

and also the fire box and tubes; then the engineer examines carefully all the sheets exposed to the flame for cracks or blisters, and all round the seams of rivets. He also examines carefully the fire box and crown sheets, observing if there are any sprung rivets, or any other flaws to be seen, and noting the whole in a book kept for this purpose. He also goes inside the boiler to see that all is right there, and to examine any supposed flaw that may be reported to him by the scrubber-out, who preceded him in the inside operations.

#### Professional Inspection.

This should be made once in six months, or according to the usage of the boiler, with a practical boiler maker present, when all these points are more carefully examined, and determined upon as to what is sufficient and what is not sufficient for the next six months; also the repairs that may be necessary on the several parts that require to be repaired, and a full report made of the whole, and submitted for the approval of the head or superintendent of the establishment. Where such a system of cleaning and inspections have been carried out, it has been attended with the best results, and has given the greatest satisfaction. In our own experience, where there are eight boilers, we have found it necessary to have the cleaning and inspection weekly. Each boiler has a heating surface of sixty horse-power, with the usual pressure of eighty pounds on the square inch. The boilers have been in operation for the last six years, working day and night (equal to twelve years ordinary use). The fuel used is coal, and the chimnies are 100 feet high; consequently the heat and flame that they have been subjected to has been intense; so much so, that the water evaporated per minute with open dampers was nearly one and a half instead of one and a tenth cubic feet—the quantity due to a sixty horse power boiler per minute. The water, too, at all times muddy, at certain seasons excessively so, and carrying just so much lime as to cake and form a crust on the shell and tubes. In this case, without the cleaning and inspection herein recommended, these boilers would probably not have run three years, until requiring such extensive repairs as to be nearly equal to new boilers; and it is quite probable that from the frequency and extent of the repairs required, without such cleaning and inspection, they would have fallen far short of the requirements of the establishment.

We shall conclude these remarks by several others, gleaned from various sources, bearing upon and corroborating the views here put forward.

#### Boiler Explosions.

In the month of January, 1866, there occurred in the United States no less than eleven different explosions, by which no less than 490 lives have been lost, and for which no cause can be assigned; 21 wounded, and for which no cause can be assigned; making a total of 511 without any ascertained cause.

"It may be well," says the *Mechanic's Magazine*, "to place the following paragraph on record: Negligence is too frequently the cause of boiler explosions. One of the enginemen engaged at the Gospel Oak Colliery, Tipton, was sent to prison on Friday morning, for placing in jeopardy the lives of about sixty miners. He had neglected to examine the boilers, as he ought to have done; and early on Friday morning, when they were waiting to go down to the pit, the boiler plates were seen to be red-hot, and it was, as it is described, almost a miracle that no explosion took place."

The same journal says: "The time has gone by when an explosion was regarded as the result of mysterious agency. It is pretty well known now, that but two causes can lead to the bursting of a steam boiler under the conditions of legitimate working. These are simply congenital weakness, owing to bad materials or an imperfect method of construction; or induced weakness, the result of over-heated plates; or corrosion. More than 80 per cent. of the explosions which occur yearly, are the result of this last cause. If we take a hypothetical case, of three boilers of precisely the same form and construction, worked under precisely the same conditions, and exposed to like causes of deterioration, but carrying different pressures; the time when each will explode may be as certainly reckoned as the moment when a watch wound up to-night will be completely run down to-morrow. Suppose that one carry 100, another 75, and the last 50 lbs. of steam; the first may last five years, the second seven years, and the last nine or ten years, simply because the process of destruction may have so far weakened all the boilers that in five years they are incapable of carrying 100 lbs. of steam, but yet retain strength enough to carry 75 lbs. Therefore only that one carrying 100 lbs. will be destroyed then; the others will last until corrosion has done a little more, but they will go in turn. 'The end of all flesh is death,' and the end of all boilers is explosion. An old writer quaintly remarks that 'If a man live long enough, he will certainly die.' In the same way, if a boiler be worked long enough, it will explode, in spite of all the safety appliances which ever were or ever will be invented. At best, these can only provide for the occurrence of certain phenomena, which, without this provision, would cause an explosion; but they certainly cannot provide for the occurrence of *all* the phenomena which produce explosions. Until a safety valve or fusible plug is invented which shall stop a leak, or put on a patch, or arrest the progress of corrosion, neither one nor the other can prove its title to be esteemed as an infallible specific. The only certain preventive is careful, properly arranged and thorough inspection; and the reports of the steam-boiler societies prove its efficacy daily.

Experience goes to prove that fully as many explosions occur while the engine is in motion, or