The Principal Cause of the Explosion of Steam Boilers.

Nature, when perfectly understood, is always extremely simple in her operations; and when the causes are perfectly comprehended, there is seldom much difficulty in accounting for effects. It is therefore necessary, in order to account for the bursting of steam boilers, to investigate the effect of heat applied to steam, both with and without water, in the same vessel.

Water boils at the temperature of 212° Fah., and the pressure of the steam on the inside of the boiler, is then just equivalent to the pressure of the atmosphere on the outside, or it is between 14 and 15 pounds upon every square inch; and the boiler consequently sustains no bursting force. But if this steam be then heated to $250\frac{1}{2}=212+38\frac{1}{2}$°, in contact with water, one pressure on the inside of the boiler becomes equivalent to two atmospheres, and the boiler sustains a bursting force of between 14 and 15 pounds, acting on every square inch of its internal surface. Again, if water be heated to 400° in an air-tight vessel (such as Papin's Digester,) without permitting it to boil, and the cover be then opened, about one-fifth of the water rushes out in the form of steam, and the remaining four-fifths instantly cool down to 212°. Consequently the steam has carried off from each of the four-fifths of the water remaining in the vessel $400-212=188$° of latent heat; that is, $188\times4+188+940$° of latent heat has disappeared. (Lavoisier states it at 1000°, Count Rumford at 1040·8°, and Watts at 940°.) That this quantity of heat was latent, in the vessel, is proved by the fact that if a thermometer be held close to the orifice from which the steam escapes, it rises only to 212°, but at a little distance from this orifice it rises to 400°: hence, it is manifest that to raise water to the boiling point of 212°, that water must receive at least 940° of caloric, or latent heat, to convert it into steam of 212°, provided the quantity escaping from the digester be correctly stated.

Water converted into steam of the temperature of 212°, occupies 1698 times the space occupied by the water, from which it was generated; and if this steam, confined in a close vessel containing water also, be then heated to a still higher degree, more and more of the water will be converted into steam, and its elasticity, and consequently its bursting pressure against the inside of the vessel, will of course advance *pari passu* with the diminution of the water on which the steam floats, and an increasing quantity of steam will be generated, until all the water has been converted into steam, and the quantity of caloric rendered latent amounts to $940\times5=4{,}700$°, or, perhaps, to $1{,}040{\cdot}8\times5=5{,}204$°, which, at that moment, will have attained its maximum elasticity, and exert a bursting pressure of nearly 20,000 pounds upon every square inch with which it is in contact, supporting a column of quicksilver 3,242 feet high—a pressure which no vessel man has ever constructed can sustain; and which, in the earthquake, heaves the solid crust of the earth, and even mountains from their base.

Doctor Thomson states, in his Chemistry, that when steam of the temperature of 212° is heated to 419°, without the presence of water, it expands only 37 times its former volume; and, at the temperature of 500°, its volume would not much exceed that of the water from which it was generated. Mr. Perkins gradually injected water into steam heated to 1,400°, gradually setting free the latent heat it contained, or in other words, gradually increasing the quantity of steam, till the elasticity and pressure were augmented to one hundred atmospheres, or between 1,400 and 1,500 pounds upon every square inch of the containing vessel, without supplying any additional quantity of caloric.

If, then, steam, without the presence of water, condenses, and consequently is made to occupy less space and exert a diminished bursting force, with any any every increasing dose of caloric, it does not seem to be so difficult to account for the bursting of steam boilers, the great cause of which has baffled the scientific world so long, as is generally believed.

We generally read:—"The boat had just cast off," &c. Now, suppose a boat stops, and the firemen fill the furnace "to put her under good headway in the start." But the valves are closed—no more steam is condensed; and the pump being also idle of course—the reservoir is neglected, and the boiler consequently receives no more water—the damper being insufficient to check the fire, especially if the fuel be stone-coal. What now is the effect? Plainly the water in the boiler is rapidly converted into steam, which decreases in volume as its concentration augments, till it no longer sustains the pressure of the atmosphere upon the outside of the boiler; and the boiler is crushed, *i. e.*, collapses. Or, if the concentration of the steam does not proceed to this extent before the boat starts: then, the steam passing through the cylinder, the air-pump exhausts the reservoir in which the steam is condensed (converted into water) and re-conducted to the boiler—the overheated steam, uniting with this, increases its own elasticity and pressure, raises the float, opens the water regulator, and admits more water, which, uniting with the rest of the highly concentrated steam increases the quantity of this in the boiler, and a violent explosion is the inevitable result; for even the safety-valve, contrived for letting off a gradual surplus, is totally inefficient to let off the enormous quantity of steam so suddenly generated.

