

Equations (61), (62) and (93) form the constitutive relations for the irreversible transition when  $0 < f < 1$ . If  $f = 0$  or  $1$ , eqs. (56) apply. This formulation of the transition process is particularly appropriate for the von Neumann-Richtmyer integration since in that procedure  $dt$  is specified explicitly.

The above formulation represents the following physical model. Each phase has an equation of state surface in  $(p, V, T)$  space, and in equilibrium the surfaces are separated by the mixed phase region;  $V$ , for example, is never double-valued. We now suppose that each phase is defined for all  $p$  and  $T$  and that  $V$  may lie on either surface, one of which is metastable, or may take any value between the two surfaces. The value it has at any moment is determined by its previous value, by  $dt$ , by the equation of continuity, and by previous values of  $p$ ,  $T$  and  $f$ ; and it seeks an equilibrium state through the operation of eq. (93) until it arrives at an equilibrium surface where  $f = 1$  or  $0$ .

As an example of the application of these equations, consider the case of iron, which has a transition from *bcc* to *hcp* at 130 kb and approximately room temperature. For the transition we assume that:

$$(94a) \quad V_2(p, T) - V_1(p, T) = -0.0059 \text{ cm}^3/\text{g}$$

$$(94b) \quad \text{static transition pressure, } p_t = 130 \text{ kb,}$$

$$(94c) \quad dp_t/dT = -0.065 \text{ kb}/^\circ\text{K,}$$

$$(94d) \quad df/dt = (f_{eq} - f)/\tau,$$

$$(94e) \quad f_{eq} = (V - V_1)/(V_2 - V_1) \text{ at } p \text{ and } T,$$

$$(94f) \quad \tau = \frac{1}{3} \mu\text{s.}$$

A constant pressure of 200 kb is applied to the surface of a half-space at  $t = 0$  and we seek the wave profile at subsequent times and the rate of decay of the precursor wave associated with the transition. The elastic precursor is ignored.

The integration was performed by a modification of the von Neumann-Richtmyer method [9]. The development of the pressure profile at early times is shown in Fig. 22 and the fully developed double wave is shown in Fig. 23. In each figure the effect of changing  $V_2 - V_1$  is shown; it influences the shape of the profile but not the decay rate. The decay of the elastic precursor is shown in Fig. 24. The computation was also made with  $dp_t/dT = 0$  with no substantial change in the results. The dashed line shown in Fig. 24 fits the decay curve obtained by numerical integration reasonably well. It was obtained analytically in the following way:

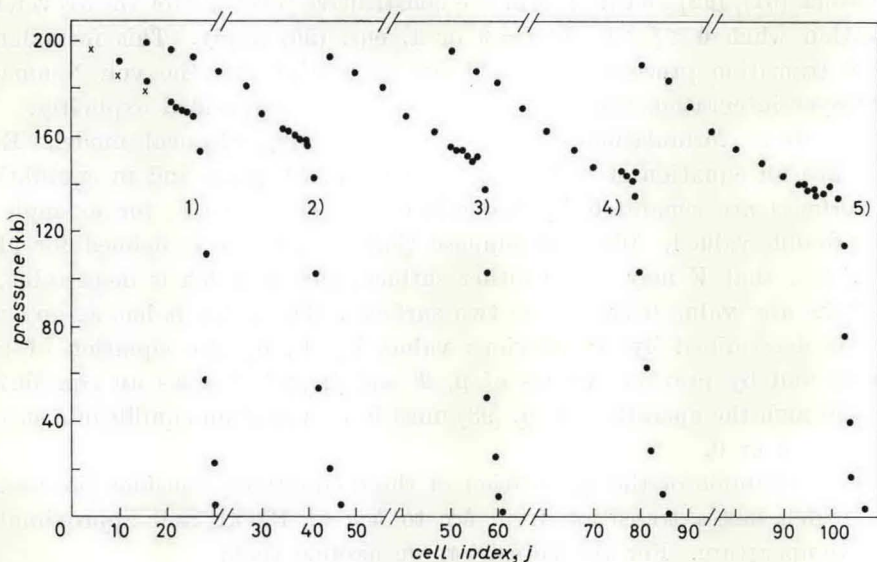


Fig. 22. - Pressure profiles at early times. (Ref. [9]).  $p_1 = 0.200$  Mb; cell width =  $0.01$  cm;  $\tau = \frac{1}{3}$   $\mu$ s; 1)  $t = 0.526$   $\mu$ s; 2)  $t = 0.812$   $\mu$ s; 3)  $t = 1.105$   $\mu$ s; 4)  $t = 1.554$   $\mu$ s; 5)  $t = 1.554$   $\mu$ s;  
 ●  $\Delta V = -0.004$   $\text{cm}^3/\text{g}$ ; ×  $\Delta V = -0.0059$   $\text{cm}^3/\text{g}$ .

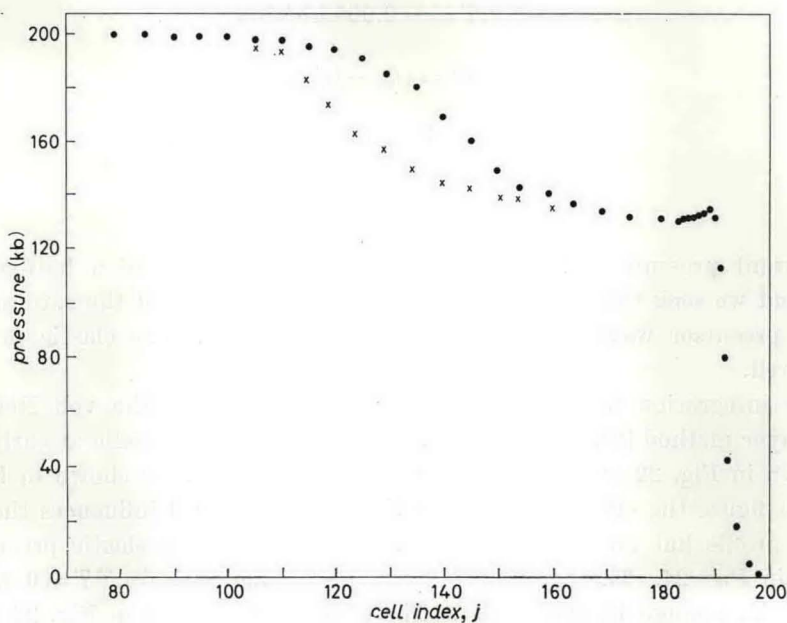


Fig. 23. - Double shock in iron. (Ref. [9]).  $p_1 = 0.200$  Mb; cell width =  $0.01$  cm;  
 ●  $\Delta V = -0.004$   $\text{cm}^3/\text{g}$ ; ×  $\Delta V = -0.0059$   $\text{cm}^3/\text{g}$ ;  $\tau = \frac{1}{3}$   $\mu$ s.