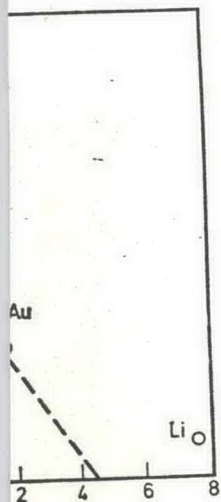


LOW TEMPERATURES

no counterpart in  $\xi$ ) we are in comparison between this quantity and  $\xi$  is approximately proportional to each other. This figure shows not only the



coefficient of  $K$  and thermoelectric power (see Mundy, 1961.)

metals under normal pressure, but, for a bcc metal. The approximate relationship is as follows. Assume  $K$  is a function only of the Fermi energy  $E_F$ , the lattice,  $\theta$ , and the temperature  $T$ ; likewise the resistivity  $\rho = 1/\sigma$

$$\left( \frac{\partial \ln \sigma}{\partial \ln E_F} \right)_{\theta, T} \frac{d \ln E_F}{d \ln V} + \frac{d \ln \theta}{d \ln V} \quad (45)$$

on the basis of the following simpli-

$$\frac{d \ln \theta}{d \ln V} = -\gamma \quad (\text{the Gr\u00fcneisen parameter})$$

$$\frac{\partial \ln \sigma}{\partial \ln \theta} = 2 \quad \text{at high temperatures (see equation 39 above)}$$

$$\frac{d \ln E_F}{d \ln V} = -\frac{2}{3} \quad \text{on the basis of the free-electron model or the effective mass approximation.}$$

Also:

$$\left( \frac{\partial \ln \sigma}{\partial \ln E_F} \right)_{\theta} = \xi \quad \text{as defined in equation (45)}$$

$$\therefore \left( \frac{\partial \ln \rho}{\partial \ln V} \right) - 2\gamma = \frac{2}{3} \xi$$

The left-hand side of this equation is just what we earlier denoted by  $\partial \ln K / \partial \ln V$  so that the relationship between this quantity and  $\xi$  is established. The coefficient of proportionality on this simple treatment is just  $\frac{2}{3}$ , and this corresponds to the dashed line shown in Fig. 22.

The basis of this derivation is that  $\sigma$  depends on  $V$  only through  $E_F$  and  $\theta$ , and that  $\theta$  has no direct dependence on  $E_F$ . (It is a simple matter to generalize equation 45 for the situations where  $\theta$  has an explicit  $E_F$  dependence.)

The experimental information thus suggests that these assumptions are approximately correct, i.e., the dependence of  $K$  on volume appears to arise largely from the change in  $E_F$  with  $V$ . This is an important fact which we will refer to again below.

2. The Behaviour of  $K$  at very high Pressures

So far we have considered only the initial slope of the resistivity-volume curves. On the other hand, considerable information is available about the pressure dependence of resistivity at room temperature up to quite high pressures. The experimental work of Bridgman (1949, 1952), for example, extends up to pressures of about 100,000 b at room temperature. Measurements to still higher pressures have been made by Stager and Drickamer (1963) not only at room temperature but also at low temperatures (see also Bundy, 1959; Balchou and Drickamer, 1961; Bundy and Strong 1962).