that d ln ϱ_0/d ln V is positive, concentration dependent and attains a maximum value of 1.38 for the $c = 0.5$ alloy. It should be noted that there may be a slight error in d ln ϱ_0/d ln V for the concentrated alloys because the compressibility of these alloys was obtained by a linear extrapolation between the values for pure Ag and Au. Bridgman [5, 6] has observed a slight deviation from linearity in the concentration dependence of the compressibility of these alloys at $T =$ $= 300$ °K. If this deviation persists to low temperatures, then d ln ϱ_0/d ln V would be slightly enhanced for the $c = 0.25$ and 0.5 alloys.

4. Discussion

According to Matthiessen's rule for binary alloys the lattice resistivity and the residual resistivity are additive. This implies that the scattering of conduction electrons by phonons and impurities are independent and a single relaxation time can describe each type of scattering process. However, deviations from Matthiessen's rule can occur for a number of reasons [8, 9]. Some of the more important effects are listed as follows: 1. the phonon spectrum can change upon alloying, 2. the Fermi surface or electronic structure changes upon alloying, and 3. the relaxation times for different scattering mechanisms can have different anisotropies. The deviation from Matthiessen's rule, Δ, is defined as follows

$$\varrho = \varrho_1 + \varrho_0 + \Delta\,, \tag{2}$$

where ϱ is the resistivity of the alloy measured at T, ϱ_1 is the lattice resistivity of the host metal measured at T, and ϱ_0 is the residual resistivity of the alloy. The pressure derivative of the resistivity for an alloy will then have three terms [1]

$$\frac{1}{\varrho}\frac{\mathrm{d}\varrho}{\mathrm{d}P} = \frac{\varrho_1}{\varrho}\left(\frac{1}{\varrho_1}\frac{\mathrm{d}\varrho_1}{\mathrm{d}P}\right) + \frac{\varrho_0}{\varrho}\left(\frac{1}{\varrho_0}\frac{\mathrm{d}\varrho_0}{\mathrm{d}P}\right) + \frac{\Delta}{\varrho}\left(\frac{1}{\Delta}\frac{\mathrm{d}\Delta}{\mathrm{d}P}\right). \tag{3}$$

In the case of the concentrated $Ag_{1-c}Au_c$ alloys studied here it is expected that deviations from Matthiessen's rule could occur for all of the above reasons. In the noble metals there are two groups of conduction electrons, the neck electrons and the belly electrons. Dugdale and Basinski [8] have shown the difference in anisotropics of the relaxation times between the neck and belly electrons to be the primary cause for deviations from Matthiessen's rule in dilute Ag–Au alloys. (Hereinafter, the underline notation, X–Y, will imply a dilute alloy with X as the solvent.)

From (3) it can be seen that the pressure derivative of the residual resistivity can be obtained by measuring the pressure derivative of the resistivity at low temperatures. The lattice term goes to zero as T approaches zero, since ϱ_1/ϱ goes to zero and $\varrho_1^{-1}\,\mathrm{d}\varrho_1/\mathrm{d}P$ remains finite [2]. On the basis of Dugdale and Basinski's model it can be shown that $\Delta^{-1}\,\mathrm{d}\Delta/\mathrm{d}P$ remains finite and Δ/ϱ goes to zero as T goes to zero. In the $Ag_{1-c}Au_c$ alloys the resistivity is independent of temperature up to 10 °K, and there should be little error in equating $\varrho_0^{-1}\,\mathrm{d}\varrho_0/\mathrm{d}P$ to the measured pressure derivative of the resistivity at 4 °K.

4.1 Residual resistivity

Lennsen and Michels [10] have shown by using Nordheim's [11] form for chemical impurity scattering that the volume derivative of the residual resistivity is $-1/3$. This result is based on the free electron approximation and that