

water on red-hot crown sheets, I will leave that subject till later.

(3.) Among the 3rd or absurd causes for explosions may be mentioned the following: The decomposition of water within a steam boiler and the formation of a powerful gas, which, under certain conditions, has been held responsible for some explosions, but which has been proved absurd by such scientists as Prof. Faraday and others. The former, in one of his reports to the British Board of Trade, says: "Decomposition cannot occur in a steam boiler, but if it could happen in consequence of low water and overheated plates, no oxygen could remain free to explosively combine with it."

The spheroidal condition of water has also been put forward as a cause for explosions, but it is never seriously considered in these days. Mr. Zera Colburn, in a paper on steam boiler explosions, and speaking of the spheroidal theory, says: "Much has been said of the spheroidal condition of water when thrown on heated plates. And it would appear that if ebullition were delayed in such a case until after a considerable quantity of water were admitted, the heat of the plate would be so far absorbed in an equal or greater weight of water, that no explosion of the latter could occur. This suggestion is given for what it is worth, but to my mind the spheroidal condition of water under the circumstances has long been an argument against, rather than in favor of, the probability of explosion."

Electricity within the steam boiler has also been given as a possible cause of explosion, owing no doubt to the fact that steam, upon being discharged into the air under certain conditions, has exhibited signs of electricity; but those who have put this theory forward as a cause of explosion have failed so far to furnish proof of the existence of an electrical current within the boiler. Even if the generation of electricity within a boiler when in operation were at all possible, those who know anything of electrical laws will know full well that it would be impossible for it to accumulate in an iron or steel vessel like a steam boiler, which is in direct electrical connection with the earth.

There are few engineers who have not at some time or other witnessed or felt the discharge of static electricity from a leather driving belt, which is at times of sufficient strength to give one a decided shock, and in my estimation it would be equally wise to lay the blame of the breaking apart of a belt so charged to electricity, as it would be to lay to it the serious charge of bursting a steam boiler.

In the case of the explosion of a steam boiler in England during the past year (where, by the way, there is a good and serviceable law in force regarding the inspection and operation of boilers, and which said law is rigorously enforced without respect to any person), it was proved by the enquiry following the explosion that the owner of the boiler had employed a blacksmith to inspect his boiler, and he (the blacksmith) had pronounced the boiler sound and safe for a working pressure of (I think) 60 pounds. However, the said boiler exploded, causing the death of some people and great destruction of property, and Mr. Blacksmith, no doubt considering himself an expert on boilers, gave it out during the course of the case for manslaughter, or criminal negligence, as his opinion, that the explosion of the said boiler was caused by "black heat."

I cannot enlighten you more on this new theory as to the cause of explosions, but it may interest you to know that the owner of the said boiler was fined a

good round sum, and imprisoned for one year for employing an incompetent person to inspect his boiler; and the blacksmith was also fined (I think) £20, and sent to jail for one year for presuming to give advice on a subject of which he was entirely ignorant.

I think such a law would prove beneficial in Canada. Probably the most frequent cause given for the occurrence of steam boiler explosions has been low water, and the pumping of cold feed water on to red-hot plates, which is generally assumed by the public to be a sure way to produce an explosion of the most violent kind; and while there is no doubt in my mind that a large number of ruptures or collapses have taken place through lack of water in the boiler, causing considerable loss of life and property, yet I am inclined to the belief that these accidents have occurred with boilers of the internally fired type, such as the locomotive fire-box, Lancashire, Galloway, and others of similar construction. With boilers of these types, low water generally results only in the collapse of the furnace crown sheet, through which the contents of the boiler may be discharged with considerable violence; but in many cases, the rest of the boiler, if of uniform strength, will not be torn to pieces, though it may in some cases be thrown some feet backward from its original seating.

I was called on once to examine an internally fired boiler, which had had its furnace crown sheet collapsed through lack of water when working at a pressure of a hundred pounds to the square inch or more. This boiler was well made and of uniform strength, and the furnace crown sheet was well stayed, but bore evidence of having been overheated sufficiently to cause it to lose its strength and collapse, being forced off all the stay bolts without even injuring the thread on the bolts. The crown sheet was forced right down into the ash-pit, and the inside plates of the furnace were torn down through the solid steel plate, and the contents of the boiler (which was a large one) were forcibly discharged into the ash-pit and through the furnace door, and the boiler itself was thrown forward several feet through a heavy wall. Some damage was done to surrounding property, though fortunately no lives were lost, nor was any person injured.

I also at one time examined a boiler of the ordinary horizontal cylindrical tubular type, which had become overheated along the side for a space of two or three square feet, just below the longitudinal seam, through an accumulation of scale, and had ruptured so quietly and gradually that the first intimation that the fireman had of anything being wrong was when he found hot water running out of the ash pit into the fire hole, yet when I examined this boiler there was a rupture 12 inches or 14 inches long through which I could easily put my hand in the centre.

This rupture had taken place so gradually and quietly at the start, that it had the same effect as the opening of a blow-off cock, and as the rest of the boiler was uniformly strong no other damage was done. I can understand the rupturing of a steam boiler through the weakening of a part of its surface by overheating, and the consequent discharging of its contents through the fracture (if large) with great violence, causing the destruction of life and property, but I have given the subject a good deal of thought, and am firmly convinced that the old and much resorted to story of "Red-hot boiler and feed-pump put to work," with a terrible explosion to finish up with, and the whole resulting