Boiler Explosions.

By Joseph Horner.

Illustrated by Photos. kindly lent by Mr. C. E. Stromeyer, Chief Engineer the Manchester Steam Users' Association.

THE explosions of steam boilers are, happily, now more rare in proportion to the number in use than they were a generation since. The reason is that such explosions may now involve the owners of the boilers in a heavy pecuniary loss, over and above that due to the damage to their property. A Board of Trade Commissioner—Mr. Howard Smith—is invested with the power to hold an inquiry into the causes of boiler explosions. He has plenary authority to assess damages towards the costs of the Court, and woe be to any boiler-owner to whom culpable neglect is brought home. These inquiries are of a most searching character, and much expert evidence is often called. It may also be mentioned, by the way, that there are comparatively few cases of boiler explosions in which some degree of wilful negligence is not proved. But it is not always possible to fix the responsibility on the right person or persons. Not infrequently, too, the culpable man is killed.

The insurance companies cannot compel proprietors to carry out the suggestions made by their inspectors, but it goes hard with the proprietors when evidence of neglect to adopt such suggestions is proved before the Commissioner. In one case a boiler insurance company was fined £50 for neglecting to use sufficiently strong and explicit condemnatory language to the proprietors in reference to a boiler of theirs which exploded while insured with the company.

The Manchester Steam Users' Association was the pioneer in boiler insurance, and it was due to the persistent efforts of the late Mr. Lavington Fletcher, the chief engineer of the association, that the Boiler Explosions Act was carried. Now, with proper inspection, there is, practically, no risk of a serious explosion occurring.

There is now, therefore, no mystery at all about boiler explosions. Previous to the formation of the various insurance societies, and the passing of the Boiler Explosions Act in 1882, all kinds of mysterious agencies were invoked to account for these disasters. It is now well known, however, that any explosion is traceable to some very matter-of-fact cause or causes. There is a specific reason for each. But all, however numerous and varied in character, may be included under one or more of three heads, namely: bad design, bad construction, or bad working. Into the technical details of these we shall not enter. But they are all preventible, all inexcusable. If proof were asked, it is sufficient to instance the fact that while about 20,000 locomotive boilers, which are the hardest worked of any, are in use daily through the kingdom, explosions of such are now practically unknown. The explanation is that they are well designed, well made, well tended, and are withdrawn from service before they become unsafe.

Steam boilers offer in some respects analogies to human organisms. They have their lives to live; are subject to weakness, diseases, and certain death; which death may come either in the course of natural decay, by the ravages of chronic or acute disease, or by accident. Their lives are insured in many cases, but the policy, unlike those on human lives, will in most cases never have to be paid, since it is an accident policy only.

In short, steam boilers are subjected to so many ills that there is a class of men—the boiler inspectors—whose lives are spent in diagnosing their complaints: testing, sounding, peering and prying within and without, visiting their patients two or three times in the course of a year, and reporting on their condition. Another class of men is occupied in analyzing the waters with which boilers are supplied, and in preparing antidotes to counteract the evil effects of incessant drinking of bad water.

In among sooty flues and furnaces, through water spaces, with lamp, candle, and hammer; with good eyes, sharpened by experience, and which can detect hidden faults that no ordinary observer would note, the boiler inspector pursues his diagnosis. It is a hard and thankless task at best, and, strangely enough, the greatest obstacles of all are not found in the hard work of inspecting the boilers, nor in having to satisfy and please his superintendent, but too often in the owners of boilers, who frequently grudge the outlay which is the price of safety. These, instead of aiding the work of the inspector, sometimes put obstacles in his way.

When a boiler does burst the effects are terrific, as disastrous as the damage inflicted by a park of artillery. Plates of iron or steel

from three-eighths to five-eighths of an inch thick are rent and twisted like paper, and sent flying scores or hundreds of yards away, dealing mutilation and death in their course, and wrecking adjacent buildings. Volumes of steam and water, hotter by many degrees than that which boils in an open vessel on the fire, doom those who escape the flying fragments to torture and a death even more awful. The harrowing scene which meets the eyes of the rescuers immediately after such a catastrophe, and before the dead and injured are removed, is one over which a veil must be drawn.

