the temperature dependent resistivity from the phonon part at higher temperatures. This can be achieved as follows: near room temperature the magnetic part of the resistance is negligeably small, at least at low pressure, i.e. low Kondo temperatures. Thus the slope of a R_Y vs. R_{YCe}-plot near 300 K determines the geometric factor m between both samples. This factor does not change by more than 0.8% for all pressures up to 25.3 kbar. Assuming the constancy of the residual resistance up to room temperature (i.e. Matthiessen's rule) and that the T-dependance of the phonon part of the resistance is identical for YCe and Y, one obtains the magnetic resistance anomaly.

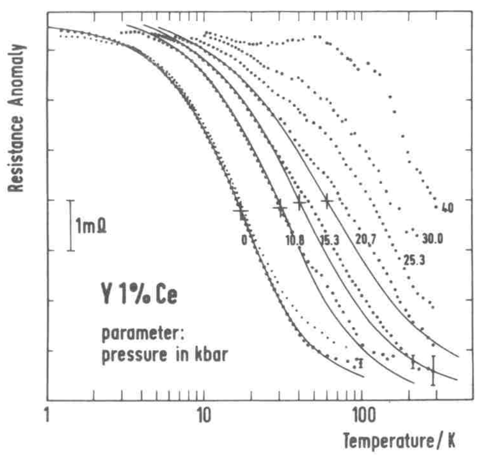

FIG. 2. The magnetic part of the resistance of Y 1 at.% Ce at various pressures and some fitted curves (solid lines) calculated from equation (1).

Figure 2 shows the result of this procedure. The main physical result is that an application of pressure shifts the Kondo anomaly rather drastically to higher temperatures. One notes that for zero pressure[12] the resistance anomaly is rather well described by the Hamann function

$$\rho_m(T) = \tfrac{1}{2}\rho_m(0)\left\{1 - \frac{\ln T/T_K}{[\ln^2 T/T_K + \pi^2 S(S+1)]^{1/2}}\right\} \quad (1)$$

over two decades of temperature (solid line), The magnitude, as determined from the fit, is 7.8mΩ, or 7.1% of the total low temperature resistance. The point of inflection, i.e. the Kondo temperature T_K, is located at 17 ± 0.3 K, while the effective spin S is approximately 0.11. It is known from the literature[13] that a fit of Hamann's expression requires considerably small effective spin values than the well known spins resulting from other measurements (0.5 for Ce). The smaller dots represent zero pressure data which were obtained after removal of pressure from 25.3 kbar. With increasing pressure a deviation from the Hamann type behaviour starts to develop above 30 K, which may be due to a deviation from Matthiessen's rule, as suggested by Loram *et al.* for CuFe, AuFe and CuAuFe alloys.[14]

This effect hinders an exact determination of the Kondo temperature, especially at pressures above 25 kbar, where it has become rather large. If this deviation from Matthiessen's rule were due to a single step in the residual resistance, as assumed by Loram *et al.*, then it should be possible to account for it from the data at higher temperatures. However, our 'step' appears to be rather broad. Also, the high temperature data become increasingly uncertain, due to the large phonon parts to be substracted (see error bars). The Hamann fits for higher pressures were thus obtained from the curvature of the data between 8 and 30 K. This regime appears free from disturbances and the data are relatively accurate. It turns out that the fits so obtained are in fair agreement with the high temperature experimental data. The fit parameters are given in the table below. While the

Table 1. Fit parameters for the calculations of $\rho_m(t)$ from equation (1). Vertical sequence of data in accord with sequence in variation of pressure

p (kbar)	T_K (K)	S	$\rho_m(0)$ ($\mu\Omega$cm)
0	17 ± 0.3	0.11	2.26
5.8	21 ± 1	0.14	2.44
10.8	31 ± 1	0.16	2.46
15.8	40 ± 2	0.20	2.46
20.7	60 ± 3	0.25	2.44
25.3	80 ± 5	0.20	2.55
0	17 ± 0.5	0.11	2.26
30	110 ± 15	0.20	2.32
40	(140 ± 40)	(0.20)	2.32

magnitude of the anomaly $\rho_m(0)$ stays close to 8mΩ (2.3$\mu\Omega$cm) up to 30 kbar the Kondo temperature rises to approximately 110 K. Adjustment of the effective spins is necessary.

