where. In certain states of the weather, the products of imperfect combustion form fogs, which are smoke clouds. The presence of these smuts in a condition of the finest subdivision is then readily demonstrated by the expectoration; the expectorated mucus is dark and inky from the particles arrested and detained by the mucous lining of the air tubes, and drawn in by the respiration. Through the fog the noon-day sun appears through a piece of smoked glass; it is really seen through a smoke-laden atmosphere. But in addition there are vegetable seeds, spore and germs; low forms of animal life, of puscells and epithelia, especially in the air of hospital wards; particles of fabrics, cotton and wool; and at times mineral matter, as sand, forming in certain regions sand clouds, the deadly simoon which the Arabs dread. Contagious particles, though too minute to be recognizable by the most powerful microscope, or detected by the subtlest analysis, are borne in the air, and their presence demonstrated by their effects. The odor of plants is due to minute particles of solid matter which are wafted off the plant, and bear the characteristics of each. The rose has its odor, and so have the violet and the woodbine, they are distinct and recognizable; but they have never been seen by the microscope, any more than has scarlatinal poison; no chemistry can determine their composition, which is as unknown as that of poison of typhoid fever.

Malarial or marsh poison cannot with certainty be referred to the class of suspended agents, possibly it belongs to the gaseous division. Organic matter has been found in the dew of malarial districts. But there exists no doubt as to the existence of malarial poison, and much is known about it, though its presence has never been demonstrated by any other means than its results. Probably fever-poisons are not gaseous but solid. We will refer to them again in their own section.

The gaseous impurities of air arise variously from the body itself, from the earth, and from manufactories. The carbonic acid which is given off by the respiration is a common cause of air-contamination. Its excess in the body is always accompanied by a deficiency of oxygen, and the effects of each are with difficulty separated. In "the back-hole of Calcutta" and the well-known case of the "Londonderry," these two were combined, and the mortality in each case was fearful; in the first 123 died out of a total of 146, in the latter out of a total of 150 no less than 70 perished. The amount of oxygen may be reduced from 23 per cent. to 20, in close ill-ventilated places; and such diminution is not only deleterious and dangerous if carried too far, but if only existing to a lesser degree, it is baneful and injurious to the health; causing great loss of vital force and leaving the person predisposed to disease.

Emanations from the earth of an injurious character generally take their origin in decaying organic matter, and form zymotic poisons, to be considered hereafter; but sometimes gases are exhaled as the choke-damp of mines, sulphureted hydrogen and carbonic acid. Earth itself is a good disinfectant, and organic matter efficiently buried rarely causes any troublesome consequences.

Air is extensively contaminated by manufactories and chemical works, and in more limited areas by fumes in certain trades, as we have seen before.

VENTILATION.

In this division will be considered the question of the amount of air required; and then the subject of ventilation; closing with the means of ventilation so intimately associated with the warming of buildings.

The amount of air which each person requires is that amount which shall not allow of an accumulation of carbonic acid beyond a certain point. This gas exists normally in the air, but below 4 parts per thousand; an atmosphere containing 1 per cent. is odious and instinctively avoided. In an atmosphere where 1200 cubic foot of fresh air was furnished to each person per hour, the proportion of carbonic acid rose to ·855 per 1000 volumes; with a supply of 1700 feet of air each man per hour it reached ·769 per 1000 volumes; where only 765 cubic feet per hour each was furnished, the carbonic acid attained to 12 per cent.; this last was obviously very unwholesome. Probably 1200 cubic feet of air per hour is the least which is compatible with health. But this calculation excludes carefully any lights or fires, which consume the oxigen of a room very rapidly, and load it with carbonic acid; the effects of which will be considered shortly. The sick require more air than the healthy, and in hospitals even 3500 cubic feet per hour per head has not been proved sufficient to prevent the peculiar offensive odor.

Now it is obvious that the mere cubic space afforded to each person will not in itself meet the question. The rate at which the air is renewed is a most important factor. If there is 200 cubic feet of space for each person, it is obvious that the air must be renewed 10 times per hour in order to afford each person 2000 cubic feet of air in that time. If the space for each person is 400 feet, the air need only be renewed 5 times per hour. The rate with which air passes into and through a room involves the question of draughts. In order to keep a small room efficiently ventilated, the movement of air must be so rapid as to cause a draught, and draughts are common exciting causes of illness. Large rooms are better than small ones, because the air has not to be so frequently renewed, and draughts are thus avoided; the number of persons being alike in each case. When the rate of change of air in a room exceeds 3 or 4 times per hour it becomes disagreable, and warmed air is requisite.

Natural Ventilation.—This is achieved by the readiness with which gases diffuse themselves through the atmosphere by winds, and the circulation of air currents. Currents are largely produced by changes of temperature: as seen in the sea breeze of the morning and the land breeze at night, the air coming off the heated pland in the evening, and returning again when the land has been cooled by night. Artificial currents exist betwixt the heated room and the cold air outside; the hot air escaping out, and the cold air coming in. The rushing of the heated air up the chimney causes a draught to the fire, and consequently ventilation of the room. It is obvious that there must be a draught where the external air enters a room and crosses it to the fireplace, and persons in that air-current are very apt to take cold. Currents are also produced by having points of entrance and exit, as open windows, especially when these face each other. This is called "cross-ventilation," and is largely employed where practicable, as in a large wards and single houses. When the configuration of the room will not permit of this, the air-currents pass from the windows to the door or fireplace, or from the door to the fireplace directly. The efficient ventilation of a room is so commonly productive of cold draughts, that various contrivances have been devised to obviate these unpleasant consequences. Ventilators have been put in the roof or ceiling, from the known tendency of heated air to espace upwards, and form the usual and common means of securing a change of the air in apartments. These ventilators often form shafts passing through the