1874.

NEW ZEALAND.

BOILER ACCIDENT AT THE KURUNUI BATTERY, THAMES GOLD FIELD,

(ROYAL COMMISSION TO INQUIRE INTO THE, AND INTO THE MACHINERY AND BOILERS ON THE FIELD GENERALLY).

Presented to both Houses of the General Assembly by Command of His Excellency.

Sir,— Public Works Office, Auckland, 24th April, 1874.

We have the honor to report that we have completed the investigations into the late boiler explosion at the Thames Gold Field, and on the boilers and machinery there generally, and with this we beg to hand you box containing our report, plans, schedules, and minutes of evidence; also minute-book, and the newspapers showing that the notices of the meeting of the Commissioners had been duly advertised.

We have, &c.,
Charles O'Neill.
James Stewart.
J. Nancarrow.

The Hon. the Minister for Public Works, Wellington.

REPORT.

To His Excellency the Right Honorable Sir James Fergusson, Baronet, Governor of New Zealand, &c., &c.

May it please Your Excellency,—

We, the Commissioners appointed by your Excellency, under Commission dated the 21st of February, 1874, to inquire into the causes of the explosion of a boiler at the Kurunui Battery, on the Thames Gold Field, by which three persons were killed; also to inquire into the nature and construction of said boiler and machinery, and the use, management, and inspection thereof; also into the nature, construction, and state of the boilers and machines used in mining and quartz-crushing operations on the said gold field, and the use, management, and inspection of such boilers and machines,—now beg respectfully to report as under:

In accordance with the terms of the Commission, your Commissioners have examined the boiler in question, and taken the evidence of the persons more or less directly in charge of the same and of the machinery at the Kurunui Battery, and of most of the principal engineers and mine managers on the gold field. We have also carefully considered the evidence taken at the Coroner's inquest touching the death of the three persons caused by the explosion.

The Kurunui Battery is one of those on the gold field ranking as first-class. It was the very first to be established on the field, and about six years ago its present arrangement was effected. It consists of 41 head of stampers, together with berdans, driven by a horizontal condensing engine, supplied by steam, at about 30 lbs. pressure, alternately by two boilers. One of these was made originally for the engine, was worked alone for about three years, and is the one which burst, and caused the death of the three men, on the morning of the 24th January last. The other, or newer boiler, was procured for the purpose of allowing alternate working and cleaning, and doing repairs, as is common on the first-class mines and batteries on the field. The water used in these boilers is from the sea. A cistern is filled at high water of every tide, the contents of which serves during the ebb for the double purpose of use in the battery-boxes and for condensation in the engine. The boilers are fed from the hot well, in the usual manner. Both boilers are of the kind known as Cornish. The one that burst has the firing flue enlarged at the furnace end to unusual dimensions, having been evidently intended for the combustion of wood.

The drawings appended show the form and dimensions of the boiler and the appearance of the ruptured plates.

The bursting took place by the collapse of the furnace, or the enlarged part of the flue; the plates of the crown tore away along two seams of rivets at right angles to each other, but otherwise the boiler was not damaged, nor was its setting in the brickwork disturbed in the least degree. The safety-valve was not moved, and was not out of working order, showing that it was not to any enormous increase of pressure that the bursting was due. The three unfortunate men who were killed had no duties which would take them to the boiler-house; they were in front of the boiler at the time, and were caught by the full force of the explosion. That this was not of a violent nature is proved by the reaction being insufficient to disturb the brick-setting, and were it not for the fatal results which followed, the accident in all probability would not have attracted much notice. But the cause of the explosion and circumstances leading to it are those surrounding many boilers, on the Thames Gold Field at least, and which, if not met with preventive measures, may at any time take effect; and from situation and surroundings be capable of equal or greater destruction to life and property.

