for the silver purities used. For their more pure silver

$$\frac{R_{4.2°K}}{R_{293°K}} = 0.00714 \text{ and } \frac{1}{\rho_{4.2°}} \frac{d\,\rho_{4.2°}}{dP} = 2.4 \times 10^{-6}/\text{bar}.$$

For MRC silver we find $\frac{d\ln \rho_i}{d\ln V} = -1.4$ using $\frac{R_{4.2°}}{R_{298°}} =$ 0.00412; for W3N silver we find $\frac{d\ln \rho_i}{d\ln V} = -0.8$ using $\frac{R_{4.2°}}{R_{298°}} = 0.00240$. Let us assume that the logarithmic volume derivative of the impurity resistance is a constant C so that

$$\frac{\rho_i(V)}{\rho_i(V_o)} = \left(\frac{V}{V_o}\right)^C .$$

Also assume the approximate validity of Matthiessen's rule $\rho = \rho_L + \rho_i$ where ρ_L is the perfect lattice resistivity. Then

$$\frac{\rho(V,T)}{\rho(V_o,T)} = \frac{\rho_L(V,T)}{\rho_L(V_o,T)} \left[1 + \frac{\rho_i(V_o)}{\rho_L(V_o,T)} \frac{\left(\frac{V}{V_o}\right)^C}{\rho_L(V,T)/\rho_L(V_o,T)}\right] \Big/ \left(1 + \frac{\rho_i(V_o)}{\rho_L(V_o,T)}\right) .$$

Computation can proceed by assuming

$$\frac{\rho_i(V_o)}{\rho_{L}(V_o,T)} = \frac{R_{4.2°}}{R_{298°}} .$$

Results at 120 kbar, for the foils used, are within 0.3% of those obtained by ignoring impurity resistivity volume dependence. Hence, this impurity effect was ignored in data analysis of the present work.

4. Final Resistivity Analysis

Up to now we have assumed $\rho = \alpha T$ for the electrical resistivity. Experimentally metals do not exactly have resistivity proportional to absolute temperature; rather, the constant pressure resistivity is given by $\rho = \alpha T + \beta$. So, to adjust theory to reality, assume $\rho = \alpha(V)T + \beta(V)$ where $\alpha(V) = A(V)/\theta^2(V)$ as before and $\beta(V)$ is an empirical parameter. From data of Kos (1973) for silver $\alpha(V_o) = 0.005988$ μΩcm/°K and $\beta(V_o) = -0.16$ μΩcm for the 150-300°K range. At room temperature $\beta/\alpha T = -0.09$.

We now need to express the volume dependence of resistivity for the above case; ignore impurity resistivity for the time being, and assume $\alpha(V) = A(V)/\theta^2(V)$ as derived in the previous analysis (Eq. (2)). Some estimate of the volume dependence of β is needed.

For estimating the volume dependence of β, the Gruneisen-Borelius relation for resistance,

$$\frac{R_T}{R_\theta} = h\,\frac{T}{\theta} - (h-1) \quad (h = 1.17)$$

will be used (Gerritsen, 1956). This is an empirical relation for isotropic metals accurate in the range $0.2 < T/\theta < 1.2$. (For silver it is accurate at least to $T/\theta = 1.5$.) If we ignore thermal expansion $\frac{\rho_T}{\rho_\theta} = \frac{R_T}{R_\theta}$, and $\rho_T = h\,\frac{T}{\theta}\,\rho_\theta - (h-1)\rho_\theta$ $(h = 1.17)$ in the form $\rho = \alpha T + \beta$. For silver $\rho_\theta = 1.18$ μΩcm implies $\beta = -0.17\ \rho_\theta = -0.20$ which is close to the exact value of -0.16 for silver from Kos' work. Actually silver resistivity is described better using $h = 1.14$.