the vapor of the breath driven from the nostrils taking at first a downward course; a breath of a fair strength, with the thermometer near freezing point, may be seen by its condensed vapor driven downward and slightly outward for a foot or more.

In this observation, a wind wheel (in air of 26° Fahrenheit), moved rapidly near the body, and steadily at a distance of six inches in front and also at two feet above the head. Notwithstanding this upward current, the breath was strongly marked by condensed moisture fourteen inches below the nostrils, and, would doubtless have been seen further down but for the dissipation of the moisture.

In a room with the air at 65° the same wind wheel was in motion close to the vital parts of the body, but stopped entirely at two or three inches distance from the body or above the head—this was anticipated, because the force that carries the wheel is the rising of the air in consequence of its greater heat and lightness than that of the surrounding air, and is proportioned to the difference of temperature. In order to determine the amount of heat operating to cause the air to rise, a thermometer was placed within the clothing near the vital parts of the body, where it was found to stand at 82°, while the person remained in air at 65°. On going into air at 20° with additional clothing, the thermometer stood at 76°. The air around the body in a warm room, therefore, would rise with a force not far from 17°, while in the outer air at 20° it would rise with a force not far from 56°. Probably the air would rise with a velocity somewhat less than these figures, but relatively they are nearly correct. A more sensitive instrument would have been affected at a greater distance, but the same wheel showed a distinct downward motion of the breath 15 inches below the nostrils in opposition to all the rising tendency by reason of the warmth of the breath and air about the body, and this motion would have been shown at a greater distance by a more sensitive wheel.

Let us now suppose, to be well within bounds, the breath to be moved 12 inches below the face, the downward motion having ceased, the upward motion should then begin, which is to carry the breath up out of the way. This old breath has about one second in which to rise from rest or reverse motion, more than 12" in order to be out of the way of the next inhalation. The difference of temperature necessary to give this movement of 12 inches in the first second, if the breath rises by heat alone, will surprise anyone not familiar with such calculations, it is not less than 180°, that is to say, the breath in order to start from rest and rise 12" in one second through air at 65°, would have to be at a temperature of 245°.

The absurdity to which this calculation and experiment reduce the idea that our breath is carried away from the face by its upward tendency from heat, is increased by the observations which every one may make, that a thermometer at 65° cannot be raised more than one degree by breathing upon it at 9" distance, and that at 10" no effect can be perceived. Under the most favorable circumstances all causes combined are not sufficient to carry the expired breath up out of the way before another inhalation, as may be seen on a frosty day, and it is evident that the air contaminated by the body, if carried upward must be inhaled.

We will consider the circumstances of a large hall of assembly and show the operation of the two systems. Suppose a floor well packed with people at the bottom of a cubical or hemispherical hall: suppose them to have entered at once, the hall being previously filled with pure air; directly the lower stratum of air in which is the audience, becomes contaminated by their exhalations and emanations. Now the problem is to get that stratum of air out of the hall before any of it can come into use again, and to replace it with fresh air of the right temperature.

It is obvious that it cannot be taken out sideways, because then many would have to breathe over again the breath of others—it can be taken only either up or down. If taken up, the fresh air that is to supply its place must enter at the floor from which the foul air rises, for no air will leave the spot till other air is ready to fill its place. In order to lift the whole of the foul air bodily from the floor, it is necessary that the whole floor should be open for the admission of fresh air. Wherever there is a piece of solid floor through which the air cannot pass, there will be a dead space of foul air above it which will not rise with the rest, but will remain to be gradually mixed with the fresh air entering around it. If the dead space is considerable, the whole amount of air required must enter in the limited space of the openings, and the velocity must be proportionately increased. According as the space is reduced and the velocity increased, the air entering has a force that carries it up beyond the place where it is to be used, and mixes it with the foul air passing off, a part of which mixture will return in counter currents and gradually replace the air in dead spaces.

Dr. Reid, of the House of Commons, England, the most scientific and experienced, perhaps, of the advocates of the upward system, seeing this necessity for introducing the fresh air through the whole extent of the floor, had the entire floor made of perforated iron. This was afterwards covered with hair-cloth carpeting, and through nearly its whole extent the fresh air was admitted. The result was, that on account of the rising of dust by the entering air, and still more on account of the uncomfortable draughts brought up against the members' legs, nine-tenths of the floor was covered with sheet lead under the carpet. When the entrance for fresh air was thus limited complaints became so loud both of strong currents and of foulness of air, that the whole matter of ventilation was turned over to Mr. Goldsworthy Gurney, who undertook it on the opposite system of introducing fresh air above and taking out the foul air at the floor.