Such seems to me to be the principal cause of the bursting of boilers, and as I never have seen any position like it stated, you will confer a favor by publishing this, provided the suggestion be new or you think proper; I have seen the explosion attributed to a deficiency of water in the boiler, and many other conjectures, but this alone could only be the cause of a collapse, if I am right, though it would evidently also weaken the boiler itself in consequence of its becoming overheated, so soon as the water is all converted into steam.

Howell, Mich. H. R. S.

For the Scientific American.

Interesting about Railroads.

WASHINGTON, PA.

Knowing that you take an especial interest in the progress of improvement in various branches of industry, science, internal improvements, &c., throughout our country and the world, I have been desirous of giving, in some favorable way, a notice in the "Scientific American," of a contemplated railroad, which is now attracting a good deal of attention, and which promises to be one of the most important thoroughfares in the United States. It is known that the great Central road of Pennsylvania, from the city of Philadelphia, is in a considerable state of forwardness, and will ere long be completed. Connected with this road, and diverging from it at Greensburg, in Westmoreland county, about thirty miles east of Pittsburg, a company has been organized, called "The Hempfield Railroad Company," to construct a road from that point directly through Washington, in Washington county, to the city of Wheeling, where it will connect with the Central Railroad of Ohio, which passes through Zanesville and Columbus, in the direction of Indianapolis, and will be extended through Terre Haute to the city of St. Louis. From Zanesville, on the line of this Central Railroad of Ohio, a company has been incorporated to construct a road through Lancaster, Circleville, and Wilmington, directly to the city of Cincinnati. An inspection of the map will satisfy any inquirer that this route will be by far the shortest of any road now in progress or in contemplation, between the cities of New York, Cincinnati, and St. Louis, and promises to secure to it an immense amount of trade and travel from the growing West. It will be found, on examination of the map, that an air-line, drawn from St. Louis to New York, passes nearly through Columbus, Zanesville, Wheeling, Washington, and Greensburg, and thus a particular scrutiny may be invited as to the merits and claims of this new line of communication, as it is believed that it possesses claims superior to any other line which has been proposed or which is now in existence.

The Hempfield Railroad, forming the connecting link between the Central Railroad of Pennsylvania and the Central Railroad of Ohio, will be less than 80 miles in length, and passes through a fertile, well cultivated, productive, and thickly settled region of country. Its location and construction have been placed under the charge of Charles Ellet, jun., Esq., the distinguished C. E. who constructed the Niagara and Wheeling wire suspension bridges, and who is favorably known throughout the country as an accomplished engineer and efficient business man. He has examined the route of the road, and found it entirely practicable. By his recommendation the Board have authorized the definitive surveys to be made without delay, with a view to the early commencement and final completion of the work. It will go on speedily and promptly; and although this Hempfield link is a short one in the connection, it is believed that no one can be found in the country that will surpass it in importance, usefulness, or profit.

J. G.

For the Scientific American.

Chemical Affinity Illustrated.

TARTARIC ACID.—When wines are allowed to stand long undisturbed, they deposit upon the sides and bottom of the cask their *lees*, which consist principally of the tartrate of potash in combination with various earthy, oily, and coloring matters. From these the salt is purified by solution, filtration, and boiling with white clay. The pure salt thus obtained consists of the tartaric acid combined with potash. Its crystals, when powdered, form the cream of tartar—so much used in the manufacture of light bread without yeast.

The processes employed for the separation of the tartaric acid from its combination with the potash, afford a beautiful illustration of the operations of the natural law called chemical affinity.

The tartrate of potash, or cream of tartar, is dissolved in water and a quantity of lime is then mixed with the solution—a chemical action immediately ensues, in consequence of the superior affinity of the acid for the lime; the acid separating itself from the potash and uniting with the lime, forms the tartrate of lime, which, being insoluble in water, falls to the bottom of the vessel, leaving the potash in solution.

The solution of potash being now poured off from the tartrate of lime, the laws of chemical affinity are, again, made use of to obtain the pure acid in a crystalized state. To effect this object, a quantity of diluted sulphuric acid is added to the tartrate. The lime having a stronger affinity for the sulphuric acid than for the tartaric, leaves the latter, and, uniting with the former, forms sulphate of lime; this compound is also insoluble, and falls to the bottom of the liquid, which is then evaporated, and yields the pure tartaric acid in transparent crystals.