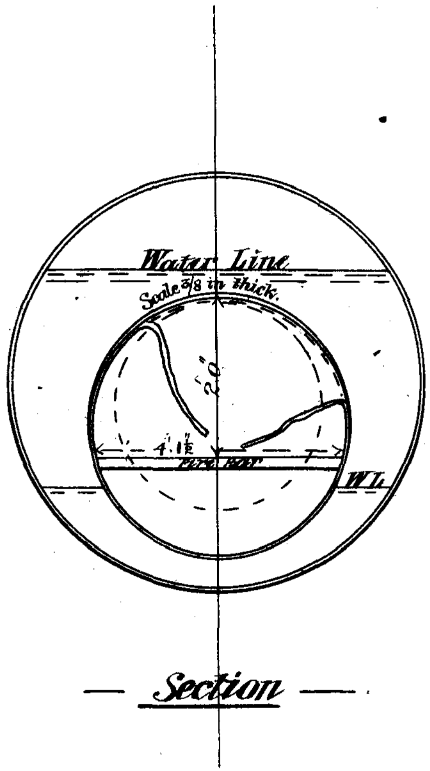
The boiler had undergone repairs, and a new plate, one of those ruptured, had been put in the crown of the furnace, after which it had been at work for only five days when the collapse took place. The usual time for working each boiler before cleaning was four or five weeks. The steaming is continuous, day and night, Sundays excepted. Three firemen are engaged, each taking a shift of eight hours. The machinery and boilers are under the charge of one engineer. From the circumstances that two of the firemen have tended this boiler from the first starting of the battery, and the third almost as long, and all are, according to the testimony of the Company's mine manager and others, "perfectly steady and regular in their duties," the collapse of the boiler five days after being repaired certainly seems remarkable. But the cause of the accident is very evident to your Commissioners, and is plainly stated by nearly all the witnesses. The shaded portion of the drawings over the flue denotes an incrustration of nearly pure salt, which overspread the crown of the furnace exactly where the heat takes most effect. The position of the rupture is just where the heat would impinge on the crown with greatest intensity; and there the thickness of the salt scale was $\frac{7}{16}$ of an inch, forming a non-conducting material sufficient to cause the plates to become hot, thus losing their strength, and hence the collapse. This result was most likely accelerated by the non-conducting scale, as it formed, impeding the evaporating power of the boiler, thus causing the fires to be forced in some degree, in order to keep up steam. The draught of that furnace is stated to be intense, and under the circumstances it would be the work of a very few minutes to heat the crown to redness. The plate put in during the repairs mentioned was of rather a laminated nature; scales $\frac{1}{8}$th of an inch thick were taken off it after the rupture. Those present an appearance of having been red hot, and had parted from the body of the plate. An area estimated at 80 square inches was thus left at, according to the laws of the strength of such flues, of less than half the strength the original thickness of $\frac{3}{8}$ths of an inch. The area of this was too small, however, to seriously damage the strength of the flue, had the iron remained free from incrustation. The flue is, as we have stated, an unusually large one—50 inches in diameter. It is true, its length at this size is only 8 feet, being tapered in, with a flush crown, to 40 inches diameter at 10 feet from the front end. The full length is 30 feet 6 inches, and no stay rings were originally on it. Taking the most favourable view of this flue, its ultimate strength, when new, was, on the data of 30 feet long, 40 inches diameter, and $\frac{3}{8}$ths of an inch thick, 96 lbs. per square inch. And the consequence of the furnace end being, for a length of 8 feet, 50 inches in diameter, must have been to reduce to some extent, not easily determined, the above not very great collapsing pressure. Then as to the pressure at which it was worked. The engineer and firemen say 25 lbs. to 30 lbs., but the valve was set to 37 lbs. per square inch, according to the data furnished by the Mining Inspector in his evidence. This pressure is $\frac{1}{2.6}$ of the ultimate resistance, and an absurdly low factor of safety. The safety-valve was seen by Kay, the fireman on duty, just before the accident, to be slightly blowing off; and it must be very evident that a flue worked at so very small a margin of safety, if indeed such a term can be applied at all, would require but very small amount of weakening to insure the destruction which eventually happened. All the evidence points to sufficient water being in the boiler, and there is no reason for doubt on this point.

The incrustation, then, we are assured, was the immediate cause of the collapse; and we have as little doubt that the incrustation was only the effect of undue saltness of the water in the boiler. This even those in immediate charge admit, although they state that they are unable to account for it. But the fact is incontestable, in our opinion; and a careful study of the evidence, and an actual testing of the salinometer in use, together with calculations relating to the evaporation, feed, and blow-off of the boiler, lead, not to wonder that the salting took place, but to astonishment that it did not work its effect long ago.

