transmission; and slightly increased concentrations, which may occur naturally, will cause marked depolarisation. The authors discuss various possible explanations of the indifference of the locust to its circulating glutamate.

In the same issue of the journal (*ibid.*, 673) Clements and May investigate this problem in great detail in the locust *Schistocerca.* They could obtain no evidence of sequestration of glutamate by haemocytes, or of binding of glutamate by haemolymph proteins. On the other hand divalent ions, calcium and magnesium, in the haemolymph do certainly form stable complexes with amino acids and the authors estimate that the level of free glutamate is probably reduced about 25% by binding to the divalent metal ions. Both increasing the calcium concentration in the test saline, and introducing magnesium ions, made nerve–muscle preparations less sensitive to glutamate. Furthermore, these authors consistently found that isolated preparations of the retractor muscle of the claw were much more sensitive to glutamate when dissected out than when perfused in the uninjured femur. The dissected preparations studied in sections showed that the connective tissue sheath of the muscle fibres was disrupted, and ready access given to the spaces between the fibres where the neuromuscular junctions lie. They conclude that the connective tissue sheath serves as protective barrier against glutamate in the haemolymph.

Clements and May are inclined to accept the view that glutamate is normally responsible in insects for the transient depolarisation of the postsynaptic membrane that follows nervous stimulation. But, as Murdock and Chapman point out, even if it does not have this physiological role, the neuromuscular junctions must be protected from the action of unwanted glutamate.

# Oscillating yield in a plastic

*from Robert W. Cahn*

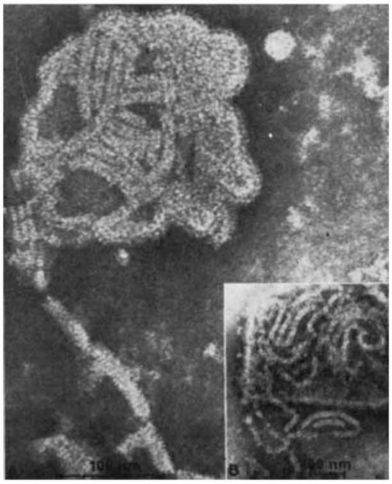
SOME years ago, a group of Russian polymer scientists (Andrianova *et al.*, *J. Polym. Sci.*, *A2*, **9**, 1919; 1971) discovered a novel form of behaviour in several polymers. The neck which forms during tensile straining of the amorphous polymer turned out to be made up of successive bands of translucent and opaque material, and the stress–strain curve showed corresponding strain oscillations. The opaque material had evidently crystallised.

This phenomenon of 'oscillating necking' has been theoretically analysed by Barenblatt in the Soviet Union (*Mekhanika Tverdogo Tela*, No. 5, 121; 1970) and to back up this analysis, Roseen of AB Atomenergi in Sweden has adopted an unusual experimental approach (*J. Mater. Sci.*, **9**, 929; 1974). He examined a tensile specimen of amorphous PETP during tensile deformation by means of an infrared Thermovision camera, which records instantaneous temperature distributions. Strips of high temperature (up to 95° C) develop in association with the opaque crystalline strips. The calibration and the resolving power of this camera are set out in some detail. It seems, therefore, that during oscillating necking, a narrow layer of crystalline material forms internally (micrographically it was shown that the surface remains amorphous). Crystallisation seems to be the result of rapid local deformation, which adiabatically heats a narrow front of polymer. The crystalline material is much less ductile than the amorphous matrix; plastic flow and its associated heat generation slows down the stress rises and the cycle repeats.

Thus, polymers may show behaviour superficially similar to the discontinuous yielding long familiar in certain alloys. This is known as the Portevin-Le Chatelier effect and is most familiar in mild steels. In essence, it is caused by the cyclic locking of dislocations by readily mobile impurity atoms (normally carbon or nitrogen). A group of dislocations breaks free, the impurity atoms catch up and lock them afresh, and the cycle repeats.

Roseen has confirmed the postulated difference in tensile behaviour between amorphous and crystalline polymer by examining the effect of intentional heat treatment of the polymer on the form of the tensile curve. Here is another unfamiliar point of similarity between metals and polymers: it is second nature to a metallurgist to examine the effect of systematic heat treatments on the mechanical behaviour of an alloy, but this is not yet a normal experiment for a polymer scientist.

One lesson from this intriguing piece of work is that it can be illuminating for a polymer scientist to know something of physical metallurgy. But it would be hubris to leave it at that. Increasingly, metallurgists have something to learn from polymer scientists, as concerns both phenomena and experimental techniques. It is time that 'polymer crystallisation' became a normal part of the syllabus of students of metallurgy and materials science.



# Viruses naked and clothed

Two views of paramyxoviruses. A, Newcastle disease virus, a pathogen of chickens. The protein envelope has been broken to allow the escape of part of the nucleocapsid. B, Nucleocapsid from Sendai virus, the favourite of those who fuse cells. The nucleocapsid in both viruses consists of one long single-stranded RNA molecule around which identical protein subunits are arranged. The periodicity of the helix thus formed is visible in B. Photograph from *Virus Structure* by Robert W. Horne (Academic Press, New York and London, 1974).

# Frenkel pairs in zinc selenide

*from John Walker*

To account for the electrical conductivity observed in some ionic solids, Frenkel suggested in 1926 that a small percentage of ions could leave their lattice sites and migrate through the crystal. The point defects so formed, the lattice vacancies and their corresponding interstitial partners, have hence been called Frenkel defects. The concept has been widely used during the past 48 years, but until recently no Frenkel defect had been observed directly. Watkins (*Phys. Rev. Lett.*, **33**, 223; 1974) has now remedied the deficiency.

After irradiating zinc selenide with 1.5 Mev electrons at a temperature of 20 K, Watkins observed a family of similar spin resonance spectra which he labelled V, $\mathrm{V^{I}}$, $\mathrm{V^{II}}$, $\mathrm{V^{III}}$, $\mathrm{V^{IV}}$. The V spectrum had previously been assigned to a hole localised on one of the four selenium neighbours to a zinc vacancy. By mechanically compressing the crystal Watkins found that he could make the hole jump freely between the four selenium atoms. (In the language of the trade, a [111] uniaxial stress makes that particular Jahn-Teller distortion energetically unfavourable and the defect flips over into one of the other $\langle 111 \rangle$ orientations.)