SESS. II.—1891.
NEW ZEALAND.

GOLDFIELDS' ROADS, WATER-RACES, AND OTHER WORKS IN CONNECTION WITH MINING.

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

Mr. H. A. GORDON, F.G.S., Inspecting Engineer, to the Hon. R. J. SEDDON, Minister of Mines.

SIR,— Mines Department, Wellington, 8th June, 1891.

I have the honour to submit my annual report, for the year ending the 31st March last, on the different works undertaken, and constructed either wholly by the Mines Department or by subsidies paid to local bodies, also on the water-races under the control of the department, and, generally, on the development of the mining industry throughout the colony.

The different subjects are classified under the headings "Subsidised Roads and Tracks;" "Grants for the Construction of Roads;" "Schools of Mines;" "Gold- and Silver-mining;" "Quartz-mining;" "Alluvial Mining, including Hydraulic Sluicing and Dredging;" "Gold Quartz;" "Gold-milling;" "Concentration of Low-grade Silver Ores;" "Kidd's Ore-concentrator;" "New Plymouth Oil-boring;" "Explosive Nature of Coal Dust;" "Extract from the Report of the French Royal Commission on the Use of Explosives in Coal-mines;" "Last Examination Papers for Mine-managers' Certificates;" and statistical tables showing the expenditure on works on goldfields.

SUBSIDISED ROADS AND TRACKS (NORTH ISLAND).

BAY OF ISLANDS COUNTY.

Road, Tamarere to Puhipuhi.—This is a road to connect Kawakawa with Puhipuhi. Drays can be taken for eight miles out of Kawakawa, *viâ* Tamarere, and over the table-land to near the Terehunga Gorge. The present subsidy of £205, on the principle of pound for pound, was authorised for the construction of about a mile and a half of road across the Terehunga Gorge to the table-land on the other side; of this amount £110 has been paid.

COROMANDEL COUNTY.

Track, Mercury Bay to Kuaotuna.—This track is in course of construction. It will give facilities to the mining community at Kuaotuna to get their supplies from Mercury Bay. Goods can only be landed at Kuaotuna in fine weather. The cost of the track is estimated at £360, and a subsidy has been authorised to the extent of £180.

Track, Maturanga.—This track is now completed, at a cost of £200, of which amount £100 has been paid as subsidy.

Road, Coromandel to Thames.—The portion of this road where the expenditure was incurred last year is between Wilson's, at the sea-beach, and Tiki Bridge, which now completes the work from Coromandel to the sea-beach. A grant of £1,000 was given towards the construction of the portion of this road between Waikawau and Manaia, and the County Council have expended a further sum of £300; of this amount a subsidy to the extent of £150 has been paid.

THAMES COUNTY.

Road to Sheridan's Mine.—A short length of dray-road was made from the flat to the mine, to enable the proprietor to get his quartz brought away with drays. The cost of the work has amounted to £25, of which sum £12 10s. has been paid as a subsidy.

Road to Bullion Mine.—There is a small crushing-battery erected by the proprietors of the Bullion Mine, on a flat some distance from the mine. A sledge- or trolly-track has been constructed to allow the quartz to be transported to the battery. The cost of the work up to the present time has been £36 5s.; of this amount a subsidy has been paid to the extent of £18 2s. 6d.

Road, Waiomo to Tapu.—This road was originally a horse-track, and recently it has been widened into a dray-road. It was estimated to cost £1,500; of this amount a subsidy was authorised to the extent of £750, the whole of which has been paid. There were numerous slips on the road at the time of my recent visit to this district, so that it could not be utilised for wheel-traffic.

Track, Alabama Creek.—A sledge- or trolly-track has been constructed from the road leading up Hape Creek to some quartz-claims that were taken up near the head of Alabama Creek. The cost of the work was £100, one-half of which was paid as a subsidy.

Road up Tararu Creek.—The road up this creek has been extended for some distance, but the whole of the road is in an almost impassable state, and will require to be metalled before it is fit

for heavy traffic. The cost of the work is estimated at £750, of which amount a subsidy to the extent of £375 has been authorised, and a payment made on this subsidy to the extent of £57 1s.

Road, Puriri to Mines.—A dray-road has been made from the Ngawhakapoupou Claim to the crushing-battery on the flat. It has cost £50; of this amount a subsidy has been paid to the extent of £25.

Road, Rocky Point.—This road is within the boundary of the Thames Borough. A subsidy of £200 on the £2 to £1 principle was given in 1885 towards the construction of the road; in 1889 a subsidy of £175 on the pound-for-pound principle was authorised to construct sea-walls and metal the road; and in 1890 a further subsidy of £39 15s. 11d. on the pound-for-pound principle was given to complete the work; thus making the total cost of the work £729 11s. 10d., on which subsidies amounting to £414 15s. 11d. have been paid.

Ohinemuri County.

Road, Karangahake Gorge.—A new road was constructed through the Karangahake Gorge to the Rahu Crossing, for which a grant of £1,000 was given. A further subsidy of £100 on the pound-for-pound principle was also authorised to complete the work, of which £23 has been paid.

Road, Karangahake to Mines.—A track was constructed several years ago from the flat up to the old Hauraki Claim, and thence round the side of the range. This track requires to be widened in places, which is estimated to cost £200; of this amount a subsidy has been authorised to the extent of £100.

Road to Waitekauri, viâ Gorge, to Mines.—A considerable amount of work is now being carried on at Waitekauri, and the present road is very bad. The County Council wishes to construct a new road with better grades, which is estimated to cost £360, on which amount a subsidy to the extent of £180 has been authorised.

Piako County.

Track, Premier Mine to Katikati.—This track was to commence from the end of the road leading from Waiorongomai to the mines through the country towards Katikati, so as to open it up, with the view of being prospected. It was estimated to cost £500, and a subsidy was authorised for this work to the extent of £250 about two years ago; but there has been no work yet done towards constructing the track.

MIDDLE ISLAND.

Marlborough County.

Road to Cullensville.—This is a road leading from the main road between the Grove and the head of Mahakipawa Sound to the diggings at Mahakipawa. The cost of the work has been £217 4s., and £108 12s. has been paid as a subsidy.

Waimea County.

Track, Baton to Karamea Bend.—It has been strongly urged that the track between the Baton River and Karamea Bend required considerable repairs, which were estimated to cost £100. On representation being made to the Hon. the Minister of Mines to this effect he authorised a subsidy of £50 about two years ago, but no work has yet been done.

Inangahua County.

Track, Globe Hill to Merrijigs.—This is a sledge- and trolly-track across the country along the range, where a number of quartz-mines has been opened. It was estimated to cost £1,560; of this amount a subsidy was authorised to the extent of £780, of which £698 13s. has been paid. This track has proved to be of immense value to miners, and been the means of ground being prospected and worked which otherwise would not have been.

Track up Mangles River to McGregor's Station.—This is a track about 6ft. wide, where trollies could be worked if necessary. It is partially constructed, and when completed will join on to the track leading to Hunter's station and the Matakitaki. It is estimated to cost £1,200, of which amount a subsidy of £600 was authorised. Payments have been made to the extent of £300.

Track, Horse Terrace, viâ Hunter's Station, to Saddle.—This is a track to open up the country for mining, and will connect with the track now being constructed up the Mangles River. It is estimated to cost £1,280; of this amount a subsidy has been authorised to the extent of £640.

Buller County.

Road, Waimangaroa to Sea-beach.—This road is to give facilities to the miners working on the sea-beach to get their supplies from the Waimangaroa Township. It is estimated to cost £240, of which amount a subsidy was authorised to the extent of £120, and £87 of this amount has been paid.

Road, Addison's Flat to Wilson's Lead.—This road was to give facilities to the miners working on the lead to get their supplies and timber, &c., for their claims. It was estimated to cost £400, of which £200 was authorised as a subsidy; but there has been no work yet done.

Track, Cedar Creek to Coalbrookdale.—This is a track for the use of the coal-miners going to and returning from their work. It is estimated to cost £100; of this amount a subsidy has been authorised to the extent of £50.

Road, Addison's Flat to Caroline Terrace.—A dray-road was constructed for the purpose of getting cement-crushing machinery on the ground, but unfortunately, after the machinery was at work, the ground was found too poor to work. The cost of the work was £200; of this amount a subsidy was paid to the extent of £100.

Road to United Alpine Mine.—This road is to give facility to the United Alpine Company to get materials up from the county road to the mouth of their adit-level. It is estimated to cost £100, and a subsidy has been authorised to the extent of £50.

COLLINGWOOD COUNTY.

Extension of Anatoki Track.—This track has been extended towards the diggings to give facilities to the miners to get their supplies. It has cost £160, of which £80 has been paid as a subsidy.

GREY COUNTY.

Track, Black Ball Diggings.—This track is to connect the horse-track up the northern side of the Grey River with the Black Ball Diggings. A number of miners has been working in this locality for many years, and had to carry their provisions on their backs. The cost of constructing the track has been £790, and of this amount £395 has been paid as a subsidy.

Track, Baird's Terrace.—A horse-track has been constructed from Baird's Terrace to join the track leading from Irishman's to Lake Brunner at a cost of £250; of this amount £125 was paid as a subsidy.

Track, New Rush, Cape Terrace.—Some twelve months ago a rush took place at Cape Terrace, between the Teremakau and New River, which at one time promised to be of considerable extent. It was estimated that a track to the place would cost £200; of this amount a subsidy was authorised to the extent of £100, but no work has yet been done.

Track, Deep Creek to Bell Hill.—The construction of this track was commenced about four years ago. It commences at the termination of the Notown Track at Deep Creek, and leads to Bell Hill; the distance being about ten miles. It was estimated to cost £1,331; subsidies have been authorised to the extent of £665 10s., and paid.

WESTLAND COUNTY.

Road, South Side of Hokitika River to New Rush.—About three years ago gold was discovered on the south side of the Hokitika River, and a commencement was made to construct a road, which was estimated to cost £100. A subsidy was authorised to the extent of £50, but, the value of the work done being only £37 18s. 6d., one-half only of this amount has been paid.

Road, Hokitika Borough Boundary.—This is a road along the eastern boundary of the Hokitika Borough to give facilities to the miners in that locality to get supplies and materials to a shallow rush which was opened up there during last year. The cost of the work is estimated at £120, and a subsidy has been authorised on this amount to the extent of £60.

TAIERI COUNTY.

Road, Nenthorne.—It was proposed to construct a road from Nenthorne to join the Otago Central Railway at Strath-Taieri, and an application for a subsidy for this work was made by the County Council. The road being estimated to cost £600, a subsidy was authorised to the extent of £300; but the work has not yet been put in hand.

LAKE COUNTY.

Road, Pembroke Flat to Nursey.—There is a road at the present time between these points, but a considerable portion of it goes through the river-bed. To make a road to avoid this is estimated to cost £240. A subsidy has been authorised to the extent of £120.

Track, Miller's Flat to Skipper's Road.—This is a horse-track from the Miller's Flat Road leading between Arrowtown and Arthur's Point. It joins the Skipper's Road near the top of the saddle. There is considerable traffic between Arrowtown and the Shotover, which will pass over this road. The estimated cost is £280, out of which a subsidy has been authorised to the extent of £140.

SOUTHLAND COUNTY.

Road, Waikaia to Whitcombe.—A portion of this road on the south side of Gow's Creek was in very bad repair, requiring about 80 chains of formation and gravelling, which was estimated to cost £200. A subsidy of £100 was authorised for this work, and £80 13s. 4d. has been paid.

Road, Waipapa to Six-mile Road.—This is a road to give facility to the miners working north of Waipapa Beach to get dredging machinery on to the ground. About 105 chains require to be formed and gravelled. The work has been let for £175, and a subsidy of £87 10s. has been authorised.

ROADS CONSTRUCTED BY DIRECT GRANTS.

Road to open up Puhipuhi Diggings.—The Puhipuhi Silver-field is partly in Whangarei County, but the principal claims are taken up in Bay of Islands County. Most of the claims, however, belong to persons residing at Whangarei, who desire communication with that place. The Whangarei County Council constructed what was termed an "air-line road"—but it might have been more properly designated a "mud-line track"—to allow people to travel from Era Nehu's gate, on the Whangarei–Kawakawa Road, to the top of the range at Puhipuhi, above the Prospectors' Claim. A road was afterwards laid off by the Public Works engineers on behalf of the Mines Department, and contracts have been let for its completion. The total expenditure on this road has been £912 6s. 3d, and it will yet require a further sum of £427 3s. 9d. to complete the work so as to make it passable for wheel-traffic. The prospectors are awaiting the completion of the road to get their crushing machinery and other appliances brought on to the ground.

Karangahake through Gorge.—This road is now completed, and cuts off a long piece of very bad road going over the range. The cost of construction was £1,000, which has been paid; but the County Council has, since the contracts were completed, expended a further sum to metal the worst portions.

Thames to Coromandel.—The portions of this road where the expenditure has been made is between Tapu and Manaia. The road has been widened into a dray-road between Tapu and Waikawau, and thence to Manaia a 6ft. track. A grant of £1,770 was made for the work, out of which £1,610 3s. has been paid.

Aorere Valley to Mokihinui.—This is the continuation of a main line of road from Jackson's Bay towards Collingwood. About thirty miles of the Collingwood end are constructed and eighteen miles of the Mokihinui end. The Mokihinui Bridge is also near completion. As soon as the slips are cleared off the track between the Mokihinui and Little Wanganui Rivers and the bridge completed the Karamea settlers will be able to drive their stock to market at Westport. At the present time there is no outlet from this settlement. About ten miles of the track were constructed during the last year, and the bridge across the Mokihiuui River is in progress. There still remain about thirty-two miles of track to construct to get through-communication between the Mokihinui River and Collingwood. The total expenditure on this road has been £25,063 13s. 9d., and the liabilities on the 31st March last amounted to £875.

Grey Valley to Teremakau.—The road is now completed between the Grey Valley and the Teremakau River. During the last two years three miles of track have been constructed, and a suspension foot-bridge erected across the Crooked River, at a cost of £900.

Jackson's Bay to Cascade River.—This is a portion of the road leading between the Arawata Valley and the Duncan River. The track is constructed on the south side of the Cascade River; but there was a gap of 9 miles 22 chains between the Arawata Valley and the Cascade River. Of this distance 2 miles 22 chains have been constructed on the southern end, and for 2 miles 8 chains on the northern end the line; has been cleared for 33ft. wide; thus still leaving a gap of 4 miles 72 chains on which no work has been done. The total expenditure on this road amounts to £5,159 10s. 11d., and the present liabilities are £150.

Arthur's Point to Skipper's.—This road is now completed from Arthur's Point to the crossing of the Shotover River about half a mile below the junction of Skipper's Creek. The total cost of the work has been £12,167 4s. 1d.

Lake Wakatipu to Milford Sound.—The survey of this road was commenced last year from both ends, and the road-line is pegged out from Lake Wakatipu towards Lake Howden for a distance of twenty miles. Mr. Holmes, one of the engineers of the Public Works Department, examined the country between Lake Howden and Homer's Saddle, at the head of the Hollyford River, and recommended this route to be continued down the Cleddan Valley to Milford Sound; but on examination it was found to be impracticable, and a reconnaissance survey has recently been completed from Lake Howden towards the mouth of the Clinton River, where a road-line could be got with grades not worse than 1 in 10, the distance from Lake Wakatipu to the Clinton River being about thirty-eight miles, and from the mouth of the Clinton to Milford, over Mackinnon's Pass, the distance is estimated at thirty-three miles. At the Milford end, the road has been laid off for about four miles, and about forty chains of clearing done by prison-labour, and a little formation. The survey at the Milford end is still being carried on up the side of Lake Ada and up the valley of the Arthur River, but all work is stopped on the Wakatipu end. About two miles of a horse-track have been constructed between Lakes Wakatipu and Rere. The expenditure on this work last year was £1,328 17s. 10d.

Garston to Nevis.—A dray-road has been constructed from Garston to P. Cunningham's homestead, a distance of about two miles and a half. From the end of this road to the upper township, at Nevis, a distance of about twenty miles, there is a pack-track following the natural undulations of the country. A dray-road is now being constructed from P. Cunningham's over the range for a distance of ten miles. This range is about 3,500ft. above sea-level. The road is laid off with gradients of not worse than 1 in 10, and its construction nearly completed. The total cost of this work is estimated at £1,545 18s. 8d. From the end of this ten miles the road passes over a flat valley, where drays can be taken down with very little, if any, expenditure. This road, however, will only be suitable for wheel-traffic for about seven or eight months in the year, as the elevation is so high that the road will be covered to a good depth with snow during the winter months. The expenditure on this work last year amounted to £788 18s. 6d.

WATERWORKS.

Thames Water-mains.—The original water-mains laid down by the County Council for supplying water to drive the various crushing-plants were constructed of rivetted wrought-iron pipes, and had become unserviceable; so that new cast-iron pipes had to be laid down. The cost of laying these pipes, exclusive of their purchase, was £1,479 10s. 5d., of which amount a subsidy was paid to the extent of £739 15s. 2d.

SCHOOLS OF MINES.

The School of Mines at the Thames is becoming a valuable institution, and the number of adults who attend the classes is becoming larger year after year. The average attendance, exclusive of the Saturday classes, last year was forty-five, while the attendance of adults for the previous year was thirty-three. To take the average attendance, including the Saturday classes, last year, namely, 93·5, it is not so large as that of the previous year, which was 96. This shows there has been a falling-off in the attendance of juvenile students who attend Saturdays lectures; but the adult attendance is steadily increasing. The average attendance of miners attending the mining and surveying classes was twenty-four last year, as against eighteen for the previous year. During last year eleven different parcels of ore were treated at the testing-plant, and a fair percentage of bullion was extracted from seven of these parcels. One of the tests proved a complete failure to extract the bullion. This was a parcel of 910lb. of ore from the Gem Mine at Waiomo, which contained a considerable portion of lead chloride. This parcel was run over amalgamated copper plates, and afterwards subjected to treatment by pan-amalgamation; but only 9 per cent. of the assay-value was recovered. The experiments and tests made with the ore from Puhipuhi show that by careful treatment a fair percentage of the bullion can be obtained, and they also go to show that the Puhipuhi field contains ore that is likely to be worked profitably.

The following is a

TABULATED STATEMENT of the PARCELS of ORE tested at the THAMES SCHOOL of MINES Experimental Plant during the last Year.

Name of Mine and District.	Quantity of Ore treated.	Assay Value of Ore per Ton.			Treated by Wet Crushing and saved on Copper Plates.				Treated by Amalgamation and Chemicals.					Remarks.
		Value.	Gold.	Silver.	Bullion.	Fineness in Gold.	Fineness in Silver.	Percentage saved.	Bullion.	Fineness in Gold.	Fineness in Silver.	Percentage saved.	Total percentage saved.	
	Lb.	£ s. d.	Oz. d. g.	Oz. d. g.	Oz. d. g.				Oz. d. g.					
Gem, Waiomo ..	256	16 2 0	3 5 13	19 18 5	..	..	..	..	*1 9 13	241·4	758·6	87·0	87·0	
" " ..	1,045	10 3 6	2 5 9	7 6 5	0 3 18	535·8	408·7	8·0	*0 16 10	415·2	584·8	33·0	41·0	
" " ..	910	10 4 6	2 5 9	7 16 6	Both on plates and pans				0 9 18	161·4	838·5	9·0	9·0	Ore contained lead chloride.
" " ..	1,165	9 19 0	2 2 20	9 4 0	Ore crushed wet and treated in pans,				Part with chemicals Part without chemicals			51·7 15·5	.. 67·0	
" " ..	121	16 2 0	3 5 13	19 18 5	Treated in berdan without chemicals ..				0 5 0	860·4	139·5	..	96 0	
Caledonia, Puhipuhi	Not given	5 4 0	..	..	2 19 0	298·6	571·4	71·5	1 10 0	012·2	971·5	6·5	78·0	
Prospectors' "	3,700	..	..	53 10 0	..	..	..	..	75 0 0	003·2	769·8	..	65·0	
" "	720	7 7 0	..	45 7 0	..	..	..	..	12 12 0	003·2	996·1	..	80·0	Subjected to chloridizing, roasting with 10 per cent. salt and 3 per cent. iron-sulphate.
" "	2,530	5 5 0	..	32 7 0	..	..	..	..	*36 5 0	002·5	799·5	..	78·5	Crushed dry.
Just-in-Time "	1,800	3 0 0	0 5 6	13 0 0	..	..	..	..	9 3 0	015·9	966·5	..	78·8	Crushed dry and raw amalgamation.
Caledonia "	340	2 15 6	0 12 14	1 16 7	0 0 21	810·0	190·0	34·0	*0 3 20	283·5	704·3	55·0	89·0	

The items marked thus * were treated with hot amalgamation.

In my last report I referred to assays, made by Mr. R. Aitken, of the water and sediment flowing out of the Kuranui Tunnel, which showed the value of the bullion flowing out daily to be worth over £30. As will be seen in Mr. Park's report, which follows, several samples were analysed during last year, which showed that Mr. Aitken's tests were worthless. In testing the water last year 1-gallon samples were operated on, which gave no bullion, and a test of a 21-gallon sample gave no better results. This shows that, in making assays known, the assayer should be careful about giving information as to values until he had checked the results by further tests.

The School of Mines at the Thames may be said to be the principal one in the colony, and the only one where the teaching is carried on continuously throughout the year, with the exception of a very short vacation. The interest taken in this school, the increased number of adults in attendance, and the good work done, cannot fail to be a great benefit to the mining community, and to greatly assist in the future development of our mineral resources. A large percentage of the miners of this field can now analyse ores, and ascertain the percentage of metals they contain.

The following is the report of Mr. James Park, F.G.S., Lecturer and Instructor of the Thames School of Mines, for the year ending the 31st March, 1891:—

"I have the honour to report that the progress and efficiency of the school during the year just ended has been most gratifying and satisfactory. The attendance shows a large increase, the number of individual students for the February term being 112, as against 81 for the corresponding period last year. The school is now acknowledged on all sides to be a useful institution, and the practical character of the instruction is especially attractive and valuable to miners and those engaged in the metallurgy of gold and silver. As an evidence that the school is becoming more widely known, it is pleasing to note that the number of students from places outside the Hauraki goldfields has increased from two in former years to ten this year from the following places: Auckland, Whangarei, Waikato, Miranda, Tauranga, and Lake Wakatipu.

"The number of students attending the different classes is shown in the following table:—

Name of Class.	1890. First Term.	1890. Second Term.	1890. Third Term.	1891. First Term.
1. Practical assaying and metallurgy	20	21	36	29
2. Practical chemistry and laboratory practice	13	18	17	22
3. Theoretical chemistry	...	...	...	22
4. Mineralogy and blow-pipe determination	6	7	6	5
5. Geology	6	7	6	5
6. Mining	20	22	29	29
7. Surveying	20	22	26	27
8. Mathematics	12	5	...	...
9. Mechanical drawing	8	8	11	11
Saturday Lectures.				
10. Geology and physical geography of New Zealand	46	44	...	...
11. Agricultural chemistry	...	...	42	...
12. Theoretical chemistry	...	...	...	61
Total attendance at all classes	151	154	173	211
Total number of individuals	81	83	98	112
Number of individuals exclusive of Saturday classes	35	39	56	51

"For two terms last year the mathematics class was conducted by Mr. R. D. Duxfield, M.A., one of the advanced students of the school. At the end of the May quarter Mr. Duxfield left the Thames, and, as it was necessary to continue this important subject, but impossible for me to do so as a separate class, as it overlapped my assaying classes, I incorporated it with the surveying class. This arrangement has been found to give the most satisfactory results, for, while as a separate class the average attendance was only two or three, at the present time the instruction is imparted to a large class numbering thirty students, to whom a knowledge of higher mathematics is absolutely necessary.

"At the beginning of the February term of the present year I commenced a class on theoretical chemistry for the benefit of the students of the practical chemistry class, as I found it necessary for the practical work in the laboratory to go hand-in-hand with a theoretical understanding of this important subject. The chemistry classes are highly appreciated, the attendance during the last term being larger than at any other period.

"The mining and surveying classes still continue to be the most popular and best attended. They are conducted with the object of enabling miners to prepare themselves for the Government examination for certificates as mine-managers. During the past year I have sent nine men up for examination, eight of whom have secured certificates.

"At present candidates for admission to the school are not required to possess any fixed standard of education, and so far no difficulties have resulted from this method. The attendance at the school is quite voluntary, and this fact is found to exert a certain selective influence, in so far that only the more intelligent and enterprising present themselves as candidates for membership.

"The following is a list of the subjects taught at the school during the year just ended: (1) Practical assaying and metallurgy, (2) practical chemistry and laboratory practice, (3) theoretical

chemistry—senior and junior classes, (4) mathematics, (5) geology—senior and junior classes, (6) mineralogy and blow-pipe determination, (7) mining, (8) surveying, (9) mechanical drawing, (10) agricultural chemistry.

"1. *Practical Assaying and Metallurgy.*—A knowledge of the fuels, appliances, fluxes and reagents used in assaying ores of gold, silver, lead, antimony, bismuth, iron, zinc, copper, manganese, tin, &c.; also the methods of melting, refining, and valuing gold and silver bullion. A great many of the students attending this class are competent and reliable assayers, and to many of them I am greatly indebted for much valuable assistance in the performance of the public assays. On our weekly round of the mines and batteries the attention of the students is directed to the different appliances and methods adopted for saving the precious metals; and when our experimental plant is working they are permitted to assist in the different operations, such as attending to the roasting of ore in the reverberatory furnace, feeding the stamps for wet or dry crushing, charging the pans, cleaning and retorting the amalgam and quicksilver, dressing the copper plates, and the general work of a battery.

"2. *Practical Chemistry and Laboratory Practice.*—The reactions of the metals and acids, the separation of the metals into their groups, &c., and the principles of qualitative and quantitative analysis. Also the analysis of coals, waters, limestones, rocks, oils, complex ores, &c.

"3. *Theoretical Chemistry.*—The atomic theory; the chemistry of the elements and their compounds. Instruction in this subject is imparted by lectures illustrated by numerous experiments.

"4. *Mathematics.*—Higher arithmetic, Euclid, and algebra. This class was conducted by Mr. R. D. Duxfield, M.A., until the end of the May quarter. Since that date it has been incorporated with the surveying class.

"5. *Geology.*—The study of stratigraphical and physical geology; the occurrence and disposition of mineral deposits; rocks; and the phenomena of faults, slides, &c. Weekly instruction is given in the field in the practice of making original observations.

"6. *Mineralogy.*—The elements of crystallography, physical characters of minerals, specific gravity; classification, occurrence, and composition of minerals; and blow-pipe determination.

"7. *Mining.*—Methods of constructing and timbering shafts, drives, chambers; explosives; ventilation and chemistry of mine-gases; pumping and pit-work; strengths of materials; dynamics of lost lodes, faults, &c.; composition and occurrence of ores of the common metals. Our text-book is "Gordon's Miners' Guide," which is the cheapest and most useful work on general mining in the hands of the public. It is very highly appreciated by men qualifying themselves for certificates as mine-managers, and has had great praise bestowed on it by mining engineers throughout New Zealand and the Australian Colonies.

"8. *Surveying.*—The procedure and practice of land- and mine-surveying with dial and theodolite in the field; different methods of connecting underground workings with surface-meridian; recording field-work, showing method of offsets; chaining and reducing slope-measurements; plotting to scale by protractor and rectangular co-ordinates; mapping; calculation of areas, of bearing and distance of last line, of line connecting underground workings with any point of surface-boundary of mining lease; adjustments of theodolite; also use of logarithms, trigonometrical functions of sides and angles of triangles, tabulation of traverses, solution of equations, and use of formulas.

"The progress made in this class has been most marked during the past year. Miners and mine-managers have not been slow to appreciate the value of a knowledge of surveying. Several of them have procured instruments of their own and made good use of them by making surveys for purposes of underground connections and holing, with results that would be creditable to any mining surveyor, and fully justify the teaching of this important subject at the School of Mines.

"I have much pleasure in stating that Mr. J. Dreyer, Mining Surveyor, has offered a miners' dial to be presented to the student who makes the best underground survey before Christmas.

"9. *Mechanical Drawing.*—This class is conducted by Mr. E. F. Adams, Mining Surveyor, whose able instruction has been amply rewarded by the very satisfactory progress made by most of the pupils. The instruction includes outline and shaded plans and sections of different parts of machinery, drawn to scale. The pupils are chiefly mechanics and artisans, to whom a knowledge of mechanical drawing is a supreme necessity.

"10. *Agricultural Chemistry.*—The different parts of plants, and their functions; fertilisation of flowers and formation of seed; storage of food in seeds, roots, &c.; germination; composition of plants and animals; the chemistry of air and water; how plants obtain their food; leaf-green; absorption of food by the roots; action of root-hairs; the soil—how formed, its composition, a source of plant-food, &c.

"*Class-work.*—The large increase of students has taxed our accommodation to the fullest extent. At present our practical chemistry class comprises twenty-three students, while our laboratory benches can only accommodate twelve; and, similarly, in the practical assaying class of twenty-nine students the limited size of our furnace-room and the possession of only one balance have caused much delay and inconvenience in the course of instruction. What we urgently require is an assay-balance, and a built-in muffle-furnace, which would render available a spare melting-furnace at present covered by the portable muffle-furnace now in use, and also effect a great saving of fuel.

"*Library.*—The committee has recently spent some £40 on well-selected standard works on mining, surveying, metallurgy, &c., which have proved a great boon to the students, and will form a valuable nucleus of a much-needed school library. More books will be added as funds become available.

"*Annual Examinations.*—At the annual examinations held last December 39 candidates presented themselves for examination for certificates in practical assaying, practical chemistry, mining, surveying, and agricultural chemistry. Of that number, 15 secured first-class, 17 second-class, and 3 third-class certificates.

"The work of the different students showed a marked improvement on former years, and was

an evidence of much application and industry on the part of many. The silver medal offered by Dr. Scheidel, of the Royal Academy, Freiberg, for proficiency in practical chemistry was won by Mr. H. Paltridge, with 87 per cent. of total marks. The special prizes presented by Dr. Williams and Mr. E. F. Adams for proficiency in mechanical drawing were secured by J. Watson, H. Paltridge, and Price. Six valuable book-prizes, presented by the Under-Secretary for Mines, were secured by Messrs Baker, Carter, Crawford, Eddowes, Forbes, and Paltridge.

"*School-buildings.*—In May the lecture-hall was unfortunately destroyed by a fire, which originated through a defective gas-pipe in one of the draught-chambers. With the most commendable promptitude the committee reinstated the building, the new hall being in many respects superior to the old one. During the building operations the classes were conducted in the office and assaying-rooms, and in the end of June the usual work of the school was resumed as before the fire. In the new lecture-hall the small wooden draught-chambers have been removed, and a large brick chamber constructed off the furnace-room, thus preventing a recurrence of fire from this cause.

"*Laboratory.*—The number of assays and analyses performed for the public during the past year was 271, being an increase of 91 over the number for the year 1889–90. These included 249 assays for gold and silver, and the analysis of coals, rocks, limestones, manganese ores, waters, and substances from the police in two poisoning cases. The supervision or actual performance of many of these by myself—for many are of a special character, requiring my own attention—together with the writing and despatching of the reports relating to them, involves on me a large amount of extra work in addition to my already very heavy duties connected with the school and experimental plant, which occupy my time to the fullest extent. Bullion and parcels of ore and tailings are bought on our assays, and in this respect the school has proved itself of public use.

"*Kurunui Water.*—In his annual report for last year Mr. H. A. Gordon, Inspecting Engineer of the Mines Department, referred to and published the results of some analysis of the waters and suspended matter issuing from this adit at the Thames, by Mr. R. M. Aitken, of the Reefton School of Mines. Mr. Aitken's tests showed the presence of large quantities of bullion both in the water and sediment, and Mr. Gordon suggested that further experiments should be made, with a view of ascertaining if those made by Mr. Aitken were reliable.

"During the past year a number of tests have been made both of this water and suspended matter, on gallon samples as used by Mr. Aitken, but no bullion was obtained. A test of a 21-gallon sample gave no better results. Mr. Aitken reported the bullion he obtained from the water and sediment as worth £2 5s. per ounce in each case; his own figures, however, show that the value of the bullion from the sediment was £1 11s. 10½d., and from the water £1 13s. 9½d. per ounce. This would tend to show that an element of error had found its way into Mr. Aitken's tests.

"*Coromandel.*—In August and December I visited this place and held classes in practical assaying, practical chemistry, mining, and surveying. The greatest interest was evinced in the mining and surveying classes. In the latter practical instruction was given in the field in the use of the theodolite, dial, and level, and in the school the surveys were plotted to scale by rectangular co-ordinates, calculated trigonometrically and by the use of logarithms. Satisfactory progress was shown in all the classes, but the average attendance was much below that of the previous year. This was said to be due to the general dulness of mining at Coromandel, and the absence of many of the miners at Kuaotuna Goldfield. Mr. William Horne, who was a most attentive and regular attendant at my classes, succeeded in passing the Government examination for mine-managers with great credit. Mr. Horne has always displayed the deepest interest in the Coromandel School of Mines. He holds weekly classes for instruction in assaying for boys and youths, and for the unselfish manner in which he has devoted his time to this purpose he deserves every praise and encouragement.

"*Experimental Plant.*—During the past year eleven parcels of ore have been treated at our plant, as against two for the preceding year. This satisfactory increase is chiefly due to the recent development of the Puhipuhi Silverfield, and the discoveries of silver-bearing ore in the Waiomo district.

"*Particulars of Working-tests.*

Five Parcels of Ore from Gem Mine, Waiomo :—

No. 1.—This was a test by amalgamation of 256lb. of dry pulp, containing free gold- and silver-chloride. The sample showed an assay-value of £16 2s. per ton, being gold 3oz. 5dwt. 13gr., and silver 19oz. 18dwt. 5gr., per ton. The ore was hot pan-amalgamated for four hours with chemicals, and yielded 1oz. 9dwt. 13gr. of bullion, 241·4 fine in gold and 758·6 fine in silver, representing a saving of 87 per cent of the assay-value.

"*No. 2.*—This was a test of 1,045lb. dry pulp, showing an-assay value of £10 3s. 6d., being gold 2oz. 5dwt. 9gr., and silver 7oz. 6dwt. 5gr., per ton. The ore was crushed wet, and passed over amalgamated-copper plates so as to save free gold. The tailings were collected in settling-pits, and afterwards treated by hot pan-amalgamation with chemicals. The plates saved 3dwt. 18gr. of bullion, 535·8 fine in gold and 408·7 fine in silver, equal to a saving of about 8 per cent. of the assay-value. The pan saved an additional 16dwt. 10gr. of bullion, 415·2 fine in gold and 584·8 fine in silver, equal to a saving of 33 per cent. of the assay-value, or a total saving by the plates and pan-amalgamation of 41 per cent.

"*No. 3.*—This was a test of 910lb. of ore, containing, in addition to gold and silver, a considerable proportion of lead-chloride, most of which was collected on the blankets. The ore showed an assay-value of £10 4s. 6d., being gold 2oz. 5dwt. 9gr., and silver 7oz. 16dwt. 6gr., per ton. The ore was treated like parcel No. 2, and yielded on the plates and by pan-amalgamation 9dwt. 18gr. of bullion, 161·4 fine in gold and 838·5 fine in silver, representing a saving of 9 per cent of assay-value.

"*No. 4.*—This was a test of 1,165lb. of ore, showing an assay-value of £9 19s., being gold 2oz. 2dwt. 20gr., and silver 9oz. 4dwt., per ton. The ore was crushed wet, and afterwards treated in an iron pan, part with chemicals, and part without chemicals. The saving by both processes was 67·2 per cent. of the assay-value: 51·7 per cent. with chemicals, and 15·5 per cent. without chemicals.

"*No. 5.*—This was a parcel of 125lb. of ore from the same place as No. 1. It was treated in the berdan-pan without chemicals, and yielded 5dwt. of bullion, 860·4 fine in gold and 139·5 fine in silver, equal to a saving of 96 per cent. of the assay-value. The tests of samples Nos. 2 to 5 were conducted by the owner, Mr. Week.

"*Ore from Caledonian Claim, Puhipuhi:—*

"*No. 6.*—This ore consisted principally of soft silicious limonite (brown hæmatite) and very wet rusty-coloured mullock, containing occasional fragments of hard, whitish-grey coloured amorphous quartz, showing traces of argentite. The ore showed an assay-value of £5 4s. 6d. per ton. It was crushed wet, and passed over amalgamated-copper plates, which saved 2oz. 19dwt. of bullion, 298·6 fine in gold and 571·4 fine in silver, equal to a saving of £3 15s. per ton, or 71·5 per cent. of the assay-value. The tailings, which showed an assay-value of 10s., were afterwards treated in pan with chemicals, and yielded 1oz. 10dwt. of bullion, 010·2 fine in gold and 971·5 fine in silver, equal to a further saving of 7s. per ton, making a total saving of £4 2s. per ton, or 78 per cent of the assay-value. These results were very satisfactory, and proved that ore of this grade could be treated successfully by ordinary amalgamation.

"*Three Parcels of Ore from Prospectors' Mine, Puhipuhi:—*

"*No. 7.*—This was a parcel of 3,700lb. of ore from the winze, No. 3 reef. The stone showed an assay-value of 53oz. 10dwt. of bullion, 004·1 fine in gold and 995·9 fine in silver. It consisted principally of hard, whitish-grey amorphous quartz, streaked with wavy lines of bluish-grey argentite, which is a free-milling ore. Small disseminated grains of ruby silver were occasionally but rarely seen. 1,820lb. were crushed dry and 1,880lb. wet, and amalgamated with chemicals for four hours, yielding 75oz. of bullion, 003·2 fine in gold and 769·8 fine in silver, equal to a saving of 45oz. per ton, representing 65 per cent. of the assay-value. The tailings from this working-test showed an assay-value of 18s. per ton.

"*No. 8.*—This was a parcel of 720lb. from the same place as No. 7. It showed an assay-value of 45oz. 7dwt. of bullion per ton, or £7 7s. 1d. It was crushed dry, and then subjected to a chloridizing roasting with 10 per cent. salt and 3 per cent. iron-sulphate, the latter being added to make up for the deficiency of natural sulphides in the ore. By hot pan-amalgamation with chemicals this parcel yielded 12oz. 12dwt. of bullion, 003·9 fine in gold and 996·1 fine in silver, equal to 39oz. 4dwt. per ton, representing a saving of 80 per cent. of the assay-value. The tailings showed an assay-value of 16s. per ton.

"*No. 9.*—This was a parcel of 2,530lb. of ore from No. 1 Level, No. 3 Reef, Prospectors' Claim. It was rusty coloured and mullocky, in this respect differing from the ore from the winze, which was quite free from metallic oxides. It was crushed dry, and sampled, showing an assay-value of 32oz. 7dwt. of bullion per ton, 003·1 fine in gold and 996·9 fine in silver, equal to £5 5s. 1d. per ton. By raw hot pan-amalgamation this parcel yielded 36oz. 5dwt. of bullion, 002·5 fine in gold and 799·5 fine in silver, equal to 32oz. 5dwt. of bullion per ton, representing a saving of 78·5 per cent. of the assay-value. The tailings showed an assay-value of 18s. per ton.

"These tests were very satisfactory, and showed that the class of silver-bearing ore present at Puhipuhi can be successfully treated by dry-crushing and pan-amalgamation with chemicals. Chloridizing-roasting may be expected to effect a saving of 12 to 15 per cent. more than by raw amalgamation, when working on a large scale; but with this class of low-grade ore it is doubtful if this extra saving would leave a margin of profit after covering the extra cost incurred in roasting, &c.

"*No. 10.*—This was a parcel of ore from the Just in Time Claim, Puhipuhi. It weighed 1,800lb., and consisted principally of hard, greyish-coloured amorphous quartz, often stained with iron and manganese oxides. It showed an assay-value of 13oz. silver and 5dwt. 6gr. of gold per ton, equal to a value of £3. It was crushed dry and then raw pan-amalgamated in an iron pan with chemicals, yielding 9oz. 3dwt. of bullion, 966·5 fine in silver and 015·9 fine in gold, equal to a saving of £2 7s. 5d. per ton, or 78·8 per cent. of the assay-value. The fine tailings showed an assay-value of 4s., slimes 3s. 6d., and heavy tailings (partly concentrates) 15s. 3d. per ton. Concentrates of tailings obtained by panning showed a value of £4 4s. per ton. The low value of the slimes would tend to prove that with a system of good settling-pits this class of sulphide ore could be crushed wet and then pan-amalgamated. This system would be advantageous in many ways, as by it very low-grade ore could be treated more cheaply and in larger quantities than by dry crushing.

"*Ore from Caledonia Mine, Puhipuhi:—*

"*No 11.*—This was a parcel of 340lb. of rusty-coloured mullocky quartz, showing an assay-value of £2 15s. 6d., being gold 12dwt. 14gr., and silver 1oz. 16dwt. 7gr., per ton. It was crushed wet, and passed over amalgamated-copper plates, which saved 21gr. of bullion, 810 fine in gold and 190 fine in silver, equal to a saving of 34 per cent. of the assay-value. The tailings were collected in settling-pits and hot pan-amalgamated with chemicals, and yielded 3dwt. 20gr. of bullion, 283·5 fine in gold and 704·3 fine in silver, representing a further saving of 55 per cent. of the assay-value, being a total saving of 89 per cent.

"Salt and copper-sulphate were used in the amalgamating-pan with all these parcels, the proportion of copper-sulphate varying from 4oz. to 8oz. per 500lb. charge, according to the assay-value and nature of ore.

"*The Occurrence of Tellurides of Gold and Silver.*—During the past year I have devoted much time to the study of some of the causes of the loss of gold which is known to take place in different parts of the Hauraki Goldfields. I have, however, found it impossible to obtain definite information as to the actual or even approximate amount of the loss, as only at two mills are regu-

lar check-assays made of the general dirt before it passes to the stamps, and of the resulting tailings. It frequently happens that the tailings assay as high as the general dirt before treatment, but it does not mean that no gold has been saved. The tailings are always concentrated to a greater or less extent, according to the character of the ore and contained gold, and the appliances used for concentration. The loss, however, must be considerable, since the tailings from the different batteries are treated profitably by the tailings-plants by a process similar to that adopted at the mills.

"Samples of ores and tailings from all parts of the peninsula have been examined at the school, with the result that tellurides of gold and silver have been found to be more widely distributed than has hitherto been suspected. These ores are not amalgamable, and are consequently lost. This matter was forcibly brought under my notice on two occasions towards the end of 1890. A parcel of ore from the Marotota Mine, at Hikutaia, had been exhaustively treated at the School of Mines' experimental plant, and still the tailings showed an assay-value of almost 300oz. of silver and 6oz. of gold per ton. The constant discrepancies between the fire-assays of these tailings led me to suspect the presence of tellurides, and subsequent investigation verified this surmise. Mr. W. Climo, one of the advanced students of the school, has made an analysis of these tailings, with the following results:—

"Silicious matter and gangue	99·32
Telluride of gold and silver	00·56
Selenide of gold and silver	00·12
	100·00

"These tailings were shipped by the owners to the smelting-works at Dry Creek, Adelaide, from which they have been forwarded, I am informed, to Freiberg for treatment.

"On another occasion a sample of tailings from the Nordenfeldt Mine, situated at the head of Shotover Gully, Thames, was forwarded to the school for assay. Afterwards the tailings were treated by amalgamation in a tailings-pan at the Onslow Works, the return being practically nil. As there was a large discrepancy between the return and the assay-value, assays were made of some black concentrates of great specific weight which had collected in the bottom of the pan. These showed an assay-value of over £800 per ton, and analysis proved that the gold existed chiefly in combination with tellurium.

"Last February I detected nagyagite (telluride of gold, lead, and silver) in a rich mineral vein in the Sylvia Mine, Tararu Creek, most of which should be saved by the very complete concentrating and dressing works that have recently been erected there.

"The gold-bearing rocks of the peninsula, consisting principally of tufas, breccias, and andesites, both in physical characters and age are closely related to those of the Western States of America and some parts of Hungary, where rich tellurides of gold and silver are characteristic ores. Their occurrence here is a promising indication.

"*Students.*—Of the students of the School of Mines who successfully passed the necessary examinations and obtained their certificates during the past year a number have received good appointments. Among these are Mr. J. Mangan, who has been appointed manager of the Huntly Coal-mines; Mr. J. Carter, who has received the management of the Consols Mine, Hape Creek, where powerful winding and pumping machinery has recently been erected; Mr. W. Baker, who by obtaining his certificate has secured the management of the well-known Cambria Mine; Mr. Malcolm Fleming, appointed manager of the Manganese Mine, Waiheke Island; and Mr. Noble, assayer and analyst to the Kauri Company's Whangapoua mines. Others have left for Australia and South Africa, with bright prospects of future success.

"The present students of the school include miners and mine-managers, battery-men and battery-owners, mechanics, bank assayers and clerks, lawyers, school-teachers, and day-students, who are studying with a view of qualifying themselves as assayers, analysts, &c.

"No other mining centre in New Zealand offers the same advantages for a school of mines as the Thames. The great diversity of the gold- and silver-bearing ores, both free-milling and complex, and the numerous systematic and scientific methods now adopted for their treatment, present special attractions to the metallurgist and millman, while the great variety of mining operations are equally attractive and instructive to the miner and mining student. The Thames Goldfield is compact and easily accessible in all parts, thus enabling those engaged in practical mining and gold-extraction to attend the school and acquire a technical knowledge of their occupations.

"In concluding, I have to thank the local committee for their hearty co-operation and assistance during the past year, and for the disinterested manner in which they have always promoted the interests and welfare of the school."

The Reefton School is not progressing so rapidly as was at first anticipated, neither is the same interest taken by the people in the district that is shown in the case of the Thames School. The reason attributed is that the mines are all situated a considerable distance from the township, which prevents the miners from attending. The ores in this district are not so complex as those in the North Island. The gold is in a more free state, and not combined with silver; but still there are lodes, such as those found in the Golden Treasure ground, which contain a large percentage of antimony, combined with gold. Only a few of the miners, who wish to qualify themselves for mine-managers, attend the classes. The importance of having a good knowledge of mineral ore and the percentage of metal it contains does not receive sufficient attention. The apathy displayed at the Reefton School shows that unless a school of mines is in the centre of a large mining population, where the miners can conveniently attend the night classes, it is not likely to prove a success. Although Reefton may be considered the centre of a large mining district, the miners are greatly scattered all over the district, none of the mines being situate within two miles of the town. The following is the report of Mr R. Aitken, lecturer and instructor of the School of Mines, Reefton, for the year ending the 31st March, 1891:—

"I have the honour to submit to you my report on the works carried on in the Reefton School of Mines and its branches during the year ending the 31st March, 1891.

"In the beginning of April, 1890, I received the appointment of lecturer at the Reefton School of Mines. I at once proceeded to Reefton, and, according to instructions, took over charge of the school from Mr. Fenton on the 1st May, 1890. At the request of the Committee of the school, I visited Boatman's, and found that the members there were very anxious for instruction, and that a good class could be obtained at least once a week. The school was in good order, but was badly in need of assay materials and chemicals. I then set down a time-table, and commenced to hold regular classes as follows: Mining and mathematics, Monday and Wednesday, at 7 p.m.; practical assaying, Tuesday at 10 a.m., and Friday at 7 p.m.; plotting, drawing, and survey work, Tuesday, at 7 p.m.; practical surveying, Wednesday and Saturday, at 10 a.m: Boatman's class, Thursday, at 7 p.m.

"It was impossible to hold a regular chemistry class on account of the want of chemicals; but chemistry and testing were done at the assaying classes. At first the classes were very badly and irregularly attended; but I am pleased to report that they have gradually improved, and that during the last three months there has been a considerable increase in the number of students. It must be remembered that this school is placed at a great disadvantage, owing to the mines, which employ a large number of men, being situated at a long distance from Reefton, rendering it almost impossible for those miners who desire instruction to attend the classes. The different shifts in the mines also interfere with the regular attendance.

"The Classes.

"*Mining and Mathematics.*—This is one of the principal classes held, and seemed to be the only regular class when I first took charge. The number of members attending at present is twelve, and the instruction given takes in arithmetic, trigonometry (including solution of plane triangles), logarithms, mining geology; timbering shafts, drives, and stopes; sizes of timber, strength of materials, hydraulics, ventilation (including barometer and thermometer), hauling and winding on inclines and shafts, and the mechanics of lodes.

"*Practical Assaying.*—This class has at present about fourteen members, who are instructed in the use and properties of the fluxes and re-agents employed in assaying, also in the assaying of gold- and silver-ores, valuing and refining bullion, and in assaying lead, tin, antimony, &c. Very little wet-assaying has been done during the year, owing to the want of appliances and re-agents. The students in this class comprise surveyors, engineers, miners, school-teachers, bank-clerks, and battery-men.

"*Practical Surveying.*—On the 7th July we received a theodolite, and this class was commenced with a good attendance, some who did not attend any other class coming to this. The students were instructed in the use and adjustments of the theodolite, miners' dial, compass, and chain; and some very accurate surveys were made by the students. One instance of the usefulness of this class was seen in one of our mines here, where a student, by making a small survey, saved the company a lot of useless driving by showing that their drive was going in the wrong direction, and by putting them right.

"*Plotting and Drawing.*—The work done in this class is tabulating of surveys, working by co-ordinates of traverse, and calculation of area; also the plotting of surveys, and the drawing of mining timbers and the different parts of pumps, &c. The number of members attending was about five.

"*Boatman's Classes.*—These classes have been well attended during the whole year, there being twenty-three members, and a very good average attendance. The members take a great interest in their school, and had they only a little assistance some good work would be the result. The subjects taught during the past year have been mining, mathematics, and assaying. One member sat for the mine-managers examination last February, 1891.

"*Laboratory.*—During the past year sixty assays for gold and silver have been made, and six lots of bullion have been refined for the Colonial Bank, together with four bullion-assays. The other assays made are—tin, 3; iron, 2; antimony, 3; and coal, 1; besides numerous tests. Thirty samples of stone and tailings, from 1lb. to 150lb., have been tested by amalgamation in the berdan, and these tests have in a great many cases given something near the battery return, and can be more relied on than the fire-assay. Taking, for instance, the following:—

"Sir Charles Russell: 100lb. in berdan gave at rate of 2oz. 4dwt. 8gr. Twenty-two tons in battery gave at rate of 2oz. per ton.

"Cumberland: 50lb. in berdan: rate, 30dwt. per ton. Five hundred tons in battery: rate, 22½dwt. per ton.

"Fire-assays have been made of tailings, &c., to show the loss of gold, and the following may be of some interest:—

"Tailings—

Venus	3dwt. 8gr. per ton.
Keep It Dark	4 dwt. 23gr. per ton.
Pandora	3dwt. 12gr. per ton
Progress	10dwt. 22gr. per ton.

"Berdan Blanketings—

Sir Francis Drake	8oz. 0dwt. 1gr. per ton.
Fiery Cross	11oz. 4dwt. 9gr. per ton.

"Blanketings—

Sir Francis Drake	2oz. 6dwt. 14gr. per ton.
Progress	2oz. 16dwt. 8gr. per ton.

"Pyrites—

Scotia	4dwt. 22gr. per ton.
Gallant	2oz. 18dwt. per ton.
Inglewood	6oz. 8dwt. per ton,

"Golden Treasure antimony-ore assays at the rate of 1oz. 7dwt. 7gr. per ton. Gold has also been found in the Devonian rocks showing in Murray Creek. This rock carries veins of quartz, and 50lb. taken from a face gave gold at the rate of 2dwt. 2gr. per ton, and another parcel of 3lb. gave at the rate of 7dwt. 4gr. per ton. There is a large body of this rock, and it is very easily obtained.

"*School.*—In June last a balance, with some chemical apparatus and assaying material, arrived from England, which only partly furnished the school with the necessary appliances for carrying on the classes. The water is laid on to the outside of the building, but is not laid over the school, and it is at present very inconvenient when putting through large samples of quartz, as all water must be carried. A good supply of chemicals is, however, what we are most in need of at present. The committee were very uncertain as to the support the Government was to give to the schools of mines, but this was explained to them by the Hon. the Minister of Mines at a meeting held in the school on the 22nd March last. The committee now intend to amalgamate with Boatman's, and to fix the school on the same basis as the Thames school, holding annual examinations and issuing certificates of competency.

"*Mine-managers Examination.*—Two candidates went up for this examination in July last, when one was successful, the other only failing in one subject. In February, 1891, six candidates sat, two under "The Coal-mines Act, 1890," and four under "The Mining Act, 1886."

"Having made arrangements, I leave Reefton on Thursday, the 2nd April, for Takaka, *viâ* Nelson, to examine and report on the new discovery said to be made in that district, and also to hold classes at Takaka and Collingwood, according to your instructions."

Mr. Aitken's duties have been confined to the Reefton and Boatman's schools, but it is intended to get him to devote part of his time in visiting and giving lectures in the different schools on the West Coast. Recently he has visited the Takaka and Nelson schools, and also the alleged new find of auriferous sandstone in the ranges between Takaka and Collingwood; he brought away a variety of samples, and assayed them at the Takaka School of Mines, which proved that, although there were traces of gold and silver, the material was of no practical value. Mr. Jacobsen, who resides at the Onahau, has for a long time been reporting that rich ore was found in this locality, and on the visit of the Hon. the Minister of Mines to the district he complained that the assays previously made by other persons of this ore were entirely misleading, as he had made a number of tests which showed the ore to be rich in gold and silver. Mr. Aitken reports, in reference to these assays, as follows: "Mr. Jacobsen separates out what he terms the component parts of the stone, namely, oxides of iron, gold, and silver, takes some gin and whisky and sets fire to it, and allows it to burn for about five seconds, then adds four times the quantity of distilled water, then sprinkles the powdered material on this solution, when any mineral laid on the top is supposed to sink, except the oxide of gold, which is to float on the surface."

The principle of making tests by this process is, to say the least, absurd. Mr. Aitken, in referring to the School of Mines at Nelson, states that it is better supplied with chemicals and appliances than any of the schools on the West Coast, but there is no interest taken in it. He delivered five lectures there, but only about six persons attended. The committee had contemplated disposing of the chemicals and apparatus to the College at Nelson. As £50 was given towards their purchase by Government, they might be procured, at small cost, for the Reefton school.

The following statement will show the expenditure by the department on the schools of mines since they were established:—

Financial Years.	Subsidies towards the Erection of Schools of Mines, and Maintenance.	Chemicals and Apparatus, also Mineralogical Specimens, supplied to Schools of Mines.	Salaries of Teachers, and Travelling-expenses, &c.	Total Sums paid by the Department towards the Schools of Mines.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1885–86	Nil	36 19 9	1,223 9 10	1,260 9 7
1886–87	257 16 6	409 1 4	2,716 9 3	3,383 7 1
1887–88	253 15 9	253 14 1	1,714 9 6	2,221 19 4
1888–89	42 10 0	6 12 9	1,139 4 1	1,188 6 10
1889–90	142 2 0	181 14 10	716 3 10	1,040 0 8
1890–91	217 6 6	54 8 0	620 9 9	892 4 3
Totals	913 10 9	942 10 9	8,130 6 3	9,986 7 9

The total expenditure on these schools during the six years they have been in existence amounts to £9,986 7s. 9d. In addition to this, £500 has been paid towards the School of Mines in connection with the Dunedin University, making the total payments to the University for the last six years £3,000. This makes the total cost of technical education in connection with mining during six years to be £12,986 7s. 9d. There can be no doubt that these schools will ultimately cause mining to be conducted on more scientific principles than heretofore, there being no industry in the colony requiring men of higher training in practical as well as technical knowledge of mining in all its branches.

WATER-RACES.

Waimea Water-race.

This water-race is in fair order; some of the boxing on the flumes is getting considerably decayed, but this can be easily replaced at any time. The understructure of the fluming is gradually being renewed; numbers of new legs have to be put in from time to time, which is done during

holidays or when the miners are not using water. The timber in the tunnels is now getting greatly decayed, and has to be replaced; but the present condition of the race is such that it is not likely to require much being done for the next twelve months. The maintenance-man at the head-works generally gets and prepares the timber for the flumes and tunnels, and has always a supply on hand ready for use when required. The inaccessible character of the country where the timber has to be obtained on this race, without any roads, and all the adjacent timber being cut down, makes the cost of repairs considerable, or, as the manager puts it, "the cost of effecting repairs, including the cost of timber, is about four times as great as the cost of repairs to the Kumara Water-race."

One of the tunnels leading from Stony Creek towards Fox's is in very bad condition. This tunnel is 2½ chains in length, and about half a chain of this distance, in the centre, goes through soft puggy ground: the legs of the timber have sunk into the bottom to such an extent that it is hardly possible to get through. If this gets in a much worse state an open ditch will have to be constructed for about 2½ chains as a new deviation, to avoid sending the water through the tunnel. The ground in the centre of the tunnel is very bad, and to raise it would necessitate the water being left out of the race for some time; besides it would cost as much to effect repairs as to construct the open ditch.

The quantity of water sold from this supply about Waimea and Stafford is very limited. During the past year it has averaged about fifteen and a half sluice-heads of day water and fifteen heads of night water, and this is in no way commensurate with the dimensions of the water-race, or the cost of construction, amounting to £118,762 11s. 8d. In addition to the quantity of day and night water sold at the current price, there has, on an average, been about six sluice-heads given to the miners as waste water at £2 per head per month, as it cannot be sold at the ordinary rates. This waste water could be turned into the supply race leading to the reservoir at the loop-line road and sold at current rates at Kumara.

The following statement will show the value of the sales of water, the amount of cash received, the expenditure on maintenance, the outstanding moneys, the number of men employed, and the approximate quantity of gold obtained from claims worked with water from this supply, and the value of the same, for the year ending the 31st March last:—

Month.	Sales of Water.	Cash received for Sales of Water.	Expenditure.	Outstanding Moneys at the End of each Month.	Number of Men employed.	Approximate Quantity of Gold obtained.	Value of Gold.
1890.	£ s. d.	£ s. d.	£ s. d.	£ s. d.		Oz.	£ s. d.
April	116 12 8	147 1 5	55 19 6	61 2 10	97	277	1,052 12 0
May	121 4 3	116 10 7	59 13 6	61 2 10	96	290	1,102 0 0
June	125 2 2	125 5 10	49 19 2	58 7 10	94	261	991 16 0
July	127 5 3	116 7 7	59 17 6	60 18 6	91	294	1,117 4 0
August	125 6 5	133 13 11	67 0 4	60 13 9	92	267	1,014 12 0
September	123 7 0	133 0 10	64 6 2	59 14 9	92	280	1,064 0 0
October	139 3 0	136 6 3	70 18 3	58 12 3	89	295	1,121 0 0
November	126 12 3	112 11 9	84 3 0	57 9 2	85	280	1,064 0 0
December..	93 5 8	68 2 5	102 8 10	59 15 5	85	200	760 0 0
1891.							
January	76 7 0	120 3 3	154 13 1	58 7 11	77	169	642 4 0
February	96 3 2	86 10 1	82 15 2	57 2 11	81	225	855 0 0
March	118 8 7	97 7 8	81 8 9	59 7 11	74	234	889 4 0
Totals	1,388 17 5	1,393 1 7	933 3 3	..	88	3,072	11,673 12 0

The amount derived from sales of water for the year has been £1,388 17s. 5d., as against £1,240 9s. 7d. for the year previous; and the expenditure has been £933 3s. 3d. last year, as against £795 7s. 7d. for the same period. This shows that, although the value of the sales of water was increased last year to the extent of £148 7s. 10d., the expenditure on maintenance was also increased £137 15s. 8d.; so that the increase in the profits is only £10 12s. 2d. The actual profit on the working of this water-race last year has been £455 14s. 2d. The value of free water given to the miners amounted to £18 15s. 7d., and the average number of men employed in claims worked with water from this supply was eighty-eight. The approximate quantity of gold obtained was about 3,072oz., representing a value of £11,673 12s. Deducting from this amount the value of the sales of water, the average earnings of the men would be £116 17s. 5d. per annum or £2 4s. 11d. per week, which shows an increase of 8s. 4d. a week per man over the earning of the previous year. Taking the actual profits on the working of the water-race for last year, it has paid about $\frac{4}{10}$ per cent. on the cost of construction, which amounts to £118,762 11s. 8d.

Kumara Water-race.

This water-race is in good order, but its carrying capacity is limited by the dimensions of the tunnel from the Kapitea Creek into Larrikins, which at present conveys about 100 sluice-heads. Out of this quantity there has to be supplied to the No. 3 Sludge-channel twenty-three sluice-heads and to the No. 2 channel ten sluice-heads as flushing-water, for which no payment is received; leaving about sixty-seven sluice-heads for supplying the different claim-holders with sluicing-water. This number of heads is varied, however, in accordance with the number of shifts the sludge-channels are used. The maximum quantity of sluice-heads sold for one day during the past year was seventy-five. In dry weather the tunnel is sufficiently large to carry all the available water, but in ordinary weather a much larger quantity could be got if the tunnel were of sufficient carrying capacity. The average quantity of water sold last year, reckoning 280 working-days of twelve hours each, was 62·7 sluice-heads. This is the largest average for the last eight years, as will be shown by a tabulated statement giving the results of working this water-race every month for that period

During the past year a new branch race has been completed along the side of Kapitea Hill and terraces, which commands all the south side of Larrikins Flat. The construction of this branch-race has been the means of a great deal of new ground being taken up which otherwise would have lain idle for a number of years, and it has given much greater facility for working many of the older claims on the flat; indeed it may be said to have greatly enhanced the value of a large number of claims on the field. The carrying capacity of this branch is about sixty sluice-heads, its length is eighty-two chains, and the cost of construction (including the by-wash and lower end), £918 10s. 6d. The largest quantity of water used on the field is now supplied from this branch. From this race a branch was constructed to convey flushing-water to the No. 3 Channel, at a cost of £83 12s. 6d.; thus making the total cost of this branch supply £1,002 3s.

In regard to the question of a larger supply of water for the field when the same is available, an expenditure of about £250 on the upper end of the tunnel coming from the Kapitea Creek would enlarge its capacity to the extent of about twelve additional sluice-heads. The tunnel is 5ft. 6in. wide, with the exception of 2½ chains at the upper end, which is only 5ft. wide. By increasing this portion to the same width as the rest of the tunnel the additional supply mentioned could be obtained, and this would justify the expenditure.

The reservoir at the Loop-line Road for supplying this water-race requires some repairs. The outlet box which comes through the centre of the embankment shows signs of weakness. This box had to be strengthened after the reservoir was constructed: as it was found that the timber with which it was made bellied in the centre on the upper side, another set of 2in. planks was put inside the box for about 30ft. of the upper end; but still, with this strengthening, it shows signs of weakness, and it would be advisable to put additional timber in, and reduce the size of the box, which at present is 4ft. 1in. square in the clear. The greatest depth of water in this outlet-box when discharging 100 sluice-heads of water is not more than 2ft. The box could be reduced in size and still be quite sufficient to discharge a greater quantity than the tunnel would carry even when enlarged, and it could be lined with 3in. planking on each side, with 6in. planking on top, and 2in. planking on the bottom; this would reduce it to 3ft. 7in. in width by 3ft. 5in. in height, but would still give it an area of 12¼ square feet, instead of 16⅔ as it is at present. The by-wash has been raised 22in. beyond the original height; this leaves the embankment about 5ft. above the level of the water when the reservoir is full; but in raising the level of the by-wash, which is constructed with a self-acting trip-gate, so that when the water comes up to the level of the 22in., the gate opens and allows the water to escape down the by-wash.

The by-wash is constructed 60ft. in width at the upper end and 50ft. at the lower end, and planked for 30ft. in length. It is made in the form of a shoot, from the end of which the water falls on the original washdrift, which is now cut away considerably; and, although there is no immediate danger affecting the stability of the reservoir, it would be better to construct a wooden tank across the end of the shoot for the water to fall into, thus forming a well, which would break the force of the water and prevent the ground being cut away any further. The cost of this would not exceed £60, which would make the by-wash secure and prevent any further damage. At the present time the drift-wash, which is of a fine character, is scoured away at the end of the shoot to a depth of about 9ft.

In connection with this reservoir and water-supply the drainage-area into the valley where the reservoir is constructed is very limited; but the supply could be increased to a considerable extent if a branch-race were constructed to some of the creeks running into the Kapitea Creek lower down than the reservoir. The Manager has been requested to see if this can be done at a small cost, and to report fully on the matter.

The following tabulated statement will show the results of the working of this water-race for the year ending the 31st March last:—

Month.	Value of Water given towards Construction of New Deviation of Channel.	Sales of Water.	Cash received for Sales of Water.	Expenditure.	Amount of Outstanding Moneys at end of each Month.	Number of Men employed.	Approximate Amount of Gold obtained.	Value of Gold.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.		Oz.	£ s. d.
April, 1890	272 11 11	300 12 6	471 11 6	100 15 8	70 12 5	153	809	3,074 4 0
May, „	247 3 6	355 11 11	282 5 0	162 9 4	81 2 7	156	836	3,176 16 0
June, „	246 17 10	368 3 2	503 15 6	149 5 11	76 14 11	156	768	2,918 8 0
July, „	115 2 11	423 9 0	580 1 10	125 10 1	66 0 4	152	700	2,660 0 0
August, „	32 2 2	622 17 11	527 12 11	107 5 4	50 6 11	152	694	2,637 4 0
September, „	..	666 7 1	639 2 6	126 10 5	65 7 4	148	827	3,142 12 0
October, „	..	720 16 1	736 17 0	117 7 8	61 16 3	150	1,042	3,959 12 0
November, „	..	701 5 10	661 5 0	147 1 6	54 3 0	155	861	3,271 16 0
December, „	..	578 1 8	668 14 0	177 9 5	50 10 0	155	660	2,508 0 0
January, 1891	..	546 17 11	394 5 0	206 18 5	63 13 8	155	794	3,017 4 0
February, „	..	691 17 11	849 1 7	170 10 3	77 19 0	164	1,010	3,838 0 0
March, „	..	689 11 8	678 11 4	175 0 3	55 10 8	159	934	3,549 4 0
Totals ..	913 18 4	6,665 12 8	6,993 3 2	1,766 4 3	..	155	9,935	37,753 0 0

It will be seen from the above statement that the value of the sales of water last year was £6,665 12s. 8d., to which must be added the value of water given towards the construction of the Sludge-channel deviation—namely, £913 18s. 4d., making the total value of the sales of water £7,579 11s., as against £5,042 7s. 6d. for the previous year, showing an increase in the sales last year of £2,537 3s. 6d. The expenditure on maintenance was £1,766 4s. 3d., as against £1,424 13s. 3d. for the previous year, showing an increase of £341 11s. The actual profit on the working of this water-race last year was £5,813 6s. 9d. The total cost of the work being £38,521 4s. 9d.; it has paid about 15 per cent. on the cost of construction. The value of free water given towards assisting parties to open out and work their claims during last year was £409

5s. 5d.; and the value of water given towards the construction of deviation and extension of the race was £793 0s. 5d., making a total of £1,202 5s. 10d. The average number of men employed in claims worked with water from this supply during last year was 155, and the approximate quantity of gold obtained was 9,935oz., representing a value of £37,750; deducting from this amount the value of the sales of water, it leaves the earnings of the men employed in the claims to be £194 13s. 3d. per annum, or £3 14s. 10d. per man per week, which is £1 4s. 6d. a week per man more than the earnings for the previous year.

The following summary will show the results of working this water-race for eight years ending the 31st March last. [*For summary, see page 16A.*]

This shows that during the last eight years the value of water sold amounted to £58,412 8s. 6d.; the value of free water given towards opening-out and assisting in working the claims, £5,580 12s. 8d.; towards deviations, £1,485 0s. 5d.; towards the construction of deviation of sludge-channel, £2,406 1s. 2d. The total value of water supplied being £67,884 2s. 9d., while the expenditure on maintenance for same period was £11,860 15s.

Kumara Sludge-channel.

The new deviation of this channel was completed in the beginning of July, 1890, and handed over to trustees appointed by the miners, to be held in trust as a public tail-race for the benefit of the miners on the field. The new deviation, 30 chains in length, is constructed 3ft. 6in. wide, and has a fall or gradient of 1 in 36, or 1ft. 10in. per chain, and is found to work very well. As soon as the new deviation was constructed the gold was taken out of the upper portion, and also the abandoned portion, this realised £843 6s. 8d.; and the abandoned portion was strengthened by centre-props, so as to prevent any portion of it breaking down, which might have the effect of weakening the new portion by making the ground heavier on the caps. The total expenditure in connection with the construction of this deviation, including the costs of the inquiry and compensation, amounted to £4,963 8s., making the total cost of the channel up to the time it was handed over to the trustees, £21,964 18s. 2d.; in addition to this the loss on its maintenance during about eight years and a half that the Government kept it in repair has been £23,798 19s. 5d., making the total loss £45,962 19s. 11d. This shows that works of this description should not be undertaken by Government unless by the way of assistance towadss their construction in the first instance. The loss on the maintenance of this channel has always been a drag on the results of working the water-race, which otherwise, notwithstanding the large expenditure on its construction, would have paid moderate interest on the cost of the construction. There is no doubt the miners will keep the channel in repair at a much less rate than it was costing the Government. They have made regulations which limit the fall of tail-races coming into it, and also the quantity of water that the different parties can use in their sluices in proportion to the fall or gradient of their boxes.

The following table shows the value of channel-fees; the gold recovered from the channel; also the expenditure for the year ending the 31st March, 1891:—

Month.	Channel-fees paid towards Construction of the New Deviation of the Channel.	Value of Gold obtained from the Channel.	Expenditure.	Outstanding Moneys.	Number of Men employed.
1890.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	
April	86 2 9	38 4 6	209 19 5	..	67
May	80 6 10	49 8 0	191 7 11	..	67
June	73 13 10	57 16 0	189 2 10	..	61
July	34 2 0	105 14 0	173 2 6	..	55
August	..	101 16 0	129 4 4	..	..
September	..	214 15 0	87 12 1	..	..
October	..	275 12 6	121 6 0	..	..
December	..	..	6 6 0	..	..
Totals	274 5 5	843 6 0	1,108 1 1	..	62½

It will be seen from the above statement that the value of channel-fees amount to £274 5s. 5d., and the value of gold recovered from the channel £843 6s., making the total receipts £1,017 11s. 5d.; while the expenditure amounted to £1,108 1s. 1d., showing a profit of £9 10s. 4d. A portion of the expenditure was incurred in recovering the gold, and in placing centre-props in the part of the abandoned channel.

The following statement will show the results of working the channel for the last eight and a half years, or since its construction:—

Year ended 31st March.	Value of Channel-fee and Gold-dust obtained from the Channel.	Expenditure on Maintenance.	Loss on Working the Channel.
	£ s. d.	£ s. d.	£ s. d.
1882–83	925 13 4	1,703 11 1	777 17 9
1883–84	2,128 18 3	6,405 10 8	4,276 12 5
1884–85	2,163 16 4	6,161 14 7	3,997 18 3
1885–86	2,219 18 7	6,215 13 0	3,995 14 5
1886–87	2,262 2 8	5,957 11 5	3,695 8 9
1887–88	1,800 0 1	4,260 12 4	2,460 12 3
1888–89	1,665 18 0	4,285 6 2	2,619 8 2
1889–90	1,228 18 2	3,213 15 11	1,984 17 9
1890–91	1,117 11 5	1,108 1 1	*9 10 4
Total	15,512 16 10	39,311 16 3	23,798 19 5

* This shows a profit for the half-year 1890.

Waimea-Kumara Water-race and Sludge-channel.

In dealing with this water-supply the Waimea-Kumara Race and Sludge-channel must be taken as one work. The following statement will accordingly show that the value of sales of water and gold obtained from the sludge-channel amount to £8,897 16s. 1d., to which must be added the value of water and channel-fees given to the construction of the new channel, namely, £1,188 3s. 9d., making a total value of £10,085 19s. 10d., as against £8,215 0s. 3d. for the previous year; while the expenditure was £3,807 8s. 7d., as against £5,433 17s. 4d. for the former year. This shows a profit on the working last year of £6,278 11s. 3d., which gives interest on the capital expended on the construction of a little over 3½ per cent., being more than in any previous year. The number of men employed in claims worked by this water-supply last year was 242, and the approximate amount of gold obtained was 13,007oz., representing a value of £49,426 12s. Deducting from this amount the value of the sales of water, it leaves the average earnings of the men employed as £3 2s. 6d. a man per week, or about 18s. per week more than the previous year.

Month.	Value of Water and Channel-fees given towards Construction of New Deviation of Channel.	Sales of Water and Value of Gold obtained from the Channel.	Cash received for Sales of Water.	Expenditure.	Outstanding Moneys at End of each Month.	Number of Men employed.	Approximate Amount of Gold obtained.	Value of Gold.
1890.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.		Oz.	£ s. d.
April	358 14 8	455 9 8	618 12 11	366 14 7	131 15 3	250	1,086	4,126 16 0
May	337 10 4	526 4 2	398 15 7	413 10 9	142 5 5	252	1,126	4,278 16 0
June	320 11 8	551 1 4	629 1 4	388 7 11	135 2 9	250	1,029	3,910 4 0
July	149 4 11	656 8 3	696 9 5	358 10 1	126 18 10	243	994	3,777 4 0
August	32 2 2	850 0 4	661 6 10	303 10 0	111 0 8	244	961	3,651 16 0
September	..	1,004 9 1	772 3 4	278 8 8	125 2 1	240	1,107	4,206 12 0
October	..	1,135 11 7	873 3 3	309 11 11	120 8 6	239	1,337	5,080 12 0
November	..	827 18 1	773 16 9	231 4 6	111 12 2	240	1,141	4,335 16 0
December	..	671 7 4	736 16 5	286 4 3	110 5 5	240	860	3,268 0 0
1891.								
January	..	623 4 11	514 8 3	361 11 6	122 1 7	232	963	3,659 8 0
February	..	788 1 1	935 11 8	253 5 5	135 1 11	245	1,235	4,693 0 0
March	..	808 0 3	775 19 0	256 9 0	114 18 7	231	1,168	4,438 8 0
Total	1,188 3 9	8,897 16 1	8,386 4 9	3,807 8 7	..	242	13,007	49,426 12 0

The following statement also shows the value of free water supplied from the Kumara and Waimea branches for deviation, and for assistance to parties working claims, for last year:—

Free Water supplied from Waimea and Kumara Water-races from 1st April, 1890, to 31st March, 1891.

