

upper stories and emerging at the roof. These ventilators are good when they are efficient; but it is not always easy to know when the ventilation through them is active.

The plan of having a strip of paper, or rag, so hung as to be visible, and by its fluttering telling of an air-current, and by its motionless condition informing us when the air-current is arrested, is one which might be more generally adopted. The incoming current of air is and should be always directed upward towards the ceiling, so that the cold draught may not strike the inmates. There are many plans in vogue for the production of this end. One is to have either a glass louvre inserted instead of the top centre pane, or to have the pane cut into strips, which may be separated or approximated by a cord. Another plan is to have the panes doubled, the incoming air being warmed in the space betwixt the panes, the course of the current being also thereby broken. A third plan is to have a wire screen at the top of the window, which takes the place of the window when it is drawn down. But no plan will ever be so effective with single windows as are those where the windows are double. This is a luxury to which English people are averse, and yet the double windows deaden sound, as well as permit of an ample space where the air can be warmed and its current broken betwixt the windows. A pane can be divided into slips in the outer window at the bottom, and a louvre put in instead of a pane at the top of the inner window, and then the rate of entrance can be thoroughly regulated, and a perfect ventilation be established without draughts of cold air. The effect of double windows is well seen in foreign hospitals, and for the sake of this improved ventilation and the deadening of sound they should be introduced into banks, business houses, and hospitals—the last especially—as well as into private houses; and their introduction would be conducive to health and comfort.

An excellent plan of ventilation is to have the interspace betwixt the ceiling of one floor and the flooring of the story above, itself well ventilated; and to allow the air carried out of a room by a ventilation in the ceiling to pass into this interspace, and from thence out into the open air. At other times the ventilator can be carried through a shaft to the roof, and then the shaft can be surmounted by a cowl. The cowl at the top of air-flues and chimneys is a plan for utilizing the aspirating power of the wind. A proper cowl rotates and turns its back to the wind and the rain, and in order that it may do so, it should be well balanced and rotate easily.

*Artificial Ventilation and Warming.*—It is almost impossible to consider the two subjects separately, as fire is used for both purposes—indeed cannot very easily be used for one without involving the other. The combustion of the fire draws a current of air towards it in addition to the action of the shaft or chimney, and by their combined action a good change of air is maintained. The open fire of England indeed is much more efficient as a ventilating than as a warming agent, and is almost the reverse of the stove of the Continent, with its heat-giving surface of glazed tile. The chimney acts as a ventilating shaft, even when the fire is not burning, though the ventilation is not unobjectionable when the air-current comes down the chimney.

In an ordinary fireplace the waste of the heat is enormous, and the statement that the actual waste of coals is greatest in private houses is well founded. No less than seven-eighths of the heat passes up the chimney; and even with reflecting backs, etc., the waste is excessive. At the same time such a fireplace and

chimney will ventilate a room capable of holding from three to six persons, as the quantity of air passing up it is equal to from 6000 to 20,000 cubic feet per hour. If the room is small and the fire brisk, the passage of the air through the room is keenly felt; and you are roasted on the side turned to the fire while the other is chilled by the cold air which rushes in behind. Large rooms, with an equal amount of fire, are much more comfortable than small ones; provided that the large rooms are not unnecessarily airy and draughty. With the ordinary fireplace then the room is rather ventilated than warmed; and when the room is too well closed against the entrance of the cold air by chinks in the doorways and windows, the chimney has down draughts, and the cold air rushes down as well as the heated air mounts. The diffusion will take place somehow. As a rule the cold air rushes in under the door; and every one knows rooms where you are comfortably warm everywhere except the feet. They are stone-cold from the cold draught betwixt the space beneath the door and the fire.

Many have been the inventions to render fires more useful as warming agents. One of the best contains an air chamber at the back, through which the air enters the room, and is at the same time so heated as to no longer cause a cold draught. Another is a cottage grate of fire clay, also with an air chamber. Less complicated plans of causing the back of the grate to lean forward and so throw back the heat into the room, have been more or less adopted. The desirable fireplace, of simple yet effective construction, has still to be discovered. Several forms of stoves have been invented to economize fuel, or to utilize the heat produced. Two favorite forms have the air introduced beneath the stove and then given off, warm flanges of metal heating the air as it passes off. A dish of water gives to the heated air the requisite and desirable moisture.

Some gas stoves warm the air ere it is given off into the room, moisture being furnished by a water dish. But all stoves are objectionable, for, while heating the air, they give it an unwholesome dryness.

Another method of utilizing flame as a ventilator is to have the gas-lights so arranged in the ceiling as to form the "sunburner," and by adding a shaft to this burner the already respired and vitiated air is drawn towards the shaft and passes away out. This forms an efficient ventilator.

But gas is an objectionable heating agent; and the arrangements must be very perfect to admit of its being used without actual detriment. The products of gas consumption are very disagreeable as well as deleterious, as every one knows who has been where gas is largely burned either as gaslight, or in the "clinker made-up grates," which when red hot somewhat resemble an ordinary fire. The air is heavy, unpleasant, and laden with the products of combustion; unless the ventilation be very perfect.

Another plan of producing warmth and ventilation is that of combined hot water pipes and air shafts. The plan of warming a room with hot water pipes has long been in vogue, and in many instances it is an excellent and efficient mode; and it has also been proposed to have around the water pipes air shafts, so that the air might be heated by the contact with the hot water pipe. This air shaft along the hot water pipe would surround the room, and by many minute perforations admit of the warmed air entering the chamber. Then, by means of propulsion, the air could be forced into the room at a fixed rate; and by a modification of the machinery its rate of entrance could be checked when desirable. Propulsion of air into rooms dates back to the year 1731.