

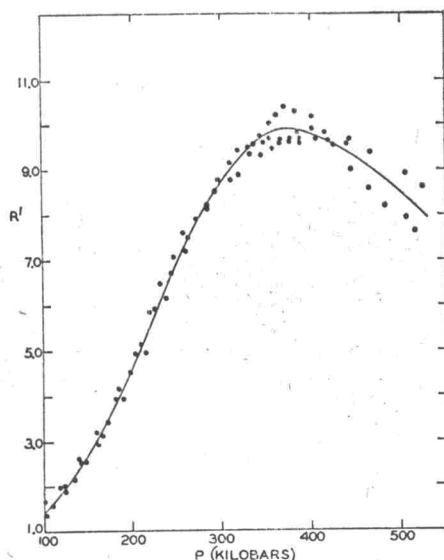


FIG. 9. Relative resistance versus pressure—calcium.

times that at 100 kb. Above the transition a maximum in the resistance occurs at 425 kb. Both maximum and transition are reversible as shown in Fig. 11. The metastability is illustrated by the sharp rise with decreasing pressure and the displacement of the maximum to lower pressures. Calcium showed qualitatively similar behavior.

Bundy⁶ observed a transition in rubidium at 107 kb (75–80 kb on our scale), accompanied by an increase of 8–10% in resistance. Because of the rapid rise in resistance and our difficulties with pressure in this range it is impossible to say whether it occurs in our samples.

A phenomenon of interest occurs immediately above the maximum in both calcium and rubidium. As an increment of pressure is applied the pressure rises slightly and then

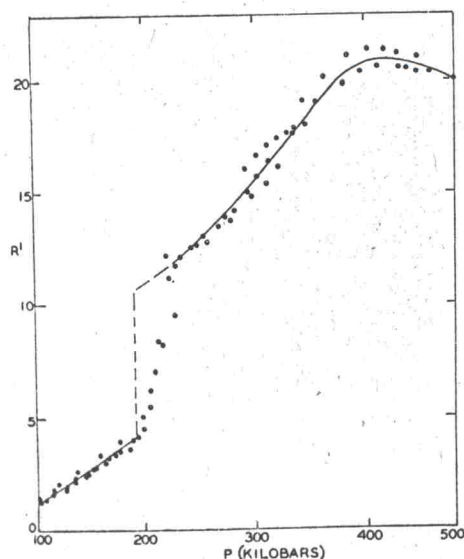


FIG. 10. Relative resistance versus pressure—rubidium.

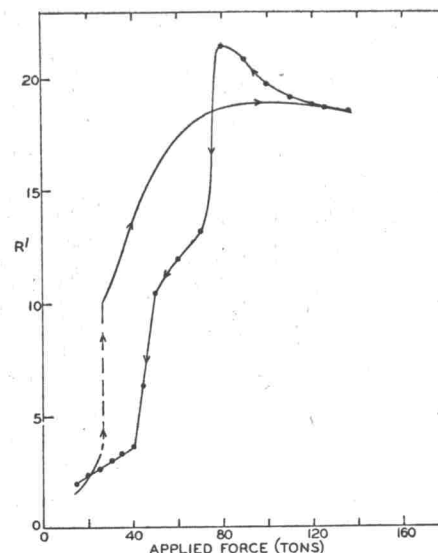


FIG. 11. Relative resistance versus pressure (increasing and decreasing pressure)—rubidium.

drops to a steady value. As one gets well beyond the maximum this phenomenon disappears.

The results obtained at higher pressure for barium, calcium, and rubidium help explain their anomalous low pressure behavior and aid in predicting the possible behavior of other metals. Sternheimer¹² explains the transition in cesium as a discontinuous increase in the d character of the valence electron. Lawson¹³ explains the large increase in resistance near the transition as due to scatter of conduction electrons into vacant d states whose density at the Fermi surface increases with pressure. Lawson also indicates that the anomalies in cerium and ytterbium are due to an increase (either discontinuous or gradual) of the d character of the $4f$ electrons. Manning and Krutter¹⁴ show that the d band of calcium overlaps the first Brillouin zone at 1 atm; the overlap increases with decreasing interatomic distance.

It appears that all metals which have a vacant d band at energies slightly above the filled levels of conduction band at 1 atm may exhibit qualitatively similar behavior. It is proposed that the transition in rubidium and the 144-kb transition in barium are electronic in nature, qualitatively similar to the transition in cesium. The maxima in calcium and rubidium have some of the characteristics of gradual transitions as noted earlier.

In general, the behavior of this class of metals may be due to the fact that in the lower pressure region the increase in vacant d states at the Fermi surface is controlling. At sufficiently high pressures the stiffening of the lattice determines the change of resistance. It is not certain whether the latter extreme has been reached in any metals studied.

¹² R. Sternheimer, *Phys. Rev.* **78**, 235 (1950).

¹³ A. W. Lawson, *Progr. in Metal Phys.* **6**, 1 (1956).

¹⁴ M. F. Manning and H. M. Krutter, *Phys. Rev.* **51**, 761 (1937).