

Compressibility and thermal expansion measurements by x-ray techniques require a relatively high degree of accuracy since the analysis yields a volume rather than a change in volume. Furthermore, relative accuracy is lost in computing volume from linear dimensions. As an illustration of the apparatus capabilities, the compressibility of barium was measured to 60 kb and compared with Bridgman's data (see Fig. 9). The problem of pressure calibration at elevated temperatures became evident during preliminary studies of thermal expansion at high pressures, and further investigation was felt necessary before reporting any data.

For low symmetry crystal systems, x rays detect, in addition to the microscopic PVT data, changes in unit cell dimensions which shed light on the single-crystal elastic constants at high pressures. We have observed, for example, the different compressibilities along the a and c axes of hexagonal NaNO_3 and hexagonal BN. For BN the percentage change in the lattice parameters, the c/a ratio, and the resulting compressibility curve as shown in Fig. 10. The work by Kabalkina and Vereshchagin⁷ to 17 kb is shown for comparison.

D. Miscellaneous Techniques

The fundamental nature of the x-ray diffraction process and its lack of dependence on external influences provide a

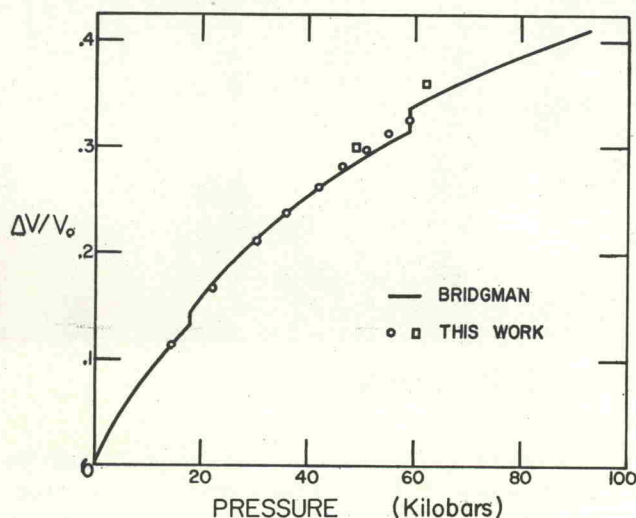


FIG. 9. Compressibility of Ba to 60 kb. $\circ$: determined using geometry A. $\square$: determined using geometry B yielding greater accuracy.

⁷ S. S. Kabalkina and L. F. Vereshchagin, Doklady Akad. Nauk SSSR 134, 330 (1960) [English transl.: Soviet Phys.—Doklady 5, 1065 (1961)].

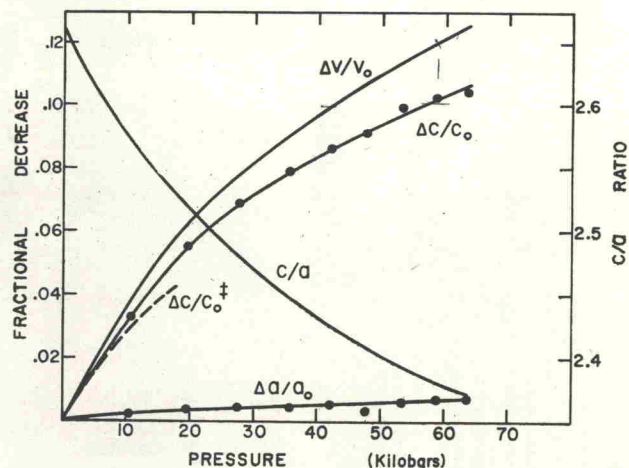


FIG. 10. Lattice parameters of hexagonal BN as a function of pressure to 70 kb. The dashed curve is data reported by Kabalkina and Vereshchagin (See Ref. 7).

