which must be procured for the purpose—and of course from 220 to 260 pounds of the best coal will be consumed in that time.

SECTION V. THE APPLICATION OF OUR KNOWLEDGE

OF THE PROPERTIES, PHENOMENA, AND LAWS OF

STEAM, TO PRACTICAL AND ECONOMICAL PURPOSES.

1. Warming apartments and buildings by steam. 2.

Heating greenhouses &e., by steam. 3. Evaporating solutions, drying fabrics, paper, gunpowder, grain, &e., by steam. 4. Warming baths, boiling liquids, and distilling by steam. 5. Preparation and economy of wholesome food by steam. 6. The steam-engine.

**1.** *Warming Apartments by Steam.*

66. One of the most important applications of steam in the economy of fuel, is its employment as a vehicle for Transferring to a distance, and distributing uniformly, the heat of a fire for the purpose of warming an apartment or building. Its great efficiency for this purpose arises from the largeness of its capacity for caloric, because, as it holds a quantity of caloric equal to 1000 degrees, it will communicate as much heat as a mass of red hot iron ; and it will have this advantage over the iron, that it can carry this heat to a distance without a similar loss ; because, the heat being latent, will not be given out until it arrive at its destination and become condensed, when the whole of its 1000° will be usefully applied.

The manner in which warming by steam is to be effected, is this. At a convenient part of the building, and as low as possible, there is to be placed a close steam boiler of the ordinary construction. From this boiler a small steam pipe is to be carried to the part of the building which is to be warmed. This small pipe should be pretty thick, and carefully rolled round with a fillet of flannel to a quarter of an inch thick, and the boiler should be wholly covered with bricks and plastered over to keep it warm. This smaller steam pipe should have an area of one square inch for every six gallons of water that the boiler can boil off in an hour. Pipes of a larger size are to be laid round the room above the floor, or under the floor if apertures be left to allow a free circulation of warmed air to enter the room ; but the best method we have seen is, to make the surbase, which passes round the room of thin iron plate or copper having the external figure of the surbase, and sufficiently strong to withstand the pressure of the steam, which strong tin plate or copper of 1½ lb. to the foot will sufficiently effect, if the surbase be not more than about 4 inches square. Into these larger pipes the steam is to be conducted, and in them the steam will be condensed into water, and will give 1000° of heat to the colder air of the room which is in contact with the outside of these pipes. In doing so the steam being condensed into water, small pipes of lead or tin must be provided, for the purpose of bringing back this condensed water into the boiler ; and, in order that they may act well, care is to be taken that a gentle slope, of about an inch in 20 feet, be given to all the pipes. The condensed water being thus conducted back to the bottom of the boiler, it will there be replenished with heat, and in the form of steam will again carry up its supply of 1000° to the apartment, again to be given off as formerly to the room, and then returning once more to the boiler, a continual circulation of the same particles of water, giving out in each circuit a quantity of heat equal to red hot iron, is uniformly and gently imparted to and diffused equally over the apartment. The pipe which brings the steam from the boiler may be called the feeding pipe, the pipes which give off the heat the radiating pipes, and the pipes which lead back the water to the boiler the return pipes. We have already given dimensions for the feed

pipe. The return pipes need not be more than 1/12 of the diameter of the feed pipe, but an increase of size could do little harm, and may have the effect of preventing accidental obstruction : the boiler will require to have a pint of water added now and then to supply accidental waste ; and a safety-valve on the boiler is indispensable. A self-regulating feeder, such as that mentioned in the article Sτεαμ-Ενgινε, among the apparatus of boilers, is also to be recomended where it can be readily attained, It is necessary, however, to give directions at greater length for the dimensions of the warming or radiating pipes, as it is upon their proper construction and arrangement that the efficiency of the apparatus entirely depends ; and the apparatus has frequently failed from the want of proper precaution. The radiating pipes in the room are generally too small. It is their extent of surface, and the free circulation of air round them, which determines how much of the heat will be given out, and how rapidly. From very accurate experiments I am induced to conclude, that a room containing 500 cubic feet of air, and exposing 400 feet of surface, may be maintained at a temperature of 20° above that of the air without—that is to say, at 60° in the inside of the room when the atmosphere is at 40 without—for a space of twelve hours, by the evaporation of 2 gallons of water, and at the expense of about three pounds of coal of the value of one farthing. But this supposes that there is no ventilation, and that the air of the room is never changed ; whereas, the presence of one individual would render it necessary to introduce nearly 400 cubic feet of external air every hour. Now, the heat of 20° given to 400 cubic feet of air would require the evaporation of 3 gallons of water ; and, therefore, the evaporation of 3 gallons of water would be required for such a room, and 3 gallons for every person in it, if properly ventilated, and for every 2 gallons there should be at least one square foot of radiating surface ; so that such a room, occupied by one person, would require a surface of warming pipe equal to 2½ square feet, and so on for every such room and occupant, for a space of 12 hours in the day.

Thus, the evaporation of 1 gallon per day for every 400 feet of surface, with a difference of temperature of 20 from the external air, and 1½ gallons per day for each person, and 1 square foot of radiating surface, is a standard from which we easily calculate.

A room 30 feet long, 20 feet wide, and 10 feet high, has a surface of 2200 feet, which would require 5½ gallons ; six people would require 9 gallons; therefore, 141/2 gallons of water and 71/4 feet of radiating surface will heat the well-ventilated room 12 hours for 6 persons at an expense of 25 lbs. of coal, or about threepence per day; or a whole house, occupied by 6 persons, may be warmed, if 30 feet high, 30 feet wide, and 30 feet deep, at tenpence aday, the price of coals being twenty shillings aton.

It is scarcely necessary to add, that the radiating pipes may be best constructed of thin copper, and ought to be roughened and blackened on the outside.

In the same way the calculation may be made for any other room, building, and number of occupants.

For more extensive and minute information on the subject of Warming, the reader is requested to consult the article “ Warming and Ventilation,” in the Encyclopedia.

The form in which the radiating surface may be distributed admits of variety.

Provision must be made for the expansion and con traction of the pipes.

The arrangement of steam in the apartment to be heated is of some consequence. It is, we have already stated, sufficiently out of the way in the surbase, but, in that case, much heat passes out into the walls and wood. It may stand on the hearth like a stove, and consist