gradient is positive, and an inversion is said to exist. There is little or no turbulence and virtually no dilution of the effluent. This condition is illustrated in figure 2.

The mathematics of turbulent diffusion is complex. This discussion will not review the theoretical methods by which quantitative relationships governing the dilution of stack effluents have been developed, but we will see what these relationships are, and how they can be used practically in air pollution studies. One equation which has been developed by Sutton [1] on the basis of a combined theoretical and empirical approach has proved quite useful in the conduct of field investigations, as we shall show by several examples.

Fig. 1.—Unstable atmosphere. Note the rapid dilution of the effluent. (Negative 3-64-9, reproduced by permission of Brookhaven National Laboratory, Upton, N. Y.)

The Sutton equation for the theoretical ground level concentration downwind of a stack is:

$$\chi = \frac{2 \times 10^3 Q}{\pi \, Cy \, Cz \, u \, x^{(2-n)}} e^{\frac{-h^2}{Cz^2 x^{(2-n)}}} \tag{1}$$

where

χ = concentration at ground level (milligrams/cubic meter)
Q = rate of emission from stack (grams/second)
h = stack height (meters)
x = distance from stack (meters)
n = turbulence parameter
Cy,Cz = diffusion coefficients
u = wind velocity (meters/second)

1. Sutton, O. G.: The Theoretical Distribution of Airborne Pollution from Factory Chimneys, Quart. J. Roy. Met. Soc. **73**:257, 1947.