an increase in the resistivity of α-Ce (this contribution is zero in γ-Ce because the 4f level is essentially filled). We can roughly estimate the decrease in the resistivity of the first two contributions mentioned above. The resistivity of the tetravalent metals titanium, zirconium, hafnium and thorium range from 18 to 43 μ ohm-cm. [43] Assuming a mean value of 60 μ ohm-cm for a normal trivalent rare earth metal with no 4f electrons*, and a mean value of 30 μ ohm-cm for the tetravalent metals, we would expect a decrease in resistivity of 30 μ ohm-cm for a metal which has undergone a valence change from three to four. The magnetic contribution to resistivity of a metal with one 4f electron is about 6 μ ohm-cm [44]. Since in the case of the cerium transformation about 2/3 of the 4f electron goes into the 5d 6s band, we would expect a resistivity decrease of about 25 μ ohm-cm (2/3 times 30 + 6). This is somewhat smaller than the 40 μ ohm-cm change observed, but it is still about the right order of magnitude to account for this change considering the approximations made. From this it would appear that the s-f and d-f interband scattering contribution to the resistivity is quite low and perhaps negligible.

It should be noted that Rocher's virtual 4f bound state model [29] appears to apply to α-Ce, and it may be considered to be an alternate approach to the understanding of the behavior of this phase.

8. BAND STRUCTURE OF EUROPIUM AND YTTERBIUM

8.1 EUROPIUM

Europium has only two valence electrons available. These two electrons could easily fill the 6s band, and if there were no overlapping 5d band europium would either be a semiconductor or an insulator and the density of states would be zero.

* Resistivities of scandium, yttrium and lanthanum vary from 57 to 67 μ ohm-cm.

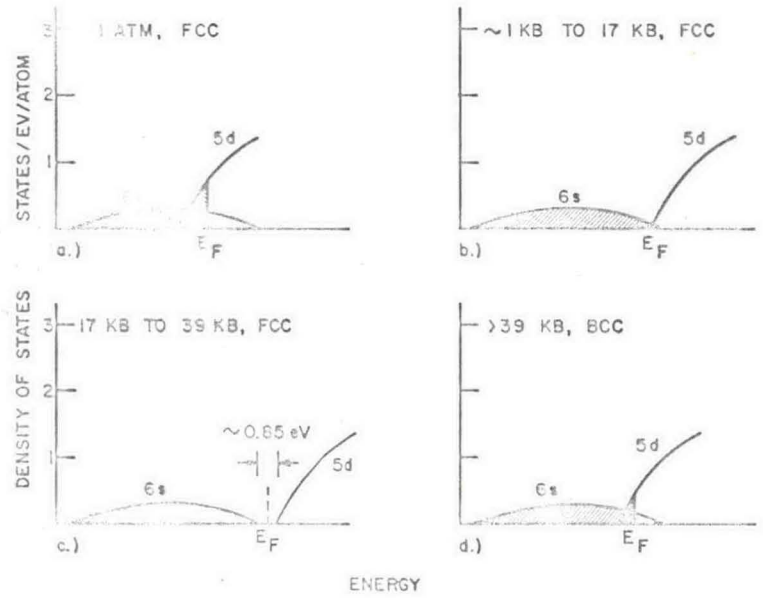

Fig. 8. Band structure of ytterbium as a function of pressure at constant temperature.

But since europium is a good conductor and it has appreciable electronic specific heat constant, there must be an overlapping 5d level. The magnitude of the electronic specific heat constant (8.83) suggests that the density of states is governed by the Fermi level in the 5d band rather than the 6s band. * In all probability there are about 1.5 electrons in the 6s band and 0.5 in the 5d band, very much like the band structure of ytterbium which is shown in Fig. 8a (ignoring the differences in the crystal structures of these two metals). Hall coefficient measurements on europium would be extremely useful.

* In metals, which are thought to [illegible] only s-bands, the electronic specific heat constant has never been found to be greater than 3.0×10^{-4} cal/g-at. deg^2 (see data given in ref. [illegible]