the heat developed, may take place in two ways—either by coming into contact with a cold body, as the iron of the boiler, or by finding too much cold air in the furnace. To fully sustain the latter statement, only a little consideration need be given to some of the fundamental principles of heat. It is well known that, if a certain amount of heat communicated to a body of certain weight and given material raises its temperature a definite number of degrees thereby, the same amount of heat communicated to twice the weight of the same material will only raise its temperature one-half the number of degrees that it was in the first case.

To apply this to combustion: One pound of carbon burned with twelve pounds of air gives thirteen pounds of gas at a temperature of 4580°F. [above] that of the external air; but it is found that this rarely, if ever happens, and that to supply oxygen in plenty to the hot carbon surrounded by gas from 50 to 100 per cent. more air is used, and the result is from nineteen pounds of gas at a temperature of 3215°F. to twenty-five pounds of gas at a temperature of 2440°F. [above] the external air; but if forty-eight pounds of air per pound of coal were admitted, the resulting temperature of the forty-nine pounds of gas would be about 1250°F. [above] the external air. With anthracite coal and coke, such a lowering of temperature is not accompanied by serious loss, but with bituminous and semi-bituminous coal, such a reduction of the temperature of the fire is always productive of great waste.

To examine this more closely, suppose a coal with one-half free carbon and one-half hydro-carbon set on fire by the heat. If such a coal were burned with twelve pounds of air per pound of coal, the temperature of the gas before the hydro-carbon ignited would be 2440°F., above the air, and the hydro-carbon would burn if supplied with oxygen enough and complete the combustion. Now if we burn this coal with twenty-four pounds of air per pound of coal, we have only about 1300°F., as temperature of the smoky product, and it is a question whether the gas would ignite; while with more air than this a great proportion of the gaseous fuel is lost and other evils are incurred.

We find, then, one marked point of difference between the anthracite and soft coal as fuel. While the former burns completely with a thin fire admitting an excess of air through it, and the free quantity of heat is developed, though the resulting temperature is not very high, the soft coal, on the contrary, absolutely requires for a perfect combustion a high temperature and plenty of room before coming in contact with