It must be emphasized that a transformation of the Ce impurities to a nonmagnetic state should result in a decrease of the resistivity at $T = 0$ of roughly $\rho_m(0)$. This actually does not appear either in our measurements (see Fig. 1) or in those of Maple and Wittig.[5] Sugawara and Yoshida[11] deduce a Kondo temperature $T_K = 40$ K from resistance measurements on YCe applying the formula

$$\rho_m(T) = \rho_m(0)[1 - (T/T_K)^2], \quad (2)$$

but the experimental data are well expressed by equation (2) only below 5 K.

We have also observed the pressure dependance of the anomaly in an isothermal experiment, i.e. we have measured $R(p)$ at constant temperatures. Several pressure runs have been made in small steps up to 44 kbar at 4.2, 70 and 300 K. No indication of a magnetic–nonmagnetic transition has been observed in the high pressure part of the resistivity. However, for all these temperatures there is a maximum in resistivity near 1.5 kbar for Y. Depending on its pressure history, the YCe alloy occasionally exhibited this effect in the two lower temperature runs. We will report on this elsewhere.

The data for 30 and 40 kbar have actually been obtained after this repeated pressure cycling. It was observed that the geometric factor m between the two materials has decreased by 5%, which we attribute to a slight cell deformation at the highest pressures. For 40 kbar m depends in a nonsystematic manner on temperature. Probably slight deformations of the cell occur during warming up at this high pressure. The data for 40 kbar in Fig. 2 must thus be considered with reservation above 40 K. Also, for this pressure the data for the Kondo anomaly quoted in the table become rather inaccurate.

In the theoretical model, first discussed by Coqblin and Ratto[15] for LaCe, the $4f$ level lies a distance E_f below the Fermi energy E_F and the effect of pressure is to shift the $4f$ level up relative to the Fermi level. Calling V_{kf} the maxtrix element of mixing between localized $4f$ electrons and the conduction electrons, the result of the Schrieffer–Wolff transformation[16] for the exchange integral J is:

$$J = 2\, V_{kf}^2/|E_f|. \quad (3)$$

Equation (3) is valid in the limit of a large Coulomb repulsion integral $U \gg |E_f|$ and in the limit $|E_f| \gg \Delta$, where Δ is the Hartree–Fock half width of the virtual bound state:

$$\Delta = \pi N(0) V_{kf}^2. \quad (4)$$

Thus the position of the $4f$ level is given by

$$E_f = 2\Delta/\pi N(0)J. \quad (5)$$

Taking $\Delta = 0.02$ eV,[15] $T_F = 75000$ K[17] and $N(0) = 2.15\ \text{eV}^{-1}$,[18] we can calculate J and E_f as a function of pressure from (6)

$$T_k = T_F^{\,1/N(0)J}. \quad (6)$$

The results given in Table 2 show that at 30 and 40 kbar the energy $|E_f|$ is still about 4Δ. Consequently no transformation from a magnetic to a nonmagnetic state is to be expected from this model, within the quoted pressure range.

Plotting $\ln T_k(p)/T_k(0)$ vs. p (with the data from Table 1) a straight line up to 30 kbar is found (the value at 40 kbar lies somewhat below this line) which demonstrates that the assumption of a linear decrease of $|E_f|$ with pressure is justified and $dE_f/dp = 0.0008$ eV/kbar up to 30 kbar.

Table 2. Values of E_f *and* J *deduced from the experimental values of* T_k *(with* $N(0) = 2.15\ eV^{-1}$, $T = 75000$ K and $\Delta = 0.02$ eV)

p (kbar)	$\lvert E_f \rvert$ (eV)	J (eV)
0	0.107	−0.055
30	0.083	−0.071
40	(0.080)	(−0.074)

In conclusion, a monotonic shift of T_k and no magnetic–nonmagnetic transition were observed. Such a transition has been inferred by several authors[4–6] from the nonmonotonic depression of the superconducting transition temperature T_c and from the maximum of the slope $|d\rho_m/d \ln T|$ with pressure on LaCe and other Ce-alloys. We note that the described result on YCe strongly supports