Yet inspectors test steam-boilers at a pressure which is very high—always higher than that at which they are intended to be worked—generally from 30 to 50 per cent. more. Boilers have sometimes exploded at a lower pressure than that at which they had been previously tested. When boilers yield under test, as they sometimes do, they do not explode with violence, and no damage is inflicted to those standing by. The difference is due to this—that the inspector's test is made under water pressure, but a boiler explosion occurs under steam pressure.

The following paragraphs relate to some of the most remarkable and disastrous explosions which are on record, briefly noting the reasons of their occurrence.

The most terrible boiler explosion which has ever occurred in England was that at the Redcar Iron Works, in Yorkshire, on the evening of the 14th June, 1895, a photograph of which is here reproduced. Out of a range of fifteen boilers which were used to supply steam to the blast and other engines, twelve burst, killing three men, and injuring seventeen others, of whom eight died subsequently. Showers of bricks and dirt rained over the place; the men who were at the furnaces were enveloped in a deluge of boiling water and steam; while, to add to the horror, some who fled had to run over pig beds of red-hot iron. Some too were nearly bereft of their clothes.

Of the boilers, some parts weighing several tons—one being 10ft. long—were carried two hundred and fifty yards away. Portions 50ft. long were hurled into a field, in which they dug deep trenches. A tank locomotive close by was embedded in *débris* up to the footplate, and stripped of the fittings in the cab. A large crane capable of lifting six tons was smashed to pieces. Shops a hundred and fifty yards away from the boilers had their windows broken and roofs riddled.

THE REDCAR BOILER EXPLOSION, JUNE 14, 1895. THE MOST DISASTROUS EXPLOSION ON RECORD.
From a Photo. by J. E. Hoggard, Coatham, Redcar.

These terrible explosions were due to the overheating of the first boiler, which, bursting, then started the series. The boilers were of a class which has long been distrusted—the egg-ended type—externally fired; which is peculiarly liable because of its great length to unequal expansion at top and bottom, if the latter part becomes overheated.

EXPLOSION OF A LOCOMOTIVE AT SIMPASTURE JUNCTION, MAY 10, 1867.

When two or more boilers thus burst simultaneously, the term "compound explosion" is applied. It does not mean that the explosions occur at the same instant, but that one boiler bursting inflicts injuries upon one adjacent, dislodging it from its seat, and starting a rent which results in its explosion, similar effects being communicated to other boilers. On one occasion five boilers burst thus simultaneously. This was in April, 1863, at Moss End Iron Works, near Glasgow.

The two ends of the locomotive in the illustration above was a sight presented at Simpasture Junction, Darlington, on May 10th, 1867. The engine belonged to the North-Eastern Railway Company, and at the time of the explosion was attached to a mineral train standing on a siding near the junction. The driver was underneath oiling the eccentrics when the boiler barrel (*i.e.*, the long cylindrical portion that connects the furnace at the rear with the smoke-box under the chimney) burst, being ripped into many fragments, which crumpled like paper. The driver was blown to pieces and the fireman badly scalded.

On June 9th, 1869, a particularly shocking explosion occurred at Bingley, Yorkshire, at the works of Messrs. J. Town and Sons' bobbin turnery. The works were situated at the rear of the National School, and eight little children who were at play at the time were killed, besides several work-people. Mr. Fletcher, of the Manchester Steam Users' Association, stated before the coroner that he had found the bottom plates no thicker than paper! The accompanying picture shows the scene of the disaster. The proprietors were "censured" only!