Name of Party.	Purposes for which granted.	Authority.	Amount of Authority.	Amount supplied to 31st Mar., 1890.	Total for Assistance.	Total for Deviations.	Total amount supplied on Authorities to 31st March, 1891.	Balances due on Authorities, 31st Mar., 1891.
Kumara Race.			£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Palmer and party ..	Deviation-race 6103	88/581	900 0 0	8 15 0	..	348 8 9	356 3 9	93 16 3
Pascoe and party ..	Steel syphon			4 5 0	..	147 15 10	152 0 10	297 19 2
Harris and party ..	Deviation-race 6135	89/644	100 0 0	52 0 0	..	48 0 10	100 0 10	..
Henderson and party	Constructing new tail-race	89/161	(2 mo'ths)	44 18 4	28 15 0	..	73 13 4	..
R. Anderson and party	Nardoo Flat syphon	87/1176	800 0 0	560 0 0	..	223 19 2	800 0 0	..
Manton and party ..						5 14 7		
Bowden and party ..						10 6 3		
Leach and party ..	Deviation-race 5354	24/7/89	35 0 0	26 5 0	..	8 15 0	35 0 0	..
J. Stuart	Old tail-race for by-wash	..	6 10 0	1 10 0	4 19 2	..	6 9 2	..
Arnerich and party..	Opening claim ..	90/523	1 month	..	38 10 5	..	38 10 5	..
Weldridge and party	„ ..	90/523	„	..	21 12 6	..	21 12 6	..
Davidson and party	Poor ground ..	90/523	„	..	26 15 0	..	26 15 0	..
Moynihan and party	Opening claim ..	90/523	„	..	25 13 4	..	25 13 4	..
Baucke and party ..	„ ..	90/612	„	..	26 0 0	..	26 0 0	..
Williams and party..	Poor ground ..	90/612	„	..	26 0 0	..	26 0 0	..
Stennard and party..	Opening claim ..	90/731	„	..	32 10 0	..	32 10 0	..
Carlssen and party..	Poor ground ..	91/77	„	..	40 10 0	..	40 10 0	..
McGlone and party	„ ..	91/73	„	..	34 15 0	..	34 15 0	..
McIlveney and party	Opening claim ..	91/75	2 months	..	27 1 8	..	27 1 8	45 0 0
Corrigan and party..	„ ..	90/732	1 month	..	33 11 8	..	33 11 8	..
Trickey and party ..	„ ..	90/787	„	..	36 11 8	..	36 11 8	..
Ireland and party ..	„ ..	90/213	„	..	6 0 0	..	6 0 0	33 0 0
Watson and party ..	Poor ground ..	91/199	„	..	..	..	..	32 10 0
				697 13 4	409 5 5	793 0 5	1,899 19 2	502 5 5
No. 2 Sludge-channel, flush-water				..	..	10 sluice-heads.		
No. 3 Sludge-channel, „				..	..	23 „		
						33		
Waimea Race.								
A. Bernard ..	Opening claim ..	90/523	1 month	..	2 0 0	..	2 0 0	..
J. Gargivitch ..	„ ..	90/523	„	..	13 0 0	..	13 0 0	..
P. Mitchell ..	„ ..	90/523	„	..	3 15 7	..	3 15 7	1 6 3
				..	18 15 7	..	18 15 7	1 6 3

SUMMARY showing the RESULT of WORKING the KUMARA WATER-RACE for Eight Years, from 1st April, 1883, to 31st March, 1891.

Water supplied.	Year.	Rate per Sluice-head per Week.	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.	Total Value of Water sold.	Total Value Free for Assistance.	Total Value Free for Deviations.	Total for Construction of No. 3 Channel.	Total Value Water supplied.	Average Number of Sluice-heads supplied Daily.	Expenditure.
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.		£ s. d.
Water sold ..	1883–84	3 0 0	371 16 5	465 2 1	700 2 6	583 9 7	702 7 6	626 16 3	808 10 5	777 3 9	774 17 11	698 2 6	1,064 0 0	774 6 0	8,346 14 11	..	..	..	..	..	..
Free	1883–84	..	46 2 6	44 5 0	183 11 8	108 19 2	108 0 0	85 7 6	244 7 6	172 18 9	63 12 6	103 9 2	86 5 0	139 3 4	..	1,386 2 1	..	..	..	..	..
			417 18 11	509 7 1	883 14 2	692 8 9	810 7 6	712 3 9	1,052 17 11	950 2 6	838 10 5	801 11 8	1,150 5 0	913 9 4	..	..	..	..	9,732 17 0	46·35	2,153 5 5
Water sold ..	1884–85	3 0 0	580 4 4	937 19 4	667 3 11	906 16 10	882 6 10	997 1 5	919 12 3	1,126 11 10	819 17 3	289 4 2	756 9 2	821 0 10	9,704 8 2	..	..	..	..	..	..
Free	1884–85	..	92 5 0	56 19 7	78 18 9	55 13 9	149 0 10	18 11 3	145 13 4	69 3 9	39 15 0	26 12 6	45 3 9	2 16 8	..	780 14 2	..	..	..	..	..
			672 9 4	994 18 11	746 2 8	962 10 7	1,031 7 8	1,015 12 8	1,065 5 7	1,195 15 7	859 12 3	315 16 8	801 12 11	823 17 6	..	..	..	..	10,485 2 4	49·92	1,656 0 1
Water sold ..	1885–86	2 10 0	665 16 0	796 6 9	893 5 3	745 19 7	773 19 10	943 13 5	953 15 6	997 7 8	697 13 5	686 4 0	708 15 8	935 19 7	9,788 16 8	..	..	..	..	..	..
Free	1885–86	..	24 13 9	9 2 0	..	..	23 15 0	31 3 4	22 1 3	18 11 10	18 7 2	49 1 4	1 5 0	13 2 6	..	221 3 2	..	..	..	..	..
			690 9 9	805 8 9	893 5 3	745 19 7	797 14 10	974 16 9	975 16 9	1,015 19 6	716 0 7	735 5 4	710 0 8	949 2 1	..	..	..	..	10,009 19 10	57·20	1,454 19 5
Water sold ..	1886–87	2 10 0	758 0 4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Water sold ..	1886–87	2 0 0	..	19 10 8	488 3 9	315 7 11	599 5 0	643 7 11	682 8 9	686 7 5	562 0 10	345 12 7	673 0 0	747 9 2	6,470 14 4	..	..	..	..	..	..
Free	1886–87	..	..	776 0 11	242 0 11	40 13 9	120 9 7	83 15 10	74 5 0	45 9 2	32 15 0	46 8 9	49 16 8	36 3 4	..	1,547 18 11	..	..	..	..	..
			758 0 4	795 11 7	730 4 8	356 1 8	719 14 7	727 3 9	706 13 9	731 16 7	594 15 10	392 1 4	722 16 8	783 12 6	..	..	..	..	8,018 13 3	56·19	1,398 18 10
Water sold ..	1887–78	2 0 0	535 5 10	679 7 8	167 10 10	656 4 7	684 16 1	694 5 0	591 12 1	710 0 0	535 10 10	519 15 5	670 17 6	734 4 5	7,169 10 3	..	..	..	..	..	..
Free	1887–78	..	26 11 8	40 19 2	15 13 9	23 10 0	47 7 11	4 11 8	34 16 8	42 10 0	27 10 0	28 6 8	19 11 8	15 17 3	..	347 6 5	..	..	..	..	..
			561 17 6	720 6 10	183 4 7	679 14 7	732 4 0	698 16 8	626 8 9	752 10 0	553 0 10	548 2 1	690 9 2	750 1 8	..	..	..	..	7,516 16 8	53·68	982 12 0
Water sold ..	1888–89	2 0 0	490 6 8	338 7 7	532 1 1	626 19 10	667 8 3	542 8 4	702 12 6	664 1 7	395 12 3	465 2 1	623 18 4	667 8 4	6,716 6 10	..	..	..	..	..	..
Free	1888–89	..	107 17 3	90 18 0	87 1 4	75 1 10	32 10 0	16 9 5	38 1 4	13 0 0	34 9 2	58 6 8	90 10 10	74 13 4	..	492 0 0	227 0 0	..	..	..	..
			598 3 11	429 5 7	619 2 5	702 1 8	699 18 3	558 17 9	740 13 10	667 1 7	430 1 5	523 9 7	714 9 2	742 1 8	..	..	..	..	7,435 6 10	53·10	1,024 1 9
Water sold ..	1889–90	2 0 0	401 13 4	495 16 4	256 16 8	377 16 3	353 4 2	237 7 11	318 10 10	293 8 4	159 18 9	219 15 10	248 19 7	186 16 8	3,550 4 8	..	..	..	..	..	..
Free	1889–90	..	45 15 0	55 3 4	43 0 0	92 15 0	105 15 0	93 1 8	41 10 0	103 18 4	105 13 4	48 17 6	54 8 4	71 5 0	..	396 2 6	465 0 0	..	..	..	..
Free, No. 3 Channel	1889–90	..	..	..	..	..	122 19 1	335 1 3	330 11 8	275 8 0	97 13 4	6 0 0	221 18 1	102 11 5	..	..	..	1,492 2 10	..	..	..
			447 8 4	550 19 8	299 16 8	470 11 3	581 18 3	665 10 10	690 12 6	672 14 8	363 5 5	274 13 4	525 6 0	360 13 1	..	..	..	..	5,903 10 0	42·16	1,424 13 3
Water sold ..	1890–91	2 0 0	300 12 6	355 11 11	368 3 2	423 9 0	622 17 11	666 7 1	720 16 1	701 5 10	578 1 8	546 17 11	691 17 11	689 11 8	6,665 12 8	..	..	..	..	..	..
Free	1890–91	..	113 5 0	119 14 2	70 7 11	71 17 6	82 9 7	110 16 8	93 13 9	106 0 10	57 5 5	113 6 8	133 2 6	130 5 10	..	409 5 5	793 0 5	..	..	..	..
Free, No. 3 Channel	1890–91	..	272 11 11	247 3 6	246 17 10	115 2 11	32 2 2	..	..	..	..	..	..	..	..	..	..	913 18 4	..	..	..
			686 9 5	722 9 7	685 8 11	610 9 5	737 9 8	777 3 9	814 9 10	807 6 8	635 7 1	660 4 7	825 0 5	819 17 6	..	..	..	..	8,781 16 10	62·72	1,766 4 3
															58,412 8 6	5,580 12 8	1,485 0 5	2,406 1 2	67,884 2 9	..	11,860 15 0

NOTE.—The above does not include water for flushing purposes as follows: No. 2 Channel, 10 sluice-heads; No. 3 Channel, 23 sluice-heads.

Nelson Creek Water-race.

The construction of this water-race was commenced in April, 1874, and completed in the beginning of 1878; a good number of the bridges and flumes have accordingly been up for sixteen years. These are all now in a greatly-decayed state. The understructure of the low flumes and small bridges can easily be replaced, and many of these have been repaired so that they will last for several years; but there are several large arch braced bridges across deep gulches from 120ft. to 175ft. deep, having spans of from 140ft. to 150ft.; and also understrutted bridges of from 70ft. to 90ft. spans, which cannot well be repaired, and would have to be replaced either by a new structure or by siphons; in most of the places where these bridges are erected there is only the ordinary fall of the race, namely, 8ft. per mile, which would require large siphons to carry the water. Most of the timber used in the construction of the large bridges and flumes is really in such a decayed state that some of them may come down any day. The amount derived from the sales of water is not sufficient to cover the cost of maintenance, neither does the extent of the auriferous-drift terraces and flats that the present water-race commands warrant any large expenditure being made to put this water-race in thorough repair.

The only new ground likely to be opened out is that in the vicinity of Ward's Gully, the lower end of Try-again Terrace, Brian Boru Gully, and the valley of Nelson Creek between Hatter's Terrace and Mr. Drennan's farm; but, with the exception of the latter place, the area of known auriferous-drift-gravel wash is very limited. There is a considerable area of auriferous-drift wash on the terraces on the west side of Nelson Creek, which was partially worked in the early days of the field, and which is likely to pay for hydraulic sluicing; but a portion of this ground would have to be worked on the hydraulic-elevating principle, as there is not sufficient fall for ordinary sluicing. To command this ground about 80 chains of steel-piping would be required, and a trestle bridge to carry the pipes across the bed of Nelson Creek. But before this could be thought of about £13,000 would have to be expended on the main race to replace bridges and flumes, and in substituting siphons in lieu of some of them; but even if this work were done the revenue likely to be derived from the sales of water would not justify the expenditure. The only other ground that the race commands is a large flat on the upper side of Sutherland's Creek (where a little gold was found during the time the race was being constructed), but which has never yet been prospected. If payable drift-wash could be found in this flat a large supply of water could easily be got, as it is on the upper side of all the bridges and large flumes.

The following statement shows the result of working the water-race during last year:—

Month.	Sales of Water.	Expenditure.	Number of Men employed.	Approximate Amount of Gold obtained.	Value of Gold.
1890.	£ s. d.	£ s. d.		Oz.	£ s. d.
April	52 1 8	74 2 0	35	119	455 3 6
May	42 2 6	77 7 5	36	93	355 14 6
June	53 12 6	71 14 0	36	109	416 18 6
July	62 3 4	77 8 0	32	99	378 13 6
August	59 1 8	74 9 8	34	102	390 3 0
September	56 4 2	74 12 0	32	97	371 0 6
October	67 10 10	84 7 3	26	81	309 16 6
November	5 8 4	72 15 0	..	..	..
December	45 6 8	84 8 0	28	78	298 7 0
1891.					
January	29 3 4	101 3 0	24	53	202 14 6
February	50 0 0	68 14 0	27	68	260 2 0
March	47 10 0	78 19 4	26	66	252 9 0
Totals	570 5 0	939 19 8	336*	965	3,691 2 6

* Average number of men employed, 28.

It will be seen from the above statement that the value of sales of water last year was £570 5s., as against £529 18s. 4d. for the previous year; and the expenditure on maintenance was £939 19s. 8d., as against £917 10s. 4d. for the former year. This shows a loss on the working last year of £369 14s. 8d., the loss the previous year being £387 12s. Considering the decayed state of the wooden structures on this water-race it is gratifying to find that the loss on the working last year was less than in the previous year. The value of free water given last year towards assistance in opening out claims and working poor ground was £84 15s., as against £128 15s. for the previous year. The average number of men employed in claims worked with water from the race during last year was twenty-eight, and the approximate amount of gold obtained by them for the year was 965oz., representing a value of £3,691 2s. 6d. Deducting the value of the sales of water from this amount, it leaves £3,120 17s. 6d. as the earnings of the miners employed for the year, which is equal to £2 2s. 10d. a week per man, being 3s. 4d. per week more than the average earnings for the previous year. The total cost of this work has been £90,722 10s. 8d., and the value of the sales of water since it was constructed amount to £17,364 0s. 7d.; while the expenditure on maintenance has amounted to £15,123 0s. 7d. The approximate quantity of gold obtained with water from this race is 32,698oz., representing a value of £125,069 17s.

Argyle Water-race.

Previous to the purchase of this water-race the miners and residents in the district petitioned the Government to construct a water-race from the Four-mile Creek to bring a good supply of water on to the field. The Chairman of the Buller County, on behalf of the Council, offered to the Government to pay one-half of the interest on the cost of construction, and at the end of August, 1878, the

Under-Secretary for Public Works wrote to the Chairman of the county informing him that the Government agreed to comply with his request to construct the water-race and that the vote would be renewed for this purpose on condition that the County Council paid one half the interest on the cost of construction. A survey of the race was made from the Four-mile Creek to Haines's Dam (at that time the property of a private company), a distance of 7 miles 30 chains. This race was estimated to cost about £7,500, and the quantity of water it would supply would be about ten heads. Instead of constructing this new water-race, the Government purchased the Argyle Water-race and Haines's Dam in the early part of 1879, then the property of a private company, for £3,000, and since that period the Government has expended a further sum of £11,701 15s. 3d., making the total cost of this water-supply up to the present time £14,701 15s. 3d.

In August last the County Chairman waited on the Hon. the Minister of Mines to urge the Government to construct an extension of the water-race from Haines's Dam to the Four-mile Creek, representing at the same time that a far larger supply of water was required for the field. The manager of the Argyle Water-race reported that twelve sluice-heads would be the maximum quantity that could ever be taken from the water-race. This being the case, it did not justify the Government in incurring a further expenditure of £7,500, and it resulted in the water-race being offered to the County Council, with a sum of £250 to execute some urgent repairs to the existing water-race. The County Council agreed to accept the offer, and the water-race was handed over accordingly on the 1st November last.

The following table shows the receipts and expenditure in connection with this water-race for seven months ending the 31st October, 1890 :—

Month.	Sales of Water.	Expenditure.	Number of Men employed.	Approximate Amount of Gold obtained.	Value of Gold.
1890.	£ s. d.	£ s. d.		Oz.	£ s. d.
April	42 8 10	47 16 3	21	56	215 12 0
May	40 6 2	51 7 0	21	48	184 16 0
June	54 6 6	90 1 3	23	60	231 0 0
July	23 9 7	42 19 9	20	30	115 10 0
August	28 15 3	29 18 0	21	32	123 4 0
September	20 11 5	31 5 0	13	22	84 14 0
October	32 3 1	92 11 3	17	35	134 15 0
Handed to County Council to effect necessary repairs	..	250 0 0	..	..	..
Totals	242 0 10	635 18 6	136*	283	1,089 11 0

* Average number of men employed, 18; average weekly wages, after deducting sales of water, £1 10s. 8d.

During the period the Government has had this water-race, about twelve years and seven months, the receipts for sales of water amounted to £5,530 16s. 10d., and the expenditure on maintenance, including the £250 handed recently to the County Council to effect the necessary repairs, has been £5,401 12s. 11d., showing only a profit on the working, during the whole period, of £129 3s. 11d. The collateral advantages have been—an average of about seventeen men employed in working ground with water from this supply, and the approximate quantity of gold obtained amounting to about 8,040oz., representing a value of £30,738 12s. The County Council has recently made a new survey of an extension to Four-mile, with the view of having the race constructed.

Mikonui Water-race.

The portion of this water-race that is constructed, about three miles at the lower end, is leased to the Mont D'Or Company at Ross for £50 per annum. The Borough Council of Ross is now laying air-pipes into the lower end of the long tunnel (which is constructed for about 45 chains), in order to ascertain its condition, and whether it would be advisable to continue its construction.

Mount Ida Water-race.

The revenue from this water-race has never been sufficient to cover the cost of maintenance. It has been handed over to a Trust to manage on behalf of the Government. The race commands a large extent of auriferous country, and is likely some day to become a valuable property ; but the present supply of water is not adequate to the requirements of the district, neither is it sufficient to pay the working-expenses. The district being at a high altitude there are at least two or three months in the winter that mining operations cannot be carried on owing to frost. At the time when this work was constructed it was part of the scheme to construct a reservoir in the valley of the Eweburn, so as to conserve the water during wet weather and have a reserve to draw on in dry weather ; but this reservoir was never constructed, and the Trust maintains that it is impossible to make the water-race a paying concern without it.

There is a good site for a reservoir in the valley of the Eweburn, and there will be no difficulty in getting good foundations for an embankment across the narrow gorge where it is proposed to be made ; but on the side of the valley next to Naseby there is some doubt whether a good foundation can be easily obtained. This requires to be looked into and tested before any design for an embankment is made. The increased revenue that would accrue from having an extra supply of water would be likely to make this race a profitable investment instead of its being a direct loss ; but it is not understood by this that the increased revenue from sales of water would pay interest on the whole of the original cost, which is £65,766, but it would be likely to pay good interest on the extra expenditure required to construct the reservoir, estimated at between £8,000 and £10,000.

The following table will show the results of working the water-race for the year ending the 31st December, 1890 :—

Months.	Sales of Water.	Cash received for Sales of Water.	Expenditure.	Amount of Outstanding Moneys at End of each Month.	Number of Men employed.	Approximate Amount of Gold obtained in Ounces.	Value of Gold.
1890.	£ s. d.	£ s. d.	£ s. d.			Oz.	£ s. d.
January	79 19 0	110 1 0	91 19 10	No monthly record kept. The outstanding accounts on the 31st December, 1890, amounted to £1,346 4s. 1d. About £1,000 of this amount is reckoned bad, having accumulated during the last fourteen years.	A full supply of water gives employment to about 130 men. The number of men employed is regulated by the quantity of water supplied. When water is scarce they are engaged in "falling" and other dry work.	250	937 10 0
February	8 15 0	82 19 0	186 16 7			200	750 0 0
March	50 9 8	65 14 0	75 5 0			210	787 10 0
April	103 15 10	61 1 7	81 18 0			200	750 0 0
May	73 6 7	50 14 6	70 13 4			150	562 10 0
June	70 1 3	3 10 0	68 17 4			100	375 0 0
July	7 5 0	94 11 10	46 15 9			..	..
August	48 5 10	29 17 8	95 11 9			30	112 10 0
September	119 4 8	38 5 8	97 8 0			300	1,125 0 0
October	193 11 4	99 13 2	106 4 4			300	1,125 0 0
November	173 2 3	43 8 5	70 17 6			320	1,200 0 0
December	100 1 3	145 14 1	69 2 0			440	1,650 0 0
Totals ..	1,027 17 8	825 10 11	1,061 9 5			2,500	9,375 0 0

This statement shows that the sales of water for the year have yielded £1,027 17s. 8d., as against £801 1s. for the previous year; while the expenditure was £1,061 9s. 5d., as against £1,089 2s. 8d. for the former year: showing a loss on the working last year of £33 11s. 9d.

The outstanding moneys at the end of last year amounted to £1,346 4s. 1d., while at the end of the previous year the amount of arrears was £1,346 4s. 1d.

The average number of men employed in working claims with water from this supply last year was 130, and the approximate quantity of gold obtained by them was about 2,500oz., representing a value of £9,375; deducting the value of the sales of water from this amount it leaves the average earnings of the mines at £64 4s. 2d. per annum, or £1 4s. 8d. per week.

Summary of Water-races.

The following statement shows the collateral advantages of the working of the whole of the water-races, namely, the value of the duty paid on gold, and the actual profits or losses on the working. The duty on gold was payable up to the end of the year ending the 31st March last, and is therefore added as part of the actual profits; but after this period the payment of duty on gold ceased in the Middle Island.

Statement showing the Profits and Losses on the Working of the Water-races for Thirteen Years.

Name of Water-race.	Value of Sale of Water, including Value of any Gold obtained.	Expenditure.	Profit or Loss on Working.	Average Number employed.	Approximate Amount of Gold.	Value of Gold obtained.	Duty received on Gold obtained.	Total Profit or Loss, with Value of Gold Duty added.	Total Cost of Construction.
Waimea-Kumara Water-race and Sludge-channel.	£ s. d.	£ s. d.	£ s. d.		Oz.	£ s. d	£ s.	£ s. d.	£ s. d.
welve years ending the 31st March, 1890	101,751 5 10	68,891 6 11	32,859 18 11	393	194,273	724,329 15 3	19,427 6	52,287 4 11	..
Year ending 31st March, 1891	10,085 19 10	3,807 8 7	6,278 11 3	242	13,007	49,426 12 0	1,300 14	7,579 5 3	..
Totals	111,837 5 8	72,698 15 6	39,138 10 2	381	207,280	773,756 7 3	20,728 0	59,866 10 2	179,248 16 5
Nelson Creek.									
Twelve years ending the 31st March, 1890	16,793 15 7	14,183 0 11	2,610 14 8	53	31,733	121,378 14 6	3,172 6	5,784 0 8	..
Year ending 31st March, 1891	570 5 0	939 19 8	*369 14 8	28	965	3,691 2 6	96 10	*273 4 8	..
Totals	17,364 0 7	15,123 0 7	2,241 0 0	53	32,698	125,069 17 0	3,269 16	5,510 16 0	90,722 10 8
Argyle.									
Twelve years ending the 31st March, 1890	5,288 16 0	4,819 9 1	469 6 11	17	7,757	29,649 1 0	775 14	1,245 0 11	..
Year ending 31st March, 1891	242 0 10	635 18 6	*393 17 8	19	283	1,089 11 0	28 6	*311 17 0	..
Totals	5,530 16 10	5,455 7 7	75 9 3	17	8,040	30,738 12 0	804 0	933 3 11	14,701 15 3
Mount Ida.									
Twelve years ending the 31st March, 1890	16,716 8 2	20,201 11 8	*3,485 3 6	101	29,261	110,805 10 0	2,926 2	*559 1 1	..
Year ending 31st March, 1891	1,027 17 8	1,061 9 5	33 11 9	130	2,500	9,375 0 0	250 0	216 8 3	..
Totals	17,744 5 10	21,263 1 1	3,518 15 3	106	31,761	120,180 10 0	3,176 2	*342 12 10	65,766 3 8
Grand Totals ..	152,476 8 11	114,640 4 9	37,836 4 2	557	279,779	1,049,745 6 3	27,977 18	65,967 17 3	350,439 6 0

* Shows a loss on the working.

This shows that the total cost of constructing these works was £350,439 6s., and that during the thirteen years these water-races have been in existence the profits accruing out of sales of water and gold-duty amount to £65,967 17s. 3d. Only one of these water-races—namely, the Waimea-Kumara—has paid anything towards the original cost during the last year. This race has returned nearly 4¼ per cent. on its original cost of construction.

GOLD- AND SILVER-MINING.

The returns of gold obtained in the colony show a considerable falling-off last year, principally from the alluvial mining districts, no doubt owing a great deal to the dry season and to the shortness of water, also to the large amount of dead-work done (especially in the Otago District) in connection with mining, such as the construction of large hydraulic plants and dredges to work the ground on a more extensive scale. With regard to silver-mining, it is difficult to ascertain the correct quantity of silver obtained, as some of it is shipped in bullion, but the quantity is not great; however, silver-mining is attracting more attention every year, and plants are being constructed to deal with silver ores. The only places at which these ores are worked as yet are Puhipuhi, where the bullion is mostly all silver, and Waihi and Karangahake, where there is a combination of gold and silver in the ore. The first plant in the Puhipuhi has been only recently erected, and consequently only test samples of ore have as yet been made.

The quartz-mining in general is looking better than it has done for several years, and the North Island districts show an increased return of gold last year, while the Reefton District on the West Coast shows only but a slight falling-off. The following is a comparative statement of the returns of the quantity and value of gold for the two years ending the 31st March last:—

Name of District.	Year ending 31st March, 1891.		Year ending 31st March, 1890.		Increase (shown thus +) or Decrease (shown thus -).
	Quantity.	Value.	Quantity.	Value.	
	Oz.	£	Oz.	£	Oz.
Auckland	38,630	153,678	31,948	125,326	+6,682
Marlborough	2,333	9,332	7,152	28,282	-4,819
Nelson	1,610	6,406	3,593	13,593	-1,983
West Coast	86,792	347,161	94,066	375,955	-7,274
Otago	41,715	168,744	65,001	260,018	-23,286
Totals	171,080	685,321	201,760	803,174	-30,680

This shows a falling-off in yield to the extent of 30,680oz., the greater portion of which is in the Otago District; but in the Auckland District there has been an increased yield of 6,692oz. There is no getting away from the fact that there is a gradual falling-off in the yield of gold from the alluvial workings every year, indicating that the early-worked auriferous drifts are getting less in extent, and that labour-saving appliances must, as a matter of necessity, be adopted to make this branch of the gold-mining industry give fair returns for both capital invested and labour employed. The quartz-mines are the only permanent gold- and silver-mines in the colony, and the permanency of these depends on the distance the lodes can be traced so as to be payable for working.

QUARTZ WORKINGS.

NORTH ISLAND.

Auckland District.

Puhipuhi.

There are a large number of licensed holdings taken up on this field, but with the exception of the Prospectors' there has been very little work done since the field was first opened. This, no doubt, can be partially ascribed to the fact that this part of the country is without either roads or tracks. There are numerous quartz lodes on the field containing silver, and some of them a little gold; but no one can say in its present state of development whether the field will become a large mining district or not. There is far more work done in the Prospectors' Mine than in any other, but even in it the lodes have not been prospected to any great depth; at the same time, many of them are clearly defined, and of good width, showing every indication of going down; but, still, that is no criterion that they will contain sufficient silver to pay for working. It is a field where many of the lodes near the surface are likely to yield fair returns for working with a plant capable of treating the ore economically, and extracting a fair percentage of the silver.

During my recent visit to this field the only mine visited was the Prospectors'. The No. 3 lode is about 4ft. in thickness, and contains some very good ore. A considerable quantity of it is stacked at the mouth of the level, ready to send to the battery, which ought to give good returns. There are numerous lodes in the ground held by the owners of this claim which contain silver, and from which rich assays have been made; but these are, in many instances, deceiving when the ore is treated in bulk. On my former visit to the field, in December last, there were forty-nine men employed in the different claims—namely,—

Name of Holding.	Number of Men employed.	Name of Holding.	Number of Men employed.
Prospectors'	17	Luminary	2
Young Colonial	2	Caberfeigh	2
Tupona	2	Silver Star	2
Broadbent and Hogan	2	Gibson's	2
Kamo	2	Lone Hand	2
Silver Fleece	2	Nelson	2
Caledonian	2	Ruby	2
No. 3 Company	2		
Caledonian	2	Total	49

Mr. Leslie McArthur is reported to have made over a hundred assays of ore coming from the field, which gave an average of 122oz. of silver to the ton; and 225lb. of ore was sent from the Prospectors' Claim to the School of Mines, Thames, and subjected to two different methods of treatment. Assays were made from the pulverised ore, showing that it contained 11dwt. 8gr. gold and 63oz. 19dwt. silver to the ton. The first lot was treated by the ordinary pan-process—namely, four hours' hot amalgamation with chemicals, at the rate of 20lb. of salt, 10lb. of copper-sulphate, 10lb. iron-sulphate, and 5lb. of alum to 2,000lb. weight of ore. This treatment only extracted 70·3 per cent. of the assay-value. The second lot, after being crushed dry, was subjected to a chloridising roasting with 6lb. of salt and iron-sulphate, and afterwards treated by hot amalgamation with chemicals in the pans, yielding 93 per cent. of the assay-value. Some small parcels were also forwarded to Sydney for treatment, which gave payable results.

The question as to whether the lodes will pay by working them in a face without selecting the ore will soon be determined, as the crushing plant erected by the prospectors is now at work, and this will afford facilities to the adjacent claimholders to get parcels tested to prove the value of their claims. This could not be done before unless at an enormous cost, as it is only recently the road has been completed into the field from the Whangarei–Kawakawa Road. Even now this road will be impassable for wheel-traffic during the winter months.

Judging from the formation of the country and the character of the lodes found in the Puhipuhi district, there is a fair probability that some further good discoveries will be made in the locality, and also between Puhipuhi and Helena Bay. The same belt of country extends towards Cape Brett, but the quartz hitherto found at the latter place is of quite a different character from that found at Puhipuhi. The occurrence of antimonial or ruby silver in some of the lodes is an indication that richer stone will be obtained below the water-level. At least, this has been the case in some of the argentiferous lodes on the Pacific Slope where ruby-silver ore was found near the outcrop. The rough and broken nature of this country, without roads or even good tracks, will make the development of the mines a slow process. Nothing but prospecting can be carried on until the country is more opened up. The prospectors, however, deserve the highest credit for the perseverance and energy they have displayed since the field has been opened for mining. They have done a great deal of prospecting-work, and opened out their mine so that the crushing plant can be kept fully at work for a considerable time on the ore now in sight. The following is a list of fire-assays made from different lodes in the prospectors' ground by Mr. George Peel, who is in charge of the reduction plant:—

No. 3 Reef at No. 2 Level, north and south of Winze.*

Sample.	Silver. Oz.	dwt.	gr.
No. 1†, 10ft. north of winze on reef...	150	13	0
No. 2, 20ft. " " ...	200	6	0
No. 3, 30ft. " " ...	180	3	0
No. 4, 40ft. " " ...	200	10	0
No. 5, 50ft. " " ...	60	8	0
No. 6, 60ft. " " ...	40	15	0
No. 7, 70ft. " " ...	150	0	0
No. 8, 80ft. " " ...	71	0	0
No. 9, 90ft. " " ...	100	3	0
No. 1, 10ft. south of winze on reef ...	166	10	0
No. 2, 20ft. " " ...	160	0	0
No. 3, 30ft. " " ...	81	3	0
No. 4, 40ft. " " ...	50	0	0
No. 5, 50ft. " " ...	53	0	0
No. 6,‡ 60ft. " " ...	50	0	0

Samples taken from Wilson Reef.

Sample.	Silver. Oz.	dwt.	gr.
No. 1,§ taken from the Fluming Level, width, 6ft.	30	6	0
No. 2,‖ taken from the Fluming Level, width, 6ft.	40	0	0
No. 3,¶ taken from the Fluming Level, width, 6ft.	40	0	0

Elsie Reef.

No. 1, taken from the cap, width 6ft...	40	3	0
No. 2, " " ...	38	10	0
No. 3, " " ...	50	0	0

Mary Reef (width, 4ft.).

No. 1, sample taken from the cap ...	43	0	0
No. 2, " " ...	56	0	0
No. 3, " " ...	18	0	0
No. 4, " " ...	13	0	0

Mary Reef (10ft. in width).

No. 1, taken in level above whares ...	20	0	0
No. 2, " " ...	10	6	0
No. 3, " " ...	33	3	0

* Specimens tested from this reef gave a return of 1,000oz. to 2,000oz. † No. 1, trace of gold. ‡ No. 6, strong trace of gold. § No. 1, 13dwt. of gold. ‖ No. 2, 6dwt. of gold. ¶ No. 3, 10oz. of gold.

If these were average samples taken from the different lodes, and if only 50 per cent. of the silver be extracted in treating the ore in bulk, then the No. 3 lode, which is more opened up than any of the others, ought to pay for working and leave a fair profit. The average of the nine assays made from this lode gives 128oz. 4dwt. 5gr. of silver to the ton. On commencing to crush a small parcel with the plant, Mr. Peel treated 1cwt. of pulverised ore in one of the pans, which yielded 12oz. of bullion, or at the rate of 240oz. to the ton; but no doubt this was some of the picked ore; at the same time it showed that the lode contained some rich ore, and that the plant was capable of extracting the metal.

Prospectors' Plant.—The plant consists of a stone-breaker, one pair of Cornish rolls, pulveriser, four amalgamating-pans, two settlers, and an amalgamating-barrel; an assay office being connected with the same building. The plant is driven by a Pelton water-wheel 6ft. 6in. in diameter. A dam has been constructed in one of the branches of the Tangiapakura Creek, by having large kauri logs placed across a narrow gorge, and well stayed with backstays footed into the solid rock. The face of the logs is dressed to receive planking, being boarded on the front side with sawn planks 6in. by 3in. The dam is about 25ft. high, and 55ft. wide at the top. The object of this dam is not so much for storage as it is to raise the water and keep a small supply in moderately dry weather. From the dam the water is conveyed for about 10 chains in a flume, 2ft. 6in. wide

by 18in. in depth, to opposite the crushing plant, and thence in a pipe 15in. in diameter to the Pelton wheel, having at this point 180ft. of head, which would be equal to about fifteen-horse power for every sluice-head of water used. The ore is conveyed by a tramway constructed along the side of the Tangiapakura Gorge to two drying-kilns, which are cut out of the rock in the form of an inverted cone, resembling to a great extent the shape of kilns for burning lime. The ore is drawn out at the bottom of these kilns and filled into trucks, to be taken to the floor on which the rock-breaker is placed.

The whole of the crushing plant is erected on framing, so that the ore passes through every stage of the process by gravitation. On bringing the ore from the kilns it is dumped on the floor, and fed by hand into the rock-breaker, which reduces it to the size of nuts. From this it passes into the Cornish rolls, where it is further reduced to the size of small peas, and then passes down to the pulveriser. As this is a new machine for reducing quartz, a description of it will not be out of place.

The pulveriser is one of Askam-Wilson's, being used in England for pulverising cement. It is in the shape of a cast-iron barrel about 3ft. 6in. in length, and about 3ft. in diameter inside, having wire-gauze on each end of sixty-mesh—3,600 holes to the square inch. A shaft passes through the centre of this barrel, on which are keyed two cast-iron arms having loose revolving rollers at their extremities. These rollers are about 8in. in diameter, and have a 5in. face. The hole in the centre of the rollers is much larger than the pin on which they revolve, which keeps them attached to the end of the arms. At the place inside the cast-iron cylinder opposite the end of these arms is placed a steel ring, on which the rollers revolve. Between the arms on the shaft there are placed what is termed "agitators," which tends to bring the material to the place on which the rollers work, and between the arms and screens at each end are fans for sending the dust through the wire-gauze or gratings. The material is fed through a small hopper fixed on the upper side of the pulveriser-casing, in the centre, and the pulveriser is driven at about 300 revolutions per minute. The rollers, being loose on the pins at each end of the arms, fly out against the steel ring inside the casing by centrifugal force, pulverising the material into the finest dust. It is calculated by those in charge of the plant that this machine will be capable of pulverising about 10 tons of ore per day.

The fine pulverised material is now taken to the

Amalgamating-pans.—These pans are a combination of the Wheeler and Watson-Denny pans. They are fitted with the same class of wings inside as the Watson-Denny, but have not a continuous discharge, nor the corrugated bottoms, the object being to treat each charge separately with chemicals and quicksilver by hot amalgamation. As soon as each pan is charged the cover is placed on the top of the pan, and the charge is heated inside by a jet of steam supplied from a boiler provided for the purpose. After working each charge for a certain number of hours, the charges in each two pans are drawn off into a settler, which is kept at work until another charge is ready. The quicksilver is then drawn off from the bottom of the settler, and the amalgam collected and strained ready for retorting.

The plant may be termed a prospector's plant. There appeared to be several defects: the framing on which it was erected was too slight, and required a considerable amount of more bracing to prevent vibration, and there was not sufficient provision made to confine the dust. The wear-and-tear of the pulveriser will necessarily be very great. It has not the appearance of an economical machine for this class of work, but it is a plant sufficient to test the ground and prove its value.

The following tabulated statement will give some idea of the work done on the field since it was opened. This does not include the prospectors' claim, which has already been referred to:—

Name of Claim or Company.	Length of Driving done	Particulars.
Prospectors' No. 2 ...	...	2 lodes, one 7ft. and the other 3ft. 1 cwt. quartz from each lode, tested at Waiorongomai, yielded fair results of silver.
Ophir	112	1 lode, 18in. wide, carrying a little silver.
Kamo and Kamo Extended	200	Several lodes discovered with a little silver.
Just in Time	40	Lode 2ft. 6in. thick. 16cwt., tested at School of Mines, Thames, gave 9oz. 3dwt. silver. Several cuttings made on surface.
Young Colonial	232	1 lode 12 in., and another 3ft., both containing a little silver.
Wai Maria	200	1 lode 3ft., another 7ft., both containing a little silver.
Try Fluke	100	3 small lodes discovered about 9in. wide. Little silver.
United	80	2 lodes cut, containing a little silver.
Silver Fleece	150	A lode discovered.
Caledonia	80	Small leader found, showing a little silver.
Tupono	200	No lode cut in drive, but there is one showing on surface 5ft. thick.
Comstock No. 3	280	No lode cut.
Jubilee	150	2 lodes cut, showing a little silver.
No. 3 Company.	200	Lode 4ft. wide, and several leaders, showing little silver.
Luminary	200	Several lodes cut showing a little silver.
Ruby	120	Lode 3ft. wide cut, showing a little silver.
Caledonian	134	Lode varies from 18in. to 3ft. 16cwt., tested at School of Mines, Thames, yielded 5dwt. gold and silver bullion.
Lone Hand		No lode cut.
Khartoum	110	No lode cut.
Caberfeigh and Comstock ...	40	No defined lode cut.
Total, about ...	2728	

There has been about 2,728 feet of drives and cross-cuts constructed and cuttings made on surface to prospect the outcrops of lodes. There are several other claims taken up which are not mentioned in this list. The work yet done is wholly of a prospecting character.

Annexed is a plan showing the position of claims taken up.

Coromandel.

The quartz-mining industry in the Coromandel district is becoming more important every year. New finds are being discovered and worked. Ground that for years had been abandoned has again been taken up, and some very good stone discovered. Although it is the first auriferous-quartz field discovered in the colony, comparatively little prospecting has been done since it was opened, about twenty-nine years ago. A large quantity of gold has been found near the surface and at shallow depths. In very few instances has the ground been worked or prospected at the deep levels. The Tokatea Company followed a lode down to a considerable depth, and constructed an adit-level for about 3,000ft., which was somewhere about 800ft. below the saddle, and in this level they left a lode under foot which they could not work advantageously on account of water. After a little prospecting no further work was done at this depth. The range on which the Tokatea Company's ground is situate, and, indeed, within the area held by that company, is nothing but a network of leaders, stringers, and veins all apparently branching off from the main lode running through the range, better known in the locality as the Main Buck Reef. This reef is known to contain gold, as it has been tested in several places, but the stone proved of very low grade. Still, when some hundreds of leaders and veins of quartz are found branching off, and containing rich patches of gold, there is a fair prospect of getting good shoots in the main lode. The Tokatea Range is so full of auriferous-quartz veins and leaders that it becomes a question whether it would not pay for working in many places to quarry it out in a face and treat the material in a wholesale manner, as is done by Messrs. Hansen and Comer at the Thames; but to carry on extensive operations it would necessitate a large crushing plant being erected. There are thousands of tons of mullock on the surface that would pay well to crush if a large plant were erected on the flat, and the material sent down by an aerial tramway. By these means the Buck Reef before alluded to would be likely to give fair returns for working. Sample parcels from it at different points have been tested, which gave from 3dwt. to 13dwt. of gold to the ton.

The question of providing cheap motive-power to drive mining machinery should be taken into consideration in this district. There is a good supply of water in the Waiau and Makarau Rivers, that could be utilised to generate electricity, which could be conveyed to any place where it was most convenient to erect a large crushing plant. It is now an established fact that electricity can be used economically to drive mining machinery. It is used by the Phœnix Company at Skipper's to drive a crushing-battery of thirty head of stamps, besides an air-compressor and rock-breaker, and one of the dredges at work in the Shotover River, at the Sand-hills, is driven by electricity, and works admirably. The advantage of using it as a motive-power cannot be overestimated, as it can be generated at the place where water is available to drive the dynamos, and transmitted by copper wires to the place where it is most convenient to erect machinery for either the reduction of quartz or other purposes.

Hitherto the mines on the Tokatea Ranges have been held by two or three companies, and for several years these have been principally worked on tribute, some of the tributers paying as much as 25 per cent. of the gross yields to the companies who hold the ground; but it is gratifying to find that recently these tributes have been reduced to 10 per cent. Where high tributes are exacted it does not pay the tributers to send low-grade quartz to the battery: they generally pick the stone after it is taken to the surface, and nothing but the best is crushed; quartz only giving 1oz., or even 2oz., to the ton in many instances is considered worthless, and thrown amongst the mullock, or left on the surface. It will be seen from the tabulated statement showing the result of working the mines on tribute on the Tokatea Range, that during last year 23 tons 4cwt. 50lb. of quartz was crushed, which yielded 780oz. 13dwt. of gold, being an average of about 33oz. 12dwt. 22gr. to the ton. This quantity of gold was got by twenty-seven tributers, which gives an average of 28oz. 18dwt. per man for the year.

Kapanga Company.—This company's mine is situate on the flat at the foot of the Tokatea Range, and worked more systematically than any other mine in the district. The company, being an English one, sent a manager out from England to conduct the operations on purely commercial principles. So far, the value of gold obtained from the mine has exceeded the expenditure on working it; but the shareholders have yet had little or no return for their capital invested. The workings last year were confined to what is known as Scotty's Lode, at the intermediate level between the 300ft. and 420ft., and also on the 420ft. level; and on the Kapanga Lode, at the 300ft. level. Most of the gold, however, was obtained from Scotty's Lode, which varies from 4in. to 18in. in thickness, and lies at an inclination of from 40° to 60°. The two lodes run in a parallel direction, but Scotty's is lying at a much less inclination than the Kapanga, and it is expected that these two lodes will meet before the 600ft. level is reached, where probably a rich patch of gold will be got. Some very rich specimen-stone is got from Scotty's, yielding as much, in some instances, as from 2oz. to 5oz. of gold to the pound of stone. The Kapanga Lode is from 6in. to 18in. in thickness, heavily mineralised. Occasionally colour of gold is seen, and the manager has great hopes that another shoot of rich gold-bearing stone will be met with before long.

The main shaft has now been sunk to a depth of 572ft.; but the inflow of water became so great that sinking had to be abandoned until larger pumps and heavier pumping machinery were acquired. It is proposed to procure a new pumping-engine, and to use the present one for winding purposes, the present winding-engine, which is a portable one, being too small for the work.

The last annual balance-sheet of this company, for the period ending the 5th July, 1890, shows that there were 1,900 tons of quartz and 1,488lb. of picked stone crushed, which yielded 3,408oz. 12dwt. of melted gold, representing a value of £10,072 19s. 11d. The work done during this period is represented by 1,022ft. of driving on lodes, 329ft. of uprises, 106ft. of winzes, cleaning out the

old shaft for 128ft., and sinking the main shaft for 22ft.; the cost of timber used in the mine and about the works being £439 15s. During the year ending the 31st of March last 1,608 tons of quartz was crushed, which yielded 1,807oz. of gold, representing a value of about £5,240; the average number of men employed during the year being about fifty-three.

The New Zealand Proprietary.—This company took up the ground known as the Corby, where very rich gold-bearing stone was taken out several years ago, but the ground was abandoned for a long time and considered valueless. After the present Kapanga Company commenced operations and found good gold in Scotty's Lode, Mr. Witheford, of Auckland, formed a syndicate and took up the ground with the view of prospecting the Scotty and Corby Lodes, which were known to run through it. A great deal of work has been done during the last year: all the old adit-levels have been cleaned out and considerably extended, and the result is that some very good stone has been found in Scotty's Lode, which is about 2ft. in thickness in places. Gold has also been found in the Corby Lode, so that what was considered twelve months ago a valueless property presents now the appearance of becoming a valuable one. There is every reason to believe that Scotty's Lode, which has proved in the Kapanga working to give good returns at a depth of 420ft. — or fully 300ft. deeper than where the same lode has been struck in this ground — will prove equally good in other portions of it as well as in the Kapanga Mine. This lode is extremely well-defined, and has the appearance of traversing the country for a considerable distance. It is well known that the gold in lodes occurs in shoots and ledges, and often suddenly cuts out, the lode still having the same appearance, with its characteristics but very little varied, and after driving for some distance along its course another shoot or ledge carrying gold is found. An average of twelve men has been employed in this claim, which is 30 acres in extent.

Coromandel Company.—This company has gone to considerable expense in erecting a powerful pumping-engine and sinking a new shaft, with the view of continuing the workings at a deeper level, but so far the proprietors have not met with the success they deserve. The workings at the deep levels are now suspended, and prospecting is being carried on at the upper levels. They are working from the Golden Pa shaft, about 80ft. below the surface, and stoping out a portion of the Golden Pa leader, from which 27 tons of stone has been crushed, yielding 153oz. of gold; but this leader is very small, being only from 1in. to 4in. in thickness. There are large lodes found at the 280ft. level, where they were previously working, and the quartz is full of iron-pyrites, containing scarcely any gold. There is, however, no reason to suppose the gold has entirely cut out. As the lodes go down, very probably at a greater depth another ledge of rich auriferous ore will be found. At the time of my visit there were fourteen men employed underground, and eight men on the surface.

Before suspending operations on the 280ft. level a good deal of prospecting was done, there being about 105ft. of driving on the Black Reef, 26ft. on the Green Harp, about 35ft. on the Cross Reef. On finding no payable stone a rise was made on the latter reef for 26ft., and 57ft. of driving done at the intermediate level. The work done may be summarised thus: Drives constructed on lodes and leaders, 577ft.; rises, 97ft.; cross-cuts, 199ft.; winzes, 141ft.; and opening up and cleaning old levels, 947ft. The large outlay this company has made deserves better success. It would seem that the gold in this part of the field was confined to the upper levels; but, having now a first-class pumping plant, the company should sink the main shaft to a much greater depth, and prospect the ground at the deep levels. In many of the mines at Sandhurst, in Victoria, the lodes found near the surface cut out, or were found not payable for working, as they went down; but on sinking through barren ground for a considerable distance new lodes were again found. The class of country in the Coromandel Mine is favourable for the existence of auriferous lodes, and very probably new lodes will yet be discovered at a greater depth.

Kauri Syndicate Property.

Lanigan's Claims.—This claim is situated at the back of the main range, behind Castle Rock, near the Opitonui Creek. Since my former visit a low-level adit was constructed from the creek, which struck the reef at 350ft. from the mouth. The lode is well defined, and is from 2ft. to 4ft. in thickness. This level at 400ft. from the mouth gives about 60ft. of backs. The upper level has from 50ft. to 60ft. of backs, but as soon as the low adit is extended to underneath the face of the workings there will be about 200ft. of backs. A crushing-battery, consisting of ten heads of stamps has been erected, and 530 tons of stone crushed, which has yielded 312oz. 2dwt. of gold. The terms on which the Kauri Syndicate leased the ground to Mr. Lanigan are as follows: Area of 15 acres, for a term of twenty-one years, at a rental of £2 per acre per annum, with a royalty of 3 per cent. on all the gold obtained when the yield is above ½oz. up to 1oz. per ton, and when the yield exceeds 1oz. of gold per ton the royalty is 5 per cent. Mr. Lanigan has the option of taking up more ground adjoining his lease at the same rental, and paying the syndicate one-third of the profits.

This syndicate has issued new regulations this year, whereby a rental of £2 per acre is demanded from the date of survey of the claim, and a royalty of 5 per cent. on the gross yield of all ore. It also reserves to itself the right of taking half an interest in all claims when payable ore or a reef showing gold is struck, and in the event of a half interest being taken an allowance is to be made for the work done in developing the claim, the persons interested in such claim being formed into a gold-mining no-liability company. These terms hold out very little encouragement to any one to prospect the property.

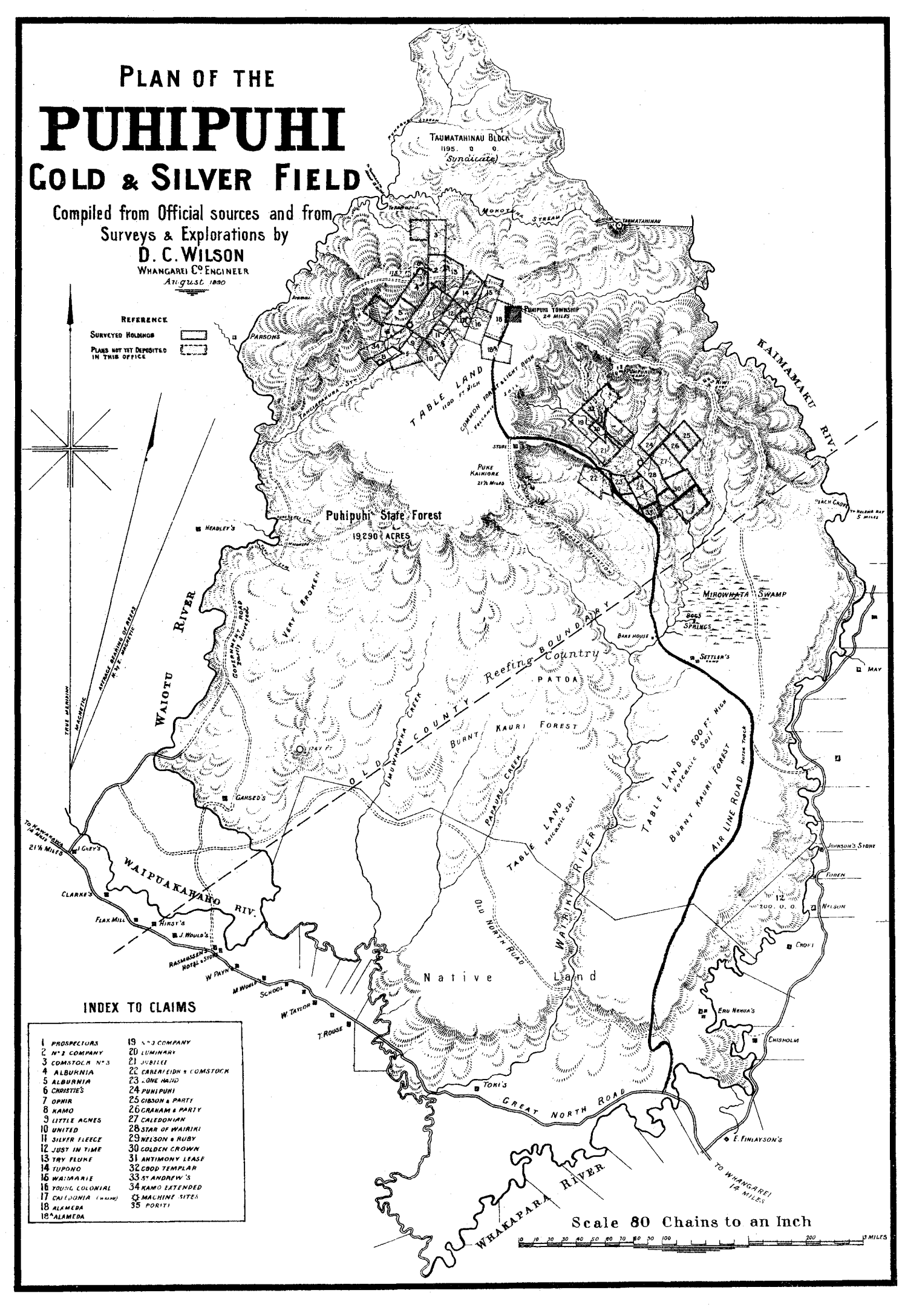
Owera Claim.—This is situate about half-way between Lanigan's Claim and Kuaotuna. At the time of my visit the lode on the upper level was about 2ft. thick, and at the mouth of the next level, which is about 105ft. lower, the lode was about the same width at the mouth, but cut out to a few inches at 40ft. in. Since it was opened 30 tons of quartz has been crushed, which yielded 136oz. 18dwt. of gold, worth about £1 14s. 9d. per ounce.

Another lode was discovered on this syndicate's property on the Otonahua Block, which was about 13ft. in thickness. This was being worked at the time of my visit by two men, and is known

PLAN OF THE
PUHIPUHI
GOLD & SILVER FIELD

Compiled from Official sources and from Surveys & Explorations by

D. C. WILSON
WHANGAREI Co. ENGINEER
August 1890



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Scale 80 Chains to an Inch

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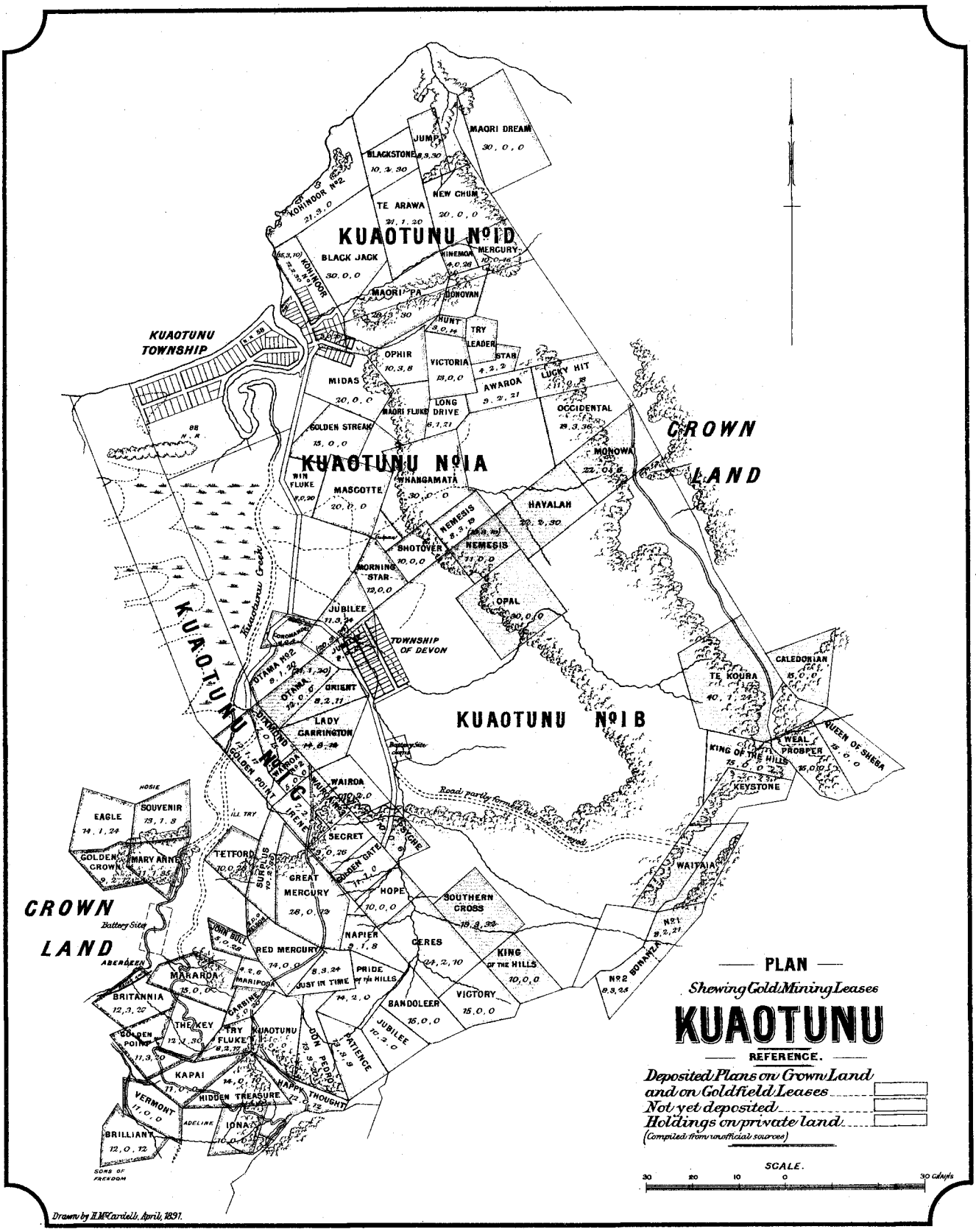


Drawn by H.M^c Cardell, April, 1897.

as Murphy and O'Connor's claim; but so far there does not appear to be any returns from it. While visiting this district a great many miners complained to me about the terms and conditions the Kauri Syndicate Company were exacting from those who wished to prospect and work the ground.

Kuaotuna.

Since my former visit to the Kuaotuna Goldfield great changes have taken place. A good-sized township is now erected where the Native whares are, near the mouth of the Kuaotuna Creek, There are two large commodious hotels, which will favourably compare with any hotel in large cities for accommodation. The field is yet but in its infancy, as comparatively little work has been done to develop it. There are numerous auriferous-quartz lodes to be found all over the field, and no doubt many more will yet be discovered, and the gold traced from Coromandel through the Kauri Syndicate's property to Kuaotuna. There is one crushing-battery at work on the field, one in course of erection, and another proposed to be erected.

Try Fluke Company.—This is the best claim on the field so far as it has yet been proved; but the lode in the second level is not anything like so rich as it was when first struck on the upper level. Still, there is sufficient gold to pay for working. The lode continues to be a good width, but the quality of the lode-stuff appears to get poorer as it goes down. They have stoped out about 80ft. in length of the lode between the first and second level, where some very rich ore was found, averaging in one crushing about 10oz. of gold per ton; but the lode-stuff at the second level will scarcely average 10dwt. per ton at their crushing-battery. The company is constructing a low level, which is about 20ft. above the level of the dray-road from the sea-beach. They expect to have to drive about 500ft. before they cut the lode. There are in all about fourteen men employed, and the area of ground held is about 11 acres. The amount of quartz crushed and gold obtained by this company from the time their crushing-battery was completed, in June, 1890, to the 31st October last was 1,408 tons, which yielded 3,308¼oz. of gold. This is exclusive of 33 tons which was crushed at the Thames, yielding 360oz.; it also does not take into account any gold got out of the tailings. The average value of the gold from this company's mine is £2 13s. per ounce.

The crushing-battery erected by the Try Fluke Company consists of eleven heads of stamps (8cwt. each) and three berdans, the ordinary copper-plated tables and blanket-tables being used. The character of the gold is extremely fine—indeed, it is in such a finely-divided state that it is held in suspension by the water. Notwithstanding this, very coarse gratings are used on the crushing-battery, having about two hundred holes to the square inch. The quantity of gold this company has already lost by imperfect gold-saving appliances is astonishing. The muddy water from the tables holds a large percentage of the precious metal in suspension, which flows into the creek, and is carried away with the stream. This is clearly proved by a gentleman at Kuaotuna, who made a new amalgamating-machine, and wished to try it on the muddy water flowing from the tailings-pits. He showed me a button of gold—probably about 5dwt.—he had obtained from the muddy water. The gold on this field is found in such a finely-divided state amongst the lode-stuff that no system of amalgamation yet in use will save anything like a fair percentage of it. If we take the amount of gold obtained from this company's mine up to the 31st October last as 3,668¼oz., representing a value of £9,720, it may safely be asserted that the value of the gold left in the tailings, and that which passes away with the muddy water into the creek must be at least £12,000.

The process for saving the gold from this company's mine should be to crush the lode-stuff to such a fineness as to pass through a sixty-mesh screen, 3,600 holes to the square inch, and afterwards treat it by the Cassell process. There is no goldfield in the colony where ores are found better adapted for treatment, by being finely pulverised and subjected to a solution of cyanide of potassium, than at Kuaotuna, on account of the gold being in such a finely-divided state amongst the quartz.

The ore is conveyed from the mine to the battery by an aerial tramway, constructed in one span of 1,090ft. The rope is of iron wire, about 3½in. in circumference, and there are only two carriers used. The full one goes down as the empty one comes up. The weight of each carrier, or bucket, is about 3cwt., and it holds 7cwt. of quartz. The top support is about 272ft. higher than the bottom, so that this reduces the horizontal span to about 1,060ft. The deflection in the rope is about 44ft. with the loaded carrier; so that, taking the weight of the rope and loaded carrier, the strain produced at each end support is about 8 tons, the breaking-strain given for an iron-wire rope of this dimension being 20 tons. This only gives 2·5 as a factor of safety, which is too little, and an accident may occur any day by the rope breaking.

Carbine Company.—This company's claim adjoins the Try Fluke Company's ground. It comprises an area of 5 acres and 20 perches. They were at the time of my visit driving along the lode, which is from 2ft. 6in. to 3ft. thick on the northern end, and 13ft. feet wide at the Try Fluke boundary. The main lode consists of low-grade ore, similar in appearance to that found on the same level in the Try Fluke ground. There are small leaders and veins of quartz going off the main lode which pay to work. Twenty-five tons was crushed at the Thames from these leaders during my visit to the northern fields, which yielded 308oz. of gold. They are making arrangements to get some of the main-lode stuff crushed as soon as the public crushing-battery which is now in course of erection on the flat about three-quarters of a mile above the township is completed. There were seven men employed about this claim.

Red Mercury Company.—This company's claim comprises an area of about 14 acres, and is further to the north-east than the Carbine Company's claim, having several auriferous lodes running through it. A parcel of 20 tons of stone from what is known as the Red Mercury Lode was sent to the Thames to be crushed, and gave a result of about 3½oz. gold to the ton. This company are waiting until the public crushing-battery is completed to get their average lode-stuff crushed.

Great Mercury Company.—It was in this company's ground gold was first found at Kuaotuna; it comprises an area of 28 acres. A company has been formed, principally of Sydney people, with a capital of £18,000, in 60,000 shares of 6s. each, the original holders getting 30,000 shares paid

up to 5s. and £1,000 in cash, on the transfer of the property, and £2,000 in twelve months. This leaves £7,500 as a working capital to develop the mine and erect machinery. There are four different auriferous lodes running through this company's property, varying from 2ft. to 6ft. in width, and the manager informed me that in addition to these there are eight leaders or veins varying from 6in. to 18in. in width. Sixteen tons from various lodes was sent to the Thames for treatment, and gave a result of about 3½oz. of gold per ton. The manager also informed me that the intention of the company is to construct a tunnel through the hill, which they estimate will be about 900ft. in length. This will cut the whole of the lodes, leaders, and veins, and prove whether the gold continues to go down. Very little work has been done on any of the lodes beyond trenching on the surface, and opening out on some of them from the face of the hill. The character of the gold is similar to that found in the Try Fluke Claim. Scarcely any can be seen with the naked eye, it is in so finely-divided a state; but good prospects can be got by pounding the stone. It will, however, require a different method than that hitherto adopted before a large percentage of the gold can be saved. Mr. Scully, one of the directors of this company, met me in Auckland, and stated that the company were going to erect machinery for the reduction and treatment of the ore, and asked what class of machinery would be most likely to prove successful in dealing with that class of ore. I recommended him to crush dry through a very fine mesh screen, and treat the crushed portion by the Cassell process. This is certainly the most effective and economical process of treatment yet introduced into New Zealand for such ores as are found at Kuaotuna.

Just in Time Company.—This company's claim is on the southern boundary of the Great Mercury. There is a small lode averaging from 15in. to 2ft. thick. They got two parcels of stone crushed, the first being 10 tons from the surface, which yielded about an average of 2½oz. to the ton; and 25 tons from the low level, where they cut the lode, which yielded about 2¼oz. of gold per ton. This claim comprises an area of 7 acres, and seven men were at the time of my visit employed.

Otama Claim.—This claim comprises an area of a little over 20 acres. It is situated on Kuaotuna No. 2 Block, on the portion which belongs to Mr. Comer. It was taken up when the field was first rushed, and has been steadily worked ever since. The lodes are small—not more than 6in. in places—but the quartz is tolerably rich, and it has paid owners of the property to forward all the parcels to the Thames for treatment. Of course, these parcels were sorted, and the residue is now at the mouth of the mine, to be treated at the public crushing-battery as soon as it is completed.

Waitaia Claim.—This claim is on Mr. McPherson's property. The owners were working on the cap of the lode during my former visit, and were then obtaining very good auriferous stone. Since then they have constructed two low levels on the lode, and have done a considerable amount of work; but the stone from these levels has not the appearance of carrying nearly so much gold as it did near the surface. Still, the lode, although small—about 1ft. in width—is well defined, and shows mineral in the stone, with indications of gold.

Annexed is a plan showing the position of claims on the field.

The following is a tabulated statement showing number of men employed on wages and tribute, number of tons of quartz crushed, and yield of gold in the Coromandel district for year ending 31st March, 1891 :—

Locality.	Name of Mine.	Average No. of Men employed.		For Owners.		For Tributers.		Tailings.	
		Wages-men.	Tributers.	Quantity of Quartz Crushed.	Quantity of Retorted Gold obtained.	Quantity of Quartz Crushed.	Quantity of Retorted Gold obtained.	Quantity treated.	Yield of Gold.
				Tons cwt.	Oz. dwt.	Tons cwt. lb.	Oz. dwt.	Tons.	Oz.
Coromandel County—									
Tokatea	Tokatea	..	10	..	..	13 10 0	284 15	..	..
"	Queen of the North ..	..	2	..	..	3 0 35	54 0	..	..
"	Royal Oak	3	4	1 3	85 10	3 4 15	182 15	..	..
"	Rob Roy	..	2	..	..	1 0 0	33 0	35	35
"	Bismarck	..	7	..	..	1 3 0	211 0	..	..
"	Harbour View ..	..	2	..	..	1 7 0	15 3	..	..
Kapanga ..	Kapanga	53	..	1,608 0	1,807 0	..	..	..	..
" ..	Scotty's	12	..	..	..	..	..	..	..
Kauri Block ..	Coromandel ..	22	..	27 0	153 0	..	..	..	..
" ..	Mint	5	..	15 0	4 3	..	..	..	..
Matawai.. ..	Castle Rock ..	5	..	60 0	509 0	..	..	..	..
Opitonui.. ..	Lanigan's	15	..	530 0	331 2	..	..	..	..
Owera	Owera	6	..	30 0	136 18	..	..	..	..
Waikoromiko ..	Lillis Claim ..	1	..	1 5	120 0	..	..	..	..
Kuaotunu ..	Try Fluke	29	..	3,083 0	5,077 0	..	..	..	..
" ..	Carbine	9	..	21 0	314 0	..	..	..	..
" ..	Red Mercury ..	8	..	75 0	133 0	..	..	..	..
" ..	Great Mercury ..	16	..	15 0	26 5	..	..	..	..
" ..	Just in Time ..	4	..	27 0	25 3	..	..	..	..
" ..	Otama	4	..	61 0	142 0	..	..	..	..
" ..	Secret	1	..	4 0	4 6	..	..	..	..
" ..	Bonanza	2	..	10 0	19 6	..	..	..	..
Mahakirau ..	Mahakirau	2	..	0 10	24 0	..	..	..	..
Coromandel County	Sundry claims ..	15	..	23 0	111 0	..	..	..	..
"	Claims and licensed holdings (no gold produced)	100	..	..	..	..	..	..	..
	Totals	312	27	5,591 18	9,022 13	23 4 50	780 13	35	35

Thames.

The mines in this district are looking better than they have done for years past. It is true there were no large dividend-paying mines last year, but the greater portion of them are paying working-expenses, while some of the companies have returned to the shareholders good interest on the capital invested; and it is gratifying to find that the mines in general are being worked on a satisfactory basis. More with the view of making them dividend-paying ventures than with the object of making money by traffic in the sale of shares. Some of the mines on the Grahamstown Flat are getting down to considerable depths, and the day is not far distant when deeper levels will have to be made. This is a question involving considerable expenditure, but it is one that will have to be faced. The Saxon Company has only about two years' work before the lode is stoped out from the No. 6 level, and sinking cannot be continued until drainage is effected to a greater depth.

At present the drainage is effected by what is known as the Big Pump, under the control of the Drainage Board. This pumping plant originally was constructed to drain the Winter's Freehold property at Ballarat, but was never erected there. It was purchased and erected at the Thames, the Government giving £50,000 for its purchase and erection. The steam-engine is one of the largest in the colonies, the cylinder being 82in. in diameter, and of sufficient length to admit of a 10ft. stroke for the piston. It is what is known as a Bull direct-acting condensing-engine. The steam is supplied by four Cornish steam-boilers. The pumps are 24in. in diameter. When this plant was first erected the shaft was sunk to a depth of 640ft., and pumping was carried on from this depth until about four years ago, the working-expenses being about £470 per month. The pumps were lifted to drain the water to the 400ft. level, in order to reduce the expenditure; but about twelve months ago they had to be put down to the 500ft. level, to allow the Saxon Company to carry on their workings. During my visit to this district in November the pump was being worked with an 8ft. stroke, making five strokes a minute, and the working-expenses were said to be from £320 to £330 per month, the quantity of Kamo coal consumed being from 275 to 280 tons per month, which costs, landed, 17s. 1½d. per ton. The following mines contributed towards the working-expenses of this plant: namely, Hansen, Comer's, Hazelbank, Moanataiari, Caledonian, Cambria, Trenton, New Prince Imperial, Saxon, Victoria, May Queen, Crawford's Special Claim, and the Waiotahi; the County and Borough Council contributing about £35 per month. Many of the mines mentioned are worked only on the upper levels, and get no benefit from the drainage, and, consequently, the heaviest portion of the expenses come on a few companies who are working at the deep levels. At the present time the Drainage Board finds it very difficult to get sufficient money to keep the plant at work. So long as present mining companies can make the mines pay for working, the drainage will be accomplished; but when the time comes when all the payable lodes are stoped out down to drainage-level a collapse will inevitably take place. At the present, when the different companies are all making their mines pay for working, is the time to combine together and prospect deeper levels than have yet been reached.

At Tapu there are a few claims being worked, but none of them are giving large returns. D. Sheridan has recently completed a low level, and cut the lode, which shows fairly good gold. There has been 179¼ tons of quartz crushed from five claims during the past year, which yielded 164oz. 15dwt. of gold. Sometimes rich specimens are got in this locality, but as a rule the lodes are very small.

