ferent conditions, but the results were consistent to 0.01%. After the cell had been leak tested at 3600 kg/cm², its volume increased 0.07%. To the final volume of 0.29405 cm³ at 1 atmos and 300°K, corrections were made for: (1) the decrease caused by insertion of the capillary tube leading out of the bath (determined by geometry to be 0.00175 cm³); (2) the contraction with decrease in temperature; and (3) the expansion with increase in pressure. For (2), the linear thermal expansion coefficients of stainless steel AISI No. 304 measured by Altman, Rubin, and Johnston[7] were used, giving a maximum correction of −0.9% at 60°K. To calculate (3), Eqs. (3.11) and (3.14) of Newitt[8] for $\delta R/R$ and $\delta L/L$, respectively, were summed as $\delta V/V=\delta L/L+2(\delta R/R)$. The computations were made with the 77°K value of Young's modulus, 27×10^6 psi, based on the work of Zambrow and Fontana[9] on 18-8 steels and of the International Nickel Company[10] on AISI No. 304 stainless steel. The value of Poisson's ratio was estimated[11] to be 0.30±0.05 (where the possible error in the ratio is equivalent to ±2.8% of the correction). At 3500 kg/cm² the expansion correction amounted to +0.5% of the cell volume.

There were two dead volumes of concern to this research. The one of major importance, designated v_1, was that volume included in the capillary "Tee" between the seats of valves 3 and 4, excluding the high-pressure cell. The quantity of gas contained in v_1 appears as a negative correction to the density determinations as discussed later in Sec. E. Dead volume v_2 was included between valves 2 and 4 with valve 3 open exactly one-half turn. This volume enters a small correction term for pressure mismatch, which is also discussed in Sec. E.

Volumes v_1 and v_2 were determined separately by filling them at room temperature with He to 1000 kg/cm² and then transferring the contents into the low-pressure volume-manometer. The determinations were carried out with a plug substituting for the high-pressure cell. Volumes were computed from densities for He reported by Wiebe, Gaddy, and Heins.[12] The results were $v_1=0.02222$ cm³ and $v_2=0.1860$ cm³.

E. Corrections

The quantity of gas in the dead volume v_1 during liquid density experiments was computed from P-V-T data for N_2 measured by Michels, Wouters, and de Boer[13] and by Benedict.[14] The calculation took account of the temperature gradient along the lead-in capillary, which was determined experimentally by thermocouples. The total dead volume correction varied with pressure from 0.8 to 6% of the liquid specific volume. The extrapolation from the experimental to the melting temperature was made with our thermal expansion coefficient and amounted to less than 0.1% of the specific volume.

The observation of the melting process actually involved the constant-pressure change in state as follows: solid at T_a→liquid at T_b. In order to get the volume change of melting, one must correct for the expansion due to warming of the solid from T_a to T_m and of the liquid from T_m to T_b. For the latter, the directly observed thermal expansion coefficient α_l was used; whereas for the expansion of the solid, an indirectly determined correction was obtained by freezing the nitrogen at different temperatures at the start of ΔV_m measurements, then choosing the α_s giving the most consistent values of ΔV_m. The expansion corrections amounted to 1 to 2% and 2 to 4% of ΔV_m for the liquid and solid, respectively.

In the event of pressure mismatch between the manganin gauge and free-piston gauge when valve 3 was opened after completion of a ΔV_m or α_l measurement, a knowledge of volume v_2, in conjunction with density data,[13,14] permitted calculation of the deficient or excess gas in the volume-manometer. This correction was as large as 1% of ΔV_m at 80 kg/cm², where N_2 compressibility is great, but it was essentially zero at 3500 kg/cm².

During the ΔV_m and α_l studies at 1920.7 kg/cm², a slight leak appeared in the system between valves 3 and 4, for which corrections were made from the observed

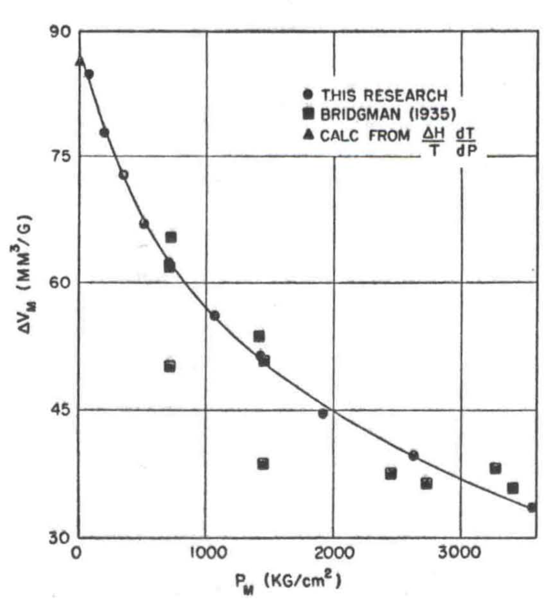

FIG. 2. The volume change on melting *vs* pressure for N_2.

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