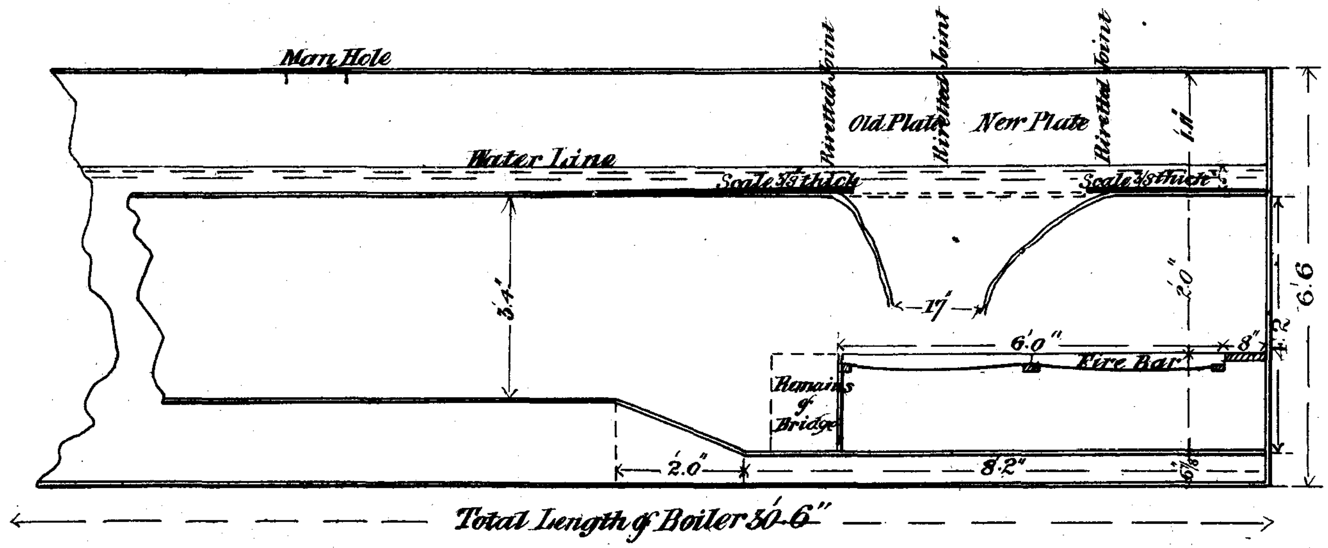
The men in charge testify to having regularly tried the density of the water in the boiler by the salinometer, but they do not show that they used it intelligently, and the tests to which we put the instrument they say they used, show that it indicated much under the truth. It is right only at the density of sea water, at 200° Fahr., or $\frac{1}{32}$ on the scale; at zero, or rain water, at 200° it indicated too much, or $2\frac{1}{2}$ oz. to the gallon; and at the other extreme at which we tried it, or at $\frac{5}{32}$, or 25 oz. to the gallon, it indicated only full $\frac{3\frac{1}{4}}{32}$, or $16\frac{1}{2}$ oz. to the gallon. Without a table of corrections, such an instrument is worse than useless. The fireman, Kay, has seen the boiler water indicated by it as at $\frac{2\frac{1}{4}}{32}$. This, we find, corresponds on a true scale to about $\frac{3\frac{1}{4}}{32}$, a most