The principal mines on the field are situate in the vicinity of the Moanataiari, Waiotahi, Waiokaraka, and Karaka Creeks, and on the Grahamstown Flat, at Una Hill and Te Papa. The total gold produced from the mines in the whole district last year was 34,498oz. 19dwt. from 40,495 tons of quartz, and 3,613oz. 13dwt. from 15,000 tons of tailings. The claimholders, employing 586 wages-men in the mines, have crushed 37,679 tons of quartz, which yielded 31,119oz. 10dwt. of gold; and 115 tributers crushed 2,815 tons, which yielded 3,379oz. 9dwt. of gold. This shows that the yield of gold produced from mines worked on wages is equal to 53oz. 2dwt. 2gr. for each man employed, and 29oz. 7dwt. 17gr. for each tributer; or, taking the average of the tributers and wages-men, it amounts to 49oz. 4dwt. 3gr. of gold for every man employed in mines on the field. This shows that mining is in a prosperous condition in the Thames district; and by referring to the tabulated statement hereto annexed it will be seen that all the mines have been getting less or more gold. The workings in a few of the principal mines merely are referred to here, but the statement alluded to will give the results of each mine on the field.

Sylvia Company.—This company have not done much work in their mine during last year, the operations being chiefly confined to the erection of an aerial tramway to connect the mine with the reduction plant, and the erection of machinery. The ore found in this company's mine is different from any hitherto found in the vicinity of the Thames, being a combination of galena, blende, gold, silver, and copper, and iron-pyrites, which show by assay to be rich in both gold and silver. Dr. A. Scheidel, who is managing director of the company, states that he made a large number of assays from the ore at different places while driving on the lode, and very high results were often recorded. Assays of blende-ore went as high as 26oz. of gold and 87oz. of silver to the ton, whilst the assays of galena-ore went in some instances 49oz. of gold and 177oz. of silver per ton. About 600 tons of ore is stacked at the mouth of the mine, ready to be transmitted to the reduction-works as soon as they are completed.

The company's claim consists of 149 acres, taken up in 1887. Portion of the ground was worked ten years previous to this by Taylor and Sons, who held a claim of 3 acres, then known as the Little Agnes, from which a considerable quantity of gold was obtained. It is stated that the amount of gold from the claim sold to one of the banks was 2,695oz., representing a value of £6,587. In stoping out the lode in the early days large veins of heavy mineralised ore were cut, but partially left in the walls, as the value of such ore was not then known. The present company commenced prospecting, and extending the level that Taylor and Sons had constructed, and came

upon very rich but complex ore. A low level since then has been constructed for a distance of 1,027ft., cutting the same lode, which gave as high results as that found on the upper level. The lode averages about 6ft. wide. It has been driven on for about 105ft., and is heavily mineralised for the whole distance. It contains a good percentage of galena in combination with copper-pyrites and blende, which proved on assay to be rich in gold and silver. An uprise has been constructed on the lode to connect the lower with Taylor's level, and the same class of ore was carried to the full height—130ft.

In constructing the lower level six different lodes were cut. These varied from 2ft. to 6ft. in thickness, and the whole of them contained complex ore. When this complex, heavy mineralised ore was first met with the workmen considered it of no value, as no free gold could be seen, and consequently it was thrown over the tip amongst the mullock for a considerable time before any assays were made and its value known. A large quantity of ore has thus been carried away by floods in the creek which would have paid to treat at the reduction plant.

An aerial tramway has been constructed from the mine to the crushing plant, at the side of the Tararu Creek; the length of the tramway being about 28 chains. The height of the mine above the battery is not sufficient to make the tramway self-acting—it has to be worked by a Pelton wheel at the lower end. The crushing and concentrating plant is erected so that the ore passes from one stage of treatment to the other by gravitation, which is a great saving of labour. The building for the battery and the ore-dressing plant covers a space of 750 square yards. About 100,000ft. of sawn timber have been used in constructing the buildings, floors, and tramways, and about 30,000ft. in the erection of the plant. Two water-races have been constructed, having a total length of 48 chains. The main race terminates on the opposite side of the creek from the plant, and pipes convey the water from this to a Pelton wheel, which drives the whole of the machinery, the head of water at the wheel being 127ft.

Dr. Scheidel has kindly supplied me with plans of this new plant, and a description of the works. As it is the first plant of this description used in the Australasian Colonies for treating gold- and silver-ores, it will be interesting to those connected with mining, being to all intents a tin-ore dressing plant, similar to that used at Mount Bischoff, in Tasmania. The following is a description by Dr. A. Scheidel:—

"At your request I have the honour to give in the following a brief description of the Sylvia Gold and Silver Mining Company's works and plant, which I erected during the last year.

"I may be allowed, first, to furnish some information on the class of ore the Sylvia Company has to deal with, with the object to make it better understood why such plant, which may be termed ore-dressing or concentrating plant, has been erected.

"The main lode in the Sylvia Mine (the Little Agnes Reef) was worked years ago on and near the surface for free gold, with excellent results. It contains in the deeper levels a high percentage of complex ore, generally called mineral, consisting of galena, zinc-blende, copper, and iron-pyrites, interlaced in veins varying in width through the lode of very friable quartz. As a rule, such complex ore does not show any visible gold, but contains in the runs, nevertheless, invariably a higher or smaller percentage of the precious metals. Particularly the galena is of great value, such ore having been met with occasionally containing as much as 5 per cent. of gold and 15 per cent. of silver. The veins of the mineral are so intimately disseminated through the quartz that a separation by hand can only rarely be carried out to advantage. Neither the usual battery process, nor any grinding and amalgamating process, will save the bullion contained in the mineral. The bulk of the ore leaving the mine is not rich enough to be treated by any smelting or other chemical process in foreign parts, the shipping expenses prohibiting exportation; and the value of the ore is not high enough to warrant the erection of extraction-works on the spot. Careful and continued investigations made it evident that the far greater part of the bullion contained in the mineralised ore is contained in the mineral, and I came consequently to the conclusion to submit the whole ore as it is broken from the lode to a concentration process, with the object of condensing the ore-value into a small compass, by getting rid of the valueless sand, and retaining solely the complex ore which contains the bullion, and is rich enough to pay either for exportation or local treatment. Experiments with the usual concentrating-machines gave unsatisfactory results, as none of them could save the slimes which are unavoidably obtained in every crushing process. The Sylvia ore-slimes invariably contain a higher percentage of very finely-divided mineral, which is very rich in bullion, and a loss of such slimes would amount to a loss of gold and silver of considerable importance; the necessity, therefore, arose to select a concentration system which would save both the coarse mineral and the fine contained in the slimes. The only system that can answer that purpose is that which is based on classification of the crushed ore into classes of certain sizes, as no single concentrating-machine will satisfactorily treat a mixture composed of coarse and fine material.

"The best system of dealing with Sylvia ores appeared to be the German system of ore-dressing, which, based on scientific principles, classifies the various sizes of grain, and deals with each class afterwards by itself. The named system has been perfected and very successfully carried out by H. W. F. Kayser, Esq., M.E., who made the Mount Bischoff Company's mines and works such an extraordinary success by exclusively dealing with his ore on the same principle. The system in question appeared to correspond completely with the requirements of the Sylvia ore, on account of the special attention paid by it to the treatment of the slimes. The Sylvia ore contains always a fair percentage of valuable galena, which is particularly liable to form slimes. I recommended, therefore, the erection of works on the pattern of the Mount Bischoff works, on plans supplied by Mr. Kayser, M.E., of which the construction and the working I propose to describe.

"The plant consists of a ten-head Howell battery, with the usual amalgamating-tables, four classifying-boxes acting as separators of the slimes from the coarse material, six jiggers for concentrating the coarse sand, two large tanks for settling the slimes, twelve rotary tables for concentrating the slimes, and three buddles for the final cleaning-up of the whole of the tailings. A

description of the battery I consider superfluous, similar constructions having been described in previous mining reports, so that I may pass over to an explanation of the dressing plant.

"The mixture of sand and mineral discharged from the stamper-boxes through woven steel-wire screens passes over tables covered with amalgamated muntz-metal for saving the free gold; it is then supplemented with a further quantity of water, necessary for the proper classification into slimes and coarse parts, which takes place in the classifiers, of which each two forms one system in connection with each five head of stamps. The classifiers, invented by Von Rittinger, are pyramidical boxes. Their action is based on the principle that a material composed of particles of different size and density may be separated by a rising stream of water into different fractions of certain size and character each. The velocity of the water-stream may be so regulated that particles of a certain size and character sink and may be conveyed off, while the remainder is carried upwards by it. By such procedure, and by repeating this operation a number of times with a gradually-decreasing velocity of the rising stream in each instance, the material can be separated into as many classes of grain as desirable. For the treatment of the Sylvia ores, two boxes, one following the other, are sufficient. The discharge of the first consists in coarse quartz and mineral, the discharge of the second in fine quartz and mineral, and the overflow of the second contains the whole of the slimes. The two qualities of classifier-material, coarse and fine sand, are discharged through pipes into separate jiggers, which are used to separate the mineral from the quartz, or, in other words, to concentrate the sand. The jiggers are wooden boxes, divided into two compartments, which are in communication with each other and filled with water. In one compartment a plunger moves up and down with short and energetic strokes; the other compartment carries a fixed horizontal sieve, covered with a bedding of very heavy mineral broken up into small particles, which are lifted up and fall back in quick succession in consequence of the jigging motion of the water produced by the action of the plunger. A mixture of sand and mineral passing over such false bottom in action will be separated into two fractions: the mineral, which, being of higher specific gravity, works its way through the false bottom into the box below; and into sand, or tailings, which are carried away by the continuous stream of water that passes through the machine. Two sieves, with the corresponding plungers, are united in one box constructed in such manner that the tailings coming from the first sieve pass over the second one, undergoing thus a second treatment before going into the buddle. Two jigger-sieves have been found sufficient to treat efficiently the material coming from one classifier. Four double-jiggers treat the whole material crushed by ten head of stamps. The concentrates from the jiggers are only in exceptional cases clean enough to make a further cleaning-operation superfluous. They contain, as a rule, a certain percentage of quartz, which has passed through the false bottom with the mineral, and which has afterwards to be separated. The finishing-off operation takes place in two jiggers of identical construction to those previously described, which are called dressing-jiggers. The products of each classifier, the coarse and fine sand, are treated by themselves in a special set of jiggers, it being one of the principles of the concentrating system that different classes of ore, once separated, are kept strictly separate through the various operations, as otherwise various qualities and sizes would after their previous separation be united again, to the great disadvantage of the process as a whole.

"The principal points to be considered for obtaining satisfactory results with the jiggers are the false bottom, the sieve, and the speed. The specific gravity of the material forming the bedding on the sieves must be higher than that of the heaviest material to be saved, and must be broken up into particles adapted to the size of the crushed ore. The thickness of the bottom is also of importance: the layer has to be kept thin for rich ore and thicker for poorer. The proportion of the thickness of the material on the first and second sieve should be two to one; the mesh of the sieve must be selected in accordance with the screen of the battery. The third point of importance in connection with the jiggers is the speed, which for the treatment of the Sylvia ores has been found best at 200 strokes for first and 250 strokes for second jigger. The overflow of the classifying-boxes contains the whole of the slimes—viz., very finely-divided quartz, very finely-divided mineral, and eventually bullion—and is conveyed through wooden launders into large settling-tanks divided in pyramidical compartments, and from each compartment the settled slimes are discharged through a narrow pipe on to a revolving-table, which separates the mineral from the sand. Such revolving-tables are 12ft. in diameter and of a conical wooden construction. Two tables are built, one above the other, on one vertical iron shaft; but each works independently from the other. They are called catch-tables, in opposition to the dressing-tables, which I shall describe later on. The tables are built of kauri and totara timber. They complete one revolution in two and a half minutes. The slimes are discharged through an iron collar launder upon one side of the table, near the centre, from where they spread over the conical surface, and are met by a supply of clean water discharged into another partition of the same launder, which washes the fine sand to the periphery of the tables, whereas the mineral contained in the slimes remains on the table until it reaches on its revolving journey the place where the first revolution is completed and where four jets discharge water under high pressure at an angle of 45°, whereby the whole material still remaining on the table is removed, and discharged into wooden tanks situated underneath the table. The fine particles of sand which leave the table at the periphery by means of sheet-iron launders are discharged into a settling-tank of small dimensions, from which the heavier part is fed into a buddle, with the object of saving the small fraction of a per cent. of the mineral which may have left the table with the tailings. Such slime-concentrates are not yet quite clean, but contain some sand: they undergo therefore a second treatment of a similar character on dressing-tables, which are a combination of three tables on one shaft, forming one system together. The slime-concentrates obtained from the catch-tables are discharged with water (by means of a pump) on the top table, where they undergo the same treatment with water as described before, but with the difference that the second story receives the concentrates for a

second treatment, and discharges its products on the lowest deck, where the material undergoes a final concentrating treatment, and is discharged completely clean.

"In the foregoing I have dealt with three different sizes of material—the coarse sand, the fine sand, and the slimes. The concentrates in each class differ in value from the other. The concentrates from the slimes have been found to contain the highest bullion-value, which is caused by their containing the largest percentage of galena. The sulphide of lead is very liable to form slimes, even if coarse screens are used at the battery. Special attention is therefore required to the treatment of the slimes; and the large number of slime-treating appliances became a special and most important feature of the Sylvia Company's plant. The whole of the tailings leaving the various concentrating-machines are discharged into concave buddles after having gone through another concentrating process by means of small settling-tanks, which discharge only the heavier part of the tailings into the buddles, where the very small amount of mineral contained in the tailings is deposited at the circumference, whereas the valueless tailings are disposed of finally through the middle of the construction. Three buddles are included in the Sylvia plant—one for treatment of the coarse jigger-tailings, one for the fine table-tailings, and one dressing-buddle for cleaning up such concentrates that have been saved in the other buddles.

"The Sylvia Company's works have been laid out in such a manner that the different floors have sufficient fall from one to another to admit of the whole of the ore being transmitted to every machine by gravitation. The quartz is conveyed from the mine to the battery by a steel-wire aerial tramway, and passes, after having been fed into the stamper-boxes, gradually through the various sheds and concentrating appliances without any other handling of the material required than the removal of the finished concentrates. The whole plant is driven by water-power acting, under pressure of 55lb. per square inch, on a 6ft. Pelton wheel. The same race that supplies the motive-power supplies also the large amount of water required for the dressing process, and the power for driving a Crompton dynamo of thirty sixteen-candle Edison-Swan lamps, which illuminate the whole of the sheds.

"In the above I did not give a full description of all the details of the various concentrating appliances which form the Sylvia Company's ore-dressing plant. Such description is contained in your report on the Mount Bischoff Company's plant ("Mining Machinery and Treatment of Ores in Australian Colonies, 1889"), where similar appliances are in use. Further information on the construction of jiggers, tables, and buddles may be obtained from the Transactions, Mining Assoc., Corn., Vol. xi., which contains an excellent paper by H. W. Kayser, Esq., M.E., who has been intimately connected with the planning and construction of the Sylvia plant.

"A few weeks only have elapsed since the opening of the Sylvia works, and it would be premature to give a statement on cost of concentration and percentage of concentrates saved; but I may be allowed to give such information at a future date.

"The whole plant works very satisfactorily, and the concentrating process, which is a mechanical and automatic one, of which the main and sole agents are specific gravity and water, is efficient and cheap, the dressing-expenses not amounting to more than a few shillings per ton. In connection with the works is a furnace for drying the concentrates; also a laboratory for assaying and analysis. The whole of the dressing-machinery has been built on the battery-site, of New Zealand material, the iron parts only having been imported. The crushing plant and water-motors have been manufactured at the Thames. The whole of the timber and other material answers the purpose excellently.

"The results of the concentration process have been so far very satisfactory. The value of the clean-dressed ore or concentrates so far obtained, varies from £50 to £100 per ton. The quantity of mineral contained in the quartz will average not less than 10 per cent.

"The prospects of the Sylvia Mine and plant are very good in every respect, the mine being opened up in an efficient manner, and the plant answering its purpose well.

"The Sylvia Company does not intend for the present to submit their concentrates to any extraction process here, but disposes of the same by selling them in the best market. Extraction-works will probably be added to the present works in the near future.

"The ore-concentration system, as described above, has not been applied before to gold-ores, neither in the colonies nor elsewhere to my knowledge; its application to the treatment of Thames complex ore may therefore be called a new departure in the metallurgy of gold-ores generally, and of the Thames Goldfield specially, and its satisfactory results will certainly prove to be of the greatest general interest and consequence. I feel confident that a very large amount of ore called refractory, hitherto neglected, may in the near future be turned to profit after the Sylvia Company have shown how to deal with such ore. I beg to enclose two plans giving views and sections of the dressing plant, and which I trust do not require further explanation."

The plant is one of the best for concentrating ore there is in the colony, and reflects the highest credit on Dr. Scheidel and those employed under him for the manner in which it has been constructed and erected; but it seems questionable whether the class of ore there is to deal with here is suitable for concentration. On my recent visit, in May last, the plant was working as well as could be desired, and was producing concentrates of a value of from £25 to £50 per ton; but this does not seem to give a high percentage on the assay-value of the ore made before the plant was completed. The large quantity of sulphides in the ore prevents anything like a large percentage of the gold and silver being extracted by concentration, especially the latter metal, sulphur being so light a substance; and its great affinity for metals will carry a certain quantity of them away with the water, which does not remain amongst the tailings, but is carried away with the muddy water into the creek, and passes down with the stream. My impression on seeing this plant at work was that there is a great loss of gold and silver, especially the

latter, in the muddy water. A few tons of the ore should be finely pulverised in a dry state and tested by the Cassell process to make a comparison as to the percentage saved, and the cost of extraction, by both methods.

Saxon Company.—The No. 5 level, on which this company has been working, is now stoped out, and another level is constructed about 75ft. below No. 5, or about 461ft. below the surface. In order to construct this new level the drainage in the Big Pump shaft had to be kept down to the 500ft. level; but, as there was no direct communication between the Big Pump shaft and the Saxon shaft, it was found that the water would not drain off sufficiently to allow the work to be proceeded with, the watercourses in the lodes and country rock being all filled up with slimes and sediment. Attempts were made in various ways to assist the drainage by using tanks to bale the water from the shaft, and also by sinking winzes on various watercourses; but all proved ineffectual to get clear of the large influx of water in the shaft to allow the level to be constructed; so that, after considerable expense and time, a cross-drive had to be made from the New Prince Imperial Company's shaft to cut off the water. During the year, ending the 10th January last, this company crushed 10,444 loads of quartz and 720lb. of picked stone, which yielded 7,024½oz. of gold; the cost of crushing and treatment being a little under 4s. 6d. per load, or about 3s. per ton. The run of gold in the No. 5 level was about 400ft. long, and the lode varied from 3ft. to 12ft. wide. Their balance-sheet for the past year shows that the expenditure on the mine, including wages, has been £14,336; on the crushing-battery, £2,214; office-expenses, £278; and on additions to their crushing plant, £372; £2,500 being paid in dividends. This makes the total dividends paid by the company amount to £15,417; while their paid-up capital is only £4,783. The mine now looks well, and, if the lode in the new level proves as good as it was in the last, this will be a dividend-paying company for a considerable time yet. The manager estimates that it will take about two years to stope out the lode from the new level. There are ninety-two men employed in the mine, six on the surface, and eight men and four boys in the crushing-battery.

New Moanataiari Company.—This company holds one of the most valuable properties in the Thames district—not altogether on account of the lode-stuff found in the mine, but more in regard to their adit-level from the main road to Tararu which commands a large extent of country, and will in future form a highway for the ground at the back being worked. This adit-level is constructed in a straight line from the mouth, which is about 30ft. above sea-level, to the boundary of the Reuben Parr ground, a distance of 3,070ft. The adit is well timbered, and about 7ft. high in the clear, and sufficiently wide for a double line of rails, which is laid for the whole distance. The adit is lighted up with gas at intervals, and a good travelling-road made in between each line of rails for the horses employed in drawing out and hauling in the trucks. By extending this level for another 400ft. it would command the Fame and Fortune ground, and prove the most economical means of getting the quartz to the crushing-battery. Indeed, this adit may be said to be the key to the back ground in this district, and therefore it becomes a very valuable property.

An uprise is constructed from the end of the main adit for 208ft., and the company have men at work on the Reuben Parr and Junction Lodes. There is also a cross-lode running at almost right-angles to the Reuben Parr, and the Golden Age Lode is about 60ft. further to the southward, running parallel with the Reuben Parr Lode. At the time of my visit over 400ft. of driving had been done on the Reuben Parr and Foot-wall Lodes. The Foot-wall Lode, which strikes off from the Reuben Parr, is entirely a new discovery, and forms a strong body of quartz, and is quite intact to the surface, a height of over 200ft. From the appearance of this lode, and the direction it is running, there seems little doubt but that it will again join on to the Reuben Parr Lode, and if so a good patch of gold is likely to be found at the junction. The workings in this mine are carried on in a thoroughly systematic manner, and are well laid out.

The manager's report for the year ending the 31st October last shows that 3,013 tons of surface dirt was crushed, which yielded 189oz. of gold; and 1,438 tons of quartz and 1,000lb. of picked stone yielded 1,576oz. of gold: whilst the tributers had 1,042 tons and 881b. of picked stone treated, which yielded 1,760oz. of gold: making a total of 5,493 tons of material crushed, which yielded 3,525oz. of gold. It is about three years since this company was formed to take over the original Moanataiari Company's property, and since then a great deal of dead-work has been done. The main adit-level has been extended 270ft., an uprise 12ft. by 4ft. constructed, and a great deal of prospecting done, and opening-out on the Reuben Parr section of the mine. The last year's balance-sheet and report shows that the property is now likely to become in future a good commercial venture. During last year calls have been paid to the extent of £4,233; gold produced, £4,606; amount paid by tributers and for crushing, £1,316; making a total of £10,155: whilst the expenditure on wages, machinery, and repairs has amounted to £8,629. Deducting the amount paid in calls from the receipts, it leaves a loss of £2,707 on the year's transactions; but, considering the large amount of dead-work done, this amount is not large, and the present prospects of the mine fully justify this expenditure. Taking the year ending the 31st March last, there was 5,304 tons of quartz crushed, which yielded 5,564oz. 18dwt. gold; and 1,401 tons of mullock, yielding 86oz.: while the number of men employed was 117—namely, sixty-nine wages-men and forty-eight tributers.

Fame and Fortune Mine.—This mine adjoins the New Moanataiari Company's ground. Mr. Kersey Cooper, one of the principal shareholders, and managing director, commenced operations in August, 1888. The ground had been worked for many years previous to it being taken up by Mr. Cooper; but it was given up as valueless. However, since the present company or syndicate commenced reworking the ground it has been shown that it is a valuable property. There are several lodes running through the ground, the largest of which is termed the Golden Age, which is from 10ft. to 11ft. in thickness. This lode contains low-grade ore; but when there is such a large body of stone very low-grade ore can be made to pay for working, especially where there is a crushing

plant belonging to the same proprietors. At the time of my visit the workings were being carried on on what is known as Fox's Leader, the Golden Age Foot-wall Leader, and on Cooper's Leader. A low-level was also being constructed to work the lodes to a greater depth. This level was in for a distance of 1,175ft., and Mr. Cooper informed me that it had cost about £2 per foot to construct. There is no doubt that the best way to get into and work the ground would be from the adit-level on the Moanataiari Mine. This would only have to be extended about 400ft., or 500ft. at the most, and then this mine would be a great deal more valuable, as the quartz could be got out and sent to the battery at a cheaper rate, besides the greater depth of backs it would give on the lodes.

Mr. Cooper purchased the old Caledonian Company's crushing-battery, which consists twenty-one heads of stamps, and thirteen berdans, driven by a Pelton hurdy-gurdy water-wheel, £800, and since the purchase a further expenditure on repairs has been made to the extent of £400 The difficulty that Mr. Cooper has to contend with in winter is the state of the roads. All the quartz from his mine has to be conveyed in drays down the road alongside the Waiotahi Creek for about 60 chains. The road gets cut up greatly, and makes the transit of the quartz from the mine to the battery more costly than it otherwise should be under ordinary circumstances. Mr. Cooper contemplates erecting an aerial tramway, which no doubt would lessen the cost of transit, and thereby be the means of making lower-grade ore pay for working. During last year 3,922 tons of quartz has been crushed, which yielded 3,314oz. 19dwt. of gold.

Cambria Company.—This company is working similar ground to that of the Waiotahi Company. The country rock is also of a similar character. The workings are carried on from Nos. 3 and 4 levels on seven different lodes and leads, varying from 1in. to 2ft. in thickness. During last year 1,045 tons of quartz was crushed, which yielded 1,525oz. 7dwt. gold.

Waiotahi Company.—This company continues to work their mine successfully. A great portion of the gold is obtained from thread-like veins, which run in all directions through the country rock—a tufaceous sandstone—requiring constant supervision and care to see that the veins are followed. There is always a certain amount of prospecting-work being carried on, and new veins and leaders found before the others are worked out. During last year 2,106 tons of quartz was crushed, which yielded 2,948oz. 10dwt. of gold.

Trenton Company.—This company has for a number of years been prospecting the ground, and has expended a large amount of money. They have been working on the Saxon Lode during last year, and crushed 810 tons of quartz, which yielded 1,201oz. gold; but before large returns can be expected they will have to sink to a deeper level, in order to get anything like a body of stone. The lode in the Saxon ground cuts out on the upper levels before reaching this company's ground, but the lode at No. 5 level goes in for some distance, but is much more broken up than it is in the Saxon.

May Queen Company.—Great expectations are formed by several mining-men that this company's mine will yet come to the front, and become a regular dividend-paying one. During last year the workings were carried on from the No. 1 level, about 294ft. below the surface. When this level was first opened 45 loads of quartz yielded 224oz. of gold, but subsequent crushings did not come up to this average. This, however, shows that there is likely to be a rich run of gold-bearing stone between the level they are now working on and the next level, which is being rapidly opened up. The statement of accounts of this company for the year ending the 24th February last shows that 793 tons of quartz was crushed from the stopes, yielding 1,133oz. 17dwt. of gold, of a value of £3,265 16s., and that £35 18s. was realised from the sale of tailings, which makes the total value of the produce from the mine last year £3,301 14s., the expenditure for the same period being £3,719 18s.; but of this amount a considerable sum was expended on plant. The amount of paid-up capital is £1,666 13s. 4d.

Dives Company.—This company's mine is situate in the locality of Una Hill. It has been worked successfully during last year, producing 974oz. of gold from 605 tons of quartz.

Occidental Company.—This company did a considerable amount of work last year, and the mine was worked successfully. From 579 tons of quartz crushed 1,968oz. of gold was obtained.

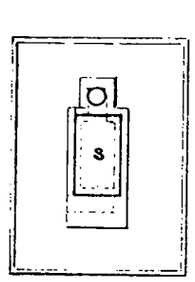
Hansen's Kuranui No. 3.—The workings here are entirely confined to crushing mullock taken from the face of the hill, and put through the crushing-battery in a wholesale manner. During last year 9,393 tons was crushed, which yielded 9,52oz. gold, being an average of about 2dwt. of gold per ton.

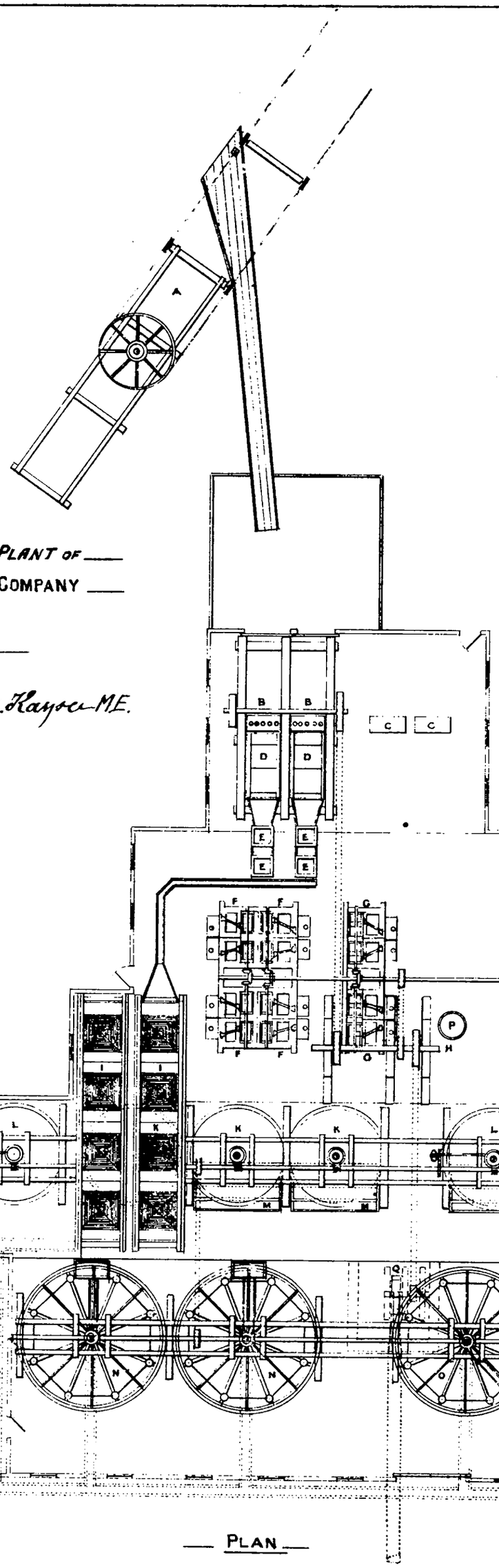
Comer's Kuranui No. 2.—The workings here have been confined to crushing mullock from the face of the range, and working lodes on tribute. The tributers crushed 384 tons of quartz, which yielded 448oz. gold; and 9,835 tons of mullock was crushed, which yielded 437oz. of gold: the yield of the mullock being only about $10\frac{3}{4}$gr. of gold to the ton, which shows that the mullock-workings could not have been a profitable undertaking last year.

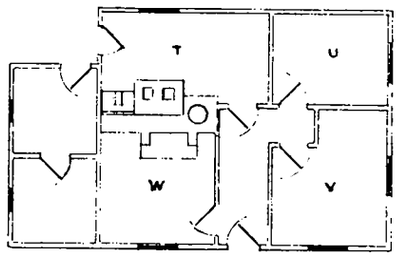
The following tabulated statement will show the result of working the mines in the Thames district during the last year, with the number of wages-men and tributers employed in each mine, also the quantity of quartz crushed, and the yield of gold therefrom:—

CRUSHING & CONCENTRATING PLANT OF
THE SYLVIA GOLD & SILVER MINING COMPANY
NO LIABILITY.
TARARU. THAMES. N.Z.

D. A. Reid del H. W. Ford. Kaiaua M.E.







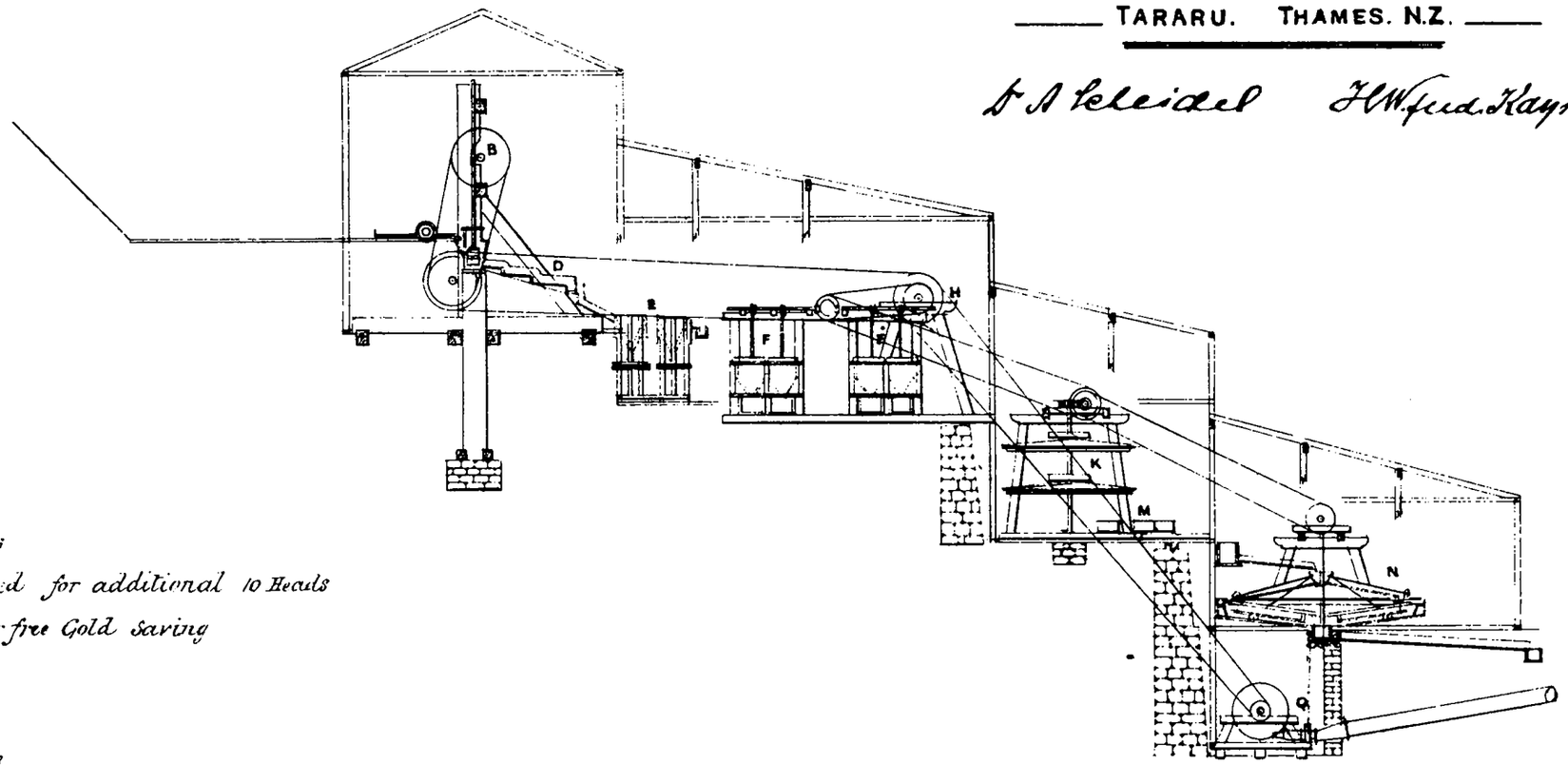
A Tramway
B Battery 10 Heads
C Bed logs provided for additional 10 Heads
D Copper plates for free gold Saving
E Classifiers
F Jiggers
G Dressing Jiggers
H Intermediate Shaft
I Slime boxes
K Double Catch Tables
L Triple Dressing Tables
M Receivers of Slime Concentrates
N Buddles
O Dressing Buddle
P Berdan
Q Main Pelton Wheel
R Store Room for Concentrates
S Furnace
T Laboratory & Furnaces for Assay, Retorting & Gold Melting.
U Balance Room
V Drawing Office
W Managers Office

SCALE
Feet 0 6 12 24 36 Feet

PLAN

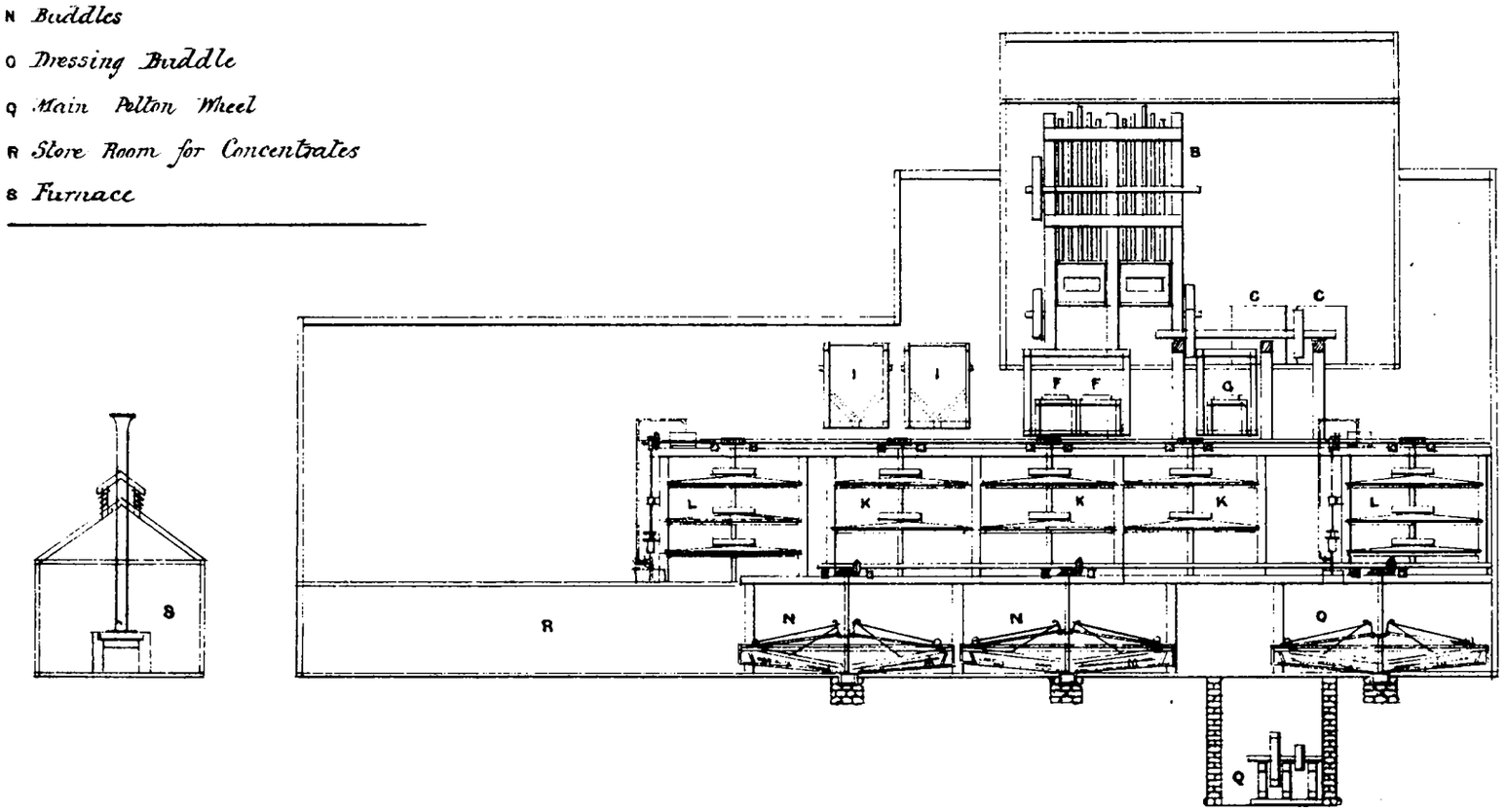
CRUSHING & CONCENTRATING PLANT OF
THE SYLVIA GOLD & SILVER MINING COMPANY.
NO LIABILITY.
TARARU. THAMES. N.Z.

F A Reliedel *H W Fred. Hayes M.E.*



LONGITUDINAL SECTION

B Battery 10 Heads
C Bed logs provided for additional 10 Heads
D Copper plates for free Gold Saving
E Classifiers.
F Jiggers
G Dressing Jiggers
H Intermediate Shaft
I Slime Boxes
K Double Catch Tables
L Triple Dressing Tables
M Receivers of Slime Concentrates
N Buddles
O Dressing Buddle
Q Main Pelton Wheel
R Store Room for Concentrates
S Furnace



FRONT ELEVATION

SCALE
Feet 12 9 6 3 0 12 24 36 Feet

Locality and Name of Mine.	Average Number of Men employed.		For Owners.			For Tributers.		Tailings.	
	Wages-men.	Tributers.	Quartz crushed.	Mullock crushed.	Retorted Gold.	Quartz crushed.	Retorted Gold.	Quantity treated.	Gold.
			Tons cwt. lb.	Tons cwt. lb.	Oz. dwt. gr.	Tons cwt. lb.	Oz. dwt. gr.	Tons cwt. lb.	Oz. dwt. gr.
Tapu—									
Keily's Claim ..	2	..	10 0 0	..	12 13 0	..	..	..	..
Sheridan's ..	3	..	28 5 0	..	95 14 0	..	..	..	..
Broken Hill ..	4	..	73 0 0	..	46 1 0	..	..	..	..
Manuel's	..	..	4 0 0	..	3 10 0	..	..	..	..
Hawke's	..	..	64 0 0	..	6 17 0	..	..	..	..
Tararu—									
Norfolk	12	..	487 0 0	..	457 16 0	..	..	..	..
Dunedin	3	..	180 0 0	..	28 0 0	..	..	..	..
Sylvia	10	..	500 0 0	..	30 0 0	..	..	30 0 0	Not given.
Shellback—									
Nordenfeldt ..	2	..	25 10 0	..	35 11 0	..	..	..	..
Kuranui—									
Hansen's Kuranui No. 3	12	..	..	9,393 0 0	952 2 0	..	..	..	..
Comer's ditto No. 2..	12	12	..	9,835 0 0	437 0 0	384 0 0	448 0 0	..	..
Turtle's ditto No. 1..	2	3	262 0 0	..	132 10 0	307 0 0	77 9 0	..	..
Deep-level Cross ..	..	4	..	..	..	109 0 0	53 11 0	..	..
Moanataiari—									
Moanataiari ..	69	48	4,438 15 0	1,401 0 0	4,532 18 0 86 0 0	865 0 0	1,032 0 0	..	..
Alfred	4	..	76 0 0	..	91 8 0	..	..	..	..
Coliban	2	..	45 0 0	..	26 14 0	..	..	..	..
Freedom	3	1	62 0 0	..	36 0 0	27 0 0	4 5 0	..	..
Orlando	8	..	228 0 0	..	283 15 0	..	..	..	..
New Alburnia ..	6	6	321 0 0	..	277 13 0	126 0 0	293 6 0	..	..
Whau	..	10	..	..	..	218 10 0	522 8 0	..	..
Foster's Claim ..	2	..	105 0 0	..	102 10 0	..	..	..	..
Dixon's No. 1 ..	..	2	..	..	..	32 0 0	26 15 0	..	..
Dixon's Extended ..	16	..	2,026 0 0	..	538 0 0	..	..	..	..
Grahamstown—									
New Prince Imperial	2	4	..	..	..	229 0 0	211 0 0	..	..
Saxon	92	..	16,000 6 48	..	7,024 10 0	..	..	..	..
Caledonian ..	15	4	240 0 0	..	183 0 0	45 0 0	132 0 0	..	..
Waiotahi—									
Waiotahi	33	..	2,106 0 0	..	2,948 10 0	..	..	..	..
New Manukau ..	6	..	215 0 0	..	290 0 0	..	..	..	..
Cambria	35	..	1,045 0 0	..	1,525 7 0	..	..	..	..
Trenton	20	..	810 0 0	..	1,201 0 0	..	..	..	..
Fame and Fortune..	55	..	3,922 0 0	..	3,314 19 0	..	..	..	..
Blanche	2	..	25 0 0	..	10 15 0	..	..	..	..
West Coast ..	..	2	..	..	..	44 0 0	45 0 0	..	..
Berry's Claim ..	2	..	3 8 0	..	62 18 0	..	..	..	..
Waiokaraka—									
May Queen ..	19	..	793 0 0	..	1,133 17 0	..	..	..	..
Crawford's Special ..	12	..	300 0 0	..	450 0 0	..	..	..	..
Karaka—									
Adelaide	2	..	44 0 0	..	31 0 0	..	..	..	..
Lone Hand ..	12	..	766 0 0	..	415 9 0	..	..	..	..
Claremont ..	1	..	3 0 0	..	62 14 0	..	..	..	..
E. and M... ..	2	..	6 1 54	..	122 6 0	..	..	..	..
Hopeful	2	..	0 2 7	..	213 10 0	..	..	..	..
Hokianga	2	..	43 0 0	..	146 0 0	..	..	..	..
Hongkong ..	3	..	6 0 0	..	27 0 0	..	..	..	..
Una Hill and Te Papa—									
Dives	12	..	605 0 0	..	974 0 0	..	..	..	..
Occidental ..	13	..	579 0 0	..	1,968 0 0	..	..	..	..
Magnolia	6	2	42 0 0	..	30 0 0	52 0 0	30 0 0	..	..
North Star ..	..	9	..	..	..	150 0 0	329 18 0	..	..
Hape Creek—									
Consols	6	6	..	..	..	113 0 0	149 15 0	..	..
Souvenir	2	..	45 0 0	..	21 10 0	..	..	..	..
Puriri—									
Puriri	3	..	108 0 0	..	51 10 0	..	..	..	..
Tairua—									
Bonnie Scotland ..	..	2	..	..	..	114 0 0	24 0 0	..	..
Thames (sundries) ..	65	..	1,037 0 0	632 0 0	699 3 0	..	..	15,000 0 0	3,613 13 0
Totals	586	115	37,679 7 109	21,261 0 0	31,119 10 0	2,815 10 0	3,379 0 0	15,030 0 0	3,613 13 0

Ohinemuri.

Mining in this district is beginning to attract considerable attention, especially at Waihi and Waitekauri. At the former place mining is carried on by the Waihi Company on a larger scale than anywhere else in the colony; and at Waitekauri preparations are now being made to carry on large operations. The Waitekauri Mine has recently been purchased by Mr. F. H. Russell, and

Mr. H. Russell is now engaged in getting the forty-stamp crushing plant thoroughly overhauled The following is a description of the alterations and additions, taken from the *Thames Advertiser* of the 20th April last: "I was first taken up to the tower which has been added to the building. It communicates with a self-acting tramway, mounted on tressels at an elevation of about 40ft. By this method the ore is run from the mine to the plant, and deposited on a gridiron made of 1½in. round iron bars, spaced at 1¼in., thus allowing stone only 1¼in. in thickness to pass through the griddle. The larger pieces of quartz fall upon the floor and are passed through the stone-breaker. This stone-crusher is Wheeler's rock-breaker No. 4, constructed at the Golden State Ironworks, San Francisco, on a new and improved principle, and I was informed it is the most powerful ever introduced into the colony. From here it falls into the quartz-bin, which automatically feeds the stampers by self-acting feeders, for the ore falls from the bin into the self-feeders, and thence into the stamper-boxes. It is then put through thirty head of stampers, and is ground to such fineness that it passes through a sixty-mesh grating, with 3,600 holes to the square inch. On leaving the gratings the crushing passes over a copper table—its width being that of an ordinary sheet of copper—and falls into a receiving-trough extending the whole length of the stamper-boxes. This delivers it into an elevator, which raises it to the roof, where four iron tanks, each 4ft. square and 8ft. deep, and constructed of $\frac{3}{16}$in. iron-plate, receive it. These tanks were constructed by Mr. Judd at his foundry in Queen Street, Thames. The heavier portion of the sludge falls to the bottom of the tanks, from which it is liberated into the trucks, which convey it to the pans and settlers for amalgamation. The lighter slimes go into other tanks, one of which is 20ft. square, and the others, eight in number, are 15ft. by 10ft. There is a fall of an inch between each of these boxes, and the overflow is gradual from one to the other. From the last of these eight there is a fall of 2ft. into still another tank, which is enclosed with fine-mesh screen, and from this the overflow is by this time almost pure water, which is conveyed by pipes into the tank which supplies the stampers with water, so that all of it is again passed through the battery. By this method it is expected that the maximum quantity of the light or floating gold will be saved. The iron tanks stand at an elevation of 33ft. 6in. above the floor of great pits which are sunk in front of the battery, and the 20ft. tank is at an elevation of 28ft. 6in. from the pits, while the other eight are 16ft. above the battery-floor. In these pits are the amalgamating machinery, consisting of six of Howell's pans, constructed at the Golden State Ironworks, which go at the rate of eighty revolutions to the minute; and three of Howell's settlers, each 9ft. square, which go at the rate of fifteen revolutions to the minute, are to be erected. They are 11ft. deep, and will contain all the requisite machinery. The finishing touches are now being put to the works, and it is expected the plant will be in full swing in about four or five weeks' time. In fact, a trial of the stone-breaker and stampers was made on the evening of my reaching Waitekauri, and everything worked very satisfactorily. The motive-power is a fine overshot waterwheel, 36ft. in diameter. It was formerly used in working the old battery, and, as will be remembered by many of your readers, was constructed by Mr. E. M. Corbett, now residing at Waitekauri. The tramway leading up to the mine has also been put in a thorough state of repair, and underneath the last grade a very large hopper is being erected. In the mine itself the old workings have been cleaned out and repaired under the management of Mr. Hollis, formerly manager of the Martha Extended, at Waihi. A level is also being put in under the chamber where the gold was formerly lost."

At Marototo there are two mines being worked—namely, that belonging to the Marototo Company, and the Silver Queen Mine, which belongs to a Sydney syndicate. Some ore was forwarded last year to Sydney for treatment. During last year the Marototo Company treated 400 tons of ore in the Fraser pans, which yielded 7,000oz. of bullion, chiefly silver.

Mining operations at Karangahake are not carried on so briskly as they might be, but the difficulty here is the treatment of the ore, which contains a great deal of silver, which cannot be recovered in the ordinary wet-crushing batteries. Although the Cassell Company have a leaching plant erected on this field it is in connection with the Crown Company's crushing plant, and they cannot treat ore from outside parties unless arrangements are made with the Crown Company to either crush it or to send the pulverised ore to them. The position in which the plant is erected prevents the latter being done unless at a great cost; but the Cassell Company are contemplating erecting a crushing plant in connection with leaching-vats, &c., on the flat alongside the Ohinemuri River, below the township. If this is done it will be fully employed by the claimholders on this field.

There is some very rich ore in the Woodstock Mine; but it cannot be treated at present. During last year 27 tons was treated at the crushing-battery on the flat, which only gave 71oz. of bullion; while 60 tons of ore was sold at the mine, which realised £3,000, or an average of £50 per ton. There are several large lodes in this mine of low-grade ore, which no doubt will all be worked when a plant is erected in the locality to treat the ore in a satisfactory manner.

Adeline Amalgamated Company.—This company during last year has only had three tributers at work. Very rich gold-bearing quartz was obtained from this mine about four years ago; but the shot of gold seemed to run out, or, at least, it has never been picked up again. Last year 76 tons of stone was crushed, which yielded 257oz. gold. The great drawback to this locality is that the cost of transit from the mine to a crushing plant precludes any low-grade ore being worked.

Crown Company.—This company have opened out a low level on what is known as the Welcome Reef. This level commences at the side of the Waitewheta Creek, about 500ft. below the level of the Crown workings. When I visited the mine in December last this level was constructed for about 100ft. on the reef or lode, which is from from 2ft. to 4ft. in thickness, and which the manager estimated was worth from £7 to £10 per ton. This lode has also been cut on the north, or opposite, side of the creek, and an adit constructed on the lode for about 50ft., which shows the same character of ore,

and is about the same thickness as that on the south side. This company use two Lamberton mills for pulverising the ore; but these mills are not suitable for grinding quartz—the wear-and-tear is far too great for the work done. The ore, as it comes from the mine, is taken and passed through a Blake's rock-breaker, where it is reduced to about a maximum of 1½in. diameter. It is then dried on kilns having an inclination of 1 in 1 and a series of small steps to prevent the ore from falling down before it is properly dried. After being thoroughly dried it is pulverised in the Lamberton mills, which have a crushing-capacity of about 1½ tons each in eight hours to such a fineness that the ore passes through a thirty-mesh grating. From this the ore is handed over to the Cassell Company to treat by their process.

Cassell Plant.

The only plant erected in the colony by the Cassell Company is at the Crown Company's crushing plant at Karangahake, where they treat the pulverised ore by their process. A description of the plant was given in my last report, so that there is no occasion to again refer to the details. On my visit to the company's works in December last the manager (Mr. McConnell) informed me that by the process from 85 to 93 per cent. of the bullion was extracted, and this has been borne out by the work done during last year, as will be shown hereafter in a statement giving the results of treating the Crown Company's ore. From all that can be seen or learnt respecting this process of treatment, it is by far the best that has yet been introduced into the colony for extracting a large percentage of the bullion from the ore at a moderate cost. At the same time it may be said that the minimum value of the ore sent for treatment must not have a less assay-value than £2 per ton, as the cost of drying the ore, pulverising, and leaching cannot be less with a good plant than about £1 3s. per ton, to which must be added the royalty which the company demands for the use of their patent, which is 10 per cent. on all ore up to a value of £8 per ton, and 15 per cent. on all ore over that value.

If this process be the means of extracting, say, 85 per cent. of the assay-value of the bullion in the ore, then a comparison might be made with ordinary crushing-batteries, which would give about 40 per cent. of the value of the bullion. Suppose the ore to have an assay-value of £2 per ton, then, by the Cassell process, £1 14s. would be recovered, at a cost of about £1 6s. 5d.—that is, including royalty—and by the other process the value of the bullion extracted would be 16s., which would be recovered at a cost not exceeding 8s. per ton. The profit by the former is 7s. 7d. per ton, while by the latter and more crude method, although only 40 per cent. of the bullion be saved, the profit is 8s. per ton, or 5d. per ton more than by the Cassell process. If ore containing an assay-value of £8 per ton were treated, the profit by the Cassell process would be £4 19s. 6d., and by the ordinary method £2 16s. It will therefore be seen that there is a limit to the low grade of ore that can be treated economically by the Cassell process, and for rich ores their process would enhance the value of the mines from which such ores are obtained.

In dealing with the question of using Cassell's process, there are several things to take into consideration—namely: (1.) That it cannot be economically used where the assay-value of the ore does not exceed £2 per ton. (2.) The royalty now asked by the company for the use of their process. (3.) The conditions under which the use of the process is offered by the Cassell Company in addition to paying royalty.

With regard to the latter, the conditions under which the Cassell Company wish to bind those who arrange to use their process is that all the cyanide of potassium must be purchased from them. This is a condition far more objectionable than the payment of a heavy royalty. At the present time, in introducing the process, it is to the advantage of the company to charge as little for cyanide of potassium as possible, in order to show that ores can be treated at a reasonable cost; but once the process is fully established, and different companies have erected plants to adopt it, the price of cyanide may rise to such an extent as to greatly increase the cost of treatment.

For moderately rich ores or ores of a complex nature, this process is well adapted and more economical than any other hitherto introduced, and it has the advantage of dissolving and precipitating gold and silver in one operation, which chlorination cannot effect, and, besides, the cost of chlorination greatly exceeds that of this process. Mr. J. S. MacArthur, who, in conjunction with Dr. Forrest, secured the patent rights for this colony, read a paper before the Society of Chemical Industry on the Cassell process, in which is given an interesting account of the action and use of cyanide of potassium in comparison with chlorination. The following extracts are from the paper:—

"An ore consisting of a complex mixture of silica and the various compounds of iron, copper, lead, zinc, antimony, arsenic, sulphur and gold, in the proportion of 10,000 parts of silica and sulphides to one part of gold, is much richer than the average auriferous ore, and the question is how can be best separated the one from the ten thousand. Under favourable circumstances the gold and the useful metals may be recovered by smelting, but these favourable circumstances, which are the proximity of the gold mine to coal, clay, limestone, and other fluxes, are quite exceptional, as auriferous reefs are generally found in primary formations. Chlorination: As no attempt is ever made to chlorinate gold-ores containing an appreciable quantity of lead, and where applicable is always troublesome and never cheap, when this question presented itself to Dr. Forrest and myself we tried to find some solvent which, unlike chlorine and mercury, would have a stronger affinity for gold than for sulphides, and we found that cyanide of potassium solved the problem.

"Our experiments were conducted first on a small scale, and on ores of all kinds and from mines in all parts of the world. The result of these small trials was so satisfactory that we gradually worked from less to more. . . . . The ore is ground to fine dust." [A thirty-mesh screen is used at the Crown Company's works at Karangahake.] "If instead of ore we are working tailings from the

amalgamation-process, these are generally not re-ground but treated as delivered. The finely-divided material is mixed with a solution of cyanide, say cyanide of potassium containing, on an average, 0·4 per cent. of cyanogen as the cyanide of potassium, or other alkali or alkaline earth. The ore and the solution are stirred together for about six hours or less, this being the average time required to dissolve the gold. In practice the time required is determined by experiment. When the gold is known to be dissolved the pulp is discharged into an ordinary filtering-tank, where the filteration may, if necessary, be assisted by suction, and where the ore is washed by water or by the waste cyanide solution from a previous operation. The ore after treatment with cyanide solution is unchanged to the eye, as nothing but the imperceptible proportion of gold has been removed. The gold now being in solution, the next object is to get it precipitated, and here we encounter a serious difficulty. Gold and cyanogen have such a strong mutual affinity that it is difficult to get any substance that will separate them. The gold cannot be precipitated by any ordinary method, such as the use of ferrous sulphate or oxalic acid. Even sulphuretted hydrogen and sulphide of sodium will not precipitate gold from its cyanide solution, though they precipitate silver. . . . . We noticed, however, that zinc precipitated gold very feebly, and tried this in the same way that copper is precipitated from its ordinary solutions by scrap-iron, but scrap-zinc had no effect. Then granulated zinc was tried, with a most imperfect and disappointing result. Then heating in presence of scrap and granulated zinc; but this had only the effect of forming urea, and assisting the precipitation very little. Further, we tried zinc-dust, but still there was no success. Finally we prepared some zinc in the form of sawdust, porous and with a large surface of bright metal. On allowing the cyanide of gold to trickle through a mass of the zinc, we found that it trickled out gold-free; and, better still, we found that the action became more vigorous and pronounced after the gold had been precipitated on it, doubtless as gold and zinc formed together a more powerful electro-chemical precipitant than zinc by itself. An arrangement of a porous mass of zinc like a sponge formed a chemical filter, which at once precipitated and collected the precious metal; indeed, so like an ordinary water-purifying device was this zinc filter that many non-technical visitors formed and held tenaciously to the idea that the gold was in suspension in the cyanide solution and the zinc was used merely because of its durability. Improvements in detail were made in the direction of increasing the surface and decreasing the weight of zinc till now we have it in threads, 1lb. of which occupies about a two-gallon measure. The zinc in this form is possessed of enormous chemical activity, of which the strongest and most direct evidence is the fact that it burns in the air like thin shavings of wood. When the gold has been deposited it is necessary to separate it from the excess of the zinc present. The filiform structure of the zinc, and the exceedingly fine powder as which the gold is deposited, renders this an easy matter. The filiform mass of zinc, with gold powder adhering, is vigorously shaken in water, when the gold falls off, and the fibrous particles of zinc may be collected in a sieve. The gold settles easily, is collected and fused directly into bullion.

"Having now described the chief points in the process from the technical standpoint, let us look at the purely chemical aspect it presents. Reference has already been made to the fact that a cyanide solution acts on gold-ores in preference to the sulphides of base metals with which it may be combined or associated. This selective action is the keystone of the whole process. It is also known that sulphides of copper, zinc, and iron, artificially prepared, are readily acted on by a cyanide solution; but we found a very different state of affairs in treating ores where these or similar compounds exist prepared by the hand of Nature herself. Nature seems to render the base metallic compounds insoluble, while the gold combined with or contained in them is more easily acted on than the metal itself. This at once raises the question, How does gold exist in base refractory ores? Is it combined or free? Judging from theoretical considerations only, gold should exist almost invariably in a free state, for, if we assume that sulphides, pyrites, &c., were formed by deposition from aqueous solution, the gold would be deposited in a metallic state. This may be shown by dropping some powdered pyrites into a solution of chloride of gold, when gold will be precipitated as metal. On the other hand, let us assume that the pyritous formations carrying gold were formed by igneous agency. In this case the gold ought to be metallic too, because any sulphide of gold already existing would be decomposed by the high temperature, and, of course, sulphide of gold cannot be formed at a high temperature. It is true that sulphide of gold may combine with an alkaline sulphide and resist decomposition by heat, but such a combination, as a matter of fact, does not occur in Nature. Telluride of gold and antimonide of gold are not decomposed by heat; but they occur in small quantities, and do not affect the general argument. In spite of these theoretical considerations, however, we have strong evidence to show that gold exists in several different states of combination or molecular structure. Let me give one case in illustration: A sample of tailings from the ordinary process of stamping and amalgamation was received, and it may safely be assumed that the mercury had extracted some of the gold from the ore which produced these tailings. We treated the finely-ground tailings by alkaline solution of bromine, which extracted a considerable portion of gold, and the bromine treatment was repeated time after time till it ceased to extract gold. Then it was treated with a hot solution of ferric bromide, which yielded a further quantity of gold. This treatment was repeated time after time till it ceased to extract gold, and finally the residue of tailings was smelted, and still a further quantity of gold produced. As this ore yielded its gold in stages to form different processes—namely, amalgamation, treatment with bromine, treatment with ferric bromine, and smelting—we infer that gold existed in four different states—mechanical or chemical. Notwithstanding the complex nature of these tailings, the cyanide acted on it almost perfectly, extracting 93 per cent. of the precious metal.

"The advantages claimed for the cyanide process over smelting and chlorination are, as compared with smelting, it requires no furnaces, no coal, and no fluxes. As compared with chlorination,

the cyanide process involves no wasting, therefore no furnaces or fuel. Moreover, by the cyanide process, ores containing lead, zinc, or other earthy carbonates which cannot be worked to profit by chlorination, may be as easily and profitably treated as any other; also, chlorination does not extract any silver, but by the cyanide method, most of the silver—invariably associated with gold in ore—is extracted along with the latter metal at the same operation. For the sake of simplicity silver has not been mentioned in the body of this paper, but the remarks made in reference to gold generally apply to the silver associated with it."

The following statement shows the result of treatment of the Crown Company's ore at Karangahake for the last year, handed me by Mr. J. McConnell, the manager of the Cassell works:—

Clearing up.	Ore.	In Ore by Assay.		Recovered.		Percentage recovered.	
		Gold.	Silver.	Gold.	Silver.	Gold.	Silver.
	Tons. cwt. qr.	Oz. dwt. gr.	Oz. dwt. gr.	Oz. dwt. gr.	Oz. dwt. gr.		
First ...	43 2 1	148 15 8	308 12 20	141 19 3	277 9 9	95·4	89·9
Second ...	72 14 0	222 7 12	488 3 6	199 8 20	374 1 12	87·7	76·6
Third ...	193 0 0	324 8 10	504 2 18	305 18 9	376 3 20	94·3	74·6
Total ...	307 16 1	695 11 6	1,300 18 20	647 7 4	1,027 14 17	93·0	79·0

Whether Cassell's process will be superseded by a less costly one remains yet to be proved, but at present it is well adapted for such ores as are found at Waihi and Kuaotuna. At the latter place the gold is so finely divided that it is almost impossible to save it by the ordinary process. The loss of gold at the Try Fluke battery alone must be very great. Taking the amount saved by the battery process last year as 5,077oz., it may be safely asserted that at least 9,000oz. was left in the tailings, and carried away with muddy water down the creek.

At the present time there are other processes being tried to deal successfully with the extraction of gold and silver from ores which may soon enter into competition with the Cassell process. The following is an abstract from a letter forwarded by the Agent-General from L. Hundeschagen, of Stuttgart, Germany:—

"Being aware that the wealth of New Zealand will to a certain extent depend on the productiveness of the mines, I take the liberty to draw your attention to a series of successful experiments which the undersigned and a friend of his made on several kinds of refractory ores that hitherto offered extreme difficulties. As refractory ores occur in your colony—viz., ores containing gold, silver, copper, lead, zinc, arsenic, antimony, bismuth, &c.—as sulphides and other more complicated compounds, accompanied by iron- and copper-pyrites in quartz, feldspar, baryta, magnetite, &c., the result of our researches may interest you. We extracted—

"90 to 92 per cent. of the silver
80 to 93 " gold
90 to 95 " copper
35 to 80 " lead
} purposely leaving other metals unextracted.

"The percentage of precious metal extracted will chiefly depend on the ore. I may mention that we have treated lots of 40 to 60 tons each, and the cost of treatment will not exceed, even in Australia, 15s. to £1 per ton, as very little fuel—wood or coal—labour, and chemicals are required, which circumstance renders our method extremely suitable for mountainous districts, and generally for the colonies. The whole plant, too, is cheap—great part of it can be made abroad—and will require hardly any repairs for fifteen to twenty years. The value of our method will, furthermore, be illustrated by the fact that what chemicals are used can be found in or near the mines, or can be produced on the spot at a nominal cost."

It will be seen from the above that there is a great probability of other methods of treating auriferous and argentiferous ores being shortly introduced which will apparently be equally as good as the Cassell process. Mr. Hundeschagen, however, gives no clue to the methods he employs to extract the metal from the ore. A company has recently been formed in London called "The Gold-ores Reduction Company (Limited)." This company in their first annual report state they can extract from 85 per cent. to 98 per cent. of the gold and silver in the ores at a nominal cost. A description of the process will be given further on.

As several inquiries have been made in reference to the patent rights of the Cassell Company, a copy of the specifications under which the patent rights were granted is hereto annexed:—

"Whereas, we, John Stuart MacArthur, technical chemist, of 15, Princes Street, Pollokshields, in the County of Renfrew, North Britain, Robert Wardrop Forrest, M.D., and William Forrest, M.B., both of 319, Crown Street, Glasgow, in the County of Lanark, North Britain, are desirous of obtaining letters patent for securing unto us Her Majesty's special license that we, and such others as we should at any time agree with, should from time to time during the term of fourteen years (to be computed from the day on which this instrument shall be left at the Patent Office) make, use, and vend within the colony of New Zealand and its dependencies an invention for 'Improvements in obtaining gold and silver from ores and other compounds,' and, in order to obtain the said letters patent, we must, by an instrument in writing under our hands and seals, particularly describe

the nature of the said invention and in what manner the same is to be performed, and make a distinct claim for the especial novelty thereof.

"Now, therefore, the nature and details of the said invention, and the manner the same is to be performed, are particularly described in the following statement:—

"This invention has principally for its object the obtaining of gold from its ores or other similar compounds such as mattes and slags, but it is also applicable for obtaining silver from its ores or compounds, and it comprises an improved process which, whilst applicable to ores or compounds generally, is effectual with ores and compounds from which gold and silver have hitherto been easily obtainable.

"In carrying out the invention, the ore or other compound in a powdered state is treated with a solution containing cyanogen or a cyanide such as the cyanides of potassium, sodium or ammonium, or other substances or compounds containing or yielding cyanogen, till all, or nearly all, of the gold or silver is dissolved, the operation being conducted in a wooden vessel, or a vessel made of or lined with a material not acted on to any considerable extent by the solution or substances contained therein. The solution is then drawn off, and the metal or metals are recovered by any suitable process, and the cyanogen, cyanide, or substance containing or yielding cyanogen may be regenerated. The cyanogen, or substance containing or yielding cyanogen, may be used as such, or such materials may be taken as will, by mutual action, form cyanogen, or substances containing or yielding the same.

"Under certain circumstances it may be found desirable to conduct the operation under pressure, in which case a closed vessel must be employed, and in any case, if found advisable, such operation may be carried on under varying conditions of temperature, and in either opened or closed vessels.

"Having now particularly described and ascertained the nature of the said invention, and in what manner the same is to be performed, we declare that what we claim is the process for obtaining gold and silver from ores and other compounds, consisting in treating such ores or compounds with cyanogen or a cyanide, or other substance or compound containing or yielding cyanogen, substantially as specified.

"And we do hereby, for ourselves, our heirs, executors, and administrators, covenant with Her Majesty, her heirs and successors, that we believe the said invention to be a new invention as to the public use and exercise thereof; that we do not know or believe that any other person than ourselves is the true and first inventor of the said invention; that we will not deposit these presents at the Patent Office with any such knowledge or belief as last aforesaid.

"In witness whereof we have hereunto set our hands and seals this 12th day of December, 1887.

"John Stewart MacArthur.
"Robert Wardrop Forrest.
"William Forrest.

"Witness—Alexander Forson Stewart, 319, Crown Street, Glasgow."

"Whereas we, John Stewart MacArthur, analytical and technical chemist, of 15, Princes Street, Pollokshields, in the County of Renfrew, North Britain, Robert Wardrop Forrest, M.D., and William Forrest, M.B., both of 319, Crown Street, Glasgow, in the County of Lanark, North Britain, are desirous of obtaining letters patent for securing unto us Her Majesty's special license that we, and such others as we should at any time agree with, should from time to time during the term of fourteen years (to be computed from the day on which this instrument shall be left at the Patent Office) make, use, and vend within the colony of New Zealand and its dependencies an invention for 'Improvements in extracting gold and silver from ores or other compounds,' and, in order to obtain the said letters patent, we must, by an instrument in writing under our hands and seals, particularly describe the nature of the said invention, and in what manner the same is to be performed, and make a distinct claim for the especial novelty thereof.

"Now, therefore, the nature and details of the said invention, and the manner in which the same is to be performed, are particularly described in the following statement:—

"Our said invention relates principally to the process of the kind described in our Patent Specification No. 2775, dated 1st February, 1888, and has for its object to improve the same, and also to lessen the quantities of chemicals employed therein.

"One improvement consists in preparatorily treating or mixing the powdered ore or other compound with potash or lime or other alkali or alkaline earth, which may be allowed to remain with the ore or compound, or which may be washed out if soluble. In some cases, as, for example, when mercury cyanide is used, it is advantageous for the alkali or alkaline earth to remain. After this preparatory treatment the ore or compound, which may consist of tailings or residues from other processes or operations, may be treated as described in our earlier specification hereinbefore referred to. We prefer, however, to cause the cyanide solution to percolate through the materials once or oftener, until all or nearly all the precious metals are dissolved. For this percolation very simple tanks, vats, or vessels may be used, such vessels being provided with permeable false bottoms or any suitable filtering apparatus. The separate solution is next made to pass through a mass of metallic zinc in a state of fine division. We find that the best results are obtained in this part of the process when the zinc has been freshly divided by mechanical or other means, so that its surfaces are as purely metallic as possible, and, further, when the quantity or mass of zinc employed is such that the solution has in passing through it ample opportunity for being thoroughly acted on.

"This improved zinc process is also advantageously applicable with other than cyanide solutions containing the precious metals—that is, with solutions, such, for instance, as chlorides, bromides, thiosulphates (sometimes called hyposulphites) or sulphates, obtained in the well-known Plattner,

Von Patera, Russell, Ziervogel, and Augustine extracting processes. We preferably employ cast zinc, and this is reduced to the requisite fine state of division by any suitable means. The degree of division is preferably such as would be obtained by shaving or cutting pieces of a cake of zinc from ¼in. to ½in. in thickness by means of a circular saw, and this is the method in which we prefer to reduce same, but instead of such method molten zinc may be caused to pass through the meshes of a fine sieve, and to fall into water. In order to obtain the best results, the finely-divided zinc should be used as soon as possible after it has been produced, either by one of the methods above described or in any other suitable manner.

"The precious metals may be separated from any excess of zinc, after separation of the solution by distillation, or the larger portion of the precious metals may be separated from excess of zinc by sieving (by preference, under water), when, with a suitable sieve, the greater part of the precious metals will pass through, the greater part of the zinc being left on the sieve.

"Having now particularly described and ascertained the nature of our said invention, and in what manner the same is to be performed, we declare that what we claim is—(1) In a cyanide process for extracting gold and silver from ores or other compounds with an alkali or alkaline earth preparatory to subjecting same to the action of cyanogen or of a cyanide; (2) the employment of zinc in a fine state of division for the purpose of precipitating gold and silver from cyanide, chloride, bromide, thiosulphate, sulphate, or other similar solutions.

"And we do hereby, for ourselves, our heirs, executors, and administrators, covenant with Her Majesty, her heirs and successors, that we believe the said invention to be a new invention as to the public use and exercise thereof; that we do not know or believe that any other person than ourselves is the true and first inventor of the said invention; that we will not deposit these presents at the Patent Office with any such knowledge or belief as aforesaid.

"In witness whereof we have hereunto set our hands and seals this 16th day of August, 1888.

"John S. MacArthur.
"Robert W. Forrest.
"William Forrest.

"Witness to the signatures of the said John Stewart MacArthur, Robert Wardrop Forrest, and William Forrest—David L. Taylor, clerk-at-law, 160, West George Street, Glasgow."

Waihi.

Waihi Company.—This company was formed about four years ago, with principally English capital, to work the ground formerly held by the Union and Rosemont Companies.

The ore from those mines contains a large percentage of silver, and requires a different method of treatment from any hitherto adopted in the district. The company has erected a dry crushing-plant, consisting of thirty heads of American stamps, with rock-breaker, Challenge ore-feeders, and a plant of eight combination-pans and four settlers.

At the time of my former visit, twelve months ago, the dry crushing caused a perfect cloud of dust in every part of the mine, but this is now remedied by the dust being partially collected and partially led away by ventilators in the roof of the building. The manager, Mr. H. Russell, deserves credit for the energy and perseverance he has displayed in combating the many obstacles he had to contend with in the erection of this plant from first to last; indeed, the expenditure made on works and plant by this company is stated to be somewhere about £60,000, and it seemed at one time as though the venture would not prove remunerative enough to pay interest on the large outlay, as the quantity of ore in the properties originally purchased from the Union and Rosemont Companies was not sufficient to recoup the outlay.

The adjoining ground was held by the Martha Company, who have been working it for over eight years without being able to make it pay more than working-expenses. The lode running through the Martha ground is very large, and on and near the surface, where the ore was oxidized, the company managed to save sufficient fine gold in the crushing-battery, which was of the old-fashioned type, to pay working-expenses, the ore yielding from 4dwt. to 5dwt. to the ton. The lode was quarried out in a face to a certain depth, and then a low level was constructed for about 500ft. alongside the foot-wall side of the lode and the lode stoped up for some distance to a width of from 8ft. to 10ft. but the class of machinery and appliances erected by this company could extract but very little free gold, and there is scarcely any free-milling ore in the lode. During last year this mine was purchased by Mr. Russell for £3,000, and at present it looks the best mining property in New Zealand. On one side of the main adit level, constructed by the Martha Company, can be seen large blotches of gold and silver combined. A cross-cut has been made through the lode for 40ft. and a commencement made to stope out the ore, but the hanging-wall of the lode has not yet been reached.

