$$\left(\frac{\partial \ln \rho}{\partial \ln V}\right)_T = 2\,\gamma(V) + \frac{d\ln A}{d\ln V}\,.$$

Now $\left(\frac{d\ln A}{d\ln V}\right)_{V=V_o}$ can be evaluated at atmospheric pressure from experimental values for $\left(\frac{\partial \ln \rho}{\partial \ln V}\right)_{T,V=V_o}$ and $\gamma(V_o)$. Then

$$\frac{\rho(V,T)}{\rho(V_o,T)} = \frac{\alpha(V)}{\alpha(V_o)} = \left(\frac{V}{V_o}\right)^B \exp\left[2\int_{V_o}^{V} \frac{\gamma(V')}{V'}\,dV'\right]$$

$$= \left(\frac{V}{V_o}\right)^B \left(\frac{\theta(V)}{\theta(V_o)}\right)^{-2} \qquad (3)$$

where $B \equiv \left(\frac{d\ln A}{d\ln V}\right)_{V=V_o}$. In this work it has been assumed that $\frac{d\ln A}{d\ln V}$ is a constant.

Dugdale (1961) used Bridgman's pressure derivatives for the resistance and found $B = -0.9$ for silver. Goree and Scott (1966) also measured isothermal pressure derivatives of the resistivity of silver. They subtracted the pressure derivative of impurity resistivity to get the perfect lattice pressure derivative

$$\left(\frac{\partial \ln \rho_L}{\partial P}\right)_{T,P=1\ \mathrm{atm}} = -4.2 \times 10^{-6}/\mathrm{bar}$$

(see Sec. III.A.3). Using Goree and Scott's derivative, a value of $B = -0.64$ was found; this value of $B$ was used for generating $\rho$ on a hydrostat. (In finding $\gamma(V_o) = 2.43$, ambient values of $\beta_T = 1.005 \times 10^6$ bar, $\alpha' = 57.1 \times 10^{-6}/°K$, and $C_V = 2.25$ bar cm$^3$/g were used.) Note that $\left(\frac{V}{V_o}\right)^B$ where $B < 0$ tends to increase the resistivity while $(\theta/\theta_o)^{-2}$ decreases the resistivity on compression.

For comparison, let us examine some of the electron scattering effects which are lumped in A(V). First consider how changing the Fermi energy influences the resistivity. (For free electrons

$$E_F = \frac{\hbar^2 k_F^2}{2m} \propto V^{-2/3}$$

where $m$ is electron mass and $k_F$ is electron wave number at the Fermi energy.) For nearly free electrons, Mott and Jones (1936) find the resistivity

$$\rho = \frac{3\pi^2\hbar^2}{e^2} \frac{1}{(\tau^2 k^2 \frac{dE}{dk})_{k=k_F}} .$$

($\tau$ is electron relaxation time, $e$ is electron charge.) Then $\rho \propto k_F^{-b} \propto V^{b/3}$ giving a logarithmic derivative of $\frac{b}{3}$, a constant. If $b > 0$, this will decrease the resistivity on compression, opposite to the behavior of A(V); $b = 3$ for free electrons.

We have accounted for the lattice vibration spectrum with a Debye model. This assumes isotropy of the vibrations. Anisotropy and changes in anisotropy of the elastic constants with pressure might be expected to affect resistivity. However, Dugdale (1965) notes that large volume dependence of the anisotropy of elastic constants in gold does not appear to have a major effect on pressure dependence of its resistivity.

We would also like to get some idea of changes in resistivity with pressure due to changes in the electron Fermi surface in reciprocal lattice space. For free electrons in an isotropic metal a simple formula for conductivity is