

TABLE I. Experimental argon melting data.

Temperature (°K)	Pressure (kilobars)	Molar volume (cm ³ /mole)		ΔV on melting (cm ³ /mole)
		Fluid	Solid	
94.73±0.02	0.451±0.007	27.30±0.02	24.34±0.02	2.96±0.02
94.74	0.459	27.31		
100.76	0.721	26.89		
108.12	1.051	26.52	24.02	2.50
110.77	1.186	26.32		
120.85	1.674	25.85	23.65	2.20
140.88	2.708	24.96	23.04	1.92
160.40	3.805	24.26	22.54	1.72
180.15	4.999	23.65	22.08	1.57
180.20	5.003	23.66	22.11	1.55
201.32	6.335	23.10	21.69	1.41

±1 bar at the lower pressures and ±4 bar at the higher pressures. Construction of this gauge had not been completed at the time the measurements on the solid-fluid phase transition in argon were made, so a Heise Bourdon-tube pressure gauge with somewhat lower sensitivity and accuracy was used in these measurements. The resulting lower accuracy in the determination of the melting pressures will soon be rectified by high-precision measurements of pressure versus temperature along the melting curve for argon and other substances, which are in progress in this laboratory.

The volume of the argon sample was determined by a method not commonly used, but which has several desirable features. In the "normal" data runs the weight of the fluid occupying the entire vessel was measured as a function of pressure and tem-

perature. In addition to these data runs another set of runs was made spanning the same pressure and temperature range, but this time with a solid iron cylinder filling most of the internal volume of the vessel. The difference between the weights of the fluid in the vessel at a given pressure and temperature with and without the iron cylinder in place is just the weight of a volume of the fluid equal to the volume of the iron cylinder at this pressure and temperature. Since this cylinder was subjected only to hydrostatic pressure, the small changes in its volume with pressure and temperature could be calculated accurately from the known equation of state of iron. Such a method for volume determination eliminates the need for assumptions concerning the behavior of a pressure vessel and its closure seals when the vessel is subjected to internal pressure. This is desirable since it was shown, at least for the pressure vessel being used in the present experiment, that the internal volume did *not* behave according to the usual assumptions.¹

PROCEDURE AND RESULTS

Using the apparatus and techniques described above, P - V - T data were obtained for argon (99.995% pure). These data consist of several isotherms, each of which is made up of a number of equilibrium P - V - T points. The procedure for each isotherm, after the system had been initially pressurized, was first to pump a small amount of argon into the vessel or to release a small amount from it. The system was then allowed to equilibrate before the values of the pressure in the system and the temperature and weight of the vessel were recorded. This process was then repeated to obtain a series of points along the isotherm. Immediately after all the points for a particular isotherm

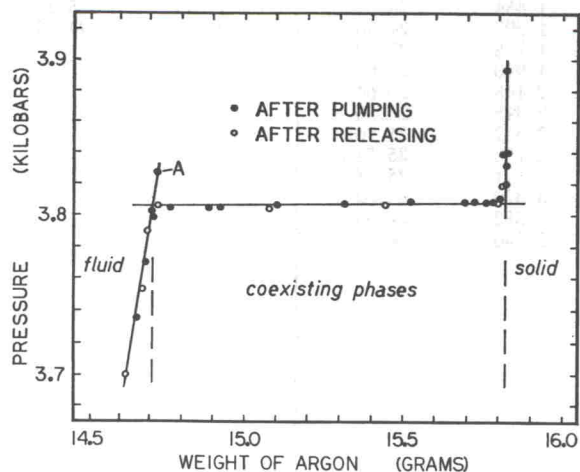


FIG. 4. Isotherm through the solid-fluid phase transition in argon. Point A indicates a pressurization into the supercooled region before the argon began freezing in the vessel.

TABLE II. Experimental P - V - T data for fluid argon (P is in kilobars; V is in cubic centimeters per mole).

