creased pressure.† Consequently we may expect a decrease of ϱ_{ph} with pressure due to the change in θ to be very much bigger at low temperatures than at high (cf. Fig. 20, which illustrates this in the alkali metals).
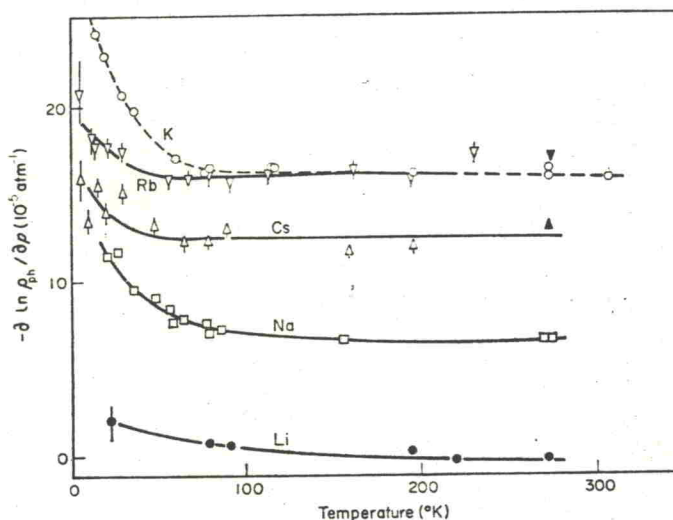

FIG. 20. Pressure coefficient of electrical resistivity in the alkali metals as a function of temperature. (From Dugdale and Phillips, 1965.)

More generally we may write:

$$\varrho_{ph} = \frac{K}{T} f(T/\theta) \tag{40}$$

where K has the same meaning as before and $f(T/\theta)$ is some universal function that varies as T^2/θ^2 at high temperatures and as T^6/θ^6 at low temperatures. Such a relationship is approximately true for several different metals and if we suppose that it is true for one metal under different pressures (with K and θ dependent on pressure) then we can relate the volume dependence of ϱ_{ph} to its temperature dependence as follows (Dugdale, 1961; Dugdale and Gugan, 1962):

$$\frac{\partial \ln \varrho_{ph}}{\partial \ln V} = \frac{\partial \ln K}{\partial \ln V} + \frac{\partial \ln \theta}{\partial \ln V} \left(1 + \frac{\partial \ln \varrho_{ph}}{\partial \ln T} \right) \tag{41}$$

† This may be seen crudely as follows. θ characterizes the vibrational frequencies ω of the lattice, and ω^2 in turn is proportional to the force constants, i.e., to the second derivatives of the atomic potential with respect to distance. The effect of pressure is to squeeze the potential well and hence to increase its curvature, i.e., essentially the force constants.