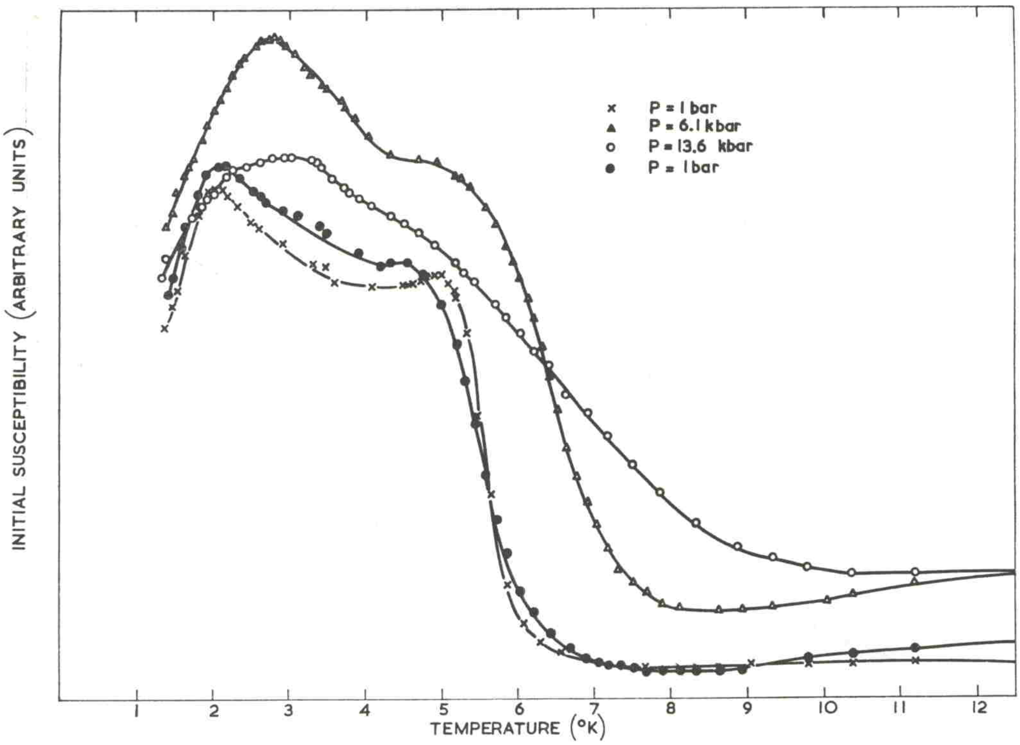

FIG. 8. Initial magnetic susceptibility as a function of temperature at a number of pressures for a sample of a 24.2 at. % In alloy.

electrons should be applied to the observed susceptibility of such a system before considering the temperature dependence of $1/\chi$.

The evidence for atomiclike moments is not established from such behavior if the value of p_{eff} is smaller than the value ($p_{\text{eff}}=1.73$) corresponding to a spin of $\frac{1}{2}$. In this case it is considered more appropriate to compare the susceptibility behavior with that expected from the itinerant model. In the absence of exchange interactions this model is usually considered to consist

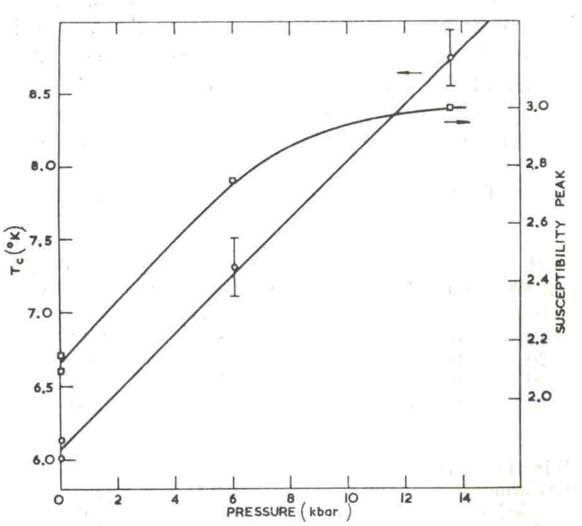

FIG. 9. Pressure dependence of the Curie temperature and the low-temperature peak in the initial susceptibility.

