argon atmosphere. The castings were then compressed in a mold to an average pressure of 8·5 kbar, machined into cylindrical samples, and threaded. A number of samples were prepared by grinding the Bi and compressing it to either 20 or 35 kbar before machining and threading. All samples were of theoretical density (9·80 g/cm^3). The differences in the vol. changes for the differently prepared samples were within the scatter of the data.

The samples varied in size from 0·635 cm dia. × 0·635 cm long to 0·900 cm dia. × 1·300 cm long with from 18 to 32 threads/cm. Initial coil inductance (corrected for leads) varied from 0·63 to 7·82 μH. The largest samples were recovered with no more than $\pm 3\%$ change in dimensions after compression to 60 kbar. Small samples suffered less than $\pm 1\%$ deformation. Formvar coated copper wire (0·01 cm dia.) was used for the coils.

With relatively soft materials like Bi it is important to make the profile of the thread to conform as closely as possible to that of the coil wire. If the latter is not flush with the core initially, it will be forced deeper into the sample under pressure, thus yielding an enlarged vol. change. It was also found useful to place a thin sleeve of a material harder than silver chloride directly on the coil before enclosing the whole in a silver chloride jacket. The hard sleeve forces the coil to conform more reliably to the sample core under compression.

There was usually some scatter in the data in the initial stages of compression (below 10 kbar).* This is the region of gasket formation in the cubic apparatus. The scatter is most likely associated with the fact that Bi is relatively soft, and some readjustment in the fit of the coil on the core takes place. There is also some uncertainty in the pressure calibration of multianvil apparatus in this low pressure range. For these reasons the present data were matched with Bridgman's up to 20 kbar. This is the range to which Bridgman's data should be most accurate.

In order to re-examine the pressure value of the upper Bi transition, it was necessary to extend the 70 kbar range of our multianvil cubic apparatus. This was done by the use of tungsten carbide intensifier plates in the manner described previously.[7] The plates were in the form of truncated pyramids 0·865 cm thick and 3·30 cm long at the base.

Pressure was measured both by the recently developed manganin gauge with integral calibrants[8] and by multiple event resistance cells. The latter consist of small sections of Bi, Tl, and Ba wire cut in lengths inversely proportional to their respective resistivities and encapsulated in series in a silver chloride sleeve. The transition pressures of the calibrants were taken as 25·4, 37, and 59 kbar for Bi_{I-II}, Tl, and Ba, respectively.

3. RESULTS AND DISCUSSION

Compression

Bismuth was the test material most widely used in developing the inductive coil technique, and a large number of experiments were made on it. Many of these were made to test various refinements in the original technique, which rendered it more quantitative in measuring "long range" vol. compression as well as vol. changes accompanying polymorphic transitions.

A typical inductance vs. ram pressure curve is shown in Fig. 1. The experimental set-up is such that the coil collapses proportionately with the sample, and the inductance, L, is related to sample vol. by the relationship $L = V^{1/3}$.

Volume changes for the transitions are calculated from the inductances at the terminal points of each event. This is because the transformations in Bi are very nearly isobaric, and pressure gradients across the sample are negligible in our apparatus.[7] This is supported by the fact that there is always a sharp step separating the two transitions regardless of the range of applied load required to complete each transition. In cases where the Bi is not jacketed by silver chloride, the spread in the ram pressure required to complete each transition is over twice that shown in Fig. 1 (see for e.g. Fig. 3). This difference in load requirement is attributed to the "cave principle" which we described earlier.[7]

* In a number of experiments some large irreversible changes in inductance (usually an increase by several per cent) were observed in this low pressure region. These are attributed to mechanical difficulties associated with gasket formation during the initial stages of compression. Such experiments were rejected. Only experiments which showed the expected monotonic decrease of inductance with pressure in the low pressure phase were considered acceptable.