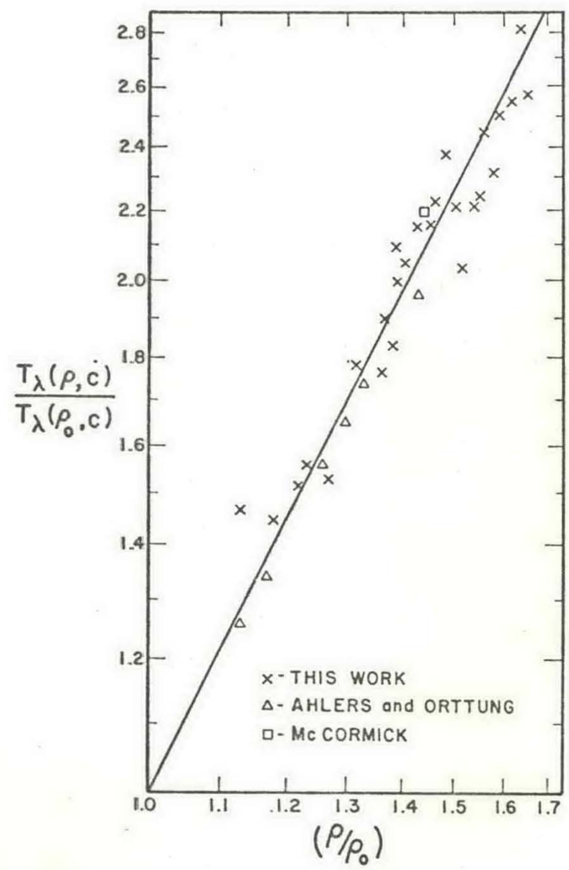

FIG. 8. Plot of the ratio of $T_\lambda(\rho,c)/T_\lambda(\rho_0,c)$ versus relative density. The solid line has a slope of 2.0. The points from specific-heat measurements are deduced from Fig. 8 of Ref. 14.

small that they cannot be measured beyond this distance. An empirical relation was obtained between ΔH and the second moment M_2 for selected samples of lines at different densities and ortho concentration (Table II). It was found quite generally that

$$\Delta H=(2.95\pm0.15)M_2^{1/2}(h/g\beta)\ (\mathrm{G}). \quad (8)$$

This ratio of 2.95 is to be compared with the value of 2.0 for a Gaussian line. In order to compare our results with those of previous workers, we will present them in terms of the linewidth as well as the root of the 2nd moment. Comparison with the theory for a rigid lattice [Eq. (4)] can then be made with help of Eq. (8). From theory one expects ΔH to be proportional to $c^{1/2}$ and to the relative density (ρ/ρ_0). That this is so is shown in Fig. 6 and Fig. 7. The line $\Delta H/c^{1/2}=7.1(\rho/\rho_0)$ G fits the points well within error. It should be noted that all these data were taken with c between 0.75 and 0.55. McCormick measured the linewidth versus relative density but with c undetermined. He found approximately $\Delta H=5.8(\rho/\rho_0)$ G. Our results would give this relation for 68% ortho. As this might have been the median value of the concentration in his work, there is no great discrepancy between his result and ours.

TABLE II. Experimental moments of H_2 lines at 4.2°K for several densities and ortho concentrations.

ρ/ρ_0	c	ΔH (in kc)	M_2 $[(kc)^2]$	M_4 $[(kc)^4]$ $(\times10^{-4})$	$\frac{M_4}{M_2^2}$	$\frac{\Delta H}{M_2^{1/2}}\frac{g\beta}{h}$
1.00	0.743	25.3	75.4	1.346	2.36	3.02
1.00	0.646	25.5	70.8	1.18	2.36	3.04
1.19	0.648	31.0	101.8	2.44	2.36	3.08
1.34	0.622	31.6	124.3	3.76	2.42	2.80
1.45	0.72	37.8	151.7	5.53	2.40	3.07
1.60	0.579	37.1	167.9	6.85	2.43	2.86
				average	2.39	2.95

With the empirical ratio [Eq. (6)] the theory of the second moment would predict the linewidth to be about 6.5 $(\rho/\rho_0)c^{1/2}$ for both the hcp and bct lattices. The agreement between theory and experiment is just within the combined error. It could perhaps be further improved if the following possibilities were considered:

(1) Clustering of ortho molecules or at any rate some sort of correlation between their respective positions and rotations.

(2) A larger influence of the zero point motion and rotation than theoretically expected.[34]

These possibilities cannot presently be discussed in more detail because of the lack of more extensive data on the dynamical behavior of solid H_2.

TABLE III. The transition temperature T_λ as a function of density and ortho concentration. (Experimental data.)

ρ/ρ_0	$P\times10^2$ (atm)	Ortho concentration c	T_λ (°K)
1.13	4	0.69±0.01	2.05±0.06
1.18	6	0.71	2.10
1.22	8	0.69	2.10
1.23	8	0.73	2.41
1.27	11	0.71	2.23
1.32	14	0.73	2.74
1.36	17	0.73	2.70
1.37	17	0.71	2.79
1.38	18	0.73	2.79
1.39	19	0.69	2.92
1.39	19	0.73	3.06
1.40	20	0.72	2.99±0.08
1.40	20	0.70	2.92
1.43	22	0.73	3.31
1.45	24	0.68	2.91
1.46	25	0.68	3.02
1.47	26	0.715	3.23
1.48	27	0.715	3.53
1.50	29	0.685	3.01
1.51	30	0.69	3.03
1.52	31	0.69	2.77
1.54	33	0.68	3.02
1.56	36	0.71	3.21
1.58	38	0.66	2.89
1.59	40	0.725	3.81±0.10
1.62	44	0.72	3.81
1.63	46	0.71	3.65
1.65	49	0.725	3.87
1.66	50	0.72	4.16
1.68	53	0.695	3.59