# ON THE "NEW" AND "OLD" PRESSURE SCALES

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Modern ultrahigh-pressure investigations necessitate the calibration of the equipment with respect to pressure, which can be most conveniently performed by measuring the electric resistivity of metals under pressure. The pressure scale used for this purpose is most often composed on the basis of fixed points of known transition pressures in metals, namely, BiI – BiII, TlII – TlIII, CsII – CsIII and BaII – BaIII. The pressures of these transitions were borrowed from Bridgman's paper [1], where the electrical resistivities of 72 elements, alloys, and compounds were measured as functions of pressures of up to $10^5$ kg/cm$^2$. The values of transition pressures in Tl, Cs, and Ba which were determined by Bridgman with respect to the volume jump in studying compressibility [2, 3] do not coincide with Bridgman's data that are given in the tables of paper [1]. This fact was repeatedly mentioned in various papers, especially in papers describing calibrations. The data published by Kennedy and La Mori [4] concerning the transition pressures in the same elements are in good agreement with the values of pressures of these transitions that were determined by Bridgman with respect to volume jumps. In connection with the discrepancy between these new data and the data from [1], the problem of the "new" and "old" pressure scales (according to data by Kennedy and La Mori and by Bridgman, respectively) is being discussed lately in periodicals, while preference is explicitly given to the first of these scales.

However, the difference between the results given by Bridgman in [1] and the results given in other papers, in particular, in measuring volume compressibility, was nowhere clearly defined until now. While most of Bridgman's data as well as data given by Kennedy and La Mori represent mean values, determined by averaging the data obtained in raising and lowering the pressure, Bridgman offers in [1] as final results only the measurements performed for rising pressure, explaining this by the considerably lower determinancy of the pressure measured while it is being reduced. Bridgman himself indicated that the values of the transition pressures which he determined with respect to the jump of the electrical resistivity may greatly differ from the previously determined average values in connection with the presence of hysteresis in these transitions. Bridgman wrote the following concerning the transition to cesium: "It seems to me that the large difference between the rising and falling pressures in electron transition must be attributed to an actual effect – most transitions occur only with a considerable disturbance of the thermodynamic equilibrium values" [1] (p. 191). Later on, other authors have apparently forgotten this statement, and they tried to explain the above discrepancy by possible errors in the pressure determinations in [1]. However, if one takes into account the transition pressure values obtained while reducing the pressure that are given in [1], the average values are in good agreement with data by Kennedy and La Mori as well as with Bridgman's previous data (see table).

Values of Transition Pressures in Tl, Cs, and Ba, kg/cm$^2$

| Element | Bridgman [1] | | | Bridgman [2, 3] | Kennedy and La Mori [4] |
|---|---|---|---|---|---|
| | tabular data (pressure rise) | pressure reduction | average values | | |
| Tl | 45000 | 28000 | 36500 | 40000 | 37400 |
| Cs | 55000 | 32000 | 43500 | 45000 | 42600 |
| Ba | 80000 | 60000 | 70000 | 60000 | 60000 |

Thus, the discrepancy between the results of electric and volumetric measurements is basically due to the fact that the pressure values corresponding to the transition to a denser modification are given in the first case, while the arithmetic means of the transition pressures determined while raising and lowering the pressure are given in the second case.

Therefore, from a comparison of the two pressure scales, it is difficult to conclude whether the "old" pressure scale that is based on data from [1] is correct or incorrect. Moreover, the experiments in [4] were performed by means of a device where special measures were taken in order to reduce hysteresis, which, unfortunately, as a rule, cannot be done in the equipment ordinarily used. The latter fact certainly must be taken into account if the data given by Kennedy and La Mori are used as reference points in calibration, since their investigations were performed mainly under rising pressure conditions.