Experimental Method

In order to determine the heat of transition in cerium under pressure we used the thermogram [see (6)] method. The application of the thermal analysis method at high pressures is described in paper (7,8). The method consists in comparing the areas of differential thermogram recordings for a substance with a known phase transition heat and for the substance studied. Usually the substance chosen for a standard is one in which the phase transformation takes place at a temperature not equal to but near that of the transformation temperature of the substance being studied. Under these conditions (with a constant rate of heating) the areas of the differential thermogram recordings are proportional to the transformation heats and the quantities of the substances used. According to our method we carried out the experiment at constant temperature, but under increased pressure; therefore, we had to choose for our standard a substance whose phase transition took place under a pressure not equal to but near that of the transition pressure in cerium. We used mercury as a standard. The curve for mercury fusion has been sufficiently studied [see for example (9,10)]. Using such a curve and using data for the compressibility of solid and liquid mercury Bridgman (9) calculated the heat of fusion of mercury at pressures up to 12,000 kg/cm^2 (which corresponds to a melting point of 22.2°).

We used 97% pure cerium.* As will be shown the phase transformation of this cerium took place under pressures close to those found for pure cerium by Bridgman in his most recent papers (4,5). A 3% correction for "inert" admixtures was made in calculating the transition heat.

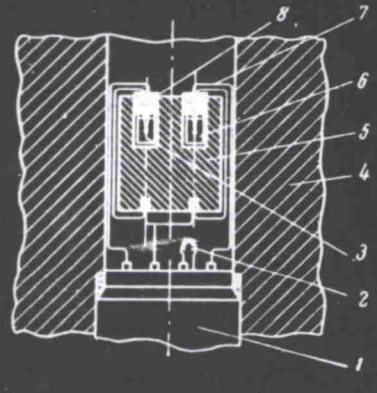

Fig. 1. Schematic cross section of high pressure container. 1 - electric lead; 2 - resistance manometer; 3-cup with cerium; 4-body of container; 5-copper block; 6-cup with mercury; 7-thermocouple; 8-ebony bushing.

The experiments were carried out in a high pressure intensifier having a working canal diameter of 25 mm permitting the formation of the necessary hydraulic (pentane) and gaseous (nitrogen) pressure. A copper block 5 was attached to the electric lead 1 (Figure 1). Samples of cerium 3 and mercury 6 were placed in two identical plexiglass cups (having 1.5 mm thick walls and an interior diameter of 6 mm) mounted securely in the block 5. The increase of temperature during phase transitions (solidification of the mercury, transition of cerium into a more compact modification) was measured by means of a differential iron-Nichrome thermocouple 7, covered with a thin layer of shellac and recorded by a N.S. Kurnakov pyrometer. The "hot" junctions of the thermocouples were centered in the cups by means of ebony bushings 8.

*It contained 1.5 per cent neodymium, 1.3 per cent praseodymium, 0.1 per cent lead and 0.01 per cent tin.