relationship, we will assume $F(v)$ is well known and use the Hugoniot for liquids[3] ($u_1=1.2$ and $u_2=1.7$) to calculate it.

## DEPENDENCE OF CALCULATED SHOCK TEMPERATURE ON $(\partial p/\partial T)_v$ AND $C_v$

Let $T_H$ denote temperature on a Hugoniot curve and $T_s$ denote temperature on an isentrope. Then Eq. (4) relating the temperatures at a volume $v_1$ on the Hugoniot centered at ($p_0=0$, $v_0$, $T_0$) and on the isentrope through ($p_0=0$, $v_0$, $T_0$) can be written formally as

$$T_H(v_1, b, C_v) = T_s(v_1, b) + (2C_v)^{-1}\int_{v_0}^{v_1}[\exp b(v-v_1)]F(v)dv, \quad (5)$$

with $T_s(v_1, b) = T_0 \exp b(v_0-v_1)$. We will use Eq. (5) to determine the qualitative dependence of shock temperature on $(\partial p/\partial T)_v$ and $C_v$. Partial differentiation of Eq. (5) with respect to $(\partial p/\partial T)_v$ and use of the identity $C_v[\partial b/\partial(\partial p/\partial T)_v]=1$ leads to the equation

$$\frac{\partial T_H}{\partial(\partial p/\partial T)_v} = \frac{T_s(v_0-v_1)}{C_v} + \frac{I}{2C_v^2}, \quad (6)$$

where

$$I = \int_{v_0}^{v_1}(v-v_1)\,[\exp b(v-v_1)]F(v)dv.$$

The integral $I$ must be positive since $T_H > T_s$ and $(v-v_1) \geq 0$. Thus $\partial T_H/\partial(\partial p/\partial T)_v > 0$ and the slope of the $T_H$ vs $(\partial p/\partial T)_v$ curve is positive. An increase in $(\partial p/\partial T)_v$ in a Walsh–Christian temperature calculation

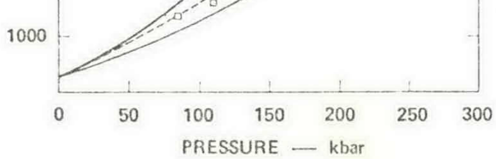


FIG. 1. Shock temperature for carbon tetrachloride. Comparison of calculated values with those obtained experimentally by the "brightness" method. The circle was obtained by Ramsay and the squares by Voskoboinikov and Bogomolov. The line $C_v$ was calculated in the present work using the Walsh–Christian method (constant $C_v$). The line $MC_p$ was calculated by Mader also using the Walsh–Christian method but using $C_p$ for the value of $C_v$. The dashed line $C_v(T)$ was calculated in the present work using $C_v$ as a function of temperature. The input data for the calculations are in Table I. For constant $C_v$ the shock temperature at 150 kbar agrees with that calculated by Dick.[13]

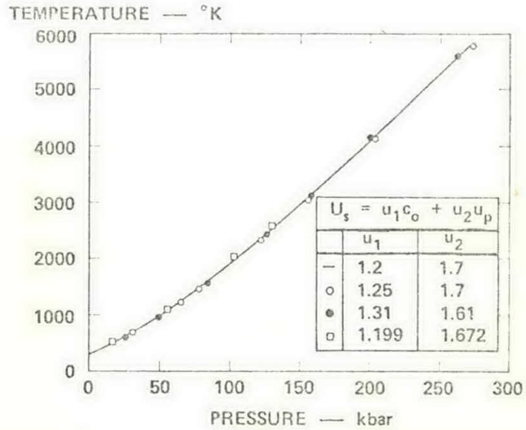


FIG. 2. Shock temperature for carbon tetrachloride. Sensitivity of the calculated temperatures to the form of the Hugoniot. $u_1, u_2 = 1.2, 1.7$ (Ref. 3); 1.25, 1.7 (this work, arbitrary variation of $u_1$); 1.31, 1.61 (Ref. 7); and 1.199, 1.672. (Recalculated from Ref. 13 by R. D. Dick). The other input data are in Table I.

will produce an increase in shock temperature, but a decrease in $(\partial p/\partial T)_v$ will produce a decrease in shock temperature. Partial differentiation of Eq. (5) with respect to $C_v$ and use of the identity $\partial b/\partial C_v = -b/C_v$ leads to the equation,

$$\frac{\partial T_H}{\partial C_v} = -\left[b\frac{\partial T_H}{\partial(\partial p/\partial T)_v} + \frac{T_H - T_s}{C_v}\right]. \quad (7)$$

Thus $\partial T_H/\partial C_v < 0$ since $\partial T_H/\partial(\partial p/\partial T)_v > 0$, and the slope of the $T_H$ vs $C_v$ curve is negative. In contrast to the former case, an increase in $C_v$ will produce a decrease in shock temperature in a Walsh–Christian calculation, but a decrease in $C_v$ will produce an increase in shock temperature.

The equation

$$-\frac{C_v(\partial T_H/\partial C_v)}{(\partial p/\partial T)_v[\partial T_H/\partial(\partial p/\partial T)_v]} = 1 + \frac{T_H - T_s}{b[T_s(v_0-v_1)+I/2C_v]}, \quad (8)$$

obtained by rearranging Eq. (7), is convenient for making a more quantitative estimate of the dependence of shock temperature on $(\partial p/\partial T)_v$ and $C_v$. Let $\Delta T_H(\delta C_v)$ and $\Delta T_H[\delta(\partial p/\partial T)_v]$ denote the change in shock temperature produced by a small decrease in $C_v$ and a small increase in $(\partial p/\partial T)_v$. Then if second- and higher-order terms are neglected, Eq. (8) can be written as

$$-\frac{\Delta T_H(\delta C_v)}{\Delta T_H[\delta(\partial p/\partial T)_v]} = 1 + \frac{T_H - T_s}{b[T_s(v_0-v_1)+I/2C_v]}. \quad (9)$$

The right-hand side of Eq. (9) has been evaluated along the Hugoniot curve, and the left-hand side has been calculated for a 10% increase in $(\partial p/\partial T)_v$ and a 10% decrease in $C_v$. The results of these calculations are given in Table III and Fig. 3. At a given shock pressure, shock temperature is more sensitive to changes in $C_v$