exhale about .6 cubic foot of this gas per hour. From these facts we may form a good conclusion regarding the rate of contamination from human respiration alone. If a person he shut up in a tight room of 3000 cubic feet capacity, he would exhale during an hour .6 cubic foot of carbon dioxid which, added to the amount normally present, would make the quantity 1.8 cubic feet in the 3000 cu. ft. of air, or .6 cu. ft. per thousand; and this amount—.6 cubic foot per thousand—is regarded by good authorities as the maximum amount to be tolerated in the air of dwellings. It is plain, then, that in order to keep the enclosed space within the permissible limits during a second hour, the place of the 3000 cu. ft. of impure air must be filled by a like quantity of fresh air from without. This amount, 3000 cu. ft. per hour per person, is regarded as a proper requirement in ventilation. Excessive as this may seem, there are some reliable authorities who place the amount higher; thus Dr. Billings says an adult needs one cubic foot of pure air per second, or 3600 cu. ft. per hour. These references are to adult persons in a condition of but moderate activity; children exhale less carbon dioxid; grown persons in vigorous exercise would exhale more than the average amount.;

I take some illustrations that have been cited in this class before. At the rate mentioned the air of a bedroom 12x14x11 feet, containing 1848 cu. ft. of space, would be contaminated by the exhalations of one person in less than 37 minutes. A room suitable for school purposes, say 28x35 feet, and 14 ft. high, containing 13,720 cu. ft. of air, if occupied by 60 children, allowing to each only 2000 cu. ft. of air per hour, would he vitiated in less than seven minutes. According to measurements made by Architect Don C. Young, the large Tabernacle building of this city has a capacity of 1,825,588 cubic feet. Suppose that building to be occupied by 8,000 adults—and such an attendance is far from unusual there—allowing to each person 50 cubic feet of air per minute (that is, on the accepted basis of 3,000 cubic feet per hour) the air would become foul in less than five minutes; and if an adequate amount of fresh air be not supplied, after that lapse of time the people will he rebreathing the foul emanations of one another's lungs.

Besides respiration, ordinary processes of combustion are to be considered as sources of atmospheric contamination, and the rate of such contamination has been ascertained with reasonable exactness. Dr. Tracy, sanitary inspector of the New York City health department, has given us the following data:

Petroleum, slit burner, 10-candle power light, produces 1.98 cu. ft. of carbon dioxid per hour.

Petroleum, round burner, 7.6-candle power, 1.98 cu. ft. per hour.

Candle, single candle power, .39 cu. ft. per hour.

Coal gas, slit burner, 7.8-candle power, 3.25 cu. ft. per hour.

Coal gas, flat burner, 10-candle power, 3 cu. ft. per hour.

Dr. Youmans has approached the subject from another side, having determined the amount of oxygen withdrawn from the air by definite quantities of combustibles. He finds that a pound of mineral coal requires the oxygen of 120 cu. ft. of air to burn it; and this means, at the rate of 5 pounds of coal per hour, the vitiating of 600 cubic feet of air per hour. A candle (of size six to the pound) will consume about ⅓ of the oxygen from 10 cubic feet of air per hour, and an oil lamp with large burner will similarly change 70 cu. ft. per hour. A gas burner consuming 4 cubic feet of gas per hour will render unfit for respiration 400 cubic feet of air in that time.

