THE POSSIBILITY OF USING REFERENCE POINTS IN THE PRESSURE SCALE

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The differences between the polymorphic transition temperatures in the "reference" metals Tl, Cs, and Ba found by different authors for different samples may be accounted for by hysteresis being present in these transitions of the first kind, the amount being essentially dependent on the experimental conditions (nature of the stresses produced in the sample). In view of this, it seems better to calibrate high pressure apparatus from measurements on a number of independent physical phenomena under pressure, such as the pressure dependence of electrical resistance, melting points, compressibility, etc.

High pressure studies above 50,000 kg/cm^2 are as a rule made on equipment that requires a pressure calibration. The calibration consists of finding the relation between the pressure in the operating volume of the apparatus and the applied load. To this end, a pressure scale is used based on fixed pressure points–known values of phase transformation pressures at known temperatures.

The present paper discusses possible discrepancies in the experimentally determined phase transition parameters which can occur as a result of using some particular kind of apparatus, and along with this, ways of using known transition pressures as reference points in the pressure scale.

At the present time, the most widely used pressure scale is the one for which the reference points are the transition pressures observed from a jump in the electrical resistance of bismuth, thallium, cesium, and barium at room temperature. These transitions were first studied by Bridgman, [1], and his data have so far been used for calibration. However, there are appreciable discrepancies between the values of the transition pressures in the above elements as found by Bridgman from measuring the electrical resistance and the bulk compressibility, and this has led to a need to recheck the transition parameters.*

The paper by Kennedy and La Mori [2] gives new data on the phase transformations in Bi, Tl, and Cs at 25°C, obtained from volume measurements.

The table gives values of the transition pressures in Bi, Tl, and Cs, found by various authors using different methods.

* It should be noted that the discrepancies between the values for the transition pressures in Tl, Cs, and Ba found from the jump in volume and from the jump in electrical resistivity at the transition are hard to account for as a systematic error in the way the pressure was measured in [1]. While Tl, Cs, and Ba gave values for the transition pressures greater than the parameters found previously from the volume jump, Sr gave a value for the transition pressure of 46,000 kg/cm^2 instead of the value 65,000 kg/cm^2 found previously from the volume jump.

Phase Transition Pressures of Bi, Tl, and Cs (kg/cm^2) at Room Temperature

Transition	Bridgman		Kennedy and La Mori*	Boyd and England
	volume measurement	electrical resistance	volume measurement	electrical resistance
BiI — BiII	25.420 [4]	24.700 [6]	25.911±97 †	—
BiII — BiIII	26.960 [4]	26.600 [6]	27.507±194	—
CsI — CsII	23.000 [5]	22.070 [6]	23.046±612	—
CsII — CsIII	45.000 [8]	54.950 [1]	42.624±1020	—
TlII — TlIII	40.000 [7]	45.000 [1]	37.414±112	37.730

* Kennedy and La Mori give their data in bars. The table gives the transition pressures in kg/cm^2, from the relation 1 bar = 1.01972 kg/cm^2.
† The uncertainties given show the hysteresis observed in the transition.