

tent, giving way suddenly, an explosion may be the result. It is a common saying among engineers that a weak boiler will not explode, but will simply blow out at the weak place, and relieve itself without breaking into fragments. It is true that weak places of smallish area, and surrounded by rigid stays or parts of full strength, often do blow out in this manner, causing damage only to such objects or persons as happen to be in range of the escaping stream of water at the moment; but it is also true that if the weak place happens to be of such extent and so located as to break with a snap and make a large opening through which the free steam instantly escapes, the explosion of the highly-heated water may break the boiler into fragments more or less completely, according to the relative quantity of water, its temperature, the form and location of the initial opening, and the direction in which the escaping water acts on the unsupported plates. But the conditions are so various that it is the veriest quackery to predict a specific set of results in any given case.

Puddling and reheating furnace boilers are often placed so that the gas from the burning coal is driven first through the reverberating chamber, where the ore, the bloom, or the iron pile, as the case may be, is placed to be heated; thence urged by a blast fan, it enters the chamber beneath the boiler, or in case of the upright flue boiler, it enters the flue or flues which pass upward to the stack.

If the intensely heated gases impinge directly on a limited area of the boiler shell or flues in a concentrated blowpipe stream, it is sometimes impossible for the iron to transmit the heat to the water as rapidly as it is delivered by the blast on the small area of the iron plate. The iron may thus become weakened by being crystallized, and especially if a seam is thus exposed; because there the lap not only doubles the thickness of the metal between the hot gases and the water, but also there is less rapid transmission on account of imperfect contact of the plates, and of the rivet heads with the plates.

Sudden cooling of long externally heated boilers that are insufficiently or improperly supported causes very severe strains on the shells of iron works boilers. They are sometimes as much as twenty diameters in length, and when such boilers have three or more supports the distortion caused by the unequal heating sometimes throws the entire weight upon the middle and end supports alternately as the boilers are heated and cooled.

Overpressure, generally accidental, has, no doubt, contributed a full quota to disastrous explosions of iron works indicating to the unpractised or thoughtless attendants that they are ready to take care of the steam in case the demand for it is stopped by the sudden shutting down of the works, are not always capable of opening sufficiently to discharge the full volume that may be produced by an active fire. One such safety valve is often expected to relieve three, four, or half a dozen large boilers with steam outlets closed and heavy fires burning. Then, if one of the lot has a sufficiently extensive weakness, no one who knows and thinks about the conditions would be astonished if the weak boiler should blow up and break its nearest neighbor, which in turn might break the next one if no sufficient masonry was there to prevent it.

In one case, eight boilers in a lot of ten, in a sawmill, are reported to have been blown to pieces in the past year. And a few years ago nine boilers likewise exploded in an iron making establishment in Ohio.

There is a prevailing idea among attendants of steam boilers, more especially those in iron works, that no boiler will explode while there is sufficient water in it to prevent overheating of the fire surfaces, and the idea is entertained by many intelligent iron masters, which is unfortunate, because they naturally take less precautions in keeping a full supply of water, perhaps the colder when pumped in the better.

Railroad locomotives usually stand near the head of the list, generally in the third place, but this year only about seven per centum of the explosions have been locomotives; thirteen only have been reported, and the same number stand against steamers.

Portable engine boilers, hoisters, pile drivers, and thrashing machines stand third in this year's classification, which is not surprising in view of the extended introduction of agricultural and thrashing engines.

In distilleries, breweries, soap and candle works, and the like, there have been eleven boiler explosions.

In steam heating and drying and in dwellings there have been seven cases of disaster.

In bleacheries, dyeing, digesting, and other works where steam and water are used in vessels remote from the generator, there have been six cases of destructive explosions. There have been during the past ten years as many as thirty-five or forty of this class of explosions. This fact, if known and understood by those who believe in explosions from low water alone, ought to shake their faith in their own creed since there can be no such thing as overheating of plates about a steam chamber remote from the generator and heated only through a small steam pipe. These cases are in all respects similar to those of steam generators. They burst and fly in a similar way, the destruction usually corresponding to the amount of the contained water and its temperature, the same as in a generating vessel that is exposed to the fire. It is not probable, however, that so great a percentage of this class go to pieces as is found among generators, because they are not exposed to so many deteriorating influences as regular steam boilers are. There have been enough, however, to fully establish the fact that it not necessary that a boiler should be empty or partly so in order to produce a destructive explosion.

In the ninth item in this classification, viz., paper mills, flour mills, grist mills, and grain elevators, there have been five explosions.

In the tenth—cotton, woolen, and knitting mills—four; in mines, oil wells, etc., three; while there have been nineteen explosions in other mills and works not characterized in the press reports.

RECAPITULATION.

Explosions in 1881.

(1) Sawing, planing, and woodworking mills.....	48
(2) Iron works.....	17
(3) Portables, thrashers, hoisters, etc.....	15
(4) Steamers, tugboats, etc.....	13
(5) Locomotives.....	13
(6) Distilleries, breweries, soap works.....	11
(7) Dwelling, steam heating and drying.....	7
(8) Bleaching, boiling, digesting and dyeing.....	6
(9) Grist, flour, and paper mill, and grain elevators.....	5
(10) Cotton, woolen, and knitting mills and factories.....	4
(11) Mines, oil wells, and works.....	3
(12) Mill and works not classified and those not characterized.....	18
	160
Number of persons killed.....	250
Number of persons injured.....	328

LEFT-HANDED GENEROSITY.

A year or two ago a Scotch firm of shipbuilders established what was widely noticed at the time as a "generous" scheme of awards to workmen in their employ who should invent or introduce any new machine or hand tool, or improve any existing tool, or make any other change of means or methods calculated to improve or cheapen the work of their shipyard. The policy was good, though, if our memory serves, it was characterized by shrewdness rather than generosity, since the granting of the award was conditioned upon the surrender by the inventor to the company of the right to use the new invention without further charge. The plan seems to have worked well for the company, who "have been encouraged to amend the scheme" in two important particulars. They now announce that should an invention or improvement be worthy of a greater reward than the sum (\$50) originally fixed, the firm will either grant a higher sum, or, should the invention be considered worthy of being protected by patent, pay the inventor \$50 and assist him pecuniarily in disposing of his patent or in completing it, at the same time reserving to the firm the right of using such invention themselves free from the payment of any royalty for patent rights.

These offers still keep well within the bounds of prudence, and indicate a sharp outlook for the main chance. The firm enjoy in consequence the pleasures of being generally lauded for generosity. We shall not be surprised if they discover in time that it will pay them to still further encourage the inventive faculty and habit among their workmen, if not by assisting them to take out patents for their inventions, at least without reserving any right of use without payment of royalty. Assistance so rendered might fairly be accredited to generosity; and yet, from a strictly selfish point of view, the generosity would pay handsomely, for the habit of constantly seeking better and more economical methods of working could not fail to make any workman more valuable to his employer, even if it did not lead him to invent anything worth patenting.