The lode is of such great width that, from the manner in which the workings are carried on, the mine-manager finds difficulty in taking it out. Blotches of gold and silver can be seen all through the lode, running generally in veins here and there; and the actual width of the lode is not yet known, but at the place where the cross-cut is made it must be at least 50ft. How far this shoot of auriferous and argentiferous ore will run along its length is not yet fully determined, but, from the appearance of the ore alongside the main level, it should extend at least for 300ft. The low-level adit gives 80ft. to 200ft. of backs. If the width of the lode be set down at an average of 30ft. the length of the shoot of payable ore 300ft.,—both measurements being considerably less than they appeared,—and the height of ore above this level 120ft., then the quantity of payable ore in sight would be about 77,143 tons, which would take the present plant nearly six and a half years to pulverise and treat, its crushing capacity being about 35 tons per day. When inspecting this

mine in December last the lode appeared to be of much greater dimensions than it proved to be on my recent visit, but nevertheless it is a large lode.

The quartz in the lode is partially amorphous and partially crystalline, and mixed with blackish-grey spots and blue streaks, and in some places coloured with oxide of iron. It is on these streaks and spots principally where gold and silver is found. The manager informed me that he forwarded 1 ton of the pulverised picked ore to the Cassell works at Karangahake, which yielded bullion to the value of over £100, the Cassell Company giving 80 per cent. of the assay-value of the ore. It seems scarcely credible that the Martha Company should have parted with so valuable a property; but it may solely be attributed to the fact that very few of the mining companies yet take any steps to ascertain the value of the ore by assay; they deem it money wasted to employ an assayer, and pin their faith to the old processes for extracting the gold. Such a case as this will tend to make mine proprietors a little more careful in examining and prospecting their properties before disposing of them. It must not be deemed that the quality of all the ore in this lode is as rich in bullion as that sent to the Cassell plant for treatment, for there is a large quantity of low-grade ore in the lode; but the whole of it taken in a face is likely to give good returns. From the appearance of the lode it is likely to continue payable to a good depth, and also to run for a considerable distance across the country. After the present level is worked out another can be taken in, which will give another 60ft. of backs.

From the report of Mr. R. Spratt, the mine-inspector of the company, it appears that the company now holds the whole of the ground comprised in the Martha Extended, Britannia, Nut, and Martha Block, and the Go Ahead, Victory, and Monmouth licensed holdings. Mr. Spratt states that the Martha Lode should also be found in the Victoria Special Claim and in the Union Special Claim, but at a considerable depth. The following is taken from the report:—

"A block of ground the whole length of the Martha Extended, as well as a portion of the Britannia and Nut, can be opened by a drive at the level of the main tramway, nearly 60ft. below the adit, which will take years to work out before it will be necessary to employ pumping or winding machinery. I have carefully estimated the tonnage of the ore within the boundaries of the Martha Extended ground, from the adit-level to the surface, not including what is in the Britannia and Nut, and, making large allowances for irregularity of the lode and stuff that might not pay for treatment, I am satisfied there are 300,000 tons, and from the adit down to the level of the main tramway 200,000 tons more; in all, 500,000 tons.

"It would be a difficult matter to arrive at an estimate of the value of this vast body of ore unless based upon actual returns from the stuff already treated, which were so incomplete at the time of my visit that they could not be accepted unconditionally. In order to afford all information possible on this most important matter, samples of ore were broken out in my presence at points marked 1 to 9, on the plan along the course of the reef in the adit-level. These samples were selected, as far as it was possible to judge, below the general average of their surroundings, avoiding in all instances what might be taken as a mean between the richest and poorest portions of the lode, and, although only atoms, will, I am satisfied, be found to represent pretty accurately the value of the whole. The parcels were in my own keeping until handed over to a competent metallurgist, who has furnished the following values of them:—

No. 1 sample, value £11 18s. 0d. per ton.	No. 4 sample, value £0 19s. 0d. per ton.
No. 2 " " £9 2s. 8d. "	No. 5 " " £0 15s. 0d. "
No. 3 " " £1 8s. 0d. "	No. 6 " " £5 14s. 5d. "

Samples Nos. 7, 8, and 9 being valueless.

"The three latter, I was certain, were worthless, but I wanted to know, and therefore had them tested. Against this, I think, might be fairly compared assays of two additional samples, marked A and B, the first being taken from the face of a drive then in work at the adit-level, and the second from various parts of the mine. Sample A gave—Gold, 23 oz. 3dwt. 16gr.; silver, 159oz. 2dwt.: value, £124 13s. 4d. per ton. Sample B—Gold, 119oz. 4dwt. 16gr.; silver, 730oz. 2dwt.: value, £622 18s. 8d. per ton. These samples have been taken only to show the richness of the ore that could easily be selected if the object of this report were to place a high value on the mine. Rejecting samples 7, 8, and 9, and A and B, as extremes, and taking the average of results 1 to 6, we shall have close on £5 per ton, which, I feel confident, will be found to be a close approximation of the value of the ore per ton.

"Next in importance to the value of the ore is the cost of treatment, including mining, milling, wear-and-tear of machinery, and all incidental expenses. This at present will not be below £1 5s. per ton, but I am certain the work will in time be done cheaper. If the value of the ore is taken at £5 per ton, and reckoning that only 50 per cent. of bullion is saved by the present process of treatment, at a cost of £1 5s. there will be a handsome profit. In course of time better results will follow, both as regards reduction in expenses and increase in the percentage of bullion extracted."

It is possible that Mr. Spratt may be rather sanguine as to the large quantity of available quartz above water-level—namely, 500,000 tons—that will average an assay-value of nearly £5 per ton. Taking the whole length of the lode the present main level has gone through—namely, 500ft.—and the average height of backs above the present level, as given me at the time of inspection—140ft.—adding to this the 60ft. additional which it is said can be got by constructing a new level, it would make the average backs above water-level to be 200ft. The lode would have to average 70ft. wide, 500ft. long, and 200ft. backs to give 500,000 tons of quartz: this is allowing 14 cubic feet of solid quartz to the ton. In estimating the lode at such large dimensions there cannot be a large allowance made for irregularity of the lode and stuff which might not pay for treatment, as mentioned by Mr. Spratt. However, be that as it may, the company has a lode of colossal proportions, and its present

appearance seems to indicate that it is one of the best mining properties ever opened up in the colony. No one can state with certainty the quantity of payable ore in such a lode, or define without properly testing it the length and depth of the shoot of payable auriferous and argentiferous ore. It is well known that gold runs in shoots and ledges, and that hitherto these shoots have not been found to run for any long distance in the lodes found in the colony without a break. Having taken all the *pros* and *cons* with reference to the quantity of payable ore above the present level into consideration, this guided me in estimating that there must be at least 77,000 tons. At the same time, there might be a large increase on this quantity; but it must be borne in mind that all calculations of this nature are of a speculative character.

There appears to be a want of a proper system in working the mine. The lode being of far greater dimensions than any yet found in the colony, a different system will have to be adopted in timbering the stopes, and in taking out the ore. The lode will have to be worked in a face, and not by bord-and-pillar, similar to working a coal-mine, such as was being done at the time of my visit, as the latter system is only mullocking up the mine, and rendering it difficult to take the ore out afterwards. There is no difficulty in taking the whole of the ore out even should the lode prove to be 70ft. wide, but in commencing to stope out from the level a proper system of timbering with sills will have to be adopted to allow the whole of the lode from the next level to be taken out with safety.

The dimensions of the lode are so great that the present plant will not be sufficient to pulverise and treat the quantity of ore obtainable, neither does it extract a fair percentage of the bullion. The present plant nevertheless may be looked on as one of the best in the colony for dry crushing. The ore as it is taken from the mine is dumped into a kiln cut out like an inverted hollow cone in tufaceous sandstone, having the sides lined with firewood, with a certain quantity of wood covering the bottom. A layer of ore is then dumped in, then another layer of firewood, and so on until the kiln is full, and the ore heaped on the top. This system of drying the ore is expensive, as the whole of the heat from the large quantity of firewood consumed is not utilised. It is of no service to attempt to roast the ore in large blocks. If roasting is required to extract a larger percentage of the metals, then this should be done with the ore pulverised. The kilns are useful only for expelling the moisture. The effect of attempting to roast the ore in blocks is to have some of the metals in the form of sulphates, while others are in the form of sulphides.

The ore is taken from these kilns and hoisted up with trucks and cages, and dumped on the floor where the stone-breaker is placed; from this it passes into ore-bins and thence into Challenge feeders, which feed the stamps. Formerly a forty-mesh screen—1,600 holes to the square inch—was used, but a sixty-mesh screen—3,600 holes to the square inch—is now adopted, as it is found to be the most economical. The stamps are about 900lb. each, and have a drop of 7in., making, when going at full speed, about ninety drops per minute, and each stamp crushes about $1\frac{1}{6}$ tons in twenty-four hours. Formerly, when the forty-mesh grating was used, the crushing capacity was said to be 2 tons each stamp, but the sixty-mesh screen reduced their capacity by nearly 1 ton each in the twenty-four hours. This shows that it requires a force of 58,320,000 foot-pounds to pulverise 1 ton of quartz to such a fineness as will pass through a sixty-mesh screen. The ore is then treated by hot amalgamation in combination-pans, which is said to give about 68 per cent. of the assay-value of the gold and 45 per cent. of the silver.

As previously stated, this is one of the best plants in the colony, and one where there are assayers constantly employed in assaying the dry-pulverised ore before subjecting it to treatment in the pans, so that the value of the bullion in the ore is accurately ascertained, yet the low percentage of the metals extracted is very marked; but it only shows that where the older methods are adopted, and no assays made to test the value of the ore, the loss in gold and silver must in many cases be alarming. The question that presents itself to my mind is, Will Cassell's process be an economical one to adopt? It certainly gives a larger percentage of the bullion, but the expense of treatment, together with the royalties the company are at present asking for the use of their patent rights, is almost prohibitive.

The value of the bullion in the ore from the Martha Mine is said to be about £1 2s. 6d. per ounce. Taking this amount as the value, and that 68 per cent. of the assay-value of the gold in the ore is being extracted and 45 per cent. of the silver, this means that about 66 per cent. of the value of the bullion is saved by a process the cost of which does not exceed 15s. per ton. To compare this with the Cassell process, and allowing that 85 per cent. of the assay-value of the ore is saved by leaching with potassium-cyanide solutions, at an expense of about £1 2s. 6d. per ton—that is, allowing 10s. per ton for drying and pulverising and 12s. 6d. per ton for leaching—then, in treating ore of an assay-value of £3 per ton, the Cassell process would extract bullion to the value of £2 11s. at a cost of £1 2s. 6d. for treatment, to which must be added 8 per cent. royalty, or 4s. 1d., making the total cost of treatment £1 6s. 7d. per ton, thus leaving £1 4s. 5d. to cover the cost of mining and for profit. If the same class of ore is treated by the Waihi plant, and 66 per cent. of the assay-value of the bullion obtained, then this means that the value of the bullion extracted would be £1 19s. 7d., and the cost of the treatment being 15s. per ton, leaves a margin of £1 4s. 7d., as against £1 4s. 5d. by the Cassell process, showing that there is no inducement for mine-proprietors to incur a large expenditure in attaching Cassell plant to their mills unless the ore be rich. Again, if we take the assay-value of the ore at £10 per ton, the Cassell Company require 15 per cent. on all ore above the value of £8 per ton. Thus the value of ore extracted on the same basis as already stated would be £8 10s. per ton. The royalty on this is £1 5s. 6d., which, added to the cost of treatment, makes £2 8s., leaving a margin of £6 2s. per ton, whilst the same ore would yield by the Waihi process £6 12s.; deducting from this the cost of treatment—15s.—it leaves £5 17s., as against £6 2s. by the Cassell's process. This shows that high-grade ores would pay to adopt the latter mode of treatment, but unquestionably the royalty charged is too high for the process to be adopted.

The Waihi Company have, however, a property which, from the present appearance of the mine, shows that it is likely to pay good interest upon the large capital expended. During last year 7,981 tons of quartz was crushed, which yielded 34,234oz. of bullion, estimated by Mr. Wilson, the Inspector of Mines, to be worth about 12s. 4d. per ounce.

Owharoa.

There are about twelve men employed in claims in this locality, but four of these have had very little out of their claims. The Smile of Fortune Mine, worked by eight tributers, has crushed during the year 392 tons of quartz, which yielded 322oz. of gold.

The total quantity of quartz crushed in the Ohinemuri district last year was 9,572 tons, which yielded 1,279oz. gold and 42,471oz. bullion; in addition to this, 330 tons of ore were sold at the mines, which realised £4,508. The value of the bullion is estimated at £26,218. Taking the value of the gold at £2 13s. per ounce, it would amount to £3,388 7s., which, added to the value of the bullion and value of the ore sold, would make a total value of £34,114 7s. The average number of men employed about the mines in the Ohinemuri district was 311.

Te Aroha.

Very little work has been done in the mines in this district during last year, owing chiefly to almost the whole of the ground being held in large claims, on which very little work has been done. The returns furnished me by the Inspector of Mines show that only thirty men have been employed, and eight of these were employed at the tailings plant at Waiorongomai. The Te Aroha Gold and Silver Company removed their plant of concentrators—the Howell revolving furnace, rock-breakers, and the Baker's blowers—to Australia, and sold the rest of their plant to Messrs. Adams and Wicks for £3,500. The plant and claims cost the company nearly £60,000. The company, on the purchase of this property, trusted to personal information derived from people in the locality as to the quantity and quality of ore in therein; and, instead of first expending a portion of the capital in prospecting the ground, they spent it on the erection of machinery and plant. In addition to the original purchase, they expended £32,780 on additional machinery, tramways, and water-races, and when the reduction-works were completed they found that the mines would not pay them for working at the levels at which they were opened out.

Messrs. Adams and Wicks, the present proprietors, have abandoned most of the ground held by the original company, which amounted to 213½ acres, and now only hold the licensed holdings of the New Find and Silver King. There never was a goldfield opened under such favourable auspices as the Te Aroha. A large crushing plant was erected by Messrs. Firth and Clark, of Auckland, to treat the ores from the different mines, and a tramway connecting the mines with this battery was constructed by the Piako County Council, at a cost of £18,000, of which amount £9,000 was given as subsidy by the Government. Since this field was opened, about eight years ago, 40,320 tons of quartz has been crushed, which yielded 26,830oz. gold and 20,416oz. bullion, and the mines may be said to be only scratched on the surface. Very little money has been expended in prospecting since the early days of the field. There is not the slightest doubt that this will yet become a good gold-producing district when it gets developed. The best mine—namely, the New Find—on the field is on a portion of what is known as the Buck Reef, which is in places 20ft. thick, the outcrop of which extends for about three miles; and when this reef gets properly prospected other rich shots of gold will be discovered in it. The quantity of quartz crushed last year was 280 tons, which yielded 75oz. 17dwt. gold; and 1,000 tons of tailings was crushed, which yielded 441oz. 9dwt. gold.

The following tabulated statement will show the results of working the mines in the Ohinemuri and Te Aroha districts during last year, with the number of men employed, and the yield of gold and bullion from each:—

Locality and Name of Mine.	Average Number of Men employed.		For Owners.				For Tributers.					Tailings.	
	Wages-men.	Tributers.	Quartz crushed.	Mullock crushed.	Retorted Gold.	Bullion.	Quartz crushed.	Retorted Gold.	Bullion.	Ore sold.	Value of Ore sold.	Quantity treated.	Gold.
			Tons cwt. lb.	Tons cwt. lb.	Oz. dwt. gr.	Oz. dwt. gr.	Tons cwt. lb.	Oz. dwt. gr.	Oz. dwt. gr.	Tons cwt. lb.	£ s. d.	Tons cwt. lb.	Oz. dwt. gr.
Ohinemuri County—													
Maratoto—Maratoto	10	..	400 0 0	..	..	7,000 0 0	..	..	..	..	..	..	..
Karangahake—Ivanhoe and Truro ..	8	..	300 0 0	..	232 0 0	..	..	..	..	..	..	..	..
" Woodstock	..	10	..	..	..	..	26 0 0	..	71 0 0	60 0 0	3,000 0 0	..	..
" Crown	27	..	362 17 84	..	455 2 12	1,016 13 22	..	..	..	..	..	..	..
" Adeline Amalgamated	..	3	..	..	..	..	76 0 0	257 0 0	..	..	..	..	..
Owharoa—Smile of Fortune ..	..	8	..	..	..	..	392 0 0	322 0 0	..	..	..	..	..
" City of Glasgow ..	3	..	26 0 0	..	7 10 0	..	..	..	..	..	..	..	..
" Madden's Folly	1	..	9 0 0	..	5 18 0	..	..	..	..	..	..	..	..
Waihi—Waihi	135	..	7,981 0 0	..	..	34,324 0 0	..	..	..	..	..	..	..
" Silverton	..	6	..	..	..	..	..	..	..	270 0 0	1,508 0 0	..	..
Totals	284	27	9,078 0 0	..	700 10 12	42,330 13 22	494 0 0	579 0 0	71 0 0	330 0 0	4,508 0 0	..	..
Piako County—													
Waiorongamai—Te Aroha Company	8	..	..	..	..	..	..	..	..	..	..	1,000 0 0	441 9 0
" Colonist	..	1	..	..	..	..	34 0 0	16 18 0	..	..	..	..	..
" Ferguson's ..	10	..	201 0 0	..	..	172 0 0	..	..	..	..	..	..	..
" Werahiko	..	1	..	..	..	..	45 0 0	29 1 0	..	..	..	..	..
Sundries	10	..	..	..	29 18 0	..	..	..	..	..	..	..	..
Totals	28	2	201 0 0	..	29 18 0	172 0 0	79 0 0	45 19 0	..	..	..	1,000 0 0	441 9 0
Summary showing the Results of working the Mines in the North Island.													
Coromandel	312	27	5,591 18 0	..	9,022 13 0	..	23 4 50	780 13 0	..	..	..	35 0 0	35 0 0
Thames	586	115	37,679 7 109	21,261 0 0	31,119 10 0	..	2,815 10 0	3,379 9 0	..	..	..	15,080 0 0	3,613 13 0
Ohinemuri	284	27	9,078 0 0	..	700 10 12	42,330 13 22	494 0 0	579 0 0	71 0 0	330 0 0	4,508 0 0	..	..
Piako	28	2	201 0 0	..	29 18 0	172 0 0	79 0 0	45 19 0	..	..	..	1,000 0 0	441 9 0
Totals	1,219	171	52,550 5 109	21,261 0 0	40,872 11 12	42,502 13 22	3,412 14 50	4,785 1 0	71 0 0	330 0 0	4,508 0 0	16,065 0 0	4,030 2 0

Estimated Value of Total Returns.

Gold	£128,416 8 6
Bullion	26,325 2 0
Ore sold	4,508 0 0
Total	£159,249 10 6

The following table shows the number of tons of stone and mullock crushed and the yield of gold from the northern goldfields since the returns have been supplied to the Mines Department. The Thames returns include the Ohinemuri district up to 1886–87:—

District.	Number of Tons of Quartz and Mullock crushed or sold.	Yield of Gold.	Average Yield of Gold per Ton.
		Oz.	Oz. dwt. gr.
Coromandel—			
1st April, 1880, to 31st March, 1881 ...	720	4,960	6 18 0
" 1881, " 1882 ...	3,358	7,352	2 4 0
" 1882, " 1883 ...	2,907	7,577	2 12 0
" 1883, " 1884 ...	1,043	4,018	3 17 0
" 1884, " 1885 ...	456	3,201	7 0 0
" 1885, " 1886 ...	550	3,382	6 3 0
" 1886, " 1887 ...	305	4,170	13 13 0
" 1887, " 1888 ...	1,923	6,774	3 10 5
" 1888, " 1889 ...	2,149	8,090	3 15 7
" 1889, " 1890 ...	1,690	6,708	3 19 9
" 1890, " 1891 ...	5,650	9,838	1 14 19
Totals	20,751	66,069	3 6 8
Thames—			
1st April, 1878, to 31st March, 1879 ...	41,917	57,207	1 7 7
" 1879, " 1880 ...	33,017	59,576	1 16 2
" 1880, " 1881 ...	32,405	53,154	1 12 19
" 1881, " 1882 ...	30,698	45,803	1 9 20
" 1882, " 1883 ...	25,867	43,311	1 13 12
" 1883, " 1884 ...	34,228	54,878	1 12 2
" 1884, " 1885 ...	31,496	37,705	1 4 4
" 1885, " 1886 ...	35,998	61,540	1 14 4
" 1886, " 1887 ...	34,827	38,142	1 1 22
" 1887, " 1888 ...	32,819	35,949	1 1 11
" 1888, " 1889 ...	47,363	35,796	0 15 3
" 1889, " 1890 ...	60,753	33,817	0 11 14
" *1890, " 1891 ...	61,756	38,113	0 12 8
Totals	503,144	594,991	1 3 15
Ohinemuri—			
1st April, 1887, to 31st March, 1888 ...	2,388	3,406	1 8 13
" 1888, " 1889 ...	3,795	3,679	0 19 9
" 1889, " 1890 ...	4,773	†8,564	1 15 21
" 1890, " 1891 ...	9,902	†12,914	1 6 2
Totals	20,858	28,563	1 7 4
Te Aroha—			
1st April, 1883, to 31st March, 1884 ...	4,262	4,629	1 1 17
" 1884, " 1885 ...	11,042	9,506	0 17 5
" 1885, " 1886 ...	6,552	4,489	0 13 17
" 1886, " 1887 ...	4,743	3,658	0 15 10
" 1887, " 1888 ...	7,166	2,918	0 8 3
" 1888, " 1889 ...	1,381	1,113	0 16 3
" 1889, " 1890 ...	4,894	‡20,416	4 3 10
" 1890, " 1891 ...	280	557	1 19 18
Totals	40,320	47,286	1 3 11
Grand totals from North Island	585,073	736,909	1 5 4

* This includes 50,856 tons of mullock crushed the last two years.

† The gold obtained last year includes 42,331oz. bullion, reckoned as being equal to 9,934oz. gold, and ore sold as equal to 1,701oz. gold.

‡ Is bullion worth only 11s. 6d. per ounce.

MIDDLE ISLAND.

Marlborough District.

Mahakipawa.

A considerable amount of prospecting work has been done on the quartz reefs in this district. Only two companies are working quartz—viz., the Ravenswood Gold-mining Company of London, and the Southern Cross Company registered in the colony. These companies hold all the ground that is at present considered of any value.

Ravenswood Company.—This company purchased the licensed holdings known as the Mahakipawa, Jubilee, Lucky Hit, Kapai, and the Waikakaho from the original prospectors, and have been carrying on prospecting operations, testing the ground at different levels. On the Mahakipawa ground the original prospectors sunk a shaft for some distance on the lode, which showed sufficient gold to warrant the claim being properly opened out. A level has been constructed for 281ft., but the lode has not yet been struck. It is expected to cut the lode at about 12ft. further in. This level will give 160ft. of backs. On the Waikakaho ground, No. 1 level has been driven on the lode for 320ft., which varies in thickness from 1ft. to 9ft., but to take the average it would be about 4ft. 6in. This level will give 235ft. of backs when it gets under the summit of the saddle. Another level 160ft. below No. 1 has been constructed by first driving a cross-cut for 195ft. and then 200ft. along the lode. In constructing the cross-cut a lode 6ft. in thickness was gone through, showing a little gold, but the driving was continued until the second lode was cut, which is the same as that driven on in the upper level. This lode was 8ft. wide at the end of the cross-cut, but after driving 200ft. on the lode it was only 4ft. 6in. in thickness. The lode in the lower level does not show so much gold as that on the upper level; but on constructing a double pass to bring down the quartz from the upper level good gold-bearing stone was got at 50ft. up. A level has also been constructed on the lode in the Kapai ground for 157ft. The lode here varies from 2ft. to 3ft. 6in. in width, and carries good gold. The company is now engaged in the erection of a crushing plant, and an aerial tramway to convey the quartz from the mine to the battery.

Crushing-battery.—The crushing plant is to be erected near the junction of the two branches of the Waikakaho Creek, about three miles from the mine. It consists of a stone-breaker, ten heads of stamps, with two Challenge ore-feeders and four Frue vanners. The crushed ore is to pass over amalgamated copper plates and afterwards over the Frue vanners, to be then deposited in a large paddock 200ft. square, so that it can be again treated by another process if the first one is not successful in recovering a fair percentage of the gold.

Aerial Tramway.—This tramway will be about three miles in length. The steel-wire rope for the tramway has been imported from England, and weighs 10 tons. The trestles have been erected for about one mile and a half, and the tramway is expected to be completed in about three months. The topographical character of the country does not admit of the tramway being carried in a straight line as other aerial tramways are constructed in different parts of the colony, and a new principle has to be resorted to. There is to be a sharp bend in one place, where the rope and buckets will travel round horizontal pulleys. It is proposed to place about 150 buckets on the rope, of a carrying-capacity of 1½cwt. each. At the terminal end of the tramway a paddock or hopper is constructed, having a capacity of 200 tons, into which the buckets empty, and from this hopper the quartz will pass down over a grizzly to the stone-breaker. The fine material and the product of the stone-breaker will fall into a second hopper, which has a capacity of 200 tons, and from the last hopper the quartz is to be fed into the Challenge ore-feeders, which in turn feed the stamps. The whole of the plant is placed on the side of the range, so that, in delivering the quartz from the tramway, it will pass through every operation by gravitation, the upper paddock being 65ft. above the floor where the Frue vanners are placed, and the second one 45ft. The tramway has not a sufficient grade—1 in 8—to be self-acting, and an overshot water-wheel 26ft. in diameter is to be erected in such a position that the waste water from the Pelton wheels can be used to drive it. The tramway will be worked by a wire rope connected with the lower terminal and the overshot water-wheel. The whole of the foundations for the battery are cut out in the solid, and provision is made to have the foundations sufficiently long, so that another ten heads of stamps can be erected if required.

Water-supply.—The water-supply is taken from the left branch of the Waikakaho Creek. A dam is to be erected in the creek, and from this the water will be conveyed to a large tank in pipes 26in. in diameter, and from the tank the same size of pipes are to be used for a short distance and afterwards steel pipes 14¾in. in diameter from this to the machine-site, which is about one mile and a half from the head works, the total fall being 258ft. These pipes are now being laid in position on the ground. The estimated cost of the plant is as follows:—

Water-race and dam	... £2,200
Aerial tramway	... 3,000
Crushing plant, &c.	... 2,000
Or, about	£7,200

Southern Cross Company.—This company holds the ground on the south end of the Ravenswood Company's property. A great deal of prospecting work has been done, and until very recently no success was met with. Nevertheless, the work was carried on, and lately a lode from 18in. to 2ft. thick was discovered, covering good gold. In driving a cross-cut at a low level the reef was gone through without being taken any notice of, and after having driven for about 40ft. past the reef, the company then came back and opened out in a northerly direction, towards the Waikakaho licensed holding, and after driving a short distance the lode widened out and showed gold very freely. This discovery may be the means of giving a fresh impetus to further prospecting in this locality.

Nelson District.

Collingwood.

The quartz-workings here are chiefly confined to the locality of Bedstead Gully. The Johnstone United Company has been working their mine steadily during last year, and at the time of my visit had about forty men employed, thirty of whom were working underground and ten on the surface. The lode in this mine lies nearly horizontal, but recently it has taken a sudden dip of about 1 in 4, which will necessitate a cross-cut being constructed for about 120ft. Recently an uprise was made from this level, and at about 50ft. up a very rich gold-bearing quartz lode was cut about 6ft. in width, from which, it is said, that 50oz. of gold was obtained from a dishful of stuff,

About 600 tons of stone is crushed a month, which was averaging at the time of my visit about 2dwt. of gold per ton. The thickness of the lode varies from 2ft. to 6ft. in places, but the average thickness may be taken at about 3ft. It is interspersed with blocks of sandstone, and the quartz, which is of a friable nature, is easily crushed. Another party has recently taken up ground in this locality, and, after carrying on prospecting operations for some time on a lode, they have lately cut very good gold-bearing stone, but none of it has yet been crushed. There is really very little prospecting of any description yet done in this district. A number of mineral leases granted by the Land Board of Nelson have been held by different parties for many years and no work done on any of them.

Red Hill Company.—The only work this company has been engaged in is sluicing in the gully running up to the saddle of the Richmond Hill, employing two men and the manager. No work of any description has been done in the quartz-workings, and it is to be feared that the present company will never do much towards prospecting the mine.

West Coast.

Waimangaroa and Mokihinui.

There has been a good deal of prospecting done on some of the quartz lodes in these localities. The Beaconsfield Company, at Waimangaroa, has sunk a shaft to a depth of 100ft. on the opposite side of the river to the old workings. A level has been constructed from the bottom of the shaft, and the lode or leader driven on for 166ft. This varied in thickness, until near the end of the level where it was only a few inches, but widened out to about 14in. at the far end. The reef is well defined, having good foot and hanging walls, but there is very little gold in the stone. An uprise was constructed to a height of 54ft., where the lode is from 1ft. to 2ft. 6in. thick, carrying a little gold. In driving towards the bottom of the winze in the old workings from the uprise shaft very good gold-bearing stone was cut, but on continuing the drive beyond the winze the stone began to pinch out. The company intends to continue the lower level for some distance further, as both the lode and the country look more promising than any they have passed through. During last year they have expended about £2,515 on prospecting and on plant. The only other quartz claim is that held by the Great Republic Company, who have during the last year extended their low adit-level 215ft. without cutting any lode.

Red Queen Company.—This company's mine is situated on the western side of the Mokihinui River, about thirteen miles up from its mouth. The mine was successfully worked for about two years on the upper level, but the work was suspended, and the whole of the mines at Mokihinui were attempted to be floated into a large company on the London market, but failed. No work was done in this mine for about three years, until lately a contract was let for the extension of the No. 2 level. The lode is said to be about 6in. in thickness, carrying a fair amount of gold; four wages-men are employed in effecting repairs previous to commencing mining operations again. The country rock here is of a very hard nature, which make a small lode like this very expensive to work.

South Pacific Company.—This company is engaged in prospecting the ground, which is situate at Mokihinui. The tunnel has been extended for a distance of 187ft., but the work could not be continued, on account of foul air, there being no appliances to force a current of air into the face. The tunnel or adit-level is now in for a distance of 415ft., and tenders are being called for extending it another 100ft. and for erecting ventilating appliances. The country looks promising for a gold-bearing lode to be found, but no regular reef has yet been met with.

Lyell.

This used to be a busy place several years ago, but there are very few mines now being worked, the principal one is the Alpine Quartz-mine. A low level has been constructed for a distance of 2,400ft. and the reef opened out, having an average width of about 5ft. The manager estimates that it will take about six years to work out the lode above the present level. During the year ending the 30th April last 5,708 tons of stone was crushed, which yielded 2,442oz. 10dwt. of gold, representing a value of £9,485 7s. 5d. The expenditure during this period being £9,038 1s. 8d., a large portion of it being incurred in opening up the mine; £1,600 was paid in dividends. The money paid in calls in the early part of the year to open out this level allowed the dividend to be paid. It is now contemplated that regular dividends of 6d. per share a month will be paid in future.

United Italy Company.—This company's mine is at present worked by four tributers. As far as can be ascertained, 49 tons of stone was crushed during the year, yielding 190oz. of gold, being about 3oz. 19dwt. per ton. This stone is from a leader from 2in. to 4in. thick. These tributers have great hopes of being able to make fair wages for a considerable time.

Tyrconnel Company.—There are only two men working on this company's ground. They are working from a winze down about 52ft. below the No. 5 level on a leader about 1½in. in thickness, which gives high returns of gold. No quartz has been crushed during the year.

Reefton.

There has been considerable improvement in mining in this district during the past year, and, although some of the steady gold-producing mines, such as the Keep It Dark and others, have not been so successfully worked as in former years, there is still a reasonable prospect of their coming to the front again. The claims in the Merrijigs district have been attracting considerable attention during the past year, and some of them are likely to turn out good investments for the shareholders. The gold returns show a marked increase upon those of the year previous, while the amount paid in calls is much less, and the dividends paid considerably increased. The number of tons of quartz crushed last year was, approximately, 39,342, which yielded 23,347oz. of gold, representing a value of £91,998 8s. 10d., as against 32,394 tons for the previous year, which yielded 17,780oz. of gold, representing a value of £69,676 12s. 1d., thus showing an increase in the yield of gold last year of 5,567oz., representing a monetary value of £22,322. The yield of gold from alluvial claims last year was 4,629oz., representing a value of £17,594 0s. 3d., as against

2,715oz. for the previous year, of a value of £10,314 15s. 2d., thus showing an increased yield of 1,914oz., of a monetary value of £7,279. The total increase in the yield of gold last year was 7,481oz., representing a value of £29,601. The amount paid in calls last year was £20,404, as against £27,531 for the previous year, while the dividends paid to the shareholders amounted to £27,325, as against £18,250 for the previous year. Deducting the amount paid in calls last year—namely, £20,404—from the amount declared in dividends—£27,325—it leaves £6,921, which is equal to 33·9 per cent. on the investments during the year.

The following statement shows the approximate quantity of quartz crushed from this field year by year and the yield of gold therefrom since 1st April, 1882:—

——	Approximate Number of Tons crushed.	Yield of Gold in Ounces.	Value.	Average Yield per Ton.
			£ s. d.	oz. dwt. gr.
1st April, 1882, to 31st March, 1883	18,928	19,194	74,856 12 0	1 0 7
" 1883, " 1884	23,433	16,547	64,533 6 0	0 14 3
" 1884, " 1885	34,349	23,997	93,588 6 0	0 13 23
" 1885, " 1886	27,198	14,591	56,904 18 0	0 10 18
" 1886, " 1887	23,930	21,143	83,171 15 5	0 17 14
" 1887, " 1888	24,403	16,775	66,030 11 5	0 13 18
" 1888, " 1889	28,564	18,663	72,720 18 0	0 13 4
" 1889, " 1890	32,394	17,780	69,676 12 1	0 10 16
" 1890, " 1891	39,643	23,347	91,998 8 10	0 10 19

As far as can be ascertained, the total quantity of quartz crushed from this district since it was first opened amounts to 506,557 tons, yielding 384,023oz. of gold, representing a value of £1,492,134, of which amount the sum of £485,106 has been paid in dividends.

There is a large extent of country between the Inangahua River and the Big River on which comparatively little prospecting has been done. This portion of the district is now attracting considerable attention, and recently some good mines have been opened up in the vicinity of Merrijigs. As the different mines in the district are fully reported by the Warden, it is only necessary to casually refer to the principal mines on the field.

Globe Company.—This company has been the most successful one in the district during the past year. It has crushed 8,407 tons of quartz, which yielded 5,752oz. of gold, representing a value of £22,721, out of which £12,100 has been paid in dividends. The total dividends declared by this company now amount to £30,100. The main shaft has been sunk to a further depth of 125ft., making the total depth 500ft. From the bottom of the shaft a level was constructed for about 120ft., where it cut the lode, which contains a large body of stone. The lode has been driven on for about 70ft., and a connection made between this and No. 3 level, where the lode is about 11ft. in thickness. The principal workings last year were between No. 2 and No. 3 levels. A winze was sunk from No. 3 level about 70ft. west from the shaft for 110ft., where a large body of stone was found, of good quality. The quartz is conveyed from the mine for a distance of about one mile and a quarter by an aerial tramway to the crushing-battery, which is erected at the side of the Inangahua River. About two years ago the company erected four Triumph concentrators, but they have discontinued using these, as they found that the quantity of concentrates in the ore did not pay for saving. This appears questionable, and possibly the real explanation is that the concentrates could not be treated properly. This, at all events, could not be done without roasting them, as the amount of sulphur they contain would carry away the greater portion of the fine gold in the water if merely treated raw in grinding-pans. There is said to be about 20,000 tons of tailings stacked, and during last year one of the Watson-Denny pans was erected to treat the tailings, but after working this pan for some time it was discontinued, as not proving payable for working.

Progress Company.—This company is working on the same line of reef as the Globe Company. During last year 11,500 tons of quartz was crushed, which yielded 5,296oz. of gold, representing a value of £21,032, out of which dividends were paid to the amount of £4,800. The lode is worked from adit-levels, the No. 1 level being 1,400ft. long, and the No. 2 level is now constructed for over 1,600ft., which cuts the reef at 215ft. below the No. 1 level. There are several lodes or blocks of stone in this company's ground, some of which are 25ft. in width, but the average thickness of the lodes may be taken as about 6ft. The quartz is taken from the mine by a tramway constructed along the face of the range to the crushing-battery, erected at the side of Oriental Creek, consisting of twenty-five heads of stamps, driven by a steam-engine of fifty-horse power. It is said that a large quantity of gold is lost at the battery. Assays have been made from tailings collected in a buddle, which gave a result of 9dwt. 12gr. per ton, and the concentrates from the blankets gave an assay of 2oz. 16dwt. 8gr. of gold per ton. Two of Fraser's pans, better known by the name of the "McKay pans," were erected, but it was found that a large quantity of iron-amalgam was collected, and so far they have not proved a success. These pans have been working for many years at Tararu, in the Thames, and are certainly the best grinding-pans that have yet been made. Mr. J. Brown has been successfully treating tailings with these pans for over ten years; therefore the non-success of the pans erected by the Progress Company must be due to the persons who are in charge of the battery not being acquainted with their working. Where charges are worked in these pans the material should be ground into a pulp, or, say, worked for about two hours before adding the quicksilver; then the mullers are raised, and the pans worked for another two hours to produce amalgamation, when the material is run into a settler, which is worked for nearly four hours before drawing off the quicksilver and collecting the amalgam.

Inkerman Company.—This company has crushed 4,083 tons of quartz from their mine during the year, which yielded 2,754oz. of gold representing a value of £10,690, out of which £2,000 has been paid in dividends. The shaft has been sunk to a further depth of 176ft., making the total depth 294ft. At 218ft. the No. 2 level was opened out. This level is constructed for 345ft. in length, and it is between this and No. 1 level where most of the stone crushed was obtained. The lode varies from 2ft. to 3ft. in thickness. In driving northwards the lode pinches out, but the walls are clearly defined, and a trace of the lode can easily be followed, so that the stone may make again some distance further on. A winze has been sunk from the No. 2 level for a distance of 71ft., and when the main shaft is down to a depth of 318ft. another level will be opened out. A block of surface-stone at the southern end of the lease averaged about 3oz. to the ton, but this is now about worked out. The average yield from the stone in the lode between the No. 1 and No. 2 levels has been about 13dwt. of gold per ton. The stone is conveyed to the crushing-battery, erected in Rainy Creek, by an aerial tramway 70 chains in length.

Keep It Dark Company.—The returns from this company's mine have not come up to those of former years, but it is expected that a good block of stone will be obtained below the bottom level. During last year the workings have been chiefly confined to the upper levels, which in the early days of this company were considered too poor to work. About 5,081 tons of quartz has been crushed during last year, which yielded 1,769oz. of gold, representing a value of £6,900, out of which £1,000 has been paid in dividends. The main shaft is down to a depth of 500ft. and a subsidiary shaft sunk from the bottom level at 500ft. in from the main shaft for a distance of 120ft. and the whole of the stone stoped out. At 90ft. in the level from the bottom of the subsidiary shaft a winze has been sunk to a depth of 110ft., where the lode is 5ft. in thickness, and at the time of my visit this lode was being driven on from the bottom of the winze. The total quantity of gold obtained from this mine amounts to 58,220oz., representing a value of £226,506, out of which £107,583 has been paid in dividends.

No. 2 South Keep It Dark Company.—A shaft was sunk several years ago at the junction of this company's ground with the Pandora and South Wealth of Nations to a depth of 280ft. This shaft was sunk conjointly by these companies, but the two latter failed to get sufficient payable stone to continue working. The main level from the bottom of the shaft has been extended for 179ft., or a total distance of 563ft. from the shaft, where a good block of stone has been found, averaging about 2ft. in thickness. This has been driven on for a considerable distance. During the last year 1,347 tons of quartz has been crushed, which yielded 1,190oz. of gold, representing a value of £4,700, out of which £1,800 has been paid in dividends.

Cumberland Company.—This Company's mine is situated in vicinity of Merrijigs, and is one of the new mines in the field. Operations were only commenced about the middle of last year, when men were engaged to prospect the ground. After about one month's prospecting a lode was found on the eastern boundary of the ground, which was at first taken to be lying in almost a horizontal position. An adit-level was constructed about 30ft. below the outcrop, and the lode cut at about 130ft. in from the mouth, and on driving on the lode it was found to be nearly standing vertical, having a thickness of 10ft. in places, but the average width would be from 4ft. to 5ft. The lode has been driven on for 150ft., and 609 tons of stone has been crushed, which yielded 630oz. of gold, representing a value of £2,533 4s. 9d., out of which £1,200 has been paid in dividends. A tramway has been constructed from the mine to the Sir Francis Drake crushing-battery for a distance of about 83 chains, but after proving the mine it is contemplated to erect crushing machinery in Deep Creek, and to connect it with the mine by an aerial tramway.

Golden Treasure Company.—There is a good deal of antimony-ore in this company's mine, which contains on an average about 1½oz. of gold to the ton, but, owing to the difficulty of separation by the ordinary battery process, it cannot be made to pay. This class of ore is found in five different portions of the mine, varying from 2ft. to 10ft. in thickness. Assays have been made of some of the ore, which showed it contained 45 per cent. of pure antimony. Two tons of ore have been sent to Germany, and 10 tons to Auckland, for treatment, but the results are not yet known. During the past year 700 tons of stone has been crushed, which yielded 587oz. of gold, representing a value of £2,313 8s. 9d., out of which £900 was paid in dividends.

Wealth of Nations Company.—This company has spent between £4,000 and £5,000 in prospecting the mine, and have now come on a block of stone which promises to yield fair returns. Since the upper workings in the mine were abandoned, an adit-level has been constructed for 800ft. in length, and at the end of this adit a shaft has been sunk to a depth of 200ft., from which prospecting operations have been carried on. A cross-cut is made from the bottom of the shaft to cut the lode, but on driving 60ft. it was found that only a trace of a lode was discernible, the quartz had cut out, and only soft mullock left between the walls. After driving on the line of the lode for about 600ft. a little quartz was found. This level has now been constructed for a distance of 900ft., and the quartz is stoped out to a height of about 60ft. The width of the lode varies from 4ft. to 10ft. in thickness, and the stone yields from 4dwt. to 9dwt. per ton. For the last three years the company has been crushing the tailings which were stored in former years when the stone was taken from the upper levels. About 4,000 tons of these tailings have been treated, yielding gold to the value of about £5,000. During last year, 1,997 tons of quartz was crushed, which yielded 594oz. of gold, and the tailings treated yielded 101oz. of gold, representing a total value of £2,705 8s. 7d.

Fiery Cross Company.—This company's mine adjoins the South Hopeful and Welcome Mines. The workings are now carried down to a depth of 720ft. The main shaft is 450ft. deep, and from the level running from the bottom there is a subsidiary shaft from which the principal workings are carried on. Most of the stone above the 600ft. level has been taken out. A winze has been sunk from this level for a distance of 120ft. This subsidiary or monkey shaft has been sunk to same depth and connected with this winze, which has opened out what is considered a very valuable block of stone, and said to be better than any got on the upper levels. Prospecting has also been carried on in the level known as the Welcome Tunnel, and a lode about 3ft. in width has been struck,

which promises to be payable for working. The present prospects of this mine look extremely well, and it must be highly satisfactory to find that the gold in the lodes shows no diminution on going down. This is the deepest working in the districts where good gold-bearing stone has been found, and no doubt will be the means of giving an impetus to other companies to prospect other mines at deeper levels. During last year 1,722 tons of quartz has been crushed, which yielded 2,303oz. of gold, representing a value of £9,136 7s. 6d., out of which £3,225 has been paid in dividends. Taking the last nine years this company has been carrying on mining operations, 17,615oz. of gold has been taken from the mine, representing a value of £78,308, of which £18,525 has been paid in dividends, while the paid-up capital has been £13,169.

The Reefton district is one with a great future before it. Quartz-mining can only be said to be in its infancy, but capital is required to develop the mines. In former years the mines were not so systematically worked, and many of those who resided in other parts of the colony who invested their money in mining, got little or no returns. Shares were purchased far above their commercial value. Mining booms were got up, and it was only those persons residing on the spot and intimately acquainted with the workings who could reasonably be expected to pocket the profits. These booms are a great drawback to the mining industry, and should act as a warning to those interested in the mines in the locality where such booms take place to sell out their interests. It is almost certain that after every boom there comes a period of depression, when shares can be purchased for less than they were before it took place. Capital is not so easily procured for mining investments as it was a few years ago, and it behoves those that are interested in the mining industry to see that the mines are worked on commercial lines, and that no new ventures are offered to those who have capital to invest, unless there is good reason to believe that such properties will return fair interest on the capital invested. Mining is looking better in this district than it has for some years past, and it would be well if mining companies were to create reserve funds out of the profits, instead of paying the whole away in dividends.

When some of the mining companies come to be analysed they do not produce a favourable impression on the outside public, nor show a healthy aspect. Take, for example, the Inglewood Company, who declared £1,200 in dividends the previous year, while this year calls were made to the amount of £200; and the Scotia Company paid £3,000 in dividends, while during last year calls were made to the extent of £1,100 for prospecting the ground. This shows that the ground was not properly prospected to justify dividends being paid. It really means that the payment of dividends tends to raise the price of shares beyond their commercial value, and is the means of many a mining company being brought into liquidation without their mines having been prospected, and properties are thrown away which otherwise might become ultimately profitable investments. If all the companies in the Reefton district be taken into consideration that have been working lodes and getting quartz crushed during the four years ending the 31st March last, mining will bear a favourable comparison with any other industry. The following statements will show the list of the companies that have had quartz crushed during that period:—

Name of Company.	Calls made.	Dividends paid.	Stone crushed.	Yield.	Value.
	£ s. d.	£	Tons.	Oz.	£ s. d
Welcome	1,725 0 0	6,750	3,326	7,131	28,207 10 6
Hopeful Extended...	103 2 6	...	195	397	1,289 16 0
Specimen Hill	3,503 0 0	...	298	199	769 12 0
Big River	7,450 0 0	...	1,210	995	3,893 6 8
Progress	900 0 0	7,200	19,190	8,745	34,945 12 8
Lone Star	3,100 0 0	...	220	75	291 12 0
Nil Desperandum	3,641 13 4	...	1,219	522	2,026 19 6
Reform	1,650 0 0	...	668	423	1,642 8 6
Fiery Cross	2,812 10 0	9,825	7,735	8,781	34,754 4 1
Just in Time	1,283 6 8	5,600	4,868	4,770	18,848 6 1
Pandora	1,000 0 0	...	370	372	1,458 10 0
Inkerman	4,500 0 0	4,000	6,541	5,211	20,366 7 0
Hercules...	1,709 0 0	300	294	269	1,061 3 3
Sir Francis Drake...	3,750 0 0	...	2,515	525	1,929 10 0
Walhalla	350 0 0	...	238	354	1,396 5 3
Happy Valley	1,300 0 0	...	127	29	110 19 1
Venus Extended	2,900 0 0	2,100	4,737	2,927	11,369 13 10
South Keep It Dark	2,900 0 0	2,400	1,767	1,546	6,089 0 0
Wealth of Nations	4,875 10 0	...	2,182	1,436	5,457 0 1
Keep it Dark	...	23,500	27,427	11,930	46,933 0 0
Globe	1,800 0 0	28,300	24,501	15,561	61,466 0 0
Inglewood Extended	2,900 0 0	1,500	4,220	2,287	8,797 0 6
Scotia	2,300 0 0	3,000	593	1,272	5,016 16 6
Energy	...	...	2,848	1,177	4,571 0 0
Golden Treasure	3,100 0 0	900	1,450	964	3,788 8 9
Merrijigs...	900 0 0	...	85	35	167 0 0
Gallant	1,950 0 0	...	674	141	541 11 0
Golden Lead Gold-mining Company ...	400 0 0	...	52	67	262 11 2
National	800 0 0	...	66	12	46 13 9
Sir Charles Russell	500 0 0	...	17	34	119 10 0
Cumberland	600 0 0	1,200	609	630	2,533 4 9
Royal	900 0 0	...	22	15	57 15 3
A1	...	...	6	124	484 0 0
	65,594 2 6	96,575	120,270	78,956	310,692 7 8

This shows that during the last four years the mines that have been opened up or partially opened up in the district have yielded 78,956oz. of gold, representing a value of £310,692 7s. 8d., out of which dividends amounting to £96,575 have been paid, while during the same period calls were made amounting to £65,594. This shows a clear profit on the working of the mines for the four years of £30,981. The foregoing list does not, however, show the whole of the mining companies that have been formed, but merely those whose mines have been partially opened up and are working the lodes. It shows the whole of the quartz crushed during the period mentioned.

The following is also a list of the mining companies that have been formed, some of which have never done anything towards prospecting the ground they took up, and it is questionable whether a good many of them are still in existence. It will be seen that out of the fifty-one companies on the list thirty-two were not returned in the list furnished by the Warden of the district as being in existence, or at least carrying on mining operations during the last year, and, judging from the small amount of calls made by many of these companies, very little, if any, actual mining work has been done. On the other hand, some of these companies have done a considerable amount of prospecting work, but the returns furnished by the Warden do not show that any quartz has been crushed by any of them for the last four years.

Name.	Calls.			Companies not returned last Year marked "N."	Name.	Calls.			Companies not returned last Year marked "N."
	£	s.	d.			£	s.	d.	
Phœnix Extended ...	766	13	4	N.	South Wealth of Nations	1,000	0	0	N.
Multum in Parvo ...	350	0	0	N.	Lord Edward	200	0	0	N.
Eclipse	600	0	0	N.	Mount Morgan	150	0	0	N.
Bannockburn	250	0	0	N.	London	250	0	0	N.
Homeward Bound ...	4,000	0	0	...	Supreme	3,283	6	8	N.
North Venus ...	300	0	0	N.	Hard to Find	900	0	0	...
Golden Point	250	0	0	N.	Londonderry	50	0	0	N.
Dauntless	450	0	0	...	Lonehand	50	0	0	N.
Rainy Creek Extended ...	1,100	0	0	N.	Maori Chief	100	0	0	N.
Eureka Extended ...	2,800	0	0	N.	Murray Creek	666	13	4	...
Suez	100	0	0	N.	Resolution	400	0	0	...
Chicago	700	0	0	N.	Reward	200	8	0	N.
Britannia Extended ...	154	3	4	N.	Triumph	450	0	0	...
Inangahua Low-level Tunnel	1,750	0	0	...	O.K.	100	0	0	N.
					Edinburgh	100	0	0	N.
South Hopeful	2,133	6	8	...	Alexandra	200	0	0	N.
Britannia	416	13	4	N.	All Nations	400	0	0	N.
Royal Oak	250	0	0	N.	Prima Donna	200	0	0	N.
Morning Star	200	0	0	N.	Guide	100	0	0	N.
General Gordon	550	0	0	...	New Britannica ...	312	10	0	N.
United Devonshire ...	1,090	16	8	...	Golden Lead ...	2,700	0	0	...
Fraternal	300	0	0	N.	Oi Polloi	100	0	0	...
Caledonian Extended ...	483	6	8	...	Exchange	400	0	0	...
Prince of Wales	100	0	0	N.	Blue Sky	100	0	0	...
Argosy	1,310	10	0	...	New Golden Point ...	100	0	0	...
Empress	450	0	0	...					
Golconda	200	0	0	N.	Total	33,568	0	0	

OTAGO DISTRICT.

NENTHORN.

The quartz reefs in this field have not turned out according to expectations, a great many persons having lost large sums in prospecting as well as in placing machinery on the field. About two years ago the discovery of gold-bearing lodes in this locality caused considerable excitement amongst mining men and others in Otago, and those who had a little money eagerly took up shares, and bought at high prices. Four crushing-plants were erected, and everything looked in a prosperous state. Gold was found on the outcrop of a very large number of small lodes running parallel with each other and comparatively only a short distance apart. The prospects on these outcrops were encouraging, and gold was carried down from 30ft. to 100ft. in some of the claims; but crushing-machinery was erected before scarcely any prospecting was done. People imagined that a new Eldorado was discovered, and that it was only losing time to prospect the ground thoroughly before erecting plants. But the state of affairs, unfortunately, presents a different aspect now. About sixty of the licensed holdings that were taken up have been cancelled, and several companies put into liquidation.

The Crœsus Company, which was the first to erect machinery on the field, did a considerable amount of work, and the lode proved payable down to a depth of about 60ft., the average yield being from 15dwt. to 1oz. of gold per ton. The shaft was sunk to a depth of 100ft., and a level on the lode driven for 400ft.; but a great portion of the lode carried little or no gold, at least not sufficient to pay for working; the lode being from 12in. to 18in. in thickness, and there was also a greater quantity of water to contend with than the small pumping-plant could manage. The crushing-battery was erected about two and a half miles from the mine, and the cost of carting and crushing the stone being from 20s. to 25s. per ton, it took rich ore to pay for working. This company had to suspend operations owing to their creditors putting it into liquidation.

The Blue Slate Company, which held the adjoining claim to the westward of the Crœsus, got some very rich stone near the surface, which induced them to erect a crushing-plant; but this class

of stone did not continue to any depth. A shaft was sunk to a depth of 80ft., but the lode was too poor for working, and the ground has been abandoned.

The Victoria Company worked a lode running parallel with the Crœsus, and only about five chains apart. Some of the stone near the surface in a trial test yielded over 3oz. of gold to the ton, but on sinking down the stone became poorer. This company and the Consolidated Company erected one of the best small crushing-plants there is in the Middle Island, which is said to have cost over £6,000; but the Consolidated Company never found any lode in the ground that would pay for working, and, consequently, the greater portion of the cost of the plant fell on the Victoria Company, as they were jointly responsible for the liabilities. After this plant was erected the latter company crushed 600 tons of stone, which gave very small returns. The liabilities being heavy the creditors put the company into liquidation. The property was sold to Messrs. Inder and Mitchell, of Naseby, for about £600, who intend crushing all the stone which is now lying on the surface.

The Break-of-Day, Prospectors', and other claims, of which great expectations were entertained and almost realised, are now things of the past. The Break-of-Day Company had about 250 tons of quartz on the surface ready to send to the battery, but as this company was involved with the Victoria when the crash came it had to be put into liquidation, and, consequently, never had a chance to test the stone to ascertain whether it was of a payable character or not. The Prospectors' had a small crushing-plant, and treated about 800 tons of stone, but the lode as it went down got too poor to pay for working, and they sold the plant to another company.

The Eureka Company is the only one successful so far. A shaft has been sunk to a depth of 200ft., and a level constructed at this depth for 300ft. on the lode. About 300 tons of quartz has been crushed, which has yielded about 1½oz. of gold per ton. The company have recently purchased the public crushing-plant, and now expect to get fair returns from the mine.

The prospects of the Nenthorn field look gloomy at present, but some good reefs may yet be discovered. The lodes here in general do not carry gold to any depth, at the same time they have not been sufficiently prospected. The whole field is a mass of parallel leaders or gash-veins of quartz—they cannot properly be termed lodes—a short distance apart; these may be found at some depth to join together and form a good lode; but the fact of the gold getting gradually less as these leaders go down does not hold out much inducement to incur a large outlay in prospecting at deep levels. However, there are now plenty of crushing-plants on the field, and every facility to test parcels from different places, which could not be done at a small cost in the early days of the field.

The quartz-workings at Deepdell Creek have not turned out according to expectations. The crushing-battery erected by the Golden Point Company has been sold, and the purchaser intends giving the reef another trial. Between Macrae's and Nenthorn a large lode is being worked by the Bonanza Company, who purchased the Prospectors' crushing-plant at Nenthorn and erected it on their claim at the side of a tributary of the Stoneburn Creek. About 600 tons of quartz is said to have been crushed for a yield of 638oz. of gold, which enabled the company to pay £900 in dividends. The stone is heavily impregnated with iron pyrites, and is said to be rich in gold.

Cromwell.

There is very little quartz-mining in this district. The Carrick Range, from which some rich stone was got in the early days, is now nearly deserted; only two parties are said to be getting gold. Eighty tons has recently been taken from the ground formerly held by the Elizabeth Company, which is said to have yielded about 1oz. of gold per ton. Mr. E. Lawrence is carrying on constant operations in his mine; but the quartz is stated to be of low grade, requiring a cheap method of crushing to make it pay.

Cromwell Company.—This company has been for several years sinking a new shaft, which is now down to a depth of 520ft., where a chamber is opened out, and a cross-cut level constructed for 197ft. to cut through the country and prospect the ground. At 132ft. from the shaft a small gold-bearing leader was cut, and followed for a distance of 51ft. to the westward, where it has widened out to about 18in. thick. A very large amount of gold was taken from this mine in the early days, and it was worked down to a depth of 420ft. But the manner in which the workings were formerly carried on and blocks of stone left, together with reports that rich gold-bearing quartz was left under foot in the bottom level, induced the present company to take up the ground and sink a new shaft; but so far they have not been successful in finding anything likely to pay them for the large outlay. The ground is extremely hard, and there is a good deal of water at the low levels, requiring the pump, which is 9in. in diameter, to be kept constantly going.

Wakatipu.

The quartz-mines in this district have been more vigorously worked than in the previous year. A good deal of prospecting has been done and works of a preparatory character constructed to admit of the mines being worked and the quartz crushed and treated at a minimum cost. The lodes are not what may be termed rich in gold, but, with improved labour-saving appliances, systematic working, and economy, many of the quartz-mines will become valuable properties. Nothing like the same amount of prospecting for auriferous lodes has been done in this district as has been carried on at Reefton and the Thames. Although the quartz-reefs at Skipper's were the first worked in the colony, comparatively little prospecting has been done, excepting by the Phœnix Company; both Skipper's Creek and the Shotover River have contributed a large quantity of gold from the drift-wash, and a great deal of the gold found in the drift is intermixed with quartz. Whether it came originally from quartz-lodes which have been denuded from the tops of the mountains, or merely from the quartzose schist rocks of which this part of the country is formed cannot be determined, but the inference is that the gold came both from the denudation of the mountains and from the scooping-out of the valleys, river-beds, and gullies by the action of water. Be that as it may, the apparent reason of the country not being prospected for auriferous lodes is that a large area of the rich alluvial drifts in Otago were easily and cheaply worked, and attracted the attention of miners and others more than quartz-workings.

Phœnix Company.—This company's mine is situate near the junction of Skipper's and Murdoch's Creek, at the base of Mount Aurum. The workings in this mine date from 1863, when it

was discovered by Sorenson and party, and was the first quartz-reef worked in the Middle Island. In 1868 the property was purchased by Mr. Bullen, who has held the mine ever since and has taken a considerable quantity of gold out of it. There are three auriferous lodes in the ground, or it may be more correctly said that these are in one lode-course, having a total width of about 120ft. The lodes are running in almost parallel directions, and possibly may be found to come together and form one lode at the deep levels. Were such to take place a rich shoot of gold-bearing stone might be expected. The auriferous shoots of gold in the lodes have been stoped out in the old workings on the east side of Murdoch's Creek to the water-level and for some distance below it. About four years ago a company took up the ground on the west side of Murdoch's Creek adjoining the Phœnix Company's ground; a shaft was sunk to a depth of 150ft., from the bottom of which a cross-cut was made southwards for a distance of 100ft., without meeting with any lode. Shortly after this the company went into liquidation, when the Phœnix Company purchased the property, and constructed a drive to the northwards from the bottom of the shaft, where it cut a lode about 9ft. in thickness containing stone which showed gold freely. It is from this shaft that the workings are now carried on. The shoot of gold has been proved on each side of the cross-cut or drive from the shaft for a distance of about 50ft., and it has also been proved to a height of 100ft. above the level, and a winze has been sunk from this level for a distance of 100ft., showing the same class of stone. But the other two lodes which were worked in this ground at a higher level on the east side of the creek have not yet been met with.

As far as can be ascertained there has been about 20,479oz. of gold taken out of the mine since it was first opened, namely, 1,500oz. by the original holders and 18,979oz. since Mr. Bullen purchased the property twenty-three years ago. During last year about 3,100 tons of quartz was crushed, which yielded 1,907oz. 16dwt. of gold, being an average yield of 12dwt. 7gr. of gold per ton. The total value of gold obtained from this mine is about £78,844.

An electric-power plant is erected in what is known as the left branch of Skipper's Creek, about one mile and three-quarters from the crushing-battery, consisting of two brush dynamos, driven by two Pelton hurdy-gurdy wheels each 6ft. in diameter. This plant is erected near the foot of a fall about 170ft. in height, over which the water is taken to work the Pelton wheels. The electrical force is conveyed by a copper wire to a Victorian motor in the battery-building which drives the machinery, consisting of thirty heads of stamps, two air-compressors, and rock-breaker. When the whole of the machinery is at work the motive-power is barely sufficient to work the crushing-plant at the proper speed. The winding is done by compressed-air. It is said that a current of thirty-seven amperes, having an electro motive force of 1,100 volts, would give all the necessary power required to work the machinery to its proper speed, which is equal to 54½ horse-power; this, however, does not seem to give sufficient power to work the whole of the machinery.

This property with careful and economical management ought to be a valuable one. The average yield of quartz is nearly the same as that from the Globe Mine in the Reefton district, and the thickness of the lode is similar. The dividends paid by the company owning that mine last year amounted to £12,100. There is every reason to believe that the lodes of the Phœnix Company's property will extend in towards Mount Aurum as well as underneath the old workings; but it is not to be expected that any of these lodes will carry payable ore for a long distance continuously; there will be breaks in the lodes, and gold will occur here and there in shoots and ledges. This requires systematic prospecting to be continually going on while these shoots of ore are being worked.

Gallant Tipperary Company.—This company had their crushing-battery thoroughly overhauled and put in good repair—new tables and also a Pelton wheel have been erected in lieu of the turbine formerly used. The work in the mine is carried on from the main adit-level, which is constructed for a distance of about 950ft. The lode above this level has been stoped out to a height of 178ft., and stoping is still going on. The lode is about 4ft. in thickness, and eight men are employed, who are able to take out sufficient stone to keep the crushing-plant fully employed; about 165 tons of quartz a week is crushed.

Sunrise Company.—This company's mine is situate on Advance Peak, at an elevation of over 5,000ft. above sea-level. A new adit-level has been driven about 700ft., but it has not yet cut the lode they were working on in the upper levels. A new lode was, however, cut at about 300ft. in from the mouth of the adit, which is about 2ft. 6in. in thickness, yielding on an average 1oz. 5dwt. of gold to the ton of quartz. At 100ft. farther in than this another block of stone was cut richer than the other. A winze has been sunk for 30ft. on this block, and equally as good gold found. A crushing-battery of ten heads of stamps has been erected at the side of the right branch of the Macetown Creek, a little below the Premier battery, and the quartz is conveyed from the mine down the range to the crushing-plant in large boxes mounted on low wheels at the front end with a sleigh at the back; these boxes hold about 30cwt. each. The company had cleaned up a crushing of 147 tons before my visit, which yielded 183oz. of gold, and there was about 210 tons on the surface ready to send to the battery.

Premier Consolidated Company.—This is a new company formed in London, who have purchased the Premier Mine and plant belonging to the old company. It is said that the available capital left to prospect and work the mine is £11,000, after paying for the property and the expenses of floating the company. A low-level is being constructed from the level of the creek, and it is from this level that the future workings of the mine will have to be carried on; but, as it will take a considerable time to get this level constructed to cut the reef, the workings in the meantime are being carried on from the upper level.

There is no work being done on any of the other quartz-claims. Many of them have been held for years without any prospecting being done: amongst these may be mentioned the Homeward Bound, Golden Link, Ladye Fayre, North Tipperary, Garibaldi, New All Nations, Maryborough, Batchelors', Victor Emmanuel, and Black Angel.

Invincible Quartz Company.—This company purchased the property of a company of almost the same name, which had been working the ground for about seven years. At first the workings were carried on with success, and dividends to the amount of about £3,000 have been paid; but afterwards they could not find any more payable stone. An inclined shaft has been sunk for 200ft., but the operations had to be suspended owing to the influx of water. The present company are now erecting pumping-machinery to keep the water down, so that they can prospect the mine at deeper levels.

STATEMENT of AFFAIRS of MINING COMPANIES as published in accordance with "The Mining Companys Act, 1886," and Amendment Act, 1890.

AUCKLAND DISTRICT.

Name of Company.	Date of Registration.	Number of Shares.	Number of Shares allotted.	Nominal Capital.	Subscribed Capital.	Value of Scrip given to Shareholders.	Amount of Capital actually paid up.	Amount paid up per Share	Number of Shares forfeited.	Arrears of Calls.	Amount of Dividends paid.
				£	£ s. d.	£ s. d.	£ s. d.	£ s. d.		£ s. d.	£ s. d.
Tokatea	30 Sept., 1869	20,000	14,851	100,000	80,000 0 0	67,200 15 6	9,636 1 4	0 10 6	5,149	..	63,625 0 0
New Prince Imperial	23 Dec., 1881	18,000	18,000	18,000	18,000 0 0	..	2,250 0 0	0 2 6	..	..	60,742 16 0
Woodstock United	14 Jan., 1890	55,000	52,568	27,500	26,284 0 0	10,513 12 0	..	..	..	..	..
New Alburnia	26 Aug., 1885	20,000	20,000	10,000	10,000 0 0	1,000 0 0	1,500 0 0	0 0 6	..	..	500 0 0
Silverton	4 Feb., 1886	24,000	24,000	12,000	12,000 0 0	..	600 0 0	0 0 6	..	..	600 0 0
Norfolk	24 April, 1889	50,000	4,995	25,000	24,997 10 0	12,500 0 0	2,226 19 6	..	500	47 17 2	..
Saxon	2 Dec., 1884	50,000	50,000	25,000	25,000 0 0	750 0 0	4,032 6 8	..	..	..	15,416 13 4
Success	4 Nov., 1890	60,000	57,000	15,000	14,250 0 0	..	..	..	..	..	..
New Moanataiari	16 Nov., 1888	50,000	49,910	25,000	24,955 0 0	2,670 0 0	9,858 8 0	..	..	36 4 0	..
Little Ned	26 Sept., 1890	40,000	36,000	10,000	9,000 0 0	2,400 0 0	368 15 0	..	..	81 5 0	..
Lonehand	22 Mar., 1889	30,000	30,000	15,000	15,000 0 0	500 0 0	354 1 3	..	..	8 8 9	..
Blanche	10 April, 1885	50,000	50,000	25,000	25,000 0 0	1,458 6 8	1,117 4 1	..	8,090	..	..
New Fearnought	22 July, 1886	50,000	50,000	25,000	25,000 0 0	1,458 6 8	1,234 5 8	..	9,750	..	..
Puhipuhi Prospectors'	18 July, 1890	53,360	43,755	26,680	21,877 10 0	10,005 0 0	624 10 0	..	..	122 10 0	..
Trenton	4 Sept., 1885	36,000	36,000	18,000	18,000 0 0	..	8,389 15 6	..	..	164 6 0	..
Adeline Amalgamated	3 Sept., 1888	50,000	47,744	25,000	23,872 0 0	..	933 1 1	..	3,867	397 17 4	..
May Queen	4 Mar., 1889	50,000	50,000	25,000	25,000 0 0	..	1,666 13 4	..	..	..	..
Vizard's	8 Sept., 1890	40,000	40,000	10,000	10,000 0 0	..	83 1 3	..	..	83 12 1	..
Diamond	1 Sept., 1890	50,000	48,000	10,000	9,600 0 0	..	..	..	..	..	..
Red Mercury	22 April, 1890	30,000	30,000	7,500	7,500 0 0	937 10 0	921 11 3	..	..	15 18 9	..
Pride of Karaka	21 Oct., 1890	35,000	32,000	8,750	8,000 0 0	2,000 0 0	393 15 0	..	..	12 10 0	..
Try Fluke	3 Sept., 1889	50,000	50,000	12,500	12,500 0 0	..	1,250 0 0	..	..	..	3,750 0 0
Mariposa	28 Feb., 1890	50,000	50,000	12,500	12,500 0 0	..	342 4 9	..	..	74 8 7	..
Occidental	2 Oct., 1890	100,000	100,000	25,000	25,000 0 0	..	..	..	..	..	..
New Manukau	10 Feb., 1883	30,000	30,000	30,000	30,000 0 0	..	1,500 0 0	..	..	..	..
Caledonian	7 Feb., 1889	24,000	24,000	6,000	6,000 0 0	..	3,600 0 0	..	..	..	..
Prosperity	22 Sept., 1890	35,000	30,000	8,750	7,500 0 0	1,500 0 0	423 15 0	..	..	138 15 0	..
Hazelbank	13 Sept., 1890	42,000	42,000	10,500	10,500 0 0	2,100 0 0	787 10 0	..	..	..	..
Magnolia	16 Feb., 1883	15,000	15,000	15,000	15,000 0 0	..	1,875 0 0	..	..	..	..
Dives	12 Aug., 1889	30,000	30,000	6,000	6,000 0 0	..	174 6 3	..	..	200 13 9	..
Victoria	20 Sept., 1890	100,000	100,000	20,000	20,000 0 0	2,500 0 0	2,500 0 0	..	..	..	..
Consols	16 Sept., 1890	50,000	50,000	50,000	25,000 0 0	..	371 6 8	..	..	44 6 8	..
Golden Gate	30 Oct., 1890	50,000	39,200	12,500	9,800 0 0	..	..	..	..	..	..
Cambria	4 Jan., 1884	44,700	44,700	44,700	44,700 0 0	12,851 0 0	1,181 5 0	..	..	..	79,357 10 0
Jubilee	24 Sept., 1890	50,000	32,850	10,000	6,560 0 0	..	..	..	..	..	..
Oriental	26 Sept., 1890	40,000	40,000	10,000	10,000 0 0	..	..	..	..	..	..
Wairoa	18 Aug., 1890	40,000	40,000	10,000	10,000 0 0	..	148 17 7	..	..	17 15 9	..
Waitara	8 July, 1890	60,000	60,000	15,000	15,000 0 0	..	..	..	..	26 10 0	..
Perseverance	15 Sept., 1890	36,000	30,000	9,000	7,500 0 0	..	..	..	..	..	..
Keystone	15 Sept., 1890	50,000	38,556	12,500	11,250 0 0	..	..	..	..	..	..
Victory	15 Sept., 1890	50,000	45,000	12,500	11,250 0 0	..	..	..	..	..	..
Just in Time	17 Sept., 1890	60,000	60,000	15,000	15,000 0 0	..	..	..	..	135 8 5	..
South Kapanga	11 Feb., 1887	20,000	20,000	10,000	10,000 0 0	2,000 0 0	1,621 13 2	..	14,017	158 1 9	..

