often used in ventilation work as an index of odors of human origin, but the information it affords rarely justifies the labor involved in making the observation[2, 3]. Little is known of the identity and physiological effects of the organic matter given off in the process of respiration. The former belief that the discomfort experienced in confined spaces was due to some toxic volatile matter in the expired air is now limited, in the light of numerous researches, to the much less dogmatic view that the presence of such a substance has not been demonstrated. The only certain fact is that expired and transpired air is odorous and offensive, and it is capable of producing loss of appetite and a disinclination for physical activity. These reasons, whether esthetic or physiological, call for the introduction of a certain minimum amount of clean outdoor air to dilute the odoriferous matter to a concentration which is not objectionable.

A certain part of the dissemination of disease in confined spaces is caused by the emission of pathogenic bacteria from infected persons. Droplets sprayed into the air in talking, coughing, sneezing, etc., do not all fall immediately to the ground within a few feet from the source, as it was formerly believed. The large droplets do, of course, but minute droplets less than 0.1 mm. in diameter evaporate to dryness before they fall the height of a man. Nuclear residues from such sources, which may contain infective organisms drift long distances with the air currents and the virus may remain alive long enough to be transmitted to other persons in the same room or building. Wells[4] recovered droplet nuclei from cultures of resistant micro-organisms a week after inoculation into a tight chamber of 300 cu ft capacity. Typical organisms of infections of the upper respiratory tract (pneumococcus type I, B. diphtheriae, Streptococcus hemolyticus, and Streptococcus viridans) were found to die out quite soon when exposed to light and air, and could be recovered from the air in small numbers only 48 hours after inoculation. Organisms typical of the intestinal tract (B. coli, B. typhosus, B. paratyphosus, A. and B. dysenteriae) were not recovered 12 hours after inoculation.

The significant factors in infection are believed to be the numbers of infective organisms encountered, the frequency of exposure, and the resistance of the individual including the degree of acquired immunity. The probability of encountering a sufficient number of organisms to break down the natural body defense is related to the air space per person and the quantity of clean air supplied. Except in badly ventilated rooms, the danger is believed to be "much contracted in space, limited in time and restricted to comparatively few diseases."[5]

Practical possibilities in sterilizing air supplies by the use of ultra-violet light are now being studied[6].

The primary factors in air conditioning work, in the absence of any specific contaminating source, are temperature, radiation, drafts and

[2]Indices of Air Change and Air Distribution, by F. C. Houghten and J. L. Blackshaw (A.S.H.V.E. TRANSACTIONS, Vol. 39, 1933).

[3]Ventilation Requirements, by C. P. Yaglou, E. C. Riley and D. I. Coggins (A.S.H.V.E. JOURNAL SECTION, *Heating, Piping and Air Conditioning*, January, 1936).

[4]Air-Borne Infection and Sanitary Air Control, by W. F. Wells, (*Journal Industrial Hygiene*, November, 1935).

[5]Preventive Medicine and Hygiene, by Milton J. Rosenau (6th edition, pp. 909-917, D. Appleton-Century Co., N. Y., 1935).

[6]Viability of B. Coli Exposed to Ultra-Violet Radiation in Air, by W. F. Wells, and G. M. Fair (*Science*, 1935, *82* p. 280).

body odors. As compared with these physical factors, the chemical factors are, as a general rule, of secondary importance.

HEAT REGULATION IN MAN

The importance of the thermal factors arises from the profound influence which they exert upon body temperature, comfort and health. Body temperature depends on the balance between heat production and heat loss. The heat resulting from the combustion of food within the body maintains the body temperature well above that of the surrounding air. At the same time, heat is constantly lost from the body by radiation, conduction and evaporation. Since, under ordinary conditions, the body temperature is maintained at its normal level of about 98.6 F, the heat production must be balanced by the heat loss. In healthy persons this takes place automatically by the action of the heat regulating mechanism.

According to the general view, special areas in the skin are sensitive to heat and cold. Nerve courses carry the sense impressions to the brain and the response comes back over another set of nerves, the motor nerves, to the musculature and to all the active tissues in the body, including the endocrine glands. In this way, a two-sided mechanism controls the body temperature by (1) regulation of internal heat production (chemical regulation), and (2) regulation of heat loss by means of automatic variation in the rate of cutaneous circulation and the operation of the sweat glands (physical regulation). The mechanisms of adjustment are complex and little understood at the present time. Coordination of these different mechanisms seems to vary greatly with different air conditions.

With rising air temperatures up to 75 F or 80 F, metabolism, or internal heat production, decreases slightly[7], probably by an inhibitory action on heat producing organs, especially the adrenal glands, which seem to exert the major influence on basic combustion processes in the body. The blood capillaries in the skin become dilated by reflex action of the vasomotor nerves, allowing more blood to flow into the skin, and thus increase its temperature and consequently its heat loss. The increase in peripheral circulation is at the expense of the internal organs. If this method of cooling is not in itself sufficient, the stimulus is extended to the sweat glands which allow water to pass through the surface of the skin, where it is evaporated. This method of cooling is the most effective of all, as long as the humidity of the air is sufficiently low to allow for evaporation. In high humidities, where the difference between the dew-point temperature of the air and body temperature is not sufficient to allow rapid evaporation, equally good results may be obtained by increasing the air movement, and hence the heat loss by conduction and evaporation.

In cold environments, in order to keep the body warm there is an actual increase in metabolism brought about partly by voluntary muscular contractions (shivering) and partly by an involuntary reflex upon the heat producing organs. The surface blood vessels become constricted, and the blood supply to the skin is curtailed by vasomotor shifts to the internal organs in order to conserve body heat. The sweat glands become inactive.

[7]Heat and Moisture Losses from the Human Body and Their Relation to Air Conditioning Problems, by F. C. Houghten, W. W. Teague, W. E. Miller and W. P. Yant (A.S.H.V.E. TRANSACTIONS, Vol. 35 1929).