

reach up to temperatures as high as the ordinary critical temperature, while ours only start in this region and extend to five times its value. On the other hand, our data are at least partly influenced by quantum effects.

Turning first to compare the values of the entropy change on melting, we find that our values are rather less than R , the gas constant, i.e. they are of the usual order of magnitude, although only about one-half of the values observed for the other inert gases at their normal melting-points (see table 9). The falling trend towards neon and helium indicates the onset of quantum effects.

TABLE 9. COMPARISON OF THE MELTING ENTROPIES OF THE INERT GASES

substance	T ($^{\circ}\text{K}$)	ΔS melting (cal/deg/mole)	source of data
He	10.0	1.52	present experiments
	20.0	1.68	present experiments
Ne	24.6	3.26	Clusius (1936)
A	83.9	3.35	Clusius (1936)
K	116.0	3.36	Clusius (1936)
Xe	161.3	3.40	Clusius & Riccoboni (1937)

Passing on now to the temperature dependence of the entropy of melting it is clear that our experiments on helium show no indication of any approach to a hypothetical 'critical point' between the solid and fluid phases. Although in ordinary substances the entropy change can be traced only over a relatively small temperature interval, the existing data indicate that to a first approximation the heat of melting remains constant. This implies that the entropy of melting *falls* in inverse proportion to the temperature; for helium, however, a slight *rise* is observed. Of course, one could say that the entropy difference is bound to be zero at absolute zero and therefore must initially increase with rising temperature. This steep initial rise, however, seems more or less to have finished on reaching the λ -point, in agreement with the general observation that all the abnormal properties of liquid helium end abruptly at this particular temperature. It is true that the solid is still very degenerate even at the higher temperatures, but, on the other hand, the specific heat of the fluid has more or less the classical value of a gas at all volumes. It is not easy to see how this behaviour of the two phases should in itself lead to a tendency of the entropy difference to increase with rising temperature. It seems that for a better understanding of this point we will have to wait for the more comprehensive measurements of the thermal properties of the fluid which are at present under preparation in this laboratory.

We have now to discuss the *absolute values of the entropy* of the two phases in equilibrium. The only data so far available are results of calculations (Simon 1937) carried out for potassium, sodium and argon, making use of the change of θ derived from the Lindemann formula, the compressibility, and the thermal expansion. These calculations naturally cannot compete in accuracy with the direct measurements, but such measurements are only possible with helium and perhaps one or two other substances of low boiling temperature. The calculation shows that the entropies of the fluid and solid phases approach a mean value, so that the entropy of the fluid falls and that of the solid rises with increasing temperature.