

energy of the electrons, and we may interpret this result as meaning that as the electron energy is increased the electrons are less scattered by the lattice waves. This conforms with the classical idea that a body with greater kinetic energy is scattered less by a given obstacle than one with lower energy.

We have here assumed that on compression of the lattice the Fermi-surface distortion remains unchanged. While this may be true of sodium for small volume changes, theoretical calculations show that this is not generally true (18). In general, in all the monovalent metals, increasing the pressure on the metal increases the distortion of the Fermi surface; if the surface is already touching the zone boundary, pressure will increase the area of contact. Such an increase in the distortion of the Fermi surface under pressure, with the consequent enhancement of Umklapp processes, tends to increase the resistivity. This was originally proposed as an explanation of the anomalous positive pressure coefficient of resistance in lithium (17), and it seems probable that the same basic mechanism occurs in all the monovalent metals.

There are thus two opposing tendencies when a metal is compressed—on the one hand an increasing distortion of the Fermi surface, which increases the interaction constant K , and on the other hand an increase in the Fermi energy, which, as suggested above, tends to decrease K . The trend of the values for $d \ln K / d \ln V$ leads us to suppose that the more distorted the Fermi surface is, the more prominent the first effect becomes. This is perhaps plausible, but without a careful theoretical analysis it is not possible to say more. Unfortunately such an analysis has not yet been made. Nonetheless, quite empirically, it does seem that in the monovalent metals, negative values of $d \ln K / d \ln V$ are associated with a Fermi surface already in contact with the zone boundary, and the large positive values, with a nearly spherical Fermi surface. We might therefore guess that if this parameter is about zero this indicates that the Fermi surface is just about to touch the zone boundary.

Bridgman (22) has measured the pressure dependence of the electrical resistance of the alkali metals at room

temperature up to very high pressures. It is interesting to consider these curves in terms of the distortion of the Fermi surface which we have just been discussing. Bridgman's results are shown in Fig. 13, in which relative resistance is shown as a function of the relative volume. As I have already emphasized, an important part of the change in ideal resistivity with volume arises from the change produced in θ . It is possible, from a knowledge of the compressibility of the lattice as a function of volume, to estimate how θ changes with volume. Using this information and that in Fig. 13, I have estimated how the interaction constant K changes with volume over the full range of pressures; these results are shown in Fig. 14. Lithium is remarkable in that, for it, K always increases under compression; this has already been discussed. The curve for cesium shows a pronounced minimum when its volume has been reduced by about 5 percent. We can now interpret this to mean that at this volume (approximately), contact of the Fermi surface with the Brillouin zone boundary occurs. The behavior of rubidium is rather similar, although for it the

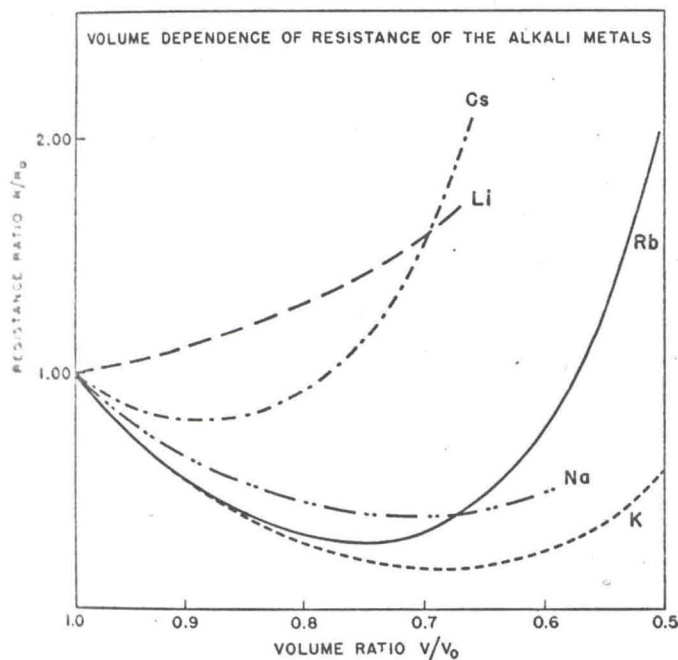


Fig. 13 (above). The change in electrical resistance with volume of the alkali metals at 0°C. [From Bridgman (22)] Fig. 14 (right). The change in interaction constant K with volume for the alkali metals. [Derived from Fig. 13]

