isothermal Birch equation at the higher pressures, as shown in Fig. 1. At the intermediate pressures, data points from Swenson's tabulation are high (by amounts up to 3%) with respect to the associated Birch curve; correspondingly, values from Eq. (58) are high also. Agreement improves for data points (not shown) at the lower pressures. Consistently with Eq. (58), the curve in Fig. 1 for 77°K lies below that for 4.2°K; this order reverses when P is plotted against V directly.

The degree of agreement obtained is exhibited more clearly by Fig. 2, which shows, for a given value of $(\mathcal{V}-V)/\mathcal{V}$, the difference $P(4.2°\text{K})-P(77°\text{K})$ of the pressures at 4.2 and 77°K as computed from Swenson's data for 4.2°K by use of Eq. (58), and as determined from the isothermal Birch equation with Swenson's values of parameters. The difference found vanishes for two values of the abscissa, and is less than three percent at the highest datum point shown. This

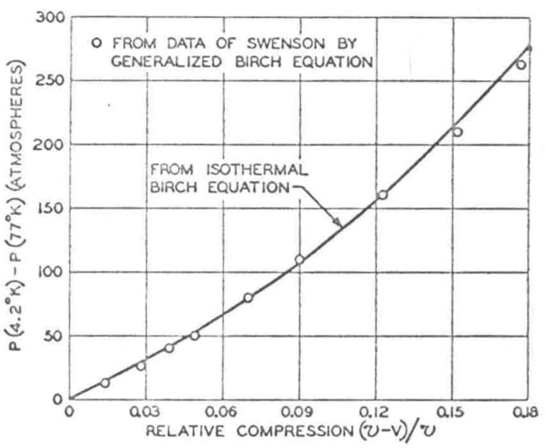

FIG. 2. Difference $P(4.2°\text{K})-P(77°\text{K})$ of the pressures at 4.2 and at 77°K for a given relative compression, as computed from Swenson's data for 4.2°K by means of the generalized Birch equation, for comparison with values determined from the isothermal Birch equation with parameter values from Table I.

comparison is unaffected by the degree to which Swenson's data for 4.2°K are fitted by the isothermal Birch equation.

VI. CONCLUSION

It is clear from the comparison with Swenson's results that the generalized Birch equation can be used directly to fit experimental pressure-volume data corresponding to a range of temperature, as the isothermal equation has been used in the past for the case of fixed temperature.

For the range of high pressures greater than a limit in the order of megabars, the effect of shock waves on solids has been treated theoretically on the basis of a temperature-dependent equation of state from the statistical atom model.[36] This equation of state loses validity for the lower pressures, where it must be supplemented by a relation appropriate to this pressure range.[12] Use of the generalized Birch equation for this purpose permits an analysis at the lower pressures on lines analogous to those followed in the case of the Thomas-Fermi equation of state.[37] The problem in question is of interest in connection with the explosive impact of meteorites and the associated crater production.

The generalized Birch equation has an obvious application in studies of the earth's internal constitution, since it should be applicable at the pressures of the mantle, where one cannot use reliably an equation of state from the statistical atom model, as is possible (within an approximation) for the higher pressures of the core. Birch has used his equation of state to estimate the density in the earth's core, by extrapolation of experimental data of Bridgman, on the assumption that the core is iron.[8] His result for the central density is about 20% higher than Bullen's value deduced from seismological data.[38] Of this discrepancy, Birch estimates that perhaps half may be due to the neglected effect of temperature. The generalized Birch equation may be of use in further study of this point.

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Note added in proof.—It has been verified that the generalized relation (15), with the multiplicative correction factor (5) included for a given temperature, fits the data of Swenson[9] for the alkali metals other than potassium. In this reference, the values of $\Delta V/V_0$ tabulated for cesium are incorrect because of a transcription error, although the corresponding contants given for the isothermal Birch equation are correct, as the author has been informed by Dr. Swenson.

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