STEAM BOILERS—THEIR CONSTRUCTION AND USE.

We make the following extracts from an address delivered recently before the Institute of Technology, in Boston, by Mr. J. A. Miller, a practical engineer and boiler maker of New York city. Many of his ideas if not new are quite suggestive:

One hundred years ago last November, Watt completed the first practically perfect steam engine. It may be fairly asserted that for the first fifty years its introduction was only in an experimental manner; when we consider that in 1812 the first steam engine in the New England States was erected in the city of Providence, for the Providence Dyeing Bleaching and Calendering Company, on the very spot on which the boiler now stands. What wonderous revolutions have not been effected by this mighty engine in a half a century. Fifty years ago a commission of the greatest scientific men of the day reported to Napoleon I. that the application of steam to the propulsion of vessels was a visionary and an impractical idea. Yet, in the short span of time, the steam engine has become so important to mankind, that if by some sudden chance men should be deprived of its use, the greater portion of the people on the civilized globe would be plunged into want and misery, and a large portion would surely die of starvation.

Yet this mighty steam engine is only as the lever, or any other mechanical device. It is not the source of any power, contains no power within itself; but is simply an instrument to apply the power generated in the boiler. The engine being the more showy and attractive part, has received all the care and attention that could be lavished upon it, whereas the steam boiler is left to the narrow notions which daily routine so frequently engenders. Mechanically constructed by a boiler maker, it is considered safe, perfect, and will pass inspection if it be only tight and able to stand a given pressure. That the steam boiler is far behind the engine, can be easily understood; when we consider that the best engines made will realize from eighty to eighty-six per cent of available power out of the power applied from the boiler. How is it with the boiler? The percentage of available power produced by the combustion of fuel averages for wood five, for bituminous coal seven, and for anthracite coal eight and a half per cent. When we consider that we get, at best, less than one tenth the power out of our fuel, in the best boiler in use, we can easily appreciate how much can and must be done to bring the boiler on a level with the engine. That the steam boiler can be made to give within a small fraction the whole theoretic power as well as the steam engine, and that it can be made as safe as a water wheel, can only be doubted by those that have never held sweet communion with nature, and admired the beauty and perfection of her laws. That steam boilers at present are not safe, is a lamentable fact, that they can be made safe, I have repeatedly proven. All that is required, is to make the construction of steam boilers a separate branch—not in a mechanic sense; but let scientific men study the laws applicable to steam, in all its relations, and soon the day will come when well defined laws govern its construction. At present, there has been no attempt at system, and many of the causes of its rapid destruction, although well known, are constantly ignored. Incrustation; that greatest source of boiler destruction, it not for one moment considered, but left to injurious powders as a remedy, when the disease is much easier reached. Nothing is done to insure circulation of the water, so as to carry the steam, as soon as made, into the steam space. Priming is only considered when the boiler proves useless on this account. There is nothing done to protect it against sudden strains which so disastrously weaken boilers. No, the boiler is simply made tight, as to the rest, it is left to chance or good luck; and yet, if it explodes and kills, maims, and carries destruction to all surroundings, the burden is laid on some mysterious cause, beyond the control of engineer or owner.

When, in a boiler, we find some attention paid to conveying the heat generated in the furnace into the boiler, we will be sure to find the question of evaporation completely set aside. When a boiler foams, or makes wet steam, a steam dome is carried up around the chimney, or the heat is carried over the top of the boiler, or a super-heater is used. All of these have been found useful and beneficial, yet they are at best but remedies—after thoughts—and, when not wrong in themselves, show conclusively that there is something seriously wrong in the boiler. Such remedies are on a par with the cobbler who, in trimming, cut the uppers of a pair of shoes and then charged at once for mending the new shoes. The plainest evidence that steam boilers are built without regard or knowledge of the natural laws applicable to the production of steam, lies in the lamentable fact that more than four hundred and twenty different forms of boilers are made, each claiming some superiority over the others; and, strange to say, not without some show of reason. Another fact, and one, I hold, fully demonstrating the lamentable state of ignorance in all that relates to vaporization, is that a boiler, and one of the latest improvements, claims to be so strong that it cannot burst under any practical steam pressure! Now what would we think of the intelligence of an individual, who having lost some gunpowder by explosion, would have his powder kegs bound with strong iron hoops, or would the Pacific Mail Steamship Company carry nitro glycerin if put up in spheres tested at 600 lbs. to the square inch. The cause, it must be evident, still remains; and the effect would be worse. If we wish to make powder non-explosive, we mix some foreign matter with it, and thereby prevent the conditions under which explosions take place; we do not strengthen the receptacle. If we would have boilers safe we must do the same, and not resort to the doubtful expedient of simple strength.

