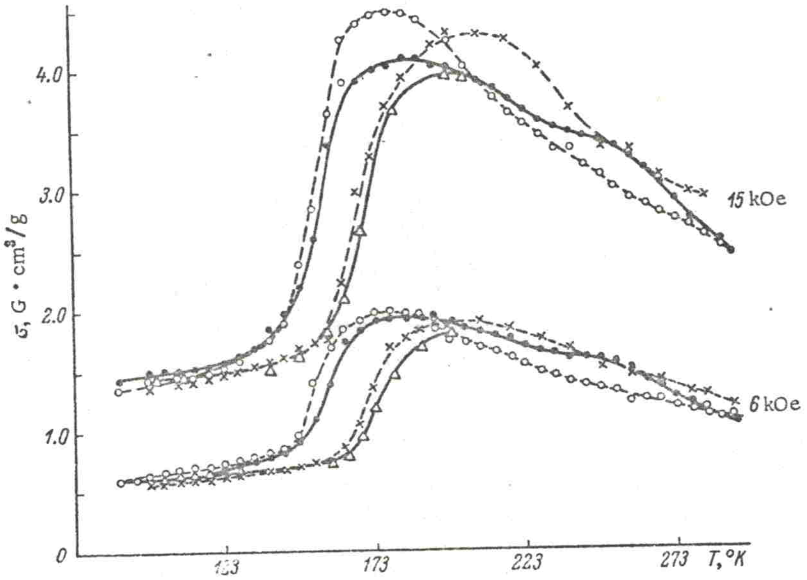

Fig. 5. Temperature dependence of magnetization of Mn_3Ge_2 alloy at atmospheric pressure (solid curves) and at 9700 atm (dashed curves).

TABLE 1. Thermodynamic Data Characterizing the Low-Temperature Transition in Mn_3Ge_2

Θ_1, °K	ΔV, cm^3/g	$\Delta\sigma_s$, $G\cdot cm^3/g$	ΔS, ergs/g·deg	ΔQ, cal/g
158	$-1.55\cdot 10^{-5}$	2.0	$0.8\cdot 10^4$ $5.0\cdot 10^4$	0.030 0.190

$\sigma = \sigma_S + \chi H$; extrapolation of the obtained lines to a zero field made it possible to determined σ_S. These values were then corrected for the Mn_3Ge_2 phase content since, as noted above, our samples were an eutectic of Mn_3Ge_2 and Ge. The change in specific volume ΔV has been found from dilatometric data and the sample density $\rho = 6.44$ g/cm³ measured by hydrostatic weighing.

As seen in Table 1 the change in entropy $\Delta S_1 = 0.8 \cdot 10^4$ ergs/g·deg calculated from magnetic measurements differs considerably from $\Delta S_2 = 5.0 \cdot 10^4$ ergs/g·deg found from the shift of Θ_1 with pressure and from the change in volume at the point of transition. Consequently, the obtained data are suitable only for a qualitative comparison with the Kittel theory, which is based on the exchange-inversion mechanism [8].

This theory states that the change of magnetic transition temperature with pressure depends on Young's modulus and on the thermal expansion coefficient in the paramagnetic temperature intervals:

$$\frac{d\Theta}{dP} = \frac{1}{E\alpha_p}.$$

Our experimental data give Young's modulus of Mn_3Ge_2 as $5.50 \cdot 10^{11}$ dyn/cm² whereas the Kittel equation gives $E = 2.5 \cdot 10^{14}$ dyn/cm²; the sign of $d\Theta_1/dP$ also does not agree with theoretical conclusions. As was already mentioned, the magnetic transition in Mn_3Ge_2 which takes place at the point Θ_1 with rising remperature is accompanied by constriction of the crystal lattice, whereas the theory [10] predicts lattice expansion in the case of an AF → F transition. The change in lattice parameter in the AF → F transition is determined by

$$\Delta a = a_F - a_{AF} = \frac{2\rho}{R} M^2,$$

where ρ is the rate of change of the exchange interaction as a function of interatomic spacing, $R = E/a^2$, and M is the sublattice magnetization. This expression makes it clear that the sign of Δa is governed by the sign of ρ, i.e., by the sign of the derivative of the change of magnetic transition temperature with pressure. It should be mentioned in this connection that the negative sign of the $d\Theta_1/dH$ effect observed experimentally also does not agree with the Kittel expression

$$\frac{d\Theta}{dH} = -\frac{1}{\rho M}\left(\frac{\partial a}{\partial T}\right)_P.$$

The exchange-inversion theory of C. Kittel has been further expanded in [14]. The entropy change