height of the 5d band at the Fermi level and the number of holes in the 6s band were derived from the specific heat and the Hall coefficient data, respectively, these properties naturally are in agreement with this model.

Rocher [29] suggested that a virtual 4f bound state model could explain the behavior of cerium (presumably γ-Ce) at high temperatures. In order to explain the high resistivity and the magnetic susceptibilities of cerium he proposed that cerium had a very large density of states (implying a partially occupied 4f band), which he believed was confirmed by the low temperature specific heat data of Parkinson and Roberts. [36] This, however, leads to two difficulties: (1) the low temperature specific heat data which yield a large γ value are appropriate for α-Ce and not γ-Ce* and (2) this large value of γ gives a C_V^e contribution at 300°K of 1.26 cal/g-at. deg and leads to a Debye temperature of 500°K, which is a factor of two to three times larger than those of any of the other rare earth metals. Furthermore, this model does not explain the large infrared absorption at 15.5μ. For these reasons it is felt that the virtual 4f bound state model does not apply to γ-Ce, however, it may be a valid model for α-Ce (see below).

Rocher [29] also pointed out that a large value of the density of states is required to explain the magnetic contribution to the resistivity and the high temperature magnetic susceptibility of γ-Ce. If this is correct, then this casts some doubt on the validity of the band model proposed herein for γ-Ce.

Rocher [29] gives a value of 70 μ ohm-cm for magnetic resistivity of cerium. This value is unreasonably large. Recent resistivity values for lanthanum vary from 57 to 80 μ ohm-cm [38, 39, 40] and for cerium from about 75 to 85 μ ohm-cm [38, 39]. If cerium had a magnetic resistivity of about 70 μ ohm-cm as suggested by Rocher, we would expect cerium to have a room temperature resistivity of 125 to 150 μ ohm-cm (*i.e.* about 70 μ ohm-cm larger than that of lan-

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* At temperatures below 100°K <u>all</u> of the γ-Ce has transformed to α-Ce. [37]

thanum). Furthermore, since the residual resistivities of most of the rare earth metals are about 5 μ ohm-cm, then for cerium almost all of the room temperature resistivity can be accounted for by only the residual and magnetic resistivities (i. e. $5 + 70 = 75\mu$ ohm-cm). For the rare earth metals the thermal contribution to the resistivity is of the order of 50 μ ohm-cm. Thus, it appears that the magnetic contribution to the resistivity of cerium is much less than 70μ ohm-cm. It is probably of the order of 5 to 20μ ohm-cm, which is in as good agreement as many of the other rare earth metals (see Table 5, p. 245 of Rocher's article in Advances in Physics, ref. 29).

In order to explain the high temperature magnetic susceptibility Rocher [29] used a modified form of the Curie-Weiss law:

$$\chi = \frac{C}{T - \theta_p} + \chi_p \qquad (15)$$

where the χ values are the gram susceptibilities, C is the Curie-Weiss constant, θ_p the interaction temperature and χ_p the temperature independent Pauli contribution to the magnetic susceptibility. Rocher was able to explain the high temperature magnetic susceptibility by using values of -45°K for θ , 2×10^{-6} emu/gm for χ_p , 2.40 Bohr magnetons for the magnetic moment (which is equal to $2.83\sqrt{CM}$, where M is the atomic weight), and 2500 cm^{-1} for the separation of the $J = 5/2$ and $J = 7/2$ levels of the ${}^2F_J$ multiplet of cerium. Since the Pauli contribution to the susceptibility (which is also directly proportional to the density of states) is about 2 1/2 times larger than that of lanthanum, Rocher concluded that cerium has a high density of states. However, magnetic susceptibility data are not sensitive enough to determine χ_p very accurately. Arajs and Colvin [1] have also analyzed the high temperature magnetic susceptibility of cerium and they obtained the following constants: $\theta_p = -50°K$, $\chi_p = 1.00 \times 10^{-6}$ emu/gm, $\mu_B = 2.52$ Bohr magnetons and 2129 cm^{-1} for the separation of levels in the ${}^2F_J$ multiplet. Furthermore,