In Eq. (6) $-E^*$ is the minimum potential energy between two molecules and r_0 is their separation when $V(\rho)=0$. Putting (6) into the limiting expression for low densities:

$$\gamma=\frac{3P_0}{b_0}\int_0^\infty \rho^{-4}e^{-\beta V(\rho)}d\rho \qquad (7)$$

(where $\beta=1/kT$, $b_0=2\pi Nr_0^3/3$) and using the parameters $b_0=115.5$ cc/mole, $E^*/k=199.2$°K calculated by Bird, Spotz, and Hirschfelder[24] from the second virial coefficient data for C_2H_4, we find: $\gamma=+0.143$ at 50°C. This figure is somewhat lower than the value $\gamma=+0.22\pm0.06$ given by the least squares quadratic fit of our low density experimental data. In this respect our results are qualitatively similar to those of Keyes and Oncley[2] for CO_2 and C_3H_8. For these gases γ_{obs} is about twice γ_{calc}.

It is hardly profitable to speculate on these differences since the C-M/d curves are apparently of quite complex form even at the lowest densities,* and the extrapolated values of γ may be subject to very large errors. There is an obvious need for more accurate C-M measurements in the density range 0–0.002 moles/cc. These were not possible with our apparatus.

A point of interest is that the densities at which the slopes of the C-M/d plots abruptly change sign correspond quite closely with the critical densities of the gases. This is shown in Table III.

It may also be significant that above this density the C-M function decreases with increasing density, an effect which is generally found in liquid systems.

TABLE III.

Temp.	CO_2 50°C	CO_2 100°C	C_2H_4 25°C	C_2H_4 50°C	
d (for max. C-M)	0.0123[a]	0.0135[a]	0.0070	0.0083	mole/cc
d (critical)	0.0104[b]		0.0079[b]		mole/cc

[a] The data for CO_2 are taken from A. Michels and L. Kleerekoper, Physica 6, 586 (1939).
[b] Values from International Critical Tables 3, 248 (1928).

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[24] Bird, Spotz, and Hirschfelder, J. Chem. Phys. 18, 1395 (1950).

* The steps in these curves which are found in nearly all the recorded data suggest that there may be relatively sharp changes in the molecular distribution functions with density.