DISCUSSION

B. Hudson[1] –The theory of Målen and Bullough [*24*] has ascribed the formation of void lattices to the anisotropic elastic interaction between the voids, which for certain metals gives a minimum in the free energy of the system when the voids lie on a lattice that is identical in structure and orientation to the crystal lattice. Subsequently, Tewary and Bullough[2] have calculated the magnitude of the interaction energy to be ~ 1/2 eV per void, which is comparable with the energy of a single vacancy. Thus the interaction appears to be quite a weak one, bearing in mind that each void is formed by the agglomeration of many tens of thousands of vacancies and each void has a surface energy of several thousand electron volts. Furthermore, an ordered void array has recently been observed at Harwell after a low-dose irradiation of aluminum,[3] which is quite close to being elastically isotropic, so that some doubt must exist as to the validity of the elastic interaction mechanism.

Recently Foreman [*25*] at Harwell has tentatively proposed a possible alternative mechanism. It is suggested that the driving force for void lattice formation could arise because a tiny fraction of the interstitial atoms produced by the irradiation are in the form of static or dynamic *crowdions*, so that they are constrained to move along a prominent crystallographic direction (probably the close-packed direction). If the crowdion interstitials can travel over distances exceeding the void spacing (~ 200 Å in molybdenum) at void growth temperatures, then the voids will throw interstitial "shadows" on one another, as illustrated in Fig. 10, and this would cause the voids to move during their growth because of the nonuniform flux of interstitials around the periphery of each void. They would tend to line up along the close-packed crystal directions, and, since this is happening along all such directions in the crystal, a three-dimensional lattice of voids would tend to form during the irradiation, with the same structure as the metal crystal.

One consequence of this mechanism is that the voids near the center of a void lattice dislocation would be exposed to an excess number of crowdion interstitials because of the incomplete shielding from neighboring voids, and these voids would therefore be smaller. This is confirmed by electron micro-

[1] Atomic Energy Research Establishment, Metallurgy Division, Building 401, Harwell, Didcot, Berks, England.

[2] Tewary, V. K. and Bullough, R., UKAEA Harwell Report TP 479, 1972.

[3] Mazey, D. J., 1972, to be published.

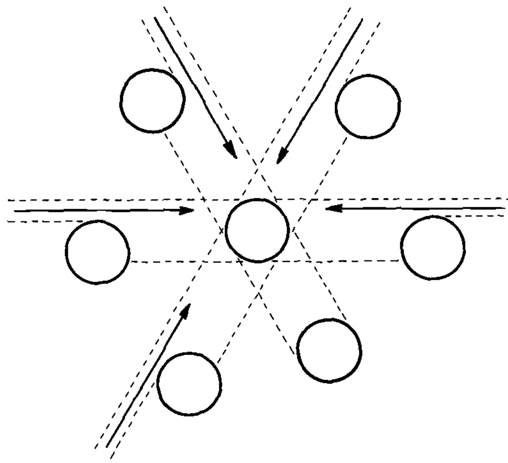

FIG. 10—*Void lattice formation.*

graphs of arrays containing dislocations, which in almost every case show smaller (and sometimes disordered) voids near the center of each dislocation. A further prediction of the theory is that the dislocations might be seen to slowly 'climb' during an irradiation in the high-voltage electron microscope, due to the gradual erosion of the unscreened voids at the center of a dislocation, but this has not as yet been investigated experimentally. A fuller discussion of this mechanism is given in the recent Harwell report [*25*].