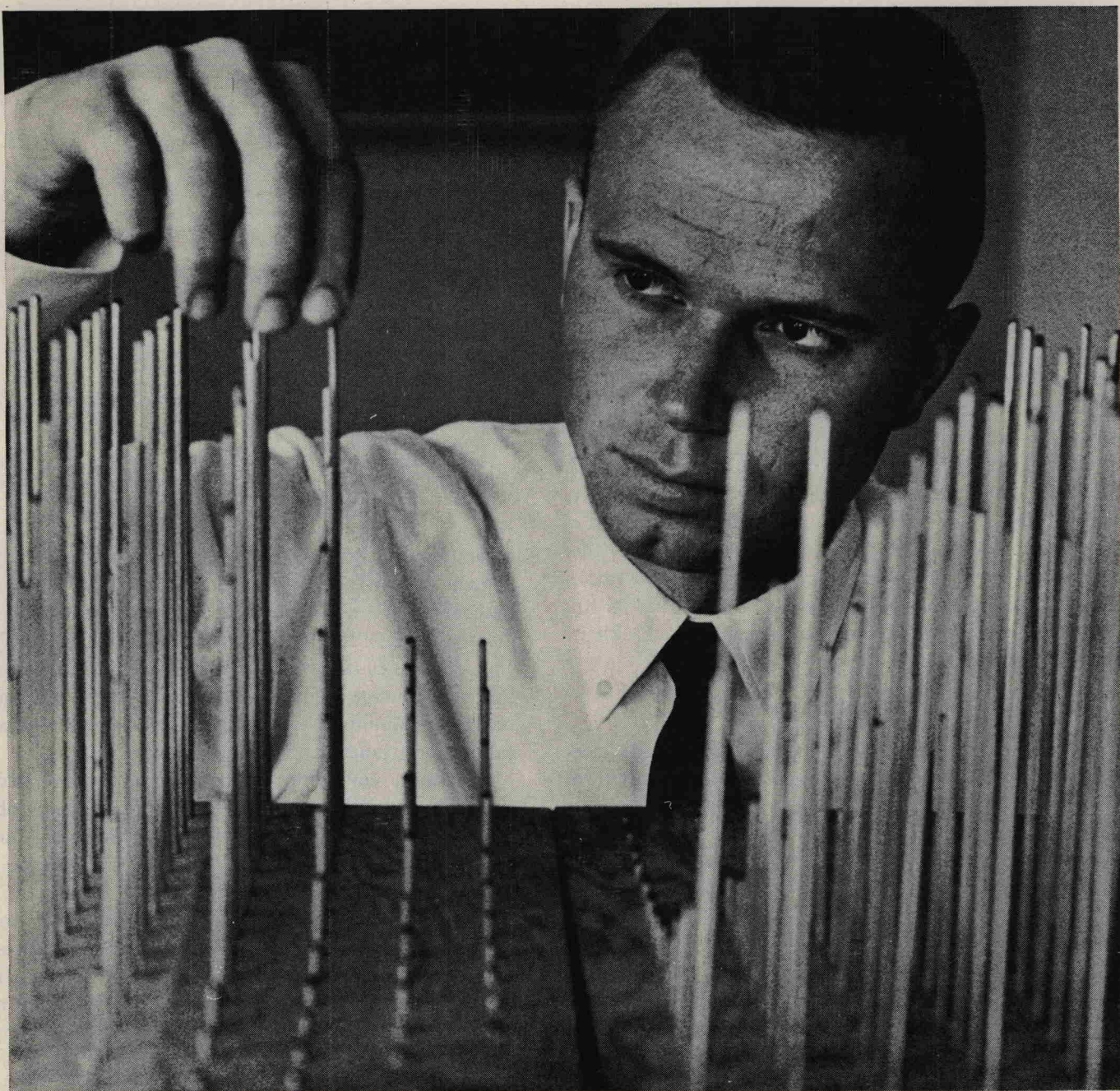
technique for investigating several high pressure phenomena in a manner not previously available. The simultaneous observation of two phases of one material as indicated for KCl in Fig. 6 is one illustration. Similarly one can simultaneously observe two different substances in intimate contact, thus assuring equal pressures. Such a technique should be useful in pressure and temperature calibration studies.

Since a one-to-one correspondence must be assumed between the atomic separation and pressure in a given phase, x-ray diffraction measurements also provide a method of separating the true sample hysteresis from apparatus hysteresis during decrease of pressure. Furthermore, if a calibrating substance of known compressibility is mixed with the sample, the pressure is known at any time after numerous applications and reversals of pressure and temperature. Such studies may be useful in learning more about the operation of the tetrahedral press itself. Limited observations of this nature have been made.

The possibility of observing the onset of a chemical reaction as well as measuring reaction rates is evident. The use of two independent counters in such a study would have great advantages. Experiments of this nature have not yet been conducted.

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