STATEMENT of AFFAIRS of MINING COMPANIES as published in accordance with "The Mining Companies Act, 1886," and Amendment Act, 1890—*continued.*

AUCKLAND DISTRICT—*continued.*

Name of Company.	Date of Registration.	Number of Shares.	Number of Shares allotted.	Nominal Capital.	Subscribed Capital.	Value of Scrip given to Shareholders.	Amount of Capital actually paid up.	Amount paid up per Share.	Number of Shares forfeited.	Arrears of Calls.	Amount of Dividends paid.
				£	£ s. d.	£ s. d.	£ s. d.	£ s. d.		£ s. d.	£ s. d.
Star of Waiareka	9 Sept., 1890	40,000	27,500	10,000	6,875 0 0	..	687 10 0	..	..	..	..
Puhipuhi Caledonian	3 Oct., 1890	40,000	28,000	10,000	7,000 0 0	2,370 0 0	430 0 0	..	..	..	..
Kuaotunu Bonanza	18 April, 1890	30,000	25,000	30,000	25,000 0 0	12,500 0 0	203 3 7	..	..	109 6 5	..
Arizona	15 Sept., 1890	30,000	25,000	7,500	6,250 0 0	..	..	..	..	..	..
Wheal Prosper..	30 Sept., 1890	50,000	45,000	12,500	11,250 0 0	..	..	..	..	..	..
Tupono	28 Nov., 1890	30,000	20,000	15,000	10,000 0 0	..	1,031 17 4	..	3,500	90 12 6	..
Young Colonial	13 Oct., 1890	30,000	20,000	15,000	10,000 0 0	..	1,000 0 0	..	4,000	61 8 3	..
Puhipuhi No. 2	28 Nov., 1890	33,300	22,200	8,325	5,550 0 0	..	1,052 0 8	..	..	..	..
Great Mercury Proprietary	19 Sept., 1890	60,000	60,000	18,000	18,000 0 0	7,500 0 0	2,580 0 0	..	..	420 0 0	..
Leopold	19 Sept., 1890	54,000	54,000	13,500	13,500 0 0	..	..	..	..	..	..
Alfred..	7 Oct., 1890	54,000	54,000	13,500	13,500 0 0	..	..	..	..	..	..
Kuaotunu	24 Sept., 1890	50,000	50,000	12,500	12,500 0 0	..	..	..	..	60 12 6	..
Waiotahi	1 Aug,, 1871	6,000	6,000	18,000	18,000 0 0	..	15,000 0 0	..	..	..	24,000 0 0
City of Dunedin	6 May, 1890	50,000	46,550	25,000	23,275 0 0	..	140 12 6	..	..	53 6 8	..
Kuaotunu Quartz-crushing	24 July, 1890	10,000	5,000	5,000	2,500 0 0	..	1,598 10 0	..	..	401 10 0	..
Champion	Oct., 1888	75,000	57,323	75,000	57,323 0 0	43,000 0 0	1,005 10 0	..	1,000	3,317 10 0	..
Hauraki	17 Oct., 1890	45,000	45,000	11,250	11,250 0 0	..	387 10 0	..	..	..	..
Silvia	16 June, 1890	100,000	100,000	100,000	100,000 0 0	69,350 0 0	10,650 0 0	..	..	125 0 0	..
Royal Oak	5 June, 1871	18,000	8,000	34,500	28,734 0 0	..	3,308 7 3	..	9,245	12 8 6	7,773 19 0
Owera..	8 Sept., 1890	50,000	40,450	12,500	10,112 10 0	6,067 10 0	166 0 10	..	..	0 12 6	..
Excelsior	8 Sept., 1890	50,000	45,000	12,500	11,250 0 0	..	..	..	..	..	..
Hongkong	8 Oct., 1890	30,000	28,800	7,500	7,200 0 0	..	..	..	..	..	..
Shotover	8 Sept., 1890	40,500	36,390	10,825	9,097 10 0	..	..	..	..	..	..
Flying Cloud	8 Sept., 1890	50,000	50,000	12,500	12,500 0 0	..	92 13 9	..	..	115 12 11	..
Crackshot	20 Nov., 1890	50,000	43,750	12,500	10,937 10 0	..	..	..	..	..	..
Lady Carrington	23 June, 1890	50,000	50,000	12,500	12,500 0 0	..	..	..	..	..	..
Junction	21 June, 1890	30,000	30,000	7,500	7,500 0 0	..	74 3 4	..	..	175 16 8	..
Kapai..	17 Sept., 1890	50,000	50,000	12,500	12,500 0 0	..	323 15 0	..	..	92 18 4	..
Souvenir	11 Sept., 1890	50,000	40,000	12,500	10,000 0 0	..	..	..	..	..	..
Pinfire	8 Sept., 1890	50,000	50,000	12,500	12,500 0 0	..	..	..	..	..	..
John Bull	4 Sept., 1890	50,000	50,000	12,500	12,500 0 0	..	..	..	..	..	..
Orlando	2 April, 1890	40,000	40,000	10,000	10,000 0 0	..	489 7 6	..	..	10 12 6	..
Calliope	8 Sept., 1890	50,000	50,000	12,500	12,500 0 0	..	..	..	..	..	..
Carbine	21 May, 1890	50,400	50,400	25,200	25,200 0 0	..	450 0 0	..	..	..	..
Golden Age	10 Sept., 1890	25,000	24,200	6,250	6,050 0 0	..	..	..	..	..	..
Mount Edward	10 Sept., 1890	45,000	45,000	11,250	11,250 0 0	..	174 15 0	..	..	387 15 0	..
Mountain Flower	10 Sept., 1890	60,000	57,000	15,000	14,250 0 0	..	..	..	..	..	..
Pride of the Hill	17 Sept., 1890	50,000	50,000	12,500	12,500 0 0	..	..	..	..	..	..
Orient	1 May, 1890	50,000	42,000	12,500	10,500 0 0	..	..	..	..	..	..
Maori Pa	17 Sept., 1890	42,000	10,500	10,500	10,500 0 0	..	..	..	..	..	..
Victoria Kuaotunu	17 Sept., 1890	50,000	50,000	12,500	12,500 0 0	..	..	..	..	..	..
Nemesis	25 Mar., 1890	40,000	40,000	20,000	20,000 0 0	..	166 13 4	..	..	46 13 4	..
Stanley	18 Aug., 1890	36,000	36,000	9,000	9,000 0 0	..	..	..	..	..	..

Freedom	18 Mar.,	1890	24,000	24,000	6,000	6,000 0 0	..	441 5 10	..	..	158 14 2	..
Midas	31 Aug.,	1890	50,000	37,500	6,250	4,687 10 0	..	..	..	..	..	..
Fall's Creek	20 Nov.,	1888	25,000	25,000	12,500	12,500 0 0	..	136 6 1	..	..	86 1 8	..
Waihi	7 Dec.,	1887	100,000	85,150	100,000	85,150 0 0	(Not given)	(Not given)	..	..	..	..
Crawford Special	15 Jan.,	1890	35,000	35,000	35,000	35,000 0 0	20,000 0 0	3,127 10 0	..	1,000	247 10 0	..
			4,016,260	3,670,842	1,710,730	1,561,088 0 0	295,232 0 10	106,684 18 6	..	60,118	7,738 10 11	255,765 18 4
NELSON DISTRICT (including West Coast).												
Royal	2 June,	1888	24,000	24,000	24,000	13,400 0 0	12,000 0 0	1,300 0 0	0 1 2	..	100 0 0	..
Fiery Cross Extended	27 Sept.,	1879	32,250	32,250	32,250	30,100 0 0	19,081 5 0	11,018 15 0	0 8 8	..	..	18,525 0 0
Johnston United	27 June,	1881	20,000	20,000	20,000	18,584 11 6	1,668 0 0	12,409 5 11	0 15 11½	8,209	..	135 1 6
Wakamarina Gorge	9 April,	1888	3,500	2,865	3,500	2,865 0 0	279 0 0	2,507 0 0	1 0 0	445	74 17 6	..
Wealth of Nations	21 Aug.,	1889	32,500	32,500	32,500	1,762 10 0	..	17,062 10 0	..	..	..	..
Keep-it-Dark	2 Mar.,	1874	20,000	20,000	20,000	20,000 0 0	10,000 0 0	2,625 0 0	..	..	..	104,666 13 4
South Keep-it-Dark, No. 2	13 June,	1887	24,000	24,000	12,000	12,000 0 0	..	4,600 0 0	..	..	..	1,000 0 0
Globe	8 Aug.,	1882	36,000	36,000	18,000	18,000 0 0	..	14,775 0 0	..	..	..	29,250 0 0
Homeward Bound Extended	3 Sept.,	1883	24,000	24,000	24,000	24,000 0 0	12,000 0 0	7,058 18 7	..	30	91 1 5	..
Golden Lead	30 Oct.,	1890	24,000	24,000	12,000	12,000 0 0	..	560 15 0	..	..	639 7 0	..
Gallant	7 Feb.,	1888	24,000	24,000	12,000	12,000 0 0	..	2,547 7 11	..	250	52 12 1	..
Golden Treasure	4 Dec.,	1888	24,000	24,000	12,000	12,000 0 0	..	2,116 12 0	..	..	15 13 4	900 0 0
Specimen Hill United	10 June,	1884	20,000	20,000	20,000	20,000 0 0	..	9,037 0 9	..	..	129 12 7	..
Big River Extended	21 Jan.,	1882	24,000	24,000	24,000	24,000 0 0	..	11,657 2 7	..	..	342 17 5	..
Venus Extended	21 Aug.,	1885	24,000	24,000	24,000	24,000 0 0	12,000 0 0	3,674 11 8	..	16	25 8 4	2,700 0 0
Sir Charles Russell	5 May,	1890	24,000	24,000	12,000	12,000 0 0	..	273 15 0	..	..	26 5 0	..
Hercules	22 Nov.,	1889	24,000	24,000	24,000	24,000 0 0	..	1,415 12 1	..	13	84 7 11	300 0 0
Sir Francis Drake	10 June,	1887	24,000	24,000	12,000	12,000 0 0	..	8,550 0 0	..	..	155 19 2	..
Supreme	28 Sept.,	1888	28,000	24,000	14,000	12,000 0 0	..	2,865 19 7	..	2,400	334 0 5	..
Happy Valley	22 June,	1882	24,000	24,000	24,000	24,000 0 0	12,000 0 0	2,950 0 0	..	..	..	..
Pandora	2 May,	1887	24,000	24,000	6,000	6,000 0 0	..	1,339 17 9	..	..	40 8 4	..
Welcome	20 Aug.,	1875	30,000	30,000	30,000	30,000 0 0	..	8,609 17 6	..	..	390 2 6	110,250 0 0
Progress	26 Nov.,	1886	24,000	24,000	12,000	12,000 0 0	..	3,900 0 0	..	..	..	4,800 0 0
Caroline Terrace	25 Oct.,	1889	10,000	10,000	10,000	10,000 0 0	5,000 0 0	2,039 18 0	..	..	210 2 0	..
New Bendigo Extended	20 Sept.,	1890	42,000	42,000	21,000	21,000 0 0	..	..	..	..	..	..
Fair Maid	14 May,	1888	25,000	25,000	12,500	12,500 0 0	6,250 0 0	3,269 5 0	..	..	1,468 15 0	..
Argosy	22 April,	1887	3,000	3,000	15,000	15,000 0 0	..	1,546 0 0	..	8,300	16 0 0	..
Inglewood Extended	25 Aug.,	1882	24,000	24,000	12,000	12,000 0 0	..	8,000 0 0	..	..	..	2,700 0 0
United Italy	24 Mar.,	1882	24,000	24,000	24,000	24,000 0 0	12,000 0 0	4,150 0 0	..	7,033	..	900 0 0
Merrijigs	1 Mar.,	1888	24,000	24,000	12,000	12,000 0 0	..	1,330 0 0	..	500	70 0 0	..
Reform	22 June,	1885	24,000	24,000	12,000	12,000 0 0	..	4,140 0 0	..	8,750	40 0 0	..
Cumberland	10 July,	1890	24,000	24,000	24,000	24,000 0 0	..	526 12 0	..	..	73 8 0	..
Scotia	10 Feb.,	1888	24,000	24,000	12,000	12,000 0 0	..	2,075 11 6	..	1,066	24 8 6	3,000 0 0
Southern Cross	13 Aug.,	1889	1,400	1,400	14,000	14,000 0 0	1,400 0 0	897 18 4	..	550	1 0 10	..
Davis and Carr Terrace Sluicing	13 Mar.,	1890	2,000	1,383	2,000	1,589 15 0	725 0 0	138 15 0	..	..	1 5 0	..
Hibernian Extended	15 May,	1889	48	45	1,200	1,165 0 0	40 0 0	1,125 0 0	..	..	..	..
Exchange	16 May,	1890	24,000	24,000	6,000	6,000 0 0	..	142 16 8	..	..	157 3 4	..
Inangahua Low-level Tunnel	18 Oct.,	1880	24,000	24,000	12,000	12,000 0 0	..	5,850 0 0	..	2,876	..	..
Inkerman	9 Feb.,	1876	20,000	20,000	20,000	20,000 0 0	..	17,833 6 8	..	..	..	3,500 0 0
Just-in-Time	9 Oct.,	1872	28,000	28,000	28,000	28,000 0 0	..	15,983 6 8	..	..	52 18 4	17,166 13 4
Walhalla	22 Sept.,	1883	24,000	24,000	24,000	12,000 0 0	..	1,269 13 11	..	310	106 16 11	..
Resolution	9 Oct.,	1889	24,000	24,000	6,000	6,000 0 0	..	329 15 0	..	250	70 5 0	..
Caledonian Extended	20 Mar.,	1880	20,000	20,000	20,000	20,000 0 0	..	6,201 3 10	..	..	164 1 0	..
Reward	24 Aug.,	1888	24,000	24,000	6,000	6,000 0 0	..	250 0 0	..	450	11 5 0	..

STATEMENT of AFFAIRS of MINING COMPANIES as published in accordance with "The Mining Companies Act, 1886," and Amendment Act, 1890—*continued.*

Name of Company.	Date of Registration.	Number of Shares.	Number of Shares allotted.	Nominal Capital.	Subscribed Capital.	Value of Scrip given to Shareholders.	Amount of Capital actually paid up.	Amount paid up per Share.	Number of Shares forfeited.	Arrears of Calls.	Amount of Dividends paid.
NELSON DISTRICT (including West Coast)—*continued.*											
					£ s. d.	£ s. d.	£ s. d.	£ s. d.		£ s. d.	£ s. d.
South Pacific Extended	26 Oct., 1882	36,000	24,034	36,000	24,034 0 0	18,000 0 0	1,721 4 1	..	11,966	19 19 5	..
Kumara Long Tunnel	16 May, 1882	16,000	8,000	16,000	8,000 0 0	..	7,433 6 8	..	..	..	2,116 13 4
Mahakipawa	25 Oct., 1889	1,000	1,000	1,000	1,000 0 0	250 0 0	501 16 10	..	92	37 16 2	..
Beaconsfield	1 Oct., 1887	24,000	24,000	24,000	24,000 0 0	12,000 0 0	6,613 8 9	..	5,060	522 10 0	..
Totals	..	1,050,698	1,025,477	794,950	715,000 16 6	134,693 5 0	226,224 1 3	..	58,566	5,570 7 6	301,910 1 6
OTAGO DISTRICT.											
Bluespur and Gabriel's Gully Consolidated	1 Feb., 1888	130,000	90,000	130,000	90,000 0 0	60,000 0 0	30,000 0 0	1 0 0	..	..	..
Phœnix Water-race	12 Oct., 1867	1,000	1,000	1,500	1,500 0 0	..	1,500 0 0	1 10 0	..	..	5,419 14 0
Longwood Sluicing	15 Oct., 1888	200	190	2,000	1,906 0 0	120 0 0	1,373 6 3	1 0 0	..	..	..
Rees Valley Quartz	30 Aug., 1890	14,000	14,000	14,000	14,000 0 0	719 0 3	..	..	..	..	..
Roxburgh Amalgamated Sluicing	2 Mar., 1889	60,000	59,130	30,000	29,130 0 0	15,000 0 0	9,186 14 6	..	..	1,008 15 6	..
Prospectors'	13 July, 1889	12,000	12,000	12,000	12,000 0 0	..	1,676 5 0	..	..	123 15 0	..
Jutland Flat	2 July, 1890	15,000	15,000	15,000	15,000 0 0	3,750 0 0	1,000 0 0	..	..	..	..
Rescue	12 July, 1888	24,000	23,105	6,000	5,776 5 0	1,800 0 0	1,351 13 7	..	..	217 16 0	..
Tipperary	8 Mar., 1883	16,000	16,000	16,000	16,000 0 0	4,000 0 0	2,124 2 0	..	1,393	191 10 0	13,500 0 0
Eureka, Nenthorn	20 July, 1889	30,000	30,000	15,000	15,000 0 0	10,000 0 0	1,892 10 0	..	..	357 10 0	..
Amalgamated Waipori Deep-lead	20 Dec., 1889	12,500	12,050	12,500	12,050 0 0	6,150 0 0	4,258 14 6	..	..	97 10 6	..
Cromwell	14 Nov., 1889	110,000	108,051	110,000	108,051 0 0	97,218 18 0	4,050 15 9	..	..	70 15 3	..
Commissioner's Flat	25 Oct., 1889	30,000	26,124	15,000	13,062 0 0	5,000 0 0	7,533 15 0	..	..	528 5 0	..
Pioneer Extended Water-race	13 Oct., 1888	400	340	2,000	1,700 0 0	75 0 0	1,625 0 0	..	..	..	..
Premier	4 Aug., 1880	12,000	12,000	6,000	6,000 0 0	..	3,000 0 0	..	..	..	1,800 0 0
Rise and Shine	22 July, 1890	10,000	10,000	3,000	3,000 0 0	1,500 0 0	..	..	..	..	..
United Hercules	13 Aug., 1888	12,000	12,000	12,000	12,000 0 0	6,500 0 0	3,850 0 0	..	..	..	4,800 0 0
Barewood	4 Dec., 1890	12,000	7,500	12,000	7,500 0 0	7,500 0 0	..	..	..	..	..
Island Block	..	60,000	50,000	60,000	50,000 0 0	35,000 0 0	15,000 0 0	..	..	..	..
Mount Ida Waterworks and Hydraulic	7 Oct., 1889	8,000	3,000	8,000	3,000 0 0	..	1,643 15 0	..	..	6 5 0	..
Undaunted	Mar., 1878	120	120	9,600	9,600 0 0	..	..	..	..	..	..
Totals	..	569,220	501,610	491,600	426,275 5 0	254,332 18 3	91,066 11 7	..	1,393	2,602 2 3	25,519 14 0
DREDGING COMPANIES.											
Maori Point	19 June, 1890	18,000	17,900	9,000	8,950 0 0	4,000 0 0	985 0 0	0 2 0	..	5 0 0	..
Six-mile Beach	22 Oct., 1889	12,000	10,000	12,000	10,000 0 0	2,250 0 0	5,261 12 6	0 15 0	..	..	..
Waipapa	23 Dec., 1890	5,000	3,529	2,500	1,764 10 0	..	210 19 0	0 2 0	..	..	..
Barrytown	7 Nov., 1888	12,000	11,500	6,000	5,750 0 0	..	423 19 2	0 0 8	..	..	..
Miller's Creek	11 June, 1890	10,000	10,000	10,000	10,000 0 0	4,000 0 0	2,102 10 0	..	..	887 10 0	..
Alexander	15 Oct., 1890	24,000	24,000	9,000	9,000 0 0	3,750 0 0	86 5 0	..	..	263 15 0	..
Wakatipu	4 Sept., 1889	25,000	25,000	12,500	12,500 0 0	4,687 10 0	4,016 10 0	..	..	671 0 0	..
Upper Waipori	3 Sept., 1889	24,000	24,000	12,000	12,000 0 0	5,000 0 0	4,600 0 0	..	..	650 0 0	600 0 0
Frankton Beach	19 Oct., 1889	25,000	23,425	12,500	11,712 10 0	4,687 10 0	3,253 7 0	..	100	570 8 0	..
Otoia	17 Jan., 1890	10,500	9,005	10,500	9,005 0 0	4,350 0 0	1,126 5 0	..	..	316 0 0	..
Sandhills	2 Aug., 1889	20,000	20,000	10,000	10,000 0 0	4,000 0 0	5,513 19 3	..	..	406 0 9	..

Matukituki	5 May, 1890	600	600	6,000	6,000 0 0	2,000 0 0	1,028 0 0	..	..	972 0 0	..
Shotover	29 July, 1889	12,000	12,000	6,000	6,000 0 0	1,500 0 0	2,488 5 0	..	97	287 10 0	..
Sew Hoy	9 Oct., 1889	60,000	54,000	120,000	108,000 0 0	72,000 0 0	5,896 1 3	..	..	2,353 18 9	1,350 0 0
White Cliffs	19 June, 1890	20,000	15,000	10,000	7,500 0 0	1,875 0 0	1,552 0 0	..	..	1,198 0 0	..
Golden Bar	7 Sept., 1889	7,500	7,251	7,500	7,251 0 0	3,000 0 0	3,506 16 0	..	..	148 6 0	..
Perseverance	19 May, 1890	12,000	12,000	6,000	6,000 0 0	2,000 0 0	780 0 0	..	..	20 0 0	..
Dunedin No. 2	29 Aug., 1887	3,000	2,992	3,000	2,992 0 0	..	1,598 8 0	..	..	13 12 0	..
Dunedin No. 2	1 Sept., 1881	7,200	7,200	7,200	7,200 0 0	..	6,240 0 0	..	..	..	7,320 0 0
Upper Shotover	29 July, 1889	30,000	30,000	15,000	15,000 0 0	6,200 0 0	1,720 0 0	..	..	920 0 0	..
Talisman	2 Sept., 1889	12,000	12,000	12,000	12,000 0 0	3,750 0 0	4,103 11 0	..	..	96 9 0	..
Horseshoe Bend	31 May, 1888	4,800	3,520	4,800	4,520 0 0	200 0 0	3,569 4 0	..	..	154 0 8	..
New Era	21 Mar., 1888	20,000	18,863	20,000	20,000 0 0	..	6,369 18 0	..	..	1,049 11 0	..
Bushy Point	15 April, 1890	15,000	11,500	7,500	5,750 0 0	2,125 0 0	1,416 5 0	..	..	385 15 0	..
Shotover Big Beach	29 Mar., 1888	300	300	3,000	3,000 0 0	..	3,000 0 0	..	..	..	600 0 0
Ettrick	29 Aug., 1890	4,500	4,500	4,500	4,500 0 0	2,000 0 0	555 15 0	..	..	71 15 0	..
Clutha	3 Nov., 1890	8,000	490	8,000	1,190 0 0	1,300 0 0	700 0 0	..	..	122 10 0	..
Cardrona	31 May, 1890	420	420	4,200	4,200 0 0	600 0 0	675 0 0	..	..	77 0 0	..
Totals	..	402,820	370,995	340,700	321,785 0 0	135,275 0 0	72,779 10 2	..	197	11,640 1 2	9,870 0 0

ALLUVIAL MINING.

MIDDLE ISLAND.

MAHAKIPAWA.

A considerable quantity of gold has been taken from this field out of a very small area; but, as the principal workings have been confined to the bed of the creek, there have been many difficulties to encounter owing to the floods which have occurred from time to time. The shallow workings near the head creek have to be carried on with an open face, and open workings are still carried on when the depth of the ground does not exceed 20ft. These open workings are liable to be filled up with every flood, causing a deal of dead-work to be done before any returns can again be obtained. The creek above the Prospectors' Claim has all been worked, so that the miners are now confined to about two miles of the creek-bed and a small portion of the flat near the township, on Mr. Cullen's freehold. Several of the claims in the actual creek-bed are termed terrace claims, and have been granted by the Warden as such; but it would be difficult now for a stranger in the present state of the workings to distinguish the creek from these terrace claims. This causes discontent amongst the miners who originally took up the creek claims with the expectation that they would be entitled not only to the actual shingle-bed of the creek, but also to the deep ground close alongside, where the creek had originally been.

The creek passes through a very narrow gorge, and the actual shingle-bed in some places is not more than 15ft. in width, but alongside this shingle there are low, flat places from 20ft. to 30ft. in width, which were at the time the creek was rushed covered with small bushy timber and vegetation. All the flat places were held by the Warden to be on the terrace, and granted as terrace claims. These have since in most instances proved to have been the original bed of the creek, being the deepest ground with the same class of water-worn rounded boulder and wash-drift. The creek claims were held by the Warden to only include the shingle-bed, and every claim granted on any place on either side of the shingle-bed was termed a terrace claim. Some of these terrace claims have paid very well, whilst the creek claims alongside are usually very poor.

The prospectors of the field, Messrs. Jackson and Paterson, were granted a considerable distance along the creek-bed as a prospectors' claim, but, beyond a small portion of the lower end, this claim has not paid anything like wages. At the time of my visit the owners informed me that they were only making from 10s. to 15s. a week per man. The adjoining claim lower down the creek, held by Greig and party, which is now worked out, paid extremely well for working. The Venture Claim has turned out very well, but it is not paying so much now. The shareholders informed me that they obtained 21oz. of gold from the last paddock taken out. Adjoining this claim is the Golden Hope, where there are seven men employed and making good wages. The Eureka Claim has also paid very well, but adjoining this is the Boys' Own, which was a good claim at one time, but is now very poor. The best claims at the time of my visit to the creek were considered to be the Wairarapa, Te Ore Ore, Venture, Hibernian, and King Solomon's Mine.

The Hibernian Company's Claim, which is at the bottom end of the gorge, where the ground opens out into a flat, is the last claim on Crown lands, adjoining Mr. Cullen's freehold. At first the ground was tried to be worked by paddocking, but, it being about 50ft. deep, this mode of working had to be abandoned, as every flood in the creek filled up the workings to such an extent that much dead-work had to be done before paddocking was commenced again. A shaft was sunk and a new water-wheel erected last year for pumping. The pump is 8in. in diameter, with a 5ft. stroke, which has to be kept working at the rate of fourteen strokes per minute to keep the water down. The return of gold for a period of six weeks prior to my visit was 50oz., but the shareholders have never got any returns yet on account of the capital expended.

The King Solomon's Mine adjoins the Hibernian Company's ground. It is situate at the upper end of the township, on Mr. Cullen's freehold. A shaft has been sunk to a depth of 80ft., and a drive put in for 22ft., the wash-drift consisting of about 2ft. of conglomerate and 4ft. of reef and ordinary water-worn-boulder drift. The gold is through the conglomerate, and, as this is of a hard, cemented character, it will be difficult to recover it without crushing. The conglomerate has in any case to be broken up before the gold can be liberated. The width of the lead in this claim is not yet known, but it is not expected to be great, and so far very little gold has been got on the shallow ground on each side of the gutter; thereby implying that the gold will principally be found in a narrow lead or gutter, which had at one time formed the creek-bed. The ground is very wet, the men having to work in oilskins. The water is lifted by an ordinary pump 9in. in diameter, with an 8ft. stroke, making nine strokes per minute, this speed being just sufficient to keep the water down; but when the workings are extended it is questionable whether the increase in the influx of water will not be too great for their pumping appliances. The pump is worked by a water-wheel 22ft. in diameter, three-quarter breast. The manager showed me a sample of the gold they were getting, which corresponds with that got higher up the creek, only it is more water-worn, the sharp edges being all rounded off. It is a class of gold which can be easily saved, as it is principally of a coarse character, in flat flakes about the diameter of peas. For three weeks' work previous to my visit the claim yielded 90oz. of gold. This claim extends from the boundary of the Hibernian ground for a distance of 900ft. down the flat; but there is a claim termed the British Empire running parallel with it, and it is yet questionable whether the deep ground will not pass out of King Solomon's into the Empire ground. Judging from the formation of the country at the mouth of the gorge there is a probability of the deep ground going through in front of Oliver's Hotel, and if this be the case the gutter will pass out of the King Solomon's ground.

The next claim adjoining the King Solomon's Mine is the Alice Fell. The company who hold this ground have been steadily at work for a period of two and a half years, and have never yet got any gold. A shaft was sunk on the opposite side of the creek from the township, but it was bottomed on a shelving reef dipping quickly away towards the creek. After sinking in the reef for some distance a drive was put in towards the creek, but it soon got into drift, showing that the deep ground was still further on. This shaft was abandoned and another one sunk to a depth of 80ft., a considerable distance of this being in the reef on the side of the creek where the township stands. When the reef was touched in this shaft it was found to be shelving away in the same direction as formerly, showing the deep ground to be still further to the northwards. After driving in all directions from this shaft to prospect the ground, and being unsuccessful in finding anything payable for working, another shaft was sunk further to the northward to a depth of over 100ft., the last 38ft. being in the reef. The company opened out at the 94ft. level, and after driving for 16ft. lost the reef again; but the character of the wash-drift showed that they were getting near the deep ground. At the end of the 16ft. a monkey-shaft was put down for 6ft., and from this a piece of gold about 2dwt. in weight was found, but at the time of my visit there was nothing definitely known whether they were in the gutter or not. The character of the wash-drift is similar to that found in the King Solomon's Mine, and probably they may be on the south edge of the gutter. During the two and a half years this company have been at work they have sunk five shafts and driven about 800ft. without getting anything to pay them for their expenditure and labour.

There is another shaft lower down the flat than those in the Alice Fell Claim, which was sunk by the Mahakipawa Company; but it is by far too much to the southward for any chance of meeting with the gutter. The workings have been suspended, and are not likely to be resumed until the Alice Fell Company get payable results in their ground. The future of the field depends a great deal on whether the gold runs down into the flat; but even if it is proved to do so the extent of the field is not great, and the area of ground that can be worked will only give employment to a limited population. Gold has been found in White Pine and some of the adjacent gullies, but never in large patches; still, there is a probability of getting it on the other side of the range. The same old schist formation can be seen cropping out near the head of Kaituna Valley, and in that valley there is a probability of a lead being found; but the ground is likely to be a good depth, and also it is likely there will be a good deal of water to contend with. This line of country passes the head of the Kenepuru Sound, and is again met with at Jackson's Head, and along it a payable goldfield may at any time be discovered. The schist in this belt is different from that further to the southward on the West Coast, the laminations being more quartzose, resembling the schists found about the Clutha Valley and the Shotover River. If further discoveries are not made in this district the present claims will soon be worked out, and, although there may be a small population for some time to come, the principal claims will be worked out in two years. There is a possibility of ground being got on the side of the range that would pay for sluicing, if water was brought from the head of the creek; but ground-sluicing operations cannot be commenced until after all the creek claims are worked out. On the Waikakaho side of the range some heavy pieces of gold have recently been found near the head of one of the branches, and some good patches have been got in the main creek; but gold was never traced into the deep ground, where it begins to widen out into a flat.

It is estimated that about 3,000oz. of gold has been produced from the Mahakipawa Goldfield during the past year, which shows a satisfactory result for the number of men employed. There was about 100 men working in the claims at the time of my visit.

Wakamarina District.

Very little mining is carried on here. A few men are employed above the Forks, but no finds of any consequence have been made. At the time of my visit work was proceeding in the Gorge Claim, near the junction of Deep Creek. Dams were constructed at both ends of the gorge, and a tip of crib-work constructed at the lower end, from which there is an inclined tramway, where the trucks are hauled up by the same steam-engine that works the pumps. The water is lifted and kept down by two draw-lift pumps about 9in. in diameter. These were lifting the water about 33ft., and the manager stated that the gorge when full of water could be pumped out in about forty-eight hours. There were six men employed in lifting the shingle at the lower end of the gorge; but at the time of my visit in March last they had not got down deep enough to get at the gold-bearing wash-drift.

This gorge has been tried year after year with no success, and, judging from the manner in which the operations at the time of my visit were being carried on, it would take a very large quantity of gold to pay for the outlay. To successfully test this gorge the working should be carried on with as many men as could be advantageously placed in two shifts, as the river is subject to heavy floods which fill up all the excavations, and in the event of a flood taking place the stripping has to be commenced afresh. Three different companies have tried to work this gorge and have expended something like £10,000. The present company deserve credit for their perseverance, and the manner in which the dams are constructed and the river turned, but they do not appear to be able to conduct their operations successfully in river-workings.

Rimu and Back Creek, Westland.

There is a large extent of auriferous drift in this locality which would give profitable employment to a large population if a good supply of water could be brought on to the ground at a sufficient elevation, so that it could be worked by hydraulic sluicing; but this cannot be done except at a very large cost. The County Council had a reconnaissance survey made for a water-supply from the Hokitika River to command the ground in this locality, which was estimated to cost some £60,000, and, from my knowledge of the country through which a water-race would have to be constructed, even this large sum appears to be far too little. A water-supply, to be of

any great value, would have to be not less than about 100 sluice-heads, as there is a great depth of wash-drift that would have to be moved, and it is only in certain layers where the gold is found. The only source from which a large supply could be had is from the Hokitika River, and the amount of money required to bring in anything like 100 sluice-heads of water from this source is beyond the reach of private parties, and it certainly would not be an advisable work for the Government to undertake. The old workings at Rimu were carried on from shafts, and the ground at the new discovery is of a similar character, excepting that the drift is more stony, and the gold of a coarser character.

The prospectors, Ward and party, are near the south-eastern end of the lead. As far as yet known there are only two claims beyond this point where payable gold has been found—namely, Higgins and party and Stephens and party. The next claim on the supposed run of gold is that of Griffin and party, which is only about 200ft. from Stephens's shaft in the direction the lead would apparently follow; but this party has not yet been successful in finding anything of a payable character. It is supposed that the lead is broken at this point; but that is yet very questionable. All the gold-bearing layers are on a false bottom, which is of fine gravel, resembling in many places other portions of the superincumbent drift; therefore if the shaft happened to be sunk on a blank place on the lead it would be difficult to know where to open out, unless the levels and dip of the run of gold in Ward's, Higgins's, and Stephens's claims were accurately taken, and even then there is a possibility of the gold-bearing layer taking a jump to a deeper or higher level. On examining the character of the auriferous layer in Stephens and party's claim, which is yielding from 7dwt. to 8dwt. of gold to the load, the only difference in the appearance of the headings, wash-drift, and bottom is that the gold-bearing layer has more heavy stones in it, and is intermixed with a mullocky sediment resembling to a great extent some of the intermediate levels on Ross Flat, and more particularly the one found on what was termed the fourth bottom in the Morning Star Company's claim. It is by no means a clean river-wash, as found in many places; at the same time, the stones amongst the wash-drift are all well rounded, as though they had been brought a considerable distance by the action of water. The same peculiarity exists here as at Ross as regards the different bottoms on which the gold is found. Some of the shafts have been bottomed on what was supposed to be the same level as that on which gold was found in the adjoining claims, and, after opening out at that level and getting a little gold, uprises have been constructed and a better layer found above. This was the case in Gibson and party's claim. A drive was put in to the eastward for 40ft. from the bottom of the shaft, in a layer which yielded from 3dwt. to 4dwt. of gold to the load; but the run cut out at the end of the drive. A drive was then made in the opposite direction from the shaft for 40ft., and an uprise constructed for 12ft., when a better layer was found, which yielded from 6dwt. to 7dwt. to the load. This has occurred in several of the claims.

The lead has been traced in a north-westerly direction from Ward and party's claim to near Arch Creek, a distance of about a mile; but it does not appear to run continuously, or, at least, the shafts on the line have not struck it; but at Arch Creek there appears to be a break, or, at least, a mullock-bar across the lead,and it has not been yet picked up beyond this point. However, the field cannot be said to be prospected yet, and it may be found to be only a continuation of the same run of gold to that found in the old workings between the Township of Rimu and the Mahinapua Creek. It is not yet certain that the claims between Ward's and Arch Creek are all on the same run of gold. There is a possibility that there is more than one lead. Indeed, it is highly probable that different leads exist on the field. There are other claims further to the eastward from Ward's, on the opposite side of a small ridge, which are evidently on a separate run of gold-bearing wash-drift, carrying the same character of gold. In all, there are twenty-eight claims on the field in which less or more gold is found. Some of these will give fair results for working, and others may prove extremely poor, as is the case on every goldfield.

In regard to the future prospects of this field, there is good reason to believe that better leads of gold will yet be found at lower levels. There is plenty of evidence to show that the country along the coast in this locality has, at some period of the world's existence, been at a much higher level, having rivers following different courses from their present ones. The deep workings at Ross clearly prove this: the same character of wash-drift found on the terrace bottom on the Ross flat, 200ft. below the present sea-level, is found on the top of Mount Greenland, and again on the terraces above the flat referred to. A similar character of wash-drift to that above the terrace bottom, in the intermediate gold-bearing layers in this flat, is found at Rimu, and no permanent bottom has been found in any shaft on the field. There is therefore every reason to suppose that other gold-bearing layers will be found at a deeper level, likely to contain more gold than the levels at which the workings are at present carried on. The average depth of the shafts on the recent discovery at Rimu is about 85ft., and there is no water of any consequence to contend with, most of the shafts being entirely free of water. That being the case, the shafts should be sunk to greater depths, in order to prove the ground.

At Back Creek the claims at the front of the terrace, which is only a short distance from the ground recently discovered, are working at a deeper level. There are, therefore three different layers of auriferous wash-drift known, none of which are on a clearly-defined bottom. Judging from the formation of the country, and the large area of drift-wash in the flats and terraces, there is every probability of far richer ground being found at the deeper levels; and, if this be so, the field is one that would support a very large population.

Should a large number of claims get on gold, there would be a difficulty in obtaining sufficient water to wash the dirt. There are no creeks in the vicinity from which water can be brought, and to attempt to form a company to bring in a large supply from the Hokitika River, in the present position of the field, is out of the question. Water will have to be obtained, and probably the cheapest way will be to wash the dirt in paddocks into a reservoir on the terrace, water being pumped from the Hokitika River. The cost of pumping machinery to lift the water would depend

on the quantity, and height it is required to be lifted. Merryweather and Sons, Greenwich Road, London, forwarded to the Mines Department through the Agent-General a description of an engine and pumps capable of lifting about two sluice-heads per minute to a height of 200ft.; the cost of which is £1,300, exclusive of pipes, &c. The engine is not, however, the one best adapted for the class of work required.

The distance to the Hokitika River from Belcher and party's shaft is about 40 chains, and the height of the surface of the ground at this point is 346·28ft. above the level of the river, but water would have to be lifted to an elevation of about 390ft. to command all the workings. There are several dams constructed on this terrace for supplying parties with water for working sluicing claims on the face of the terrace, but, with the exception of one, they are at too low an elevation to supply water for washing the dirt from the claims on the new rush. Annexed is a map showing the position of the claims on the field and the depths of the different shafts. This map and longitudinal section accompanying it show forty-nine shafts, varying from 43ft. to 100ft. in depth. There are about 147 men at the present time working on the field, and of this number about 110 men have claims which are considered payable. At the time of my visit, at the end of March last, wash-drift in the claims contained gold varying from 2dwt. to 10dwt. to the load. Taking an average of all the wash-drift in the different claims it would yield about 4¾dwt. of gold per load. There is a large extent of drift terraces likely to contain leads of gold between this and Ross which have never been prospected.

Hydraulic Sluicing.

Wherever water can be obtained, hydraulic sluicing is the most economical method of working alluvial drifts. Whether these drifts form terraces or flats, there are very few localities where there is not a little gold in layers all through them. In many instances the gold in the top drifts is of a very fine character, and requires a different method of saving than by an ordinary narrow sluice-box. In many instances the sluice-boxes and tail-races are too narrow. The idea that many of the old miners have is that it requires a moderately narrow sluice to get the material to run well, so as to keep it clear, whereas it is quite the reverse. A wide box will work better with less fall than a narrow one, and save considerably more gold. The principle of gold-saving is to have as thin a film of material running over the bottom of the box as possible, consistent with the quantity of material to be washed away. Whenever there is a great thickness of drift-gravel in the boxes it is a sure sign that a great deal of fine gold is being carried away, and where there are large quantities of fine material amongst the drifts, it is very liable to block the narrow sluices, causing loss of both time and gold.

It may be interesting to mention the quantity of gold lost by the miners at Kumara sluicing into the Kumara Sludge-channel during the last few years. Each of the parties sluicing into this channel had long tail-races, in which sluice-boxes were placed. These boxes varied from 18in. to 22in. wide, and were supposed to save most of the gold. The channel into which the tailings from these boxes were discharged was 3ft. 6in. wide, with a gradient of 1 in 28·8, or 3ft.6 ½in. to the chain, and during the last four years that this channel was maintained by the Government 957oz. 9dwt. 15grs. was attained, representing a value of £3,638 8s. 9d.; and had this channel been a much greater width far more gold would have been recovered. Indeed, the quantity of water atnd tailings this channel carried away was far too great for its capacity. If it had been 6ft. wide ia would have worked much better, and more gold would have been saved. Although this channel was fully three-quarters of a mile long gold could be got at its extreme end. Wherever large hydr ulic-sluicing operations are carried on there should be a series of grizzles and drops in the main sluice and undercurrent boxes. These undercurrents are a series of shallow wooden boxes about ten times the width of the main sluice, and from 40ft. to 50ft. long, set on a gradient of from 1 in 10 to 1 in 12 if paved with riffles, but if paved with stones the gradient should be about 1 in 9. These undercurrents are divided into partitions by having longitudinal planks set on edge for the whole length, dividing the wide box into sections of about 5ft. in width.

In America every hydraulic-sluicing company uses a series of these undercurrents. The North Bloomfield Company in 1882, with a sluice 1,650ft. in length, had eight undercurrent boxes in this distance, and the gold return was £80,447. Of this amount, the gold saved by these undercurrents was equal to a value of £3,021, or nearly 4 per cent. The returns from Manzanita Mine showed for the same year a value of £45,109, while of this amount gold was obtained from eleven undercurrents, constructed at different places in the sluice—which was 7,600ft. long—to the value of £3,134, or about 7 per cent. of the total yield, At the French Corral Mine, in the same year, gold to the value of £38,040, the length of the main sluice being 5,300ft., and in this distance there was ten undercurrent boxes, from which gold to the value of £3,974 was obtained, or about 10·4 per cent. of the total yield. In America a large quantity of quicksilver is used in the sluices. In the Bloomfield sluice as much as 9,000lb. of quicksilver has been used during the year, but there is always a great loss in quicksilver, and consequently there must be a loss in gold. The undercurrent boxes ought, however, to be charged with quicksilver. There will always be a certain loss, but the extra quantity of fine gold saved will fully justify the use of quicksilver.

Hydraulic sluicing, where a plentiful supply of water can be got, will make very poor ground pay for working. Where there is plenty of dump for tailing, and where water can be obtained at a high elevation, the auriferous drifts in the low flats will be made to pay by lifting by hydraulic elevators at a small cost. More attention is being given to the construction of hydraulic plants than formerly. The canvas hose is rapidly disappearing, and iron or steel piping taking its place, although there are some places yet where the miners cannot see the advantage of substituting piping for the canvas hose. Some of the miners are content to pick down the material from the face and break it up by manual labour before running it into their sluice with water. This system, however, is rapidly disappearing, and water is made to do the work where manual labour was formerly employed.

Charleston and Addison's Flat.

At Charleston the miners have not had a constant supply of water, and the ground is becoming very poor, so that any loss of time in waiting for water becomes a serious matter to them. There is a large area of cemented sand, containing a little gold, but this sand requires to be pounded up before the gold can be got out of it by sluicing. One or two parties have erected crushing-batteries to treat this cement, and, as far as can be ascertained, they are making good wages. All the available water in the district is taken up and conserved in dams and reservoirs, and a survey has recently been made by the County Council of a water-race from the Four Mile Creek, to bring an additional supply on the field. At Croninville there are a few good claims, but the scarcity of water does not allow them to be worked to advantage.

At Addison's Flat there are several very good claims; some of them have been worked for many years, and have given good returns. There is a large extent of auriferous ground in this locality, with a great depth of gravel-wash; some of which contains little or no gold until the bottom layer is reached. In the early days of the field some of the richest portions then known were driven out, but where the ground was deep there was always water to contend with. A large quantity of gold was taken from the Shamrock lead, but as it got into deep ground the water became too much to overcome. At the time this lead was worked a party constructed about three miles of a tunnel tail-race, but the levels not being correctly taken, it was found, after being completed, that it was not constructed at a deep enough level to be of any use to drain the ground. This tail-race has been abandoned for many years. Some of the claims are worked on the flat by having tail-races which are both used for drainage and for sluicing into, the stones and tailings being lifted up on an inclined tramway by a water-balance and stacked in the worked out-ground. The large areas of ground worked and still being worked on this principle show that this is a flat which would support a large population if a good supply of water could be brought on to the field. There are two claims worked on the hydraulic-elevating principle—namely, the Fair Maid and Gladstone and Mace and Bassett's. A large amount of money has been expended in bringing in a water-supply and putting plant on the ground. The Fair Maid and Gladstone Company have brought in an additional supply of water, so that the sluicing operations can now be steadily carried on. The scarcity of sufficient water has been a great drawback to this company, as sluicing could not be continuously carried on, some of the ground being poor, and had to be sluiced away, in order to get a gut into richer ground. All this comparatively dead work told against the company when the receipts for the value of gold obtained were placed against the expenditure. Next year this company expects to make good profits by steadily working the ground. The hydraulic elevator and whole plant is one of the best in the colony. At first some trouble was caused by the constant breakage of the cast-iron liners at the bottom of the elevating-pipe, but lately the company have been using cast-steel liners, which is a great improvement on the iron ones, and gives no trouble. Their gold-saving tables are the best in the colony for recovering the fine gold, and they are known by the name of "Guthrie's patent." Tables of this description are required for saving the fine gold on the dredges, and, if they were used at many of the sluicing claims in Otago, it would be found that the extra quantity of gold saved would soon recoup their cost. The tables used at the Fair Maid and Gladstone Company Claim have a surface-area of about 1,440 square feet.

Mace and Bassett have now been working their claim for about three years, and are satisfied with the returns. They have gone to considerable expense in constructing dams, a main line of supply pipes, 20in. in diameter and 7,000ft. in length, giving a head of water at the claim of about 75ft. Recently they have suspended operations, and are shifting the hydraulic elevator further ahead, the distance of running the material to the elevator being too great for the fall. They have recently had a survey and levels taken, with the view of bringing in another supply of water, so that they can work two elevators, which is likely to be undertaken during the ensuing year.

Kumara District.

This is the largest hydraulic-sluicing field in the colony, and one that is likely to continue to give payable returns for working for the next twenty years, even although no fresh discoveries are made. No doubt the lead will yet be traced to the south-east of Larrikins' Flat, on the terrace between the Kapitea Creek and Larrikins, and to the north-westward towards the sea-beach, and it is possible that gold will be traced through the township. Indeed, there are payable claims now opened out below the township, within the borough boundary. A claim known as McIlveney and party has recently been opened out alongside the zigzag leading to the Teremakau bridge. This party has only had twenty-four three-hour shifts of ten heads of water, they washed up at the time of my visit and obtained 25oz. gold, which must be considered extremely good, seeing that the claim is only being opened out. The depth of ground is about 25ft., but they are working on a false bottom. Another claim, known as Kellar and party, have been working for about two years, and their Christmas washing paid them about £5 per week each; but the run of gold this party has been working on has nearly run out, and they will have to do some prospecting before they get payable returns again. Arnerich and party have opened out a claim lower down than Kellar and party's claim, but so far the returns have not proved payable. Still lower down the terrace facing the Teremakau River there is a special claim of 50 acres held by Pearn and others. Working has been carried on in this claim for about four months, but so far the returns have not given the men wages. The ground, however, has been very regular as regards the quantity of gold. The average earnings of the men being about £2 6s. per week. The last three mentioned claims are using undercurrents constructed on the American principle, which saves a good deal of gold.

The workings on Nardoo Flat continue to progress favourably. There are four claims in this locality, and from the manner in which the workings are carried on one would expect payable returns. There are three claims alongside the main road between Kumara and Dillmanstown which are giving very good returns, and will last for the next fifteen years. The one most recently opened—viz., Stenard and party—was taken up in the early days of the field and abandoned

as duffer ground. It lay idle for six or seven years, until about six months ago, when the present party reopened it, and by the improved method of hydraulic sluicing now adopted it is made to give payable results. In working this claim with sixty three-hour shifts of ten heads of water 95oz. of gold was obtained. Judging from the quantity of material sluiced away with the quantity of water mentioned, which is about 27,000 cubic yards, the yield of gold per cubic yard is extremely small, being only 1·69 grains. The next claim above this one—viz., Davidson and party—is said to have obtained about 80oz. of gold with thirty-five three-hour shifts of eight sluice-heads of water.

The principal workings on the field are on Dunedin Flat, Ross Terrace, and Larrikins. At the former place the ground is rapidly being washed away, but there are still seven claims being worked, some of which will last for four years. All the claims on this flat have been very good. On Ross Terrace there are ten claims being worked, some of which are paying very well, but the whole of the ground here cannot be worked until a deviation of the Kumara Water-race is made. At the time the water-race was constructed it was taken over ground that has since proved to be about the best on the field, and time after time deviations have been made to allow the ground to be worked. There are still about 16 chains of high fluming which will shortly have to be removed, to allow the workings to be carried on. This fluming not only locks up the ground on which it actually stands, but, as the depth of the wash-drift is 70ft., a considerable reserve has to be left on each side to render the flume safe.

At the head of Larrikins' Flat there are nine claims being worked, three of which will only last about two years—viz., Turnbull and party, Wilridge and party, and Corrigan and party. The ground here is much shallower than at Ross Terrace, being only about 25ft. deep. The heaviest sample of gold in the field is found at the head of this flat, and possibly, as the claims get worked further up, the lead of gold may be traced into the Terrace. Some of the claims pay very well, but some of them are very poor. The main difficulty in working the ground is the fall. All the tailings have to be discharged on the tailings-site, alongside the Teremakau River, and some of these claims are worked by tail-races and sludge-channels for over a mile in length, and the fall in the upper part of the tail-races has to be very small, necessitating a large quantity of water being used to sluice away a sufficient quantity of wash-drift. Coming down the Larrikins' Road there are eight claims, some of which have paid very well for working. Some of the claims are in the ground which was granted as a licensed holding and special claim several years ago, but which was never worked until it was purchased in blocks by private parties, who have paid large sums for the ground.

The only ground worked besides the claims mentioned is that held by the Long Tunnel Company. This company holds a special claim of 50 acres, but some of this area has now been sold to private parties. They are said to have expended about £13,000 in construction of reservoirs, water-races, iron-piping, and an underground tail-race about 3,000ft. in length. The claim at present is let on tribute, but the returns are very poor, and the ground for the deposit of the tailings is getting rapidly filled up.

The sluicing-ground on this field will, as previously stated, take a long time to work out; but there is apparently a great future for this field, even when the top ground is all washed away. The whole of the workings are on a false bottom, and there are several layers containing gold all through the wash-drift, besides there is a track of deep ground running through the flat which is likely to prove payable. This track is hemmed in on both sides by a blue reef. This reef crops out on the banks of the Teremakau River, and in constructing tail-races it is found to dip away into the flat; again, on the other side of the flat, the blue reef crops out at the foot of Kapitea Hill. Some shafts have been put down near the base of the hill, showing the reef dipping at a high angle into the flat. The ground resembles to a great extent that on Ross Flat, in the Totara district, where nine different gold-bearing layers have been passed through; but there is no terrace bottom as at Ross Flat. At the same time a similar description of blue reef is seen about Donnelly's Creek before it is covered by the terrace bottom. There is no doubt this is a field where all the miners who now hold claims ought to combine, and either sink a shaft or put in a tunnel from the Teremakau River to test the deep ground, as there is a great probability of a rich lead being discovered; if so, it would greatly enhance the value of the present claims, and give a permanency to the field; besides, the lead would be more likely to be traced towards the sea-beach.

The greatest difference one sees in this field on visiting it year after year is the rapid disappearance of fluming, which is now almost substituted by iron and steel pipes and siphons. At one time the flat was nothing but a network of small flumes, and frequent applications were made to have these flumes taken over by the Government, especially if they were in a decayed state, or else a subsidy was wanted to effect repairs; but since these flumes have been replaced by pipes every one seems satisfied, as they can be so easily laid down on the worked-out ground, and shifted to another place when required. There is no doubt that the use of iron and steel pipes has contributed greatly to the life of the field, as the old flumes occupied a considerable area of ground that could not be worked. The miners have also begun to see that small pipes are of very little use, as they will not supply a sufficient quantity of water, and the loss of head by friction destroys the useful effect of the water. Some of the claimholders have now pipes of 24in. in diameter, which a few years ago would have been looked on as a waste of money to procure. The following is an extract from the manager's report on the use of iron and steel pipes instead of fluming:—

"During the past year all the high fluming on the Kumara Goldfield has disappeared, with the exception of Lee's (arrangements have been made to remove this), and has been replaced by iron and steel piping, which is more suitable and more economical, both as to first cost and future repairs.

"The total length of iron and steel piping at present in use at Kumara is 48,395 lineal feet, or 9 miles 13¼ chains, made up as follows:—

"6,157	lin. ft.	30in. in diameter.
1,989	"	26in. "
792	"	24in. "
2,935	"	22in. "
4,848	"	18in. "
5,772	"	15in. "
18,128	"	13in. "
7,774	"	11in. "
48,395	lineal feet.	

"This does not include a large number of 11in. and 13in. pipes not now in use, having been discarded by the miners as too small for economically conveying the large quantities of water now used in hydraulic sluicing.

"The pipes hitherto in use at Kumara for conveying water for hydraulic sluicing have been altogether too small, and miners have recognised the necessity and economy of conserving the head, and consequently the power of the water, by the use of pipes of greater carrying-capacity. The loss of head from the use of small pipes may be ascertained by an inspection of the table on page 195 of Gordon's "Miners' Guide," which is quite correct for this purpose, as well as for ascertaining the quantity of water discharged by pipes of various diameters *running free* on different hydraulic inclinations.

"A length of 1,000ft. of 11in. pipe will discharge 9·85 sluice-heads of water, with a loss of head of 1 in 10, or a total loss of head of 100ft.; while the same length of 28in. pipe will discharge 10·33 sluice-heads, with a loss of head of 1 in 880, or a total loss of head of only 1·13ft. The result may be tabulated thus:—

Length of Pipe.	Diameter of Pipe.	Discharge in Sluice-heads.	Hydraulic Gradient.	Total Loss of Head.
1,000ft.	11in.	9·85	1 in 10	100ft.
1,000ft.	13in.	10·26	1 in 20	50ft.
1,000ft.	15in.	9·90	1 in 60	16·66ft.
1,000ft.	16½in.	9·91	1 in 90	11·11ft.
1,000ft.	18in.	10·30	1 in 125	8ft.
1,000ft.	20in.	10·18	1 in 200	5ft.
1,000ft.	22in.	10·12	1 in 300	3·33ft.
1,000ft.	24in.	10·34	1 in 440	2·27ft.
1,000ft.	26in.	10·06	1 in 660	1·51ft.
1,000ft.	28in.	10·33	1 in 880	1·13ft.

"The total loss of head from any other length and diameter of pipe, and quantity of water conveyed, may be ascertained by a similar inspection of the table referred to, or by the rules immediately preceding it. The intake end of every line of pipes should have a bell mouth, or taper pipe of considerable length, so as to gradually increase the speed of the water until the required speed is attained, as the sudden increase of the speed from a state of comparative rest to a high velocity causes a great loss of head.

"Regarding the size of pipes that will produce the best result, with due regard to economy, where the head and power of the water has a value, the area of the pipe should be such that it will convey the required quantity of water at a rate of speed of from 3ft. to 6ft. per second, the lower rate of speed or less when the power is very valuable and the greater rate of speed or more when the power is of small value.

"From measurements made, it has been ascertained that, with tail-races having a fall of from 12in. to 14in. to the box (12ft.), some parties sluice away 150 cubic yards of wash per hour with ten sluice-heads of water, or at the rate of 15 cubic yards per hour for every sluice-head. The ground at Kumara is poor, and it is only by putting through large quantities of wash that it is made to pay. Without any fresh discoveries there is still a large area of ground to work, and some of the present claims will last for from fifteen to twenty years. There is also a fair probability of a good lead of gold-bearing wash-drift being traced both towards the ranges and also towards the sea, as gold is found in many places far below the level of the false bottom of the present workings, so that a payable run of gold-bearing wash may be fairly looked for at deeper levels than hitherto."

Recently a new description of air-valve has been adopted on the pipes on this field, which consists of a hole of about 2in. in diameter being cut in the pipe, a leather or vulcanized india-rubber clack being fixed inside the pipe, and held in its place by small screw-bolts. It is to all intents like the clack of a pump-bucket. When the pipes are full of water the clack is held firmly against the pipe, but when the water commences to run out of the pipe the clack drops, and admits a supply of air. This little valve answers much better than the more expensive air-valves which formerly were used, only costing about 2s. 6d. each.

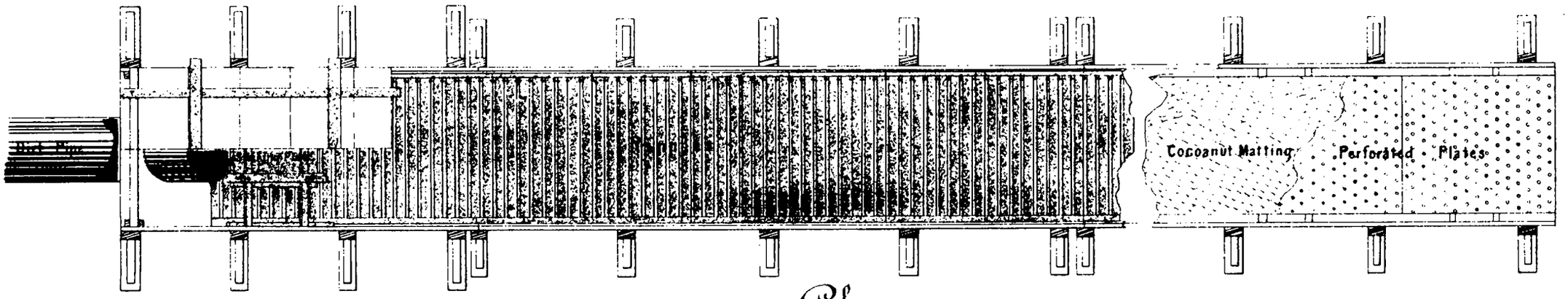
The following table will show the number of hydraulic-sluicing claims on the field, with the quantity of water used, and the fall or gradient of the tail-races or sluices; also showing the different claims that are worked by means of the different water-races, sludge-channels, and private tail-races, with the number of men employed in such claims.

Hydraulic Elevating Plant.

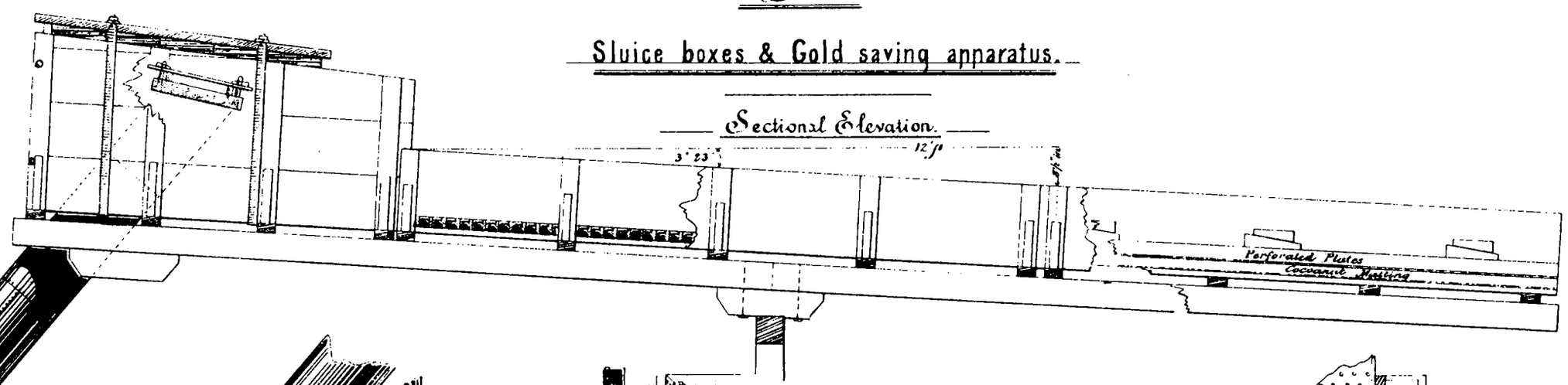
Blue Spur Consolidated Gold Comp.ᵍ.

Gabriels Gully.

Thos. Thomas Jackson
Civil Engineer
Launceston

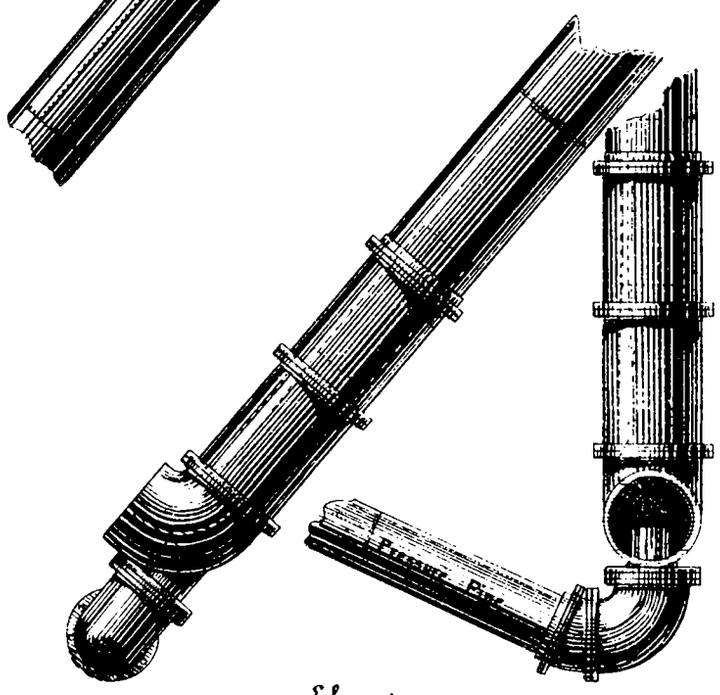


Plan.

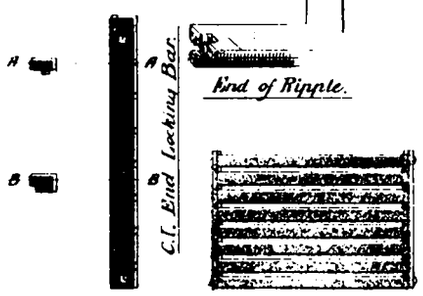


Sluice boxes & Gold saving apparatus.

Sectional Elevation.

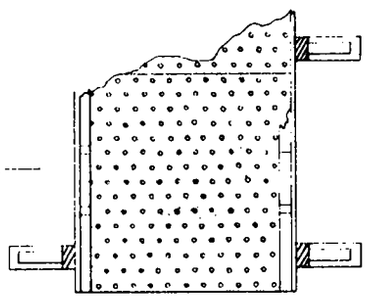


Side Elevator. Front.

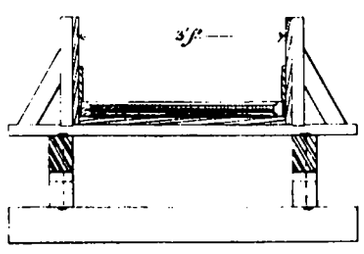


End of Ripple.

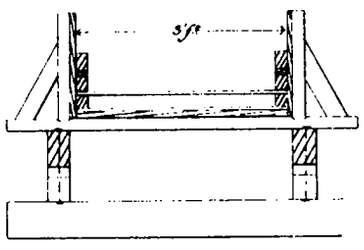
Patent Angle Iron Ripple.



Scale 3/8 inch to one foot.



Sect shewing Ripples.



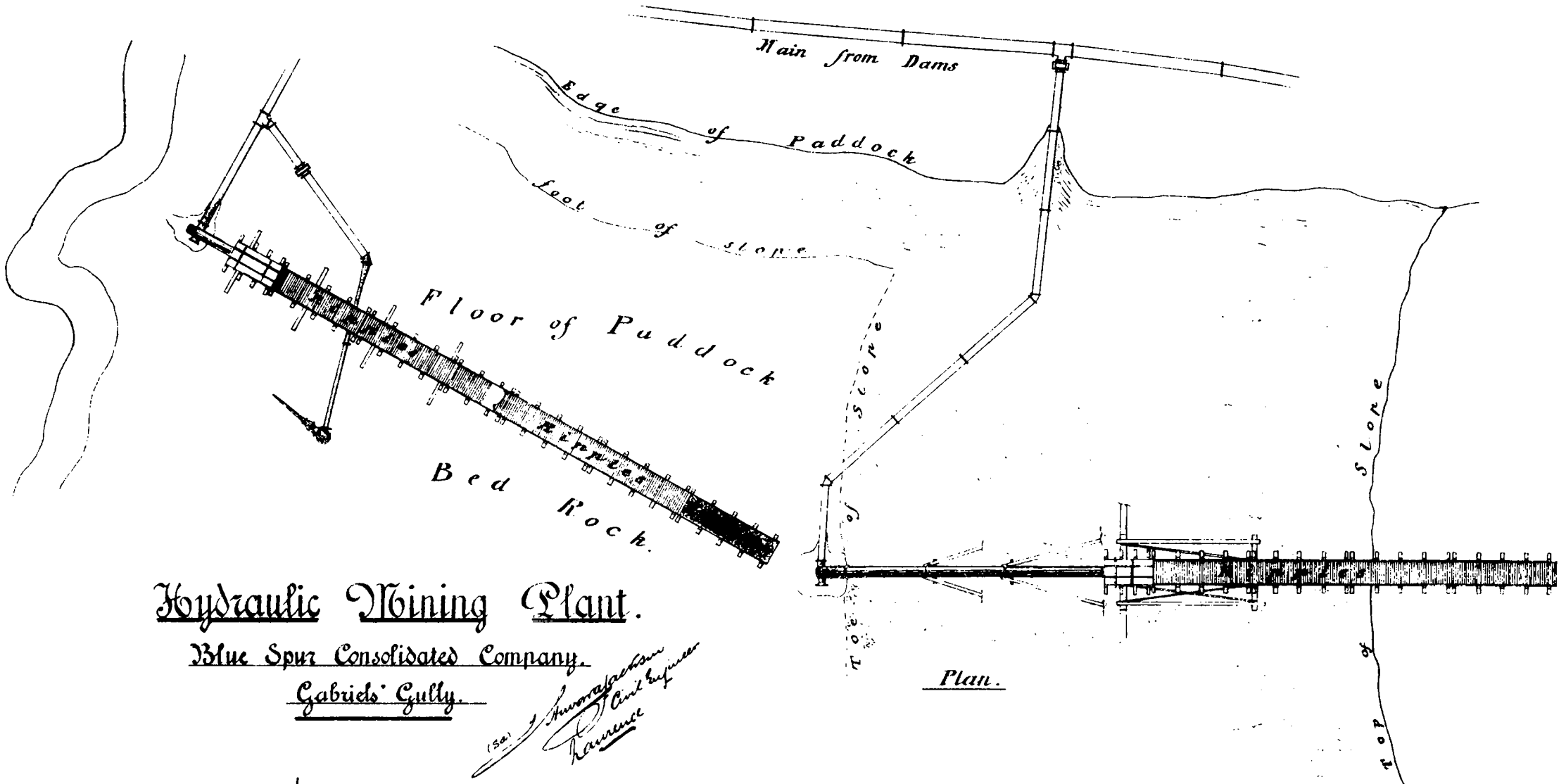
Sect shewing Plates, Matting.

Hydraulic Mining Plant.

Blue Spur Consolidated Company.

Gabriels' Gully.

(Sd.) Thomas Jackson
Civil Engineer
Launceston



Average quantity of Tailings sluiced and elevated per shift	180 tons.
Do. height elevated	60 feet.
Do. quantity of water used per elevators	17¾ Sqr.ᵉ heads.
Do. head of water	400 feet.

Scale 10 feet to 1 inch.

Side Elevation

Back Elevation

Top casing

Stripping Elevator

Bottom casing

Liner

Gravel intake

Set

Quartz Point

INCHES 12 9 6 3 0

0 1 2 3 FEET

Stripping Elevator in Position

Bed Plate

Water Supply Pipe

12 6 0

0 1 2 3 4 FEET

Gravel opening for Bottom Wash Elevator

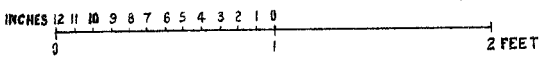
INCHES 12 9 6 3 0

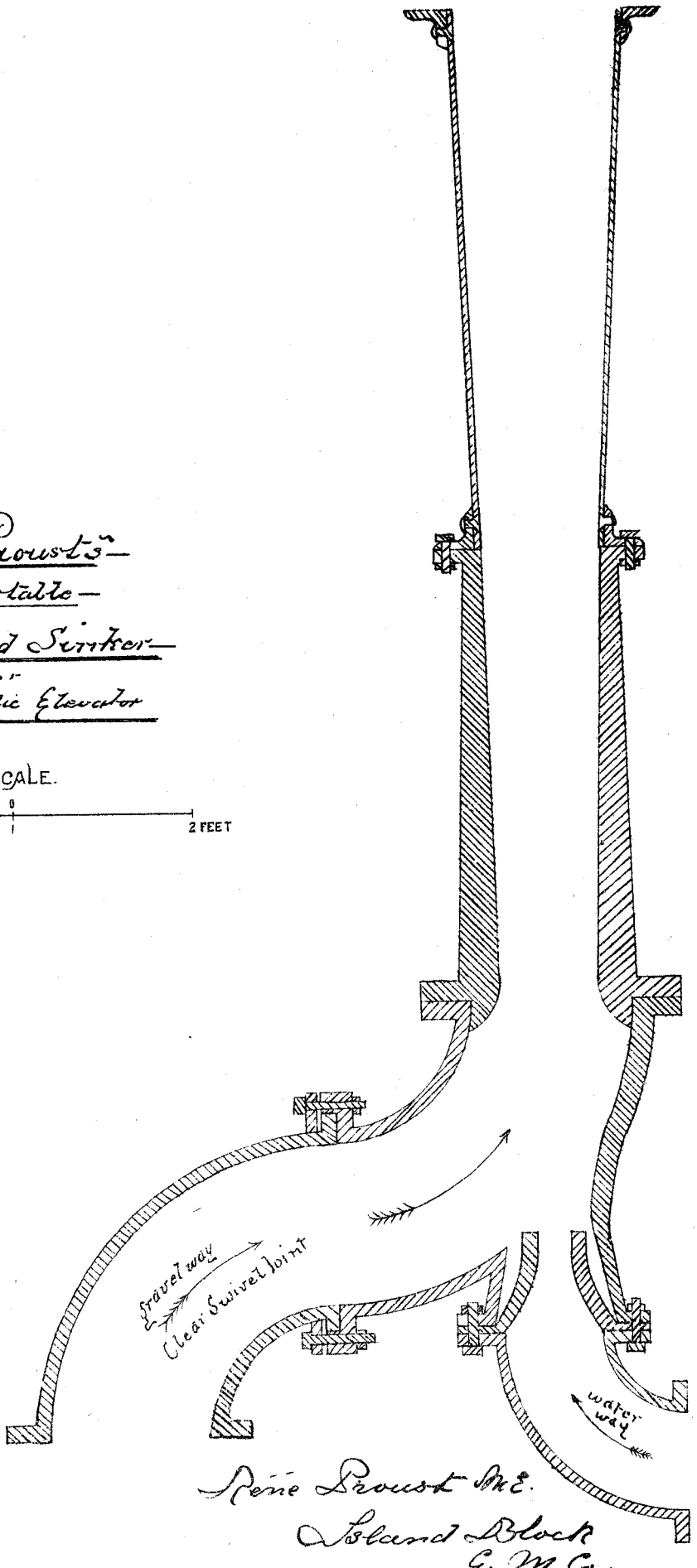
0 1 2 3 FEET

René Proust
Island Block
J. Mc Coy

Proust's Portable Rapid Sinker for Hydraulic Elevator

SCALE.

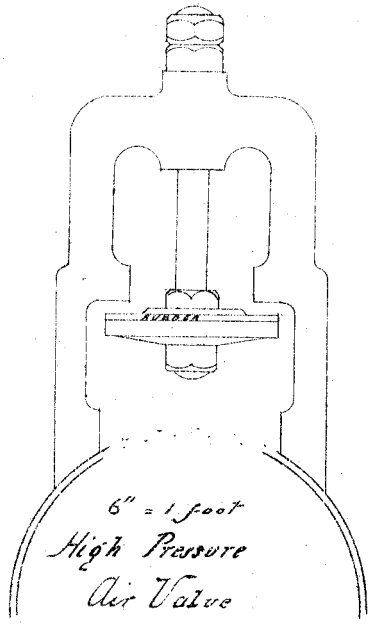




René Proust Sc.

Island Block

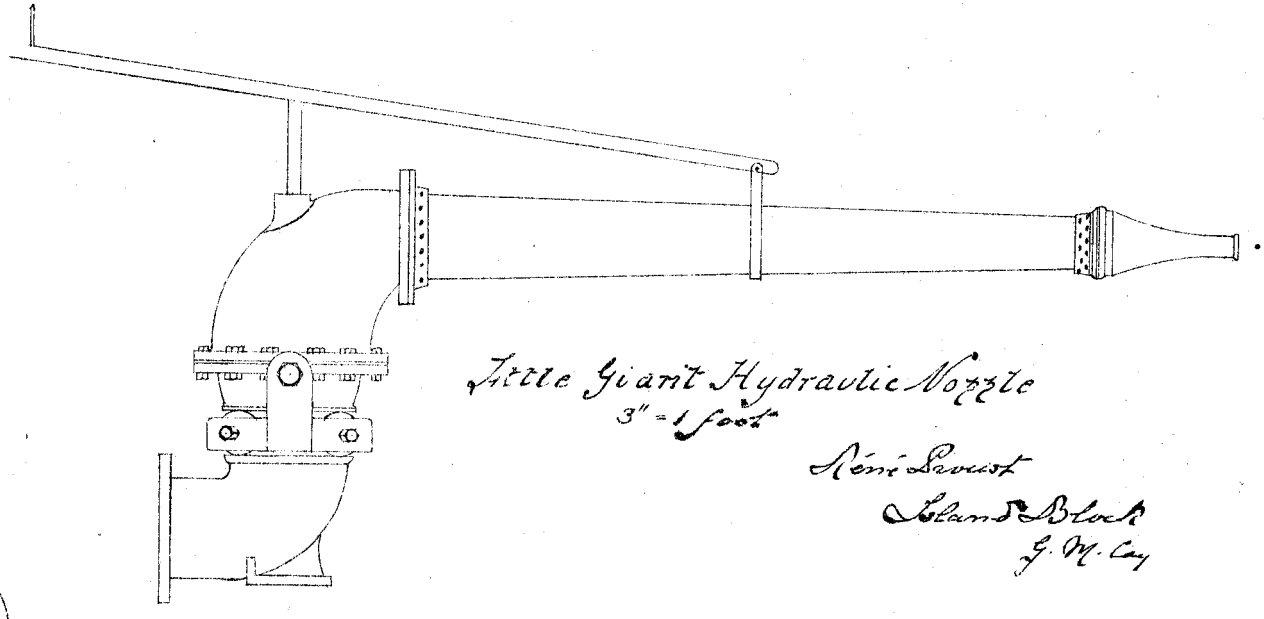
G. M. Coy



6" = 1 foot

High Pressure
Air Valve

Séné Lavoie



Little Giant Hydraulic Nozzle
3" = 1 foot

Séné Lavoie
Island Block
G. M. Co.

MAP OF
BACK CREEK RUSH
SHEWING PLAN AND LEVELS OF CLAIMS AND SHAFTS.

SCALE OF CHAINS.

