will be briefly noted, as serving to show the effect of changing conditions and indicating methods of instruction which are most likely to satisfactorily meet the requirements of the future. First, the decline of the apprenticeship system is declared to be due to unwillingness of employers, especially in cities, to take apprentices, rather than to opposition on the part of the trades unions. It is further declared, and few will be disposed to question the statement, that the keenness of modern competition among contractors, will not permit time to be given to the instruction of apprentices. The building trades in London are recruited from the ranks of apprentices trained in the country, where time can be found for giving instruction, and where hand-work prevails to a much larger extent than in cities. Workmen in the building trades are found to be averse to attending technical classes, and to be unfitted by their employment to handle drawing materials ; the conclusion therefore is that attendance upon these classes should precede entrance upon practical work. On this point Mr. Barter, organizer of manual instruction under the London School Board, declares that boys who have entered for the Technical Education Boards' Competition in Science and Technology pick up trades quicker than others and work more accurately. They understand the meaning of drawings before they have learned to handle the materials. Bricklayers were found to be less intelligent and much less able than carpenters to understand drawings —consequently less qualified to rise to the position of foremen or to commence business on their own account. The system under which the trades unions seek to place all workmen on the same level so far as the standard of wages is concerned, is found to be a serious obstacle in the way of inducing the artizan classes to strive by means of better education and a higher standard of workmanship to improve their position.

WARM VENTILATION OF HOUSES.

A POLISH writer inveighs against the inconsistency of the people of Western Europe who he says have to be always making fires because they leave windows open. "We in Poland," he says, "make our fires only in the morning ; then we close the doors and windows tight, and the house remains warm all day."

The Poles seem to be more successful than we in the art of making doors and windows, but their system of heating leaves something to be desired. To put the matter briefly the art of heating a house consists not in warming the air that is in the house and keeping it from getting out, but in supplying new warm air to take the place of that which is in the house, as fast as it cools or escapes. We want the air to escape as fast as it is used, and as we cannot exactly accomplish that ideal—which would amount to breathing in air from the room and breathing it out up the chimney—we must aim at the next best thing, to keep up such a withdrawal of old air and introduction of new air as will in the course of any given time effect the introduction of fresh air sufficient to dilute that which has been vitiated by respiration so as to maintain a certain standard of purity.

The heating question is therefore really a problem of ventilation ; the introduction of warmed air. As in summer we ventilate our houses in order to cool them, so in winter we must ventilate our houses in order to warm them. This is scientific heating. Whether the system be steam, hot water or hot air is immaterial to the genera scheme, and will vary according to internal considerations of convenience and cost. But inasmuch as indirect radiation by steam or hot water costs more than is usually applied to the heating of an average house, it will be assumed, in this endeavor to consider the subject in a practical way, that the instrument for warming our air is a warm air furnace.

It would be well if in the matter of the heating instrument we could come closer to the conditions of the Polish peasant. The great stove, which is so prominent in pictures of the interior of a hut in that country, or in the northern part of Russia, is built of brick or some similar form of clay which gives a large heating surface of a moderate temperature and, when once heated, is slow to cool and easy to keep at a temperature nearly uniform all the time. It is mainly, no doubt, on account of the nature of their stoves that the poles find it necessary to make a fire only in the morning. It radiates all day a comfortable heat, and, if by night it is somewhat cooled, that is also a condition of comfort ; for the family bed is on top of it, and in bed though it is well to be warm it is not well to be too warm. In other parts of Europe, clay is the material affected for stoves. Soapstone furnaces have also been advertised in the United States, chiefly as a better means of retaining the carbonic oxide gas, which is said to be the source of our headaches, and which not only leaks through the joints of an iron furnace but will pass through red hot cast iron. This is an undoubted advantage, and if, in addition to it, we could obtain, by the use of clay material or soapstone, the soft and equable heat which is the great comfort of hot water heating, the furnace might once more be admitted into the better class of moderate sized houses which at present affect hot water. However, until some one makes the experiment and publishes results, we have no data for calculation as to the workings of a furnace of this kind, and must assume, for the purposes of this article, the ordinary cast iron furnace.

In order to make arrangements for supplying warmed air to a house, we must first find out how much air it is necessary to supply, then how to make sure that the amount supplied will approximate to the amount required, and finally the capacity of furnace to meet this requirement.

The quantity of air vitiated by an adult man in an hour is given by Kidder as 215 cubic feet, but this does not help us very much. It will not do to suppose that the introduction of an equal amount of fresh air in the hour will restore the air to its former freshness. The vitiated air is diffused evenly through the body of air contained in the room. This, in an ordinary sitting room, 16′ 0″ × 13′ 6″ × 10′ 0″, containing 2160 cubic feet, is ten times the quantity which a man vitiates in an hour. Each cubic foot of air is therefore one-tenth vitiated. If, then, 215 cubic feet of air be driven out to be replaced by fresh air, of the air driven out nine-tenths is fresh air and only one-tenth vitiated ; that is to say, nine-tenths of the original quantity of vitiated air still remains in the room. It is clear that in order to preserve absolute purity the quantity of air which it would be necessary to supply would be enormous. The utmost we can expect to do is to supply fresh air in sufficient quantities to dilute impurities until they are harmless. The question is how much dilution is sufficient ; or, in other words, how much impurity we can stand. The instrument used for making this test is the nose, which was given us by Nature for that purpose.