

perature as the boiling water with which it is in contact. In an open vessel the temperature of boiling water is 212 deg. and this is not sufficiently high to char paper. When scale is present, the water cannot absorb the heat as fast as it is put into the vessel by the flame, and as a result the temperature becomes greater than 212 deg. and burns the postage stamp.

It is the same with steam boilers. If the water comes in direct contact with the thin plates, the heat is absorbed, the temperature of the plates remains practically the same as the water, and no harm is done. If there be a considerable thickness of impervious scale in the boiler, the water cannot absorb the heat as fast as it is put into the plates by the furnace, and so the plates become overheated, get red, become plastic, and finally give way to the force of steam pressure, causing a bag, or a rupture, or a violent explosion of the boiler.

Scale endangers the safety of boilers in other ways. It clogs the feed pipes, preventing the feed water from freely entering the boiler. It clogs the connections to the water gauge, causing it to indicate ample water when it is at a low level in the boiler. Pieces get under valves and prevent their closure.

Scale in boilers is a serious matter, and in order to prevent its accumulation, it is good practice to eliminate the scale-forming matter from the feed water before allowing it to enter the boiler. This can be accomplished either mechanically by means of separators, or chemically by treating the water in vats especially arranged for the purpose. If preferred, compound may be fed with the water into the boiler, but in such case the water should be analyzed, and the proper compound prescribed by a chemist making a specialty of such matters. Kerosene fed into the boiler has proved beneficial in many instances.

It is an almost universal custom for boiler owners to have their boilers insured and inspected. The insurance serves as a guarantee that the inspections will be intelligently and carefully made and the inspections lessen the chance of accident.

When boiler insurance is carried, an inspector visits the plant at regular intervals and critically examines the boilers, both internally and externally. During the past 10 years the company represented by Mr. Boehm made 1,101,140 examinations and reported 140,989 defects, many of which consisted of dangerous fractures in or near the riveted seams, and that one boiler out of every eight examined, contained defects serious enough to warrant their being reported.

CLEANING THE WATER MAINS.

It is of interest to note that during the past five years the water department of Cincinnati had been almost constantly employed in removing deposits from the water mains of that city. Previous to 1907 the muddy Ohio River water, having a turbidity varying from 7 parts per million to over 300 parts per million, was pumped directly into the distribution system. In 1907 the purification plant was installed and placed in operation. The deposits in the mains so decreased their capacity as to make it necessary to remove them, and although the work has been in progress for five years a large part of the system still remains to be cleaned. The enormity of the expense of cleaning will be recognized from the cost figures which vary from 10 cents to 26 cents per foot of pipe cleaned. The carrying capacity of the distribution system is greatly increased after the deposits are removed and an increased pressure results at all points on the distribution system.

DRIVING THE LARAMIE-POUDRE TUNNEL.

General methods and records of progress in driving the Laramie-Poudre Tunnel were described in our issue of April 10, 1912. The bonus system used in paying the men and descriptions of the method of loading the holes is of special interest and are further described in a paper by David W. Brunton, published in a recent Bulletin of the American Institute of Mining Engineers. We abstract from this paper as follows:

European tunneling methods were copied as closely as the American wage scale and differences of conditions would permit. A workman once assigned to a position in the tunnel remained there, not being allowed to change even from one side to the other. He was not allowed to drop his tools at shift-change, but was obliged to hand them to his successor, and, in case of his successor's non-arrival, was expected to work another shift, care being taken, of course, that either a substitute was found, or meals were sent in to the man working a double turn.

To give each man a personal interest in the work a bonus system was maintained. At first the bonus paid to each underground workman was 25 cents per day for each 25 ft. in excess of 400 ft. for the month.

After a few months this schedule was discontinued, as it was found to be both cumbersome and excessively high, considering the rate of progress made possible by the superior equipment; and the following bonus rate was adopted:

When the rate of driving for any calendar month exceeded 400 ft. and was less than 500 ft., each underground employee was paid \$10 extra; between 500 and 600 ft., the bonus was \$15; and between 600 and 700 ft., \$20.

This bonus should have been paid to the men in currency, so as to distinguish it from the earnings under the wage schedule, but, as this was impracticable, money earned under the bonus was paid with a separate check, thus giving the men a better opportunity to realize what speed meant to them as well as to the contractor.

The list of employees and their rate of wages is as follows:

1 Superintendent	\$ 10.00 per day
3 Foremen	each 5.00 per day
9 Drillers	each 4.50 per day
6 Helpers	each 4.00 per day
18 Muckers	each 3.50 per day
6 Drivers	each 4.50 per day
3 Dumpers	each 3.50 per day
1 Track and pipeman	3.50 per day
1 Master mechanic	6.00 per day
1 Stable boss and janitor	3.00 per day
2 Power engineers	each 110.00 per mo.
1 Car greaser	3.00 per day
1 Man at odd jobs	3.00 per day
1 Timberman	4.00 per day
1 Timberman's helper	3.50 per day
2 Blacksmiths	each 5.00 per day
2 Blacksmith's helpers	each 3.50 per day
1 Book and timekeeper	110.00 per mo.

In the operations of setting up the machines, drilling, firing and mucking, the utmost regularity and system were observed; and, while the time consumed in these different operations varied somewhat from day to day, there was a remarkable degree of uniformity in the amount of work performed by the different shifts.

Picking down the roof and squaring up places on the sides for the drill-bar rarely occupied more than 10 minutes. The adjustable end of the cross-bar was always placed on