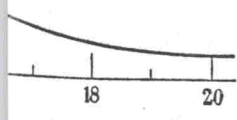


compressibility the volume thermal expansion shows the variation of the expansion coefficients at different densities.

SOLID HELIUM; THE VOLUME EXPANSION COEFFICIENT AS A FUNCTION OF TEMPERATURE

- 15 ml.
- $10^4 \alpha$
- 0
- 1.05
- 10.2
-
-
-
-

the internal energy at absolute zero. In this calculation, the value of the zero-point energy per mole (Simon & Swenson 1950;



0°K as a function of volume.

Swenson 1950). The resulting values of U_0 are estimated to be accurate to 2% and are shown in figure 11.

To obtain the lattice energy from the internal energy at absolute zero it is necessary to subtract from it the zero-point energy. The latter may be approximately evaluated, assuming a Debye model for the solid, as $\frac{3}{8}R\theta_D$, where the θ_D values are those appropriate to the absolute zero.

From the experiments of Webb *et al.* (1952) which, of all the measurements on solid helium, have extended to the lowest values of T/ϕ , the θ_D for a molar volume of 20.6 ml. was taken as 22.7°K at absolute zero. On the basis of these assumptions, the lattice energy of solid helium was derived and the results are shown in figure 12.

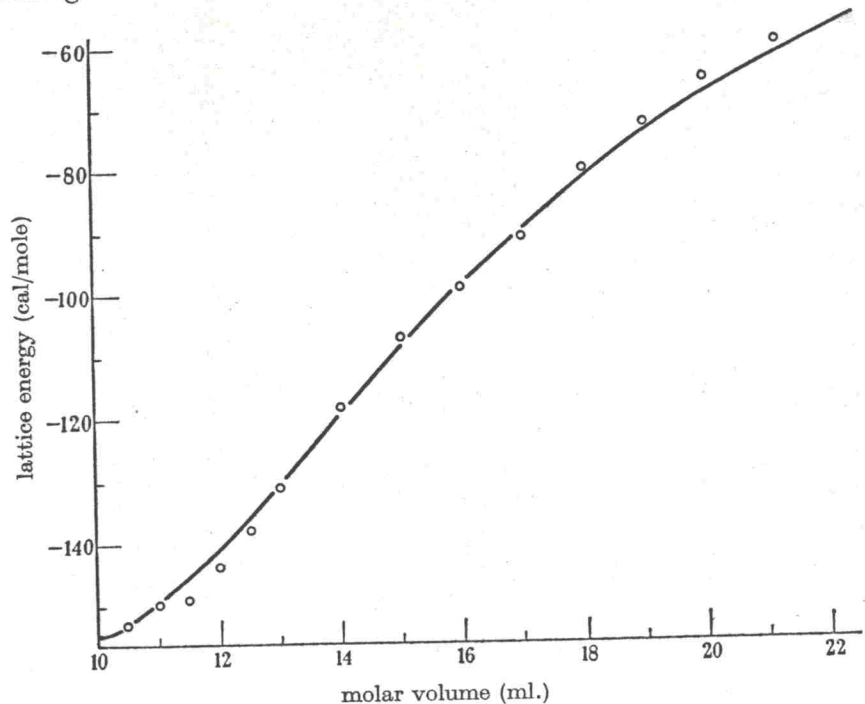


FIGURE 12. The lattice energy of solid helium as a function of volume. O, derived from experimental measurements; —, calculated by London.

London (1936) has calculated this lattice energy as a function of volume for a close-packed structure assuming the Slater-Kirkwood intermolecular potential for two helium atoms, and his values are represented by the continuous line in figure 12. Considering the inaccuracies involved in (a) the Debye model, (b) the extrapolation of the Debye θ to 0°K, and (c) the lattice energy calculated from the Slater-Kirkwood potential, it must be concluded that the very close agreement is accidental. It may be mentioned that the recent work of Yntema & Schneider (1950) has shown that the Slater-Kirkwood potential reproduces quite well the variation of the second virial coefficient with temperature over a wide range of temperatures, and is, indeed, more successful than the more refined expression due to Margenau.