There are two experimental observations of the decay of the first wave for iron (13, 14).

For α-quartz Wackerle (15) did not observe a two-wave structure corresponding to the stishovite transformation. This may indicate that the transition is neither rapid nor complete.

In order to study transient effects in shock wave propagation, we must solve the flow equations. In Lagrange coordinates for plane, one-dimensional, time-dependent flow these are:

1. Newton's second law

$$\rho_o(\partial u/\partial t)_h + (\partial(p+q)/\partial h)_t = 0 \qquad (3.3)$$

where h = Lagrangian space coordinate

t = time

ρ_o = initial density = $1/v_o$

q = viscous stress

Introduction of q makes the flow continuous through the shock front and the jump conditions unnecessary.

2. Continuity equation

$$\rho_o(\partial v/\partial t) - \partial u/\partial h = 0 \qquad (3.4)$$

3. Energy conservation

$$\partial E/\partial t + (p+q)(\partial v/\partial t) = 0 \qquad (3.5)$$

4. Constitutive relation

In order to solve the above differential equations in four independent variables (p, v, u, E), constitutive relations are required. Ignoring solid rigidity, which

should play a secondary role in the problems considered
here, these will consist of an equation of state, $p = p(v,E)$, an expression for q, and, in the mixed phase,
a statement of the kinetics of transition.

3.2 General Constitutive Relations for Two-Phase Flow

We assume the following conditions to apply in a small
mass element when both phases coexist:

1. Equal pressure exists in both phases.

2. Temperatures of the two phases are equal, i.e., the
   heat released by the transition is instantly re-
   distributed.

3. Particle velocities are the same for each phase.

4. No surface energy is associated with the interface
   between the two phases.

5. No heat is transferred between mass elements by
   conduction.

Conditions 1 and 3 insure that Eqs. (3.3)-(3.5) apply
for the coexistence region as well as for a single phase. The
only change needed is a reinterpretation of v and E. This can
be done as follows:

Regardless of phase transition, the total mass of a
given Lagrangian volume is conserved. Therefore, if
we denote by v the total specific volume of the mix-
ture of two phases, then from condition 3 above, v
satisfies Eq. (3.4) on p. 3.4. But the variable v must
also satisfy the following relation in the coexistence
region:

$$v(p,T) = (1-\alpha) \, v_1(p,T) + \alpha v_2(p,T) \qquad (3.6)$$