

indicate that such a vaccine could control both male and female fertility and that the effects should be fully reversible. These data also emphasize the significance of sperm-zona interaction as the stage of fertilization that should be the focus for the development of a contraceptive.

A key issue raised by the paper in this issue¹ is whether antigens similar to PH-20 might be involved in mediating sperm-egg recognition in the human. The human spermatozoon also possesses surface antigens (HS 1A.1) which change in location during the acrosome reaction¹⁷, although there seems to be little relationship between this peptide and PH-20. The existing evidence suggests that the zona receptors on human spermatozoa com-

prise a group of small peptides with molecular masses of 15–18K¹⁸. Hence, although cross reactivity between human and guinea-pig sperm antigens undoubtedly exists¹⁹, there is, as yet, no clear evidence that PH-20 will exhibit contraceptive potential in the human. Nevertheless, the major impact of the paper of Primakoff *et al.* is unequivocally to demonstrate that the principle of an anti-sperm contraceptive vaccine is well founded. Characterization of the antigens on the surface of the human spermatozoon involved in sperm-zona recognition is now of immense importance. □

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Materials science

Order in disorder

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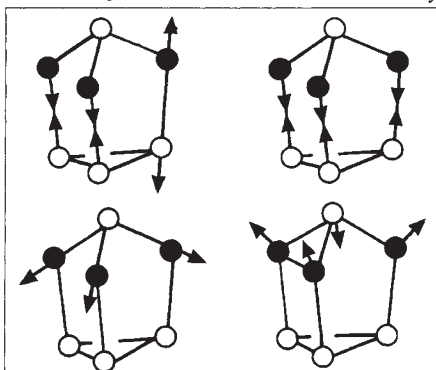
SINCE Zachariasen's seminal work¹ on the structure of oxide glasses it has been commonly accepted that such glasses are made up of a partially continuous network of SiO₄ tetrahedra, interspersed irregularly with alkali and alkali-earth metal ions. The experimental evidence for this proposition, mostly from X-ray scattering, has built up steadily over the years — for example, from the famous study of vitreous silica by Mozzi and Warren². Nevertheless, the second half of the proposition, what might be called the currant-bun model of the distribution of the metal ions, has never been established as firmly as the idea of the SiO₄ network. On page 525 of this issue³, Eckersley *et al.* marshal evidence indicating that the calcium ions in a calcium silicate glass have a first-neighbour shell ordered nearly as well as the oxygens around silicon atoms.

A common experimental trick for focusing structural information on a particular species in a glass is to determine scattering profiles for X-rays of two different wavelengths, one near an absorption edge for the element in question, so that scattering amplitudes are different; a differential Fourier transformation then gives specific information about the environment of the targeted atomic species. An even better way of achieving this end is to scatter neutrons, using two successive samples containing different isotopes of the target atom, with widely different scattering cross-sections.

Eckersley *et al.* used the latter approach with the calcium in their glass, and establish that, out to a distance of about 0.5 nm (2 atomic diameters), the environment surrounding calcium ions is closely similar to that in crystalline CaSiO₃ (which has a composition close to that of the glass examined). Specifically, about 85 per cent

of the oxygen ions nearest to a calcium atom in the glass must be disposed similarly to the corresponding ions in the crystal. A further implication of this finding, as the authors prove by careful calculations, is that calcium ions are not randomly distributed but have rather well defined, preferred separations. The venerable network model must thus be modified in the direction of enhanced order.

Although the network model is firmly



Four of the ten possible vibrational modes of the molecule P₂Se₃. The observation of these and other modes in the vibrational spectrum of P₂Se₃ glass permits Verrall and Elliott⁵ to infer the presence of molecular units in this system. (○, Phosphorous; ●, selenium.)

entrenched for oxide glasses based on silica, it is less so for metallic glasses (for example, Ti-Cu), over which a battle — by no means entirely semantic — has raged between the adherents of the dense-random-packing model introduced by Bernal and the microcrystallite model favoured by Gaskell⁴. For the latter, small groups of metallic atoms form virtually crystalline unit cells which are, of course, not disposed in parallel orientation to each other. Eckersley, Gaskell *et al.* make it specifically plain that their new findings

reported in this issue concerning the calcium silicate glass do not support the microcrystallite model for that glass.

A third category of glass is the molecular variety, where complete, undistorted individual molecules (monomers or polymers) are disposed in a non-crystalline array. These have hitherto all been organic materials, which are difficult to study with precision by scattering methods because the constituent atoms scatter X-rays and photons only weakly. Verrall and Elliott in a new study⁵ of a glass of composition close to P₂Se₃ establish that at least this inorganic glass is essentially molecular in its structure. Curiously, although the method they use again involves neutrons, in this case they were used to determine the vibrational density of states, not coordination shells of the material.

The use of spectroscopy, as distinct from scattering studies, to obtain information about glass structure is well established^{6,7}, especially for oxide and chalcogenide (sulphide, selenide and so on) glasses. What is new about Verrall and Elliott's study is the application of the method to a glass consisting, as it turns out, of well defined, distinct, inorganic molecules (see figure). The vibrational density of the states for the glass shows remarkably sharp peaks, normally characteristic of discrete molecules, and a comparison with Raman spectral peaks for crystalline P₂Se₃ shows an excellent correspondence. The observations⁵ even allow an estimate to be made of the nature of the intermolecular material when another P-Se glass, of divergent composition, is examined. Perhaps in due course a proper diffuse X-ray scattering study will be undertaken to establish just how, statistically, the molecules are disposed with respect to each other.

The conclusions of Verrall and Elliott are particularly interesting in view of current debates about structural issues in respect of chalcogenide glasses⁸. Thus, pressure-optical experiments on glassy GeS₂ established that this glass consists of an irregular array of two-dimensional layers rather than a three-dimensional polymeric array. The new work by Verrall and Elliott adds to the structural variety of germanium-based chalcogenide glasses. □

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