the immediate future.

And on page 229 of this issue, Wu introduces a new approach to analysing the position of DNA-binding proteins within or around hypersensitive regions[15]. He uses exonuclease III of *Escherichia coli* to digest chromatin within the hypersensitive site after its cleavage by a suitable endonuclease (DNase I or a restriction enzyme). The exonuclease is thought to stop when it encounters a protein, thus defining one boundary of the binding site. In an analysis of a heat-shock protein gene (*hsp70*) of *Drosophila*, a resistant (protein-bound) site is found 12–40 bp 5′ of the transcription start site in normal cells; in heat-shocked cells, however, an additional resistant site is observed in the region between 40 and 108 bp.

Techniques recently devised to cross-link protein with DNA should provide a second method for mapping these interactions, and the potential to identify the proteins involved, although at present this is frequently limited to cases where antibodies against the protein are available (for example, refs 16,17). Concerted application of these techniques could lead to a full definition of the DNase I hypersensitive site in molecular terms within the next few years. □

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Archaeological dating

New method for bricks?

from E.T. Hall

An unexpected byproduct of investigations of the chemical stability of clays employed in the storage of nuclear waste is the suggestion of a new method of dating bricks, ceramics and other materials fired in antiquity. The technique, suggested by Waddell and Fountain[1], depends on the diffusion of Ca^{2+} ions from mortar or cement layers into the clay brick. The authors report a relationship between time and calcium content at the interface of the clay brick with the mortar but base their report on only seven samples. These show that there is an increase of calcium with time, although the experimental nature of the curve relating the distance migrated by calcium to time is far from clear. The migration distances are small (< 20 µm in 200 years), whereas the matrix of bricks is comparatively coarse. An electron microprobe was used for the analyses, providing a resolution of 2.5 µm; there can be little doubt that the analytical results from the traverses across the cement–brick interface must be very 'noisy' and accurate measurement difficult to achieve, even though multiple passes were made to obtain an average result.

The new technique is interesting but still at a preliminary stage of development and its application to real archaeological dating may well be problematical. Clearly it has a long way to go before it can rival the most successful of the methods for dating fired materials — thermoluminescence. The work of Aitken[2,3] and others[4] has made thermoluminescence the standard procedure[5] for testing the authenticity of doubtful ceramics, particularly when public or private purchasers are contemplating their purchase in the saleroom. For bricks whose environment is known, so that the thermoluminescent component arising from their surroundings or from cosmic rays can be estimated, thermoluminescence can be expected to provide dating that is accurate to within ~7 per cent.

Another technique for dating bricks and other fired clays is archaeomagnetic dating[6], where the past history of the Earth's magnetic field, both in direction and intensity, is used. In the case of bricks, which will have the direction of the Earth's field induced in them at the time of firing, we do not normally know the orientation of the brick when fired and so measurement of direction of the brick's magnetic moment will not help us. However, recent measurements[7] of intensities of magnetization, which can be related to the ancient field strength, have provided some evidence that this might become a useful method of dating, albeit at a lower accuracy than is provided by thermoluminescence. □

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Fractals

Aggregationism

The problem of aggregation is both ancient, as in the manufacture of carbon black, and modern, with the recognition in the past few years that microscopic structures as different as snowflakes and colloidal precipitates may be examples of physical structures with fractional dimensions — fractals in the sense intended by Hausdorff in 1919 and more recently given wide currency by the proselytizing of B.B. Mandelbrot. One page 225 of this issue R.M. Brady and R.C. Ball report one of the most direct demonstrations so far that aggregation does yield fractal structures.

Brady and Ball are concerned only with aggregation whose rate is limited by that at which extra particles can reach the surface of a growing cluster. The circumstances therefore do not necessarily correspond to those which determine the growth of, say, a snowflake from water vapour, where the shape of the crystal may be governed by the rate at which latent heat can escape. Either way, the application of macroscopic arguments to the growth of these structures is hampered by the non-linear character of the instabilities that form on growing surfaces (departures from regular shape grow more quickly) whence the interest in the microscopic simulation introduced by T.A. Witten and L.M. Sander three years ago (*Phys. Rev. Lett.* **47**, 1400; 1981).

That model is simple enough. Put a seed particle at the centre of a finite patch of, say, a square lattice and allow fresh particles to enter the system at random places on the periphery and to make their way through the lattice by random walking, following the rule that they stick to the growing aggregate whenever they reach a neighbouring position on the lattice. Brady and Ball confirm the computer prediction for the three-dimensional lattice (that the density should be a decreasing function of the radius of an aggregate) by their neat set-up in which the electrolysis current at constant voltage is simultaneously both a measure of distance and, when integrated over time, a measure of the total mass.

As it happens, an experimental investigation of the other obvious case of aggregation — that typified by the aggregation of colloidal particles in homogeneous suspension — has also just been published (Weitz, D.A. and Oliveria, M. *Phys. Rev. Lett.* **52**, 1433; 1984). The model, in this case, is one in which the particles initially occupy many sites of a lattice, then diffuse randomly through it and stick together whenever they encounter another particle or growing aggregate. The unpublished result of the simulation (due to P. Meakin) is said to be a fractal dimension of about 1.75, which Weitz and Oliveria say they have confirmed by the measurement of individual particles of colloidal gold in aggregates formed by controlled flocculation. □