of two terms, a temperature-dependent (Pauli-Landau) term $\chi_c(T)$ associated with the electrons at the Fermi surface, together with a temperature-independent (Van Vleck) term χ_0 associated with all of the conduction electrons. If the electrons are free, or nearly free, then the variation of $\chi_c(T)$ with temperature is small ($\sim 5\%$ variation from 1 to 300°K) and is proportional to T^2. On the other hand, a strongly temperature-dependent χ indicates that the energy band or bands at the Fermi surface vary only slightly with k (i.e., tightly bound electrons), so that there is a sharp peak in the density of states. Such a peak may occur due to the presence of a Van Hove saddle point at an energy close to the Fermi energy.[27] However, such a peak will not produce divergence unless an exchange interaction is present, and then the susceptibility is given by

$$1/\chi(T)=1/\chi_c(T)-I/2\mu_B^2, \qquad (2)$$

where I is the exchange energy per electron which is assumed independent of the wave vector and the band, but is spin-dependent.[28] $\chi(T)$ is obtained from the observed susceptibility by correcting for χ_0 and the diamagnetism of the system. This equation has the same form as the Curie-Weiss equation,[29] but there are

[27] E. P. Wohlfarth and J. I. Cornwell, Phys. Rev. Letters **7**, 342 (1961); S. Alexander and G. Horwitz, Solid State Commun. **4**, 573 (1966); W. M. Lomer (private communication).

[28] W. M. Lomer, in *Proceedings of the International School of Physics, Varenna 1966*, (Academic Press Inc., "*Enrico Fermi*" London, 1967), p. 1.

[29] This is seen by writing (1) in the following form:

$$1/\chi(T)=T/C-\theta/C.$$

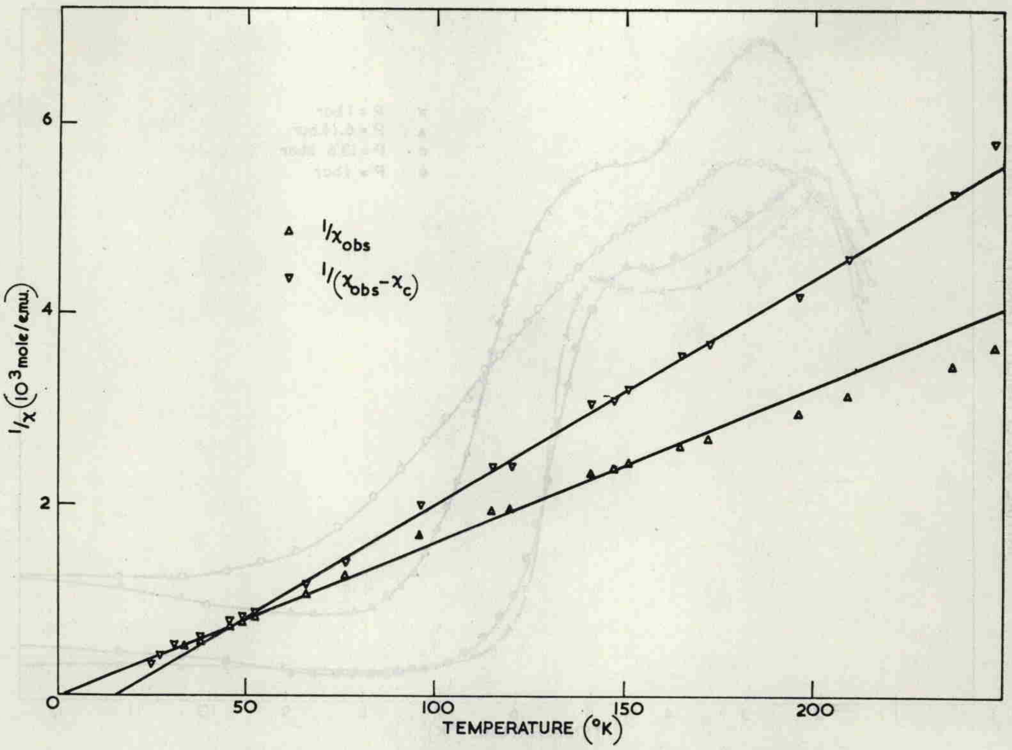

FIG. 10. Plots of $1/\chi_{obs}$ and $1/(\chi_{obs}-\chi_c)$ as a function of temperature.

no restrictions on the value or temperature dependence of $\chi_c(T)$, which is determined by the details of the shape of the density-of-states curve. Furthermore, the value of $T(\theta)$ which causes (2) to diverge,

$$1/\chi_c(\theta)=I/2\mu_B^2, \quad (3)$$

is not necessarily the same as the Curie temperature, since the latter is determined by the equation

$$1/N_+ + 1/N_- - 1/2I \gtrsim 0, \quad (4)$$

where N_+, N_- are the density of states of the up- and down-spin bands respectively at $T=T_c$.[28]

It is clear from Fig. 2 that the magnetic susceptibility of the Sc_3In phase is strongly temperature-dependent. We shall compare with theory only the data obtained for the 24.2 at. % In alloy since the sample taken from this alloy had the largest susceptibility at any given temperature. If we follow Matthias *et al.*[3] and simply plot $1/\chi_{obs}$ as a function of temperature we find the variation shown in Fig. 10. It can be seen that the points so obtained do not fall on a straight line over the full temperature range of the measurements. If, however, a straight line is drawn through the points between 50 and 150°K, values of p_{eff} and θ can be determined from it and these are presented in Table III, where they are compared with the values obtained by Matthias *et al.*[3]

A more satisfactory comparison with the Curie-Weiss relationship can be made by correcting the observed data for the Pauli term (assumed to be temperature-independent).[30] A plot of $1/(\chi_{obs}-\chi_c)$ as a function of temperature is also given in Fig. 10. A straight line can now be drawn through the points between 50 and 250°K and the values of θ and p_{eff} obtained from this line are also given in Table III. It can be seen that correcting the data causes the value of θ to increase

TABLE III. Comparison of the values of θ and p_{eff} derived from plots of $1/\chi_{obs}$ and $1/(\chi_{obs}-\chi_c)$.

Plot	θ (°K)	p_{eff}/g at.	p_{eff}/(Sc atom)	Moment/(Sc atom) (μ_B)
$1/\chi_{obs}$	3	0.70	0.81	0.29
$1/(\chi_{obs}-\chi_c)$	16	0.58	0.67	0.20
$1/\chi_{obs}$[a]	7	0.65		

[a] Reference 3.

TABLE IV. Data from magnetization curves.

H (kOe)	Moment/Sc atom (μ_B) 6.08°K	4.2°K	1.23°K	$(\partial M/\partial H)$ at 1.2°K (10^{-6} emu/g at.)
10	0.048	0.051	0.056	2500
20	0.055	0.057	0.060	1450
30	0.059	0.061	0.063	1250
40	0.063	0.065	0.066	1200

[30] In the absence of specific-heat data for the Sc_3In phase we have estimated this correction (100×10^{-6} emu/g at. from the data available for pure Sc [H. Montgomery and G. P. Pells, Proc. Phys. Soc. (London) **78,** 622 (1961)]. This correction may be contrasted with the somewhat smaller value (60×10^{-6} emu/g at.) which would be necessary to correct for the orbital and diamagnetic susceptibilities in order to compare the data with Eq. (2).