pally from industrial plants, accumulating during periods of exceptionally prolonged meteorological *inversion* and fog, contributed to the illness of many persons, and to the death of some who were especially susceptible.

Absorption of Solar Radiation

Absorption of solar ultraviolet light by smoke and soot is recognized as a health problem in many industrial cities. Measurements of solar radiation in Baltimore[6] by actinic methods demonstrated that ultraviolet light intensity in the country was 50 percent greater than in the city. In New York City[7] a loss as great as 50 per cent in visible light was found by photoelectric measurements.

ODOR NUISANCE

A problem companionate with smoke abatement is the control of odor nuisance in the neighborhood of industrial plants discharging noxious or offensive air contaminants. Community planning and zoning will avoid much of the difficulty in the future, but meanwhile many industrial cities must resort to corrective measures by requiring installation of air cleaning devices, alteration of manufacturing processes, or termination of the offensive operation in residential or commercial districts.

Control of outdoor odor nuisance is especially troublesome because of the extremely minute quantities of contaminant that are capable of offending through a wide area. New industrial chemicals with strange or unfamiliar odors tend to receive more attention from the neighborhood than the customary odors generated by well known processes and raw materials. Methods of odor control currently in use include charcoal adsorption, scrubbing towers and air washers, chlorination, condensation, masking, passage of the odorous air through combustion chambers, dispersion through a tall stack, and best of all, substitution of less offensive materials whenever possible.[8, 9, 10, 11]

Control of air quality within buildings ventilated for human occupancy is discussed in Chapter 6. Tobacco smoke odors, cooking odors and body odors are air contaminants of the nuisance type which now command a decisive position in the standards of air quality for indoor comfort. However, the engineer will find, at times, that odors originating *outside* buildings in industrial or business districts may determine the kind and capacity of equipment he must provide for a high quality air supply installation.

INDUSTRIAL AIR CONTAMINANTS

Many industrial processes are sources of contaminants. Their control is an important function of the ventilating or air conditioning engineer, because the atmosphere within buildings is the medium whereby such finely divided matter is dispersed and transported from the source to remote locations where it may cause property damage, nuisance, fire, explosion, disease and even death.

Tables 3, 4 and 5 give maximum allowable concentration values for many industrial air contaminants. Some of these values have been proposed by *ASA* Sectional Committee Z37 on Allowable Concentrations of Toxic Dusts and Gases, and others by the Committee on Threshold Limits of the *American Conference of Governmental Industrial Hygienists*. The

values have been adopted by the *American Conference of Governmental Industrial Hygienists* and by many of the official industrial hygiene agencies.

It must be emphasized that these limits in the great majority of instances are only *suggested maximum working levels* since they are estimates, based in many cases upon incomplete environmental and medical studies. Where there is agreement between the *ASA* Standard Z37 and *A.C.G.I.H.* values, reliability of the *ASA* Standard is increased. The values are not fixed, but are subject to revision, upward or downward, with the development of new information. There is by no means complete agreement regarding these values among responsible industrial hygienists.

In applying these guide limits, the following factors must be considered:

1. The duration of exposure is 8 hr a day for 5 or 6 days a week.

2. The measurements are indicative of the concentration in the breathing zone of the exposed person.

3. The M.A.C. is usually accepted as the average exposure value when the upper limits do not greatly exceed the M.A.C. value. For example, it cannot be assumed that if 100 ppm is considered *safe* for 8-hour exposure, that 800 ppm for one hour will be permissible.

4. Two substances with similar M.A.C. values may be quite different as to physiological effects at other concentrations. In one instance the selection of a limit may be predicated upon a discomfort factor, with a wide margin of safety before systemic effects would be encountered, while in another case the value represents an appreciable fraction of the concentration which may be associated with severe and irreversible injury.

5. These values are *upper* limits; it is desirable to operate well below the levels if the engineering and economic factors permit. The prudent engineer will incorporate a reasonable margin of safety in his estimates of ventilation capacity.

In Table 3, Column 1 lists the *ASA* Sectional Committee Z37 M.A.C. values; Column 2, those of the *A.C.G.I.H.* Committee on Threshold Limits. Column 3 gives the value in grams per cubic meter or ounces per 1000 cu ft for the corresponding *A.C.G.I.H.* limits; Column 4 shows the liquid ounces of chemical, if liquid at 20 C (68 F), which, if equally dispersed in 1000 cu ft, would give the corresponding M.A.C.

In Table 4, Columns 1 and 2 are respectively the M.A.C. values from the *ASA* and *A.C.G.I.H.* Committees.

In Table 5, the M.A.C. values for industrial dusts as given were obtained from data of the *A.C.G.I.H.* Committee on Threshold Limits.

A.C.G.I.H. limits for either gamma or Roentgen radiations are 0.3 roentgens per week.

Information on the properties and effects, with respect to health, of specific industrial air contaminants is available in publications listed at the end of this chapter.

FLAMMABLE GASES AND VAPORS

Adequate ventilation is a primary requirement for minimizing the hazard of fire or explosion due to gases and vapors. The need for good ventilation is not removed by the use of other precautions, such as the elimination of known ignition sources, segregation of hazardous operations, adoption of safe building construction, and installation of automatic alarms. Some safety engineers regard over-ventilation of an operation employing flammable liquids as a legitimate operating charge for the privilege or necessity of using a dangerous process. However, it is not possible to