Based on the assumption that Hugoniot data between 130 and 250 kbar are for partially transformed material, the lever rule was used to calculate the mass fraction, f, of phase 2 which is experimentally related to excess stress above the transformation stress. These data show that f varies exponentially with G_{21}, the difference between Gibbs energies of the bulk phases, giving the expression

$$1 - f = \exp(\theta(G_{21}-A)) \ ,$$

where θ is constant and A is the value of G_{21} at onset of transformation.

Previous workers have shown that such a relationship describes athermal martensitic transformations; this similarity strengthens the link between martensitic transformation and the shock-induced alpha to epsilon transformation. A possibility which has not been previously investigated is that equilibrium embryos of the second phase, which always exist as a result of statistical fluctuations, may be "frozen-in" by sudden application of sufficient pressure to bring the material into the stability field of the second phase. A relation between number of "frozen-in" nucleation sites and driving force can be established; this fact suggests a basis for understanding both athermal transformations and the shock-induced alpha to epsilon transformation.

Better theoretical calculations on "frozen-in" nucleation sites are needed which include strain effects and surface energy of small clusters of atoms; errors which result from use of the hydrostatic Gibbs energy for solids need to be evaluated.

Experiments to date have not revealed the operating mechanism for the ultrafast transformation in shocked solids. If the alpha to epsilon transformation is martensitic as suggested, then experiments with different grain sizes should give different kinetic results at close-in distances. Single crystal studies would be useful since it may be a shear-induced transformation with preferred directions and planes. If the transformation is nucleated on twins, cold rolling to eliminate twin formation prior to shock loading might change the kinetics of transformation. Double shock experiments in which first shock amplitude is varied in order to vary the shock-induced twin density should be interesting.

Surface roughness may prevent stress on the metastable or extended phase 1 surface from reaching the driving stress which would violate a basic assumption in Horie and Duvall's theory of plastic I decay and estimates of relaxation time inferred from close-in measurements. A possible experiment to eliminate surface effects would be to deposit within a few nanoseconds, at some depth, enough high energy electrons to create a shock exceeding the transformation pressure. This would not be a simple experiment, but it would avoid the surface problem since the shock would be formed internally.