A steam boiler tested and built to work under a pressure of 80 lbs., is worse than a powder mill, if under any circumstances that pressure may be increased accidentally, even one pound. An English writer on this subject says: "It is a truism that the strength of any structure is its weakest point," but who can say where the weakest point of a steam boiler is; as ordinarily made. Some will say the safety valve is an efficient remedy, while others contend that the same has been found wanting in many cases; both parties are right. A steam generator in the true sense of the word, one that will make dry steam without superheating in any manner, one that will simply change the cohesive force of the water the repellant force of the steam, and leave the water a dense mass free from steam, such a steam generator wants only a simple and reliable safety valve. But a regular steam boiler (we had better call it a water boiler), wants more, or rather to make it perfectly safe under all circumstances, wants—well, it wants to be kept cool.

I have for years made heat and steam my specialty. I have experimented during that time on a pretty large scale, and on all kinds of boilers. I have examined forty-eight exploded boilers carefully, have conversed and compared notes with practical men at home and abroad on this subject. I believe that I understand this subject as thoroughly as Professor Agassiz does anatomy, and I am learning, laboring, reading, and investigating daily, yet I own, that the more I search the more clearly I comprehend the laws that lie at the root of the production of steam, the more I marvel not that steam boilers explode, no, but rather that they do not explode more often. When on a steamer I hold my life worth but little, when I think that there is a power, and a more dangerous power, stored in the boilers, than could be in a hundred powder kegs; when I think that this power is under the control of men knowing nothing of its laws, and little more of its nature, than the children in New York did, who threw a piece of conglomerated powder (dropped by a careless cartman in the street) into the fire, causing the loss of four innocent lives. Tell this man of his great responsibility, of the number of lives placed in his hands and dependent on his skill, and he will point to the glass gage, if such a thing is used at all, considering that all is done that can be done when the water is at a sufficient hight. And yet there are many cases on record, where it is known beyond a doubt, that at the time of explosion the water was at its proper hight. So great, in fact, is the fear of low water, that I do not think one engineer in a thousand ever lets his water get low enough to cause danger from that source. There are many boilers so constructed that the water actually changes place with the steam, or where the water is lifted out of the lower, or water leg, and is forced into the steam room. To such an extent does this take place at times, that water is found in the upper gages.

Are such steam boilers safe? Are they constructed for any definite object except to boil water?

Let an inspector examine such a boiler, and he will subject it to a certain cold-water pressure, and certify to its capacity. Now I will here make the assertion, that there are plates in most boilers which are subject to a higher strain empty, without any steam pressure in the boiler, than they are under a hundred-pound pressure. The construction of our boilers at present depends on so many faithful or faithless, sober or drunken, skillful or ignorant men, on whom the contractor does, or must depend, that no man can be for one moment responsible for their safety.

If a steam boiler were made of a flexible material, in the same manner as they are made of boiler iron, it would present a curious shape and puckered seams, but the iron allows the boiler maker to hammer it into shape. Each sheet is stretched and pulled and hammered, sometimes more than the iron can stand, and the sheet is taken out, torn and rent, before the boiler is completed.

All this is wrong, and the sooner we leave off forcing and compelling unfit material to assume an unnatural shape, and perform unnatural functions the better.

All things in nature or art to be perfect, must be graceful and harmonious. The strongest beam we can cut out of a tree will be the most agreeable to the eye. A steam engine that works silently, smoothly, you need not ask, but be sure it works well. The same is true of gearings, railroads, and all other machines, tools, or other things that move; a graceful motion is a sure indication of speed in a horse, or any other animal, the one that moves most gracefully, moves with the least expenditure of force. It is a fundamental law, that perfection, harmonious operations and economy, go hand in hand.

Here, one word about the safety valve. It is too frequently the case that a number of boilers are connected by one steam pipe, and that for convenience sake, the safety valve is placed so remote from the boiler that it can, under no conditions, be more than a simple pressure gage, wholly inadequate to carry off any steam, that may from some cause, be rapidly forming in the boiler above the working pressure. Directly on the boiler, and that on each boiler, is the proper place for a safety valve.

If we lift the safety valve on a cylindrical boiler made of a glass tube, we will at once see the water suddenly rise like a wave—we see in both ends the water fall and all flowing toward the center. If not sufficient steam pressure is stored up in the water, we see it suddenly return to its level, and observe a violent agitation of the water. If an engine is attached to the boiler, we see the same agitation at every stroke.

