The other spectra are so similar to V that Watkins also assigns them to zinc vacancies. But the V^I centres do not reorient under uniaxial stress. They are therefore locked in position in the strain field of a nearby defect—the zinc atom which has been ejected to create the vacancy. It occupies the interstitial site nearest to the vacancy.

Warming the crystal above 20 K causes the interstitial zinc atom to move to a new site, behind one of the four selenium atoms surrounding the vacancy. This configuration, called V^{II}, is of lower energy than V^I because the polarisable selenium atom is between the vacancy and the interstitial. In V^{III} the interstitial lies in the $\langle 100 \rangle$ direction. No model was proposed for V^{IV}, the spectrum of which is very weak.

Directional effects observed during irradiation confirm the models. For example, when the electron beam direction is [$1\bar{1}1$], more V^I defects are observed in the [$\bar{1}1\bar{1}$] configuration than in other $\langle 111 \rangle$ orientations.

Another interesting observation is that the isolated vacancy V is not produced linearly with electron dose. The creation rate follows a square (or perhaps a cube) law. This suggests a two-stage process, the formation of close-pair Frenkel defects being the first step.

The direct observation of vacancy-interstitial pairs in a solid is an interesting confirmation of Frenkel's original suggestion, although its impact is perhaps lessened by our present awareness of the richness and complexity of point defects created by irradiation. (An awareness due in great measure to Watkins, one might add.)

The lessons for *aficionados* of spin resonance are twofold; look for these Frenkel defects in other materials; and use the uniaxial stress technique, without which their identification in zinc selenide would have been much more difficult.

Components of the amoeba membrane

from a Correspondent

FASCINATING details of the surface structure of some primitive animal cells, amoebae and sea anemones, have recently come to light. They provide evidence for new classes of polyanions that may serve functions in primitive organisms, similar to those performed by glycoproteins containing sialic acid and the gangliosides and proteoglycans of metazoal cell surfaces.

Korn and his colleagues have been studying *Acanthamoeba castellanii*, a small free living soil amoeba that grows well on a soluble medium. About a third of the membrane is made up of a unique component that is extracted into solution with 8 M urea, or better, aqueous butanol, and is easily purified free of a non-glycosylated protein fraction. The new component contains neutral sugars, mainly mannose glucose and xylose, about 14% of fatty acids that include unusual branched chain 2-hydroxy fatty acids, and aminophosphonic acids. Of these last derivatives, the parent compound but not 1-hydroxyl-2-aminoethyl phosphonic acid are known constituents of lipids in various species of lower marine invertebrates but perversely not to any significant extent in amoebae.

Clearly the lipophosphonoglycan described by Korn and his colleagues Dearborn and Wright (*J. biol. Chem.*, **249**, 3335-3341; 1974; **249**, 3342-3346; 1974) is an integral component of the membrane and presumably is anchored into it by association of the fatty acids with the phospholipid-sterol matrix of the membrane. Brief mention is made of unpublished electron microscopic evidence by Bowers and Korn that the polar moieties of lipophosphonoglycan including phosphate groups and concanavalin A reactive sites (α-mannosyl groups) are exposed on both sides of the amoeba surface membrane.

The exact structure of this polymer is unknown. If the sugars are in normal glycosidic linkage, a core structure of galactosamine residues and aminophosphonic acids, both perhaps substituted with fatty acids and forming the attachment sites for the neutral sugars, seems to be most likely. The linkages between the constituents of the 'core' region are not known except phosphoamide bonds are excluded since these would be labile to acid hydrolysis and this is not observed.

In another publication Allen *et al.* (*J. Cell Biol.*, **60**, 26–38; 1974) describe somewhat similar material at the surface of a uninucleate, freshwater phagocytic amoeba T_1D_{13}. The only anionic group detected by Allen *et al.* at the cell surface is phosphate which accounts for more than 10% of the isolated surface membrane. Most of this phosphate (90–95%) has been isolated as a polymer in association with *neo*-inositol. Amino phosphonic acids were not detected. The large sugar content, mainly mannose rhamnose and glucose, of these plasma membranes was isolated separately in an uncharacterised fraction that seems to contain appreciable organic phosphate. It seems that these two fractions may be more closely related in the native structure, and perhaps are hydrolytic fragments produced during isolation (a part of the phosphate is very acid labile according to Allen *et al.* whereas the remaining phosphate is much more stable; the pronounced stability to acid hydrolysis of C–P bands as in phosphonic acids is a characteristic of the Korn polymer). Some structural similarity between the undegraded phosphorylated polymers of *Amoeba* T_1D_{13} and *Acanthamoeba* cannot therefore be totally excluded particularly since the analysis of Korn and his associates for lipophosphonoglycan purified from *Acanthamoeba* still leaves substantial leeway for inclusion of a polyol such as *neo*-inositol.

The clearest existing analogy to the amoeba lipophosphonoglycan is perhaps the lipopolysaccharide of certain Gram negative bacteria. Both sorts of compounds contain fatty acids including hydroxy fatty acids, and neutral and aminosugars. The bacterial polymer contains ethanolaminephosphate, the ester analogue of 2-aminoethyl phosphonate. The fraction isolated by Allen *et al.* perhaps suggests superficially a resemblance to another ubiquitous class of bacterial polymers, the teichoic acids which are based on ribitol or glycerol phosphate derivatives. Of course, it may turn out that the amoebae polymers are unique structures with no known biological precedents.

Aminophosphonic acids also turn up in phosphonoglycoproteins isolated from *Metridium dionthus* (Hilderbrand *et al.*, *Biochemistry*, **12**, 4756–4762; 1973). These partially purified fractions contain 2-aminoethyl phosphonic acid, neutral sugars and hexosamines but apparently not significant amounts of fatty acids. The structural relationship of these polymers to the lipophosphonoglycan and in particular the method of attachment of the chains containing organic phosphorus to the polypeptide moiety will be of interest.

The prevalence of surface negatively-charged polymers of diverse structure in the lower invertebrates suggests a positive function in the ecological success of these organisms. This role may be as a mechanism providing a stable environment surrounding the cell, and may be related to the ability of the amoebae surface to absorb large quantities of various cations. This function in turn has relevance to subsequent pinocytotic events during feeding and in the uptake of nutrients under culture conditions. The existence of an anionic surface that could function as a buffering system could also form a valuable protective role against foreign cationic substances present in the surrounding medium (sea water). Alternatively, if present in the buccal cavity the phsophonate compounds may protect the organism from self dissolution by degradative enzymes spilled over from the digestive tract.