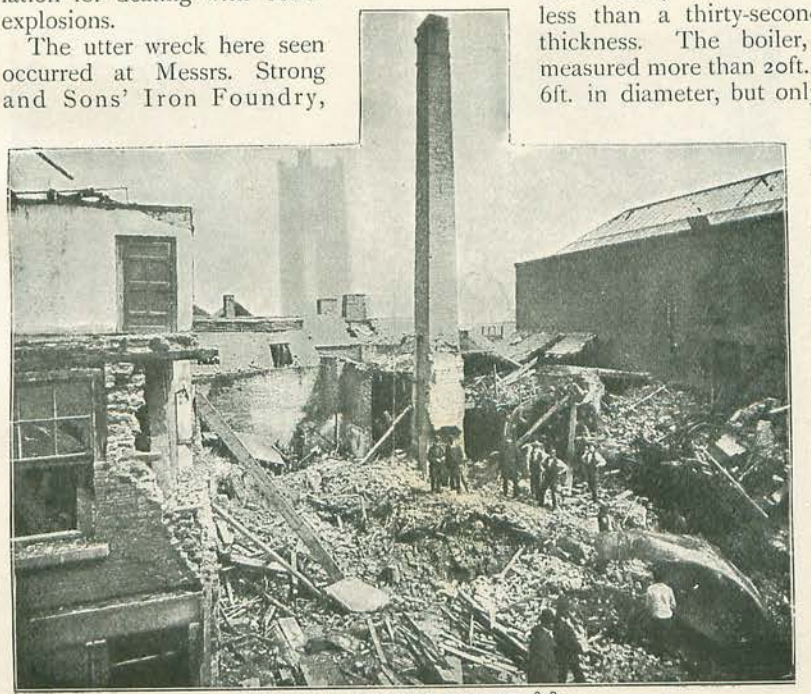
The fearful wreck seen on the next page occurred at Ashley Lane, Manchester, on December 23rd, 1867, at the dye-works of Messrs. Chapman and Hollands. Portions of the boiler—a Cornish one, 18ft. long by 6ft. in diameter—are seen amidst the ruins of the works, which it utterly demolished. Six poor fellows were killed, not by scalding, but by the fall of the buildings. The coroner's verdict was "Accidental death," but the jury found that great neglect was attributable to the employers. Something more severe

THE BINGLEY EXPLOSION, JUNE 9, 1869.

THE EXPLOSION AT ASHLEY LANE, MANCHESTER, DECEMBER 23, 1867.

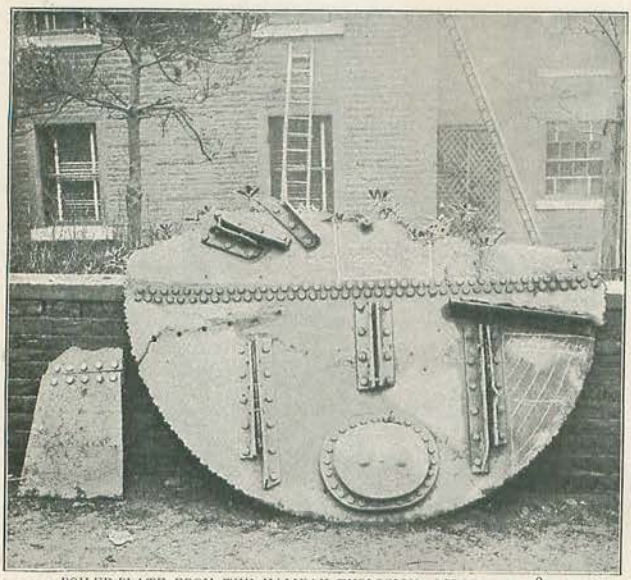
would have been meted out had such a thing happened in these days of Board of Trade inquiries. For the boiler had been shamefully neglected, and the bottom plates which had rested on the brickwork were found no thicker than brown paper throughout nearly their entire length. Such gross cases of neglect as these helped to hasten legislation for dealing with boiler explosions.

The utter wreck here seen occurred at Messrs. Strong and Sons' Iron Foundry, Hammond Lane, Dublin, on April 27th, 1878. Fourteen lives were sacrificed, including those of several persons who were not in the employ of the firm, and fourteen were injured. The first portion of the boiler was shot right across Hammond Lane, and lodged against the doorway of a house opposite. The rupture started from a plate at the bottom, which had been corroded to less than a thirty-second of an inch in thickness. The boiler, a Cornish one, measured more than 20ft. in length and over 6ft. in diameter, but only a piece of bent plate is seen remaining amid the wreck. Want of inspection was responsible for this heavily fatal catastrophe.



THE DUBLIN EXPLOSION, APRIL 27, 1878.

The ragged-looking half of a boiler-plate seen on the following page has a tragic history. It formed a portion of one end of a boiler that killed six persons, including the senior partner of the firm to whom it belonged. This happened on October 9th,

