TABLE I

Physical Data for the Five Natural Neon Samples

Sample	No. moles	V, cm^3/moles[a]	P_0, bar	P_m, bar[b]	θ_0, K[c]	T_m, K[d]
Ne 4	0.2142	13.60	—	521	—	31.75
		(13.39)	0	(768)	75.1	(34.8)
Ne 5	0.2195	13.30	—	885	—	36.20
		(13.23)	147	(976	77.7	(37.25)
Ne 6	0.2261	12.95	—	1364	—	41.80
		(12.87)	511	(1514)	83.1	(43.2)
Ne 7	0.2318	12.67	—	1862	—	46.80
		(12.59)	841	(2033)	87.6	(48.5)
Ne 8	0.2361	12.48	—	2301	—	51.10
		(12.39)	1192	(2555)	91.5	(53.5)

[a]Values are uncertain by ± 0.01 cm^3/mole. The first volume for each sample is for the melting line. The volume in parenthesis is the calculated value for that sample at $T = 0$, with the corresponding estimated T_m and P_m which would be observed in a constant-volume experiment. The Ne 4 sample pulled away from the bomb walls at approximately 15 K.

[b]Values are uncertain by ± 3 bar.

[c]Values are uncertain by ± 0.1 K.

[d]Values without parentheses are uncertain by ± 0.05 K.

is equal to approximately 2.55 ± 0.03 at high temperature, so $\gamma^2 = 7$ was assumed in a self-consistent calculation of C_V from the data. The correction term in Eq. (1) is less than 1 % below 20 K for all of the samples, and increases to approximately 4 % for the Ne 8 sample at 50 K, so the volume V also was assumed to be constant for a given sample.

The resulting values of $C_V(T)$ for each sample are not true values for constant volume, since the internal pressure in the bomb and hence its volume increase with increasing temperature. The molar volume of the sample rather than the bomb volume will be used in the following discussion since these differ only by a proportionality factor. Thus, the molar volume given in Table I for the melting temperature and pressure for a sample must be greater than the molar volume at 0 K (in parentheses). The change in internal pressure for neon can be estimated from the Mie–Grüneisen equation of state

$$P^* = \gamma U^*/V \tag{2}$$

where γ, the Grüneisen parameter, is a slight function of volume and $C_V = (\partial U^*/\partial T)_V$. The increase in the internal pressure of the neon with increasing temperature at constant volume $(\partial P^*/\partial T)_V$ will be decreased slightly due to the finite expansivity of the bomb κ and the bulk modulus B_T of the neon, with a resulting relation $(dP/dT)_{\text{bomb}} = (1 + \kappa B_T)^{-1}(\partial P^*/\partial T)_V$, which is analogous with Eq. (1). As a result, the actual pressure in the bomb at a given temperature can be calculated from the melting line parameters as

$$P(T, V) = P_m(T_m, V_m) + (\gamma/V)(1 + B_T\kappa)^{-1} \int_{T_m}^{T} C_V(T, V)\, dT \tag{3}$$

In this equation V is the actual volume of the bomb and will be a slight function of the temperature, and C_V is as calculated from Eq. (1). The present experiments do not supply sufficient information to allow the precise determination of the pressure from Eq. (3), and the values of P_0 and hence of $V(P_0)$ given in Table I are calculated using this relation and a combination of the heat-capacity results and piston-displacement equation-of-state data.[10] One problem, for instance, is that while B_T is only slightly temperature dependent at constant volume, it increases by 50% with the change in volume from Ne 5 to Ne 8. The major volume decrease occurs for the highest melting Ne 8 sample, but even then is only 0.7%. The volume change indicated in Table I for the Ne 4 sample is misleading since the pressure in

TABLE II

Smoothed Thermodynamic Functions for the Ne 5 Sample as Corrected to Constant Volume, $V = 13.23\ \text{cm}^3/\text{mole}$

T, K	C_V, J/mole·K	Θ, K	U^*, J/mole	S, J/mole·K
0	0	77.71	0	0
1.0	4.155×10^{-3}	77.64	1.038×10^{-3}	1.383×10^{-3}
2.0	3.376×10^{-2}	77.24	1.675×10^{-2}	1.115×10^{-2}
3.0	1.189×10^{-1}	76.14	8.692	3.846
4.0	3.041	74.24	2.877×10^{-1}	9.45
5.0	6.446	72.21	7.471	1.961×10^{-1}
6.0	1.175×10^{0}	70.77	1.641×10^{0}	3.576
7.0	1.895	69.96	3.161	5.906
8.0	2.776	69.57	5.845	8.996
9.0	3.778	69.42	8.755	1.284×10^{0}
10.0	4.855	69.41	13.07	1.738
12.0	7.069	69.66	25.00	2.821
14.0	9.179	70.10	41.27	4.077
16.0	11.081	70.59	61.57	5.436
18.0	12.743	71.09	85.44	6.851
20.0	14.154	71.69	112.37	8.281
22.0	15.336	72.41	141.90	9.702
24.0	16.326	73.22	173.6	11.100
26.0	17.168	73.97	207.1	12.460
28.0	17.90	74.86	242.2	13.47
30.0	18.54	75.57	278.6	15.06
32.0	19.11	76.10	316.3	16.30
34.0	19.61	76.60	355.1	17.50
36.0	20.02	77.33	394.7	18.66
37.3	(20.24)	(78.)	(421.)	(19.2)