— KURANUI BOILER —

— Sectional sketch of Boiler after the accident —

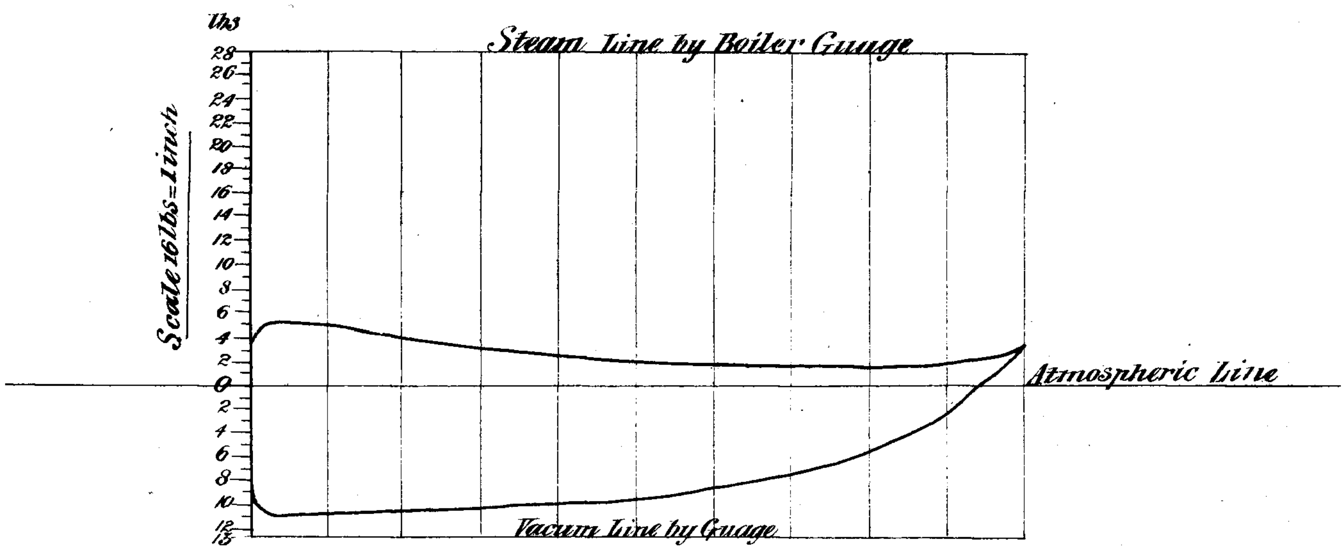


— Section —



— Longitudinal Section —

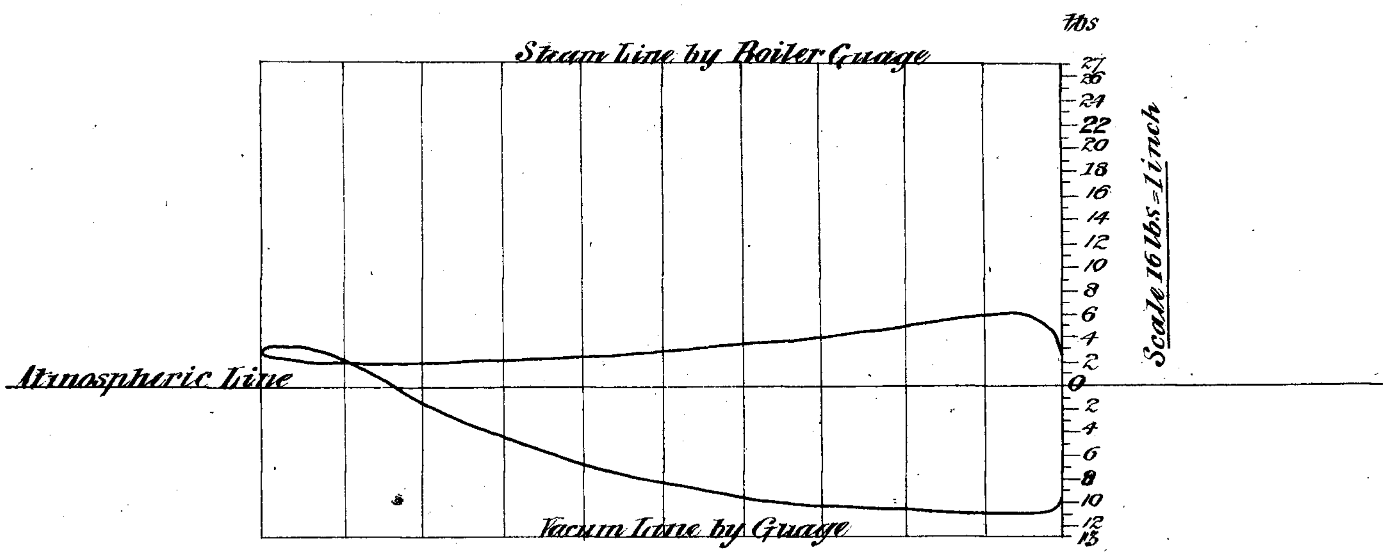
— Scale —



Forward Stroke 3/4 power Revolutions 23 per Min^t.

