and it is likely that the values in these two directions are very similar, if not identical, in NH_4Br also.

Transverse waves. There is no appreciable attenuation for ultrasonic shear waves corresponding to the elastic constant c_{44}. However, the transverse wave propagating in the [110] direction and polarized perpendicular to the [001] direction (c' wave) does exhibit critical attenuation. Initially it was difficult to obtain a satisfactory echo pattern at high frequencies, but proper impedance matching and improvement of the parallelity of the (110) faces by repeated flycutting of crystal II resulted in a reasonably good exponential pattern of more than 15 echoes at room temperature. Because the attenuation of this c' wave was smaller than that of the c_{11} wave, it was possible to carry out 30 and 50 MHz measurements closer to T_λ than before. Plots of α vs f^2 were linear at all temperatures, but the intercept was not independent of temperature as in the case of the c_{11} wave. The background attenuation α_0 had an essentially constant value of 1.3 dB cm^{-1} in the range $4.5 < \Delta T < 12.5$ °K but increased steadily on approaching the transition (for example, $\alpha_0 = 2.1$ at $\Delta T = 2.37$ °K and 4.8 at $\Delta T = 0.80$ °K). Smooth-curve values of α_c/ω^2 as obtained from the slopes of these α_{obs}-vs-f^2 plots are given in Table I. It is possible to approximate these transverse α_c/ω^2 values with the power law given in Eq. (1), but since a log-log plot of α_c/ω^2 vs ϵ shows distinct curvature, one is not able to determine an unambiguous value for the exponent l. Values of l between 1.35 and 1.5 are compatible with the data: for $l = 1.35$, one finds $S = 0.6 \times 10^{-19}$ sec^2 cm^{-1}; for $l = 1.5$, the corresponding $S = 0.3 \times 10^{-19}$ sec^2 cm^{-1}.

B. Attenuation in the Tetragonal Ordered Phase

Since no measurements were made below T_λ on crystal II, we observed only the longitudinal attenuation corresponding to that measured for the c_{11} wave in the disordered phase. It is not known for certain that the ordered crystal consisted of a single domain. Even if it did, the tetragonal axis could have been oriented either parallel or perpendicular to the direction of sound propagation (see Sec. III C). Since the longitudinal attenuation and velocity measurements were made in the same run, without heating the crystal above T_λ, the α values reported here and the $c_{1\alpha\varepsilon}$ values reported in Sec. III C definitely correspond to the same configuration of the ordered crystal.

The longitudinal attenuation in the tetragonal phase was only measured at 10 MHz since echoes could not be obtained at higher frequencies between 200 °K and the transition. The data reported here were obtained from an echo pattern which was as exponential as those in the disordered phase. Far from the transition, five echoes were measured and the average deviation of the attenuation values obtained from different echo pairs was less than 10%. (Two preliminary runs on the somewhat imperfect crystal with path length $2L = 1.4132$ cm gave much larger α values and more scatter in the data as a function of temperature. This suggests the necessity of having a very good single crystal in order to achieve a single domain in the tetragonal phase.)

A simple power-law dependence of $\alpha_c = \alpha_{obs} - \alpha_0$ on ΔT could be obtained when α_0 was assigned any constant value between 0.3 and 0.7 dB cm^{-1}. In view of the fact that α_0 was 0.3 dB cm^{-1} in the disordered phase, a value of 0.5 dB cm^{-1} was assumed to be a reasonable choice for the ordered phase since some additional background attenuation would be expected owing to imperfections in the domain structure. The α_c values shown in Fig. 2 and the α_c/ω^2 values given in Table I were calculated using this choice of α_0. As indicated by Fig. 2, the 10-MHz longitudinal attenuation can be well represented by Eq. (1) with $S = (130 \pm 30) \times 10^{-19}$ sec^2 cm^{-1} and $l = 0.75 \pm 0.05$.

C. Velocity Measurements

The ultrasonic velocity u in the tetragonal ordered phase has been measured at 10 MHz by bonding a transducer to one of the (100) faces of a disordered cubic crystal and cooling the crystal slowly with a temperature gradient applied parallel to the direction of sound propagation (see Sec. II). When a good echo pattern was observed be-

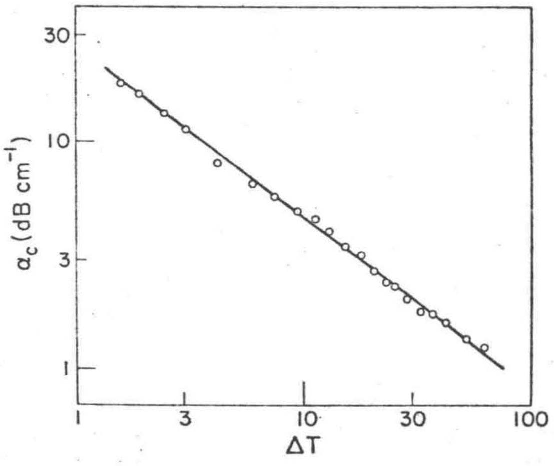

FIG. 2. Log-log plot of α_c vs ΔT (in °K) for a 10 MHz longitudinal wave in the tetragonal ordered phase of NH_4Br. These α_c values were obtained using $\alpha_0 = 0.5$ dB cm^{-1}. The line represents a power-law fit to the data using Eq. (1).