

discrimination, and amplification circuit; records were taken on a Brown strip-chart recorder.

The sample (A.D. MacKay, Inc., 99.9 per cent pure) consisted of a thin disk punched from rolled sheet and sanded to remove oxide. The pellet thickness was usually between 0.5 mm and 0.8 mm and always 4.6 mm in diameter. Two major experimental difficulties were encountered at high pressures and temperatures. First, cerium oxidizes quite rapidly at room temperature, and when exposed to air at 150°C the peaks of the cerium are nearly gone in 5 min. To avoid such oxidation, a few hundred bars pressure was applied to the sample when raising the temperature 200–300° for a pressure run at constant temperature. Secondly, cerium flows very rapidly at 200°C and 15 kb, so much so that movement up alongside the beryllium pellet cut off the X-ray beam to the extent that several runs had to be abandoned. Furthermore, the cerium flows around the lower piston so that the lower plug and upper plug (B and C, Fig. 1) could only with difficulty be removed upon cooling. Much better results were obtained by making the pellet 3.2 mm in diameter so that it was entirely surrounded by and constrained by the 4.6 mm beryllium pellet.

### 3. RESULTS

Figure 3 is the phase diagram of cerium-I and cerium-II as established from the X-ray data of several runs. Runs were made at both constant pressure and constant temperature. To establish which phase was growing, the integrated intensities of the strong 111 peaks of both phases were compared. The slope of the phase boundary was found to be 25.5 deg/kb and the room temperature (300°K) transition pressure, 7.6 kb. Comparison with results of other workers are made in Table 1, from which it can be seen that there is considerable variation in the transition pressure given for room temperature. The heat of transition  $\Delta H$ , is not given for Bridgman's data because the only value for the volume change given corresponded to the 8 per cent he found at 12,430

kg/cm<sup>2</sup>.<sup>(5)</sup> The value for  $\Delta H$  given by Likhter, *et al.*, was given in the original paper as 0.023 eV, which is equivalent to 530 cal/g atom.

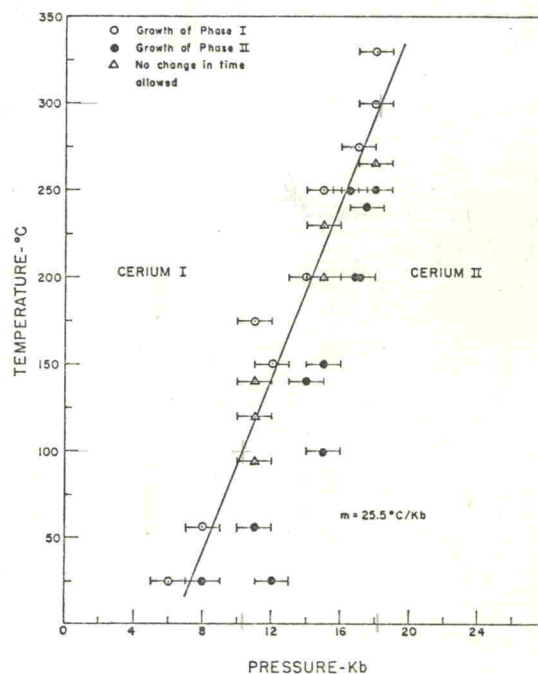


FIG. 3. Partial phase diagram of cerium showing stability regions of phases I and II as determined by X-ray data. Horizontal bar at each point indicates pressure uncertainty.

The cerium I–cerium II transformation is sluggish enough to allow X-ray examination of both phases in a region of pressure and temperature considerably removed from the phase boundary. As a result of several runs at constant pressure and

Table 1

	Transition pressure* (kb)	dT/dP (°C/kb)	$\Delta H^*$ (cal/g. atom)
Bridgman <sup>(4)</sup>	8.0	29.7	-----
Hermann and Swenson <sup>(22)</sup>	7.4	20.8	1150 ± 100
Likhter, <i>et al.</i> <sup>(11)</sup>	8.5	23.8	530
Poniatovskij <sup>(21)</sup>	8.0	22.0	-----
Beecroft and Swenson <sup>(23)</sup>	6.5	23.6	800 ± 50
Davis and Adams <sup>(29)</sup> and this paper	7.6	25.5	798

\* All at room temperature.