— ENGINE DIAGRAMS KURANUI BATTERY —

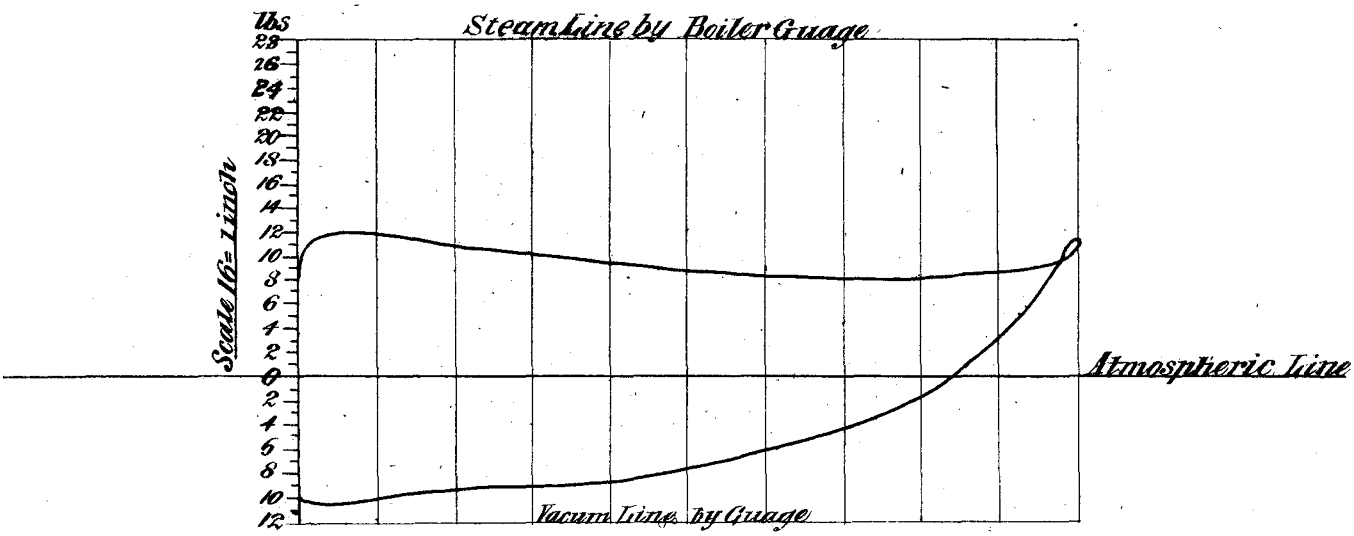
Indicating 37.2 HP



BACK STROKE *3/4 power. Revolutions 22 per Min^t.*

Cylinder 24¼ in diam:

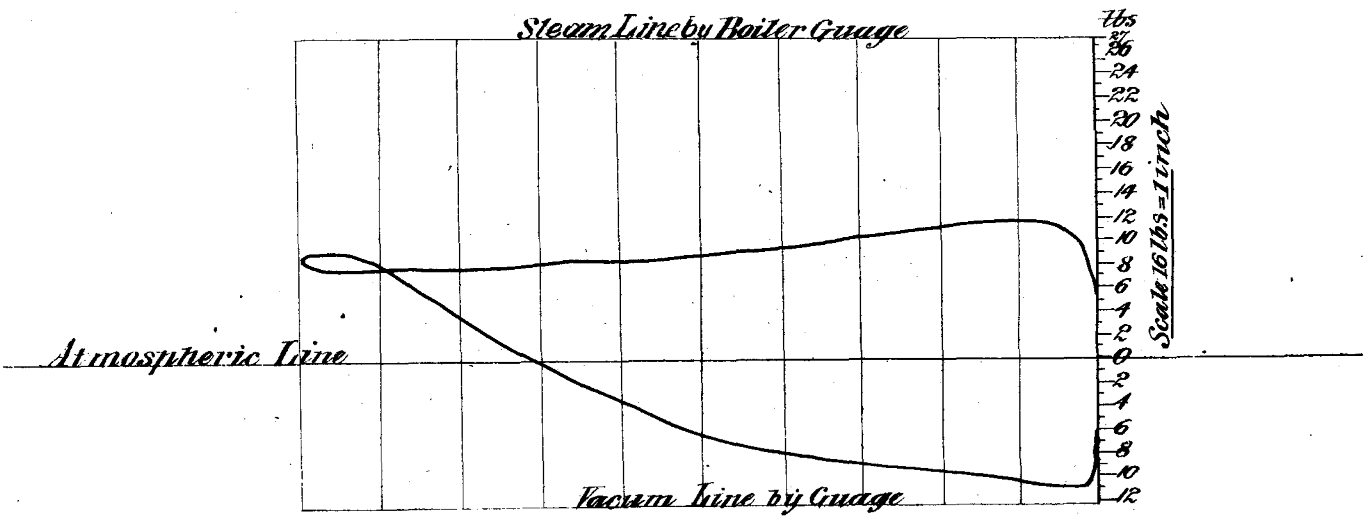
Stroke. 72 ins



FORWARD STROKE 22 Revolutions per Min^t

—ENGINE DIAGRAMS. KURANUI BATTERY—

Indicating 56 HP



BACK STROKE 24 Revolutions per Min^t

Cylinder 24¼ ins diam:

