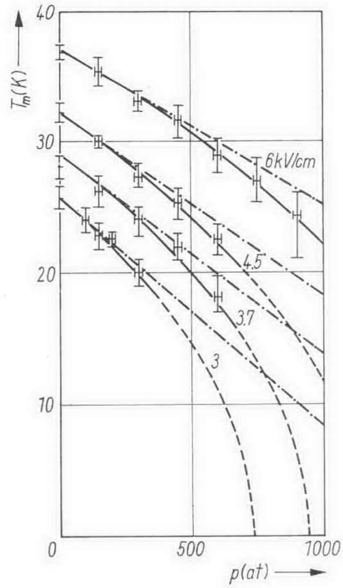

Fig. 3. The temperature T_m of the $\varepsilon(T)$ maximum in dependence on the pressure (1 at = 0.981 bar). The curves correspond to the equations (1) and (4) with the constants according to (2). They are equivalent to the straight lines in the right diagram of Fig. 4. The dash-dotted straight lines correspond to the initial value of the pressure shifting according to equation (5)

by pressure to lower temperatures and their absolute values decrease. The maximum values of the dielectric constant decrease irregularly with pressure, although we carefully operated in changing the pressure and the field. Thus a quantitative relation for the pressure dependence of the maximum values of the dielectric constant cannot be given. The reason for this behaviour may be due to changes of the domain distribution. For shifting the temperature T_m of the dielectric constant maximum by means of an electric field a non-linear dependence has been indicated already in an earlier paper [2]. As can be seen in Fig. 3 non-linearities may be observed also in the pressure shift of the field-induced maxima.

4. Discussion

A suitable representation of the behaviour can be found in the analysis of Pietrass and Hegenbarth [8], starting from a simple thermodynamic potential with quadratic temperature dependence of the coefficient A.

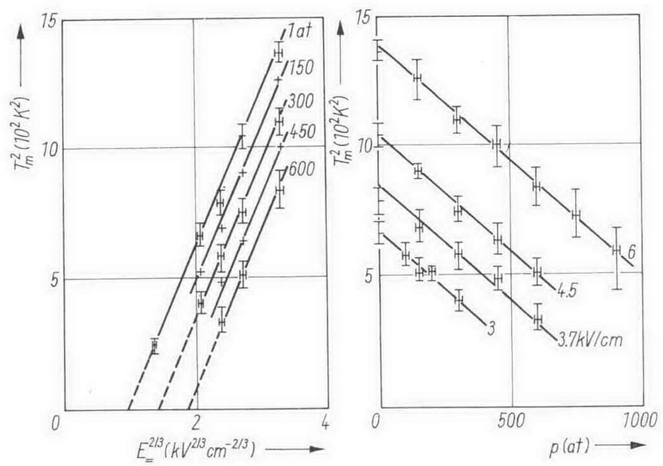

Fig. 4. The temperature T_m of the $\varepsilon(T)$ maxima of $SrTiO_3$ in dependence on the electric field $T_m^2 = f(E^{2/3})$ and in dependence on the pressure $T_m^2 = f(p)$ (1 at = 0.981 bar). The straight lines correspond to equation (1) with the constants according to (2)

For the temperature T_m of the dielectric constant maximum as a function of hydrostatic pressure p and dc field E the relation

$$T_m^2 = \alpha^{-1}(\beta E^{2/3} - A_0 - Kp) \tag{1}$$

was found [8], with $\beta = (3/2)\,(B/2)^{1/3}$. The constants A_0, B, K, and α are the same as in paper [8].

Plotting the T_m values determined from the measurements in the manner as in Fig. 4, equation (1) is confirmed:

In the left diagram of Fig. 4 the isobars $T_m^2 = f(E^{2/3})$ yield parallel straight lines. The shift of the isobars by pressure is linear. The measuring points in the right diagram are generally well represented also by a set of parallel straight lines for $T_m^2 = f(p)$ at $E = \text{const.}$

From Fig. 4 and from other experimental results [10] we obtained

$$\begin{aligned} A_0 &= 4.6_6 \times 10^6\ \text{Vm/As}\,, & K &= 0.075_2\ \text{m}^4/\text{A}^2\text{s}^2, \\ \alpha &= 8.2_4 \times 10^3\ \text{Vm/K}^2\ \text{As} & B &= 0.65_8 \times 10^{10}\ \text{Vm/A}^3\text{s}^3. \end{aligned} \tag{2}$$

These values deviate somewhat from those in [8], but they are likely to be more reliable. They describe the behaviour of T_m at the influence of dc field and pressure quantitatively.

Now we consider the equation (1) and Fig. 4 for the case $T_m \to 0$. A maximum in the $\varepsilon(T)$ dependence only occurs, if an electric field strength

$$E_0 = [(A_0 + Kp)/\beta]^{3/2} \approx \left(0.97 + 1.55\,\frac{p}{\text{kbar}}\right)^{3/2} \frac{\text{kV}}{\text{cm}} \tag{3}$$

is exceeded. The existence of a critical field strength has been already demonstrated earlier [2]. From (3) we get $E_0 \approx 0.94$ kV/cm for $p = 0$. In [5] no maximum was found at $E_0 \approx 0.95$ kV/cm down to temperatures $T = 0.045$ K. It has to be noted that (3) can only be derived with the assumption of the validity of a quadratic temperature dependence in the coefficient A of the thermodynamic potential [8]. Since, however, for $T \to 0$ a term with T^4 dominates [7] in the coefficient A, equation (3) can only represent an approximation. This behaviour could be studied more exactly at weak fields $E = 1$ to 2 kV/cm which induce dielectric constant maxima in the temperature range of liquid helium.

For the pressure dependence of T_m the relations

$$T_m^2 = T_0^2(1 - p/p_0) = T_0^2 - Kp/\alpha = \alpha^{-1}\,(\beta E^{2/3} - A_0)\,(1 - p/p_0) \tag{4}$$

can be given, with $T_0 = (T_m)_{p=0}$ and $T_m \to 0$ for $p \to p_0$ [8]. In the investigated range the quadratic temperature dependence is confirmed well (Fig. 4).

For small pressure we get for the initial value of the pressure shift of T_m

$$\left(\frac{\mathrm{d}T_m}{\mathrm{d}p}\right)_{p=0} = -\frac{K}{2\alpha T_0}. \tag{5}$$

This shift still depends on the field strength through T_0. The initial pressure shift is plotted in Fig. 3 as dash-dotted line. Experimental investigations by Martin [14] show that the dielectric constant maxima do not fulfill the relation (4) at higher pressures and they do not vanish at p_0. This behaviour is caused by influences [14] not being important in the investigated temperature range.