6 5 4 3 2 1 0 6 12

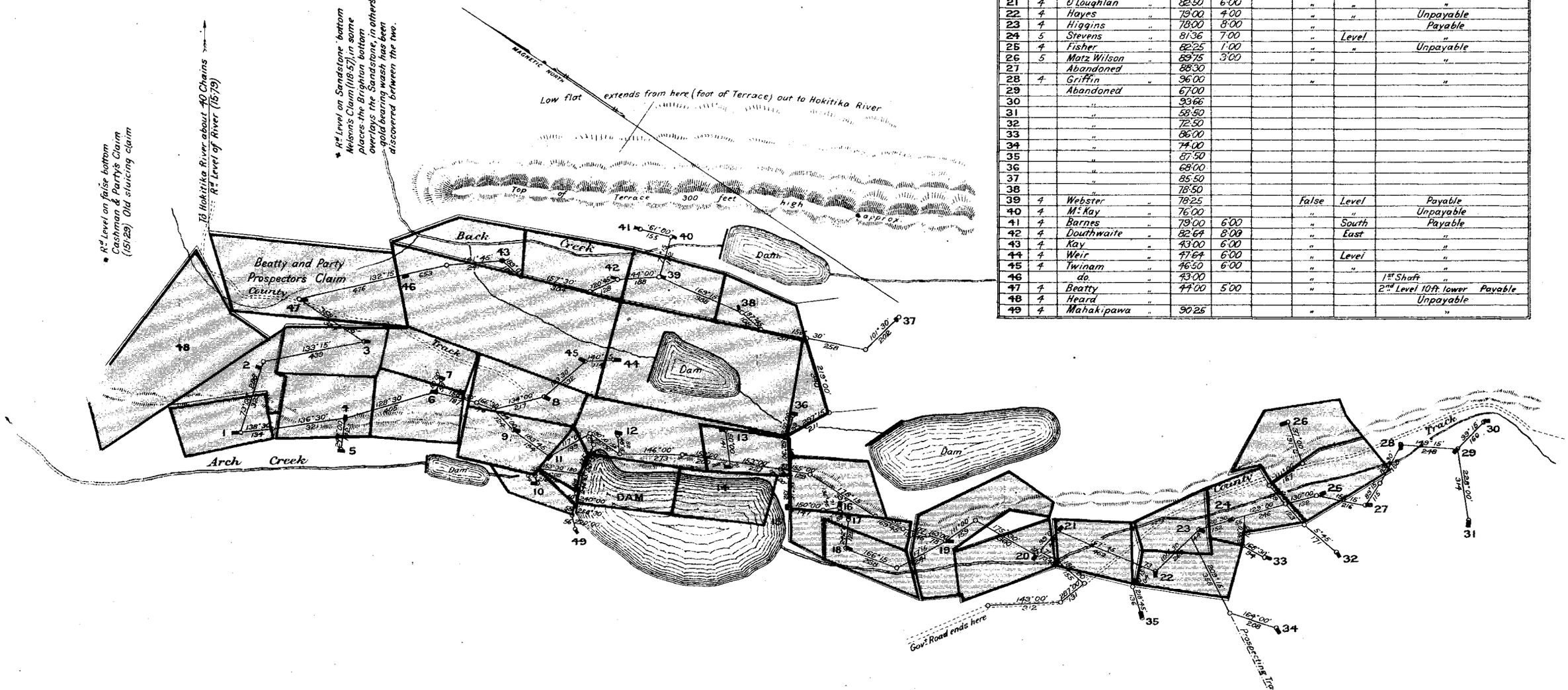
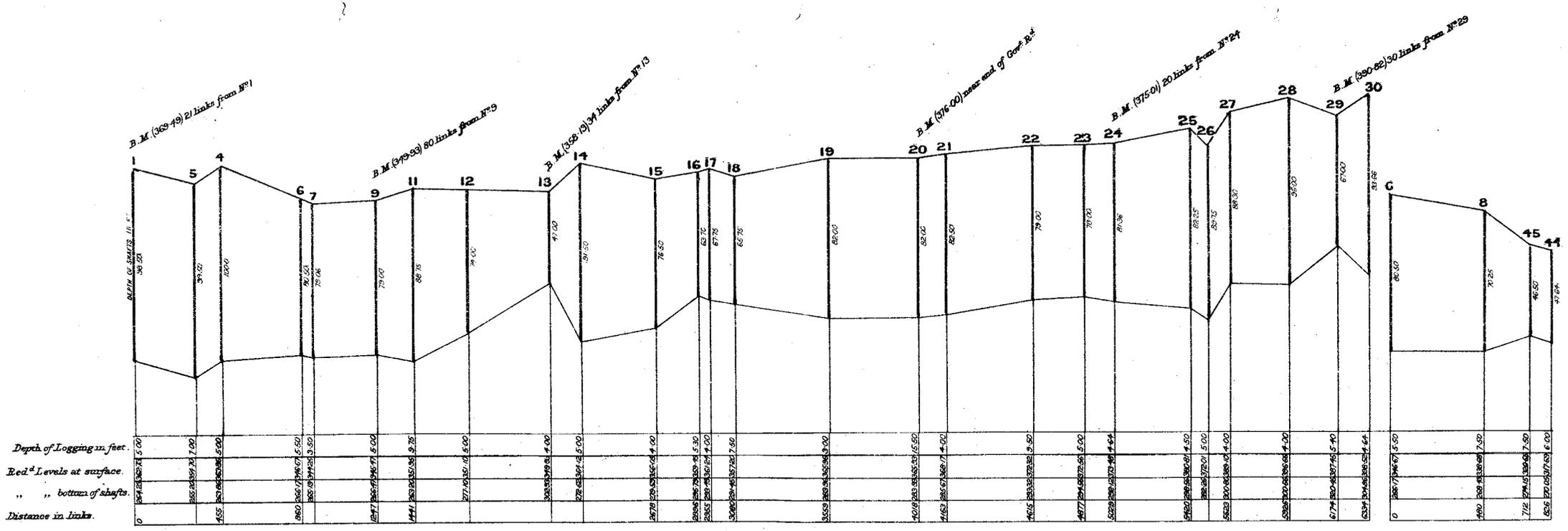
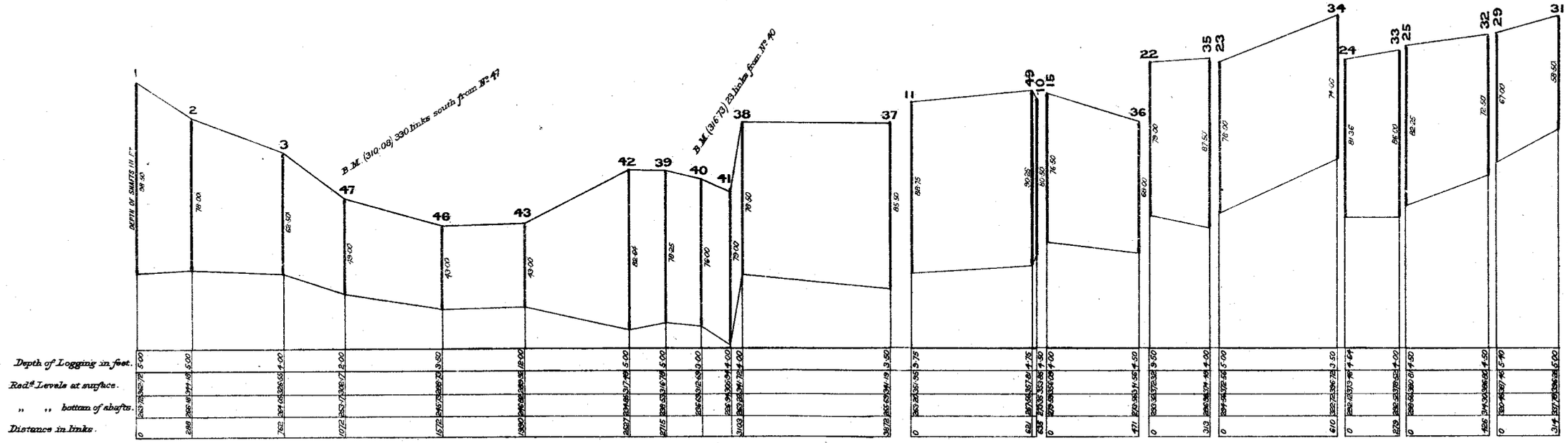


TABLE OF REFERENCE.

No. of Claim	No. of Men	Name of Party	Depth of Shaft	Thickness of Wash 1st Level	Thickness of Wash 2nd Level	Nature of Bottom	Direction of Dip	Remarks.
1	4	Bletcher and Party	98.50	4.00		False		Payable
2	4	Silcock "	78.00	6.00		"		"
3	4	Gibson "	62.50			"		"
4	4	Mc. Donald "	100.00	7.00		"	West	"
5	4	Thomas "	99.50	7.00		"	East	Unpayable
6	4	Jack "	80.51	9.00		"	"	Gets gold above this. Payable
7	3	Duske "	79.06	10.00		"	"	Payable
8	4	Dehn "	70.25	4.00		"	"	"
9	4	Ferguson "	79.00			"		"
10	4	Surgeoner "	80.52	3.00		"		Unpayable
11	5	Williams "	88.75	4.00	8.00	"		2nd Level 10ft. above 1st Payable
12		Abandoned	74.60					
13	3	Nicholson "	47.00	6.00	12.00	"		Got gold 33ft. below this Payable
14	4	Mc. Lachlan "	91.50	6.00		Brighton	Level	Payable
15	4	Cox "	76.50			"		Unpayable
16	5	Callaway "	63.70	31.00		False	North	Payable
17	4	Wellington "	67.75			None		"
18	4	Hughes "	65.75		8.00	False	Level	"
19	6	Bath "	82.00	5.00		"		"
20	3	Ward "	82.00	6.00		"	West	"
21	4	O'Loughlan "	82.50	6.00		"	"	"
22	4	Hayes "	79.00	4.00		"	"	Unpayable
23	4	Higgins "	78.00	8.00		"		Payable
24	5	Stevens "	81.36	7.00		"	Level	"
25	4	Fisher "	82.25	1.00		"	"	Unpayable
26	5	Matz Wilson "	89.75	3.00		"		"
27		Abandoned	88.30					
28	4	Griffin "	96.00			"		"
29		Abandoned	67.00					
30		"	93.66					
31		"	58.50					
32		"	72.50					
33		"	86.00					
34		"	74.00					
35		"	87.50					
36		"	68.00					
37		"	85.50					
38		"	78.50					
39	4	Webster "	78.25			False	Level	Payable
40	4	Mc. Kay "	76.00			"	"	Unpayable
41	4	Barnes "	79.00	6.00		"	South	Payable
42	4	Douthwaite "	82.64	8.09		"	East	"
43	4	Kay "	43.00	6.00		"		"
44	4	Weir "	47.64	6.00		"	Level	"
45	4	Twinam "	46.50	6.00		"	"	"
46		do. "	43.00			"		1st Shaft "
47	4	Beatty "	44.00	5.00		"		2nd Level 10ft. lower Payable
48	4	Heard "						Unpayable
49	4	Mahakipawa "	90.26			"		"





LONGITUDINAL SECTIONS.

SCALES.

HORIZONTAL.

CHS. 3 2 1 0 3 6 9 12

VERTICAL.

FT. 30 20 10 0 30 60 90 120

Name of Party.	Number of Men employed in the Claim.	Fall to 12ft. in Tail-race.	Number of Sluice-heads of Water used.	Name of Party.	Number of Men employed in the Claim.	Fall to 12ft. in Tail-race.	Number of Sluice-heads of Water used.
No. 2 Channel — Water from Kumara Race—		In.		*Private Tail-races—Water from Kumara Race—*	In.		
Turnbull and party ...	5	8	6½	Davidson and party ...	6	12	8
Arthur and party ...	4	8	8	Seater and party ...	5	6	10
Holst and party ...	4	8	10	Blake and party ...	6	6	10
Watson and party ...	5	8	10	Henderson and party...	6	7	10
Morris and party ...	2	5	11	Lee and party ...	7	7	12
Hughes and party ...	4	6	12	R. Anderson and party	6	10	10
Palmer and party ...	6	8	10	Shroeder and party ...	4	12	10
Harvey and party ...	3	5	10	Hanson and party ...	6	9	10
Rodgers and party ...	3	8	7	Stennard and party ...	5	14	10
Ireland and party ...	4	5	12	McIlveney and party...	4	8	12
Pascoe and party ...	6	8	9	P. Arnerich and party...	4	10	10
Baucke and party ...	4	4	10				
Corrigan and party ...	3	6	10	*Water from Holmes's Race—*			
No. 3 Channel — Water from Kumara Race—				Collins and party ...	4	8	10
O'Sullivan and party...	5	9	6	Brown and party ...	5	7	10
Harris and party ...	6	8	8	Payne and party ...	5	7	10
Rothwell and party ...	5	9	6	Dinan and party ...	6	7	10
Anderson and party ...	5	5	10	Evenden and party ...	4	10	10
Hillier and party ...	4	9	6	Burke and party ...	5	10	10
Bain and party ...	4	9	6	Bowden and party ...	6	10	10
Rizzi and party ...	4	8	7	Johnson and party ...	3	12	10
Williams and party ...	3	8	8				
Carew and party ...	5	9	7	*Water from Private Water-races—*			
Light and party ...	5	6	10	Pearn's lease ...	6	10	15 to 20
Thomas and party ...	6	8	8	Long Tunnel Gold-mining Company ...	6	7	10 to 15
O'Connell and party ...	5	9	6				
Moynihan and party ...	4	8	8				
Trickey and party ...	5	5	11				

Waimea District.

There is still a considerable quantity of ground on the terraces on the south side of the Waimea Creek that can be worked with water from the Government water-race, but the fall for sluices and available ground for the deposit of tailings is very limited. The bed of the Waimea Creek has been raised 20ft. in places by the discharge of tailings from the terrace claims. The miners state that the ground is very poor, and only pays very small wages for working; but from the principle on which the claims are worked, it would require to be good sluicing-ground to pay wages. It is true there is very little fall in their sluices—somewhere about 5in. to the 12ft. box, or a grade of about 1 in 29—but the limited quantity of water used for this grade, together with the small iron pipes and canvas hose, which are still in use, with the full pressure from the race not utilised, it cannot be expected that low-grade auriferous drift can be made payable for working. The principle of working adopted is by using a small nozzle at the end of the pipes or canvas hose for breaking down the ground and letting the rest of the water flow over the face. Fully double the pressure can easily be got from the race, but it is not considered to be of any advantage to use it; indeed, if these terraces were at Kumara, and worked in the same systematic manner, there is little doubt that many of the claims could be made to pay fair wages.

Representations were made to the Hon. the Minister of Mines during my visit to this locality that there was a considerable area of payable auriferous ground in the vicinity of Callaghan's Creek and on the north side of the Hokitika–Kumara Road if a deviation of the race was made. The manager of the water-race has been instructed to thoroughly examine the ground in this locality, and to report as to the area of payable auriferous drift that the race would command if a deviation was constructed. He is also to furnish an estimate of the cost of such deviation, together with its length and sectional area, if it was constructed on a gradient of 1 in 660, or a fall of 8ft. per mile. There is said to be a considerable extent of auriferous drift-wash about Scandinavian Terrace and German Gully which the proposed deviation would command, but which cannot be worked for want of water. This will be fully inquired into when the report of the manager has been received.

Arahura District.

Humphries' Gully United Company.—This company has expended a large capital, but have not yet completed the works to a paying point. The claim is situated on the Hokitika Harbour Board Reserve at Humphries' Gully. There is a depth of about 250ft. auriferous-drift terrace in this locality, and the object of the company is to work this ground by hydraulic slucing, which requires a large quantity of water to make much impression on it. They have constructed a large head-race for about 10¾ miles, which intercepts several creeks, from which a good supply can be obtained in wet weather, but, the drainage-area of each of these creeks being very small, the water diminishes rapidly in fine weather, and the supply for working the ground is cut off. It is estimated

that it would take £25,000 to extend the head-race for four miles and three quarters to the Arahura River, where an unfailing supply can be obtained. About £70,000 has already been expended on plant and claims. The value of gold obtained last year was £2,536 10s. 6d., as against £1,916 8s. for the previous year. The working-expenses last year were £1,382 6s. 2d., and under the head of management £436 7s. 7d. was incurred, which makes the total expenditure £1,818 13s. 9d., thus leaving a profit on the working of £717 16s. 9d. for the year. The tributers are said to pay the company over 60 per cent. of the gross yields, the company keeping the water-race in repair and supplying the water. There is work for many years in this locality, but the property will not be of any value to the shareholders until a large and permanent supply of water is brought on to the ground, so that different faces and sluices can be kept going.

Ross.

This place still continues to support a considerable population, but the available ground in the flat above the water-level is gradually getting worked out, or, at least, the best portions of it. There are several terraces high up the range between Ross and Mount Greenland, and even on the top of Mount Greenland, that would pay for working by hydraulic sluicing if water could be brought on to them; but there is no possibility of getting a regular supply of water up to this elevation. The only hope of mining reviving in this locality is to get the workings in the deep levels commenced again. If even the water were pumped down to allow what was known as the second bottom there are a good many pillars, and even some of the ground that was worked in the early days would give fair remuneration for working. There seems to be at the present time a dislike to invest money in mining ventures. Outside capital is required to prospect and develop the deep levels, which are likely to produce a large amount of gold. There is no question that there is rich gold-bearing drifts in the deep levels, but powerful pumping machinery will be required before the ground can be worked.

Ross United Company.—This company holds the whole of the ground on Ross Flat, but all mining operations at the deep levels have been suspended for the last four years, and since these workings were stopped the company has been deriving a small revenue by letting the ground on the upper levels on tribute. It is estimated that an expenditure of about £20,000 will be required to erect powerful pumping machinery, sink a new shaft, and open out the ground. At the time that the mine was flooded out the company were working good ground. In six months they obtained from the deep levels gold to the value of £8,415 15s. 6d., and three companies who worked these levels previous to the present company acquiring the ground obtained gold to the value of £43,865 10s., in an average of thirty-three weeks' work. The same company holds a special claim at Donoghue's, which is being worked with elevators and a tunnel tail-race. In connection with the latter claim, a large water-race is constructed along the face of the range to intercept Squatter's, Blue Gully, and Redman's Creeks, and carry on until the Mikonui River was reached, where there is an unfailing supply of water. There is yet about one mile and a half to construct before the water can be lifted from this river. The supply of water at present is intermittent, and it is only in moderately wet weather that a sufficient supply can be obtained to work the elevators and carry on sluicing operations at Donoghue's.

There are also elevators at work at Ross Flat, and a tunnel tail-race constructed to the ocean beach, by which the ground is drained to a depth of about 90ft. The company holds an area of ground comprising 260 acres in special claims. The amount of gold got by the tributers last year, working both sets of elevators and from shafts, was 1,632oz. 5dwt. 8gr., of which 786oz. 13dwt. 13gr. was from Ross elevators, 490oz. 14dwt. 18gr. from the Donoghue's elevators, and 354oz. 17dwt. 1gr. from other tributers. The amount of gold obtained from the upper levels since the operations in the deep ground were suspended—from 17th February, 1887, to 30th March last—was 6,262oz. 12dwt. 7gr.., representing a value of £23,787 17s. 6d. The tributers working the Ross elevators pay 35 per cent. of the gross yield of gold, and the company gives them water from the upper water-race to the extent of eight sluice-heads, and also the use of the two lower water-races, which the tributers have to keep in repair. The company also find material for all repairs to machinery and plant, but the tributers have to find the labour. The tributers of the Donoghue's elevators pay 30 per cent. of the gross yield, and get the use of the water-race, and also all material for effecting repairs to the machinery and plant, but they have to supply all labour. The other tributers pay from 5 to 10 per cent. of the gross yield. During the last year the tributes amounted to £1,730 14s. 6d., and sales of water from the upper water-race to £91 3s. 6d., making the income for the year £1,821 18s., while the expenditure for the same period, was £1,253 11s. 4d. in working-expenses, and £420 1s. 4d. in connection with office-expenses, directors' fees, &c., making the total expenditure in connection with the actual working of the ground £1,673 12s. 8d. This shows a profit of £147 5s. 4d. for the year.

Mont d'Or Company.—This is one of the most successful mining companies in Westland. Their claim is situated at the head of Sailor's Gully, which now includes the ground formerly held by the Greenland Company. This ground was purchased, in conjunction with the water-races and plant, &c., about two years ago by the Mont d'Or Company for about £8,000, and they work both hydraulic plants during wet weather, but in moderately fine weather they confine their operations to the Mont d'Or ground. This claim will take a lifetime to work out, and is likely to be a dividend-paying one for many a year.

Tuapeka District.

There is very little mining in this district now. The old workings have been turned over again and again in many places, and still some of the Chinese manage to make a livelihood working the old ground. It may be said that, with the exception of the workings at the Blue Spur, there are very few Europeans mining in the district; but there are a good few Chinese scattered here and there in Weatherstone's, Gabriel's, and Tuapeka Flat. The Chinese seem to

turn over the old ground and pick up a certain portion of the reef, where, apparently, most of the gold found by them is got, but the number of Chinese is getting less year by year, which shows that the alluvial ground is getting pretty well exhausted.

Blue Spur Company.—During last year this company has had a great deal of litigation and many difficulties to contend with, but they now appear to have got over their troubles, and are getting very fair returns from their ground. Their workings so far have been confined to tailings at the head of Gabriel's, opposite the Blue Spur. These are being elevated on an average to a height of 60ft. The manager estimates that during the year ending the 31st December last 410,000 cubic yards of tailings have been elevated and sluiced, which yielded 1,478oz. of gold. This would give an average yield of only 1¾gr. of gold, or 3½d. per cubic yard. The expenditure on wages during the same period was about £2,580, or about 1½d. per cubic yard of material sluiced. This shows that extremely poor ground can be made to pay for working. In my last report some figures were given to show the power required to elevate the tailings. In comparing these with the work done now, the following figures will show the power absorbed in friction: They have two hydraulic elevators, one of which is single, and the other double. The single elevator lifts the material to a height of 56ft. 4in., using 150in. of water on breaking-down nozzle and 350in. on the elevating-jet, and lifting 56 cubic yards of tailings per hour, or 3,136lb. of tailings per minute. The quantity of water lifted is 500in., which is equal to 46,875lb., making the total weight lifted 50,011lb. to a height of about 56ft. 4in. per minute. The quantity of water used to do this work is 350in., with a head of 400ft., which is equal to 397·7 theoretical horse power, while the actual power required to lift the water and material is equal to 85·4-horse, thus showing that 312·3-horse power is absorbed in friction. The second elevator lifts the material 68ft. 6in., using 500in. of water in the elevating-jet on the upper lift and 300in. in the nozzle and elevating-jet combined on the lower lift, which elevates the water and material to a height of 14ft., the head of water on the elevating-jet being about 400ft. Taking, therefore, the total quantity of water and material lifted by the upper lift, it amounts to 5,137,500 foot-pounds, and the horse-power required to do this work is equal to 155·6, while the power of the 500in. of water, with a head of 400ft., is equal to 568·2 theoretical horse power. This shows that 78 per cent. of the power of the water was absorbed in friction in the case of the single hydraulic elevator, and 73 per cent. in the case of the upper elevator in the double one.

During the three months ending the 31st March last 760oz. of gold was obtained, thus showing that the ground that has recently been worked was considerably richer than any the company have worked previously; but this ground is nearly sluiced up to the gut going through the Blue Spur. The cement in the Blue Spur is apparently lying in a basin, the bottom of which is about 40ft. deeper than the bed-rock in the bed of the gully, where the present sluicing operations are carried on. This basin is at the present time filled with water to a depth of about 70ft. It is the intention of the company, as soon as the tailings are sluiced away up to the place where the cement commences, to sluice off the top of the cement after breaking it up with either blasting-powder or dynamite; but, judging from the hardness of the cement, very little of it can be worked by this method. If it contains gold all through it, it requires pulverising machinery to be adopted before the gold can be recovered in the sluice-box.

At the time of my visit the company were increasing the capacity of their water-race from the Beaumont River, from which they hold a right of eight sluice-heads of water. The water-race was constructed many years ago, but its carrying-capacity was only about three and a half sluice-heads. It is now being enlarged for about 4 miles 22 chains, to carry twelve sluice-heads, and the water is then led into the Waipori Race, at the Beaumont Saddle. When this enlargement is made the company will have a supply of about forty-two sluice-heads of water, instead of about thirty heads, as at the present time.

Annexed are plans of the hydraulic plant used by the Blue Spur Company, furnished me by Mr. J. Howard Jackson, the superintendent of the company. These show all details of the elevators and washing appliances.

The elevating-pipes are 15in. in diameter, some of them being made of steel, No. 12 B.W.G. The liners at the bottom end are made of hæmatite iron having an internal diameter of about 6in. when new, and they wear away until the inside diameter increases to 8in. and sometimes to 9in. On asking the manager about the wear-and-tear on these bottom liners, he informed me that the material being fine gravel with very few large stones amongst it it never breaks the liners until the metal is worn down to about 3in. thick, the wear-and-tear on the rest of the elevating-pipe being very small. In connection with gold-saving, Mr. Clayton, the working manager, has applied for a patent for a ripple made with cast-iron sides and cross-bars of angle-iron 2in. wide placed ¾in. apart. These are 3ft. wide, and made in 2ft. lengths. There is nothing peculiar in the shape of these ripples, neither are they new. Last year when visiting the Island Block Company's and the Hercules Company's workings in the Clutha Valley, angle-iron ripples were used, the only difference being that they had no cast-iron sides, which would not make the slightest difference to their gold-saving capabilities. There have been, on an average, about thirty men employed by this company during last year.

Clutha Valley.

This is one of the richest auriferous-drift valleys in the colony: almost every place containing wash-drift on the hillsides and also the beds of the tributaries leading into this valley contain sufficient gold to pay for working if a supply of water could be obtained. When so large a river as the Molyneux is flowing through this valley it may be wondered why a supply could not be obtained from this river, or some of the lakes which drain into it, but this would be so gigantic an undertaking that it would require an immense capital to carry it out, and unless a very large area of ground was secured the outlay would not be justified. The country along the side of the Clutha Valley is of such an extremely broken and rocky character, that it would require an immense number of viaducts or siphons to cross gullies and breaks in the side of the range; the character also of the

ground on the side of the range is loose, and even the schistoze rock contains many fissures, so that it would be found in many cases cheaper to convey the water in wooden fluming and iron pipes than to construct open conduits. All the tributaries of the Molyneux River from Alexandra to the Beaumont are taken up in water-rights, and possibly the day may come when water will be lifted from Manuherikia River near Ophir. This seems to be the only large supply in the district not utilised that could be brought on to the side of the ranges at a high elevation, but such a scheme would involve a large amount of capital, and a company constructing works to bring a supply from this source would require to secure a large area of ground to ever recoup them for the outlay.

Island Block Company.—This is an English company which made arrangements with Mr. Joseph Clarke, of Victoria, the proprietor of the ground the company now holds, to allow them to work five miles of the valley, which, no doubt, had at one time been the bed of the Molyneux River. This ground had for years previous to its purchase been considered highly auriferous, but the amount of capital required, and the question of the method of working was a problem not easily solved. It was only after Mr. Perry commenced working the tailings in Gabriel's Gully that it dawned on people that the low flats containing auriferous drifts could be worked to advantage, and the ground drained, if a sufficient supply of water could be got at a high elevation. When the scheme of working this ground was first mooted in the colony, it was not expected that sufficient capital could be raised to bring the works to a successful issue, but now this is an accomplished fact. Sometimes this company is said to get from 700oz. to 800oz. of gold a month.

There is one of the best hydraulic plants erected on this claim existing in the colony. Indeed, as far as the steel pipes are concerned, there are no others in use equal to them. They are manufactured of steel from $\frac{1}{4}$in. to $\frac{3}{16}$in. in thickness, and have all lap-welded joints. There is a good supply of water in moderately fine weather, but in a dry season, such as the last one, the supply is not sufficient to carry on operations to the best advantage. There are four hydraulic elevators on the ground, and all the appliances are of the most improved description. Annexed are sectional plans showing the improvements made at the bottom of the elevating-pipe, with liner, &c., designed by Mr. Rene Proust, the company's engineer.

The Island Block Extended Company.—The name of this company is misleading, as it has nothing to do with the Island Block Company on the opposite side of the river. Their claim is situated on the Miller's Flat side of the river, a little above the bend at the head of the Island Block. The company have commenced working at the side of the river, but have not yet got down to the bed-rock. The operations were suspended for a long time owing to the company being heavily involved in money matters, and differences of opinion existing amongst the directors and shareholders as to the course to proceed. These have now been arranged, and operations have been recently resumed. Before suspending operations a paddock was worked, having a surface of about 60ft. square, sloping on all sides to a very narrow space on the bottom, but it never got down on the bed-rock; nevertheless, 50oz. of gold was obtained, which shows that the claim is likely to become a valuable one. A fair supply of water has been brought in from the Menzionburn by an open conduit for a distance of six miles, at an elevation of 801ft. above the level of the claim, the water is conveyed from the conduit to the claim by 78 chains of either iron or steel pipes. The company has gone to a large expenditure in bringing in the water-supply, and placing a hydraulic plant on the claim with this head of water. The material can be lifted, if required, to a height of at least 80ft.

Hercules No. 2 Company.—This company purchased part of the ground belonging to the United Hercules Company, having only recently got their plant completed and in working-order. The first few weeks' washing gave a yield of 36oz. of gold. This was obtained from the upper drift-wash. None of the bottom has yet been cleaned up.

United Hercules Company.—This company had several drawbacks to contend with last year. They are working near the side of the Molyneux River, which was in flood for a certain time, causing a heavy drainage in their paddock, which is considerably below the level of water in the river, and during last summer the dry season affected their supply of water. They commenced sluicing operations in November, 1889, and up to May last have obtained gold to the value of about £12,000, out of which £4,800 has been paid in dividends. The expenditure on plant and claim has been about £6,000, so that the shareholders have had 16s. returned within two years for every £1 expended, or 40 per cent. per annum on the outlay. This shows that mining properties in this locality are worth investing in. Since the beginning of the present year operations had to be suspended for a considerable time, owing to the river being flooded and other causes, so that comparatively little work has been done. Gold to the value of only £1,634 has been obtained, but the company are now in a fair way to commence paying dividends again. They lift the water from the Teviot River, and have at their claim 450ft. of head. So far as the workings extend out into the flat, there seems to be little if any diminution in the yield of gold, hopes being held out that the auriferous drift will extend back to the foot of the steep range.

The next flat down on the same side of the river as the United Hercules Company's ground is a very extensive one, and has never yet been prospected beyond sluicing on the banks of the river. From the appearance of this flat it is evident that the river has at one time flowed through different portions of it, and therefore there is every reason to believe that rich runs of gold will be found here. However, most, if not all, of it is private property, and some of the ground is cultivated, but if once proved to contain good gold there is no doubt that the whole of it will be worked. The only difficulty there is in the way of this being done is getting a supply of water, as all the available streams on that side of the river are taken up and utilised.

Roxburgh Amalgamated Company.—About two years ago this company purchased the claims known as Waight and party and Anderson and party, who had been working for many years on the bank of the Molyneux River, opposite the township of Roxburgh. They also took up a special claim at the back, further into the flat than where these and other parties held claims, and now they hold

altogether a special claim, comprising an area of 160 acres. They also hold the Dismal Swamp, a large flat at the upper end of the Gorge of the Teviot River, as a site for a reservoir, and intended to build a masonry or concrete dam in the mouth of the gorge to raise the water when full to a height of 17ft. This height of water is said would cover an area of 640 acres to an average depth of 9ft., which would be equal to 250,905,600 cubic feet of water. Deducting 40 per cent. for evaporation in dry, hot weather, it would leave 100,362,240 cubic feet available for sluicing purposes, which is equal to a supply of about twenty sluice-heads of water flowing continuously for two months. This, together with the quantity of water coming into the reservoir, and the water being stored on Sundays, would insure almost a constant supply, unless in an exceptionally long, dry season. The scheme has not been carried out, the wall forming the dam has only been raised to a height of 8ft., and consequently the supply last year was inadequate to work the ground to advantage. It is estimated that a masonry or concrete wall can be built now to a height of 20ft. at a cost of about £1,500, and no doubt this work will soon be undertaken. The hydraulic elevating operations commenced at the end of December last, and from the quantity of material operated on the results have been satisfactory. The ground, it is said, improves as it gets back from the side of the river.

Several private parties hold claims higher up the river on the same flat as the Roxburgh Amalgamated Company, which give high yields of gold when water is available, but as none of these parties have a supply of water at a sufficient elevation to work a hydraulic elevator in the deep ground, their workings are in a great measure limited. They either have to pump the water and lift the material by hand-labour, or merely sluice off the ground to such a depth as the level of the water in the river and fall for their boxes will permit.

Commissioner's-Flat Company.—This company has commenced sluicing operations on a flat on the same side but about four miles further up the river than the flat last referred to; they are sluicing off the top portion of the wash-drift to such a level as the water in the river will permit, before commencing to elevate the material below this depth. So far they have not obtained much gold; but this was expected, as it is in the lower wash-drift where most of the gold is got in this place. As soon as a sufficient area of the top drift is washed off a commencement will be made to elevate the material. The water-supply is taken from Coal Creek, on the west side of the Molyneux River, and brought in an open conduit for about five miles in length, which discharges into a reservoir constructed on tolerably flat ground on the range. From there the water is conveyed in pipes of 128 chains in length, varying in diameter, the first 20 chains being 18in., 15 chains 17in., and the remainder 16in. in diameter. The pipes are carried across the Molyneux River to the claim. There is a length of 120ft. of sluice-boxes 3ft. 6in. wide laid down, with a fall of 3in. to 12ft., and stripping is being carried on. The company has expended about £8,000 on their plant and claim.

Ophir.

Owing to the dry season, a number of miners have been enabled to utilise the tail-race constructed many years ago, and work the ground, which is generally very wet, on the flat above the township. The ground last year was comparatively dry, and men are said to have been making fair wages. At Ida Valley, the Deep Lead Company, which expended £3,000 in prospecting the ground, has been wound up, and all operations have ceased. The Green Reef Company is also wound up, and their cyclone crusher, which cost about £500, was sold for £4 10s. The whole of the plant belonging to the Quartz Company, purchased by them for £1,750, including water-race, dams, and fluming, is said to have been sold for about £188. This shows that mining property is of very little value in this locality. At Blackstone Hill very little mining is carried on. The Garibaldi Company, which was expected to turn out a good mining venture, has been proved, it is said, a complete failure, there being no means of getting a good supply of water on to the ground. Indeed, the dry season last year has completely paralysed mining where the operations depended on a steady supply of water.

Tinkers.

This is one of the richest places in the colony; it is so far limited in extent, but the gold obtained by those who are working the ground will average more per man employed than on any other diggings. The scarcity of water last year has, however, been a great drawback. Several of the claims could not be worked continuously, and the yield of gold for the last year must have been considerably less than in former years. Last season was one of the driest experienced for years. In my last report reference was made to the value of mining property. A small water-race at a low elevation, two miles in length, having the first right of seven sluice-heads of water from Thomson's Creek, was sold by auction, and was purchased by the Undaunted Company for £10,800. This is the highest price ever paid for a similar water-supply in the colony. This company have been able to work more regularly than most of the other claims, and anticipate having 1,500oz. of gold for the season's work, which would represent a value of about, in round numbers, £5,925, showing that the value of this water-supply was not overestimated. The ground in this company's claim is from 70ft. to 80ft. deep of gravelly wash-drift, containing a little gold all through it, but the best of the wash is the layer next the bottom.

Matakinui Company.—This company's ground, which is 25 acres in extent, adjoins the Undaunted ground, and is of similar character, but does not contain nearly so much gold. They have a head-race from the Lauder Creek, and have had a very fair supply of water during last year. The ground they have been working for several years has been what is termed rather poor for this locality, but last year they got into better ground, obtaining 600oz. of gold between the months of September and April. Since washing up a seventh share in the company's property has been sold for £1,500. This company deserves to meet with success. They have gone to a very great expense in bringing in a water-supply and placing a hydraulic plant on the ground. Their tail-race is not deep enough to admit of their sluicing the whole of the ground in the ordinary manner, a portion of it has therefore to be lifted by a hydraulic elevator.

Nearer the foot of the range there are four claims—namely, Reed and party's (known as the Sugar-pot Claim), the Mountain Race, Ewing's, and Symes and Morgan's. These claims have a rich run of the quartz grit wash-drift going through them. This seems to be comparatively a narrow run of ground following the foot of the range, and at the time it was deposited the range must have been steeper than at present, as it is now partly underlying the foot of the range. This means that slips have come from time to time as the quartz-drift was being deposited, and kept extending over the deposit further every time a slip occurred. This makes the drift difficult to take out of the underlying position in which it is now found, as in doing so a large quantity of *débris* from these old slips has to be removed at the same time. The depth of this character of wash-drift, which is of a much older formation than the gravel-drifts further out on the flat, has never yet been ascertained, neither here nor at any place where it has been worked in the district. A shaft was sunk near the boundary of the Mountain Race Company's ground and the Sugar-pot Claim to a depth of 240ft., showing no indication of being near the bottom, containing about the same quantity of gold all through; but the question of being able to work to this depth is a problem not yet solved, but there is no doubt that it will yet be worked by several hydraulic elevators, one below the other, to a considerable depth. The wash in the shaft does not appear to be rich enough to drive out, but will give good returns for working by hydraulic elevators and sluicing. How far this run of ground may traverse the foot of the range has not been ascertained, and, indeed, it is of very little use for any one to go prospecting for sluicing-ground in this locality, as all the available water that can be brought on to the ground is taken up and utilised.

Mountain Race Company.—This company has done more work here than any of the others, having been longer at it. They have washed off the top of the quartz-drift run, which was very rich, and have also worked a considerable portion of the gravel wash-drift ground, which pays well for working; but the shortness of water has greatly affected their workings for the last year, they having only about five weeks' water during the year.

Ewing's Claim.—This claim adjoins the Mountain Race ground, and has the quartz-drift wash running through it. The claim comprises 10 acres of very rich ground, and adjoining this, further out into the flat, Mr. Ewing holds a special claim of 60 acres. The 10 acres now being worked was held by Mr. Foggart for many years as a mining lease, but owing to all the available water being taken up, he never did any work on it. About three years ago he sold it to Mr. Ewing for £500, and since then who has expended about £10,000 in bringing in a water-race from Thomson's Creek, and placing a hydraulic plant on the ground. The termination of the head-race is 500ft. above the level of their workings, and from that point the water is laid down in steel pipes 18in. in diameter, having double-rivetted longitudinal seams. The plant was all completed ready for a start last year, but owing to the very dry season they have only had a small supply of water for about eleven weeks, during which period 320oz. gold was obtained, which was sufficient to cover all expenses in working and give 10 per cent. on the capital invested. Sluicing operations were commenced in October last. During the eleven weeks water was available about 76,800 cubic yards of material was sent away, and the average quantity of water used was eight sluice-heads. This is equal to about 1,164 cubic yards per day, or, if the water was used continuously, it shows that one sluice-head of water shifted 6 cubic yards per hour. It may be said that only sufficient work has been done to test the ground, which shows that it is highly payable, although only containing 2gr. of gold per cubic yard. The great head or pressure of water on the breaking-down nozzle is sufficient to disintegrate any clay or mullock in the wash to a fine pulp, which is a great advantage, for any lumps of mullock and clay passing down the sluice or tail-race are certain to carry away gold with them. The nozzles or directors first obtained were not strong enough to stand the pressure, but every other part of the plant answered admirably. It may be mentioned that in addition to the ordinary sluice the material passes over a wide set of tables somewhat similar in principle to Guthrie's patent gold-saving tables, which are used by the Fair Maid and Gladstone Company, at Addison's Flat, in the Westport district, which recover a large percentage of fine gold that would not otherwise be saved.

Reid and Party.—This party has very rich ground, but they have only been able to get water to work with for six weeks during the season, nevertheless during this period they obtained 100oz. of gold.

Symes and Morgan.—This party are working further to the southward than any of the others. They have opened out some new ground, which is proving highly auriferous. This also shows that the same run of gold-bearing wash is extending more in the direction of Clyde, and possibly some good claims may yet be opened out still further southward. If there is a large extent of this character of ground it would pay to bring in water for a long distance to work it.

St. Bathan's.

The scarcity of water in this locality has greatly affected the yield of gold from the claims. Some of the companies have not washed up for the season. Amongst these are the Scandanavian and M. and E. Companies, which are working at Muddy Creek on similar character of ground to that found at St. Bathan's and the quartz-drift at Tinker's. During last year Mr. Ewing has placed a new hydraulic plant on his claim at Kildare Hill, near St. Bathan's Township. A new main line of 18in. steel pipes has been laid down, and he is elevating the material about 46ft. In connection with this elevator one of Robertson's patent atmospheric nozzles is used. At one time some people thought these nozzles would be of immense advantage in lifting the water and material, but Mr. Ewing has not found them come up to expectations. There is no doubt they are an improvement if the intake of the elevating-pipe gets submerged, but so long as it is working free they are of no direct advantage. Operations with the elevator commenced in January last, and up to May the yield of gold in that time was 1,500oz., which shows the ground to be extremely rich.

There is very little doing in the other claims at St. Bathan's. Most of the top material has been sluiced off the run of ground where most of the gold is got. The sludge-channel has to be

taken further up before the claim can be advantageously worked. This sludge-channel has been in course of construction for the last five years, and it will take a considerable time yet before it is taken up to the intended level, which is from 60ft. to 70ft. below the level of the present workings; it will, however, shortly benefit a few claims to some extent. The whole of the material from the excavation of the channel is passed over wide gold-saving tables, similar to those used at Ewing's claim at Tinker's, and for about seven months' work gold was obtained to the value of about £500, which covers all the expense of construction. The whole of the material is shifted with water.

Vinegar Hill.—Mr. Ewing has also a claim here, but the ground being deep and all of a mullocky character, requiring a good supply of water, he has not been able to send away the quantity of material he did in former years, owing to the scarcity of water last season. The tail-race is too high to be able to sluice the material in the ordinary manner; it has to be lifted by a hydraulic elevator for about 25ft. This, together with the character of the ground to be worked, requires a large supply of water. The yield of gold for last year—about 550oz.—is, however, sufficient to pay all expenses in connection with working the claim and leave a good margin of profit.

Watson and party's claim has been paying very well, giving, it is said, about £8 per man per week. Messrs Morgan and Hughes also have a very good claim, but they did not work it last year on account of having to construct a tail-race to enable them to work it at deeper levels. The quantity of gold obtained last year from Watson and party's claim was about 300oz., three men being employed. Another claim, worked by P. Tiernan and another, yielded 250oz. of gold for the year.

Naseby.

This is a field where there is a large area of auriferous ground, but in many places the wash-drift is shallow and the claims are quickly worked out. This, together with the ground containing very little gold, prevents many of the miners placing a good hydraulic plant on their claims, they being content to follow the methods of sluicing used in the early days—namely, a canvas hose with very little head, the ground being broken with picks before turning on the water. This method of working poor ground cannot be advantageous to the claimholder. To any one visiting this district and observing the manner in which a great many of the claims are worked, the question would present itself to them: How can these claimholders make a livelihood? There is no doubt that there is a large area of drift-wash containing a little gold, but it requires a constant supply of water and all the improved hydraulic appliances to make this character of ground pay for working.

The present supply of water on this field is not sufficient for the number of men employed, and the ground being at a high elevation, subject to severe frosts in winter, there are at least about two months in the year that sluicing cannot be carried on, and, again, during the summer months, in dry weather, there is a scarcity of water. The principal supply of water is obtained from the Government water-race, which is managed by a Trust. This water-race takes its supply from the Manuherikia River and some of its tributaries. It is sixty miles in length, principally an open conduit, and this open cutting is carried across numerous wide shingle-beds of small creeks, coming out of the high mountains close to the race. Every flood brings down a quantity of gravel and shingle from the side of the steep range, filling up the open cutting; which has to be reconstructed before any water can flow down the conduit, and no doubt these breaks interfere considerably with the constant supply. Indeed, many of these shingle-gully beds should have been crossed with iron pipes. The expense in connection with the repairs to the open ditching in these gullies would have covered the cost of pipes long ago.

There is another thing which interferes with the supply of water for working the ground, and that is the quantity of flush-water required to work the sludge-channel in the bed of the Hogburn Creek. This sludge-channel is ten miles long, constructed partly on a gradient of 1 in 60, and partly 1 in 100. This channel requires a considerable quantity of flushing water, which could be used to work the ground in the vicinity of Spec Gully, where most of the sluicing will in future be carried on, the greater portion of the ground in the vicinity of the Hogburn Creek being worked out. The tailings from several parties having private head-races run into this sludge-channel. The water for flushing is given from the Government race free, irrespective of who is using it. The great complaint in this locality is the want of water, and the necessity for the Government constructing a large reservoir in the valley of the Eweburn Creek is constantly being brought up. The question of the construction of this reservoir is referred to in my report on the working of the Mount Ida Water race, but, even if a larger supply of water were brought in, the day is not far distant when the water-race will have to be extended across Spec Gully and on towards Kyeburn.

There is a large extent of country between St. Bathan's and Naseby, and the run of the old quartz-drift, which is successfully worked at Mount Burster, apparently traverses the country towards St. Bathans, and follows on round the foot of the high range to near Clyde. Some portions of this quartz-drift give high returns of gold for sluicing, and most probably a fresh discovery will yet be made between the Maunherikia River and Naseby. A prospecting shaft at the upper end of the Hogburn Valley was put down several years ago to a depth of about 120ft., which got into the quartz drift-wash containiug a little gold, but this shaft was never bottomed. The same run of ground is found at Mount Burster, where some of the claims last year turned out very well, but these claims can only be worked for about six months in the year, owing to their high altitude.

Guffie and Inder's Claim.—This is one of the claims on Mount Burster which is about 4,500ft. above sea-level. This claim turned out very well last year, yielding about 400oz. of gold. Owing to the remarkably fine season, the workings were carried on for eight months, but part of that time the men working in the snow, having to tunnel through the snow in places along the line of the head-race in order to get the water through to the claim. The quartz-drift wash is about 90ft. deep here, the richest patches of gold-bearing drift being generally found near the bottom; and, wherever there are large blocks of the bed-rock projecting above the general level of the bottom, rich wash-drift is always obtained. The existence of this run of quartz-drift, and the manner in which the layers occur, containing in many places, as, for instance, at St. Bathans and Muddy Creek,

layers or beds of leaves, trees, and logs of wood which are now turned into lignite, clearly shows that the configuration of the country has greatly changed since the deposit was made, as every place where it is found points to its being in the course of an ancient river or stream; but the question of the locality whence the deposit was carried from cannot be identified, as none of the mountains in the locality contain drift of this character, but it may be presumed that the whole of it has been denuded from the mountains and ground up by the force of currents, causing the particles of material to roll against each other, producing a pulverising action.

Cardrona and Criffel.

There has been no new ground discovered in either the vicinity of Cardrona or Criffel during the past year. At the former place there are about eighty miners employed, but the scarcity of water has greatly affected the yield of gold; nevertheless the miners may be said to have made fair wages, the approximate quantity of gold obtained being about 2,500oz. About 1,190 acres have been applied for as dredging claims. Some of these have been prospected with boring-tubes to a small extent, but no actual work has yet been done towards getting dredges on the ground. The Warden reports that, out of the area applied for, seven claims of an aggregate area of 678 acres have not been taken up, and 303 acres are under application for cancellation.

At Criffel the whole of the water-supply brought on to the field is now held by one party, and the number of men is therefore limited to the quantity of water available, the ground being now all worked by hydraulic sluicing. McNab Brothers, and Hawthorne and party, have been very successful this season. Indeed, it may be said that all the men working here last year have done very well. The approximate quantity of gold obtained during last season was about 1,800oz.

Arrow and Macetown.

There are a few parties sluicing on the terraces facing the Arrow River, one of whom brought water on to the terrace on the west side of the Arrow River, below the junction of the Macetown Creek. The water is conveyed across the valley of the Arrow in a siphon of about 9in. in diameter, having a dip in the centre of about 250ft.; this siphon is of considerable length, and caused a large outlay for a private party of miners. The work is well done, and the ground they are now working is said to be paying them well.

Davis and Moody's Claim.—This claim belongs to the same men who have brought in a water-supply from Skipper's Creek to work Burke's and Londonderry Terrace in the Skipper's district. They have a claim embracing 1½ miles of the bed and valley of the Arrow River, commencing from a rocky gorge at a point where a large slip from the side of the steep range has taken place, many years before it was known that gold was to be found in the colony. About three miles above Arrowtown the river-bed is completely filled with large rocks at this point to a depth of 60ft. or 70ft., and now forms a series of falls. At the bottom of these falls a tunnel has been commenced, which is now constructed for 925ft. and is within about 25ft. of being completed. This tunnel is constructed in the solid rock, in the range alongside the bed of the river on the west side; it is 10ft. wide, having vertical walls for 4ft. high and then arched to a further height of 3ft., making the height in the centre 7ft. It is constructed on a gradient of 1 in 24, and the bottom is paved with stone. At every 20ft. a beam of wood, 12in. by 12in., is laid across the tunnel and bolted down to the rock; this is done as a precaution to prevent the stone paving, which is also 12in. deep, being swept out by the force of the water when the river is turned through it. In the event of part of the paving giving way at any time, by this means only 20ft. of paving could be removed if a break took place. When the tunnel is completed to the required distance, two uprises will be constructed in the solid rock, these will be sufficiently large to have gates placed in each of them 8ft. by 4ft., having a small auxiliary gate of about 2ft. square in the centre of each of the large gates, in order to be able to let out a sufficient quantity of water to make the large gates more easily lifted; the other uprise shaft is to take the water in the river during the time the cutting is being constructed towards the natural bed of the river. When this is done the whole of the drift in the river-bed will be sluiced through the tunnel, and in the event of a flood occurring the gates will be shut down to such an extent as to regulate the quantity of water passing through the tunnel, and the overflow will pass down over the present bed. The upper end of the main tunnel will be about 80ft. below the present bed of the river where the uprises are made. From this point the river-bed is a great width up to the junction of Soho Creek. This part of the river-bed was tried to be worked in the early days, but the water was too much to contend with. Above and below this the wash-drift in the river contained very rich patches of gold. Mr. Miller, the manager, deserves credit for the manner in which the works have been laid out and constructed, both as regards this claim and the one at Skipper's. The expenditure on the Arrow Claim, up to the time of my visit, was about £2,800, the tunnel being constructed at £2 15s. per foot by contract, and the paving being done on wages.

Shotover and Skipper's.

The Shotover has been the richest river in the colony for gold, and the whole of the terraces along its valley where there is any wash-drift pay well for working by hydraulic sluicing. During past ages this river has been a main tail-race, where immense slips from the mountain sides have from time to time been washed away, cutting down the bed or channel of the river by slow degrees. This can be clearly seen by the different levels of the terraces. Where some of these terraces are worked the old bed of the river is clearly shown, and proves that at different periods it has changed its course, and in these ancient channels rich auriferous wash-drift is always found.

Davis Brothers' Claim.—This claim is situate on Stoney Creek Terrace, on the western side of the Shotover River, above Maori Point. The depth of wash-drift is about 260ft. A good supply of water has been brought from Stoney Creek, and the head is utilised by leading it down in iron pipes of about 11in. in diameter from near the terminating point of their race. They use a 4in. nozzle, and

about ten sluice-heads of water. The tail-race where the gold is received is 2ft. 6in. wide, paved partly with stone and partly with small iron rails laid longitudinally. The workings can only be carried on for about nine months in the year, and during last year they got about 500oz. of gold, representing a value of £1,925. This claim is worked with five men.

Johnston's Claim.—This claim is situate on Pleasant Terrace, being the adjoining terrace higher up the river than that on which Davis Brothers are working. Mr. Johnston has been working this claim for the last twelve years. He has a head-race from Pleasant Creek brought in at a good elevation, but does not utilise the head in working the ground. The water falls down the face of the range for a considerable height, and is stored in a dam constructed on a flat at the foot of the range. From this dam it is again led in an open cut or ditch from the first on to a second terrace, where he is working. The depth of gravel wash-drift at the present workings is only about 30ft., and the water is simply brought over the face, a canvas hose being used for the breaking-down nozzle. Previous to this Mr. Johnston was working a run of very deep ground through this terrace, and sluicing into a creek, but there was not sufficient fall for his tailings. Before commencing operations in this run of ground again, a tail-race tunnel will have to be constructed from the Shotover River. The area of ground worked is about 8 acres, having an average depth of about 81ft. Taking the cubical contents of ground worked, there would be about 1,045,440 cubic yards, or about 87,120 cubic yards sluiced away per annum. This claim has paid, so far, very well.

Sorrenson's Claim.—This claim adjoins Johnston's, but there is no available water to work it by hydraulic sluicing. The wash-drift on the bottom is being driven out from a tunnel which is constructed from the side of Pleasant Creek, but this is not found to be a profitable way of working the ground.

Moody and Davis' Claim.—This claim is partly situated on Londonderry Terrace and partly on Burke's Terrace, next to Skipper's Point, and comprises an area of 36 acres. It is held by Messrs. Davis, Moody, and Company, of Melbourne, who are represented by Mr. D. Miller. They have constructed a water-race from Skipper's Creek, lifting the water from both branches. The race is constructed on the east side of Skipper's Creek to a point about one mile above its junction with the Shotover River. Up to this point the water is conveyed in an open conduit, excepting at three gullies, which are crossed by siphons 22in. in diameter, and 20 chains of iron pipes 3ft. in diameter laid with the same fall as the open conduit—viz., 1 in 660 over bad ground. The water is conveyed across Skipper's Creek by a siphon 22in. in diameter, its length being 40 chains, and the greatest depth in the centre 250ft.; the pipes in the siphon are made of Nos. 12, 14, and 16 B.W.G., single-rivetted, having angle-iron flanges every 18ft. On the west side of Skipper's Creek the water is again conveyed in an open conduit to a gully near Johnston's Hotel, where there is another siphon of the same diameter 1,000ft. in length, having a dip in the centre of 175ft. From this point the water is again conveyed in an open conduit to a small reservoir excavated out of the tolerably level piece of ground at the head of Burke's Terrace, and from this reservoir iron pipes are laid to the ground where sluicing operations are to be commenced. The water is again conveyed in a ditch to Londonderry Creek, where a by-wash will be constructed. The total length of this water-supply is five miles. The open conduit, where not constructed in solid rock, is puddled in the bottom and sides, and lined with sods, and is 2ft. 6in. in the bottom, 3ft. 6in. at the top, and 3ft. deep. All the iron pipes were manufactured on the ground in 18ft. lengths, with angle-iron flanges on each end. The cost of making the pipes was 1s. 9d. per foot, all the material being supplied by the company. The total cost of labour and material, including screw-bolts for joining the pipes, was £3 18s. 6d. for each 18ft. length, or, in round figures, 4s. 6d. per foot. Seeing that all the material had to be taken partly on sleighs and partly on pack-horses from Queenstown to Skipper's Point, a distance of about twenty-three miles, the cost of pipes of this size is very small.

The depth of wash-drift in Burke's Terrace, where the sluicing operations are to be commenced, is about 150ft., and there is plenty of fall for the tailings into the Shotover River. Mr. Miller expected to be ready for work in about ten days from the time of my visit on the 16th April last. The cost of the work to that date was about £8,000.

Aspinal's Claim.—This claim is situate on the west side of Skipper's Creek, on the side of the Shotover River. There is still about 2 acres of ground to work, but last year being extremely dry, and having to depend entirely on drainage-water from the side of the range, there was only about fourteen hours' water available during the whole of the season. The ground is said to be extremely rich, averaging about 2oz. of gold to every hour that six sluice-heads of water are used.

Monk's Claim.—This claim is situate on the west side of the Shotover River, on a low terrace above Skipper's Creek junction. It is said to be one of the richest claims on the Shotover Valley. The ground is only 25ft. deep, and two men get from 100oz. to 150oz. of gold per annum, and have scarcely any water to work with.

Smith's Claim.—This claim is situate on the east side of the Shotover River, below the sand-hills; it has been worked for the last twenty years, paying good wages whenever water is available.

Schusted and Gemmell's Claim.—This party took up the sand-hills about three years ago, and brought on water from a small creek, using about 1,500ft. of 7in. pipes. The supply of water is very limited, and in wet weather the pipes are not large enough to carry a sufficient supply; nevertheless the ground pays very well for working.

There are two other parties working terraces above the sand-hills, making fair wages; and several parties are working on the branches, but they complain greatly of the scarcity of water. There is scarcely any terrace on the side of the Shotover that would not pay for working if a good supply of water was available, and most probably the time will come when a large water-supply will be brought from the upper branches of the river to command all the available ground. Some of these terraces are at a good elevation. The one worked by Robertson and party is 450ft.

above the bed of the Shotover River, on the opposite side of Deep Creek, and at this elevation the ancient bed of the river can clearly be seen; but the scarcity of water precludes the ground being worked profitably; nevertheless, men are content to wait for a heavy day's rain to allow them to carry on sluicing operations. This alone shows that some of these terraces must contain very rich auriferous drifts.

DREDGING.

Dredging for gold in the river-beds of the Molyneux has been successfully carried on for many years past, but it is only within the last four years that any large attention has been devoted to this branch of the mining industry. The impetus given to dredging of late years is due in some measure to representations made by Messrs. Brooke-Smith, Gibson, and Welman that suction dredges could work the beds of rivers and the ocean-beaches at comparatively small cost, but none of them have been successful in their efforts to get the suction dredges largely introduced. Mr. Brooke-Smith introduced a small Ball dredger, and commenced operations on the ocean-beach at the Five-mile, below Okarito, and, although this is one of the richest beaches on the West Coast, he could not make the ground pay for working. The dredge he erected was not suitable for the purpose for which it was intended. Mr. Welman has constructed several of these suction dredges, two of which were placed on the ocean-beaches on the West Coast, one at the Saltwater Lagoon and another at the Three-mile Beach below Okarito. Neither of these dredges could make the ground pay for working on the principle on which they were constructed. Mr. S. Brown, of Wellington, also erected a suction dredge known as the Cataract pump, but this also was a failure. These suction dredges, so far, have proved that they are capable of lifting sand and fine shingle, but that they are not suitable for dredging where large stones and coarse gravel exist.

Every year will bring about improvements in dredging appliances. What now is looked on as the most suitable machine for lifting gravel and stones from the beds of rivers, or for working alluvial flats where there is water to contend with, is what is known as the centre-bucket dredger, and, as far as lifting the material is concerned, these dredges act admirably; but more attention has been devoted to the lifting appliances than to the washing apparatus and the saving of the gold. Many of the dredges now at work on the rivers are lifting large quantities of material, but the greater portion of the fine gold amongst the wash-drift is again discharged over the stern of the dredge. It is admitted by all those who have been accustomed to working the ocean-beaches and black-sand leads that a large quantity of sand cannot be rushed over narrow tables and save the gold. The width of tables and corresponding quantity of water must be in proportion to the quantity of material required to pass over them. This principle does not seem to be carried out in working the dredges on the rivers. So long as the sand does not actually bank up on the tables, so as to make the water flow over the sides, everything is regarded as working satisfactorily.

The question of erecting good gold-saving appliances on the hull of a dredge is beset with many difficulties, as there are so many elements to consider and provide for, to be able to recover a fair percentage of the gold from the material lifted. There is a great deal of fine scaly gold in the beds of the rivers, and it is this class of gold that is most difficult to recover. Very little of it is saved in the ordinary sluice-box, and it is on wide tables where most of this class of gold is to be recovered; but, before the material can be allowed to run over the tables, the stones and fine gravel have to be separated from the finer sands. This operation does not seem to be successfully performed in any of the dredges working at the time of my visit to the Wakatipu district. There is a difficulty in getting sufficient surface of tables erected on the hull of a dredge to treat the whole of the material that is lifted, and also in erecting sufficient separating appliances to classify the material so as to have fall for the tables without having the tumbler-shaft too high, which would make the dredge top-heavy.

Before the dredges will be successful machines for working the beds of rivers so as to recover a fair percentage of the gold which the gravel contains, the material from the buckets must pass through a machine, or some appliance to separate the stones from the fine shingle, afterwards to be separated from the fine sand before it is allowed to pass over any table which is covered with either cocoanut matting, baize, blanketing, or plush. The fine sand also requires to be so regulated that it is carried down over the tables with a thin film of water, having always the surface of the matting, &c., perfectly clear. As soon as sand appears on the surface of the tables it is certain that little or any of the fine scaly gold is being saved. Sufficient attention has not been given to this part of the process of gold-saving on any of the dredges working on the Shotover up to the time of my visit.

Sand-hills Dredging Company.—This company has constructed a dredge on the upper side of the sand-hills on the Shotover River, and it had been working for nearly six weeks previous to my visit in April last. As this dredge is worked by electro-motive force, a description of it may be interesting. It is a centre-bucket dredge, with revolving cylinder for separating the stone and gravel from the fine material. The latter passes over tables covered with matting set transversely with the hull, having a chute at the bottom end of the tables which conveys the waste material over the stern, while the large stones pass over a grating, and are discharged by another chute over the stern, and the rest of the material passes into a sluice-box about 2ft. wide and 40ft. long, filled with ripples and false bottoms. The hull of the dredge is 80ft. long, with 18ft. 3in. of beam, and 4ft. 6in. deep, the height of the tumbler shaft above deck being 16ft., and the buckets dredge to a depth of 20ft. below the water-level. The revolving cylinder is about 3ft. in diameter and 10ft. long, perforated with very small holes, as it is only intended to allow the fine sand to get through. The revolving motion of this cylinder causes a greater discharge at one side than the other, and, although the tables were working fairly well on one side of the screen, on the other side they were covered with sand to such a depth that it was impossible to save any gold. After observing the motion of this screen, and the irregularity in the discharge, it would seem that either a long cradle having a perforated hopper-plate, or a transverse shaking-table set on such an inclination that the stones

would pass over the end while the fine stuff went through the perforators and passed into the sluice-box and tables, would answer better than a revolving screen, the fine material being distributed more regularly on the tables. The dredge is constructed to lift about 60 tons of material per hour, but the manager stated that only about 30 tons are lifted, as it is found that the washing appliances are not capable of treating a larger quantity. This is perfectly true, as it is not capable of treating even this quantity of material properly, the total surface of the tables being only 144 square feet. The quantity of gold obtained up to the time of my visit was about 110oz., but since then the returns have been much larger.

The electro-motive force which works the dredging appliances, pumps, and other machinery, is generated by two Brush Victorian machines, having armatures of 2ft. in diameter. These machines or dynamos work at a speed of about 500 revolutions a minute, producing a current of forty amperes, having an electro-motive force of 650 volts. The dynamo can be worked to produce 800 volts, or equal to about 36-horse power each. These dynamos are driven by Pelton water-wheel 4ft. 6in. in diameter, which makes 213 revolutions per minute. The water for supplying the motive-power is lifted from Rapid Creek, from which it is brought in an open conduit round the side of the range, at an elevation of about 700ft. above the level of the Pelton wheel; but about 500ft. of head is only utilised. The pipes leading from the tank to the wheel are 18in. in diameter for the first 100ft., for the next 900ft. they are 15in., for the next 400ft. 13in., and thence diminishing to 6in. diameter at the lower end, having a nozzle of 1½in. in diameter, which is capable of discharging about two sluice-heads of water.

The electrical plant is situate about one mile and a half further up the Shotover River than where the dredge is at work, and the electro-motive power is transmitted by a copper wire about ¼in. in thickness. This is connected with a similar dynamo or motor to that used for generating the electricity on the dredge, and from this machine the whole of the machinery is driven with rope belting. This plant works extremely well, giving no trouble, and shows how electricity can be applied to work machinery of any description when water-power is available within a reasonable distance. Mr. Fletcher, the electrical engineer who erected this plant, deserves the highest credit for the manner in which the work is performed. The same gentleman erected the electrical plant which drives the Phœnix battery at Skipper's, and he has had considerable experience in applying electro-motive power for working machinery.

Sew Hoy Company.—This company has recently had three additional dredges constructed. They have now three working on the Big Beach, and one immediately above the bridge at Arthur's Point. These are all constructed on the centre-bucket principle, and are made to dredge a depth of 30ft. The three new dredges were at first all filled with revolving cylinders, but the perforations were found to be too large, and they have been discarded. The material passes from the buckets down the sluice, which is 37ft. long and 3ft. wide, a grizzly at the end, over which the stones and coarse shingle pass over the stern, and the fine material goes over return tables covered with cocoanut matting, but, judging from the manner in which the sand was lying on this matting, it would seem that a great deal of gold could not be saved. The water for sluicing is supplied by a centrifugal pump, 18in. diameter, making 800 revolutions per minute, lifting it into a tank, from which it is regulated into the sluice-box and tables. Each of these dredges is worked with three men on each shift, and kept going for the whole twenty-four hours.

There is another dredge constructed in the gorge between Moke Creek and Arthur's Point, but work had not been commenced at the time of my visit. The situation of it is such that an accident may occur at any time when the river is flooded. It is certainly in a very unsafe position, and men should not be allowed to remain on board when the river is flooded.

Talisman Company.—This company has a dredge on the Shotover River, below the gorge leading from the Big Beach. The ground here ought to be payable for dredging, as the bed of the river was not worked in the early days. However, so far the dredging operations have not proved successful. It is found that there is a great depth of shingle and gravel on top of the wash-drift, and it is questionable whether the ladder is sufficiently long to dredge to the bed-rock.

Frankton Beach Company.—This company's dredge is working at the side of the Kawarau River. It is constructed to dredge to a depth of 30ft., and is filled with a revolving screen and side transverse tables somewhat similar to those used on the Sand-hills Company's dredge. These two dredges have the best washing appliances so far of any working in this district. The managing director, Mr. Jenkins, informed me that he had obtained 59oz. 11dwt. of gold for the two weeks' work previous to my visit. Since dredging operations were commenced a strip of ground, 200 yards long and 50 yards wide, yielded gold to the value of about £800. This was for three months' work.

Two more dredges are working at the side of the Kawarau River, between the Shotover and Arrow Rivers, and are said to be getting gold. The cost of each of the dredges at work in this district is stated to be from £4,500 to £5,000; and the one at the Sand-hills, including the electric plant, cost about £7,500.

On the Molyneux River, from Coal Creek down to the Beaumont, there are about twelve dredges, some of which have been working the river successfully for many years. The early dredges are worked by a current-wheel, which answers very well in the stream, but they are not suitable for working the beaches where there is an eddy in the river. In some cases steam-engines have been placed in lieu of the current-wheels; these are found to be more profitable, as dredging can then be carried on at any part of the river.

Waipapa.

The dredges in this locality are constructed on the Welman principle, which are suitable for the class of material to be lifted here, which is principally sand, with very few stones. The Waipapa Creek Dredging Company has been re-formed under the name of the Waipapa Dredging Company, and are only waiting for a new suction-pump, which is daily expected from England, before again commencing operations.

Six-mile Beach Dredging Company.—This company's claim is situated about 18 miles from

Fortrose, on the ocean-beach, towards Waikawa. The plant has been erected, and operations commenced, and up to the present time there has been an expenditure of about £7,500 on the claim—water-race, dam, and plant. As this dredge has all modern improvements, the washing appliances being specially constructed for saving fine gold, a description of the plant taken from the *Otago Witness* of the 23rd April last may be interesting.

"The plant, generally speaking, consists of a Welman dredger, suction on the centrifugal principle being the means adopted in raising the material. The hull for the machinery is 60ft. long by 20ft. wide, with two side pontoons for the outriggers carrying the gold-saving tables. All the machinery is walled and roofed in with corrugated iron, together with subsidiary portions for the nozzleman, gold-saver, electric-lighting plant, &c. The pump, with a 13in. delivery, is 3ft. 6in. in diameter, and strongly constructed of cast iron and steel, and is driven at a speed of 260 revolutions per minute by a 25-horse power compound surface-condensing engine, made by Davey, Paxman, and Co. The cylinders are 10in. and 16in., with an 18in. piston-stroke, and the working steam-pressure is 120lb. to the square inch. All the latest improvements have been adopted to economize fuel, and the engine is fitted with automatic cut-off expansion gear, sight lubricators, &c. The engines, boilers, and pumps are substantial and highly-finished pieces of machinery, and will doubtless give good working results. The steam-winches are controlled by levers leading to the nozzleman's house, on the upper deck, and the whole manipulation of the dredging apparatus is controlled by one man with the utmost ease, the nozzle being raised, lowered, and transversed at will. The suction-pipe works on a radius of about 40ft., and is fitted with Welman's patent sleeve-nozzle and revolving cutter.

"The gold-saving appliances are very complete, the tables being 64ft. in width, a fall of 18in. to the 12ft., side boxes collect and carry all the tailings to the stern of the dredge, where they are received by a tailings-pipe, 15in. in diameter, and conveyed on to the beach, gravitating thence into the sea. The tailings-pipe is fitted with a universal socket-joint, and suspended from a post-crane, so that the tailings-pipe can swing in any direction where it may be desired to deposit the sand from the tables. The material to be treated is composed principally of sand; the bottom consists of a strong wash of varying size. The stones are caught on the hopper-plate, and disposed of on either side on the ground already dredged, the sand passing through the perforated plates into the hopper, whence it is distributed with the water on to the various tables in equal proportions, each table being separately connected to the hopper-box by an independent run. The gold, which is extremely fine, is caught on the plush mats, the latter being washed every shift into the gold-box. On the starboard-side of the dredge there is an appartment which contains an amalgamating barrel and special tables for saving the quicksilver and amalgam. The barrel gearing is driven by a Tangye engine, which also supplies motive-power for working a 4in. centrifugal pump for streaming down, and drives the dynamo that generates the electricity for lighting purposes. An arc lamp of 2,000-candle power will illuminate the tables and nozzle, while the engine-room and other apartments are lighted with sufficient incandescent lamps of 20-candle power each.

"As the suction dredger only lifts a small percentage of solid material compared with the quantity of water raised and used on the tables, it will be readily realised, where 60 or 70 tons an hour have to be treated, that an abundant water-supply is necessary, and the company have taken measures to meet this demand. A dam has been constructed in a specially suitable site, giving a storage-area of not far short of 150 acres. This reservoir is now full, and it is estimated to contain about 75,000,000 cubic feet of water. The reservoir is fed from three creeks, and also a water-race bringing in four heads of water from Cook's Creek, Waikawa, on the adjoining watershed. The reservoir is connected with the beach by an 18in. cast-iron pipe, from whence the water is conveyed to the dredging-paddock by timber fluming, the supply being regulated by an 18in. sluice-valve."

The dredging company at Lake Brunton has commenced operations. This dredge is fitted with a suction-pump similar to that in the Six-mile Company's dredge. This pump, it is said, readily passes stones 56lb. in weight through it with the greatest ease, and if the stones get caught by the arms of the runner they are broken to pieces without causing the slightest injury to the pump. This goes to show that with improved suction-pumps dredging can be successfully carried on. If the lifting of the stones can be got over it will then become a question of the cost of the wear-and-tear as compared with bucket-dredgers, and the suction-dredgers could then be used with more advantage to lift the gold of a hard, rocky, rough bottom, which cannot be done by bucket-dredgers.

The dredge employed in working Waipori Flat has also proved successful, and shows that where there is wet ground, with no fall for draining or working by hydraulic-sluicing, dredges can be used to advantage. It is also gratifying to find that a large percentage of the dredges which have been carrying on operations are likely to become profitable investments to the proprietors. Taking the returns published in the *Gazette* of the dredging companies formed in the colony which have published statements of affairs in accordance with the provisions of the Mining Companies Act, the capital subscribed amounts to £322,585, of which £72,879 10s. is paid up, and dividends to the amount of £9,870 have been paid. The dividends appear small in proportion to the expenditure, but it must be borne in mind that this branch of mining is only commencing, and very few of the companies referred to are yet carrying on active operations.

West Coast.

Mr. Joseph Taylor, who has been successfully carrying on dredging operations for the last two years on the North Beach, near Greymouth, has recently sold his property to a company in London with a capital of £20,000, who intend carrying on dredging operations on a larger scale. Mr. Taylor has been, ever since he commenced operations, making experiments with different dredging and washing appliances, and the class of plant now to be used is described in the *Mining and Finance Journal* of the 1st May last as follows:—

"At last a definite system was decided upon, the plant being adapted and designed by Mr.

James Bishop, C.E., and the water-supply tables, &c., by Mr. Thomas Jones, and constructed by Mr. James Brown, of Kumara. It is intended to work the ground with four central plants, consisting of fixed elevators, driven by steam-power, either directly or with electro-motors, obtaining their power from a central station. The elevators will be sunk in paddocks close to the sea; the sand, &c., will be sluiced to them; and, after being lifted 40ft. and panned over the tables, will be sent away by a deep-sea tail-race. The first of these plants is now in position, and will be at work in a few days if the fine weather continues, all that remains to be done being to extend the tail-race 40ft. or 50ft. into the sea, so as to get beyond the action of the breakers. The present elevator plant consists of a 42ft. ladder, carrying thirty-six buckets, having a capacity of 1½ cubic feet each, and is driven by the converted engine-power of the Priestman grab. A powerful Marshall's engine is used for driving the centrifugal pumps, which serve the double purpose of draining the ground and supplying water for washing purposes. In connection with the water-supply, two large dams and a considerable length of race have been constructed, principally with the object of trapping the surface-waters and saving the pumping-power. The dams are connected with the table by some 10 chains of 2ft. by 2ft. substantially-constructed fluming, mounted on trestle work. The tables are what are known as "Jones's novelty," and are an improvement and adaption of the American undercurrent system The blankets cover a space of 600 square feet. The tail-race, 4ft. by 2ft., is some 5 chains in length, and, when completed, will deliver into the sea well under low-water mark. The working of the present plant will be carefully noted, and any improvements that suggest themselves will be effected in the other three."

