

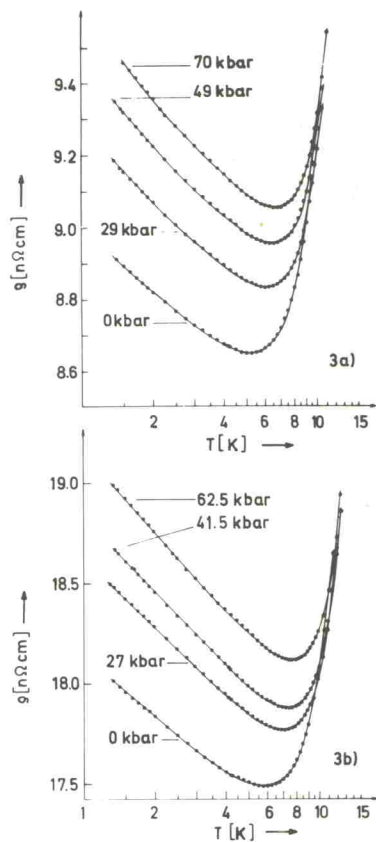


FIG. 3. Measured resistivity vs temperature. Left is spin-scattering resistivity, right is phonon resistivity. The solid lines connecting dots are to distinguish data at different pressures. (a) Au-(17 p.p.m. Mn), (b) Au-(50 p.p.m. Mn).

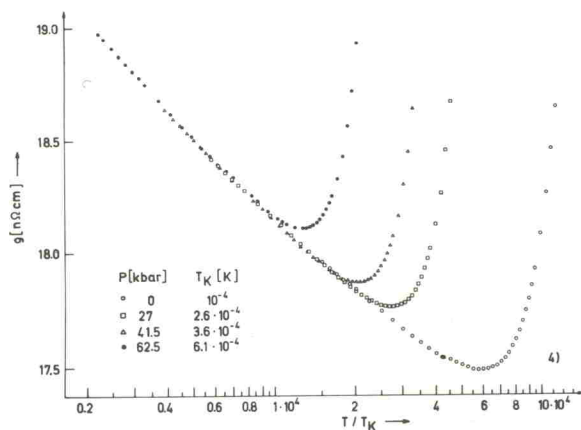


FIG. 4. Resistivity of Au-(50 p.p.m. Mn) vs reduced temperature T/T_K for several pressures.

that $|J_{\text{eff}}|$ and, therefore, T_K also increase by an amount of $\delta \approx +1.1\%/kbar$ in good agreement with the value determined above. The observed increase in slope with pressure in these measurements was found to be reversible in pressure and is thus not a spurious effect but clearly due to an increase in T_K .

The results of measurements on two Au(Mn) alloys are shown in Fig. 3. Although these results are qualitatively similar to those on Au(Fe), due to the very small value of the slope $|d\rho_{\text{spin}}/d \log T|$ for Au(Mn), the resistivity is only for $T \leq 3$ K completely free of phonon scattering, and also the scatter in the data becomes relatively more important. For these reasons, it is not possible to determine δ accurately by using the overlap method (Fig. 2). From the observed increase in slope with pressure, however, one obtains $\delta \approx +6\%/kbar$. Using this value of δ , the resistivity curves for Au-(50 p.p.m. Mn) are plotted in Fig. 4 vs T/T_K , and they are seen to overlap satisfactorily.

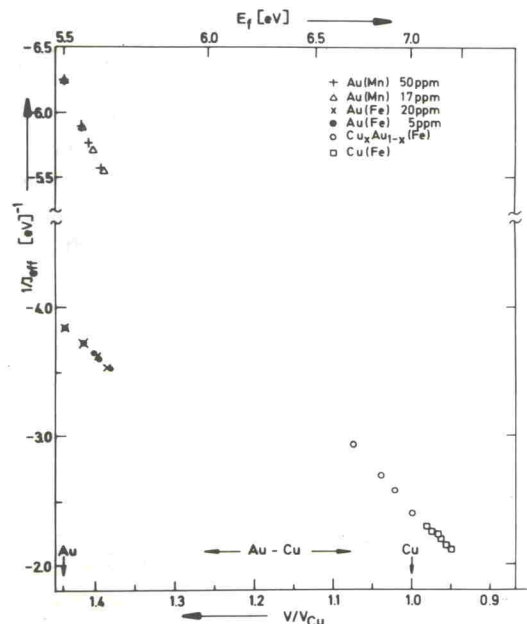


FIG. 5. Volume dependence of the inverse effective exchange constant $1/J_{\text{eff}}$ relative to the atomic volume of Cu at $p = 0$. Au(Fe) and Au(Mn) our data, open circles from Cu-Au(Fe) alloy data by Loram *et al.*⁵ squares from our Cu(Fe) high pressure data.² Values of the Fermi energy E_f are those of a free electron gas.

Since $T_{\min}$ occurs at the temperature where the slope of the spin-scattering and phonon resistivity are equal in magnitude, $T_{\min}$ increases with pressure due to both the observed increase in the slope of ρ_{spin} and the decrease in ρ_{phonon} with increasing pressure. The reduction in ρ_{phonon} is due to an increase in the Debye temperature of the host alloy with pressure.^{2,9} An estimate of the $T_{\min}$ shift is in good agreement with the observed shift $(\Delta T_{\min}/T_{\min})/\Delta p \approx +0.2\%/kbar$. The $p = 0$ data shown was carried out on an annealed sample outside the pressure cell. Relative to this data the high pressure data shows a significant shift in $T_{\min}$ to higher temperatures which is probably due to the stiffening of the lattice and raising of the Debye temperature from cold working the sample in the pressure cell.¹⁰ The increase of $\Delta\rho(T) = \rho(1.5\text{ K}) - \rho(T_{\min})$ with pressure is due essentially to the shift of ρ_{spin} to higher temperatures.

From the pressure dependence of T_K , one can extract the volume dependence of the effective exchange constant J_{eff} , as shown in Fig. 5. (The change of $n(E_F)$ with volume is small for the noble metals).² Also shown are the results of our pressure measurements on Cu(Fe) and the alloy data of Loram *et al.*⁵ on $\text{Cu}_{1-x}\text{Au}_x(\text{Fe})$. Using the Schrieffer-Wolf transformation,¹¹ one finds $\Delta(1/J_{\text{eff}})/\Delta V \approx \text{constant} \approx (S/|V_{kd}|^2)\Delta E_d/\Delta V$ where S and V_{kd} are assumed pressure independent and E_d is the energy separation of the virtual bound state from the Fermi surface,

V_{kd} being the covalent admixture matrix element. The increase of T_K with pressure found in our measurements could thus be explained in terms of a reduction of E_d with volume. However, an increase of $|V_{kd}|$ with pressure would also account for the observed T_K increase. That the results in Fig. 5 for Au(Fe) and Cu(Fe) do not lie along the same line could be due to inaccuracies in the value of T_K used for $p = 0$, or effects of local environment.

At the present time, work is being carried out on further Kondo alloys [Au(V), Au(Cr), Cu(Cr), Cu(Mn), Ag(Mn)] in an effort to ascertain to what extent the above results are of general validity. Preliminary measurements on several of these alloys indicate that also here T_K increases with pressure. Although the precise mechanism for the observed T_K increase is not known at this time, it is probable that the same mechanism is at work in all of the above systems.

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