

more slowly with magnetic field than at helium temperatures.

Non-Ohmic behavior of sample 7B was observed at helium temperatures and at pressures up to 4 kbar. This could be seen on I - V plots at various magnetic fields. But more features can be seen on the V - B curves shown in Fig. 10, which is a photograph of the direct recorder traces of the voltage drop (or electric field) along the sample as a function of magnetic field at various constant currents. At currents below 1 mA the resistivity rises smoothly with magnetic field. At higher currents it rises more slowly and in particular shows a slight "knee" or discontinuity in slope. In Fig. 10 the positions of the knees are seen to fall on a straight line on the plot of electric field vs magnetic field. The top portion of Fig. 10 shows a plot of the derivative vs magnetic field of the 2-mA curve. In addition to the "knee" other structure with a complicated current dependence is observed. At 1 mA no corresponding structure (or knee) in the derivative could be detected. At present we do not understand this behavior.

ANALYSIS USING $\bar{k}\cdot\bar{p}$ MODEL

The observed variation of the electron concentration with pressure P results from the pressure dependence of the energy gap E_g . We have fitted the n -vs- P curve for sample 7B at 77 °K (Fig. 5) by assuming a linear pressure dependence:

$$E_g = E_0 + \alpha P,$$

where E_0 is the energy gap at zero pressure, α the pressure coefficient of E_g , and P the applied pressure. A similar method has been used by Schmit²⁸ to calculate the intrinsic concentration in $\text{Hg}_{1-x}\text{Cd}_x\text{Te}$ alloys.

The concentration of ionized acceptors, N'_A , was assumed to be independent of pressure, and equal to $1.5 \times 10^{16} \text{ cm}^{-3}$, the value of p determined from the limiting value of R at high pressure. The position of the Fermi level was adjusted at each pressure until the calculated values of n and p satisfied the condition

$$p - n = N'_A.$$

The electron concentration was obtained by numerical integration of an expression given by Harman and Strauss²⁹ which is based on the Kane model and includes the effects of nonparabolicity and statistical degeneracy. A value of $8.4 \times 10^{-8} \text{ eV cm}$ was used for the Kane matrix element. The valence band was assumed to be parabolic with an effective mass m_v^* and the hole concentration was obtained using the standard density-of-states expression. The calculations were made for masses between $0.3m_0$ and $0.7m_0$, the range of values reported for m_v^* in $\text{Hg}_{1-x}\text{Cd}_x\text{Te}$ and HgTe .⁵⁻¹¹

The values of E_0 and α were adjusted to fit the calculated curve of n vs P to the experimental curve. The curve obtained for the two extreme values of m_v^* are shown in Fig. 5. The pressure coefficient in both cases is $7.0 \times 10^{-3} \text{ eV/kbar}$ and the values for E_0 are +2 and -8 meV for m_v^* of $0.7m_0$ and $0.3m_0$, respectively. These may be compared with values of +11.6 and -15 meV obtained for $x=0.15$ from empirical expressions for $E_g(x, T)$ given by Wiley and Dexter⁸ and Scott,³⁰ respectively. The behavior of the electron mobility shown in Fig. 6 is consistent with $E_g=0$ near $P=0$. The failure to fit the experimental n -vs- P data well at low pressures may be due to an incorrect choice of m_v^* or to the invalidity of the assumption that N'_A is constant. The latter will be strictly true only if the acceptor ionization energy is small relative to kT , and the analysis below indicates that the acceptor energy in this sample is comparable with kT at 77 °K. At higher pressure where $N'_A \gg n$, the slope in Fig. 5 is sensitive to the pressure coefficient, and relatively insensitive to the other parameters. The fitting at 77 °K should therefore yield a reliable value for α .

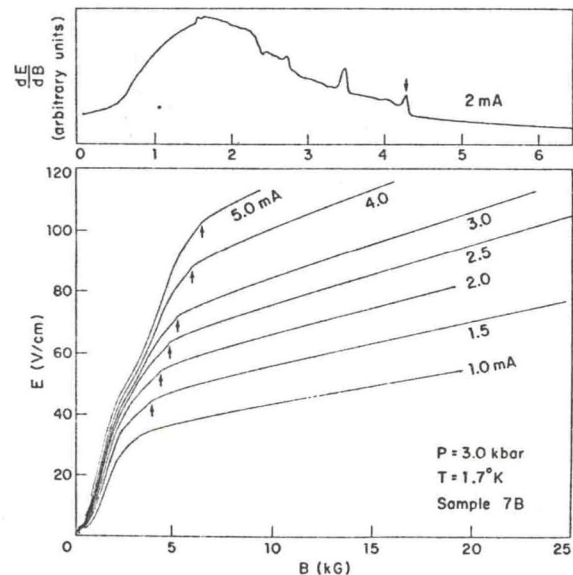


FIG. 10. Photograph of the direct recorder traces of the voltage drop (or electric field) along sample 7B as a function of magnetic field for several currents. (The sample cross-sectional area is $2.5 \times 10^{-3} \text{ cm}^2$.) The sample is non-Ohmic, since for $B > 5 \text{ kG}$, E is not proportional to the current. In addition, structure is observed in the region $1.5 < B < 6 \text{ kG}$ for sample currents greater than 1 mA. This structure is shown on an expanded scale by the derivative curve in the upper part of the figure. "Knees" appear in the curves at fields (4.25 kG on the 2-mA curve) which mark a disappearance of the structure. These "knees" marked by arrows are seen to fall on a straight line on the E -vs- B plot.