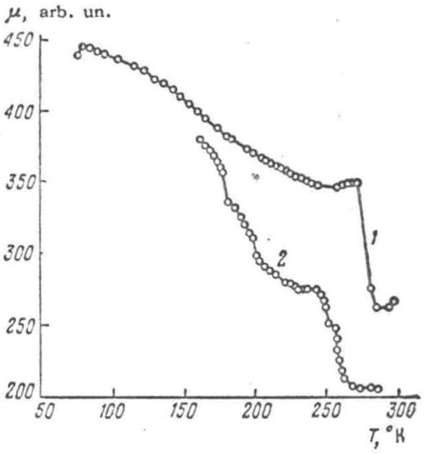

FIG. 2. Dependence of magnetic permeability of gadolinium on temperature at atmospheric pressure (1) and at pressure 15 kbar (2). The curves were taken under increasing temperature.

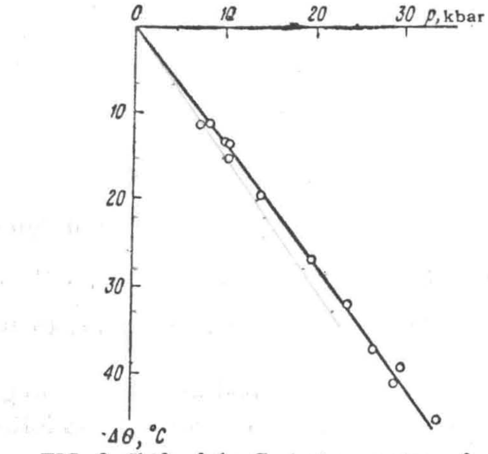

FIG. 3. Shift of the Curie temperature of gadolinium with pressure.

measurements were made at frequency 500 cps, at effective field intensity 5 to 6 Oe.

The pressure at which a ferromagnetic transition occurs, at a given temperature, was determined by the point of intersection of the prolongation of the steep parts of the $\mu(p)$ curves with the straight line to which these curves go over in the paramagnetic region (see the dashed curves in Fig. 1a).[1)] The value of the magnetic transition pressure was taken to be the arithmetic mean of the values obtained for it on increase and on decrease of pressure—as is customary in the method of "piston displacement." Tests of this method of pressure determination, by comparison of values of the polymorphic-transition pressure in cerium [5], teflon [6], and bismuth [7], obtained under purely hydrostatic conditions and under so-called quasihydrostatic pressure, show that in this method of pressure determination, the error allowed in the piston-displacement method usually does not exceed ±150 bar over the whole pressure range.

The value of the Curie point at atmospheric pressure was determined by extrapolation of the curves $\mu = f(T)$ into the paramagnetic region. As is known [8], the magnetization of polycrystalline gadolinium in weak fields (up to 10 to 15 Oe, and especially up to 1 to 2 Oe) has a complicated dependence on temperature: it increases in the temperature interval 100 to 200°K, passes through a maximum (the position and form of which depend on the field intensity), decreases sharply with temperature in the interval 210 to 250°K, and drops a second time upon transition to the paramagnetic state.

The temperature dependence of the permeability, on the whole, repeats the temperature behavior of the magnetization described above. Under these conditions the drop of permeability with temperature ceases at a temperature about 30° below Θ. Control experiments, conducted at a pressure of about 15 kbar, showed that the size of this temperature interval and the general character of the $\mu(T)$ dependence are retained also under pressure (Fig. 2).

As the result of twelve independent determinations of the pressure at transition into the paramagnetic state, there was obtained a p-T diagram of the magnetic transition in gadolinium up to pressures of 35 kbar and down to temperature −36°C (Fig. 3). The shift of the Curie temperature with pressure is expressed satisfactorily by Eq. (1); the value of a according to our data, defined as $\Sigma\Delta\Theta/\Sigma p$ ([9], formula (11.35)), is 1.34 ± 0.06 deg kbar^{-1}. The mean deviation of the experimental points from the straight line (1) amounts in temperature to 0.8° and in pressure to 0.6 kbar.

In connection with our discussion of the results of our measurements, we remark that there was published comparatively recently an investigation by a group of authors [4] who, working with a method in many respects similar to ours, reached the conclusion that the Curie-point line in the p,

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[1)]The magnetic transition pressure obtained in this way refers to the mean temperature between the ascending and descending branches of the $\mu(p)$ curves. It is obvious that the greater the absolute value of dp/dT along the phase-transition line, the greater is the necessity for maintenance of a constant temperature in the experiments. In the case of the p-vs-T line of the Curie point of gadolinium, a departure of 0.2° from isothermal conditions corresponds to a shift of the transition pressure by about 150 bar.