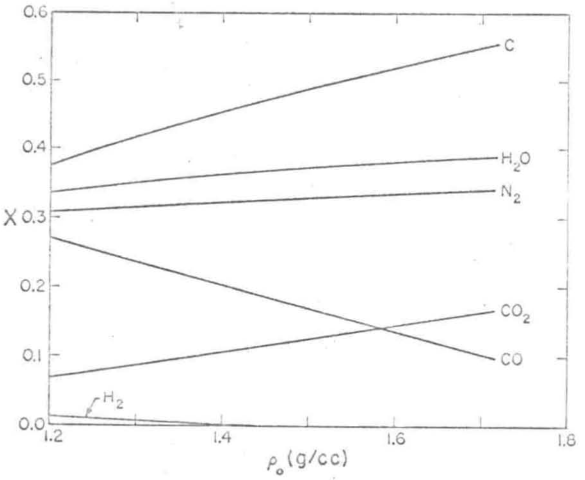

FIG. 9. Variation of C−J composition with loading density for 65/35 RDX/TNT. For the gaseous components the ordinate x is the mole fraction n_i/n_g; for carbon, x is n_s/N_C, the fraction of the total amount of carbon which is present as graphite.

Thus it appears to be unlikely that the large disagreement between the calculated and experimental p_{CJ} for TNT can be due to having the wrong γ^* for graphite. Although this disagreement remains unexplained, several calculations were done to see if a set of parameters could be found which would produce agreement with the experimental data for TNT only. It was found that with $\alpha=0$ (β and κ being adjusted to match experimental $D-\rho_0$), the calculated and experimental values of p_{CJ} for TNT agreed to within 2%. Agreement could also be obtained by taking $\alpha=0.25$ and assuming that the graphite was present in such a finely divided state that its heat of formation relative to that of the bulk material was +20 kcal/mole. However, both of these assumptions produced serious disagreement with experiment in the case of the other four explosives.

Table VI compares C−J quantities calculated with a number of different equations of state. With the exception of Paterson's, these equations of state all contain some adjustable parameters which have been evaluated with the aid of experimental $D-\rho_0$ data. The wide variation in the calculated $D-\rho_0$ relation is due in large part to differences in the experimental data obtained from various sources. Since the calculated pressure depends strongly on the detonation velocity [see Eq. (17)], comparisons are perhaps more appropriately based on the purely thermodynamic quantities γ^* and α^* than on the hydrodynamic pressure. Upon any basis the data in Table VI are notable mainly for variety rather than consistency. However, the most extreme values, namely, those due to Cook, Caldirola, and Paterson, are associated with equations of state such that $(\partial E/\partial v)_T = T(\partial p/\partial T)_v - p$ is zero. Thus these equations do not provide for any potential energy of molecular interaction; this can hardly be physically accurate since the densities concerned are greater than those of the undetonated solid explosive. The obvious result is excessively large thermal energies, hence the high C−J temperatures calculated by these authors.[30]

In summary it may be said that the Kistiakowsky-Wilson equation of state is perhaps as satisfactory as any which has yet been proposed, insofar as agreement between calculated results and experimental data is concerned. However, its calculated value for the C−J pressure of TNT leaves a good deal to be desired, and it has other unattractive features as well. The results obtained with the geometrical k_i (Fig. 6), and the rather different set of k_i (Table III) required to give agreement with experiment, indicate that *a priori* estimation of the covolumes is likely to be unsatisfactory and extensive least squaring together with additional experimental data would be required for the introduction of any new chemical components into the detona-

TABLE V. Adiabat and shock Hugoniot through the C−J point 65/35 RDX/TNT ($\rho_0=1.715$ g/cc).

	Adiabat		Shock Hugoniot	
V/V_0	p	γ^*	p	R(Eq. 13)
0.600	0.5316	2.98	0.5344	1.259
0.625	0.4710	2.96	0.4723	1.202
0.650	0.4195	2.94	0.4201	1.151
0.675	0.3755	2.93	0.3757	1.104
0.700	0.3377	2.91	0.3377	1.063
0.725	0.3050	2.90	0.3050	1.025
0.743(CJ)	0.2843	2.89	0.2843	1.000
0.750	0.2765	2.89		
0.800	0.2297	2.85		
0.900	0.1646	2.81		
1.000	0.1227	2.76		
1.2	0.0746	2.69		
1.4	0.0495	2.62		
1.6	0.0350	2.55		
1.8	0.0260	2.50		
2.0	0.0201			

TABLE VI. Comparison of calculated[a] C−J quantities ($\rho_0=1.6$ g/cc).

Explosive	Source	D(m/sec)	$dD/d\rho_0$	T (°K)	p (Mb)	γ^*[Eq. (17)]	α^* (Fn.29)
RDX	Experimental	8060	3470	···	0.265[b]	2.92[b]	0.32
	This paper	8037	3250	2788	0.273	2.79	0.30
	Brinkley-Wilson[c]	7520	3120	3570	0.218	3.15	0.49
	Cook[d]	8040	~3570	5750	0.258	3.01	~0.34
TNT	Experimental	6840	2800	···	0.168[b]	3.44[b]	0.68
	This paper	6894	3120	2715	0.196	2.88	0.25
	Brinkley-Wilson[c]	7290	4900	3170	0.178	3.78	0.30
	Cook[d]	7030	~3660	4170	0.152	4.20	~0.84
	Caldirola[e]	6900	2780	4030	0.212	2.59	0.18
	Jones-Miller[f]	7480	5260	3300	0.175	4.12	0.41
	Kihara-Hikita[g]	6950	3440	2270	0.195	2.96	0.21
	Paterson[h]	6790	3310	3900	0.127	4.81	1.26

[a] Some of the entries are approximate only, involving graphical interpolation or extrapolation from data for other loading densities.
[b] Estimated from the values in Table II with the aid of (17) and our calculated variation of γ^*+1 with ρ_0.
[c] See reference 10.
[d] See reference 2.
[e] See reference 1.
[f] See reference 3.
[g] See reference 6.
[h] See reference 4.

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[30] S. R. Brinkley, Jr., J. Chem. Phys. 15, 113 (1947).

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