fires are apt to be neglected, the proper time for their replenishment is not observed, and the fuel is not supplied in proper quantities. In such circumstances the best constructed fire-places will not prevent smoke. However, the following rules will apply, both to the construction of the fire-place, and the manner of using fuel. Let the fire be small and vigorous rather than large and slow. Let it have a good horizontal area, and not too much depth. Let it be well supplied with air in every part. Let fresh fuel be put on in small quantities and small pieces, and when there is a strong heat in the fire. It is a well-established fact that a proper quantity of heat cannot be obtained from fuel except it be vigorously and rapidly consumed. When it is brought at first in contact with a strong heat, and sufficient air, the heavy hydro-carbon vapours are not formed, the coal is burned at once, and the double process of combustion of its volatile parts, is avoided. Gas manufacturers understand this principle, and always charge their retorts when at a cherry red heat, and a readily combustible gas is produced; a lower heat would give a large quantity of heavy, hardly combustible vapour.

The method of working steam furnaces to produce the best effect, is to feed a little at a time, and often; and to spread the fuel evenly over the grating. It is by these means that the Cornish steam furnaces produce such excellent effect. Anthracite coal and coke require attention to the above rules, as well as bituminous coal, for, although they give no black smoke, they are subject to waste of another kind when burnt slowly and in deep fires. When anthracite coal, coke, or any other form of carbon is perfectly burned, the product of combustion is carbonic acid ($C\ O_2$), that is, one atom of carbon combined with two of oxygen, and the full quota of heat is given out; but carbon can be united with oxygen in another proportion, forming carbonic-oxide ($C\ O$), or one atom of carbon with one of oxygen, when much less heat is evolved—it is said only one-fifth of that due from its perfect combustion. This wasteful product is formed, more or less, in all fires, more in those that have great depth, or are insufficiently supplied with air. It is supposed to be formed, not directly by the union of carbon with the oxygen of the air, for this always forms carbonic acid; but by the carbonic acid formed at the lower part of the fire passing through the red hot coals above and taking from them another atom of carbon, and thus becoming carbonic oxide; but in the process it destroys a large quantity of the heat already generated, and if it pass away without combustion, will be the means of much loss. Carbonic oxide is, however, a combustible gas: it is that which is seen burning with a beautiful blue flame, at the top of a brisk fire of red coals, when sufficient air is supplied there to burn it, it having been formed in the fire by the process above described. A beautiful example of utilising this property of carbon is shown in the furnaces for calcining copper ore in Wales, in which a strong flame, which is required for that process, is obtained from anthracite coal, which burns naturally with scarcely any. A description of these furnaces, with diagrams, is given in Tomlinson's Encyclopædia, article "Copper," which is well worth a study. In order to prevent waste in our ordinary fires by the carbonic oxide, it is necessary to supply plenty of air all through the fuel, also some at the top to burn the gas as it passes from the fire; and also to avoid too great depth of fire, so as to give less opportunity for its generation.

Before leaving this part of the subject, we will call attention to a sanitary danger in burning carbon slowly, and without a sufficiently rapid draught of chimney. It is said that in such circumstances there is a continual flow of carbonic acid gas from the stove into the apartment, poisoning the air. Some of the so-called fuel economising stoves have produced more evil, by this means, than any saving of fuel can compensate for. For more full information on this subject, we would refer our readers to Dr. Ure's dictionary of Arts, Manufactures and Mines—articles "Chimney" and "Stove."

Fuel is subject to waste by water being contained in it when burnt, as such water is converted into steam, which passing off carries with it its latent heat. Wood, as it is generally used, contains much water: in that newly felled, as much as 50 per cent.; and after being felled a year, sometimes as much as 20 per cent. Thus, if we suppose 5 lbs of wood in its ordinary state to contain 20 per cent. of water, that is 1 lb., it will require, to evaporate this water, according to our table, more than one-fifth of the heating power of one pound of the wood, or more than 4 per cent. of the whole, and the larger the amount of water the larger proportion of the heat of the fuel is spent in evaporating it—hence dry wood is the most economical.* We hear from time to time of plans to use water as a fuel: it is assumed by the projectors of such plans that, as water is a compound of hydrogen, and as hydrogen is highly combustible, water may in some way be made to burn. A

* Newly felled or partially green wood gives out a greater amount of heat than very dry wood: this arises from the fact that in almost all dry wood used for fuel, decay has commenced, and consequently its heat-giving power is diminished.