

vessel *H*. Before entering *H* the gas passed through the cold trap *I* at 4 °K. After most of the gas was transferred into *H*, valve 4 was closed and the gas allowed to warm up and enter the high pressure Toepler pump. From this stage on the procedure was the same as with ⁴He. Before filling with the gas the calorimeter and high pressure Toepler pump had to be evacuated. In the case of ⁴He the system was pumped for 3 days and then flushed several times at pressures up to 2000 atm with clean ⁴He. In the case of ³He this method could not be followed. The system was therefore first thoroughly flushed with hydrogen in order to avoid contamination with ⁴He and then pumped for 11 days. From tests with ⁴He and a helium leak detector, this time was known to be sufficient to empty the system adequately.

2.4. Determination of molar volume and mass of sample

The molar volume of the helium samples was not determined directly but inferred from the melting data of Mills & Grilly (1955), and Grilly & Mills (1959). As the samples were held at constant volume melting took place over a finite temperature interval. The temperature at the beginning of the melting range, T_m , was obtained by taking heating curves. A well pronounced kink in the curve of temperature against time was observed which allowed T_m to be estimated to within 0.002 degK. From this temperature the pressure at the beginning of melting, p_m , and the molar volume V could be calculated using the data of Mills & Grilly.

For the measurements on ⁴He the mass of the sample was obtained in the following way. After completion of the heat capacity measurements the high-pressure Toepler pump was disconnected at valve 3 (figure 4) and the low-pressure Toepler pump connected to this valve. The gas filling the calorimeter and the dead space up to valve 3 was then transferred quantitatively by means of the Toepler pump to a stack of calibrated volumes *K*. The volumes *K* (roughly 0.6, 1.2 and 2.4 l.) had been calibrated by weighing with water. They were immersed in a water bath whose temperature could be determined to about 0.01 degK. The pressure in *K* was read on the constant volume manometer *L* to better than 0.1 mm using a cathetometer. The mass of helium gas was determined from the p - V - T data given by Keesom (1942) after due corrections for dead space had been applied. The dead space consists of the two high-pressure capillaries *D* and *E* (0.016 cm³), the Bourdon gauge *F* (0.058 cm³), and the calorimeter side of the closed valve 3 (0.0018 cm³). The whole dead space correction is approximately 2.3% and is estimated to be known to better than 15%. The accuracy of the mass determination is estimated at 0.5%.

From the mass determination and the molar volume V , the volume v of the high-pressure cell could be calculated. The results for v (about 1.46 cm³) obtained in this way showed a slightly increasing cell volume with increasing pressure which agreed with the elastic data for drill rod steel. The average deviation of v found in the four ⁴He experiments from a straight line is 0.2%.

In the case of ³He it was not thought feasible to transfer the cell content after each measurement to the calibrated volumes. The mass of the samples was instead calculated from the molar volume V , obtained as described above, and the cell volume v , obtained from the measurements on ⁴He as described.