TABLE III

PROPERTIES[a] OF THE TRANSITION IN SOLID He^3, $\beta \rightarrow \alpha$

P (kg/cm^2)	T (°K)	dP/dT (kg/cm^2/deg)	ΔV (cm^3/mol)	ΔS (cal/deg/mol)
140.44[b]	3.148[b]	34.0	0.116	0.092
130	2.805	27.0	0.118	0.074
120	2.370	19.2	0.100	0.045
112	1.846	11.6	0.072	0.019

[a] Smoothed values.

[b] Triple point for solid α, β, and fluid.

TABLE IV

GAS DENSITIES OF He^3 AND He^4 AT 24.40°C

P kg/cm^2	ρ He^4 Amagats	ρ He^3 Amagats
53.44	46.30	46.28
112.45	94.95	94.81
204.55	166.20	165.99

TABLE V

CONSTANTS[a] IN EQ. (1) FOR THE VOLUME CHANGE OF MELTING

Solid	A	B	C	P_m range, kg/cm^2	rms dev. cm^3/mol
He^4	1.60677	0.33439	−103.25	175–3555	0.0051
He^3 α	1.56464	0.39023	−29.998	51–128	0.0064
He^3 β	1.51053	0.30825	−42.581	146–3555	0.0031

[a] Pressure units in kg/cm^2 and volume units in cm^3/mol.

TABLE VI

CONSTANTS[a] IN EQ. (2) FOR THE VARIOUS TRANSITIONS

Transition	A'	B'	C'	D'	E'	T range, deg K	rms dev., kg/cm^2
Solid He^4 → fluid He^4 I	33.280	−44.156	31.799	−4.8159	0.30313	1.8–5.2	0.23
Solid He^3 α → fluid	27.256	−0.64696	16.0205	−1.39505	0	1.2–3.1	0.16
Solid He^3 β → fluid	3.873	30.5539	4.08176	0	0	3.2–4.4	0.10
Solid He^3 α → Solid He^3 β	104.906	0	−0.053454	1.15635	0	1.8–3.1	0.42

[a] Pressure units in kg/cm^2 and temperature units in deg K.

TABLE VII

CONSTANTS[a] IN EQ. (4) FOR MOLAR VOLUMES OF FLUID ALONG THE MELTING CURVE

Fluid	a'	b'	c'	d'	P_m range, kg/cm²	rms dev., cm³/mol
He^4 II	0	−0.17145	1	27.570	26–30	0.0006
He^4 I	14.854	48.5273	−0.107253	−10.0712	35–3555	0.0097
He^3	1.075	51.1102	−0.161532	−3.2482	50–3555	0.0137

[a] Pressure units in kg/cm² and volume units in cm³/mol.

2. Thermal expansion and compressibility of the fluid

The thermal expansion coefficient of fluid He^3 along the melting curve exhibits a maximum in the vicinity of the triple point, as shown in Figs. 3 and 4. The maximum is broad compared to that for He^4 and is less than one-half as large. In general, one expects α to increase with T and decrease with P; however, along the melting curve the "normal" behavior of α_f increasing with decreasing P_m and T_m indicates that P_m changes overcome T_m changes. For He^4 the maximum in α_f appears to be a direct consequence of the λ-transition. In He^3 the nuclear spin part of α_f becomes more negative at lower T, according to Goldstein (*25*), and it apparently overcomes the "normal" behavior of the nonspin part of α_f.

From values of α_f and β_f in Fig. 4, it is possible to compute the following thermodynamic quantities for fluid He^3 along the melting curve:

$$(\partial P/\partial T)_V = \alpha_f/\beta_f ; \tag{5}$$

and

$$(C_P - C_V) = TV_f\alpha_f^2/\beta_f . \tag{6}$$

These quantities are shown as the curves in Fig. 10. Neither curve exhibits a maximum over the range studied. The plot of $(C_P - C_V)$ versus P_m is linear below 180 kg/cm² and extrapolates to zero at $P_m = 47$ kg/cm². This extrapolation gives a good determination of the point where α_f goes through zero on the melting curve.

The pressure-temperature locus of $\alpha_f = 0$ in the fluid domain is shown in Figs. 5 and 9. For completeness, the point of Taylor and Kerr (*26*) on the vaporization curve has been included.[3] The points represented by open circles were obtained by extrapolation to zero of a series of α_f values measured at constant pressure and various temperatures. This could be done reliably because the slopes were quite constant. Extrapolations were made below about 1.4°K, the

[3] Lee *et al.* (*27*) also reported a density maximum at approximately 0.5°K, presumably at saturation.