of the inclusion. However, the calculation in § 2 indicates that the value of the maximum shear stress attainable at the interface is independent of the size of the elastic discontinuity. This apparent paradox can be resolved if the details of the conditions necessary for the propagation of dislocations from the particle/matrix interface are taken into account. On this basis, a segment of dislocation is generated at the interface of a particle, independent of its size, when the pressure-induced shear stress reaches an appropriate value. However, the achievement of a full prismatic loop which can move away from the particle is strongly size dependent, as shown by the following argument.

It is apparent from fig. 3 (*a*) that a dislocation (at L) of radius of curvature $a/\sqrt{2}$, where a is the radius of the discontinuity, nucleated on the circle of maximum shear stress marked II can glide under the action of shear stress parallel to its Burgers vector and the axis of the indicated glide cylinder (i.e. the shear stress circle marked I). The resulting development of a full prismatic loop thus occurs in accordance with the ‘ punching ’ mechanism suggested originally by Seitz (1950) and modified for the thermal stress case by Jones and Mitchell (1958). The shear forces developed as a result of differential compression must support the line tension, F, of the dislocation, which can be written as:

$$F=\frac{Gb^2}{4\pi(1-\nu)}\left\{\ln\frac{R}{b}+1\right\}, \qquad (6)$$

where R is the radius of the loop and b is the Burgers vector. For small loops of the order of 500 Å (i.e. 200 b), F can be approximated as $Gb^2/2R$ and equated† with the work done by $\tau_{\max}$ at L:

$$\tau_{\max}\, b=\frac{Gb^2}{2R}. \qquad (7)$$

Equation (7) demonstrates that a pressure giving a shear stress which is sufficient to achieve the complete loop stage for a discontinuity of given diameter will be too small to reach this stage for a particle of smaller diameter. However, despite the qualitative agreement with observation, numerical calculations for the various tungsten cases based on this simple approach give critical sizes of discontinuity which are approximately one order of magnitude smaller than those at which dislocations were observed experimentally. In the case of copper, to be discussed later, closer quantitative agreement was obtained.

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† Recently and independently, a similar argument has been used for the case of the generation of glide dislocation loops by thermal stresses induced by quenching (Gulden and Nix 1968) to compute the critical particle size necessary to form the initial complete dislocation loop.