

relation is used for $T/\Theta_0 > 0.08$. The data for ^{20}Ne and ^{22}Ne have been converted to Θ -vs.- T relations, and these relations have been normalized through the use of appropriate values of Θ_0 to make them fit onto this curve. The agreement is excellent, with uncertainties in the apparent values of Θ_0 of ± 0.1 K for ^{20}Ne and ± 0.2 K for ^{22}Ne , where the data are more limited. The low-temperature deviations are due to the onset of the anomalous behavior associated with the hydrogen. The heat-capacity data have not been corrected for the presence of the $0.2 \pm 0.1\%$ hydrogen impurity since the thermal properties of solid hydrogen are similar to those of neon at temperatures well away from the anomaly (that is, above 3 or 4 K).³⁴ Table VII gives the values of Θ_0 which were used to scale the isotope data. The relatively large uncertainty in the ^{22}Ne value of Θ_0 occurs because of a greater uncertainty in the quantity of sample for these measurements.

We also have plotted in Fig. 10 the low-temperature results for the natural neon Ne 4 sample using $\Theta_0 = 75.1 \pm 0.1$ K. This sample did not fill the bomb completely due to a low initial pressure at the melting line, so a $C_p - C_v$ correction has been applied to the data above 6 K using the data of Batchelder *et al.*⁷ A similar correction has been applied to the highest temperature ^{22}Ne point, although not to the ^{20}Ne data since these were taken at constant volume.

The values of Θ_0 given in Table VII refer to the actual molar volumes of the samples; these are unambiguous for ^{22}Ne and natural Ne 4 since the samples had pulled away from the walls and were at zero pressure, so the molar volumes of ^{22}Ne (13.321 cm^3) and natural Ne (13.391 cm^3) as given by Batchelder *et al.*¹⁶ can be used. The molar volume of the ^{20}Ne sample is as given previously in this section.

These various experimental results can be compared most legitimately at a common molar volume, so we have made use of our value of $\gamma_0 (= 2.6)$ for natural neon and the Grüneisen relation $\Delta\Theta_0 = -\gamma\Theta_0\Delta V/V$ to reduce the Θ_0 values to the molar volume of the natural neon (13.391 cm^3). The uncertainty for the ^{20}Ne data increases in this calculation because of the

TABLE VII
The Results for C_v at Low Temperatures for the Neon Isotopes

Mass, g/mole	Experimental data		$\Theta_0(V_0),^a$ K	$\Theta_0 M^{0.5},$ K-(g/mole) ^{0.5}
	Θ_0 , K	V , cm ³ /mole		
20.00	75.9 ± 0.1	13.38 ± 0.01	$75.7^5 \pm 0.2$	338.8 ± 1.0
20.17	75.1 ± 0.1	13.391	75.1 ± 0.1	337.3 ± 0.5
22.00	73.5 ± 0.3	13.321	72.5 ± 0.3	340.0 ± 1.5

^a $V_0 = 13.391 \text{ cm}^3/\text{mole}$.

somewhat greater uncertainty in the molar volume for this sample. An elementary picture suggests that Θ_0 should vary as the inverse square root of the isotopic mass, and this postulate is tested in the last column of Table VII where $\Theta_0 M^{0.5}$ is tabulated. The agreement appears to be within experimental error. The concentration of the major component for ^{20}Ne is 99.9% or better, while that for ^{22}Ne is 99% or better, in agreement with the Mound Laboratories specifications.

The present data can be compared directly with the results of Somoza and Fenichel,¹⁸ who performed constant-pressure heat-capacity measurements on separated neon isotopes. Our values appear to lie approximately 1.6 K higher than theirs for each of the isotopes, and this is slightly higher than the combined estimated uncertainties for the two experiments. A direct comparison with the data of Clusius *et al.*¹⁷ is not possible since their C_p data extended only down to 8 K.

The high temperature C_V data (near 30 K) for the two isotopically pure samples tend to lie slightly higher (by 1–2%) than the data for the natural neon at the same values of T/Θ_0 . This perhaps is understandable in terms of the hydrogen impurities, since in each case we are approaching pressures and temperatures which are close to the hydrogen melting line. We know very little about the effect of dissolved hydrogen or neon on the melting properties. The observation can be made, based on the heating which we observed at low temperatures, that the hydrogen must exist in the solid neon as discrete (although perhaps very small) particles since the ortho–para conversion can take place only via the mechanism of an interaction between two orthomolecules. The conversion would be very unlikely if the H_2 molecules were distributed in random solution. If these particles exist, then local melting effects could be observed with an enhanced specific heat for the solid as a whole. Certainly, there do not appear to be any significant deviations of the neon isotope data from the reduced curves which we find for natural neon.

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