$T>2.17°K$. It was fitted with an empirical formula,

$$\beta'(2.200°K)=0.30\times10^{-3}+(72.0+6.66P)^{-1}\text{ atm}^{-1}, \quad (3)$$

to about 1.5%; deviations of the measurements are given in Fig. 3. Also given there is a comparison with β derived from density data of Keesom and Keesom[1] and of Edeskuty and Sherman.[5] Agreement between the three sets of results seems reasonable and the comparison is valid since no λ anomalies exist at this temperature.

A view of Fig. 2 again shows that a compressibility curve between 1.80 and 2.05°K parallels the 2.20°K curve at low pressures, but with increasing pressure it rises above the 2.20°K curve, reaching a peak at P_λ. At $P>P_\lambda$, the values of β drop continuously and approach the 2.20°K value. The minima in the β-versus-P curves increase in depth and breadth as P_λ increases, but they seem flattest in the middle of the P_λ range. Although the peaks become more distinct with increased P_λ, the sharpness of all the peak tips required a

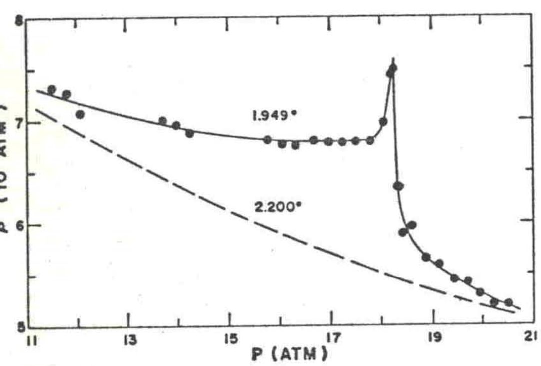

FIG. 4. Compressibility of liquid He^4 at 1.95 and 2.200°K.

higher than normal resolution; therefore the pressure increment of a measurement was reduced from the usual 0.27 to 0.05 atm in the vicinity of the peak. Portions of the 1.95 and 1.80°K curves are shown in Figs. 4 and 5, respectively, along with the 2.20°K values for comparison. The peak at P_λ fades away with increasing temperature until it almost disappears at 2.05°K, although the compressibility excess over the 2.20°K value is still obvious.

In the region between 1.60 and 1.75°K, no λ transition occurs. However, the results in Fig. 6 show that a minimum in the β-versus-P curve persists down to 1.70°K; at 1.75°K, the rate of rise beyond the minimum is similar to that at 1.80°K. Below 1.70°K, (the 1.65°K curve is omitted for clarity) the minimum disappears, but a compressibility excess over the 2.20°K curve remains, amounting to 15% at 1.60°K near the melting pressure.

The temperature variation of β at constant pressure changed according to the proximity of (T,P) to (T_λ,P_λ). For all temperatures, β at $P\ll P_\lambda$ increased with in-

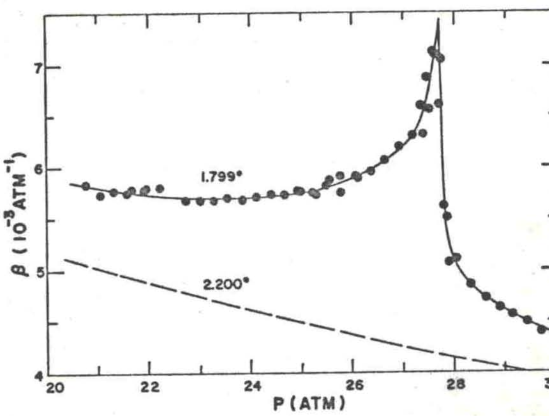

FIG. 5. Compressibility of liquid He^4 at 1.80 and 2.200°K.

creasing temperature. Near the λ transition, the variation of β with temperature became inverted. The reversion of $(\partial\beta/\partial T)_P$ to the normal plus sign at $P\gg P_\lambda$ was not indicated—the compressibilities for different temperatures merged to a common value within $\sim2\%$, the experimental error, at the highest pressures.

The accuracy of the measurements is summarized here. From a straight sum of possible individual errors in cell calibration plus those from readings of ΔV and ΔP, the maximum error in an individual β should be 2.5 to 5.0% for high to low values of β, respectively; from the root mean square of individual errors, a probable error in β is 1.5 to 3.0% for high to low values. Consideration of $\Delta P_L/\Delta P_U$ alone in Eq. (2) leads to a precision error of 1.0 to 1.7% for high to low values of β. Near the λ transition, the decrease in ΔP for greater resolution probably lowered the accuracy, but here we are mainly interested in the reproducibility of results over a short range of pressure and time. Error in these results is estimated at 2%.

IV. DISCUSSION

The present compressibility measurements provide a view of normal and abnormal behavior in liquid He^4

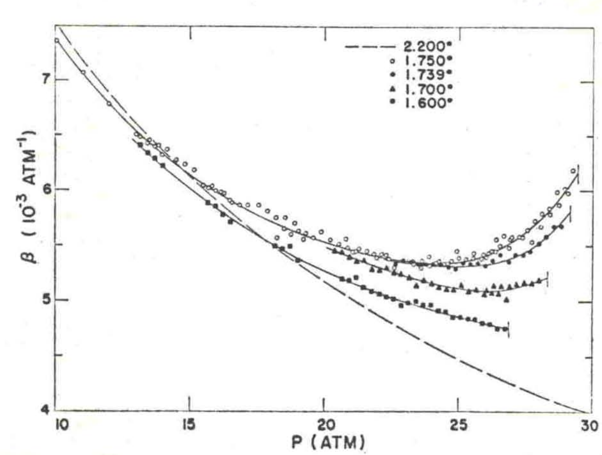

FIG. 6. Compressibility of liquid He^4 at several temperatures below 1.76 and at 2.200°K.