

dangerous point of saltness. None of the firemen knew the necessity of using the salinometer at a constant temperature of 200° Fahr.; and although we found it almost impossible to draw off the requisite quantity of water into the testing pot, as usually done there, from the low water-cock, and procure it hotter than 200° when the density was as it should be, yet at a density implied from Kay's evidence as above, the boiler temperature would be 5 or 6 degrees higher, and even this increase in the salinometer pot would further lead to error, and cause the density to be undervalued still more. Proceeding further on this head, we find at the very most the firemen were in the habit of blowing off three times every shift of eight hours, and each time not more than four inches. Now, this amounts, as ascertained by calculation, to about 50 cubic feet of water each time, or 150 cubic feet in eight hours. The evaporation in eight hours of full working of the battery, as ascertained by indicator diagrams from the cylinder, is 480 cubic feet, the proportion of which to the blow off indicates a density of $\frac{4.2}{3.2}$, a most dangerous state of affairs. As no difference seems to have been made in the blowing off, whether the battery was in full work or not, we can only account for the accident not having happened long ago from the fact that frequent cleanings up, and consequent hanging up of sets of stampers, made an average demand of less than the full evaporating power of 60 cubic feet per hour; and in consequence, if the same feed and blowing off was continued, a less dangerous point of density of water would result. That is all that can be said for it. As data for this line of evidence was only to be had by direct experiment, we obtained it from a series of indicator diagrams from the engine, at three-fourths power and full power respectively; and we may remark that the result shows this engine to be, as at present constructed, wasteful of steam in the extreme; and had the end in its design been to use the greatest amount of steam with the least effect, it is difficult to see how a more perfect result could be obtained. Appended are a pair of diagrams, each at three-fourths and full power. These are of value as indicating the enormous waste of fuel, and consequent necessity for heavy firing. A striking point in them is the great difference in pressure in cylinder and boiler, equal at full power to 16 lbs. out of 27 or 28 lbs., and at three-fourths power to 22 lbs. out of the same, disclosing the important fact that one-half of the boiler pressure would have sufficed to keep up the same conditions in the cylinder at full power. The difference in boiler and cylinder pressure is due to wire-drawing in the regulator alone. The peculiar construction of the valve gear is such that the distribution of steam is the same for all circumstances. To recapitulate: everything thus points to a dangerous density of the boiler water, caused by a want of intelligent knowledge of the salinometer, and the proper ratio for blowing off to evaporation; and lastly, the effect, the actual existence of nearly half an inch of salt, which could not have been formed there had the water been kept fresh enough. We are of opinion that the period of time during which the greatest density of water existed previous to the collapse was very short, else the deposit would have showed signs of forming over the remainder of the flue. The amount of salt actually found in a solid form could not have weighed more than 80 lbs.; and when it is considered that every hour's work at full power withdrew steam which left behind it in the boiler 120 lbs. of salt, and further, that were blowing off neglected altogether, it would take just under four days to render the water in the boiler a saturated solution of salt, no wonder need be expressed that such formation of scale took place. Salt begins to be deposited on the hotter parts of a boiler when the density reaches from $\frac{3}{3.2}$ to 4, and we have seen, from the evidence of the engineer and firemen most favourable to the freshening of the water, that with full power a density of under $\frac{4.2}{3.2}$ could not be maintained, and every shift in which the water was lowered 4 inches, twice only, instead of thrice, would raise the density to 5.8. All wonder ought to cease that such results followed a practice considered not inconsistent with the implied regulations, of "blowing down twice each shift, and oftener if required, and about 4 inches of the gauge glass each time." On the rupture taking place, of course a large quantity of water was, by the sudden release of pressure, vaporized, and the remainder thus rendered more dense. It is clearly proved that what remained (about 500 gallons) was at the point of saturation; but from the fact that the fire-bars and plates, and even rivet-holes, after the joints had torn asunder, were coated with about $\frac{1}{8}$ th of an inch of very hard salt from the escaping water, it is also more than probable that a very high degree of density had been attained before the rupture. In fact, we believe that the boiler had for years been worked at the point of extreme danger, and the conclusion is to us irresistible that it required a combination of but very ordinary circumstances, such as the alteration of the battery stamper lifts, and consequent increase of work, as set forth in the engineer's evidence, and the filling of the boilers on that last occasion with sea instead of fresh water, to pass from the point of danger to that of destruction.

The remaining portion of the inquiry, as directed by your Excellency, relates to the nature, construction, use, management, and inspection of the boilers on the gold field generally, and the preventive measures advisable to be taken should an improvement in the law be necessary, with regard to public safety. We append lists showing the number of steam engines in use for gold mining purposes on the Thames, and also on the Coromandel Field. It will be seen that the power of these varies from 303 horse-power to 2 horse-power, and collectively the horse-power is 1503.

The construction and nature of these vary as much as their size, and there are to be found small portable and semi-portable engines, tubular boilers, egg-ended and Cornish boilers, and some of a very superior design and construction.

We made personal examination of certain of the boilers fed with creek water, having strong corrosive powers; also some fed with the town supply, and with sea water. The town water is