plained by a somewhat noncircular cross section. The appearance of the intermediate state at the higher temperatures could be due to a decrease of Δ. Such a temperature dependence would, however, be contrary to the usual interpretations of other experiments.[7] Further investigations are in progress.

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Anomalous Longitudinal Magnetoresistance of Metal Single Crystals

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MEASUREMENTS of the longitudinal magnetoresistance of pure (99.92 percent) antimony single crystal plates have been made in fields up to 60 kilogauss at several temperatures ranging from 1.5°K to 300°K. The results for a representative rectangular crystal plate (10 mm long, 2.5 mm wide, and 0.69 mm thick) are shown in Fig. 1 where the change in resistance (ΔR) divided by the zero field resistance (R_0) at the particular temperature is plotted as a function of magnetic field strength (H). The trigonal axis of the crystal was perpendicular to the wide face of the plate while a binary axis was parallel to the width. The measuring current and H were both parallel to the length of the plate. Current and potential leads were attached to the crystal with low melting point solder. Potential measurements were made to 10^{-7} volt by means of a five-dial potentiometer. The anomalous behavior is most clearly seen in the low-temperature field sweeps (1.52°K and 4.21°K). At these temperatures the value of $\Delta R/R_0$ not only exhibits a maximum, but also passes through zero and becomes negative. At the strongest field (60 kilogauss) the resistance was 56 percent less than the zero field resistance. The maximum in $\Delta R/R_0$ was still clearly observable in the 52°K run, but at 78°K the curve seems to be approaching either a maximum or saturation at 60 kilogauss. Room temperature data (300°K) show no unusual behavior.

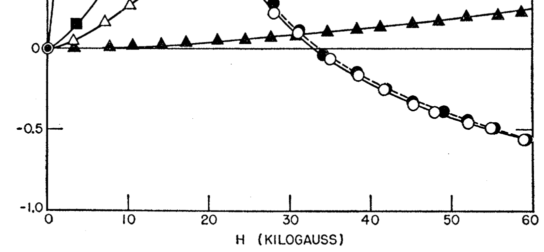

FIG. 1. Change of resistance for an antimony single crystal in a longitudinal magnetic field.

The changing shape of the curves as the temperature increases suggests that there are at least two conduction mechanisms responsible for the totality of data. At high temperatures (300°K) the curve exhibits the parabolic field dependence that might be expected for an anisotropic conductor.[1] At low temperatures it would seem that there is a second mechanism which decreases the resistance as H increases. Such a mechanism may be similar to that proposed by MacDonald[2] to explain the results of his experiments with fine sodium wires (diameter less than mean free path). His explanation is based on the decrease in scattering from the surface when the classical orbit radius of the electron, due to the applied magnetic field, becomes comparable to the specimen size. Since the thickness of the plate in the present experiment is at least ten times the diameter of the wires used by MacDonald, it seems likely that the magnitude of the bulk electronic mean free path relative to both the specimen thickness and the classical orbit radius will enter into the description of the phenomena. The fact that the maximum is still observable at 52°K suggests that there might be a dimension less than the thickness but greater than atomic dimensions, which is a measure of some internal cleavage plane spacing. Further experiments are underway to resolve this question and the dependence upon crystal orientation.

A phenomenological explanation of the high-temperature data (bulk effect only) based upon the electronic ellipsoid scheme for antimony derived from magnetic susceptibility[3] data is being attempted and will be reported at a later date.

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