voted their time and energies to the investigation of a question apparently obtruse, yet of the utmost practical importance to those who employ steam power. We certainly regard it as remarkable in the extreme, that these men have, one and all, overlooked the fact that, in the operation of getting up steam to the working pressure required, an amount of power is stored up within every boiler, almost without exception, sufficient to account for the most disastrous explosions on record. The mathematical investigation of this truth, we may safely leave in the hands of such men as Airy and Rankine; but the *Mechanics' Magazine* is perused by thousands, who have neither the time nor the ability, to study and comprehend profound mathematical disquisitions. We, therefore, once more place our explanation of the matter before our readers, convinced as we are that the violence of a boiler explosion, is as much the result of simple laws of nature, as the succession of day and night, or the fall of a body under the influence of gravitation.

It is impossible to communicate heat to water without immediately developing power, which we may or may not subsequently render available by means of a cylinder and piston. Every pound of coal consumed in a steam-boiler furnace, represents a certain amount of force either stored up for future use, or conveyed at once to the steam engine, and through its agency distributed in various ways. Explosions occur at various pressures; and the measure of their violence is, other things being equal, the quantity of coal required to raise the steam from zero to the pressure existing within the boiler at the moment of the explosion. This will of course, vary with the pressure, the quantity of water, the quality of the coal, and the construction of the boiler. But it may be in all cases approximately calculated from the quantity of fuel consumed per hour. For the sake of illustration, we will suppose the case of a boiler, of the simplest construction, of fifty effective horse-power, burning 300 lbs. of coal per hour. Such a boiler will probably require some sixty minutes to get up steam from cold water to a working pressure of 60 lbs. per square inch. The same quantity of fuel will be burned during this hour per square foot of grate, as though the engines were at work. Now, 50-horse power exerted for an hour, is equivalent to 1,650,000 lbs. raised a foot high per minute, or to 99,000,000 foot-pounds, if the whole exertion of force, instead of being extended over an hour, were concentrated in a single minute. Now, we have seen that power is continually—to make use of a metaphor—poured into the boiler for an entire hour, in the act of raising the steam. On starting the engine, the further accumulation of force within the boiler is arrested; but none of that already stored up is withdrawn until the pressure falls below 60 lbs. per inch. Were it possible to avail ourselves of all the energy retained in the boiler, it would suffice to raise 99,000,000 of pounds a foot high in one minute were the fire withdrawn.

Owing to the imperfections of machinery, and other causes on which we need not dwell, this we cannot do. Still the power is there, and cannot disappear, unless the steam is withdrawn from the boiler or this last suffered to cool down, "Power may be wasted, but it is never lost." When a boiler explodes, it is probably torn into fragments in a minute fraction of a second, and the entire amount of force, due to the combustion of 300 lbs. of coal, is called into action and extorted in that space of time. Even though the catastrophe lasted one entire second, the heat stored up in the water would exert a force great enough to raise 99,000,000 lbs. a foot high?—that is, the entire work of fifty horses exerted for an hour, concentrated in one second. The only thing remarkable is, that explosions are not more destructive than they are.

We have given this calculation to our readers, as though the heat employed in raising the water from 60 deg. to 212 deg. should properly be included in the total, from which the amount of work done by an explosion may be deduced. This is a point however, open to discussion; and as a quarter of an hour, would probably suffice to raise the steam to 60 lbs. in our supposed boiler, from water at 212 deg., we prefer to divide the number of foot-pounds given above by four, the result still giving an amount of power sufficient to produce the most destructive results by its sudden exertion. It is not necessary to call in exploding hydrogen, electricity, or any of the occult forces of nature to account for the ruin of buildings, or the destruction of life and property.

Simple as all this is thus far, and easily as the *violence* of an explosion may be explained, we find the causes which lead to the first rupture of a boiler surrounded by much that is mysterious. The primary cause of an explosion is a rupture above the water-line. Whether this rupture is the result of congenital weakness, or of corrosion, depends on particular circumstances not easily ascertained in most cases. The singular effects produced on the plates of a boiler by oxidation, trituration, vibration, &c., have received much attention, and an amount of research has been expended on this branch of the subject which will, we trust, soon divest it of the uncertainty which hangs around it at present.

In order to understand the *rationale* of a boiler explosion, it is only necessary to comprehend the following facts:—Every body of water is made up of an assemblage of spherical particular atoms, capable of free motion on each other. When heated, the atoms of water within a boiler are surrounded by, so to speak, an atmosphere of caloric, tending violently to repel each one from its fellows. This force is equilibriated by the pressure of the steam in the upper portion of the generator, resting on the surface of the liquid, and thereby forcing the constituent atoms into propinquity. The instant, however, that an opening is made above the water-line sufficiently large to remove the pressure instantaneously, the repulsive action of the heat comes into play, and the water is separated into its ultimate atoms with a force proportionate to the quantity of heat stored up; rending the boiler into fragments, and destroying everything in the immediate neighbourhood. It is a mistake to imagine that any true dynamic steam is produced during this stage of an explosion, or that the water is dispersed in masses. Every particle repels its fellows with equal force, and it is opposed to reason, to suppose that many of the atoms can remain in that close approximation, which enables them to constitute a liquid, while