little reflection upon the nature of combustion will shew us the fallacy of such plans. The burning of hydrogen is its union with oxygen, and the product of this union is water. Water is burnt hydrogen just as carbonic acid is burnt carbon; and in order that either the hydrogen or the carbon may be burnt again, they must be unburnt; that is, the oxygen must be separated from them. This is done when, by means of sulphuric acid and zinc, hydrogen is evolved from water in the ordinary way of producing hydrogen gas, and when the sun light in vegetable growth separates carbon from the air. Hydrogen may also be separated from oxygen by electricity, heat and other means, and afterwards used as fuel; but this is not using water as fuel, but only one of its component parts; and it requires just as much heat force, or its equivalent in electricity or chemical action, to effect the separation, as will be given out by its after combustion. This law of conservation of force might be brought to bear upon many other fallacious proposals. Any fuel which is joined to its proper quantity of oxygen cannot be combustible again, until as much force, of some kind, has been used for its separation from oxygen as is equivalent to the heat which will be evolved upon its recombustion.

We proposed to explain why so small a proportion of the mechanical energy contained in fuel is realized in that form by the steam engine, The deficiency is usually attributed to imperfection in machinery, loss by radiation, &c., but there is a large residue of heat inseparably connected with the use of steam as a mechanical agent, which no perfection of machiney can convert into mechanical force, but which may be utilized for general heating purposes. In the conversion of water at 212° into steam at the same temperature, having a pressure equal to that of the atmosphere, as much heat is required as would have raised the water, had it remained such, say 1000°. Now the whole mechanical effect which can be obtained from steam at this pressure, is by atmospheric re-action upon its condensation. Any pressure exerted by steam against the atmosphere, must be by heat applied to it in addition to that of its conversion. If steam at any pressure whatever be introduced to the cylinder of a steam engine in such quantity that, when worked expansively, it shall have at the end of the stroke a pressure balancing that of the atmosphere, we then have a cylinder full of steam which has cost to produce it the equivalent of its latent heat, but which can only produce the mechanical effect due from atmospheric pressure upon its condensation. By putting these into figures, we shall see the reason of the main discrepancy between *heat cause* and *mechanical effect*, in the steam engine, and also the theoretic principle upon which it can be reduced. Let us suppose a cylinder one foot high, holding one pound of steam, the bulk of which will be 47,001 cubic inches. Its horizontal area will be (omitting fractions) 3,916 square inches. If we take the pressure of the atmosphere as 15lbs. on the square inch, the force exerted by it upon condensation of the steam will be equal (leaving out the bulk of the resulting water, which is trifling) to 58,740lbs. raised 1 foot high. The amount of heat required to convert a pound of water into a pound of steam is equal to that required to raise 1000lbs. of water 1° Far.,* or 1000 units of heat; each unit is equal to the mechanical force required to raise 772lbs. 1 foot, therefore the mechanical energy taken from the fuel by the pound of steam is equal to 772,000 foot pounds, or more than 13 times the effect produced. There is a constant residue of 713,260 foot pounds of energy passing away unused for every pound of steam which is condensed in the engine, even when worked to the utmost expansion. Of course there is more in non-condensing engines, and still more proportionally as steam is emitted at higher pressure. Whatever amount of latent heat and elastic force remains in the steam at the end of the stroke is of no further mechanical use, except for the atmospheric reaction it will cause if it is condensed. It is so much of the energy from the combustion of the fuel lost, unless it can be applied to the purpose of heating an apartment, boiler, or some other object. The theoretic principle upon which the discrepancy between the value of the fuel used, and the mechanical effect produced may be reduced, is to increase the proportion of active to latent heat in the steam, either by bringing it to a high pressure by additional heat in the boiler, or by superheating it after it is cut off from it, and to work it to the utmost limit of expansion. Steam once made, having absorbed its latent heat, or perhaps more properly speaking, its constructural force, from the fuel, is subject to laws of expansion by heat which allow of more satisfactory mechanical results. Air has this theoretic advantage over steam—as a mechanical medium for heat—it is found ready made, requiring no latent heat to produce it, but is ready upon the first application of heat to expand with force.

*We select from the various estimates of the latent heat of steam that of 1000°, because it is a round number and more easily worked in our calculation. It is near the average of them However, a few degrees of difference will not materially affect the result.

IDLENESS travels very leisurely, and poverty soon overtakes it.