upon a number of factors, including the dietary and hygienic habits of the occupants (frequently reflecting their socio-economic status), the outdoor air supply, air space allowed per person, odor adsorbing capacity of air conditioning processes, and temperature and relative humidity. The intensity of odor sensation has been found to vary as the logarithm of the concentration of the odoriferous substance in the air, or inversely with the logarithmic function of the amount of outdoor air supplied and the air space per person.

The relation between air supply and occupancy has been reported by the Harvard School of Public Health[2] (Table 1) and the A.S.H.V.E. Research Laboratory.[3] Outdoor air requirements for removal of objectionable tobacco smoke odors are not accurately known, but available information and current practice indicate the need of 15 cfm per person or more.[4]

The total quantity of outside air to be circulated through an enclosure is often governed chiefly by physical considerations for controlling temperature, air distribution, and air velocity. Other factors which must be taken into consideration, include the type and usage of the building, locality, climate, height of rooms, floor area, window area, extent of occupancy, and the operation of the system distributing the air supply. Frequently, some of these factors, particularly the need for air movement and good distribution, may be satisfied by recirculation of inside air rather than outside air.

It will be noted that, with adequate air space, the rate of air change indicated in Table 1 is from 10 to 30 cfm per person. In rooms occupied by only a few persons, such an air change will be automatically attained in cold weather by normal leakage around doors and windows, and can easily be secured in warm weather by the opening of windows. With a space allotment of 400 cu ft per person, only 1½ air changes per hour are necessary to provide a ventilation rate of 10 cfm per person.

Therefore, in the ordinary dwelling with adequate cubic space allotment, no special provision for controlling chemical purity of the air is necessary (aside from removal of fumes from heating appliances). For such conditions, the control of air temperature is the major consideration.

In more crowded rooms (large offices, large workrooms, auditoriums), where the cubic space per person is less and it is usually impossible to admit untempered outside air without creating drafts, mechanical ventilation is essential.

The present data regarding the effect of cubic space on ventilation requirements are not universally accepted. The Code of Minimum Requirements for Comfort Air Conditioning[1] prescribes definite minimum requirements which should be familiar to the designing engineer. It should be emphasized, however, that the code fixes *minimum*, rather than *adequate* requirements.

Notwithstanding the rapid advance made in air conditioning, some persons still believe there is a stimulating quality in outdoor air (particularly country, mountain and seashore air) under ideal weather conditions, which is lacking in artificially conditioned air. It is apparent, however, that modern air conditioning insures control of the phenomena of nature for the service and comfort of man independently of weather conditions. Freedom of movement, action and thought, together with the variability of stimuli experienced by persons under ideal conditions in the country, mountains or seashore, undoubtedly has some stimulating effect. Various experimenters have attempted to duplicate the invigorating qualities of

TABLE 1. MINIMUM OUTDOOR AIR REQUIREMENTS TO REMOVE OBJECTIONABLE BODY ODORS UNDER LABORATORY CONDITIONS[2]

TYPE OF OCCUPANTS	AIR SPACE PER PERSON CU FT	OUTDOOR AIR SUPPLY CFM PER PERSON
Heating season with or without recirculation. Air not conditioned.		
Sedentary adults of average socio-economic status	100	25
	200	16
	300	12
	500	7
Laborers	200	23
Grade school children of average socio-economic status	100	29
	200	21
	300	17
	500	11
Grade school children of lower socio-economic status	200	38
Children attending private grade schools	100	22
Heating season. Air humidified by means of centrifugal humidifier. Water atomization rate 8 to 10 gph. Total air circulation 30 cfm per person.		
Sedentary Adults	200	12
Summer season. Air cooled and dehumidified by means of a spray dehumidifier. Spray water changed daily. Total air circulation 30 cfm per person.		
Sedentary Adults	200	<4

outdoor air by the use of ozone, ionization, or ultra-violet light, but results to date have been inconclusive or negative.[5]

Ozone in amounts of 0.01 to 0.05 ppm of air is allowable in comfort air conditioning. Above this limit there is a pungent, unpleasant odor and perhaps respiratory distress, depression, and stupor.[6]

PHYSICAL IMPURITIES IN AIR

Dust particles of almost any type can produce irritation of the mucous membranes of the nose and throat, if present in high concentrations. Certain dusts may be very harmful, but coal dust is tolerated well. The effects of various industrial dusts, pollens, etc., are discussed in Chapter 8.

A certain part of the dissemination of disease in confined spaces may be due to pathogenic organisms floating in the air like dust particles. (See Chapter 7).

While in some instances it may be possible to reduce the physical impurities of the air by dilution from a non-contaminated source, such a source is rarely available. Frequently, outside air contains a higher concentration of physical impurities than indoor air. Therefore, it is usually desirable to reduce the concentration of physical impurities by air cleaning methods. (See Chapter 33.)

THERMAL INTERCHANGES WITH ENVIRONMENT

Body temperature depends upon the balance between heat production and heat loss. Heat resulting from oxidation in the body (metabolism)