In these comparisons and illustrations reference has been made to the increase of carbon dioxid in the air, this being taken as an index to the state of purity; but beside this gaseous emanation, other substances, particularly water and organic matter, are thrown into the air from the lungs and skin of human beings. All are familiar with proof of moisture in the breath afforded by breathing on a mirror, or by the visible condensation of the breath in cold weather. That similar emanations come from the skin may be proved by enclosing the hand in a dry glass jar; then sealing the mouth of the vessel by wrapping a cloth around the wrist; in a short time moisture will be seen on the inner surface; this may increase in quantity till it collects in drops and runs down the bottle walls. If a vessel containing moisture from the skin, or from the lungs, be tightly corked, then set in a warm place, a foetid odor will be soon manifest when the bottle is opened; this is due to the decomposition of the organic matter thrown off from the body; and these putrescible substances constitute in reality the greatest source of danger from foul air. The microscope may aid us in determining the nature of these organic particles. To collect such for examination, cause a large quantity of air to pass through convoluted tubes, kept cold by immersion in a freezing mixture; by these means the moisture of the breath is condensed and carries the solid particles into the liquid. Another way is to cause the air to pass through a drop of glycerin, in which the solid particles will become entangled. If the microscope be turned upon a drop of the condensed liquid or the glycerin, a surprising lot of solid debris will be seen, mostly epithelial cells, and other fragments of tissue. It is among these particles that the germs of certain specific diseases are frequently communicated. A simple means of demonstrating the presence of organic matter in exhaled air consists in causing the breath to pass through a tube into strong sulphuric acid, the acid chars or blackens any carbonaceous particles and by the decoloration proves their presence.

In connection with our present topic of air contamination the question of the effect of impure air upon the body is pertinent. We have an array of the best authorities to support the view that the breathing of foul air is productive of a multitude of ills. In the first place many specific diseases are caused by these means. Scrofulous disorders are common among those who dwell in foul air. *Consumption* is a frequent result of breathing contaminated air, as are also certain forms of sore throat, particularly *Tonsilitis*. This latter, resulting also by the breathing of air contaminated from the back flow from sewer pipes, is commonly known as sewer-air throat. Concerning its symptoms, Dr. Parkes, of London, has said:

"It is marked by great inflammatory swelling of the tonsils, very foul tongue, gastric derangement, accompanied by severe headache and intense depression. The temperature of the body is often not much raised, certainly not to a height proportionate to the severe symptoms; but this low temperature, together with the intense prostration, are characteristic of most illnesses resulting from the entrance of sewer-polluted air or water into the system."

But beside these specific disorders, the breathing of foul air tends to weaken all the bodily and mental powers. A body so subjected is robbed of a large part of its vitality, the capacity to resist the encroachments of disease is lowered, and the chances of an early surrender to the influences of destruction very much increased. Let me call your attention to some authenticated instances of ill effects from this cause:

The extreme cold of the winter of Iceland reduces the system of domestic ventilation in that country to very primitive principles. A traveler there was so choked one night by the close atmosphere of the air-tight little chamber in which he slept with all the male members of the family, as to be compelled to wake his host, who sprang out of bed at the call, pulled a cork from a knot-hole in the wall for a few minutes, and after replacing the cork, with a shiver returned to bed.—*Science*, 1889.

On the imagination of mothers, educated as well as ignorant, the feeling still seems to be stereotyped, that the free, pure, unadulterated air of heaven falls upon the brow of infancy as the poppies of eternal sleep, and enters the lungs and circulates as a deadly poison; and still the shawls and blankets, sleeping and awake, are pretty generally employed to deprive the objects of the most rapturous, paternal solicitude of what was originally breathed into the nostrils of the great archetype of the human race as the "breath of life."

During the English war in India in the last century, 146 persons were shut up in a room scarcely large enough to hold them. The air could enter only by two narrow windows. At the end of eight hours but 23 persons remained alive, and these were in a most deplorable condition. This prison is well called "The Black Hole of Calcutta." Percy relates that after the battle of Austerlitz, 300 Russian prisoners were confined in a cavern, where 260 of them perished in a few hours. The stupid captain of the ship Londonderry, during a storm at sea, shut the hatches. There were only 7 cubic feet of space left for each person, and in six hours 90 of the passengers were dead. —*Dr. Steele.*

[The lecturer here read numerous other instances, quoting Lord Derby, Dr. Newell, Dr. Youmans, Von Pettenkofer, Bernay, etc.] Continuing he said:

Yet how terribly neglectful are a great part of mankind to this pressing requirement! Fortunately for us carpenters and builders ofttimes do their work imperfectly, and leave many a crevice through which air may enter our dwellings, against our knowledge and our consent. Not alone in our domestic habitations do we lay the foundations of weakened minds and bodies by such unclean atmospheric surroundings, but in places of general assembly, in lecture halls, and sad as it is to say—in places of worship erected in the