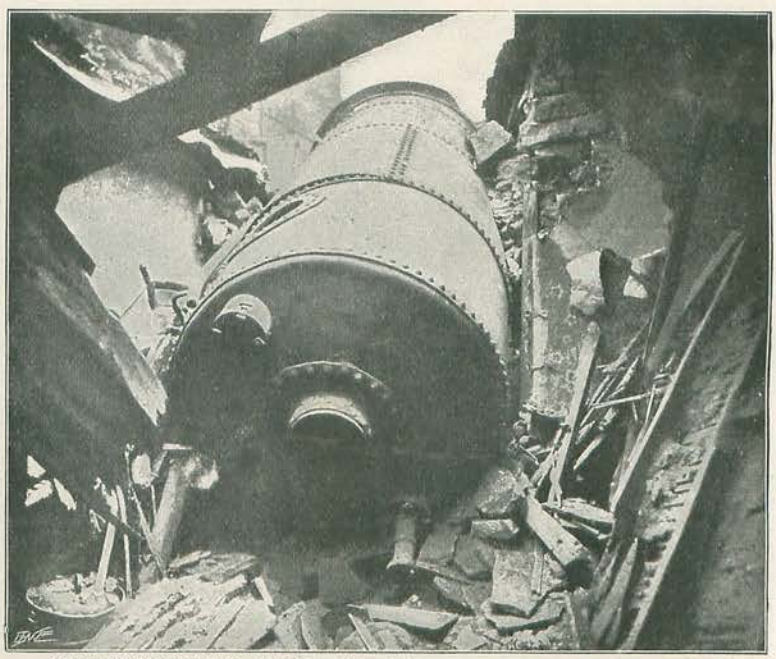


BOILER-PLATE FROM THE HALIFAX EXPLOSION, OCTOBER 9, 1879.
From a Photo. by E. Greaves, Halifax.

1879, at the works of Messrs. Balme and Pritchard, of Halifax. The steam pressure was only 45lb. to the square inch, yet the boiler was carried bodily to a distance of 102ft. through a workshop, spreading ruin in its course, and was only stopped by striking the angle of a house. The plate was not properly stayed, the owners had put difficulties in the way of inspection, and, as a matter of fact, nearly four and a half years had elapsed since the interior had been inspected!

The boiler seen in the illustration on this page found that resting-place—a room on the upper-floor of a public-house into which it crashed through the roof—after a journey of fifty yards. The injury to the boiler itself is invisible, being internal, and consisting of a rupture of the crown of the fire-box. Fortunately no one was killed. But the owner had to pay £50 into court, for this happened so recently as March 4th, 1892, and the Commissioners of the Board of Trade adjudicated upon it. The boiler had a chequered history typical of many others, having changed owners several times, including those of second-hand brokers. A boiler insurance company had warned the owner in present possession that it was unsafe, but no notice was taken, with the result that it went through the roof of its house. It was a serious case, and the fine inflicted was properly made heavy.

On the morning of the 8th of May, 1886, the boiler of a tug, *The Rifleman*, blew up in Cardiff Harbour. The crew, comprising four men and a boy, were all killed. It is supposed they were standing round the boiler, warming themselves. The bodies of the four men were carried into the air, and alighted on the head of the pier, one at a distance of fifty yards. The violence of the explosion wrecked the vessel, so that she sank immediately; and a pilot, who was in the fore



THE BURNLEY EXPLOSION, MARCH 4, 1892. THE BOILER LYING IN AN UPPER ROOM OF "THE CROSS KEYS INN," HAVING ENTERED THROUGH THE ROOF.

Photo. by] EXPLOSION ON BOARD "THE RIFLEMAN," CARDIFF, MAY 8, 1886. *[Collins.*

cabin at the time, was picked up from the water unconscious. The shell of the boiler was shot to a great length, and dropped at a distance of three hundred yards on the stern of an Italian ship, killing a man who was standing at the wheel. The captain of a tug was also struck by the *débris*, and had, in consequence, several ribs broken. It came out at the inquest that the safety-valve had been held down with a pin! Had the engineman survived he would have been indicted for manslaughter.

An explosion of this kind suggests one possible explanation of the record of steam vessels the loss of which has never been accounted for. It is reasonable to suppose, in the absence of direct evidence, that a very violent explosion of one or more boilers —and there are several on board large steamers — may produce a rent in the hull sufficiently large to sink a steamer before boats could be got out.

