thrown in, is unconsumed gas, decomposed from the fuel without enough oxygen to burn, although there may have been a sufficient supply of heat."

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"A second cause why the whole value of the produced heat is not obtained, is that so much is abstracted from the gases in passing through long tubes, that there is not enough left to continue the combustion, although the inflammable gas is still there. That a tube or any substance in the way of the gas does absorb heat enough to prevent the burning of the gases, is proved by the action of Davy's safety lamp. This is a common light, surrounded by a wire gauze, which so absorbs the heat from the flame, as to extinguish the latter at the gauze, by applying fire above the gauze the gas is again kindled, showing plainly that want of heat above had extinguished the flames."

To remedy the waste of heat resulting from these causes Mr. McConnell of the London and North Western Railway (England) introduced in some of his Locomotives what he termed a "*Combustion Chamber*," dividing his flues into two lengths—into this chamber a sufficient quantity of fresh air was introduced to produce the combustion of the gases; escaping unburned from the first length of tubes—in fact producing precisely the same phenomena in the combustion chamber as we frequently notice at the top of steamboat funnels. The arrangement is said to have produced the most satisfactory results as regards economy, though the practical difficulties in carrying it out, have prevented its introduction to general use; enough was done, however, to demonstrate the correctness of the theory, and there is no doubt but a duly regulated supply of oxygen in the tubes at that point in the length where the heat of the escaped gases would be just sufficient to ignite the mass, would be productive of a more complete absorption of the heat generated, than is affected in flues of the ordinary construction.

A most important influence is exercised on the consumption of fuel by the form and position of the heating surfaces through which the heat is transmitted to the water. Mr. Armstrong found that "a cubical metallic box submerged in water, and heated from within, generated steam from its upper surface more than twice as fast as from the sides when vertical, and the bottom yielded none at all. By slightly inclining the box, the elevated side much more easily parted with the steam, and the rate of evaporation was increased, while in the depressed side the steam hung so sluggishly, as to cause overheating of the metal."* Hence the advantages resulting from inclining the fire box

* Tredgold on the Steam Engine, vol. 1, 1850.