TABLE II. Experimental data for explosives.

Explosive and density for p_{CJ}	Detonation velocity[a] $D=A+B\rho_0$, (m/sec) A	B	Dural pressure[b] (Mb)	C–J pressure[c] (Mb)
RDX				
$\rho_0=1.800$	2515	3466	0.398	0.341
$C_{3.5}H_{6.2}O_6N_{5.6}$[d]				
$\rho_0=1.748$	2785	3233	0.378	0.316
78/22 RDX/TNT				
$\rho_0=1.755$	2702	3193	0.382	0.317
65/35 RDX/TNT				(0.286)[e]
$\rho_0=1.715$	2673	3127	0.358	0.292
TNT[f]				
$\rho_0=1.640$	2360	2799	0.226	0.177

[a] Reference 24.
[b] Reference 13.
[c] See text.
[d] Explosive presently classified.
[e] Reference 14.
[f] More work on the TNT $D-\rho_0$ curve is in progress.

and transmitted shocks, respectively; the subscript 0 refers to material ahead of the shock. (All velocities are referred to the material ahead of the shock in question.) The value of R need not be known accurately, the so-called "acoustic approximation" $R=1$ giving results correct to within a percent or so. However, we have used values of R obtained by calculating shock curves for the detonation products.

The measurements of p_{CJ} and $D-\rho_0$ were taken on explosives of slightly differing composition and density, so all the data were corrected to the composition and density values in Table II by means of an error expression obtained by differential analysis of (13) with $R=1$, and by making use of the experimental dependence of D on composition and density:

$$\delta U_{fs}/U_{fs}=-0.86\delta\rho_0-0.0023\delta(\%\text{ RDX}), \quad (14)$$

in which U_{fs} is the experimentally measured free-surface velocity. All pressure values quoted in the table are believed to be accurate to 1 or 2%.

In attempting to determine a set of equation-of-state parameters from this experimental data, we started with a set of "geometrical" k_i (Table III) based on molecular sizes estimated from both virial-coefficient data and spherical volumes from bond lengths and van der Waals radii. Using these k_i in preliminary calculations it was found that $\alpha=0.5$, $\beta=0.09$, $\kappa=11.85$ would give $D-\rho_0$ and p_{CJ} close to the experimental values for 65/35 RDX/TNT. However, the agreement for other explosives was rather poor (Fig. 6). A least-squares process was therefore carried out (with this same α and β) to determine a set of k_i which would give the best agreement with all five explosives. Since the calculations indicated that the reaction $2CO\rightarrow CO_2+C$ (graphite) shifts appreciably to the right as ρ_0 is increased, we allowed points of different ρ_0 for the same explosive to enter the least squaring on an equal weight with those from different explosives. Accordingly, the least squaring was carried out as follows:

Using a guessed set of k_i, a value of $k=\kappa\sum x_i k_i$ was determined at four loading densities (1.2, 1.4, 1.6, and maximum) for each of the five explosives by adjusting κ in each case until the calculated D was equal to the experimental value. If we designate these values of k as k_{obs} we then have a set of 20 linear equations for the set of k_i:

$$\sum_i (x_i)_r k_i=(k_{obs})_r, \quad r=1,2,\cdots 20. \quad (15)$$

These were solved by least squares for a new set of k_i.

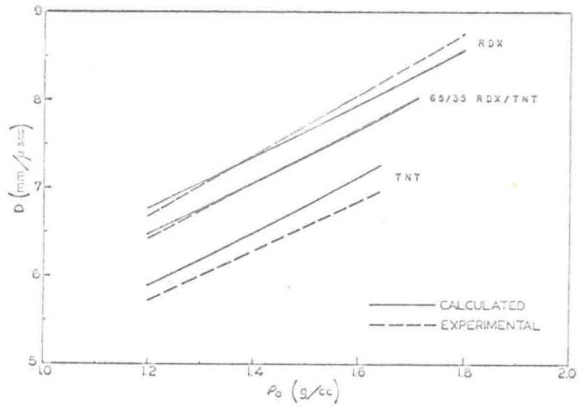

FIG. 6. Comparison of calculated and experimental $D-\rho_0$ curves for "geometrical" k_i; $\alpha=0.5$, $\beta=0.09$, $\kappa=11.8516$.

The first result of this process was large negative values for k_{H_2} and k_{NO}, probably because H_2 and NO were present in such small amounts. Therefore the equations were solved again with these two covolumes held constant at their original values (multiplied by the average κ from the determination of all of the k_{obs}). Table III contains the resulting k_i,[28] together with our "geometrical" set and the values obtained by Brinkley and Wilson.

In Figs. 6 and 7 the calculated results for $D-\rho_0$ are compared with experiment for both the geometrical and the least-square k_i. (To avoid confusion, results

TABLE III. Values of k_i.

Source	k_i H_2	CO_2	CO	H_2O	N_2	NO
Brinkley-Wilson[a]	153	687	386	108	353	233
"Geometrical"	180[b]	670	390	360	380	350
	2133[c]	7940	4622	4267	4505	4148
Least squares	2133	6407	3383	3636	6267	4148

[a] See references 9 to 11.
[b] Original set, chosen so that k_{CO} would be about the same as that used by Brinkley-Wilson.
[c] Scaled by the average κ (11.85) from the determination of all of the k_{obs} (see text).

[28] In a preliminary trial of the least-squaring process on three explosives with $\alpha=0.6$ it was found that carrying out the entire least-squaring process a second time (starting with the k_i produced from the first least squaring) produced almost no change in the k_i. It was also found that the rather sizeable change in k_i from the initial geometrical set to the first least-square set produced composition changes of at most a few percent of the original mole fractions. Since the determination of so many k_{obs} is rather expensive in machine time, the final least squaring was started with the k_i from the above trial run and was done only once.