Is there no lesson in all this? If not, do not all explosions happen, either at the moment the safety valve is rising, or when the engine is either started or taken fresh steam, or when dye becks or tanks are suddenly connected? We have hundreds of well authenticated cases to prove this. As there is no circulation in the water, and as most water contains some impurities, the water can be heated to a higher degree of temperature than corresponds with the pressure of the steam, if we now, by opening a valve, cause a local relief of pressure, the water nearest the valve first rises, then suddenly falls, causes agitation of the same, and a sudden relief of large quantities of steam, which, if the boiler is weak at any one spot, causes rupture, and this rupture causing additional relief and additional generation of steam, causes the explosion.

Imitating Cluster Jewelry.

"'Cluster work,' or that style of jewelry which, in the form of breast pins, buttons, earrings, etc., consists of an aggregation of small stones arranged in a cluster, is commonly made by mounting each stone, or its glass imitation, in an appropriate plate, furnished with as many settings as there are stones, each stone being held in the grasp of its appropriate setting by the friction of the edge of the latter against the surface of the stone. In the manufacture of genuine work this method is the only one practicable, on account of the small size and high value of the jewels employed."

The present improvement applies only to the manufacture of imitation cluster jewelry, and consists in having the "jewels" all made in one piece or plate of glass, the "jewels" being raised on the glass plate, forming bosses. The setting is also made in one piece of metal—a sort of net work, filling the spaces between the bosses.

Recently patented by W. O. Draper, A. C. Sweetland and G. H. Draper, of North Attleboro, Mass.

Mechanical Decoy Bird.

"My invention is designed to supply cheaply, to gunners, a means for causing, at will, a motion of the wings of a decoy, to attract the attention of flying birds; and it consists in the combination, with the body of a decoy, of wings which are made to move by a line or lines leading from the body of the decoy to the gunner, so that he can, at will, by pulling on the string or strings, cause a movement of the wings, which will attract the attention of flying birds." Patented by Nathaniel Wales, Boston, Mass.

Science Familiarly Illustrated.

Curious Things About Frost.

One morning in October I found all the tomato and pumpkin vines used up and killed by frost, but the bean vines, the potatoes and the cabbages in my garden were in fine order still. Three weeks after the frost came again, and not finding any tomatoes and pumpkins, he laid hold on my pole beans and my potatoes. They became black and died as if strangled. An old farmer said that this frost that killed the potatoes was a "real black frost."

"Ha!" said I, "black frost and white frost—do they ever mix?"

"You watch and you'll see the difference," said the old farmer.

And I began to watch. The cabbage in my garden was not killed yet. The chickens have a wonderfully good time nipping off the edges of the big, tough leaves. Well, I watched to see what the frost would do next. One morning I noticed that the bridges and the board walks were white as snow, but the dirt roads, gravel walks and stone sidewalks could not show a single speck of frost. And I saw that there was no frost on or near the spikes in the board walk, but were spots instead.

Yet I remember, on one winter day about noon, when things were thawing a little, that the board walks all dried off, leaving a spot of frost on each spike, and all the stone walks and dirt roads were cold and hard as ever with snow and ice! Every fall the boards become frosty, while the spikes and stones are warm and wet. Every spring the boards are warm and wet, while the spikes and stones are frosty! Funny frost!

One day the good woman who cooks for us, made some doughnuts, some folks call them fried cakes (they are good no matter what you call them), and when she had done frying them, she set the hot lard out at the door, by the side of a basin of water, to cool. The lard and the water both froze solid that night, and the next morning I saw the frost had made a hollow in the lard and a hump in the water Frozen lard shrinks, frozen water swells! Funny frost! how you do. And out in a barn on a beam, I had one bottle with castor oil it, to oil my carriage wheels, another with neatsfoot for my harness, and another bottle full of water. They all froze up solid, one cold night, and the water bottle split, but the others did not.

Off the coast of Newfoundland and Nova Scotia, sailors often meet with icebergs a hundred feet high, and all the books say that there is nearly as much ice under the water as there is of it on top of the water, and none of that was under water at all. And yet, when I break off a piece of ice, and put it in a pitcher of water, it floats just like an iceberg, six times as much under water as there is above it.

An Indian was found dead by the roadside, one very cold morning, with an empty rum bottle beside him. He was frozen stiff. The wise Indians came and examined to find what had killed him. They decided that there had been too much water in his rum, and the water had frozen hard and killed him. Rum never freezes, but men with rum in them freeze more easily than other men who drink water only. Queer, funny frost again.

These are only a few of the curious things that frost has set me to thinking of. If any one of the readers can explain all these curious things, they will be wiser than some professors in our colleges. And professors are the wisest people I know of.—*Little Corporal.*