Stroke 72 "

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 $\frac{4 \cdot 2}{32}$, 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 $\frac{3}{32}$ 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 $\frac{4 \cdot 2}{32}$ 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 $^{5 \cdot 8}$. 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 ⅛th 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 by far the best, and for boiler purposes could not be better adapted; but its supply is exceedingly limited, and the cost for steam raising almost prohibitory. As a consequence, boilers are in use with water of every degree of quality short of that of the more highly acid mine and creek waters. Some small boilers derive an excellent supply from wells, some from the creeks above the influence of minerals from the mines. Some use the creek and mine waters of average quality, but still very bad, and just short of being dangerous. Several of the largest sets of boilers near the beach use sea water, as the Kurunui does. The danger and injury to boilers using the Karaka Creek water was forcibly presented to us by the inspection of the interior of four boilers situated close together in that locality. Three of these use the water of the creek, and the other uses the town supply. The creek water, at the time of our visit, when freed from the sand and mud constituting battery tailings, appeared to the sight quite pure, but in the boilers it becomes almost blood red, and the water from the cocks stains everything within reach with a deep dull red colour. As a matter of course this is owing to the solvent powers of the waters on the iron, and the interiors of the boilers are being corroded and pitted all over the surfaces of the water spaces. In these cases it is the purest and softest iron that is first attacked, and the action will cause the boilers to become useless in a fraction of the time they would last with good water.

The fourth boiler mentioned is one which at one time, from its faulty construction and the use of creek water containing much sediment, narrowly escaped a disastrous explosion. It is now fed with the town supply, and has all the appearance of lasting a very long time. No contrast could be greater than that presented by the interior of this boiler compared with those of the others, one of which, having been off steam for some weeks, had been shut up wet, and the flue was covered with about half an inch of a rich red paste of oxide of iron. In the management of the other salt-water boilers we found no salinometer in use; the boilers are worked a good deal by guess. In one we found more incrustation than was good for it; it was not salt as at the Kurunui, but carbonate or sulphate of lime.

The extraordinary effect of mine water on the Caledonian boilers is described by several witnesses. These proved impossible to be worked by that water, and in a very few hours after thorough repair were as bad as ever. So also with those in the Golden Crown Battery. In both these cases the remedy was the use of purer water.

The corrosive action of water in the Albion shaft is stated by Captain Richards in his evidence to be sufficient to drill holes in a quarter-inch boiler plate by dripping on them in the chambers for three or four days.

The first and greatest desideratum is a proper supply of pure water. The town supply is conducted in a main of only four inches diameter; and although it has been proved exceedingly beneficial to the town, yet the quantity available is totally inadequate to the requirements, and, unless largely increased, steam users cannot hope to avail themselves of it, at present. £50 per annum is charged to the Caledonian Battery for a half-inch bore of water.

Regarding the inspection of these boilers, it appears the Mining Inspector has some powers under regulations by the Superintendent. The practical effect of these, however, seems to us to amount to nothing, and no system has been established for the regular conduct of any supervision in a practical sense.

Bad water is only one of the dangers to which boilers are subject. Malformation is often a source of danger. The water-glasses are sometimes so connected with water and steam spaces that a false height of water is indicated when the engine is drawing steam. Manholes are often weak, and are sometimes placed so as to weaken the shell more than need be. Corrosion and groving are sometimes steadily cutting into the plates, unsuspected, if not looked for by an experienced eye. Flues are to be found of undue length in proportion to the diameter, thickness, and pressure; stays and angle fastenings are often to be seen of ample size, and to spare, but which are fastened to the shell or parts they ought to strengthen by absurdly disproportionate sizes of bolts or rivets. Safety valves are not uncommonly faulty in proportion of parts and out of order from rusty pins. Pressure gauges are not uncommonly found 10 lbs. to 20 lbs. wrong in indication. Often a blind dependence is placed on a boiler because it had stood an hydraulic test to perhaps twice or more times its working pressure, when that very act may have crippled it in part, and rendered it dangerous from the strains exceeding the elastic limit of the iron. This mode of testing should be done with great circumspection, and more as a test of workmanship than of sheer strength, which is, provided the material is good, more easily and surely determined by calculation. But hydraulic pressure is of much value in testing flues, which ought to be carefully examined while under it with lathes set so as to detect the slightest change of form. One custom seems to obtain universal adoption on the gold fields, viz. the covering in entirely of boilers, wherever possible, with bricks and mortar. This practice is costly and dangerous. It has not one merit to recommend it, as radiation of heat can be much more effectually prevented by other and cheaper means. It is next to impossible for a boiler so covered to be detected in a small leakage, which may go on till the parts around are reduced to the thickness of a shilling. The destructive action of a leak is so well known to engineers that it is strange so much trouble and expense is taken to brick in boilers, when this effectually conceals such leakage and its effects. Brick setting of any ordinary sized boiler need not touch the plates for greater width than nine inches in any one place, and that is too narrow to conceal any fault from a practical eye. Perhaps the most imminent danger to which some of the boilers on the gold field are subject is that of unqualified attendants. On this point, the evidence of owners and managers is very explicit, and, at the same time, the difficulties are not overlooked which may arise in attempting to deal with this matter.