210.16°K ^a		190.73°K		170.36°K		150.73°K	
P	V	P	V	P	V	P	V
0.209	61.45	0.203	51.55	0.209	42.37	0.212	36.79
0.277	51.60	0.277	44.99	0.280	39.30	0.274	35.44
0.360	45.77	0.348	41.66	0.347	37.50	0.341	34.35
0.437	42.71	0.418	39.49	0.422	36.02	0.416	33.38
0.515	40.43	0.483	38.02	0.489	35.00	0.489	32.62
0.598	38.68	0.559	36.72	0.560	34.14	0.573	31.91
0.702	37.04	0.633	35.67	0.634	33.39	0.664	31.25
0.782	36.03	0.729	34.56	0.719	32.67	0.753	30.68
0.884	34.98	0.824	33.68	0.820	31.93	0.854	30.12
0.977	34.15	0.938	32.79	0.930	31.23	0.984	29.50
1.072	33.43	1.044	32.08	1.051	30.57	1.112	28.96
1.195	32.61	1.174	31.33	1.178	29.96	1.255	28.45
1.315	31.92	1.299	30.72	1.311	29.42	1.412	27.95
1.420	31.41	1.432	30.14	1.458	28.88	1.575	27.50
1.552	30.78	1.565	29.63	1.634	28.33	1.754	27.05
1.734	30.06	1.728	29.07	1.829	27.78	1.958	26.63
1.939	29.38	1.935	28.46	2.015	27.33	2.153	26.25
2.146	28.75	2.136	27.93	2.220	26.89	2.369	25.86
2.355	28.22	2.346	27.45	2.434	26.50	2.605	25.48
2.530	27.81	2.552	27.03	2.648	26.10	2.840	25.14
2.759	27.33	2.776	26.61	2.914	25.69	3.115	24.77
3.035	26.83	3.026	26.18	3.179	25.31	140.94°K	
3.306	26.37	3.261	25.83	3.450	24.94	P	V
3.577	25.99	3.554	25.42	3.726	24.62		
3.839	25.61	3.835	25.07	4.000	24.31		
4.123	25.26	4.139	24.72	4.301	24.01		
4.462	24.88	4.478	24.37	160.47°K			
4.806	24.53	4.797	24.07	P	V	0.208	34.84
5.143	24.22	5.134	23.78			0.291	33.53
5.484	23.95	5.486	23.50			0.380	32.47
5.823	23.67	5.561	23.43			0.459	31.75
6.160	23.42					0.537	31.14
6.464	23.20					0.632	30.52
201.29°K		180.21°K				0.725	29.97
P	V	P	V			0.823	29.48
						0.924	29.05
0.205	57.20	0.203	46.62	0.203	39.60	1.059	28.53
0.275	48.50	0.275	42.05	0.263	37.63	1.173	28.13
0.348	44.12	0.352	39.29	0.346	35.81	1.308	27.71
0.416	41.55	0.424	37.52	0.409	34.79	1.445	27.33
0.493	39.48	0.487	36.39	0.469	34.01	1.589	26.98
0.554	38.24	0.553	35.40	0.540	33.24	1.756	26.58
0.624	37.08	0.634	34.45	0.626	32.47	1.939	26.21
0.731	35.69	0.724	33.55	0.728	31.69	2.114	25.88
0.838	34.58	0.831	32.67	0.833	31.02	2.310	25.55
0.941	33.68	0.935	31.95	0.939	30.42	2.524	25.22
1.041	32.95	1.053	31.23	1.053	29.88	2.720	24.95
1.163	32.18	1.160	30.67	1.184	29.30		
1.266	31.59	1.282	30.10	1.317	28.82		
1.401	30.93	1.406	29.60	1.454	28.37		
1.550	30.28	1.554	29.08	1.597	27.96		
1.716	29.66	1.749	28.46	1.728	27.59		
1.938	28.95	1.949	27.92	1.940	27.09		
2.355	27.86	2.152	27.43	2.148	26.64		
2.566	27.40	2.355	27.00	2.345	26.26		
2.768	27.01	2.558	26.61	2.562	25.90		
3.002	26.60	2.787	26.22	2.788	25.54		
3.249	26.20	3.038	25.81	3.041	25.18		
3.517	25.80	3.316	25.42	3.320	24.82		
3.791	25.44	3.573	25.09	3.582	24.50		
4.130	25.03	3.871	24.74	3.846	24.22		
4.458	24.67	4.136	24.44				
4.806	24.33	4.444	24.14				
5.150	24.03	4.738	23.86				
5.488	23.74	4.916	23.71				
5.824	23.47						
6.203	23.20						