...nt indicated that ...Br. Three differ- ...re used to obtain ...a pair of natural ...chanical cutting ... [100] direction ...er at 20°C were ... 1.1935±0.0005 ...) was fly cut to ...d the length L_{20} ...007 cm at 20°C. ...the atmosphere, ...ll these crystals ...length measure- ...vere applied to ...es in the elastic

...calculated from ...C; this unit cell ...x-ray investiga- ...elastic constants ... of temperature

$$\ldots)^2/\delta^2, \tag{5}$$

...s the true round- ...ound wave, and ...temperature T. ...l from the poly- ...of Simon and ...ture x-ray data ...Obviously, the ...l cell dimensions ...ion that a large ... small domains ...mains lying at ...100] directions, ...t of the volume ...very good agree- ...where the x-ray ...s change in L_T ...inuous variation ... data was used ...has a negligible ...lastic constants

...s a function of ...e another path- ...e sample length ...$_p$ is the length at ...al applied pres- ...temperature can

..., Acta Cryst. 14, ...J. Phys. Chem. 63, ...1957).

then be obtained as a function of pressure from equations of the type

$$C(p)=C(1\text{ atm})(\delta_1/\delta_p)^2 s(p), \tag{6}$$

where δ_1 and δ_p are the transit times corresponding to 1 atm and to a pressure p. In general, the calculation of $s(p)$ requires a knowledge of the isothermal compressibility as a function of pressure. However, an excellent approximation to $s(p)$ can be calculated directly from our present adiabatic velocity data[18] since the difference between the isothermal and adiabatic compressibilities is very small except in the immediate vicinity of the lambda point. [At 300°K and 1 atm, $(\beta^T-\beta^S)/\beta^S$ is only 0.007.] Since $s(p)$ values vary only between 1.00 and 1.02 for the pressure range 0 to 12 kbar, small uncertainties in the $s(p)$ variation do not cause significant errors in the elastic constant values (which depend mostly on δ_1/δ_p).

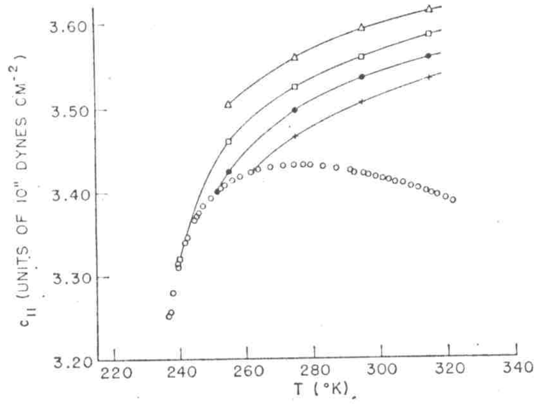

FIG. 3. Variation of c_{11} with temperature. Open circles represent data at 1 atm; for a definition of the symbols used for values at various constant volumes, see the legend of Fig. 5.

For measurements made at 1 atm, the quartz transducers were cemented to the sample with Dow resin 276-V9 as the seal material for all runs between 215° and 320°K. Below 215°K, these seals broke and Nonaq stopcock grease was used in a few runs despite the fact that it seemed to dissolve the sample slowly. Since the Dow resin was soluble in the hydraulic pressure fluid, it was necessary to find a new seal material for the high-pressure work. A polymer of phthalic anhydride and glycerin was found suitable[12] and was used for all the pressure runs.

The Dow resin and Nonaq seals were all very thin. Thus the phase shifts γ were small (between $-5°$ and $-8°$) at all temperatures, and the corrections to the transit times[12] due to phase shifts amounted to only 0.01% at 1 atm. Since all high-pressure measurements were carried out at a frequency equal to the resonance frequency of the transducer at 1 atm, there were appreciable changes in the phase shifts γ as a function of pressure. This effect of pressure on the behavior of

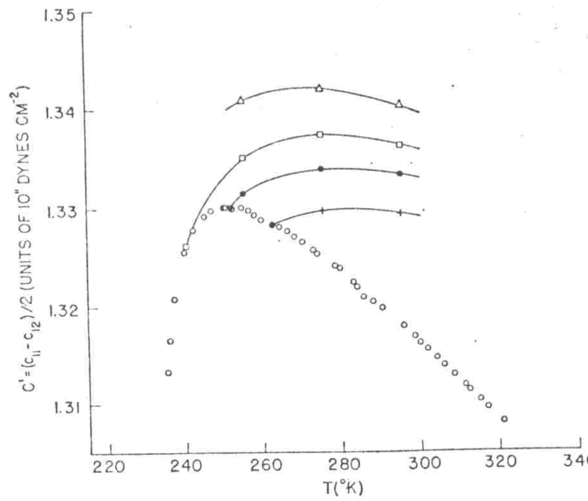

FIG. 4. Variation of C' with temperature. Open circles represent data at 1 atm; for a definition of the symbols used for values at various constant volumes, see the legend of Fig. 5.

the transducers is known[14] and was corrected for. The effect of pressure on the seal is not known and has been neglected.

RESULTS

Constant-Pressure Data

The open-circle points shown in Figs. 3–5 are experimental data points for the elastic constants c_{11}, c_{44}, and C' as functions of temperature at 1 atm. Smooth-curve values of these directly measured quantities are presented in Table I together with the adiabatic bulk modulus $1/\beta^S$, which can be calculated from

$$1/\beta^S=c_{11}-4C'/3. \tag{7}$$

Since the temperatures in Table I are all above the lambda point, all entries pertain to the disordered cubic phase of NH_4Br.

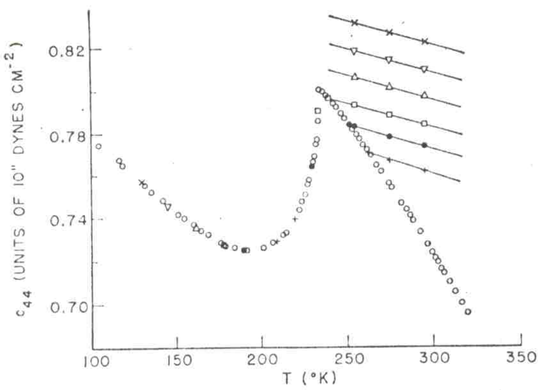

FIG. 5. Variation of c_{44} with temperature. Open circles represent data at 1 atm. Values at various constant volumes are distinguished by the symbols: $X\cdots V_{12}$ ($a_{12}=4.040$ Å); $\nabla\cdots V_{13}$ ($a_{13}=4.0425$ Å); $\triangle\cdots V_{14}$ ($a_{14}=4.045$ Å); $\square\cdots V_{15}$ ($a_{15}=4.0476$ Å); $\bullet\cdots V_{16}$ ($a_{16}=4.0496$ Å); $+\cdots V_{17}$ ($a_{17}=4.0517$ Å).