It was not without some hesitation and misgiving that we proceeded to the consideration of Legislative improvement on this subject. Knowing the difficulty attending the adoption of any change in the present system in England, the number of times the subject has been under Commissioners and Committees, and the fact that even yet the problem is still unsolved, we believed some difficulty would present itself in the way of carrying out any such scheme here.

Three methods of dealing with the subject present themselves, much the same as in England:—

First, Non-interference, but enacting that penalties shall attach to neglect or explosions.

Secondly, A voluntary system of insurance and inspection, as exists by means of four or five large associations for that purpose in England.

Thirdly, A system of Governmental inspection.

As to the first method. In England there seems to be an unwillingness to take the responsibility of the steam users for damage arising from explosion. What that responsibility really amounts to, may be learned from the verdicts of coroners' juries, by which the most flagrant and gross cases of negligence are put down as accidental. When we find an owner buying an old and cast-off boiler, working it, although parts were not thicker than a shilling, and when it exploded, carrying along death and destruction, the responsibility is found to amount to "Accidental Death,"—in a case like this,* which is an actual fact, surely prevention is better than cure. Now although in this Colony we have not reached a point of manufacturing competition which induces steam users to use the cheapest boilers and employ the cheapest attendants, yet on the gold field many boilers are now getting old, and in the inducement for cheap motive power the risk is apt to be overlooked. The second or voluntary system of inspection may be dismissed as thoroughly impracticable here. The field is too small, the interests too varied in nature and value for such, and no one we examined was ready to believe such a system possible. Lastly, the plan of Governmental inspection falls to be considered.

In favour of this, it will be seen in the evidence, there is a remarkable unanimity of opinion expressed by those whose interests are bound up in the prosperity of this gold field, which can only continue to be developed by the aid of steam machinery. And we are decidedly of opinion that the subject can be dealt with by a carefully-devised and well-balanced enactment.

The opinions of those we have examined point, it will be seen in the evidence appended, to governmental supervision, both of boilers and their attendants. This we believe ought to be provided for as soon as possible, but wish to point out what in our opinion, founded on what we think is the result of careful and intelligent thought on the part of most of the Engineers and Mine Managers examined by us, are the points to be guarded against in the compulsory inspection, and the best method of procedure in carrying it out.

We think it will be easily seen that a system of inspection of boilers and tests for Engineers, such as are exacted by the Board of Trade for marine engines, would not be suitable for those on land. The rules for examination ought to possess an elasticity which would be as properly applicable to the gold fields as inapplicable to the marine. And for Engineers the tests should be based on the nature of the work they would have to perform. The difference in the circumstances under which an inspection of land boilers can be carried out as compared with those of the marine is such as would warrant a very wide departure from that precedent. A Sub-Inspector would have his district always before him. No need would exist for a rigid adherence to stated times for examination, but boilers would be examined at intervals commensurate with their requirements. In a very short time a Sub-Inspector could tell the boilers which, from their conditions, the water used, and the character of the attendance, it would be sheer waste of time to thoroughly examine oftener than once a year. Also he could very soon discover others that would not do to let steam nearly so long without some particular part being examined, and its state noted and compared with that of previous examinations. Standards should be kept by which all pressure gauges and salinometers could at any time be compared, and a table of corrections or index errors furnished to the users. The Sub-Inspector ought to be provided with ample powers and authority, and just as ample discretion should be allowed to him in the exercise thereof, consistent with satisfying the chief of the Department that the duty is properly performed. The Sub-Inspector should be a practical boilermaker, with sufficient understanding of the principle on which the strength of boilers is calculated, and perception to see and carry out the instructions of the Chief of the Office in an intelligent manner. The office, we believe, would best be under that of the Marine Department, and the Colonial Engineer Surveyor should be the executive head.