GOLD-MILLING.

The reduction and treatment of auriferous ores is a question of the deepest interest to those engaged in gold-mining, and one which does not receive the attention it deserves. Very few mine-proprietors have yet adopted the practice of assaying the ore as it comes from the mine, but seem quite content to treat it by the method in common use, so long as that method leaves sufficient to pay the cost of working the mine. The loss of gold is looked upon as something that cannot be avoided, and yet, if proper care and appliances were used, a far larger percentage would be saved, especially if the gold is in a free state; and when it is combined with pyrites, the system generally now adopted for extracting it cannot be expected to give good results. The question of extracting a large percentage of the gold in the ore at a cheap rate is one which has not yet been solved, and, even were a process found to treat certain ores which would give 95 per cent. of gold at a small cost, it could not be expected to be suitable for every class of ore. The character of the ore determines the mode of treatment, and this necessitates that those in charge of milling operations should have some knowledge of metallurgy.

At the present time the loss of gold at some of the milling plants is something appalling. If average assays were made of the ore as it comes from the mine it would be found that in some instances not more than 33 per cent. of the gold was saved, as, for instance, at the Try Fluke mill, at Kuaotuna, where a large percentage of the gold flows away in suspension amongst the water, and does not lodge among the tailings. There are certain portions of a milling plant common to every class of ore, such as pulverising machinery, but even then it becomes a question as to fineness. The ore has to be pulverised before the whole of the gold is liberated from the quartz sands. If the gold is coarse fine screens are not required, and the probability is that, if the coarse gold is in a free state, a fair percentage of it will be saved by careful amalgamation, but, if it is extremely fine, such as that found at Kuaotuna, the ore has to be pulverised very fine before one can expect to get the minute particles of gold free from the quartz sands; or, if there is a large percentage of auriferous pyrites in the ore, it becomes a question as to the fineness or coarseness of the screens. It will be found more economical to use coarse gratings, letting the pulverised pulp from the mortar or pulverising-machine after passing over the amalgamated copper plate on the apron run on to concentrators to collect the pyrites, leaving the waste material from the concentrators to be reground in pans and amalgamated. Pyritous ore should be crushed to such a degree of fineness as only to liberate all the pyrites, and then to have it separated from the gangue previous to grinding the sand into a fine pulp suitable for amalgamation.

There is a great want in most of the mills in New Zealand in not having complete crushing machinery. The ore is brought from the mine and dumped on the same floor as the mortars, hand-feeding being generally adopted, the stamps being used for both crushing and pulverising. The effect of this is that large pieces of rock are fed into the mortar, the fall of the stamp first breaks up these pieces into cubes, which fly with a great force against the screens, causing undue breakage, and leaving too great a depth of material on top of the dies. The crushing-capacity of a stamp battery reaches its maximum when the feed is so regulated that there is only sufficient material on top of the dies to keep the stamps from bumping. Where there is more than this the force of the blow is destroyed by the depth of material in the mortar forming a cushion for the stamp. In order that feeding may be done uniformly the ore should all be broken up to about 1½in. cubes before it is delivered into the stamps. This applies to both hard and soft ores, for, although the soft ores do not damage the screen to the same extent as the hard while being broken, a great depth of material on the dies destroys the pulverising-power of the stamps.

The use of rock-breakers in a mill cannot be overestimated, as the wear-and-tear on these machines is much less for the duty they perform than on any other machine now employed, but the difficulty in using rock-breakers at quartz-mills is that the machinery of the mills is not arranged in such a manner as to enable the use and benefit of rock-breakers to be as advantageously adopted as they should be. Every quartz-mill should be constructed so that the ore from the mine can pass through all the stages of treatment by gravitation. This necessitates the mill being built with several floors. The quartz should be first dumped on to a grizzly, the bar of which should not be more than 1½in. apart, the fine stuff going through the grizzly falling into an ore-bin, having the large pieces of quartz going over the grizzly, passing through a rock-breaker to be reduced to 1½ cubes, thence falling into the ore-bin, which should be constructed in the form of a hopper. From this hopper the ore should pass into automatic ore-feeders to feed the stamps.

In order that the ore may go through all the different stages of treatment by gravitation, the settlers should be placed on the first or ground-floor, the amalgamating-pans on the second, the concentrators on the third, the stamp battery on the fourth with the automatic ore feeders, the stone-breaker on the fifth, and the upper end of the grizzly about 18in. below the level of the tramway or level where the ore is brought in trucks or drays from the mine. The configuration of this country is well adapted for the erection of quartz-mills on the plan suggested, as it is generally almost hilly in every place where milling machinery has to be erected. The floors of the mill can be cut out in benches on the sidings of the hills and ranges, so as to allow the ore to pass through every process of treatment by gravitation. This does away with all unnecessary labour or elevating machinery.

It will be of interest to persons engaged in gold-milling to give an extract from a paper read by Hoffman, before the American Institute, on gold-milling at the Black Hills, Dakota, wherein he describes the process adopted for the reduction and treatment of auriferous ores. The gold is extracted by amalgamation, but somewhat different in principle to that adopted in the mills in New Zealand. About 60 per cent. of the gold saved is got inside the mortar-amalgamator, copper plates being used, one of which is about 6in. wide, placed directly underneath the bottom of the screen running along the length of the mortar, and in one of the mills there is also another plate at the back of the mortar, directly underneath the lip of the feed-aperture. The following is an from the paper referred to:—

ORES.

"The gold in the district is found in quartz and pyrites, finely distributed through vast bodies of mica- and amphibole-schists, argillites, and phyllites, and also impregnated with schists themselves. The belt embracing the section of Lead City, Terraville, and Central City is the only part worked at present. The principal associated mineral is iron-pyrites, with some arseno-pyrites and chalco-pyrite, garnet, and asbestos. The ores from open cuts and upper levels are far more free milling than those from underground workings, below water-line. Hence the mills running on oxidized ore have tailings of as low a value as 1s. per ton, while tailings from unaltered ore run sometimes up to 9s. 3d. per ton. By watching the pulp when it runs down the plates it can be readily determined whether the ore comes from higher or lower levels. In the former case it will generally have a brownish-red, and in the latter a bluish-gray. The amount of free gold in the ores, therefore, varies with the depth at which they are mined. It is difficult to give a correct average figure of its value, but it is somewhat near 16s. 4d. per ton. The total value of the ore is not definitely known, as its weight is not actually determined, but only estimated. Regular dry assays are not made at all.

"To determine the amount of free gold in the ore the following method is in practice: Samples are taken daily from different workings in the mine and sent to the sampler, who crushes these, pans them, and estimates the gold in the pan. Every valuation thus made is booked, and at the end of the month the average is taken and compared with the output of the mill, and the amount of gold recovered is thus approximately determined. The mode of operation practised by the sampler is simple. The sample, weighing, say, 10lb. is emptied into a four-gallon bell-shaped mortar, 13½in. by 12½in., and crushed to correct size with a heavy pestle swung from a spring-pole. From it 2lb. is then transferred into a second mortar of the same size with a wooden lid, and there pulverised wet to a fine pulp by means of a small steam-stamp, which is in reality an old powder-drill fitted up for this purpose. When sufficiently fine the pulp is panned until all the pyrites and other heavy sands are washed off with the tailings, and only the free gold remains. The sampler of the Homestake Company pans from fifty to fifty-five samples a day. Great skill is acquired in thus estimating the value of the ore, the sampler being able to make from eight to ten valuations an hour. As these are the only determinations made, it can be readily seen that the amount of the non-free-milling gold which enters the mill is not known. The percentage of sulphurets has been determined in several instances, and varies from 2½ and 3 per cent. to 6 per cent., and even 10 per cent. The assay-value of pure concentrates freed from rusty gold, or gold still enclosed in quartz—the ore not being sufficiently crushed—has lately been shown to vary from 16s. 4d. to £18 per ton, the average for the district being about £5 per ton.

Sorting the Ore.—As the gold is finely disseminated throughout the entire vein-matter, comparatively little sorting in the mine can be expected. There occur, however, in many parts of the veins igneous intrusions locally called "porphyry," which form "barren horses." When the Nevada system of timbering in square sets was exclusively in use no distinction was made between the mill-rock and waste, but it was considered the cheapest way to get clear of the latter was to run it through the mill. Lately, however, it has become the custom to fill the chambers forming this timbering with the wash muterial, and to hoist any excess of it to the dump, thus sending less waste through the mill; but large quantities are still got rid of in the old way, by running through the mill.

"*Enumeration of Mills.*

Name of Mill.	Year of Erection.	Location.	Name of Company.	Number of Stamps.
Homestake	1878	Lead City ...	Homestake Mining Company ...	80
Golden Star	1879	" ...	" " ...	120
Highland	1880	" ...	Highland " ...	120
Deadwood	1879	Terraville ...	Deadwood-Terra " ...	80
Golden Terra	1880	" ...	" " ...	80
Father de Smet... ...	1878	Central City ...	Father de Smet " ...	100
Caledonia	1879	Terraville ...	Caledonia " ...	60

Although these mills are owned by four separate companies, they are all, with the exception of the last, under the management of the Homestake superintendent. Thus it follows that the working details of the six mills are all, as far as practicable, after one model—the Homestake. The Caledonia mill stands alone, and works on a very different rock. Therefore the details of the plant differ considerably from those of the others. The details will therefore be summarised under two heads—Homestake and Caledonia.

"Outline of Plant and Process.

"The crushing is done by means of rock-breakers and stamps. The breakers first reduce the ore to a size suitable for stamps. The ore arriving at the highest level of the mill in the mine-cars, is discharged from the side or bottom of the car over grizzlies to the crushing-floor, or it goes direct to the crusher-hopper. The small-ore particles passing through the grates of the sizing-screen, and the coarse ore, which has been reduced by the rock-breaker, both drop into the same ore-bin, which reaches down to the cam-floor. Water is fed continuously into the mortars, and forms with the ore a liquid pulp, which passes through a screen at the front on to and over the apron-plates on the lower floor of the building. The Caledonia mill has blankets on the lower end of these plates to catch any coarse, heavy particles; in the other mills the pulp passes directly from the apron-plates to the mercury plates, and through them on to sluice-plates. From the traps placed at one end of these the pulp runs into one main sluice, which may again have one or more traps before the pulp is finally allowed to run to waste. Thus the entire process of passing the auriferous coarse rock from the ore-floor to the final discharge at the end of the main sluice is an automatic one.

"Battery amalgamation is used to extract the gold. It begins in the mortar, where mercury is added at intervals—while the continuous fine crushing with stamps is taking place—and ends on the apron-plates, where nearly all the amalgam not retained by the inside amalgamated copper plates is daily collected, any deficiency in the collecting mercury and amalgam on the plates being supplemented by the various traps. As the mills on the belt have to treat low-grade ores, it is necessary to their profitable operations that large amounts should be put through as rapidly as may be, and that at the same time as much gold as possible should be saved by simple means. To effect this a compromise is made between the two extreme methods of gold-milling. One of these aims at extracting as much gold as possible in the battery at the expense of capacity; the other, by amalgamating outside the battery, increases the crushing-capacity, but requires a number of expensive operations to recover the gold. In the Black Hills amalgamation is carried on both inside and outside the battery, thus combining the simple way of recovering the gold from the first method with the large capacity of the second. The aim is to crush rapidly to the desired fineness, and arrange the amalgamation so that it shall be adapted to the large amount of pulp produced.

"General Features of the Mills.

"The following table gives a comparative view of the dimensions, power, batteries, and product of the mills:—

Name of Mill.	Dimensions (*a*).			Boilers (*b*).		Engines.			Five-stamp Batteries.					Product.		
	Length in Feet.	Width in Feet.	Vertical Distance of Crusher-floor above Bottom of Ore-bin, in Feet.	Number.	Cords of Firewood consumed in Twenty-four Hours.	Type.	Cylinders. Diameter.	Cylinders. Stroke.	Number.	Distance between Lines, in Feet.	Wght. Stamps (*c*).	Drop in Inches.	Number of Drops per Minute.	Tons of Quartz crushed per Stamp in Twenty-four Hours.	Tons milled in One Year.	Bullion produced.	Average Yield per Ton.
							Inches.				Lb.					£	s. d.
Homestake ..	100	80	14¼	2	11	A	20	42	16	44½ (*d*)	850	9	85	4·5	96,790 (*e*)	184,445	15 2
Golden Star..	120	88¾	23¾	4	14	B	20	60	24	36 (*d*)	850	9	85	4·5	146,565 (*e*)		
Highland ..	112	92	22¾	4	14	C	26	60	24	46 (*d*)	850	9	85	4·5	146,013 (*f*)	83,902	11 5¾
Deadwood ..	112	46	22¾	2	11	A	20	42	16(*i*)	*k*	850	9	85	4·5	216,361 (*f*)	130,509	12 0¾
Golden Terra	112	46	22¾	2	11	A	18(*h*)	42	16(*i*)	*k*	850	9	85	4·5			
Fath'r de Smet	68	60	40	2	11	A	20	42	20	36 (*l*)	850	9	85	4·5			
Caledonia ..	84	46⅔	..	2	..	D	20	30	12	*k*	850	12	74	3·3	73,422 (*m*)	60,395	16 3

"The following is an explanation of the letters employed in the table:—

"A. Horizontal 155-horse-power engine, with Meyer's cut-off. B. 300-horse-power Corliss engine. C. 350-horse-power Corliss engine, Fraser and Chalmers pattern. D. Two 60-horse-power horizontal engines, with automatic cut-off. (*a.*) Length and width are always of mill proper, excluding the engine-room. (*b.*) The boilers in the table are all horizontal, tubular, 54in. in diameter, 16ft. long, with 46 tubes of 3½in. in diameter. Steam-pressure is kept at 90lb. per square inch. (*c.*) Made up as follows: Wrought-iron stern—length, 14ft.; diameter, 3⅛in.; weight, 340lb.: cast-iron-head, 240lb.—height, 18in.; diameter at top, 9in.; at bottom, 8in.: cast-iron shoe, 140lb.—cylindrical butt, 8in. high and 8¼in. diameter; tapering shank, 4½in. diameter at the base, 3½in. at top, and 5in. long, the shoe being made of white iron, chilled for 6½in. from the base, the next 1½in. and the shank being cast in sand and cooled slowly: cast-iron gib-tappet or disc—diameter at ends, 9¼in.; in the middle cylindrical part, 6in.; wearing-faces, 2½in. thick; middle part, 7in. long; total length, 12in.; weight, 130lb. Total, 850lb, stem, head, shoe, and disc or tappet, being proportioned as 34, 24, 14, 13. (*d.*) Batteries in two rows, back to back, leaving this space between the rows for ore-bins and feeders. (*e.*) From June, 1887, to May, 1888, inclusive. (*f.*) Estimated from report of Homestake Company, June, 1888, when product of 200 stamps in company's mill is given as 243,355 tons for the year ending the 30th May, 1888, or 1,216·775 tons per stamp. (*k.*) Batteries in single line. (*l.*) Batteries in two rows, but face to face, with this space between them. (*m.*) Intentionally slower, crushing on harder rock than the other mills. (*n.*) For year ending the 30th April, 1888.

"*Distribution of Power.*—The methods employed in transmitting power from the engine to the different parts of the mill may be classed under three types, represented respectively by the Highland, Homestake, and Golden Star Mills. The Caledonia may be placed with the Golden Star, and the Deadwood, Golden Terra, and the Father de Smet with the Highland, notwithstanding local variations, especially such as are necessitated in the Father de Smet by the peculiar arrangements of the batteries.

"(1.) In the Homestake mill the continuation of the engine-shaft forms the one line-shaft of the mill, and is placed on the battery-sills. This is a cheap construction, and gives a solid foundation for the boxes in which the line-shaft rests. The shaft is kept in line by the even pull of the long belts placed on each side, at an angle of about 30 degrees. The supposed advantages of being obliged to stop the entire mill if anything happens to the line-shaft is insignificant. When the mill was built, in 1878, the line-shaft was not made of sufficient thickness, in consequence of which it became twisted, and broke within two years. The new shaft, having requisite strength, has been steadily in use ever since. For minor repairs the position of the shaft is a disadvantage. It is in an obscure place, where it escapes attention, particularly as everything has to be done by artificial light.

"(2.) In the Golden Star mill the power is transferred from a small main-shaft to two line-shafts cam-floor, the main shaft being nearly on the same level. This arrangement is favoured by the builders on the Pacific Coast.

"(3.) In the Highland mill (see plate) the main shaft is placed between the cam-floor and the battery-floor, and is connected with two line-shafts placed on the battery sills behind the mortars.

"Both the Golden Star and Highland mills have two line-shafts, which is probably necessary, considering the power required for a 120-stamp mill. The disadvantage is that the pull of the belt on the one side only of the shaft has a tendency to draw it off the line, and also causes great wear-and-tear. As to placing the line-shafts in front of the batteries, on the cam-floor or behind the battery-floor, there is a diversity of opinion. The arrangement at the Golden Star Mill gives the best light in the mill, and makes the shafts easily accessible. The power from the engine-shafts is transmitted to the line-shafts, and from there to the cam-shafts, by long belts, which are nearly horizontal. They require no tighteners, and last longer than those of either the Homestake or Highland mills. On the other hand, the boxes of the line-shafts rest on transverse sills on the cam-floor, which, although braced and strengthened in various ways, cannot furnish the same sure foundation as that at the Homestake and Highland mills. Experience has shown, however, that this disadvantage is more than counterbalanced by the smaller consumption of belts, and the easy accessibility of the line-shafts. The Highland mill has the line-shafts on a sure foundation of the battery-sills; but the darkness and exposure of the line-shafts thus placed behind the mortars, to the buckling of water and fine ore, are serious disadvantages. Again, the belts from the main-shaft down to the line-shafts, and from these up to the cam-shafts, are short and steeply inclined, requiring powerful tighteners, which cause an increased consumption of belts. The mill, however, like the Homestake, is so arranged as to leave the battery, with the apron and sluice-plates, free from any superstructure.

"In the following table the particulars as to shafting-belts, &c., are given:—

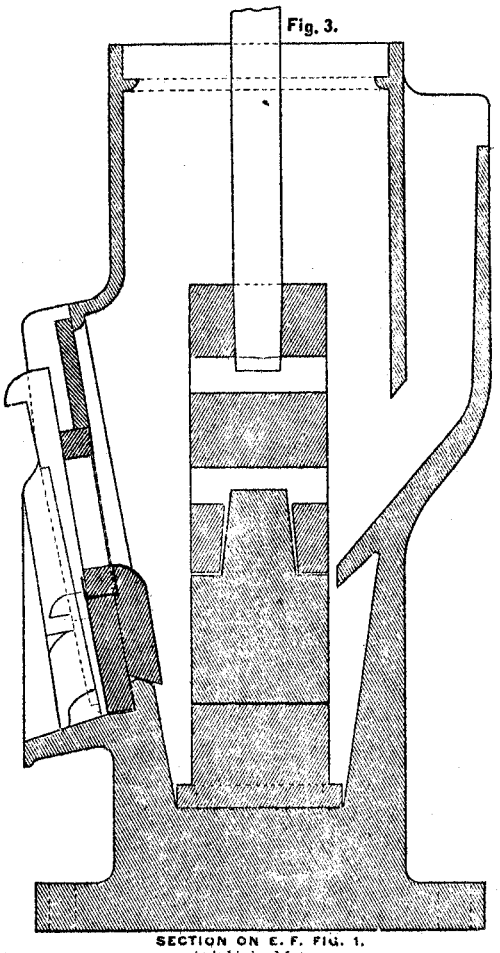
Name of Mill.	Line-shafts.			Rock-breakers.		Character and Size of Belts.											
		Diameter in Inches.				Main to Line-shafts.			Line- to Cam-shafts.			Line to Crusher-counter Shafts.			Crusher-counter to Crusher Shafts.		
	Number.	Near Engine.	At Opposite End.	Number.	Type.	Type.	Ply.	Width.	Type.	Ply.	Width.	Type.	Ply.	Width.	Type.	Ply.	Width.
Homestake	1	7	4½	5	E	..	..	..	G	5	14	H	..	18	G	4	9
Golden Star	2	9	4½	6	E	G	6	28	G	5	16	G	5	12	G	5	10
Highland	2	7	4	6	E	H	..	41	G	5	12	G	5	12	..	..	..
Deadwood	1	7	4	4	E	..	..	..	G	5	12	G	5	12	..	..	..
Golden Terra	1	7	4	4	E	..	..	..	G	5	12	G	5	12	..	..	..
Father de Smet ..	2	5½	3⅝	5	E	..	..	..	G	6	12	G	5	24	..	..	..
Caledonia	2	5 5/16	4½	1	F	G	5	28	G	5	12	G	5	24	..	..	..

NOTE.—E, No. 5 Blake rock-crusher. F, No. 6 Gates crusher. G, Rubber. H, Leather.

"The relation of the horse-power of the engine to each stamp averages for the seven mills about 1·7 to 1. This low figure is due to the larger number of stamps in each mill—80 to 120—which is much higher than the common average in gold-mills.

"*Supply of Water and Fuel.*—In this district the supply of water is chiefly furnished by two companies, at prices varying from 2s. to 2s. 3d. per stamp per day, the supply being brought in ditches. In winter water becomes scarce, and then the Homestake management are supplied in part by pumping from the Homestake and Deadwood-Terra Mines. This water otherwise runs to waste. The Big Highland mill would be obliged to stop four months each winter if the tailings from the Homestake, Golden Star, and Highland mills were not settled and the clear water pumped back into a supply-tank. The method by which this is done is simple and effective. The tailings from the three mills are discharged into a creek called the Gold Run. A little way further down this creek widens out, and is closed by two dams, one below the other, forming two reservoirs. The upper overflows into the lower, which is four times its size, and this in turn has its overflow into the bed of the creek. The dams consist of cribbing filled up solidly with waste rock. On their upper sides they are lined with watertight planking. Down the middle of this runs a wooden

Fig. 3.



SECTION ON E. F. FIG. 1.
Scale; 1 inch = 1 foot.

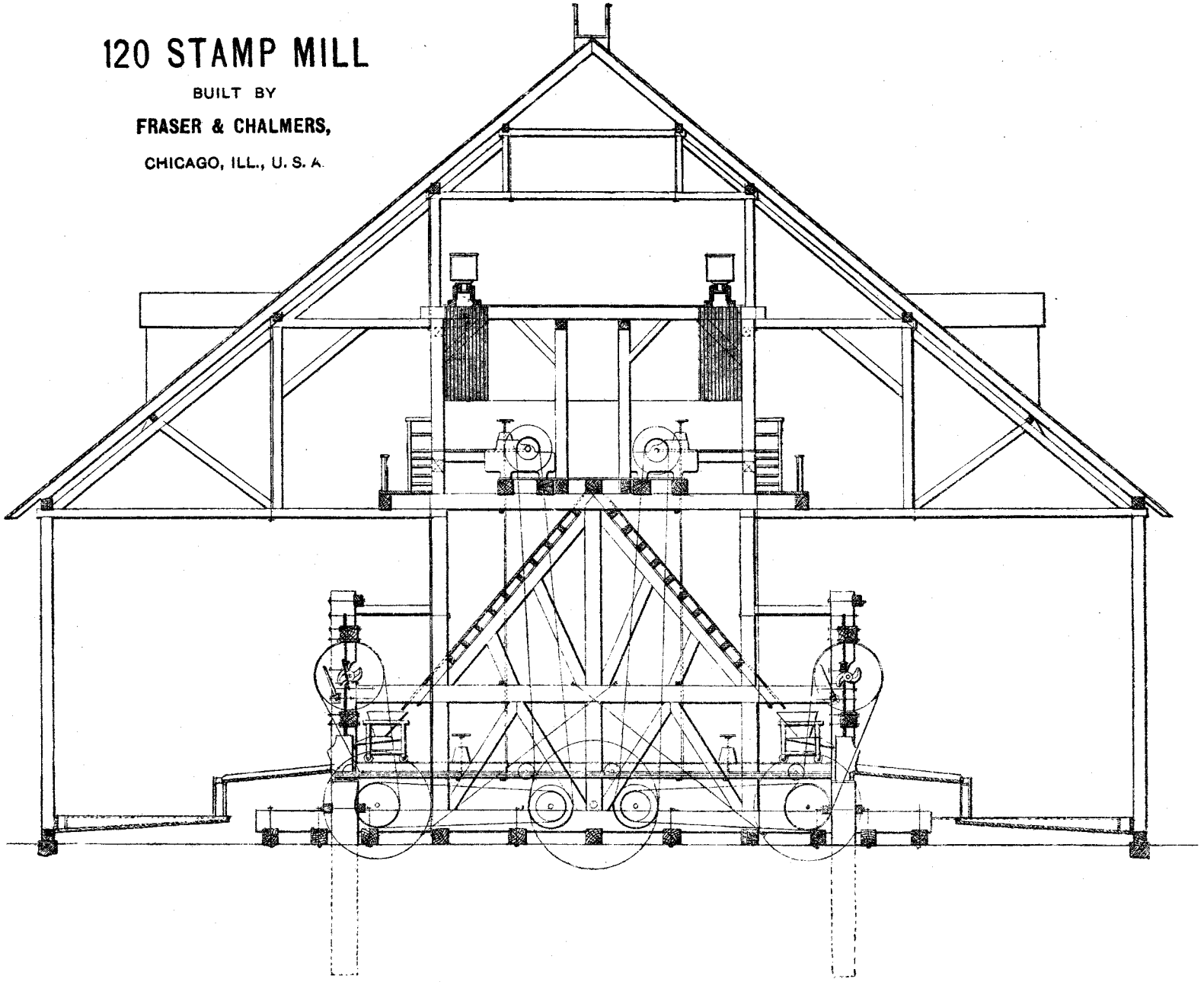
The Homestake Mortar and Stamp.

120 STAMP MILL

BUILT BY

FRASER & CHALMERS,

CHICAGO, ILL., U. S. A.



box, three sides of which are made of solid plank, the fourth side being left open. When the reservoir is filled this box is closed by pieces of heavy plank laid transversely. As far as the mere filling of the reservoir is concerned, the box might as well be closed by one solid piece; but the object of a number of pieces is to discharge the water gradually. This is done by removing the pieces one after another as the water is lowered, so that the sands may be kept in suspension and carried through the culvert. Were the box open at the bottom, or to its full height at once the sands would be carried into the culvert in such a quantity as to clog it. This culvert, in which the box ends, passes through the dam and under the lower reservoir and lower dam to the bed of the creek below. The lower dam is arranged in the same way. When the reservoirs are not in use the water in the creek passes through the culvert, and when they are not filled the boxes are closed. The water accumulates in the upper reservoir for about six hours, after which it overflows, leaving all the coarse sands in the upper reservoir, and carrying only with it the finer slimes, which settle in the lower one. From this the clarified water is pumped at the rate of 60 cubic feet per minute to a height of about 200ft. into a tank at the Highland mill. The coarse sands are removed from the upper reservoir every twenty-four hours. In order to do this, the tranverse planks on the discharge-box are removed one after another, and the water passes off, conveying the sand with it. As this process takes four hours, and the filling six hours, there are fourteen hours of overflow into the lower reservoir where the slimes settle. These are removed once in two months in the same way.

"The fuel for the mills under the Homestake management is supplied by the Black Hills and Forte Pierre Railroad Company. This road, with about thirty miles of 3ft. gauge track, runs along the divide between Gold Run and City Creek, terminating at a point about fourteen miles south of Lead City. The whole section was originally heavily wooded, but it has been quite denuded by the constant demands made upon it. The railway is very winding, and is quite a feat of engineering. It runs down the slope into Whitewood Creek, and up the opposite height, until it finally reaches the point where timber is still to be obtained. This road, as soon as spring opens, is employed in transporting wood and timber which has been cut and stored along its line, and is in constant use until the heavy snows block it for the winter—generally from January to April. It has three branches towards the three towns where the mills are situated, and communicates directly with these by means of long wooden chutes down which the wood is discharged. These are from 700ft. to 1,500ft. long, running down the slope of the mountain. The chutes are 25ft. wide by 12in. deep, and are made of planks 4in. in thickness. The bottom and 9in. of the sides are lined with iron $\frac{1}{4}$in. in thickness. The fall of the chute is 6in. to the foot, until the curves begin, when it is 4$\frac{1}{2}$in. to the foot. This continues to the nozzle, which is elliptical. When the chute is in use a small current of water is passed through to prevent the iron from becoming too hot, and also to act as a lubricator. The cordwood, unloaded into the top of the chute, passes down the incline with great velocity. At the nozzle it is deflected from its course, and, through the momentum obtained in its downward passage, the timber shoots up into the air and drops some distance off on the wood-pile. In order to discharge wood on a somewhat larger area the nozzle is made movable. The Caledonia mill has its wood hauled by teams, but is making experiments with soft coal, as the price of wood is £1 4s. 6d. per cord.

"*Auxiliary Arrangements.*—As the thermometer often sinks to 40° and 50° Fahr. below zero the mills and the water used in them have to be warmed. This is generally done by the use of steam. Along the ground-floor, in front of the apron-plates, there runs a sheet-iron drum 18in. in diameter, through which the waste steam from the engine is conducted. The battery-water is prevented from freezing by steam coils passing through the supply-tanks. Fire-plugs, with necessary attachments, are placed at regular intervals, to be used in case of accident.

"To reduce the cost of repairs and renewals, which is so large a part in the expenses of gold-milling, the Homestake Company has a foundry where rock-breaker shoes and dies, pitmans and toggle-plates, mortars and dies, boss-heads, tappets, thimbles for props, cams and hubs of cam-shaft, pulleys, and all shaft-boxes are cast from No. 1 and No. 3 foundry iron and worn-out castings. These are sometimes bought at a $\frac{1}{2}$d. a pound. The casting is all done in sand, with the exception of the rock-breaker shoes and dies and faces of the battery dies, which are chilled.

"*The Mills in Detail.*

"The six mills under the Homestake management have the same patterns for all parts, needing frequent renewal. This greatly reduces the amount of material kept on hand and the labour and cost of repairs.

"*Grizzlies.*—These are coarse screens, upon which the ore arriving from the mine is dumped and separated, the screened portion dropping directly into the bins. This relieves the rock-breaker of ore not requiring to be crushed, and only the coarse ore has to be shovelled into it. They are from 3ft. to 4ft. 6in. wide, from 10ft. to 14ft. long, and set on an angle of about 40deg., representing a rise of about 7$\frac{3}{4}$in. to the foot. They are made generally of wrought-iron bars 1in. in width and from 2in. to 4in. in depth, and spaced from 1$\frac{1}{2}$in. to 2in. apart, being held in place by sometimes five iron rods an inch in diameter, provided with washers at proper intervals. The weight of a grizzly 4ft. 6in. by 12ft. in size, with twenty-four bars 1in. wide and 2in. deep and 1$\frac{1}{2}$in. apart, is given as 2,040lb. These grates last about four years. In some instances old wrought-iron rods, with base turned up, take the place of standard rectangular bars, but they do not last much over one year.

"*Rock-breakers.*—All the Homestake mills use the Blake. The coarse ore rolling down from the grizzlies collects on the crusher-floor, and is fed by hand into the mouth of the breaker on the same level. From the crusher it passes into the bins, which have already received the fine ore from the grizzlies. The No. 5 breaker used—the largest pattern in the market—has a receiving capacity of 9in. by 15in., and is set to crush from 1$\frac{1}{2}$in. to 1$\frac{3}{4}$in., and is run twenty hours out of the twenty-four, each crusher being calculated to serve twenty stamps. The

amount crushed per day is not known, as there is no easy way of determining how much of the ore in the bins has passed through the crusher. If one-fourth of the ore—a probable proportion, in view of the slaty character of the ore—passes through the screens, escaping the breaker, and if twenty stamps crush 90 tons of Homestake ore in twenty-four hours, the amount crushed in twenty hours by one breaker is 67½ tons, or 3·4 tons per hour. This small figure, as compared with the capacity of the crusher, which is given at 7 tons, is due to the smallness of the mouth of the crusher, which necessitates the breaking-up of the ore—a serious matter, occasioning much delay. No part of the mill-work is so laborious as this breaking and feeding of the ore, which has to be done by hand.

"The wear-and-tear of material in a crusher is comparatively small, a shoe lasting two months and a die four months. The small receiving-capacity of the No. 5 Blake is a marked disadvantage to it in comparison with the Gates crusher lately introduced at the Caledonia. The ore of the Caledonia Mine breaks rather coarse—that is, it does not show much of the slaty character of Homestake ore, and is dumped immediately into the mouth of the crusher without the use of the grizzly. With about the same horse-power as three No. 5 Blake's, and set to the same size, one No. 6 Gates crusher, with three receiving-openings, each 12in. by 18in., attended by one man only, crushes 200 tons in ten hours. When three Blakes were in use it required five men to produce the same amount in twenty hours. Mr. T. L. Skinner, the superintendent, states that this new crusher saves him about £5 10s. a day. In order to make the iron head last longer, he uses three sets of concaves, of graduated thickness, the thinnest first, and so on. When, after some time, the head and first set of concaves have become so worn away as to increase the width of discharge above 1½in., the second set is introduced; and when they in turn wear, then the third. By the time these are worn down—about five months—it becomes necessary to replace the head. The disadvantage of the Gates crusher is its enormous weight—No. 6 weighs 30,000lb.—and the consequent difficulty of transporting it, especially in some mining regions. The best arrangement for a large mill seems to be to use a still larger Gates crusher—No. 8, with receiving-openings 18in. by. 48in.—set to crush coarse, and discharging into No. 6 crushers, set to crush fine. Thus the largest pieces of rock that man could handle would pass directly into the crusher, and the breaking by hand in the mine and mill would be reduced to a minimum. The smaller Gates crusher, with correspondingly small mouths, are not to be preferred to the Blake crusher.

"*Ore-bins.*—These receive the ore from the grizzlies and crushers directly over them, and discharge it through chutes into the hoppers of the feeders. They are triangular, with one vertical side, facing the battery, and reaching down to the cam-floor. Just above the latter are the openings—one for each feeder—through which the ore passes downwards into the chutes, terminating in the hoppers of the feeders. The quantity discharged is regulated by a sliding door. In a double mill the inclined bottoms of the two bins diverge, leaving an open space between, which has the shape of an inverted **V**. This arrangement is common to all the mills except the Father de Smet.

"The bottoms of the bins, which are 3in. in thickness, are made of 1in. board running lengthwise, with 2in. plank placed at right angles upon it crosswise; the bottom and sides are carefully braced with strong beams. There are no separate compartments or special arrangements for directing the ore towards the discharge-openings. The descending ore soon wears out such contrivances. It is advisable to line the upper part of the bottom on which the ore drops from the grizzlies and crushers, otherwise it wears out much faster than in the middle and lower parts, which lasts from five to six years. It is best to make ore-bins as large as practicable, so that in case of accident in either the mine or to the rock-breaker the mill need not stop. The capacity ought never to be less than one day's supply. By multiplying in each of the three double mills the horizontal distance between the two sets of batteries with the vertical distance between the crusher-floor and the cam-floor the comparative size of the ore-bins can be approximately estimated. The following table shows the result. It is assumed that the distance between front of bin and battery, as well as the incline of the bin, is about the same in all:—

Name of Mill.	Horizontal Distances in Feet.	Height in Feet.	Product in Square Feet.
Homestake	44·5	14·25	634
Golden Star	36·0	23·75	855
Highland	46·0	27·75	1,046

"This would show, that of these mills in which the batteries are arranged back to back, the Highland has the largest bin-capacity. In the Father de Smet, where the batteries discharge towards the centre, the bins built entirely above the batteries, and extending to the side walls of the building, have a still larger capacity, the figures corresponding to the dimensions given above being 57ft. by 30ft., or 1,710 square feet. There are, however, decisive objections on other grounds to this arrangement. The apron-plates are so overshadowed by the inclined bottoms of the ore-bins above, that the facility of supervision claimed as one advantage of this plan is largely neutralised by the prevailing darkness, even at noon-day.

"*Feeders.*—The working-capacity of a battery, and its exemption from unnecessary wear-and-tear, depend greatly on regular and equal feeding. This used to be done by hand, but is now generally accomplished by automatic feeders placed at the back of the batteries, and discharging either directly into the feed-opening of the mortar, or, as in the Caledonia, upon a small inclined iron-lined apron, which leads to the mortar. By the latter arrangement, a little more room is left between the feeder and the mortar, and the feed-opening can be narrower and longer, and the ore

more uniformly distributed under the stamps. Thus, the Homestake mortar feed-opening is 24in. long and 4½in. wide, while that of the Caledonia, occupying the entire length of the mortar, is 52in. long and only 3in. wide.

"The two ore-feeders used in the district are the Hendy Challenge and the Tulloch Automatic. Each has a well-earned name, the Challenge being, perhaps, the most desirable for wet ores. Both right-and left-hand feeders are used, the bumper-rod standing between stamps 1 and 2 or 4 and 5. The Challenge feeders introduced with the twenty new stamps of the Caledonia mill are central feeders, the bumper-rod being placed next to the central stamp. The rod is guided from the cam-floor, to which a piece of board, with a suitable hole for the rod to pass through, is fastened. The comparative advantages of the two feeders may be summed up by stating that, while the sheet-iron plate below the hopper of the Tulloch wears out quickly—with Homestake ore in two years—it is cheap, and can be patched or renewed by any blacksmith; whilst the circular cast-iron carrier-table of the Challenge lasts seven years with the same ore; but it is costly, and, if anything is out of order with the gearing, it requires a shop and a machinist.

"*Battery-foundations, Frames, and Guides.*—The essential importance of a good foundation is well known. In preparing it a rectangular pit, from 11ft. to 14ft. deep, is first dug to receive the mortar-block. It is made sufficiently long and wide—4ft. by 6ft. 6in.—to leave a space of about 24in. all around the block. The bottom is then carefully levelled, and some sand tamped down. On this are laid two layers of 2in. plank, spiked crosswise to each other, and then the planks which form the mortar-block. The latter used to be placed directly on the bottom of the pit, the uneven tops being sawn off afterwards. Now care is taken that this 4in. wooden floor shall be accurately horizontal, and that the distance between it and the bottom of the mortar shall have the length of the mortar-block. The top of the block is only planed off, which saves time. By use of this flooring the time required for replacing a mortar-block is reduced from six or seven days to five days. The mortar-block consists of planks 11ft. to 14ft. long, according to the depth of the pit, or varying breadth, and not more than 2in. or 3in. thick, as it is difficult to find wood of greater thickness which is sound throughout. They are spiked together, and are fastened above and below, bolted to each other by transverse rods, the upper binders—8in. by 12in.—being even with the top of the mortar-block, and the lower binders—12in. by 12in.—about 3ft. lower down. The space around the mortar-block is then carefully filled and tamped with rock and tailings up to the level of the mudsills, which are about 4ft. below the bottom of the mortar. When the top of the mortar-block has been planed off and levelled a sheet of rubber-cloth ¼in. in thickness is placed over it, and the mortar put in place. Through the four holes on each side pass eight bolts, from 3ft. to 4ft. 6in. long, and from 1⅝in. to 1½in. diameter, with which the mortar is fastened to the block.

"In placing the planks forming the mortar-block, and in adjusting the bolts that hold down the mortar, a decided improvement has been made at the Homestake mills. The planks, which always stand on end, were formerly spiked so that the width was parallel to the short side of the mortar. The holes for the eight bolts were then bored into the mortar-block from above. At a suitable distance below recesses were chopped out to receive the nuts which screw the lower ends of the bolts. Now the planks are so placed that their width is paralled to the long side of the mortar. The bolts have only at the upper end a thread, and end in a loop at the bottom. Through these loops and through the mortar:block pass horizontally 2in. iron rods. The planks on the two sides of the block, where the bolts pass down, are cut out to receive them. The advantages of this arrangement are apparent. In addition to the mortar being more securely and evenly tied to the block, it is easier to renew the mortar-block if necessary. The pit need only be dug in front of the mortar, and, when the front binders have been removed, it is easy to tear out the planks one after another with pick and adze. In putting in the new block, the two outside rows of planks, with places cut to receive the bolts, are kept ready, so that only four horizontal 2½in. holes for the rods need be bored when the planks have been spiked together. With the old method two trenches had to be dug instead of one if a mortar-block was to be exchanged. Then the planks had to be chopped out in pieces, until room enough had been made for them to be torn off.

"*Battery-frames.*—These are generally 12in. by 24in. in size, with recesses for the boxes of the cam-shaft. They are placed on the short sides of the mortar, and are independent of the mortar-block standing on cross-sills—which are placed on the top of and at right angles to the mud-sills—and tied by the upper and lower guide timbers, and at the foot by two longitudinal beams bolted to them and let into the cross-sills. The frames are braced either from the back or the front of the battery, according to the way in which the power is transmitted to the cam-shaft. In the Homestake, Highland, Golden Star, and Father de Smet mills, where the line-shafts are at the back of the battery, the frames are braced by posts, generally placed on an incline between the frame and the cross-sill, leaving the entire front of the battery unobstructed. In the Golden Star and Caledonia mills the cam-shafts receive their motion from line-shafts placed on the cam-floor, and the frames are braced against the cross-beams, to which the boxes of the line-shafts are bolted.

"*Guides.*—The stamps are held upright by two guides, fastened to the guide-timbers, which tie the battery-frames. The upper guides are above the tappets or discs, the lower one between the cam-shaft and top of mortar. At the Homestake mill the centre of the lower guides is 17½in. above the top of the mortar, and the cam-shaft, revolving between the two set of guides, is 3ft. 10½in. below the centre of the upper, and 4ft. above the centre of the lower, making the total distance between the two sets 7ft. 10½in. At the Caledonia mill the distance from the top of the mortar to the centre of lower guides is 16½in., from these to centre of cam-shaft 3ft. 4½in., and from this to centre of upper guides 4ft., 2¼in., making a total of 7ft. 6¾in. Each set of guides consist of two pieces of 4in. pine plank, 16in. deep, having semicircular grooves, through which the stems of the stamps pass. Between the two posts of the guides, when new, are inserted small pieces of wood to keep them slightly apart. When the grooves are somewhat worn these slats are removed, and the guides brought nearer each other. Later on the faces are planed off to diminish the size of the grooves, so that the stamps may not be held too loosely. Each set of guides is secured

to the guide-timber with eight $\frac{7}{8}$in. bolts, the grooves in the guides are lubricated with a preparation of black-lead and linseed-oil, mixed warm, in such proportions as to form a soft paste. Oak guides last eighteen months, and those made of pine only about four months.

"*Mortars.*—Two kinds of single discharge mortars are used in the district. Each consists of one solid casting. The bottom and sides are so thick as not to need any lining, this thickness decreasing very considerably as the feed is approached. The outside walls are vertical, with the exception of the discharge, which projects somewhat. The top is closed by two pieces of 2in. plank, which rests on legs $\frac{3}{4}$in. wide, cast in the mortar 2in. below the top. These planks have each five semicircular recesses, which, when placed together, form holes for the passage of the stems. In addition to these five large holes, two smaller ones are bored for the two 1in. water-supply pipes placed between stamps 1 and 2 and 4 and 5. Two mortars are placed close together, as the stamps in both are set in motion by one cam-shaft. In order to reach the mortars, &c., a passage-way is left between every two pairs of batteries. From it passes upwards a 2in. pipe between each pair of batteries. The water-supply is derived from a 3in. main running along the front of the batteries. With this is connected a 2in. horizontal pipe, from which four 1in. pipes branch off at right angles, two for each mortar. In addition to this water-supply there is a 1in. pipe at each passage-way, close to the mortar, coming from the 3in. main. A hose is attached to this to clean the apron-plates, and for other purposes. The points of difference between the two mortars lie in the inside dimensions of the lower part of the mortar, and in the arrangement and number of the inside amalgamated copper plates.

"(1.) The Homestake mortar (Figs. 1, 2 and 3), weighing 5,400lb., is 54$\frac{1}{2}$in. high and 54$\frac{3}{4}$in. long. The feed-opening, beginning 6$\frac{1}{2}$in. below the top, is 24in. long, 4$\frac{1}{2}$in. wide, and 7in. deep. On entering the mortar it remains 24in. long and 7in. deep. At the bottom of the feed, forming the continuation of the incline, over which the ore passes into the mortar, is a lip 4$\frac{3}{4}$in. wide and 1$\frac{1}{4}$in. thick, designed to discharge the ore against the upper half of the stamp head. The lower edge of the lip is 14in. above the inside bottom of the mortar. As the lip wears out first it might be well to cast it thicker, as has been done in the Caledonia mortar. Taking the front view of the mortar, we find, 15$\frac{1}{2}$in. from the bottom, the discharge-opening, 48$\frac{1}{4}$in. long and 21$\frac{3}{4}$in. high. The frame is inclined outwards, about 10° from the vertical. On the short sides of the discharge-opening are grooves to receive the chuck-block, screen-frame, and curtain, which are held in place by keys and sockets. The chuck-block is also fastened at the bottom by two horizontal keys, supported by lugs on the outside lip of the mortar, below the discharge. Viewing the mortar in cross-section, we have the two bottom flanges 3in. high and 5in. broad. The bottom of the mortar—the mortar-bed—is 7$\frac{1}{2}$in. thick, and the sides at the bottom of the dies 3$\frac{1}{2}$in. The inside dimensions are at the bottom 10$\frac{1}{2}$in. and length 50in. Formerly the width was 14in., but in order to increase the crushing-capacity it was reduced—the height to issue of mortar, not of pulp—8$\frac{3}{4}$in.; width at this point 13$\frac{1}{2}$in., at the top of the discharge 20in., and at the top of the mortar 16in.; total inside height, 47in. The casting is $\frac{3}{4}$in. thick from the top down to the feed opening, on three sides, the back being a little thicker. A mortar lasts four years wearing, pretty uniformly at the sides and back.

"(2.) The Caledonia mortar weighs 5,700lb., is 57$\frac{1}{2}$in. high, and 54in. long. The feed-opening beginning 15$\frac{1}{2}$in. from the top, is 3in. wide and 11in. deep, extending the entire length of the mortar, having a strengthening-rib in the centre. At entering the mortar it is 50$\frac{1}{2}$in. long and 7$\frac{1}{2}$in. deep. Here the lip 2$\frac{1}{2}$in. thick and 8in. wide, measured on the incline, begins. The bottom of the lip is 15in. from the bottom of the dies. As in the Homestake mortar, the ore is discharged towards the head of the stamp. The lip also serves as a protector to the amalgamated copper plate below it. The discharge-opening in front is 50in. long by 17in. high, and begins 20in. above the bottom of the flange. Its frame is also inclined outward, about 10° from the vertical. The grooves on the sides, receiving only the screen-frames and curtain, are simpler in construction than those of the Homestake mortar. The lugs for the horizontal keys are the same. Taking the cross-section, we find the flanges 3in. thick and 4$\frac{1}{2}$in. wide. The mortar-bed is 7in. thick, and the sides and the foot of the dies 4$\frac{1}{2}$in. The width at the bottom is 10in., length 50$\frac{1}{2}$in., and the height 14in. to the issue of the mortar and pulp, where the width is 16in., increasing to 19in. at the top of the discharge, and the top is only 13$\frac{1}{2}$in. wide, the total inside height being 50$\frac{1}{2}$in. The casting from the top of the mortar to the feed-opening is $\frac{3}{4}$in. thick. A mortar lasts six years, and wears out more at the short sides than at the back.

"In comparing the two types, we see that they differ in the feed-opening as already stated. The feed-lip also differs, that of the Caledonia being thicker and wider than the other. The increased width is necessitated by the presence of the amalgamated copper plate below the lip. The mortar itself is also wider at the issue for the same reason. The depth of the Homestake mortar is 8$\frac{3}{4}$in., and that of the Caledonia 14in., the latter corresponding with the height at which the pulp occurs. In the Homestake mortar the issue is raised by the insertion of the chuck-block 16$\frac{1}{4}$in. above the bottom of the dies, thus giving, with a shallower mortar, a deeper issue of pulp than in the Caledonia.

"*Dies.*—The Homestake management cast its own dies. The quality of the iron used is between gray and mottled, the top of the cylindrical part being chilled. The foot-plate has bevelled corners and is 10in. long, 10$\frac{1}{2}$in. wide, and 1$\frac{1}{4}$in. thick. The cylindrical part, or "boss," is 9in. in diameter and 5in. high. The level of the die is 10in. below the discharge, which takes place over the chuck-block. The die weighs 121lb.—one-seventh of the weight of the stamp—and lasts six weeks, crushing 189 tons. By that time the cylindrical part has become slightly convex, and is worn down to 2in. from the foot-plate, its weight being reduced to about 30lb. Thus 48lb. of iron are consumed for every 100 tons of rock crushed.

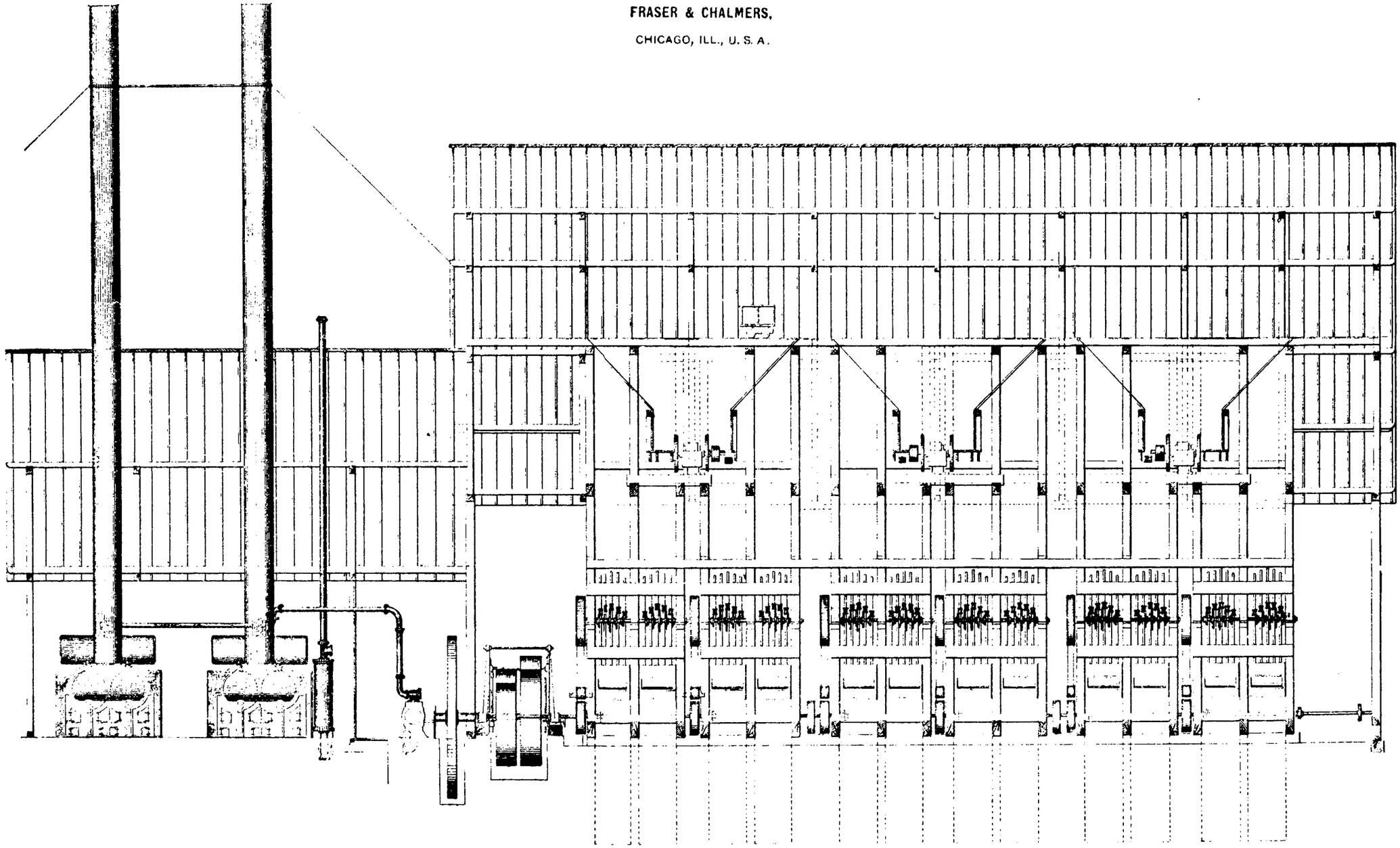
"The Caledonia mill buys its dies outside, which are of chilled white-iron. The foot-plate has also bevelled corners, is 10in. wide by 9$\frac{1}{2}$in. long, 1$\frac{1}{2}$in. thick, the cylindrical part being 8in. in diameter and 5$\frac{1}{2}$in. high. While the dies of the Homestake mortar fill its bottom completely, those of the Caledonia fit perfectly in the width only, there being a space of 3in. in the length that has to

120 STAMP MILL

BUILT BY

FRASER & CHALMERS,

CHICAGO, ILL., U. S. A.



SECTIONS SHOWING CONSTRUCTION AND ARRANGEMENTS OF THE HIGHLAND MILL, LEADVILLE.

be divided up between the five dies. The distance from the bottom of the screen to the top of the dies is 6in. The die weighs 160lb.—about one-fifth of the weight of the stamp—and lasts three months, crushing 300 tons of hard rock. The cylindrical part is then worn down within 1in. of the foot-plate. The worn-out die weighs about 38lb., making the consumption of iron 40lb. for every 100 tons of rock crushed.

"*Amalgamated Copper Plates.*—These are placed along the entire length of the mortar. In the Homestake mortar one plate is set to the discharge-opening. In the Caledonia mortar there are two plates, one under the discharge, and the other beneath the lip of the feed-opening. The Homestake mills use the so-called chuck-block (see half-elevation, Figs. 2 and 3), placed against the lower flange and the two side-flanges of the discharge. The chuck-block consists of a 2in. plank, bolted to the back of a 1¾in. board, and extending from 2in. to 2½in. above it, its inside edge being rounded off, and over this and along the inside face a $\frac{3}{16}$in. copper plate is fastened with iron screws. The recess formed on the top of the front board, 1¾in. wide, and from 2in to 2½in. deep, is taken up by the lower part of the screen-frame. Between this and the front board is placed a strip of carpet to form a tight joint. The frame is held in place by a vertical piece of flat iron, bolted to the centre of the front board, a horizontal wedge being driven between the two. The front board has an iron facing along its lower half, and two vertical strips towards the ends, to protect the wood against the two horizontal and the two vertical wedges with which it is fastened to the mortar. To the back—beneath the 2in. plank having the sheet copper—is tacked a strip of rubber cloth, which helps to make a tight joint between the wood and the flange of the mortar. Two chuck-blocks are in use. When the dies are new a block 7in. high is inserted, and when they have worn down 2in. another chuck-block 5in. high replaces it. Thus the height of the discharge is kept nearly uniform. The distance between the face of the shoe and chuck-block—2in.—is rather small. The violent motion of the battery water drives the sands against the copper plate, and scours off amalgam that has been caught on it. Thus comparatively little amalgam can settle on this plate. Wooden chuck-blocks last six months. After this period the copper plates have to be removed and put on new blocks, or they are scraped very carefully, put aside, melted, and sold. Mr. R. Graham, the millwright of the Homestake mill, has therefore replaced in his mill the 2in. plank to which the copper plate is screwed by ¼in. iron, to which the $\frac{3}{16}$in. copper plate is rivetted with copper rivets; the face of the 1¾in. wooden board with ⅛in. iron: thus the distance between face of shoe and Graham's chuck-block is 3⅝in., instead of 2in. This iron chuck-block lasts as long as the mortar, and more amalgam collects on it than did on the plate attached to the wooden one. Of the free gold recovered, 55 per cent. is caught on this inside plate.

"The reason the Caledonia mill has amalgamated copper plates at both back and front is that the ore melted is not oxidized at all, which makes it harder to extract the gold. The aim is to keep the pulp longer in the battery, and thus counteract the refractory character of the ore. The plate in front is 5in. wide, and the one at the back 8in., both plates being made of copper $\frac{3}{16}$in. thick, and are simply bolted to the mortar, the lower edges of the plates being 9in. above the foot of the dies. Of the free gold recovered, 60 per cent. is caught on these inside plates.

"*Screens.*—Both diagonal-slot and wire screens are used in this district, with the exception of the Father de Smet mill, which uses partly No. 30 brass-wire screens. All Homestake mills use diagonal-slot screens, made of heavy Russia iron, the needle, No. 7, corresponding to a thirty-mesh wire screen, the width of the slot being 0·024in., the thickness of the iron being No. 24½ American wire-gauge, and its weight 0·9871b. per square foot. The slots are ½in. long, and there are eight to the inch. The punched surface of the screen is 48in. by 7in., a margin of 1in. being left around the screen making its size 50in. by 9in. A screen of this description lasts two weeks. The wooden frame is 4ft. 4in. long and 11½in. deep, has a strengthening-rib 6½in. long down the centre. In fastening the screen to the frame the lap is first tacked on to hold it in its place; then a piece of rubber cloth 2in. wide is placed over it. Small holes are punched through the rubber, and lap of screen and are both nailed to the frame. The screen is placed on the frame, with the rough side facing the mortar. On the outside of the frame are fastened, by means of two screws, three iron facings ½in. by 9in. and $\frac{3}{16}$in. thick, which protect the wood from the one horizontal and two vertical keys that serve to wedge the frame against the chuck-block and the planed flanges of the discharge.

"Some time ago experiments were made with screens of aluminium-bronze, which proved extremely satisfactory. The bronze contains, according to a letter from the Cowles Electric Smelting and Aluminium Company, 5 per cent. of aluminium, 95 per cent. of copper, and a trace of silicon, and is furnished in imperforated sheets at 1s. 10d. per pound. When new it has a golden colour, which it loses with use. The width and length of the slots are the same as in the ordinary screens, but there are nine slots instead of eight. The sheet is 0·035in. thick, and the screen lasts six months, and does not break, while the Russia-iron screens break in two weeks. The wear is uniform over the entire surface, the slots enlarging to No. 5½ needle, when the screens are then past use. The bronze, however, is not lost, but can be melted down and made into new screens. It is the intention of the Homestake management to introduce this screen throughout all its mills. This would have been already done had not the contract for Russia-iron screens been made before the bronze screen was tried.

"The Caledonia mill use No. 24 brass-wire screens, the thickness of the wire being No. 26, and the screening-surface 48in. by 5⅝in., the screen lasting one week. It is fastened to a simple wooden frame 53in. by 12½in., the horizontal sides being 3½in. wide, the vertical sides 2½in. Three wooden ribs 1in. wide divide the screen-surface into four panels, and thus prevent it from bulging out. The fastening of the screen to the frame and the wedging of this against the mortar are the same as at the Homestake, except that there the screen-frame is placed on the chuck-block and here it is keyed against the lower rim of the mortar-discharge. The Caledonia uses wire screens because, although its stamps drop 3in. farther than those of the Homestake mills, the splash is not so great, by reason of the greater width of the mortar and the space taken up by the amalgamated copper plate below the feeding-lip. The force of the splash in the narrow Homestake mortar is

thrown entirely against the screen; that of the wider Caledonian mortar is divided between the screen in front and the recess at the back.

"The upper part of the discharge of classes of mortars above the screen-frames is closed either by an inch board, or by a canvas curtain, or piece of old belting suspended from a lath. This curtain or belt hangs down and meets the screen in the mortar. It has the advantage over the board, inasmuch that the amalgamator can readily pass his hand into the mortar and remove any chips of wood, &c., floating on the water or adhering to the inside of the screen. We have seen that in the Homestake the pulp is driven with force against the screens. In order to break its fall upon the apron-plate, a splash-board is fastened to the frame of the latter, thus preventing any amalgam collected there from being washed away. The Caledonia mortar has no splash-board, as the pulp does not pass through the screens with sufficient force to endanger the amalgam collected at the head of the apron-plate.

"*Stamps.*—The stamps used by both companies are of the ordinary pattern. They weigh 850lb., about 16lb. to the square inch of crushing-surface, and their centres are from 9¾in. to 10in. apart. (For dimensions and other particulars as to different parts see table already given.) The stem tapers 6in. at both ends, so that when it breaks, usually where it enters the head, it may be reversed. At the Homestake mills a stem lasts about three years before new ends have to be welded to it. The Caledonia mill requires for its sixty-stamp mill about five stems yearly. The tough cast-iron head is without the wrought-iron rings, which are often used at the upper or lower end. It has the usual keyways for the removal of the stem and shoe. These are parallel instead of being at right angles as usual. To fasten the head to the stem the lattter is let down through the guide-holes and the socket of head placed directly beneath it; the stem is then lifted and dropped and driven with a hammer if necessary. Then the stem and head together are dropped several times on a piece of timber placed beneath until they are quite firm. At the Homestake mills a head lasts five years, after which the socket has become so enlarged that the stem cannot be securely fastened in it any longer.

"Both the managements buy their heads from outside foundries. To fasten the shoe to the head, the shank is surrounded by small wooden wedges tied around it with a string; the shoe is put in place, and the stem and head are allowed to drop. Thus the shank is wedged into the recess of the head, and by raising the whole, and allowing it to drop several times, the shoe becomes thoroughly fastened in. To prevent it from injuring the die a piece of planking is placed on the latter. At the Golden Star mill a very neat arrangement is in use for fastening the wedges to the shank of the shoe. After the wedges have been placed around the shank a strip of canvas is wound around them and tacked to each wedge, forming a sort of collar, which can easily be slipped over the shank of the new shoe. This simple arrangement saves a great deal of time and labour on clean-up days, when a good many shoes have to be replaced.

"After being some time in use in the battery a shoe becomes slightly concave at the base, but wears, on the whole, more evenly than the die. At the Homestake mill a shoe lasts two months, crushing 270 tons of rock. It is then worn down to 2in. from the base of the shank, and weighs 40lb. This corresponds to a consumption of 37lb. of iron to every 100 tons of rock crushed. At the Caledonia mill a shoe lasts three months, and crushes 300 tons. It is replaced when worn down to 1in., and weighs 35lb., which corresponds to a consumption of 35lb. of iron for every 100 tons of rock. It may be asked why the Caledonia mill, which buys both its shoes and dies, does not use steel, which is so much more durable, and, consequently, cheaper, especially if the heavy freight-charges are taken into consideration. The answer is that, because steel last so much longer than iron, steel shoes and dies would continue in use after they had become uneven. This would reduce the crushing-capacity of the battery, and thus in the end would be no saving at all.

"In order to secure the tappet to the stem, the wrought-iron gib is first put into the recess. The tappet is then slipped over the stem, and, when it has reached the desired place, is secured by keys which pass at right angles between the gib and the iron shell of the tappet surrounding the stem. All the tappets of the Homestake mills have two keys; those at the Caledonia have some two and some three. Both faces of the tappet are used as working-faces. In wearing down they become uneven, and ridges are formed. The tappet then has to be removed and planed off in a lathe before it is fit for further use. Once in three years, when the two faces have worn down 1¾in., the tappet is renewed by a new one. Case-hardened tappets and cams have been tried at the Homestake mills, in the expectation that the hardened working-surfaces would last longer; but the tappets cracked and became useless, as they could not well be planed off. Steel tappets and cams have not been tried. It takes from six to eight hours to change the tappets and cams of one battery.

"At the Homestake mills the drop is 9in., the number of drops per minute 85, and the order in which the stamps fall is 1, 3, 5, 2, 4. At the Caledonia mill the drop is 12in., the number 74, and the order 1, 3, 5, 2, 4 and 1, 4, 2, 5, 3. The Caledonia mill has such a hard rock to pulverise that it is forced to have a higher drop, and, consequently, a smaller number of drops per minute. The Caledonia mill has two different orders of drop, which is quite unimportant, as they both comply with the same requisition—namely, that no stamp shall be immediately followed in falling by either of those next to it.

"*Cams and Cam-shaft.*—The stamps are lifted by cams fastened to a shaft, which rests in boxes. These are supported by shoulders in the front of the battery-posts, to which they are bolted. Ten cams are keyed to one cam-shaft, which is set in motion by the cam-pulley. The cams are double-armed, and are made of tough cast-iron, having the form of the involute of a circle—slightly modified at the end—the radius of which is equal to the distance from the centre of the cam-shaft to the centre of the stamp. The hub of the cam, which is on the off-side of the stem, is not strengthened with the wrought-iron band shrunk on it, which is often used, but is cast sufficiently thick to stand the strain. At the Homestake mills the cams have a working-face 2in. wide and 3½in. deep. The strengthening-rib, beginning at the end of the cams, gains in depth towards the hub, where it is 9½in. deep. The hub itself is 3¼in. thick. The distance from the centre of the hub to the

end of the cam is 17in., and a cam lasts about three years. The cams of the Caledonia mill differ only slightly from those of the Homestake mills. The face is 2½in. wide and 2in. deep, the strengthening-rib at the hub 10½in. deep. The hub is 3½in. thick, and the distance from the centre of the hub to end of the cam is 19in. The cams, being made of car-wheel iron, last over four years.

"The cam-shafts are of tough wrought iron, turned down in a lathe, and they have one longitudinal key-seat. The keys with which the cams are fastened to the shaft are of steel, and are hand-fitted. Wrought-iron keys lose their shape too quickly, and machine-fitted keys get loose very quickly, a great disadvantage. It takes ten hours to replace a broken cam-shaft supposing that the keys have been already fitted. This ought always to be done, as the fitting of each key-seat takes about an hour. A well-appointed mill always has on hand several cam-shafts, with necessary cams and keys ready for use. The cam-shafts of the Homestake mills were formerly made 4½in. and 4¾in. in diameter, and lasted about five years. Now the tendency is to make them stronger. The largest in use at present is 5⅜in. in diameter, and this is said to be good for ten years. The distance between the cam-shaft and the stem is 5½in. The cam-shaft of the Caledonia is 4 1/16in. in diameter, and its centre is 6½in. distant from the centre of the stem.

"The cam-shaft pulleys at the ends of the cam-shafts vary slightly in the different mills. At the Homestake they are 6ft. and 7ft. 5in.; at the Caledonia 7ft. 4in. in diameter, the face being usually 15in. wide, and they are made of wood, as iron could not stand the continuous shocks caused by the dropping of the stamps, and they would also be too heavy. The pulley is built on a cast-iron hub with flanges, and keyed to the cam-shaft. When put in place the shaft is made to revolve, and the face of the pulley turned off to the desired form, so that it may be perfectly true. The cams are lubricated with axle-grease, and to prevent any of this from dropping on the apron-plates and hindering amalgamation, a curtain is stretched out beneath the cams to catch any particles of grease that these may throw off while in motion.

"*Crushing-capacity.*—The crushing-capacity of a battery depends on the efficiency of the stamp; that is, the number of foot-pounds developed, the character of rock under treatment, and the discharging capacity of the mortar—that is, the height and size of the discharge, the character of the screen, and the width of the mortar at the discharge. The Homestake stamps weigh 850lb., drops 9in., and makes eighty-five drops per minute; thus it develops 78,030,000 foot-pounds in twenty-four hours, crushing 4½ tons of rock, or 17,340,000 foot-pounds for every ton crushed. The Caledonia stamps weigh 850lb., drops 12in., making seventy-four drops per minute; thus developing 90,576,000 foot-pounds in twenty-four hours, crushing 3·3 tons, or 1 ton for every 27,447,272 foot-pounds developed. Thus, although the efficiency of the Caledonia stamp is greater than that of the Homestake, it crushes less ore. There are several reasons for this—first, the character of the rock, which is much harder than that of the Homestake; second, the width of the mortar at the discharge—16in., as against 13½in.—the 2in. recess for the 8in. amalgamated copper plate below the feed, which is absent in the Homestake mortar. From the lower discharge of the Caledonia mortar—6in., as against 10in.—a greater crushing-capacity would be naturally expected than from the Homestake mortar. The above reasons will explain why this fails. The smallness of the Caledonia screen—258 square inches, as against 376 square inches—may be assumed to be counterbalanced by its character—Caledonia No. 24 wire, against Homestake No. 7 slot, which corresponds to No. 30 wire. The Caledonia claims that more gold is recovered by its slow method than by the more rapid one of the Homestake. This point could only be definitely settled by exact tests.

"*Apron-plate, Mercury-traps, Sluice-boxes.*—In order to save the fine particles of gold that have not been caught on the inside copper plates, and to collect any amalgam and quicksilver that have passed through the screens and amalgamated copper plates, the apron-plate is placed in front of the mortar. The motion of the battery-water caused by the dropping of the stamps throws with the drop of each stamp some pulp against and through the screen. This, passing over the lip of the mortar, flows in small waves over the apron-plate. During the slight interval between these waves any heavy particles of pulp—quicksilver, amalgam, or fine gold—passing over the amalgamated plate have a chance to settle upon, adhere to, and combine with it. The plate consists of one sheet of copper, nearly as wide as the discharge of the mortar, fastened with iron screws to the inclined wooden table beneath it. In all the Homestake mills—excepting the Deadwood and Golden Terra, where it is 12ft. long—the copper plate 3/16in. thick is 10ft. long, falls 2in. to the foot, and discharges into a copper-lined trough leading to the mercury-trap. The apron-plates of the Caledonia are 8ft. long, 4ft. 6in. wide, and the copper is ⅛in. thick, the plates in all the mills having the same fall. The wooden table extends 4ft. beyond the end of the copper plate, at the same time narrowing to a width of 4ft. It has a 1in. rib down the centre, and is overlaid with two blankets 5ft. wide and 22in. long, the upper overlapping the lower. On these the heavy sands collect, and they are washed every half-hour into a tank. These blankets last about six months. Carpets were tried, but they frayed, and had to be thrown out after one month. The pulp from the blankets flows into the mercury-traps, one being placed in the middle of the discharge for every plate.

"The plates are Lake copper, furnished to the mills ready for use, and do not require any annealing to make them porous. They have, however, to be flattened with wooden mallets to make them lie smoothly on the wooden table, and to remove any inequalities produced during transportation. At the Homestake Mills they are first scoured with sand-paper, followed by emery-cloth, or with tailings and a wooden block 4in. square, or with a grindstone, until the face is perfectly bright. If necessary, the sand is moistened with a weak solution of potassium-cyanide, and spots are often removed with dilute nitric acid. The surface of the pure metallic copper receives a solid coat of potassium-cyanide, which is applied repeatedly as a strong solution by means of a soft paint-brush. After two days the mercury is sprinkled on this cyanide coat, and rubbed into the plate with a moist cloth and tailings. When the plate is thoroughly amalgamated it is put into place, and is ready for use. More than the usual amount of mercury is added to the mortar, that

the new plate may become normal. This takes from two to four weeks, during which time the plates are continually discoloured by copper salts. To get these into solution, potassium-cyanide or ammonia is added to the battery-water. At the Caledonia mill the procedure is similar, only more care is taken to saturate the plate with mercury before it is put into use. Only the ordinary quantity of quicksilver is then added to the mortar with the new plate. In none of the mills are the plates coated with amalgam before they are put to use, nor are there any silver-plated copper plates used in the district.

"The mercury-traps through which the pulp passes on leaving the apron-plates save the amalgam and quicksilver not collected on the apron-plates. There are additional traps at the termini of the sluice-plates outside. At the Homestake mills, until three years ago, the pulp flowed from the apron-plates directly to the sluice-plates into the wash-flume; then traps were introduced. How important this simple contrivance is can be seen from the fact that in the Homestake eighty-stamp mill there are recovered every month by the inside traps 80oz. of amalgam and 144oz. of quicksilver; by the outside traps, from 10oz. to 12oz. of amalgam, and 40oz. of quicksilver. These traps are emptied only once a month. If they were emptied twice a month, on clean-up days, a still better showing could perhaps be made. At the Caledonia the traps are emptied daily, when the apron-plates are being dressed. This is done because of the accumulation of concentrates.

"At the Homestake mill the inside trap consists of a wooden box, with copper-lined bottom 14in. long, 17in. wide, and 24in. deep. It contains three sliding wrought-iron plates parallel with its short sides. These are placed 2¼in. apart, the centre one extending to the bottom of the box, the others 3in. above it. The pulp flows under the first, over the middle one, and again under the third. The outside trap is larger, the box being 48in. long, 14in. wide, and 48in. deep. It has three partitions, set 10½in. apart, reaching from the bottom of the box up to 1½in., 3in., and 4in. below the level of the inlet, the outlet being 6in. below this. In the middle, between the two wooden partitions, is let down a sliding wrought-iron plate, ⅜in. thick, reaching to 3in. from the bottom of the box. The Caledonia traps are much smaller, since there is one for each apron-plate.

"The sluice-boxes receiving the pulp from the inside traps are simple wooden troughs, with copper-lined bottoms. At the Homestake they are from 8ft. to 10ft. long, 18in. broad, and have a fall of 1in. to the foot, the copper used for the bottom being ⅛in. thick. At the Caledonia mill they are 8ft. long, and only 8in. wide, as less pulp passes through them. The main sluice into which they discharge is 2ft. square.

"*Daily collecting of Amalgam and dressing of Plates.*—The amalgam which has collected on the apron-plates during the previous twenty-four hours is removed every morning, when the day-shift begins. At the Homestake mills, the head amalgamator; at the Caledonia mills, the day amalgamator, each with an assistant, has charge of the operation. Every amalgamator has his own way of managing the details in this work, although the general outline is always the same. The method of the Golden Star mill will serve for illustration.

