TABLE 7

Analyses of Particulates in Atmospheres of Nonurban Areas
(Average values in $\mu g./m^3$)

| | Vicinity of | | | | |
|---|---|---|---|---|---|
| | Boonsboro | Salt Lake City | Atlanta | Cincinnati | Portland |
| Acetone-soluble | 8.7 | 6.2 | 9.3 | 9.0 | 12.6 |
| Mn | 0.00 | 0.04 | 0.11 | 0.07 | 0.04 |
| Pb | 0.1 | 0.1 | 0.9 | 0.4 | 0.3 |
| Sn | <0.01 | <0.01 | <0.01 | 0.01 | <0.01 |
| Fe | 3.7 | 4.1 | 2.7 | 2.4 | 3.6 |
| V | 0.003 | Nil | 0.004 | <0.001 | 0.002 |
| Cu | Nil | 0.28 | 0.01 | 0.19 | <0.01 |
| Be | 0.0001 | <0.0001 | 0.0002 | 0.0001 | 0.0001 |
| Ti | 0.26 | Nil | 0.13 | 0.01 | Nil |
| As | 0.01 | 0.03 | 0.01 | <0.01 | 0.04 |
| $F^-$ | — | — | Nil | 0.26 | |
| $SO_4^{--}$ | 0.3 | <0.01 | 0.5 | 1.9 | 0.2 |
| $NO_3^-$ | — | — | — | 0.7 | |
| *Total load* | 68 | 55 | 71 | 45 | 86 |

TABLE 8

Relationship between Averages of Total Particulates and Organic Fraction

| | Average total load ($\mu g./m.^3$) | Average acetone-solubles ($\mu g./m.^3$) | Per cent acetone-soluble |
|---|---|---|---|
| Large cities | | | |
| Los Angeles | 265 | 57.3 | 21.6 |
| Philadelphia | 188 | 30.0 | 15.9 |
| Detroit | 344 | 50.9 | 14.8 |
| Chicago | 280 | 45.8 | 16.4 |
| New York | 244 | 37.7 | 15.5 |
| Intermediate cities | | | |
| Cincinnati | 176 | 31.4 | 17.8 |
| Kansas City | 146 | 18.4 | 12.6 |
| Portland | 143 | 32.1 | 22.4 |
| Atlanta | 137 | 24.2 | 17.6 |
| Houston | 129 | 18.5 | 14.3 |
| San Francisco | 104 | 19.4 | 18.6 |
| Minneapolis | 120 | 15.8 | 13.2 |
| Washington | 130 | 27.3 | 21.0 |
| "Atypical" cities | | | |
| Anchorage | 308 | 21.4 | 6.9 |
| Charleston | 288 | 25.4 | 8.8 |
| Fort Worth | 110 | 14.1 | 12.8 |
| Nonurban areas | | | |
| Boonsboro, Md. | 68 | 8.7 | 12.8 |
| Salt Lake City | 55 | 6.2 | 11.3 |
| Atlanta | 71 | 9.3 | 13.1 |
| Cincinnati | 45 | 9.0 | 20.0 |
| Portland | 86 | 12.6 | 14.7 |





## A. AIR-CLEANING DEVICES

The most effective and positive method of controlling air pollutants is at the source with proper air-cleaning devices. This method of control is adequately discussed in Chapter IX.

## B. DILUTION

The dilution or dispersion of the pollutants prior to reaching the ground level from tall stacks has been the subject of extensive study for many years. In 1932 Sutton[35] developed a theory on dispersion by assigning an expression of the appropriate dimensional form to the correlation coefficient of Sir Geoffrey Taylor's statistical theory of turbulence. Shortly thereafter Bosanquet and Pearson[36] published in the *Faraday Society Reports* a theoretical equation based on voluminous studies of smoke from stacks of different heights, which in substance is as follows: The peak concentration of an effluent reaching the ground from a stack occurs about 10 stack lengths from the base; and varies inversely as the square of the stack height. This means that the ground concentration from a 150-foot stack would be approximately 17 times that of a 600-foot stack. After the peak the concentration falls off until after some 50 stack lengths it varies as the inverse square of the distance from the source.

The temperature of the gases being emitted also has considerable influence on the ground concentrations. The investigation of Hill, Thomas, and Abersold[37] show clearly the effect of stack gas temperature on ground concentrations. During periods of low wind speed, the effluent rising from a stack continues to rise until it encounters air of equal density. Then it disperses laterally in all directions. The height that the effluent will reach will depend on its temperature unless it is forced out of the stack at great velocity. It is estimated that each degree Fahrenheit of rise in stack temperature is the equivalent of $2^1/_2$ feet of added stack height.

R. S. Scorer[38] has pointed out that there is a great advantage in giving the plumes the largest possible cross section, since this will minimize losses of their buoyancy to the surrounding air and so raise the height to which they will eventually rise. In his words: "The objective should be, therefore, to get them as high into the air as possible by means of a very few tall, wide chimneys and a certain amount of brute force."

[35] O. G. Sutton, A theory of eddy diffusion in the atmosphere, *Proc. Roy. Soc.* (*London*). A135, 143–165 (1932).

[36] C. H. Bosanquet and J. L. Pearson, The spread of smoke and gases from chimneys, *Trans. Faraday Soc.*, **32**, 1249–1263 (April 1936).

[37] C. R. Hill, M. S. Thomas, and J. H. Abersold, Effectiveness of high stacks in overcoming objectionable concentrations of gases at ground level, *Ind. Hyg. Foundation Amer., Proc. of Annual Meeting, November, 1944.*

[38] R. S. Scorer, Plumes from tall chimneys, *Weather*, **10**, 106–109 (1955).