was stored below atmospheric pressure in a 12-*l* tank. It was pumped by a pressure-vacuum, reversible, 2-stage vane pump[2] through a purifying train consisting of a charcoal trap cooled to liquid N_2 temperature and a charcoal trap cooled to liquid H_2 temperature. The gas then entered a cryogenic pump where it was liquefied at ~2°K and 2 kg/cm^2 gauge pressure. Upon warming, the purified high-pressure gas was forced either into the ΔV_m apparatus or into a small compression cylinder for additional pressure boosting. At the completion of an experiment, He^3 in the low-pressure metering system was transferred back to the storage reservoir by the same vane pump. Residual gas at a few microns pressure was removed by a conventional vacuum system. Mass spectrometer analysis of the purified gas indicated the following impurities: 0.06 percent He^4, <0.015 percent H_2, <0.005 percent D_2, <0.005 percent T_2, <0.01 percent N_2, <0.002 percent O_2.

The source of the He^4 was an A.E.C. cylinder (H size) filled at the Bureau of Mines Amarillo Station. The gas was pressured by a 3-stage compression cylinder and passed through a liquid-N_2 cooled trap into the measuring system. Mass spectrometer analysis indicated the following impurities: 0.01 percent H_2, 0.03 percent N_2, 0.002 percent O_2.

B. GENERAL PROCEDURE

The experimental technique used in measuring ΔV_m was essentially the same as that described earlier (*15*). However, the temperatures employed in freezing and melting the sample were, in general, much closer to the equilibrium melting points. This obviated large corrections for the thermal expansion of solid and fluid.

At pressures below 1000 kg/cm^2, the fluid coefficient of thermal expansion α_f was determined by the following piston displacement method. Fluid in the cell was brought to pressure equilibrium with the piston gauge at a cell temperature near the freezing point. A valve was closed, isolating the cell, whereupon the cell temperature was raised ~0.2°K. After temperatures had equilibrated, the valve was opened and the corresponding piston travel in the piston gauge was observed. From known PVT of the gas, the volume change could be computed. This procedure was repeated over several ΔT's at the same pressure and for both warming and cooling. At pressures above 1000 kg/cm^2 the earlier technique (*15*) was used.

The fluid compressibility coefficient β_f was measured similarly. At constant temperature the cell was balanced against the piston gauge. The cell valve was closed, an additional weight was added to the piston pan, the valve was opened and the piston displacement observed. At a given temperature the procedure

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[2] A brief description of this pump is given by Sydoriak and Roberts (*19*).

was repeated at different ΔP's up to the freezing point. Measurements were also taken for pressure decrements.

For redeterminations of the melting curves below 200 kg/cm^2, the apparatus and technique described in a preceding paper (*20*) were employed. Determination of the solid-solid transition line for He^3, however, was carried out in the ΔV_m apparatus as follows. With the He^3 pressure held constant at some value below the triple point, the bath was lowered out of contact with the cell. The bath temperature was then adjusted to a value just below the expected transition line, and the bath level was raised slowly until the cell was about one-half immersed. This filled the lower portion of the cell with solid. The existing temperature gradient in the upper part of the cell kept the cell opening from plugging with solid. With the bath temperature and level held constant, small weights were added stepwise to the piston gauge. The piston dropped by small decrements due to the compressibility of the system until the transition line was reached, at which point an additional weight caused the piston to drop by a large amount corresponding to the volume change of solid-solid transition, $\Delta V_{\mathrm{trans}}$, which took place in the lower portion of the cell. Unfortunately the measurement of $\Delta V_{\mathrm{trans}}$ could not be made quantitative by this method since the exact amount of solid in the cell was indeterminable. A different method for determining $\Delta V_{\mathrm{trans}}$ is discussed in Section IV-B-1.

The room temperature density of gaseous He^3 and He^4 was measured at three different pressures up to 200 kg/cm^2 by simply emptying an equilibrated cell content into the low-pressure metering system. Fluid density along the melting curve was measured as before (*15*).

The procedures outlined above will, in general, succeed only at temperatures which can be maintained by boiling liquid baths. No attempt was made to obtain ΔV_m and related data in the region 4.7°K to 14.7°K.

C. TEMPERATURE MEASUREMENT AND CONTROL

The liquid baths used were helium (1.2–5°K), hydrogen (14–24.5°K), and neon (24.5–31°K). Constant homogeneous temperature was effected by maintaining constant vapor pressure above the bath while stirring the bath with bubbles generated by a small heater at the bottom. In the helium region, temperatures were computed to 0.001° on the 1958 scale described by Van Dijk and Durieux (*21*). In the other regions, temperatures were computed to 0.001° on the scales used previously in the melting curve determinations (*1*).

D. VOLUME CALIBRATIONS

The volume of the large, thin-walled cell was determined to be 0.48252 cm^3 at 300°K and 1 atmos from the weight of mercury required to fill it. As indicated previously (*15*), corrections to the volume were made for: (1) the decrease