The duties of the Sub-Inspector would be, first, to make a thorough examination of all the boilers on the field, as far as it is possible from their size and construction to do so, and to make a careful entry of all particulars in note-books, devoted one to each boiler on the field, and as often as necessary afterwards make examinations partial or complete, but not more seldom than

* The case is that of the boiler explosion at Elland, where a boiler which had been sold as scrap iron for £5, then for £8, then for £18, and finally for £40, exploded in December last year and killed three persons. The verdict of the jury on the inquest was "Accidental Death." Numerous instances could be gathered of the same nature. One notable one is known as the Bermondsey explosion, caused by a collapse of a flue worked at 60 lbs. pressure, but of which the safe working load, as stated by a Board of Trade Surveyor, should have been 15 lbs. This was also a case of "Accidental Death."

once each year should a complete examination be made. The particulars of each examination should be entered as they occur, and twice a year abstracts in some clear and condensed form should be forwarded to the Chief Office. Twice a year the Engineer Surveyor should visit the field, and carefully examine the records of examinations in detail, and satisfy himself that the duties have been properly conducted, and make what personal inspection is necessary. The Sub-Inspector should supervise, on the part of the Government, all important repairs to boilers and the manufacture of new work, and apply the proper tests. Permanent certificates should be issued from the Chief Office, and be countersigned by the Sub-Inspector on each occasion of a satisfactory examination. Certificates should be withdrawn, should occasion arise, by order from the Chief Office.

Boiler attendants should be examined by the Sub-Inspector in a practical manner, and receive certificates from him according to their qualifications, only those having such to be eligible for employment in tending boilers.

Such is an outline of a scheme calculated to effect, we believe, great good on the field. Although not likely to be self-supporting, yet the fees payable annually in proportion to the power would go considerably in that direction; and as soon as the success of the measure is established, its provisions can be applied to steam power generally, and not confined to the gold field, when, we doubt not, the charge on the State would be very small.

In conclusion, we have to express our thanks for the great readiness with which our inquiries were seconded by all on the gold field with whom we were brought in contact.

Certified under our hands at Auckland, this 24th day of April, 1874.

Charles O'Neill, Chairman.
James Stewart.
Joseph Nancarrow.

Return showing the Number of Steam Engines in use on the Thames Gold Field for Mining Purposes, and the Power.

	H.P.
1. Flora Macdonald	14
2. Brown and Campbell	40
3. Clarkson's	12
4. Kurunui	30
5. Shotover	18
6. Herald	22
7. Caledonian	113
8. Prince Alfred	14
9. United Pumping	303
10. Pyrites Reduction	20
11. Imperial Crown	50
12. Manukau	32
13. Tramway	10
14. Golden Calf	12
15. Central Italy	20
16. Nonpareil	15
17. Waitemata	14
18. Morning Star	20
19. Middle Star	12
20. Moanataiari	75
21. Whau	15
22. Alburnia	21
23. Pioneer	8
24. Ballarat and Clunes	24
Brought forward	914
25. Weston's	21
26. Criterion	25
27. Hand in Band	8
28. Waiotahi	20
29. Souter's	15
30. Golden Crown	70
31. Eglinton	6
32. Spencer and Hall	6
33. Prince Imperial	10
34. Little and Good	6
35. Bright Smile	45
36. Bull's	10
37. Una	16
38. Perry's	12
39. Lucky Hit	20
40. Raithby and Muir	6
41. Greenway's	8
42. Albion	40
43. Waiomo	8
44. Vickery's	10
45. Grove's	7
Total	1,283

Return showing the Number of Steam Engines in use on the Coromandel Gold Field for Mining Purposes, and the Power.

	H.P.
1. New Zealand Quartz Crushing Co.	24
2. Ditto ditto	24
3. Golconda Gold Mining Co.	14
4. Tokatea Gold Mining Co.	12
5. Reduction Works	2
6. Kapanga Gold Mining Co.	120
7. Ditto ditto	12
8. Union Beach	12
Total	220

Totals.

	No.	H.P.
Thames Gold Field	45	1,283
Coromandel Gold Field	8	220
Grand totals	54	1,503

By Authority: George Didsbury, Government Printer, Wellington.—1874.

Price 6*d.*]