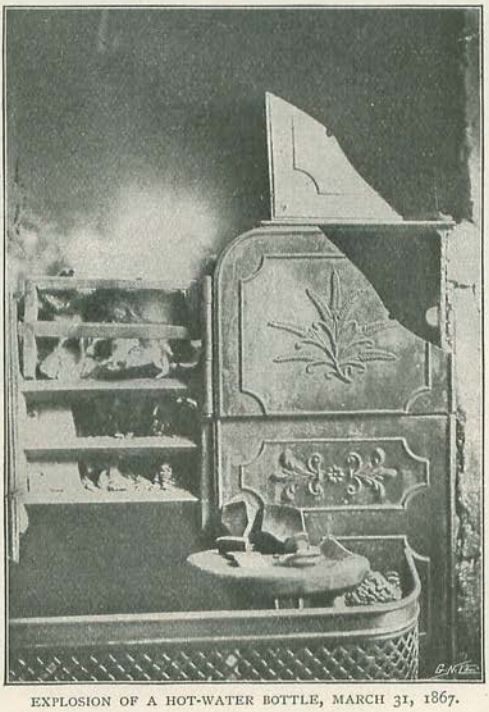
On the afternoon of Saturday, February 16th, 1895, a terrible explosion of the boiler of an agricultural engine occurred at Manor Farm, Yeovilton, in Somersetshire. The engine had been working — doing thrashing all day. About four in the afternoon, some of the farm hands having gone home, others were sitting round the engine to eat, the weather being cold, when the boiler exploded. The driver, Hann, was blown into a rick close by, which immediately caught fire, and the man was charred to death, his skeleton only being recovered later. Another man, Perry, was mutilated so terribly as to be scarcely recognisable. Other men suffered from scalds and broken limbs.

The force of the explosion was such that the engine, which weighed about three tons,

Photo. by] EXPLOSION OF A TRACTION ENGINE AT YEOVILTON, FEBRUARY 16, 1895. *[J. Chaffin.*

was lifted in the air, and carried to a distance of twenty-six yards. Perry's hat was picked up a hundred yards away; fragments of the engine were thrown about; the fire was scattered—setting fire to ricks in the vicinity; and the local fire brigade only extinguished the flames after much damage had been done. In this case the engine was about thirty years old. It had no gauge to register pressure, the fire-box was badly corroded, and it appeared as if the safety-valve had been screwed down, to increase pressure.

One of the principal methods by which boilers have been tested is by working them to destruction, and observing their behaviour. This is almost invariably done under water pressure. But in one series of experiments in America boilers were tested under steam pressure, and the actual explosion of one of these was witnessed by a large number of persons. The boilers were set in a ravine, and the pressure gauges were brought behind a bomb-proof structure only 3ft. away. In one of these experiments the steam pressure mounted up in eleven minutes from 30lb. to 50lb., and two minutes afterwards the explosion occurred. One portion, weighing about three tons, was hurled to a great height in the air, and fell at 450ft. away from the original position of the boiler.



EXPLOSION OF A HOT-WATER BOTTLE, MARCH 31, 1867.

The explosions of kitchen boilers are responsible for the loss of several lives and the destruction of much property, whenever a hard winter occurs. In the hard weather of February, 1895, there were four such explosions in one day, the 7th; on the next day nine boilers burst; on the next, four more. By the middle of that month six people had lost their lives and thirty-four had been injured. In the winter previous, during two short frosts, nineteen persons were killed and fifty-four injured. Explosions of this character are due to stupidity or carelessness. The simple and sufficient remedy is, never to let the water become quite cold in hard weather, and this can be insured by banking the fire at night.

The broken kitchen range seen on this page has a tragic history of one life lost and two persons seriously injured, and caused by a simple hot-water bottle of earthenware. It occurred on the 31st of March, 1867, at the house of Mr. Thomas Manton, Leicester. The bottle, of about a quart capacity, was used as a bed-warmer. Instead of filling it in the proper way with hot water, it was filled with cold, and corked, and the cork tied securely with a wax-end, such as shoemakers use, and so put into the oven of the kitchen range! Of course, an explosion occurred, as steam was generated, and with the cork tied in. The bursting bottle broke off the corner of the oven door, and the fragments were shot into the room with the results named, the life lost being that of a child.

As many of the readers of THE STRAND are owners of boilers, we may remark that the Board of Trade Commissioners never accept ignorance as an excuse for neglecting to take proper measures to insure that a boiler is being worked under safe conditions. Their decision is: "That if a person, for the purpose of his business, chooses to use steam appliances which, if neglected, become a source of very grave danger, not only to himself, but to others, he must, in the event of an explosion, be taken to have known that it was his duty to ascertain that they were kept in good condition; and, further, that if he was not able to ascertain this himself, it was his duty to have called in a competent person from time to time to examine the boiler, to ascertain if it was fit to be worked at the pressure required."