It is very important in the warming and ventilating that the pure air to be supplied should be of the same degree of temperature and the same amount of moisture as that of an open space in a pleasant time in summer.

With respect to the actual degree of ventilation necessary for health there is great difference of opinion. The following volumes of air in cubic feet per person and minute have been assigned by different experimenters: Dr. Arnot, 2 to 3; Tredgold, 4; Mr. Toynbee, 10; Dr. Bell, 10 to 25; Peclet, according to circumstances, 10 to 20; Peclet, at least 5; Roscoe, (insufficient in Barracks), 10; Roscoe requires at least 20; Dr. Reid, minimum, 10; Dr. Reid requires according to circumstances, 20 to 60; Vierordt, 2½; Hood, ("Warming and Ventilating") estimates the air required for ventilation by the amount needed to take up the moisture from the skin and lungs. The air required for respiration (*i. e.* oxidation) is very much less than that needed to hold in solution the vapor of the skin and lungs which evolve 12 grains of water per minute. If the temperature of the room be at 60° with a dew point at 45°, a cubic foot of air will absorb 2¼ grains of vapor, or in other words, the perspiration from the body will saturate 5¼ cubic feet of air per minute. If, however, we take the dew point down say not to exceed 20° to 24°, then 3¼ cubic feet of air per minute will be required to carry off the insensible perspiration, while for pulmonary supplies ¼ cubic foot will be needed, making a total of 4 cubic feet. In summer the dew point is higher, more air will be required, viz., 5 cubic feet per minute for summer ventilation.

Professor Miles in his report on ventilation of houses and schools assumes that if the temperature of the air ranges from 65° to 70 degrees Fahrenheit, we have the following average results from the respiration of an adult: number of respirations per minute 20; cubic inches of air inhaled and respired 20; cubic inches of air inhaled per minute 400; cubic inches of oxygen each respiration 4; cubic inches oxygen each minute 80; products respired: 1. damaged atmosphere with nitrogen in excess; 2. fifteen cubic inches of carbonic acid gas; 3. three grains of vapor of water.

The surrounding air is vitiated by the mixture of the products of respiration with it at the rate of 2½ cubic feet per minute. The total average loss by the lungs and skin in twenty-four hours is almost 3½ pounds of water, of which somewhat more, ⅔ say 2½, are furnished by the skin, of these 2½ pounds (only 1/6) is furnished by the vital process of secretion by the sweat glands, for the greater part of the moisture transudes through the skin by simple evaporation. For health the body must evaporate a quantity of water within certain limits; the amount evaporated is influenced by the hygrometric condition of the air and by the state of the body itself. The evaporation is increased by muscular action and by a dry atmosphere, it is diminished by repose and by a moist air.

EXTRACT FROM THE REPORT OF A SELECT COMMITTEE ON THE VENTILATION OF THE HOUSE OF COMMONS, LONDON, PRINTED MAY 31ST, 1886.

"The plan adopted and worked for many years under the superintendence of Dr. Percy consisted in drawing the fresh air into the House and the vitiated air from the House by means of heated shafts in the clock tower and in Victoria tower. By this exhaust process the air in the House was placed under a somewhat lower pressure than the air outside, and a pull thus created which caused the entry of foul air from any accidental source of impurity within reach of this pull, as from closets, etc. Since this plan was established many years ago much progress has been made in the art and science of ventilation, especially in mechanical appliances for the purpose, and by means of these, greater efficiency and certainty, as well as increased economy in working was attained than was possible under the older system.

The great advantage of mechanical ventilation is that as the air is pumped in, a slight excess of pressure exists in the ventilated spaces over that in the outside, and therefore any section of air from impure sources, such as imperfect soil pipes, closets, etc., is avoided. The Committee, for the above reasons, are of opinion it is advisable to cut off the exhaust so that the air pressure may be above rather than below that of the external atmosphere." But it appears by evidence given before the Select Committee of the House of Commons on ventilation, June 1891, that the recommendation in the previous reports had only been carried out to a limited extent, and that the system of extracting the vitiated air at the ceiling is still in operation—the witness stated that air drawn from the Court Yard passes by steam batteries by which it is warmed—it then passes down the floor of the house which is perforated all down the centre and in various other parts, there it ascends through the ceiling and passes down four shafts about 700 feet in length to the basement and then horizontally through the basement for a considerable distance and discharges into the Clock Tower where there is a very powerful up cast, which must require a very much larger consumption of fuel than would be necessary if the exhaust were from the floor of the House by mechanical means.

POSITION OF HALLS.

Some adverse criticisms having been made with respect to the House of Representatives at Washington being surrounded by