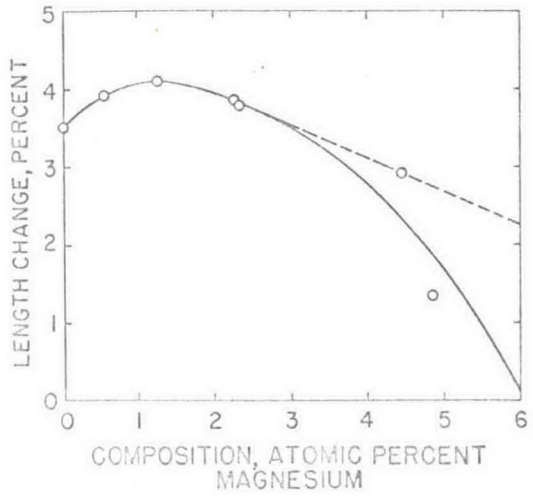


Fig. 5. The length change for the $\gamma \rightarrow \alpha$ transformation of some cerium-magnesium alloys as a function of composition.

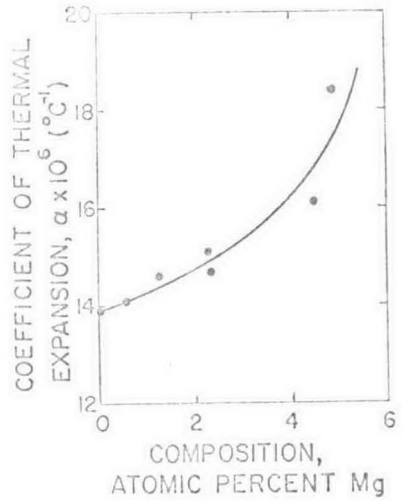


Fig. 6. Mean coefficient of linear thermal expansion from 200° to 295°K (−73° to +22°C) for some cerium-magnesium alloys as a function of composition.



These data, which are also substantiated by the thermal expansion results (see below), suggest that a critical point would exist at about 10 a/o magnesium, 0°K and 1 atm if this amount of magnesium were soluble in cerium.

*Expansion Coefficients.* The average coefficient of linear thermal expansion from 200° to 295°K (−73° to +22°C) is increased from $13.9 \times 10^{-6}$ ($^\circ K^{-1}$) for pure cerium to $18.4 \times 10^{-6}$ ($^\circ K^{-1}$) for the alloy containing 4.8 a/o magnesium (see figure 6 and Appendix III). The increasing value of the thermal expansion coefficient with increasing magnesium content is also indicative of an impending critical point at higher magnesium concentrations. Waber and co-workers[20] have found in cerium-thorium alloys that the coefficient of expansion is quite large, $\sim 60 \times 10^{-6}$, for the alloys in the vicinity of the critical composition. One might reasonably expect the coefficient of expansion to reach this value for the critical composition of these cerium-magnesium alloys. On the basis of this assumption and the data shown in figure 6 it is concluded that the critical composition is probably higher than 6 a/o magnesium. These data, therefore, also support the choice of 10 a/o magnesium for the critical composition rather than the lower value of about 6 a/o magnesium.

*Formation of β-Ce.* As is well known, β-Ce (hex. 2*c*-axis) forms from γ-Ce at approximately 250°K (−23°C) during cooling.[10] In previous studies it was observed that the solutes scandium, thorium and plutonium stabilize γ-Ce, and thus prevent β-Ce from forming, if more than 10 a/o of the solute is present,[1] and that the rare earths, in general tend to stabilize β-Ce.[6] It is possible to detect the formation of β-Ce from the appearance of the dilatometric curve, even though the volume difference between β and γ is only 0.4 percent and only small percentages (<10 percent) of β may be present.[1,6] Examination of the dilatometric curves for the cerium-magnesium alloys indicates that the amount of β-Ce formed decreases with increasing magnesium content. That is, 30 percent of β-Ce formed in pure cerium during the first cooling cycle was decreased to about 5 per cent in the 4.4 a/o magnesium alloy. Therefore, it is concluded that magnesium is a γ-Ce stabilizer.