from $x_1 \cong -10.4$ to $x = -1$; z is positive from $x = -1$ to $x_2 \cong -0.1$, and the Kondo effect has in principle disappeared in this region.

If we compare the dependence of $dR_m/d \ln k_B T$ on pressure given theoretically by expression (16) with experiment (Figure 4), we see that quantitative agreement is relatively poor. Qualitatively, we observe a maximum in $|dR_m/d \ln T|$ for $La_{0.98}Ce_{0.02}$ at roughly 13 kbar, a little lower in pressure than the maximum of ΔT_c for the same alloy. The occurrence of a maximum in $|dR_m/d \ln T|$ is a very good qualitative check of formulas (8) and (16), although the maximum does not appear at precisely the right position, i.e., the maximum in $|dR_m/d \ln T|$ occurs at $\varepsilon = -1.5\Delta$, whereas the maximum of $-(dT_c/dc)_{c=0}$ occurs at $\varepsilon = -\Delta$. Moreover, $|dR_m|d \ln T|$ is not zero when $-(dT_c/dc)_{c=0}$ is a maximum as predicted by the theory, but it is suggestive that, at the 18 kbar limit of present experiments, $|dR_m/d \ln T|$ begins to decrease more rapidly than ΔT_c. Further experiments at higher pressure on $R_m(T)$ would be interesting to clarify this point in relation to the theoretical curves of Figure 6. The curves of resistivity versus temperature in the $Y_{0.99}Ce_{0.01}$ alloy (Figure 5) are obviously in qualitative agreement with the theoretical results; the Kondo effect disappears at high pressure when the 4f level goes above E_F. The nonmagnetic nature of Ce impurities in **Y**Ce alloys at high pressures is also consistent with the rather small depression of T_c ($\sim 0.5°K$/at. % Ce) above 100 kbar.[12]

The total temperature dependent contribution to the resistivity is given by

$$R = \beta T^n + R_m \tag{20}$$

so that the temperature of the resistivity minimum is

$$T_{\min} = \left(\frac{\alpha c}{\eta \beta k_B} \Gamma_1^3\right)^{1/n}_{z^{1/n}} \tag{21}$$

where $n \cong 3$ for La[20] and $\cong 4$ for Y.[21]

The function $z^{\frac{1}{3}}$ is plotted in Figure 6 and is obviously significant only when z is positive. Again, there is good qualitative agreement between theoretical calculations and experiment on $La_{0.98}Ce_{0.02}$ for which $T_{\min}$ increases very slowly with pressure. For an $Y_{0.99}Ce_{0.01}$ alloy, Figure 5 shows that $T_{\min}$ is roughly constant between 0 and 25 kbar, in qualitative agreement with formula (21).

(3°) *Low temperature resistivity*

We have argued above that the present experimental results are probably in the regime $T > T_k$. Our model predicts that the low temperature ($T < T_k$) resistivity plateau should decrease with pressure ($p < p_c$) according to the formula[15]

$$R_m = \frac{2m_0 c}{\pi z N e^2 \hbar \rho} \cos^2 \delta_v = \frac{2m_0 c}{\pi z N e^2 \hbar \rho} \frac{x^2}{1 + x^2} \tag{22}$$

the function $v = \dfrac{x^2}{1 + x^2}$ is plotted in Figure 6.

For $p > p_c$, in the nonmagnetic domain, the residual resistivity should decrease according to the Friedel formula

$$R_m = \frac{2\pi c}{z k_F} \xi \sin^2 \delta_f = \frac{2\pi c}{z k_F} \xi \frac{\Delta^2}{E^2 + \Delta^2} \tag{23}$$

Resistivity experiments conducted at low temperatures would therefore provide a good check on this model which predicts a decrease of R_m with increasing pressure and a typical transition pressure in the 30 kbar range.

Another very desirable experimental quantity would be the susceptibility with a change from a Curie–Weiss law in the magnetic domain to an exchange enhanced Pauli behavior in the nonmagnetic domain.

IV. CONCLUDING REMARKS

Some interesting aspects of this problem remain to be discussed. The first concerns the shape of the variation of T_c versus impurity concentration. In Figure 2, the isobaric curves of T_c versus c are plotted for different pressures. At low pressures (below 15 kbar), the curvature is slightly negative as predicted by the Abrikosov–Gor'kov theory. At 23 kbar, the curvature is slightly positive while at higher pressures, the positive curvature becomes quite pronounced. At very high pressure (105 kbar), the curvature although still positive, is less apparent due to the decrease of the initial slope $-(dT_c/dc)_{c=0}$ with pressure. The same type of curvature is exhibited by **Th**Ce, $(Th_{1-x}Sc_x)_{1-c}Ce_c$ and $(Th_{1-x}Y_x)_{1-c}Ce_c$ alloys (Figure 7) as well as **Th**U[22] and **Al**Mn[23] alloys. All these alloys are nonmagnetic or only weakly magnetic.[24]

Another remark concerns Hamiltonian (1). For the case of magnetic cerium impurities, a new Hamiltonian[25] has been recently derived for the resonant scattering term Γ_2 but not for the normal scattering term Γ_1. For this reason we have relied on Hamiltonian (1). Nonetheless, the main results of the present paper are basically conserved with the new Hamiltonian, particularly the variation of z, y and v with x (or pressure) given by formulas (17), (19) and (22).

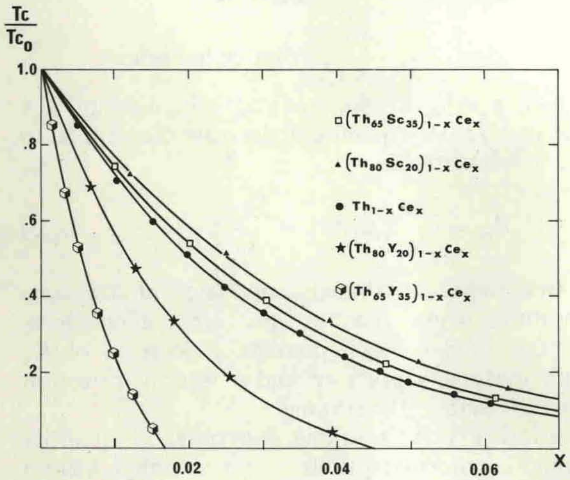

FIGURE 7 T_c/T_{c0} versus Ce concentration c in $(Th_{1-x}Y_x)_{1-c}Ce_c$ and in $(Th_{1-x}Sc_x)_{1-c}Ce_c$ alloys (reference 8).

In the nonmagnetic domain, we have presented both zero and large spin–orbit coupling limits. Large spin–orbit coupling is probably appropriate, although without direct measurements, we have preferred to consider both limits.

A drawback of the theory for the nonmagnetic domain is the absence of a formula for T_c taking into account correctly the spin fluctuations. The effect of spin fluctuations is probably not very important far away from the magnetic–nonmagnetic transition, i.e., above 50–60 kbar, but close to the transition, a better theory of exchange enhancement would certainly improve agreement between experiment and theory.

In summary, we have developed a model for the first observation of the smooth and continuous transition of a dilute metallic alloy from magnetic to nonmagnetic behavior.

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