The hypothesis (Radcliffe 1964, Bullen, Henderson, Hutchison and Wain 1964) that generation of dislocation occurs as the result of localized shear stresses developed from differential elastic compression of the matrix and particle is qualitatively in keeping with the prismatic dislocation arrays that have been observed. Approximate values of the shear stresses induced in this way were computed, on the basis of a general solution obtained by Edwards (1951) for the stress distribution around a spheroidal inclusion in an arbitrary uniform state of stress, by Hahn and Rosenfield (1966) in a comparison of the effects of differential strains developed by particle growth, thermal contraction on cooling and external hydrostatic pressure. A general analysis (using a sequence of imaginary cutting, straining and welding operations) for the determination of the elastic field of an ellipsoidal inclusion and the way in which the presence of an inclusion having elastic constants different from those of the rest of the material disturbs an applied stress-field was developed by Eshelby (1957). However, this approach was not applied specifically to analyse the stresses developed under externally applied hydrostatic pressure at the interface of the inclusion and matrix for the general case where both have finite but different compressibilities. A particular difficulty in developing quantitative models is that for the systems in which pressure-induced dislocations have been observed previously the relevant elastic constants for the second phases are unknown or not well established.

The present investigation was undertaken with the principal objectives of calculating the stresses at the interface of an elastic particle in an isotropic matrix upon subjection of the system to high hydrostatic pressure in order to define the conditions for dislocation generation and of comparing the calculated conditions with those observed experimentally in the following systems: (*a*) tungsten—as an isotropic matrix—containing voids or different types of solid particles (ThO_2 and HfC) of second phase, and (*b*) a model system in which the elastic properties of the matrix and second phase are known and the matrix has a low flow stress. For the latter system, copper containing internal voids was selected. Transmission electron microscopy was used to examine the effects of pressurization up to 40 kilobars on the dislocation structure adjacent to the elastic discontinuities in these various systems.

§ 2. Elastic Stress Distribution around a Spherical Inclusion in an Isotropic Solid under Hydrostatic Stress

A local elastic discontinuity in an isotropic solid represents a discrete region where the elastic properties are different from those in the matrix. Voids and rigid inclusions are the limiting cases where the values of the bulk moduli of the discontinuity are zero and infinity respectively. The presence of such discontinuities perturbs an otherwise uniform stress in a solid; for example, Goodier (1933) calculated that the stress-concentration increased by a factor of approximately 3 near a spherical cavity in an isotropic solid subjected to uniform tension.