This acid is well known as the acidifying principle used in meads; also in the effervescing soda and siedlitz powders, combined with carbonate of soda. Here, again, the pleasant effect is owing to a law of affinity, by which the tartaric acid unites with the soda and leaves the carbonic acid to bubble up through the water in which the ingredients have been mixed. H. W. H.

(For the Scientific American.)

Everett's Method of Blasting Rocks.

I have lately seen an improved method of blasting rocks, illustrated in the "American Artizan," and secured by a patent. The inventor offers to let one, or all, who want to put a charge in a rock that happens to be in the way, have the privilege, if they will contribute something for *his* comfort. I am now practising a method of charging rocks that is vastly superior to any patented method that has been used, and which I wish all to have the benefit of, and I shall exact no fees; the process is a cheap one, and is certain to tear the rock into pieces. Fill the hole from one-third to half its depth with powder; place a straw or tube filled with powder in the side of the hole, from the charge to the top of the hole (or a piece of blasting fuse will be just as good); then put a little dry sand on the charge—one-fourth of an inch is enough, this is to prevent accident. After this, place a round bar of iron, as large as will fill the hole, on the charge; let the iron be long enough to extend a few inches above the hole; then fill the space around the bar with dry sand; place a piece of timber on the top of the bar of iron, and place 200 or more pounds weight on it, being careful to press down the charge as little as possible in placing the weight on it. It is better to have the iron bar made with holes through it, and put a nail or pin through above the hole in the rock; the weight resting on the pin, instead of the charge; the pin being as small as will bear the weight, so that the explosion will break off the pin instead of moving the bar of iron. For a match, soak paper in a solution of saltpetre or gunpowder; take a strip an inch wide and four inches long, this will, in burning, give you time to walk twenty rods before the explosion, when you may return and see the havoc made with the rock which is thrown apart; and the iron bar, which you never expected to see again, is where the hole was, not having been moved out of its place. If the hole is horizontal the weight may be put against the end of the iron bar, and the effect is the same. I have tried this method hundreds of times, and never had a single charge fail of breaking the rock. The common method of charging, by driving stone or brick into the hole, is unsafe, is liable to blow out, and ought to be laid aside. I hope that all papers wishing well to others, will publish this method of blasting; any information that will prevent accidents from the use of gunpowder ought to be given to the world, and used till a better method is discovered.

ADDISON EVERETT.

Middlefield, Mass., June 10, 1851.

Remarkable Automaton Tree.

We had an opportunity, says the Wolverhampton Herald, (England,) of inspecting, at the bazaar of Mr. Cheetham, on Thursday last, an automaton, as novel in its action as it is beautiful in design. This remarkable piece of mechanism consists of a hawthorn tree in full bloom faithfully copied, the crusted or semi-perished bark on the trunk, and the foilage, being most naturally imitated; and on several of the branches stuffed humming birds are perched, which, now waving their wings and anon hopping from spray to spray, and pouring forth a flood of music, almost charm the spectator into the belief that it is a pleasing reality, and not an illusion, which is presented to his admiring view. One of the tiny creatures jumps from one branch to another in pursuit of flies and insects—another lies basking on one of the hawthorn flowers, a third sits on its nest, whilst several others are disposed in different parts of the tree. The singing of the birds is not only accurate and natural, but the motion is also admirable—one of them flying from one branch to another, a distance of about eight inches, with the greatest possible precision, and alternately turning completely round in going or returning, and without anything being observed to cause such an effect, or even to discover the motion of this unique and elegant specimen of industrial art. On the base of the tree, which abounds in moss, tufts of grass, and the concomitant herbage (composed of a material which, above all others, appears least suited to the purpose) with a number of shells &c., &c., are a taniger and Chinese fly-catcher, both birds of beautiful plumage, and the latter is incessantly pecking the carcase of a golden beetle amongst the moss in the foreground, now and then stopping to swallow, what he may have managed to cull with his slender beak. The artist has achieved a work of which he may be justly proud, the *ensemble* being such as to strike the beholder with involuntary wonderment, whilst the most erudite ornithologist or professor of botany would fail to distinguish the imaginary from the real at first sight. The whole is enclosed in a glass case, and has been produced by that renowned Parisian, Stevenard.

By the late news from Europe, cotton had fallen in price; this makes the cotton manufacturing trade dull. Few buy where prices are falling.