physics.

The glass transition is a transformation not between globally stable equilibrium states but between metastable states: a supercooled liquid and a disordered solid. This, then, is the fundamental difficulty — the glass transition is of a dynamical nature, representing the point at which molecules become localized and relaxation times become very long. Yet the critical phenomena most studied in statistical physics — that is, the second-order phase transition as one passes through a critical point such as the Curie point of a ferromagnet — are transitions between



equilibrium states, for which a static, thermodynamic description is sufficient. How to reconcile the dynamical character of the glass transition with a thermodynamic picture has recently been an issue of wide interest (see, for example, S. Sastry *et al. Nature* 393, 554–557; 1998). The key seems to be the relationship between the topographic character of the energy landscape of the system and the way in which this is explored as the system evolves from one configuration to another.

Glotzer and her colleagues take a somewhat different approach, by focusing on correlations in the atomic motions of the glass-forming medium, in this case a polymer. At a critical point, correlations between the interacting particles develop a range much longer than the extent of the intermolecular forces. Take ferromagnetism: as the temperature is lowered through the Curie point, the spins on each magnetic particle become aligned. At the critical point itself, the correlation length of a spin becomes infinite — the spin is sensitive not just to the alignments of its near neighbours but to all others in the system.

Can such a diverging length scale be identified for the glass transition? The simulations by Glotzer and co-workers show that there seems to be a divergence in a dynamical length scale at the glass transition, namely the distance over which monomer displacements on the polymer chains are correlated. This is illustrated in the picture, a snapshot of the polymer very near the glass transition in which monomers that are moving in a correlated fashion are coloured similarly. (Red and yellow denote high mobility, and purple low mobility.) Related to this length scale is a dynamical variable that behaves like the static order parameter that characterizes equilibrium critical phenomena (the magnetization, in the case of a ferromagnet). In other words, it may be possible to mould the well-established conceptual framework of critical phenomena to the case of glass formation.

Philip Ball