

curves are used for the fusion curve and the Ba I–Ba II phase boundary in Fig. 8, plotted using these data. The continuation of the fusion curve and the Ba II–Ba III phase boundary in the pressure region from 140 to 400 kbar was also found from the electrical resistance discontinuities.<sup>[35]</sup> A part of the boundary between the solid phases in the 15–20 kbar region was obtained by Bridgman from measurements of the volume discontinuity at a polymorphic transition.<sup>[42]</sup> X-ray diffraction analysis carried out at room temperature up to pressures of 60 kbar showed no changes in the structure up to 59 kbar and then the diffraction pattern changed, accompanied by a sharp increase in the electrical resistance.<sup>[43]</sup> The x-ray structure analysis data showed that the Ba II modification had the hcp A3 type structure.

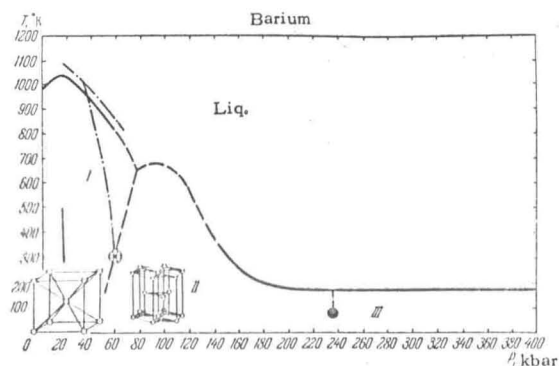


FIG. 8. P–T phase diagram of Ba. The fusion curve and a part of the phase boundary in the region of 60 kbar, shown by continuous lines, are plotted in accordance with the DTA method.<sup>[40]</sup> A part of the boundary in the 15–20 kbar region was found by Bridgman from volume discontinuities.<sup>[42]</sup> Dot-dash curves indicate the fusion curve and the phase boundary found from resistance discontinuities;<sup>[41]</sup> the same method was employed to find the part of the diagram between 140 and 400 kbar.<sup>[35]</sup>

#### 4. METALS OF GROUP II-B

As mentioned before, zinc and cadmium have hcp type A3 structure, strongly elongated along the c axis. The ratio of the axes is  $c/a = 1.86$  for zinc and  $c/a = 1.89$  for cadmium, i.e., the interatomic bonds in the hexagonal layers are stronger than along the c axis between the layers. In the case of mercury, the binding forces in the crystal lattice are even weaker and under normal conditions it is liquid. When it solidifies, mercury crystallizes in the  $\alpha$ -modification with the orthorhombic type A10 lattice with a single atom per unit cell. This structure can also be described in terms of hexagonal axes; it is then found that the ratio of the axes is  $c/a = 1.94$ .

Thus, metals of group II-B have a very loose structure with strongly anisotropic physical properties; for example, the compressibility of cadmium along the c axis is seven times higher than its compressibility along the a axis.

Polymorphism has not been observed in polycrystal-

line samples of cadmium and zinc at pressures up to 100 kbar.<sup>[37]</sup> However, Bridgman found that cadmium single crystals exhibited a clear volume discontinuity in the region up to 10 kbar;<sup>[44]</sup> he also plotted parts of the phase boundaries, assuming the existence of polymorphic transitions. In the phase diagram of cadmium, shown in Fig. 9b, the Bridgman data are in the form of short lines in the region of 10 kbar. X-ray diffraction analysis was carried out on polycrystalline cadmium but it revealed no changes in the structure at pressures up to 16 kbar;<sup>[46]</sup> it is possible that Bridgman observed the twinning of single crystals under pressure, especially as twinning is very easy in cadmium.<sup>[47]</sup>

The P–T phase diagram of mercury is shown in Fig. 10; it is clear that the boundary between the solid phases  $\alpha$  and  $\beta$  is almost parallel to the fusion curve.

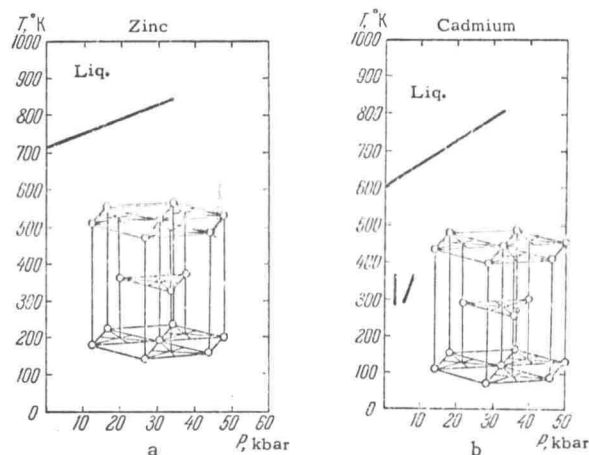


FIG. 9. P–T diagrams of Zn and Cd. The fusion curves were obtained by the DTA method.<sup>[45]</sup> The parts of the boundaries between the solid Cd phases were found from volume discontinuities in single crystals.<sup>[44]</sup>

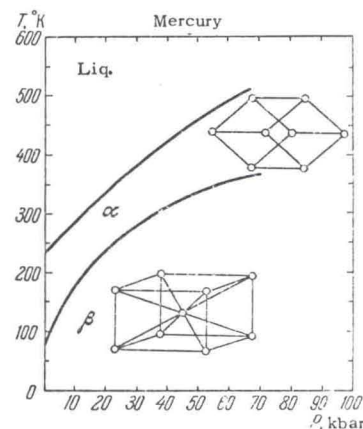


FIG. 10. P–T phase diagram of Hg.<sup>[48]</sup>

Since the  $\beta$ -Hg modification is stable at low temperatures and atmospheric pressure, it was investigated using the low-temperature x-ray diffraction technique.<sup>[49]</sup> The analysis showed that the high-pressure phase  $\beta$ -Hg had the tetragonal body-centered structure with two