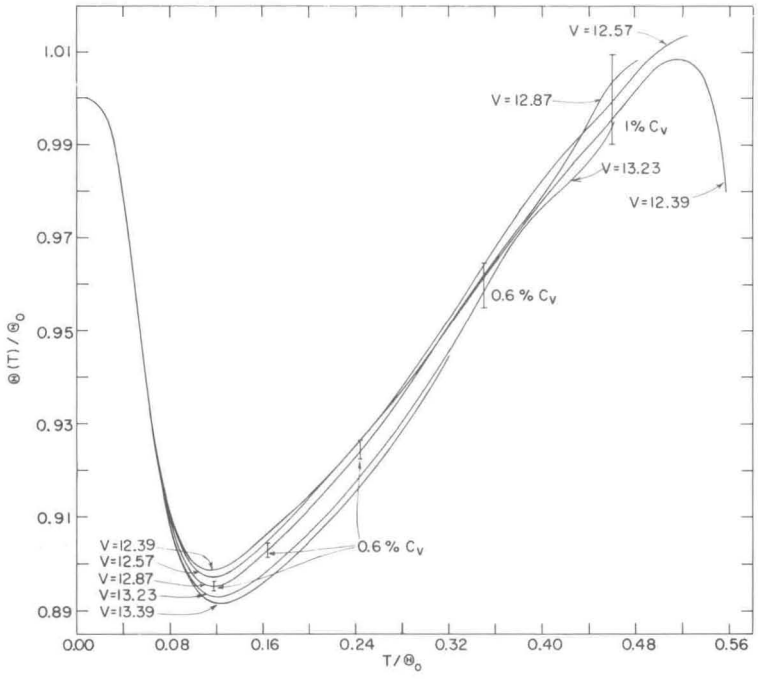

Fig. 6. A plot vs. reduced temperature of the smoothed specific heat results of Tables II–VI as expressed in terms of equivalent reduced Debye Θ's. The values of Θ_0 are given in Table I and are plotted in Fig. 5.

linearly from it as

$$S(T/\Theta_0, V) = S_{\text{Ne }6}(T/\Theta_0) + [(\partial S/\partial V)_{T/\Theta_0}]_{\text{Ne }6}(V - V_{\text{Ne }6}) \tag{6}$$

The derivative, which must be evaluated at the molar volume of the Ne 6 data, is a function of (T/Θ_0) and is zero for temperatures below $0.08\Theta_0$. Equation (3) then can be used to calculate γ at this molar volume as

$$\begin{aligned}\gamma(T, V_{\text{Ne }6}) &= (V/C_V)[(\partial S/\partial V)_T + (\partial S/\partial V)_{T/\Theta_0}]_{\text{Ne }6} \\ &= \gamma_0(\text{Ne }6)[1 + \alpha(T)]\end{aligned} \tag{7}$$

since the first term in the brackets is the temperature-independent value of γ_0 given in Fig. 5. Hence, the relative temperature-dependent contribution to γ, $\alpha(T)$, is equal to the ratio $(\partial S/\partial V)_{T/\Theta_0}/(\partial S/\partial V)_T$. The entropies given in Tables II through V were plotted as a function of T/Θ_0 for the various volumes, and no systematic differences greater than $\pm 0.5\%$ were found at any temperature. This result is combined with the average values of $(\partial S/\partial V)_T$, which can be calculated from these tables to conclude that the magnitude of

the temperature-dependent contribution to γ is no greater than 1%. Figure 6 can be interpreted in terms of a temperature dependence for γ, so we will assume that γ changes from γ_0 to a high-temperature value γ_∞ between temperatures of $0.08\Theta_0$ and $0.2\Theta_0$, with γ_∞ differing from γ_0 by $+1\,(\pm 1)\%$. This postulate is in excellent agreement with the independent analysis which is carried out in Ref. 10.

The variation with volume of the lattice frequency spectrum or the dispersion relations also has been determined directly at 4.7 K using inelastic neutron scattering techniques.[6] These measurements give γ's for the longitudinal acoustic and transverse acoustic modes as $\gamma_{LA} = 4.2 \pm 0.6$ and $\gamma_{TA} = 2.9 \pm 0.5$, respectively. While these results can be compared with the present data only after a suitable average over all modes, the small temperature dependence of γ which we observe and the magnitude of $\gamma_0 = 2.6$ suggest that the value of γ_{LA} is perhaps a bit high.

The present extrapolated results for $V_0 = 13.39\ \text{cm}^3/\text{mole}$ are compared in Fig. 7 with theoretical calculations,[2] with previous calorimetric results[11,12] (as reduced to this same molar volume by Batchelder *et al.*[7]), and with C_V as calculated from the neutron scattering results.[6] The agreement between the calorimetric results is quite good, although we do not observe the systematic oscillations which Fenichel and Serin[12] report for the Θ-vs.-T curve. The values from the neutron experiments[6] appear to scale very well with ours, with a systematic difference of 1.3%, about one-half of which could be

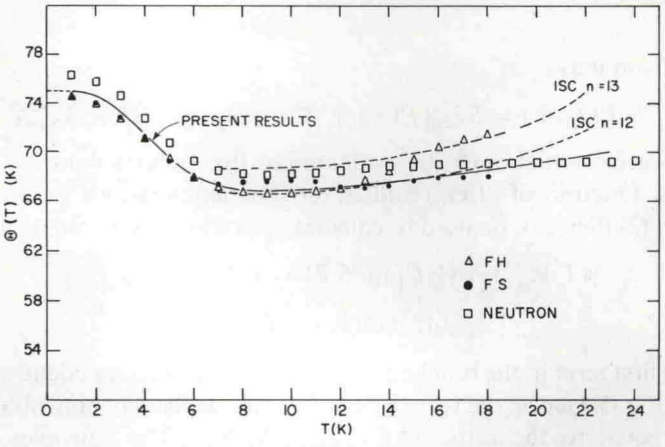

Fig. 7. A plot of equivalent Debye Θ's for $V_0 = 13.39\ \text{cm}^3/\text{mole}$ for the present results (Table VI) (solid line), for the data from Refs. 11 (FH) and 12 (FS) as analyzed in Ref. 7, as calculated from inelastic neutron scattering experiments of Ref. 6, and as given by theoretical calculations in Ref. 2 (dashed lines).