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A COMPILATION AND ANALYSIS OF MELTING CURVE DATA FOR ARGON

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An attempt is made to fit a Simon type equation to the melting curve of argon in the pressure range 0-8 kilobar. These data points have been collected from experiments made over the past 17 years. When the fit is extrapolated to the pressure range 18-26 kilobar, serious disagreement with observed results is found.

Over the past seventeen years, articles have appeared containing experimental measurements of the melting curve of argon [1-9]. The most recent of these has shown conclusively that a Simon-type equation does not fit the P - T melting curve of *both* mercury and argon [3]. Now it is of interest to compare (especially in the high pressure region) the least squares fit of a Simon equation fitted to P - T points at low pressures (0 - 18 kb) to those experimental points at higher pressures (18-26 kb). This interest has been generated, in part, by the conjecture that the solid-liquid coexistence line ends in a critical point.

To fit the equation of form $P = A[(T/T_0)^c - 1]$, the parameters A and c must be determined, the triple point temperature T_0 having been taken as 83.809°K [6]. The 41 data points from zero to eight kilobar provided input for an iterative computer program which gives A = 2.249 ± 0.040 kb. The figure ± 0.040 kb represents the ninety-nine percent confidence limit for A when A is calculated in the above manner. Its importance is that, if a second A-value is calculated for another data set and the difference between the two is greater than ± 0.040 kb, then one must conclude that something other than random error has caused the difference. The c-value obtained from this process is 1.528 ± 0.070. Hardy, Crawford and Daniels, on the other hand, have determined A = 2.2293 ± 0.0035 kb and $c = 1.5351 \pm 0.0012$ (a summary of differences in calculated pressure between the two fits is found in table 1).

A graph of argon melting curve points is presented below [1, 2, 4-9]. The line drawn through the melting curve data is the graph of $P = 2.249[(T/T_0)^{1.528} - 1]$.

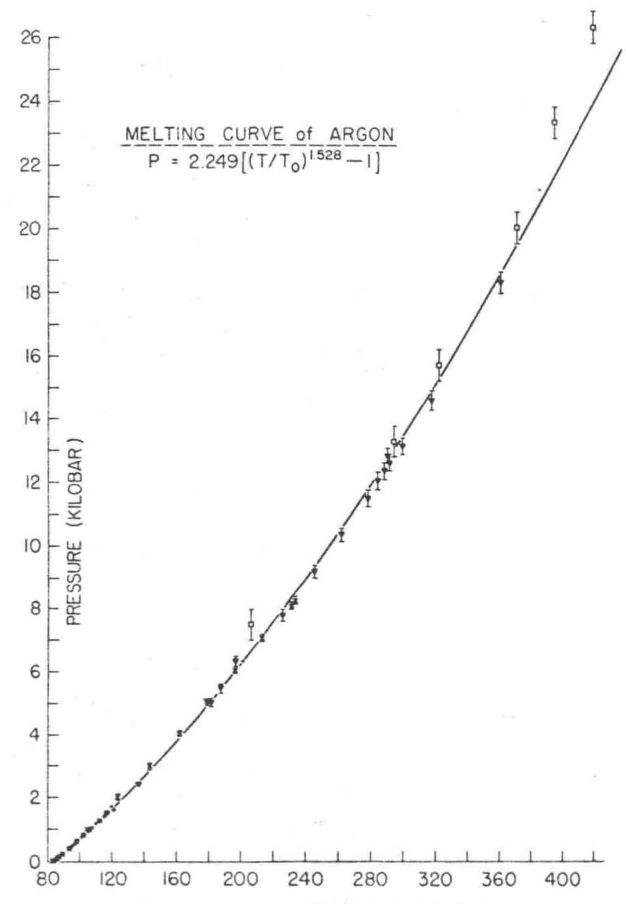

Fig.1. The points plotted above are: Grace and Kennedy □, Lahr and Eversole ▼, Robinson ×, Crawford and Daniels ●, Michels and Prins ■, van Witzenburg and Stryland +.

Table 1
The quantity P_1-P_2 is the difference in calculated pressure at various temperatures, where

$$P_1 = 2.249[(T/T_o)^{1.528} - 1]$$

and

$$P_2 = 2.2293[(T/T_o)^{1.5351} - 1].$$

T (^oK)	$P_1 - P_2$ (bar)
100	2.5
125	5.0
150	5.9
175	5.1
200	2.7
225	-1.4
250	-7.0
275	-14.4
300	-23.5
325	-34.1
350	-46.3
375	-60.2
400	-75.6
425	-92.7
450	-111.3
475	-131.4
500	-153.1
525	-176.3
550	-201.1
575	-227.3

Since Hardy, Crawford and Daniels' work has shown that the melting curve of mercury and argon cannot *both* be represented by a Simon melting equation, and since neither their fit nor the present one fits the data when extrapolated to the 20-26 kilobar region (pending more and better data at these pressures), serious doubt has been cast upon the accuracy of the Simon equation's description of argon melting phenomena. Additionally, this raises some question as to the use of a Simon equation fitted to mercury melting data as a secondary pressure standard, a practice which has never been theoretically justified [10].

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