"When the plates are cleaned the water-supply of the one battery is shut off, the stamps are hung up, and the splash-board removed and washed at the head of the apron-plate with water through a hose. It is then placed at the lower end of the plate, and the hose is turned on to the screen and apron to remove all the sand collected there. The plate, if normal, is now clear and bright, except for occasional spots, so-called blisters, resulting from iron and copper salts. These are removed with a scraper—a blunt, double-edged chisel. Then the two men loosen the amalgam with heavy whisk-brushes, beginning at the top and working downwards. When this is done the amalgam is swept in the opposite direction and collected at the head of the apron. There it is brushed into the amalgam-scoop with a rubber scraper—a small, sharp-edged piece of belting—and emptied into a small iron receiver. After this the plates are brightened by brushing them with a whisk-broom, using tailings moistened with a dilute solution of potassium-cyanide, the men working from the head of the plate downward. If necessary a little quicksilver is sprinkled on the plate from a bottle, over the neck of which a piece of canvas is securely tied. After being brightened the plates are smoothed with soft paint-brushes passed transversely over them, beginning at the bottom. This finishes the operation, which requires four hours to twenty-four plates.

"The amalgam attained is contaminated with impurities. To remove these it is placed in a wedgewood mortar, and diluted with quicksilver. The amalgamator then adds water, and works the amalgam to bring all impurities to the surface. These are in part washed off with a hose, in part removed with a sponge or wet cloth—the base-metal amalgam—until the amalgam is perfectly bright. It is then passed through a small strainer, and the residual pasty amalgam is transferred to a piece of linen, where the excess of quicksilver is pressed out by wringing. The ball of hard amalgam obtained is locked up in a safe and kept until the next clean-up. All the sands are returned to the battery; the waters go to waste, and the quicksilver goes back to the main stock.

"*The Clean-up.*—Twice a month the gold amalgam adhering to the inner plates is removed, when the necessary repairs to the mill are also made. At the Caledonia mill the operations are the same at the 1st and 15th of every month, and similar to those of the 1st of the month at the Homestake mills. At the latter the clean-up in the middle of the month differs from that at the beginning. At the first of the month the entire mortar is emptied, and shoes and dies are changed if necessary, while on the 15th of the month it is intended to remove only the amalgam from the inside plates, and to clean up the mercury-traps.

"At the Golden Star mill the clean-up at the 1st of the month is carried on in the following way: It begins at 7 o'clock in the morning. The feeding of the battery is stopped a quarter of an hour beforehand. The stamps are made to drop slowly, so that at 7 o'clock no more ore may be found in the mortar above the screen-frame. The splash-boards are removed, the stamps hung up, the water shut off, and the engines stopped. The mortars on one side of the mill are then opened by removing the curtains, screens, and chuck-blocks. The curtains and screens are first roughly washed by playing a hose over them. They are put aside to be more carefully cleaned later on. The six chuck-blocks from the batteries facing the side of the mill which is being cleaned up

are placed on two apron-plates, at each of which are four men to remove the amalgam, under the supervision of the head amalgamator. This is done by scraping the plates with a chisel, when the hard amalgam drops off on the apron-plate beneath. As much amalgam is removed as is possible without exposing the copper. Then quicksilver is sprinkled on the plate, to dilute the hard amalgam somewhat. This is then divided evenly over the plate and brightened by scouring with a whisk-broom and tailings, and finally smoothed with a soft paint-brush. The amalgam that has dropped on the apron-plate from the three chuck-blocks is collected at the head and put under lock and key by the head amalgamator. Thus the chuck-blocks of the entire mill are scraped and cleaned in four sets of six each. In the meantime another set of men scrape and wash the rim and flanges of the mortar and collect the amalgam. They also remove the plate amalgam which has settled down during the past twenty-four hours, which is then taken in charge by the head amalgamator. The dressing of the plates does not take place yet. In order to keep them soft, a little quicksilver is sprinkled over them and evenly distributed with a brush. A third set of men begin with the work on the mortar as soon as the amalgam from the apron-plate has been removed. Two small platforms are placed at its head on the wooden frame for the men to stand on. They then remove the water still remaining in the mortar, and shovel out the sands above the dies into a heap on the apron-plate. As the sands consist simply of coarse ore, and does not contain any amalgam, they are returned to the battery after the dies have been put again in place. Before the die can be taken out the stamp has to be raised higher. Formerly block and tackle were used for this purpose. Now a piece of timber is placed crosswise on the rests of the splash-board, serving as a fulcrum for an iron bar, with which the stamp is raised. It is kept in this position by placing a 4in. piece of wood on the prop of the stamp and allowing the tappet to rest on it. The dies are prised up with an iron bar, lifted out, and roughly cleaned. Those which are to be exchanged are taken away and piled up, to be carefully scraped and washed in due time. Those that are still good are returned to the mortar without further cleaning; the dies usually last six weeks. After the dies have been taken out the remaining sand is shovelled out and piled up in a convenient place in the mill to be treated separately in the rocker and pan. It is rich in amalgam, and contains pieces of iron that have accumulated in the mortar. Any particles of amalgam adhering to the rough sides of the mortar are removed and added to the sands, and the dies put in place again. If new shoes are required they are placed on the top of the dies with the wooden collar slipped over the shank. Then the recesses for the chuck-block, screen-frame, &c., are cleaned by directing a hose on them, and these are put in place, the screens having first been cleaned in a wooden box with a brush and water. When the chuck-block is in its place the sands first removed are shovelled in to fill up the bottom of the mortar up to the top of the dies. The drop of the stamp has now to be regulated; if new shoes are used the wooden block 1in. higher than the drop is placed on the shoulder of the shoe, and the stamp let down until the head rests on the block. If the shoe has not been replaced the block stands on the die. In both cases the keys of the tappets are loosened. These are allowed to fall on to the prop, and are then keyed up again. The apron-plates are now dressed in the usual way. Any amalgam adhering to the small sluices leading to the mercury-traps and to the sluice-boxes is removed, and these are brightened up in the same manner as the apron-plates. When the engine has been started the stamps that have new shoes are first allowed to drop several times until the sound and the vibration felt when touching the tappet show that the shoe is thoroughly fastened to the head. The splash-boards are put in place, some ore is fed into the mortar, the water is turned on, and the stamps of one battery after another are let down from the props. Special care has to be taken by the feeders to regulate the ore-supply, as the mortars are empty above the dies when the mill starts. In cleaning up a mill, all hands have to take part, the night-shift working six hours extra.

"The detail description of the clean-up of a 120-stamp mill has been given, because it seemed important to show how it is possible to accomplish it in the short space of seven hours without requiring any outside help. When it is remembered that more than a day was formerly consumed in this work it will be seen how admirably the operations are now systematized and worked one into another. When the clean-up of the mill is over, and the stamps are once more in operation, the sands that were shovelled out of the bottom of the mortar have to be worked up, and the amalgam has to be cleaned, so as to be ready for the retort. Two crusher-men are detailed to clean-up the sands. These contain bits of iron that have come from the tools used in the mine, or the crushing machinery of the mill, and also pieces of amalgam. The sands are first treated in a rocker; any coarse pieces of iron are picked out and collected in a heap. When the sands have been rocked for a little, while the hose has been playing on them, the residue in the hopper is broken as fine as possible with a wooden mallet. The products obtained by rocking are the coarse particles remaining finally in the hopper; these are washed in a coarse screen over a clean-up pan, and any amalgam remaining on the screen is picked out and thrown into the pan. The sands go back to the battery. The heavy sands which collects on the curtain and riffle are taken up in a bucket to be worked in the pan. Those settling in the sluice which conduct the sluices to the waste-flume are shovelled out and returned to the battery.

"There remains the purifying of the amalgam collected from the chuck-blocks, apron-plates, sluices leading to the mercury-traps, mortars, old shoes, dies, and screens. It is charged with water into the clean-up pan—5ft. in diameter, the muller making thirty revolutions per minute—and from 600lb. to 700lb. of quicksilver are added. It takes about three hours to clean in the pan all the by-products that contain any amalgam. When this is all collected and the water above it is somewhat clear, the muller is raised with block and tackle and the entire contents of the pan are emptied through the lowest discharge-opening into a square box which overflows into the tailings discharge-box. The muller and the bottom of the pan are cleaned with a brush and water. The liquid amalgam in the first box is now freed from water and passed through a strainer; the resulting pasty amalgam is removed, and freed from the excess of quicksilver by wringing it in canvas bags in water. The balls of hard amalgam remaining in the bags contain about 38 per cent. of gold. The quicksilver collected beneath the strainer goes back to the main stock; that obtained by

squeezing the pasty amalgam is first purified by adding some nitric acid, stirring it, and then washing it with water. The clean-up in the middle of the month is much simpler than that on the 1st, as only the chuck-blocks are taken out, and the mortar is left intact, except, of course, when any break has occurred in a shoe or die. On the 15th, however, the mercury-traps are cleaned; their contents go simply into the pan and are worked with the rest of the products containing amalgam. This clean-up lasts five hours; that is two hours less than the one on the 1st of the month.

"The cleaning-up of old iron and wood chips which is done once a year still remains to be mentioned in this connection. The pieces of iron picked out of the sands in the bottom of the mortar are first scraped to remove any amalgam adhering to them. They are then thrown into an enclosed heap in the yard and left there to be corroded by atmospheric action; the rusting is hastened by adding some salt to the heap at various times. Once a year the iron that has fallen to pieces is charged with quicksilver into the pan and its gold extracted. The chips of wood which float on the top of the water in the battery, and often clog the screens, are repeatedly removed and collected in a box in one of the window recesses. They are then emptied on a heap in the yard, and once a year are set on fire. The ashes are collected and amalgamated in the pan. In this way are saved from 16lb. to 18lb. of amalgam from the two mills of the Homestake Company—200 stamps.

"*Retorting and Melting.*—The quicksilver still retained by the hard amalgam is removed by retorting. Both bulb retorts and cylindrical ones are used. The cylindrical retort of the Homestake Company is 12in. in diameter and 3ft. long, and holds about 1,000lb. of amalgam. The usual charge of 500lb. is retorted in about six hours with a quarter of a cord of wood. The loss in quicksilver is nominal. The retort metal amounts to 38 or 40 per cent. of the original charge. At the Caledonia mill it is only 33 per cent. less, care being taken in cleaning the amalgam; and at the Deadwood-Terra mills it is often only 25 per cent., by reason of the fine condition of the gold, which requires more quicksilver to form amalgam.

"The retort metal is now melted into bars. At the Homestake mill two kinds of moulds are used—the 1,500oz. mould, 5in. by 5in. by 11½in., and the 700oz. mould, 3½in. by 4in. by 9½in. The bars are cast from 3in. to 4in. thick, and weigh from 1,000oz. to 1,400oz. It takes about four hours to melt four 1,400oz. bars, and the crucible lasts from six to eight charges. The loss in melting with the Homestake retorted bullion is 1·5 per cent., and the average composition of the bars is 820 gold, 165 silver, and 15 base metal. The loss in the Caledonia bullion is greater—7 per cent.—as less care is taken in cleaning the amalgam; the average composition of the bullion is 798 gold, 182 silver, and 20 base metal.

"*Working Results.*

"The Homestake and Golden Star mills together produced, according to the report of the Homestake Company for the year ending June, 1888, gold worth £184,445 from 243,355 tons of ore, which corresponds to a yield in free gold of 15s. 2d. per ton. It is claimed that 85 per cent. of the free gold is saved. According to this, the ore would run in free gold to the value of 17s. 7d. per ton. Two sets of experiments were made in the spring of 1885 by Dr. R. Goering on the Homestake and Golden Star tailings—the first when the mills had no mercury-traps, the second after these were introduced. Up to that time there had been collected, by means of blankets in a separate building, 1,124 tons concentrates, which assayed £7 3s. 4d. per ton. These panned down gave 20·5 per cent. of cleaner concentrates, which gave an assay-value of £8 3s. 7d. per ton. When amalgamated in the pan they yielded 56·9 per cent. of their total value, the remaining pure pyrites assaying a value of £3 9s. per ton. This shows that the gold recovered must have been either enclosed in quartz, or rusty, or that amalgam had been carried off with the tailings, and was recovered by the blankets. When, in consequence of these tests, the mercury-traps were introduced the loss was reduced. The concentrates then assayed a value of £5 12s. 9d. per ton. They gave 92 per cent. of the gold in the pan, but the pure pyrites still assayed a value of £2 10s. per ton, showing that, while the loss had diminished, it had not been stopped. The concentration of tailings by blankets, being too expensive, was given up.

"The Caledonia mill crushed, for the year ending May, 1888, 73,425 tons of ore, and produced bullion worth £60,395, equalling a yield of 16s. 3d. per ton. It may, however, be stated that the blanket concentrates of the Caledonia amalgamated raw in the pan yield a product of pure pyrites giving an assay-value of £18 7s. 6d. per ton, and that the tailings from the blankets, when panned, yield concentrates of a value from £1 8s. 7d. to £1 16s. 9d. per ton. The following table shows the cost of milling in 1887–88 at Homestake and Golden Star mills:—

Items.	Homestake Mill, 96,790 Tons treated.		Golden Star Mill, 146,565 Tons treated.	
	Amount expended.	Cost per Ton.	Amount expended.	Cost per Ton.
	£ s. d.	s. d.	£ s. d.	s. d.
Labour	5,081 18 7	1 0·60	6,424 8 3	0 10·32
Supplies	259 1 2	0 0·64	235 13 5	0 0·39
Water	3,429 18 7	0 8·51	5,144 12 1	0 8·42
Wood	5,488 11 4	1 1·60	8,232 1 8	1 1·47
Machinery	1,829 8 8	0 4·54	3,666 8 4	0 6·00
Oil	215 16 0	0 0·53	252 16 2	0 0·41
Candles	31 19 7	0 0·07	43 19 5	0 0·07
Quicksilver	205 5 2	0 0·50	758 14 4	0 1·24
Lumber	140 4 8	0 0·34	163 16 7	0 0·26
Total	16,682 3 9	3 5·25	24,927 10 3	3 4·75

"In comparing the cost of milling in the 80- and 120-stamp mills it seems strange that there should be so little difference. Special causes must have affected this year's work, for the cost per ton in 1880 was 5s. 4d. and 3s. 2¼d. respectively. The cost of milling at the Caledonia mill for 1887–88 was 3s. 6¾d. per ton, 1s. 3d. being for labour, and 2s. 3d. for material. This is a low figure, if we consider that the mill has only sixty stamps, and that the ore treated is very hard in comparison with any Homestake rock.

"*Labour in the Mills.*

"All heads of the different departments are responsible to the superintendent. The mill proper is in the charge of a foreman thoroughly acquainted with every detail of work. One foreman often has the general charge of several mills, as with the Homestake and Deadwood-Terra Companies. Next comes the millwright, who sometimes has, as in the Homestake mill, an assistant, called the pipe-fitter. The millwright comprises the trades of carpenter and machinist. His duty is to make the guides, put them in place, and keep them in order; to exchange cams and cam-shafts, fasten any cams that may become loose, make and replace screws, make and repair chuck-blocks, to reverse and exchange shoes and dies of crushers, and to look after all the piping in the mill—in one word, to erect and keep every part of the mill in order for which any mechanical knowledge is required. One of his duties, for example, consists in lining all the shafts, and babbitting their boxes.

"In this connection might be mentioned a method of lining shafts which originated with the millwright of the Homestake Company, and which has proved to be quick and effective. When a shaft has to be lined the boxes are placed so as to be approximately in line. The lower bearing, which is to receive the shaft, is loosely packed with clay, and a wooden centre pressed into it. This consists of a semi-cylindrical piece of dry wood, having the same diameter as the shaft, and about the length of the box. The wooden centres of the two or more boxes are now carefully lined, and the clay packed around them. When in line, the centres are removed one after another, and the clay cut out crosswise in the middle of each box. The centre is then replaced, and the hollow space filled by pouring in babbitt metal. The centre and the remaining clay are then removed, and upon the ribs of babbitt, in the middle of each box, is placed the shaft, which is now accurately in line. Finally the space left is filled with babbit-tmetal. In this way the shaft can be quickly and accurately lined, the bearings will be absolutely true, and the lining from ½in. to ⅝in. thicker than the ordinary ¼in. lining; consequently the shaft will last longer.

"After the millwright comes the machinist. The Homestake Company having a large shop, all repairs are made there. At the Caledonia mill the foreman is also a machinist, and any extensive repairs are made by the Homestake Company.

"As the mills are driven by steam, each one has two engine-men, who are responsible for their foremen. To guard against fire or any accident there is generally a night-watchman for every mill. These men are directly responsible to the foreman.

"The man who has the immediate charge of running the mill is the head amalgamator. He also stands directly under the foreman, and is responsible for all his assistants—the amalgamators, crusher-men, oilers, feeders, and day-labourers if there are any. As, in addition to running the mill, he has charge of the collecting and safe-keeping of the amalgam, he must be thoroughly trustworthy, as well as capable. The amalgamators feed quicksilver, regulate the water-supply, set tappets, renew shoes, dies, screen, and chuck-blocks, and look after the running of the battery in general. Quicksilver is fed by the hand every half-hour with a little wooden spoon, similar to a mustard-spoon. The quantity required in twenty-four hours ranges from ¼lb. to ½lb. for every battery, according to the character of the ore, which varies a good deal. The correct amount is found by the 'feel' of the amalgam collected on the apron plates. If this be hard and crumbly, there is danger of amalgam being carried off by the pulp, and more quicksilver is added. On the other hand, if too much quicksilver is fed into the mortar, the plates become too soft and slippery, less amalgam collects on the inner plates, and there is a danger of liquid amalgam rolling off the apron-plates. Two methods of adding quicksilver are in use. At the Homestake mills all the quicksilver is added in the mortar, and the amalgam obtained is of medium hardness. At the Caledonia mill it is the aim, by adding only part of the quicksilver in the mortar, to make the amalgam on the inside plates as hard as may be, and to add the rest to the apron-plates, keeping these somewhat softer than those of the Homestake mills. Each management is satisfied with its own way of feeding the quicksilver, and it would be difficult to decide in favour of either method. Perhaps the fact that the Caledonia ore has, on the whole, coarser gold than the Homestake ore, may explain this difference in feeding.

"The entire loss in quicksilver incurred by the Homestake management a year per stamp is 5·27lb., or, according to the tons of ore milled by the Homestake and Golden Star mills, 0·0044lb. per ton of rock crushed. The entire loss incurred by the Caledonia mill is 7lb. a year per stamp, or 0·011lb. per ton of rock crushed. Of course, with the hard and strongly-mineralised rock the Caledonia mill has to crush, more quicksilver will be floured per stamp than with the Homestake rock; and on account of the smaller quantity of rock crushed per stamp, less quicksilver is consumed per ton.

"The amount of water required will vary according to the specific gravity of the rock, the percentage of sulphurets, and the incline of the apron-plates. An excess of water will make the pulp in the mortar too thin, thus preventing an intimate contact with gold and quicksilver; will assist coarse crushing, and will hinder the settling of amalgam on the apron-plates. Too little water will assist amalgamation, but will hinder the pulp from passing the screens, and will not carry that which has passed through them. As a rule it is better to use too little water than an excess. The right amount will just convey the pulp evenly over the apron-plates. The Homestake mills use, in twenty-four hours, 1in. of water for each battery. The Caledonia mill uses 1¼in.

"The setting of tappets is necessary, so that the stamps may always have the same height of drop, whether the shoes and dies are new or somewhat worn down. To accomplish this the stamps are hung up, the mortar opened, the stamps then lifted up by means of an iron bar used as a lever,

and a block of wood 1in. higher than the desired drop is placed between the shoe and die. The tappet is then loosened and allowed to drop on to the prop and again keyed fast. As the prop and the block of wood placed between shoe and die are both 1in. higher than the required drop, on removing the block the stamps will all have the desired uniform height of drop, while the different levels at which the tappets are keyed to the stem will indicate how much the shoe and die are worn down.

"The crusher-men, in addition to looking after the grizzlies, breaking the coarse ore, and feeding the crushers, have to watch for any pieces of wood and iron found amongst the ore, take it out, and throw it aside. This is the only way in which the chips of wood entering the mortar can be reduced to a minimum. All small pieces of wood that pass through the grizzlies are finally found in the mortar, where they are periodically removed by the amalgamators, if not taken previously by the ore-feeder men when the ore passes from the trough of the automatic feeder into the mortar.

"The oilers have to keep all the wearing iron parts of the mill lubricated, and have to be especially careful not to use any excess of grease at parts where it might drop into the mortar or upon the apron-plates. The feeders attend exclusively to the regular and uniform feeding of the ore. The principle followed is to feed "low." The height of ore between the shoes and dies should never be more than 1in., and as much less as possible without the stamp beginning to pound. One or two day-labourers are generally found around a large mill, because there is apt to be constant need of extra work which does not fall within the province of the regular hands. The shifts in the mill are changed monthly. The following table shows the rates of wages:—

Class.	Caledonia, 60 Stamps.			Homestake, 80 Stamps.			Father de Smet, 100 Stamps.			Golden Star, 120 Stamps.			Comparison of Wages paid if Eight-hour Shifts were adopted, as in New Zealand.
	Number of Men employed.	Length of Shift, Hours.	Wages per Shift.	Number of Men employed.	Length of Shift, Hours.	Wages per Shift.	Number of Men employed.	Length of Shift, Hours.	Wages per Shift.	Number of Men employed.	Length of Shift, Hours.	Wages per Shift.	
			£ s. d.			£ s. d.			£ s. d.			£ s. d.	£ s. d.
Foreman	1	..	1 6 6	⅔	..	0 17 8	1	..	1 0 5	⅔	..	0 17 8	0 17 8
Millwright	1	12	0 18 4	1	10	0 17 4	1	10	0 17 4	1	10	0 17 4	0 11 6½
Pipe-fitter	..	..	..	⅓	10	0 14 3	..	..	..	⅓	10	0 14 3	0 9 6
Engine-men ..	2	12	0 14 3	2	12	0 14 3	2	12	0 14 3	2	12	0 14 3	0 9 6
Firemen	2	12	0 13 3	2	12	0 12 3	2	12	0 12 3	2	12	0 12 3	0 8 1
Watchmen	..	..	..	½	12	0 12 3	1	12	0 12 3	½	12	0 12 3	0 8 1
Head amalgamator ..	..	..	..	1	10	1 16 4	1	12	0 16 4	1	10	0 16 4	0 10 10½
Amalgamators ..	2	12	0 15 4	4	12	0 14 3	4	12	0 14 3	4	12	0 14 3	0 9 6
Crusher-men ..	1	10	0 12 3	5	10	0 12 3	6	10	0 12 3	6	10	0 12 3	0 8 1
Oilers	..	..	..	2	12	0 12 3	2	12	0 12 3	2	12	0 12 3	0 8 1
Feeders	2	12	0 13 3	2	12	0 12 3	4	12	0 12 3	4	12	0 12 3	0 8 1
Day-labourers ..	1	10	0 10 2	..	..	..	1	10	0 10 2	..	..	..	0 7 7½
Total number ..	12	..	..	20½	20½	..	25	..	..	23½	..	..	..

"From the foregoing table it will be seen that the Caledonia mill employs fewer men than any of the other three mills. In comparing the 80- and 120-stamp mills of the Homestake Company, located next to each other, and working on the same ore, we see that only three more men are required in the latter than in the former, although the product is half as much again. From this it can be seen that a large number of stamps is very profitable, as greatly increasing production without necessitating commensurate outlay of labour."

GOLD-QUARTZ.

An interesting paper was read before the American Institute of Mining Engineers at the Ottawa meeting, 1889, by W. M. Curtis, on the appearance of quartz, as to whether it is likely to be auriferous or not, of which the following is an abstract:—

"There seems to be a well-established belief that there is an indescribable something in the appearance of gold-quartz, not to be learned from books, that enables those who are fortunate enough to have acquired the power to recognise this characteristic to pronounce at once that a certain quartz will or will not pay. The stronger this claim is made the more certain is the claimant to be one of the self-styled practical miners. After several years spent among the gold-mines of California with practical and professional gold-miners, my conclusions are that very few care to risk an opinion on a piece of quartz until some of it has been 'horned out.' Nevertheless, there is what the miners call a 'kindly' appearance that is more often followed by good results than is a vitreous water-wet-looking quartz. A dark, resinous quartz seems to be the most in favour, but there are so many exceptions that even quartz as 'white as a hound's teeth' produces gold in some mines.

"The ribbon-quartz, a laminated variety separated by thin talc or chlorite partings, has a well-known name. The slides of rich-quartz specimens show that this parallelism is a microscopical characteristic of the only microscopical distinction that, as a rule, these quartz show. This is shown in Figs. Nos. 12 and 13, being photographs of the richest quartz, that averaged £13 per pound. It is noticeable also in Figs. Nos. 7 and 9, and others. Dr. Henzolt, of Columbia College, who prepared a large number of my slides, says of Figs. Nos. 12 and 13, 'This variety of quartz differs considerably microscopically from the others of your locality, and is in more than one respect remarkable. Like the others, it is crowded with fluid enclosures; but the cavities, instead of being irregularly scattered, are here arranged in parallel lines or rows with considerable symmetry. Many, if not all, of them contain vacuoles in a state of continual motion, which makes me inclined to

believe that the liquid they imprison is carbonic acid. When warmed and tested with a stage thermometer the bubbles suddenly disappear, when a temperature of about 86° Fahr. is reached, but return again on cooling.

"'Now, between 86° and 88° Fahr. is the so-called critical point of the liquified carbonic acid—that is, above this temperature carbon-dioxide can no longer maintain its liquid condition, but transforms itself into a gas, no matter what the pressure may be. This has been conclusively shown by Professor Andrews, of Belfast, who thus determined the critical point of every known liquid. I am not aware of any other liquid of which the critical temperature is so low. The inference to be drawn from this is that, inasmuch as carbon-dioxide is a gas which can only be reduced to a liquid condition by extreme pressure, the quartz in which these cavities occur has been exposed to great pressure—tons to the square inch—during its formation or crystallization.'

"This parallelism is found more or less developed in most of the specimens of rich quartz on some part of the slide. The quartz, Figs. 12 and 13, referred to by Dr. Henzolt occurred in small leaders coming obliquely from the hanging-wall into a large vein of block-quartz of very low grade. The appearance of the latter quartz suggested a second opening of the fissure after it was solid, or nearly so. It is brecciated on the edges, and broken up into large blocks, which seem afterwards to have been cemented together with iron-oxide and jasper carrying gold. The remarks of the late Professor Clayton on the quartz of the Drum Lummon lode are fully confirmed in the character of this quartz in the Tiger Mine. The fissure occurs in sericite-schist, broken through by diorite dykes, and the quartz is accompanied by a parallel diabase band, that sometimes entirely crowds out the quartz. Both diabase and diorite have been differently named from slides taken at various points. The limestones have been altered to marble; some of the dykes have been turned to soapstone. The country seems to be one of intense metamorphic action.

"While millions of dollars have been taken from the surface of this district in the early placer days, and all the little gulches leading up to the veins have proved rich, yet, although pockets of rich quartz of considerable importance have been found, no one has made a success in working the veins. Many companies have been wrecked on them. The average value of the quartz near the surface is about 12s. per ton, but it varies between 3s. and many pounds sterling. The quartz contains iron-pyrites, copper-pyrites, tetrahedrite, sometimes rich in gold, sometimes rich in silver, and then again barren. A depth of 400ft. has been reached, and, from the continued improvement in the microscopic character of the quartz, and the occurrence of occasional bunches of very rich ore, I am satisfied that a company with money and courage to open up a depth of 1,000ft., as is being done in the mother lode, will meet with success. The barren block-quartz, while not entirely free from vacuoles, sometimes arrayed in parallel bands, usually shows very few. More frequently the quartz is clouded with patches or streaks of iron-oxide. In the appearance of its slides it stands between rich quartz and the chert or jasper that occurs in this district in barren veins.

"The slides from Grass Valley, several mines in Amador and Calaveras Counties, California, in Sonora, Mon., New Mexico, and the newly-discovered quartz veins of Michigan, have been examined, taking the most prominent mines from which rich ore could be got. The Idaho, North Star, Empire, Allison, Tiger, Soaproot, Scorpion, Sheep Ranch, Nevill's, and Bonanza represent all the different characteristic veins of the California gold-belt. The photographs which were taken by Mr. W. H. Walmsley, of Philadelphia, clearly show the arrangement of the vacuoles and markings, more or less parallel in the rich quartz and irregular in the barren. This is so marked in some cases as to lead me to suppose that it would prove a good rule to distinguish rich and poor veins. However, the more slides that were examined the less certain it became as a positive sign. Still, there is a chance of error in the apparent exceptions. A poor piece of rich quartz may be sent to me instead of the quartz from the barren zone. No rich quartz that has been examined by me is without the parallel arrangement, more or less distinctly defined on some part of the slide, while the greater portion of the barren quartz show no such markings. The quartz of the enclosing schists does not show parallel vacuoles, but the arrangement of the minerals is parallel. There seems to be no special difference under polarised light. The rich quartz, however, is usually monochromatic, over a larger field, sometimes almost the entire slide, whereas the colouring of the poor slides shows a granular structure.

"From the examination of many rich gold-quartz specimens the conclusion was formed that the quartz was in a gelatinous condition when the gold was introduced rather than in the plastic condition of melted slag. A local circumscribed intense action must have been the cause of the deposits of rich gold pockets. In one case the quartz was covered with a rose-pink coating, where the gold was very rich; but, unfortunately, the specimen passed out of my hand before there was a chance of determining its value. The cavities between the quartz-crystals and the gold were filled with dried mud of strong solfataric smell. It would be premature to say that parallelism is a sure sign of rich ore, but if we judge from the material collected from the mines visited the indications are at least worthy of further investigation. They seem to show that the same causes which crowded the quartz with vacuoles in parallel bands impregnated the quartz with gold. If it could be proved that these vacuoles were filled with carbonic acid it might prove to be a second fact to weave into a theory of the deposition of auriferous quartz.

"Many of the slides show a peculiar formation along certain bands like streams of little disks of concentric structure. These seem to indicate chalcedonic change of the quartz. As a rule, the barren quartz has but few vacuoles, seldom arranged in lines. The dark spots shown in the slides, instead of being large vacuoles, are patches of foreign matter."

Annexed are eighteen photo-lithographs of slides of quartz. The following table gives the particulars of quartz-slides shown in lithographs;—

Number of Sample.	Average Value per pound.	Value per Ton.	Average Value of the Ore in the Lode.	—
1	Nil	Nil	Nil	Poor quartz, of same kind as rich specimen No. 9.
2	"	"	"	Volcanic quartz; contains no minerals of value.
3	"	"	"	Barren quartz, granular type.
4	"	"	"	Green chert. Barren cross-seam.
5	"	"	"	A barren vein of jasper-quartz.
6	"	"	"	This is said to be a barren portion of vein, but similar to the rich quartz, being parallel in part, although not so evident.
7	£1 4s. to £2	£2,688 to £4,480	Not given	Some masses are more than half gold. This is from a pocket mine, the other quartz being of no value.
8	..	£4 8s.	"	This is from the usual run of ore. Masses of quartz exceedingly rich occur in the lode.
9	Not given	Not given	"	The sample was quartz from the specimen ore.
10	..	£2 8s.	12s to £1.	No remarks.
11	Not given	Not given	Not given	Average ore going to stamps.
12 and 13	£13	£29,120	12s.	The good quartz from all parts of the lode has this character, while the barren quartz-block is like No. 3.
14	..	£100	£100	The large dark spot is native gold. Parts of this quartz are nearly as parallel as No. 12.
15	Not given	Not given	Not given	Average ore shows no free gold.
16	..	£15 to £120	"	Narrow veins of high-grade sulphurets, with some free gold in granite walls.
17	..	14s. to £2 8s.	"	The specimen shows free gold.
18	..	Not given	"	Same in formation as No. 16.

CONCENTRATION BEFORE AMALGAMATION FOR LOW-GRADE SILVER ORES.

We not only have large deposits of low-grade auriferous ores, but it will be found also, when the silver ores found at Puhipuhi come to be tested properly, that there will be a considerable quantity of low-grade ore found in that district. When the ores are decomposed, or partially decomposed, very low-grade ore, if suitable for concentration, can be made to pay for working. The following is an extract of a paper read before the American Institute of Mining Engineers, at the Colorado meeting, in June, 1889:—

"The treatment of silver-ores of too low a grade to justify either smelting or preliminary roasting, and yet not free enough to permit of raw amalgamation, has ever been a serious problem. As bearing upon it, the operations of the Combination Mining and Milling Company of Black Pine, Deer Lodge, Montana, during the past year, may not be without interest. It is not claimed that the process to be described is not susceptible of improvement, nor is any claim of originality made for it; but its use is, as yet, not very general, and it seems to offer a means of profitably working the large class of partially-decomposed argentiferous ores, which, by reason of their low-grade, demand some cheap and continuous process for their profitable treatment.

"Taking the average of the vein exposed during the past year, its width will not exceed 2ft., its greatest size being 4ft., and its smallest 6in. It is usually laminated in structure, bands of from 6in. to 18in. of decomposed ore, assaying from 20oz. to 200oz. of silver per ton, being attached to both the hanging- and foot-walls, having the middle portion of the vein consisting of quartz more or less barren. It has been noticed that where the country rock was hard and tight the vein was always pinched and impoverished, and no change for the better occurs without a concomitant change in the walls of the vein. Quantitative tests of the ore gave, on analysis, the following results:—

	Per Cent.		Per Cent.
"Silica	84·09	Zinc	0·30
Sulphur	0·19	Manganese	0·35
Iron	7·05	Antimony	0·66
Copper	1·31	Silver	0·08
Lead	1·01	Arsenic	0·05

The value of gold per ton being about 2s.

"*Milling.*

"The mill, as originally constructed by Messrs. Fraser and Chalmers for the Black Company, was an ordinary ten-stamp wet-crushing mill, with room left between the battery and the settling tanks for concentrating machinery should it be found necessary to add it. As illustrating the impracticability of working these ores by raw amalgamation alone, a short summary of the operations of the Black Pine Mining Company may be given.

"The mill was started on the 16th July, 1887, and the run lasted until the 14th September of the same year. During this period 1,178 tons of ore were treated, assaying 17·5oz. to the ton, containing 20·615oz. of silver. Of this amount there was recovered, in the form of bullion, 9,482·9oz., or 46 per cent. of the battery-assay. We need only note the points of difference between the Combination Company's plant and the form of mill ordinarily employed for treating silver-ores of the class usually termed 'free milling.' These are well known, because their low grade precludes their profitable treatment by the various other more efficient, but vastly more expensive, methods. The ore is stamped, passed over four Frue vanners, the light pulp that goes over their 'tails' being settled in tanks, shovelled into pans, and there amalgamated, discharged into settlers, and the resultant amalgam strained, retorted, and melted in the usual manner. An analysis for the month of October, 20 tons into 1, gave the following results:—

	Per Cent.		Per Cent.
"Silica	82·50	Sulphur	1·19
Lead	9·10	Zinc	0.81
Copper	8·22	Silver	0·54

"Samples of pulp going into the pans for the same month showed that it contained—

	Per Cent.		Per Cent.
"Copper	1·05	Sulphur	0·09
Lead	0·48	Silver	0·05
Zinc	0·25		

"For the year ending the 31st May, 1889, the details of milling were as follows:—

"Dry tons crushed			9,061·96
Average assay of silver per ton			22·67
Gross contents of ore, silver ounces			305,434·75
Estimated per cent. of reduction			80·70
Estimated product, silver ounces			165,785·84
Dry tons of concentrates produced			541·80
Average assay of concentrates in silver per ton			136·17
Silver in concentrates	73·777·55		
Silver in bullion	97·660·60		
Total production of silver ounces			171,438·15
Actual percentage of silver saved			83·45
		£	s. d.
Total cost of milling		8,105	4 2
Average cost per ton		0	17 11

"The average crushing-capacity of each stamp int wenty-four hours was 2·61 tons.

"When the mill was started by the present management an assay of the escaping slime-water was made, showing the value of the slimes carried away with it to be 52oz. of silver per ton, or more than double the silver contents of the original ore. A series of carefully-conducted experiments were at once inaugurated, and from them it was learned that 3 tons of these slimes dry, containing 156oz. of silver, were passing through the waste-gate from the settling-tanks every twenty-four hours. These slimes were too light to permit of their being settled by even the most extensive system of tanks, and to check this heavy loss a china pump was placed in the last of the series of slime-tanks. This pump discharges into a small tank placed above and immediately in front of the mortars. It is only 1ft. deep, being made shallow in order to prevent the gradual settlings of the slimes in it, and consequently the necessity of cleaning it out from time to time. From the side of this tank and near its bottom is the 2in. pipe for supplying the water to the stamps. The only purpose of this tank is to furnish water to the stamps at uniform pressure. By prohibiting the use of any clear water in the battery, the escape of these slimes was very materially reduced; but this of itself was not enough to stop all overflow, as it would be in an ordinary wet-crushing mill, for reasons that will be explained later on.

"The immediate effect of turning back into the battery, say, 2 tons of slime every twenty-four hours, carrying twice as much silver as the original ore—and this proportion of value has always existed—was to heavily 'salt' our battery-sample; and, as the most rigid economy was essential to the commercial success of the property, the question of securing an accurate check on the mill became momentous. After careful consideration, it was decided to adopt the following system: Night and day samples are taken from the battery-launders in the usual manner, and are assayed daily with the other mill-samples, but the results are corrected by the salting for the previous month. To determine this percentage it is simply necessary to obtain the actual battery-assay, and this is secured from the date furnished by the balance of the mill-work, after the monthly averages are made up, in the following manner: The number of tons crushed, *minus* the number of tons of concentrates produced, must equal the number of tons amalgamated. The number of tons amalgamated, multiplied by the average assay pan-sample, must be equal to the total silver contents of the pulp amalgamated. This, added to the total silver contents of the concentrates produced, secured in the same manner, gives the grand total of ounces of silver in the ore. This, divided by the number of tons crushed, gives the actual battery-assay. In this computation all tons are dry tons. The percentage of salting thus determined varies slightly, but the fluctuation is due more to errors in sampling than to any change in the actual amount of the salting. Usually this is about 5 per cent.

"There was still a heavy loss in the escape from the settling-tanks of water carrying rich slimes, owing to the introduction of water at the head of the vanners. To stop this a small jet-pump using steam from the boilers, and supplied with 50ft. of steam-hose for a discharge, was placed at the tanks, and the slime-water used in lieu of clear water for thinning down the pulp in the pans. While this corrected the evil, it had also the effect of increasing the difficulties in the way of concentraiont, as, in order to stop all overflow from the tanks, only as much water could be used on the heads of the vanners as was pumped into the pans, *plus* the evaporation. After much experimenting it has been found that with the limited quantity of water that can be used on the vanners, a speed of 180 revolutions of the crank-shaft per minute, with a belt-travel of 3ft. 6in. per minute, and an inclination of 3½in. in the length of the machine, gives the most satisfactory results on these ores, although intelligent and constant adjustment is rendered necessary by reason of the changes occurring from time to time in the character of the pulp treated.

"By reference to the details of milling for the year ending the 31st May, 1889, it will be noticed that the mill overran its assays 2·49 per cent., or 5,144·63oz. As the actual battery-assay is determined by the assays of average pan and concentrate-samples, and as the pan-sample is of necessity taken

before the rich slime-water is pumped into the pans for the purpose of thinning down the pulp, the mill is bound to over-run, presuming perfect accuracy of sampling and assaying, exactly the amount of that part of the silver contained in the slime-water used in the pans which is amalgamated. As the greatest care is exercised to secure the most accurate sampling possible, a large portion of the amount that the mill overran may safely be credited to the use of the slime-water in the pans. The pan-charges have been changed constantly, according to the character of the pulp treated, and amalgamation-tests have been many and varied. The charge now being used, which seems to be the best tested, is 50lb. of salt, 2lb. of sulphuric acid, and ½lb. of cyanide, with 100lb. of quicksilver strained in after the pan has been running for four hours. The temperature of the pulp is raised by steam to 180° Fahr., and the charge is run at sixty-five revolutions per minute for eight hours. Settlers are run fourteen revolutions per minute, and give good agitation with 3in. shoes.

"In the battery forty-mesh brass-wire screen-cloth has been used during the past year, with the exception of about two weeks, when thirty-mesh screen was tried by way of experiment. After a thorough test it was found that the loss occasioned by higher tailings exceeded the profit accruing from increased crushing-capacity, and the forty-mesh screens were replaced. The falling-off in the savings during the time the thirty-mesh screens were in use was largely owing to the fact that the difference between the very finest of the slimes and the coarse particles that would pass through a thirty-mesh screen was so great that, with the increased quantity of pulp to be treated by the vanners, they could not be made to do close and clean work."

KIDD'S ORE-CONCENTRATOR.

The following is a description of a new ore-concentrator, patented by Mr. Edward Kidd, taken from the *Scientific American* and published in the *Sydney Mail* of the 17th of January:—

"A machine for working pulverised ore-bearing rock, earth, sand, or tailings, and similar material, has been patented by Mr. Edward Kidd. The concentrating-table consists of a series of sections of a pane of glass each, the upper services being concaved and the panes being fitted with a watertight joint into a frame, the construction of the latter varying with the different forms of the table. The tables in their normal position are inclined, the combined sections representing essentially an inclined plane, while each table may be provided with a shaft or spindle for tilting it at will. A waste-flume is held upon uprights above the table, and at the upper end of the table is a frame in which a beam is held to slide vertically, the extremities of the beam being connected by links with the crank-arms of a rock-shaft, journalled near the base of the frame. At each side of the table is a support for a beam held to slide horizontally, motion being communicated thereto from the rock-shaft, and from the centre of this beam extends an arm carrying an agitating-comb reciprocating over one or more of the upper sections of the table. These sections are made with a flat upper face, and above them is a fixed hopper, below which is a water-chute, whereby a current of water may be turned upon the face of the concentrating-table at any time. To the upper end of the waste-flume is securely fastened one extremity of a flexible pan or hopper, the other extremity of which is detachably attached to the vertically reciprocating beam. This hopper may be made of rubber, canvas, or raw hide, and above it is a chute for supplying to the hopper such a current of water as may be desired. The pulp, gravel, ground, earth, &c., to be operated upon having been placed in this upper hopper under the stream of water is rolled backwards and forwards with the alternate rise and fall of the hopper, caused by the vertically sliding beam, the slimes, light gravel, &c., passing off through the waste-flume at every upward motion, the concentrates settling in the centre of the pan. When the charge has been sufficiently washed the upper end of the hopper is released from its attachment, and the contents dumped into the fixed hopper below, where they are further cleaned and concentrated in passing over the glass sections in the presence of water, the material being also agitated at the upper end of the table by the comb."

NEW PLYMOUTH OIL-BORING.

Indications of petroleum have always been found in the vicinity of New Plymouth, and a company was formed some twenty-four years ago to bore for oil. At that time very little was known in reference to boring oil-wells, so that the old system of hand-boring was resorted to, and, from the amount of work done by that company, a considerable amount of capital must have been expended. The first company put down a bore to a depth of about 300ft., a little to the north of the Sugar Loaves, which gave indications of oil, and some of the strata passed through gave off a small quantity of carbureted hydrogen gas. Another bore was put down on Mikotahi Island for about 200ft., with the same result, but neither oil nor gas was found in any appreciable quantity. The first company became disheartened with the results and suspended operations. Subsequently another company was formed, who sunk a shaft about 12ft. above high-water mark, directly in a line with the present breakwater, to a depth of 60ft., when the quantity of carbureted hydrogen became so great that sinking could not be proceeded with. At the depth of 44ft. a porous stratum was passed through containing a little oil. After sinking was abandoned a borehole was put down from the bottom of the shaft to a depth of 680ft. A little oil and considerable quantities of gas were met with at different levels in boring, but the largest quantity of oil was found at the 44ft. level. It is stated that about 50 gallons of oil per week were got for a few weeks out of this borehole. The oil was collected by pumping out the borehole into a tank and skimming off the oil from the top of the water.

Recently an English company has been formed to carry on a system of boreholes, to ascertain whether petroleum can be found in such quantities as will pay for working. This company has commenced boring operations at the place where the previous company sunk a shaft, and have put down a borehole to a depth of 680ft. This borehole was down at the time of my visit, on the 17th February last, to a depth of 340ft. In boring this distance a little oil has been met with, and also

POOR QUARTZ

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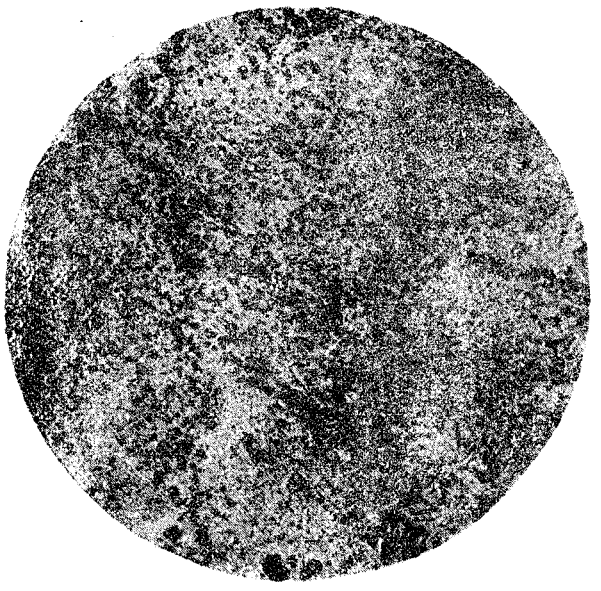

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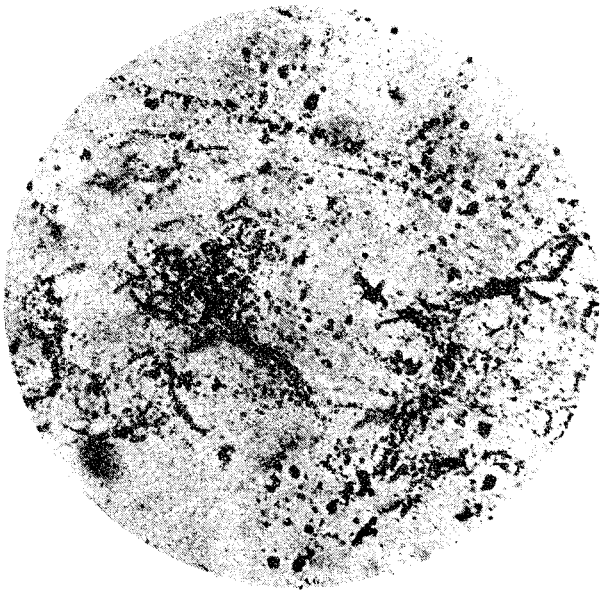

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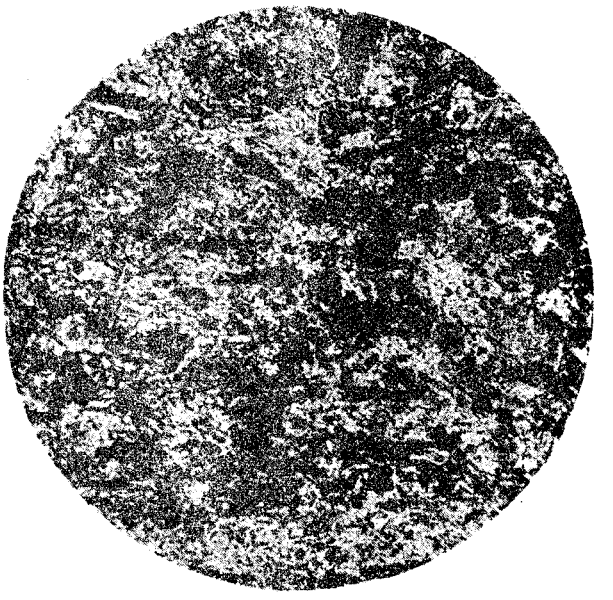

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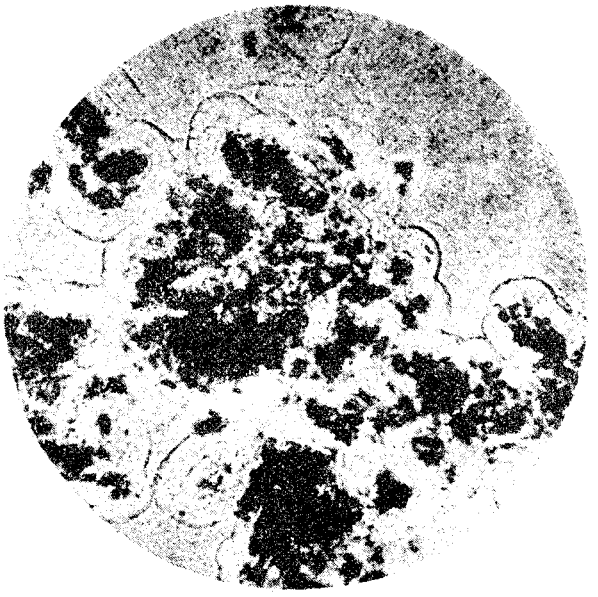

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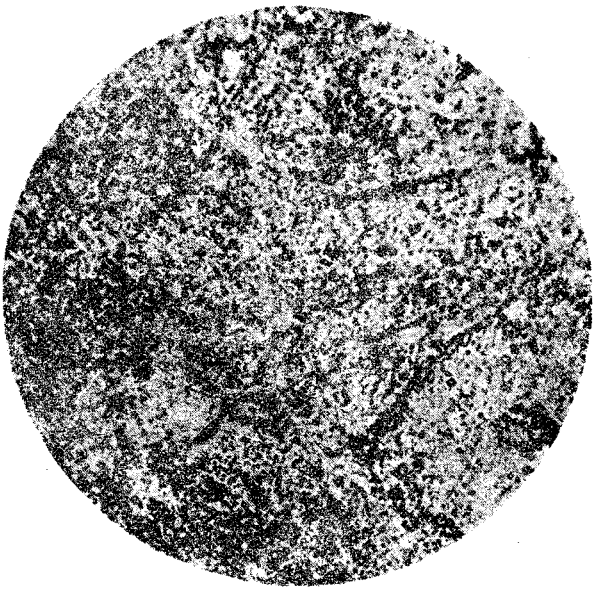
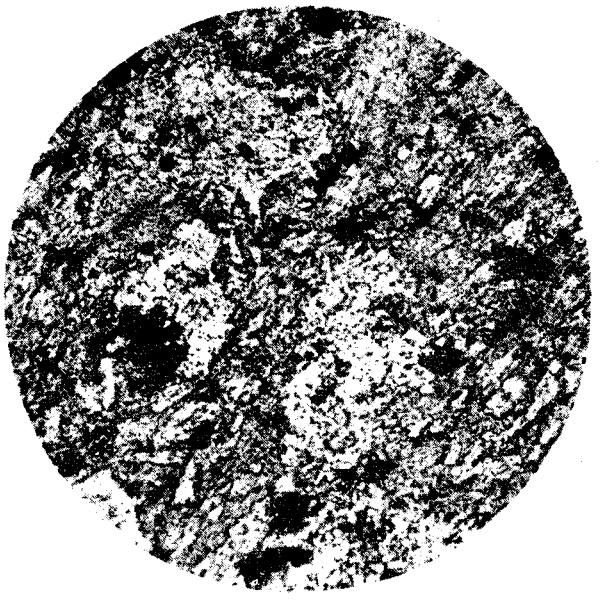


GOOD QUARTZ

No. 7

No. 8



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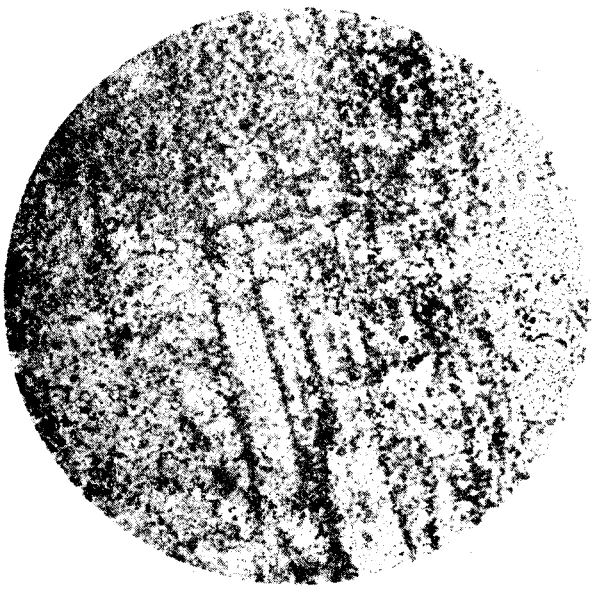

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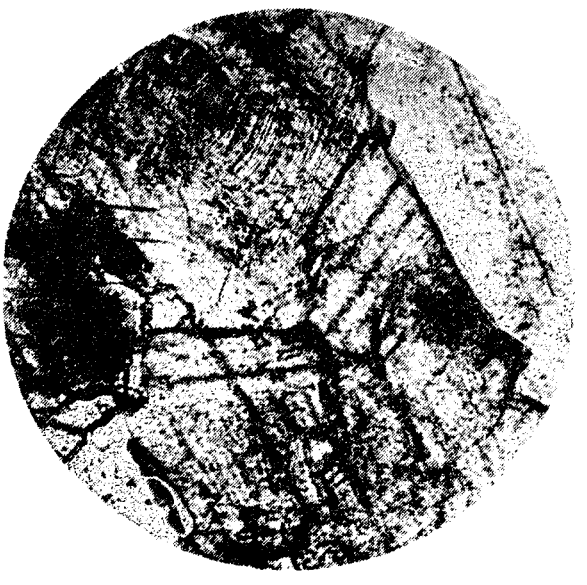

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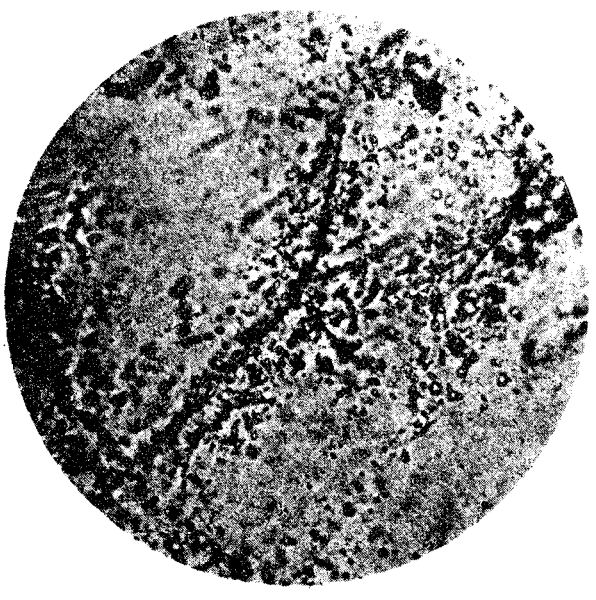

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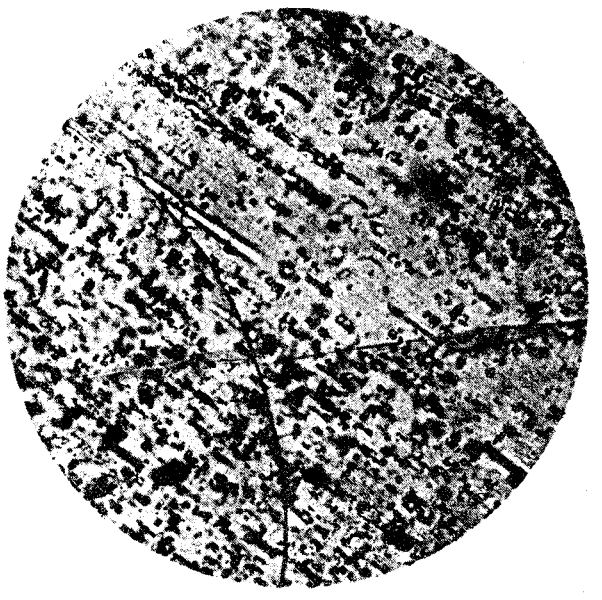

GOOD QUARTZ

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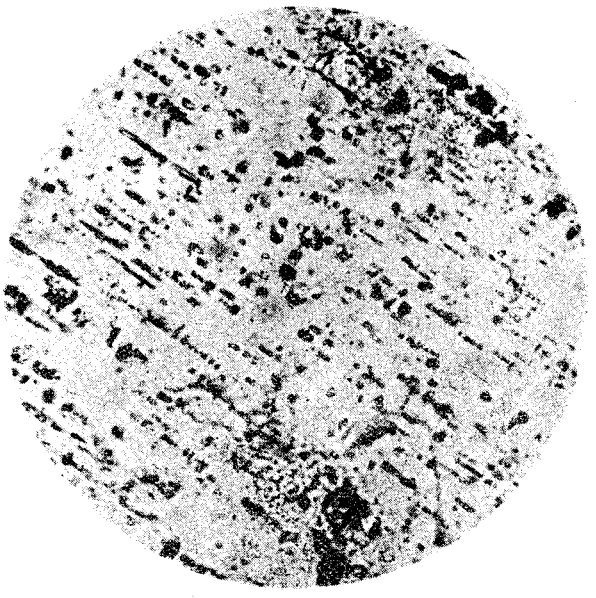

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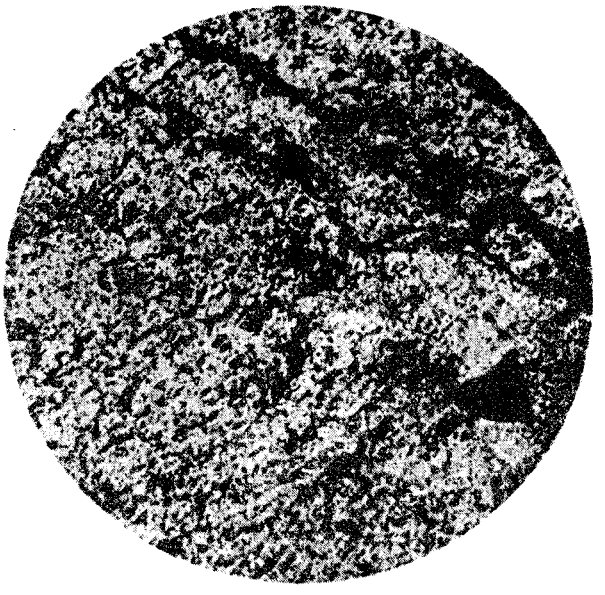

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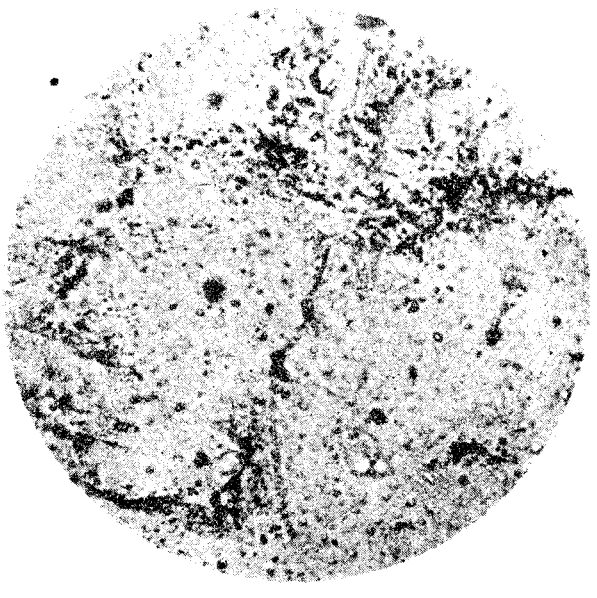

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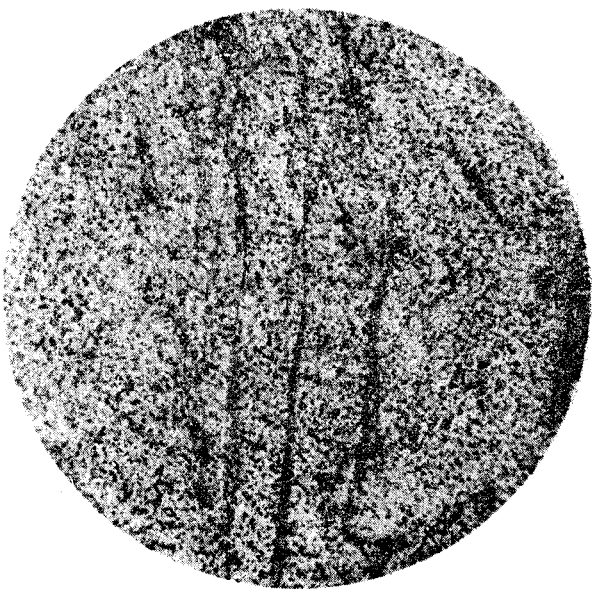

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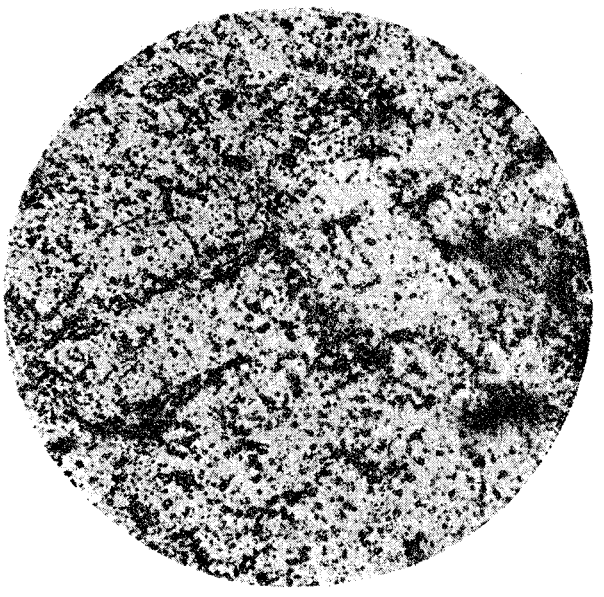
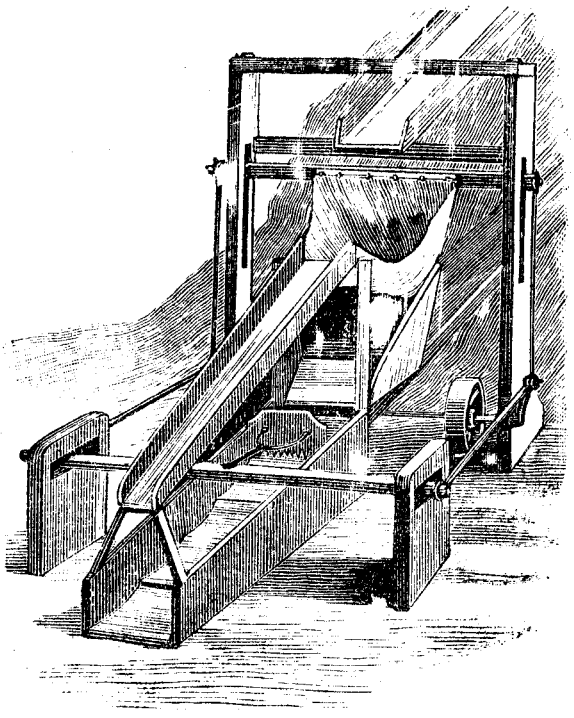




FUDD'S ORE CONCENTRATOR.

gas, but the manager does not expect to meet with oil for a considerable distance yet. He states that the bore had gone through conglomerate gravel and sandstone.

The surface of the country in this locality is covered with a thick deposit of agglomerate breccia, having ferruginous seams running through it. This breccia is to a certain extent porous, and capable of holding small quantities of oil, such as would be deposited from a condensation of the gas coming up through the seams and fissures in the rocks; but at about 200 yards further southward of the places where boring operations are being carried on there is a belt of country of a much older formation in which the conical hills known as the Sugar Loaves are situate. These appear to be portion of a dyke running back inland, and it is on the northern side of this dyke petroleum is likely to be found. The place where indications of petroleum exist is in a belt of country not apparently more than 500 yards wide. The oil is found on the ocean-beach at low water, on the north side of the breakwater, where the gas is found bubbling up, bringing with it small quantities of oil; also, when carrying on dredging operations for the foundations of the breakwater, small quantities of petroleum were seen all the way out until the end of the breakwater was reached, and small quantities can always be seen on the surface of the water, when the sea is smooth, between Mikotahi and Mutaroa Islands.

During my visit to this district some three years ago, when examining the country where indications of petroleum were found inland, on the north side of the dyke previously referred to, Mr. Kyngdon, a settler about a mile and a half in a direct line back from the ocean-beach towards Mount Egmont, stated that he sunk a well some 60ft. deep, and found the water so impregnated with petroleum that it was totally unfit for domestic purposes; he therefore filled up the well again. The surface of the ground where this well was sunk is about 380ft. above sea-level. Travelling further inland, over what is known as Burton's Hill, there is a flat valley or basin about 630ft. above sea-level, and in this valley several of the settlers state that they have sunk wells where the water tasted so strongly of kerosene that they could not use it. There is no reason to doubt the existence of small quantities of potroleum having been met with in these wells, and this goes in a great measure to show that it will yet be found over a large area. The only question remaining to be solved is whether it will be found in sufficient quantities to pay for working. A sample of the oil was shown me that came out of the deep bore which the former company put down. It is of very dark colour, of high density, and a viscid appearance, resembling thin syrup. Comparing this oil with the description of the oils found in other parts of the world, it is likely to be found in a limestone formation, but the oil found near the surface is merely a secondary deposit, either by the condensation of gas, or by hydrostatic pressure, and the formation carrying the oil will be found at a very considerable depth. The mere fact of finding petroleum oozing out in small quantities on the surface is no criterion that it will be found in payable quantities by boring to a great depth; indeed, this indication rather favours an opposite view—namely, that it is not likely that large accumulations of petroleum will be found without an approximately impervious roof, such as thick beds of close shale on top of the stratum forming the oil-reservoir.

Small quantities of petroleum have been for centuries known to exist on the western shores of the Red Sea, at the mouth of the Gulf of Suez. There is a mountain at this point named by the Arabs, Jebel Zeit, or Oil Mountain. The oil is found in surface-holes, and by digging anywhere along the foreshore, as soon as the surface of the water is reached, the strata, which are usually of a soft character, are found to be black and oily, and, after a time, each excavation fills with salt water, having a film of petroleum on the top. Boring has been carried on in this locality without finding any stratum containing a reservoir of oil. The opinion of some of those having large experience in oil-boring, is that, where there are surface-indications, it will be found in most cases that the conditions necessary to the storage of oil are wanting, and that therefore, though at one time oil might have existed in large quantities, or the conditions for its production been present, the oil stored or produced has been lost.

The question as to the origin of petroleum is one that cannot be satifactorily answered. Different theories have been advanced, but so far scientists have not agreed on any definite theory, so that it may be said at the present day to remain a hypothesis. If we were certain of its origin, and the conditions in which petroleum was formed, we should be better able to consider the probabilities of finding it. So many theories are propounded as to its origin that it may be interesting to those who reside in a district where indications of petroleum are found for me to state some of those theories.

In 1866 Berthelot, the French chemist, propounded a theory that the alkaline metals—viz., potassium and sodium—exist in the interior of the earth in a free or uncombined state, and necessarily at a high temperature, and if water carrying in solution carbonic acid should find access to these metals chemical action takes place, resulting in the formation of a series of hydrocarbon compounds. In such a theory as this the process of the oil formation would be deeply seated, and continuous constant supplies would be always forthcoming.

Another theory was advanced by a Russian chemist—Mendeljeff—in 1877, which attracted a good deal of attention amongst scientists. This was that the interior of the earth contained large masses of metallic iron and also metallic carbides—compounds of carbon and metals—all at a high temperature. The contact of water under these conditions and with these bodies would, in his view, generate metallic oxides and hydrocarbons. Mendeljeff accordingly held that petroleum is never of an organic origin, but is purely a product of chemical affinity.

Again, Dr. T. Sterry Hunt, Professors J. P. Lesley, J. S. Newberry, J. C. White, J. D. Whitney, and also S. F. Peckham hold different views, which are more easily reconcilable with the conditions in which petroleum is found. They all believe it to be of organic origin, but differ in the way in which it was formed and deposited. Dr. T. Sterry Hunt lays great force on the view that petroleum originates in and is mainly derived from limestones. In speaking of the oil-fields of Canada, he says,—

"The facts observed at this locality appear to show that the petroleum, or substance which has given rise to it, was deposited in the beds in which it is now found at the formation of the rock. We may suppose in these oil-bearing beds an accumulation of organic matters whose decomposition in the midst of a marine calcareous deposit has resulted in their complete transformation into petroleum, which has a lodgment in the cavities of the shells and corals immediately near. Its absence from the unfilled cells of corals in the adjacent and interstratified beds forbids the idea of the introduction of the oil into these strata, either by distillation or infiltration. The same observations apply to the petroleum of the Trenton limestone; and if it shall be hereafter shown that the source of petroleum, as distinguished from asphalt, in other regions is to be found in marine fossiliferous limestones, a step will have been made towards a knowledge of the chemical conditions necessary to its formation. . . . . In opposition to the generally-received view, which supposes the oil to originate from a slow destructive distillation of the black pyroschists belonging to the middle and upper divisions of the Devonian, I have maintained that it exists ready formed in the limestone below."

Professor J. P. Lesley also urges the view that petroleum is derived—at least, in some conspicuous instances—from vegetable remains that are still found associated with it in the rocks, but he does not base his theory as to whether it results from primary or secondary decomposition, and that petroleum and gas have been gathered in the sandstones that now contain them from some lower source. Professor J. C. White also supports the view that the petroleum of the third oil-sand of Venanga County, Pennsylvania, in the United States, is indigenous to this rock, basing his belief on the abundance of vegetable remains that he finds in the outcrop of this sandstone in Erie County, Pennsylvania.

Scientists who hold that petroleum is of organic origin differ as to whether it is derived from a primary decomposition of organic matter stored in, or associated with sandstone which now contain it, or whether it is derived from a secondary decomposition of organic matter stored in the rocks—that is, the original vegetable and animal matter having suffered a partial transformation, is now held as hydrocarbon compounds, from which, by a process of distillation, oil and gas are derived. The bituminous shales are counted the chief sources of these products. After distillation it is held that the gas and oil are mainly carried up by hydrostatic pressure to some overlying porous stratum which serves as a reservoir.

Professor J. S. Newberry and Mr. S. F. Peckham hold the view that petroleum is derived from a secondary decomposition of organic matter stored in the rocks. Newberry, in referring to its origin in the extensive deposits of Devonian and Sub-Carboniferous shales, and particularly black shales that underlie the productive districts in which oil is found in America, considers petroleum and gas the products of a slow, spontaneous distillation of the organic matter of the shales, and regards the process of their formation a continuous one. In speaking of the rock-oil of Ohio, he says,—

"The precise process by which petroleum is evolved from carbonaceous matter contained in the rocks which furnish it is not yet fully known, because we cannot in ordinary circumstances inspect it. We may fairly infer, however, that it is a distillation, though generally performed at a low temperature." Again, he says, "The origin of the two hydrocarbons—petroleum and gas—is the same, and they are evolved simultaneously by spontaneous distillation of carbonaceous rocks." Mr. S. F. Peckham, when referring to the oils of Pennsylvania and adjacent territory, states, "These oils are undoubtedly distillates, and of vegetable origin. The proof of this statement seems overwhelming. Pennsylvania petroleum was examined in 1865 by Warren and Stover in this country, and in 1863 by Pelouze and Cahours in France, who found the lighter portions to consist of a certain series of hydrocarbons identical with those obtained in the distinctive distillation of coals, bituminous shales, and woods, when the operation was conducted at a low temperature." And, again, he states, "Too little is known about petroleum at this time to enable any one to explain all the phenomena attending the occurrence of petroleum on any hypothesis, but it seems to me that the different varieties of petroleum . . . . . are products of fractional distillation, and one of the strongest proofs of this hypothesis is found in the large contents of paraffin in the Bradford oil under the enormous pressure to which it is subjected. If this hypothesis . . . . . really represents the operations of Nature, then we must seek the evidence of heat-action at a depth far below the unaltered rocks in which the petroleum is now stored."

In the eighth annual report of the United States Geological Survey, Edward Orton, in referring to the different theories, states, "That the different statements, inadequate and incomplete as they appear, are probably the most careful and extended that have been made upon the subject. They bring before us the main views as to the origin of petroleum, viz.:—

"(1.) Petroleum is produced by the primary decomposition of organic matter, and mainly in the rocks that contained the organic matter. Of this view Hunt is one of the chief advocates.

"(2.) Petroleum results from the distillation of organic hydrocarbons contained in the rocks, and has generally been transferred to strata higher than those in which it was formed. Newberry and Peckham supports this general theory. Newberry holds that a slow and constant distillation is in progress at low temperature. Peckham refers the distillation of the petroleum of the great American fields to the heat connected with the elevation and metamorphism of the Appalachian Mountain system.

"These views as to the date of the origin of petroleum and gas are seen to cover almost all the possibilities in regard to the subject. Hunt believes it to have been produced at a time when the rocks that contain it were formed once for all. Newberry believes it to have been in the process of formation, slowly and constantly, since the strata were deposited. Peckham refers it to a definite and distinct time in the past, but long subsequent to the formation of the petroliferous strata. He supposes it to be stored in its subterranean reservoirs from that time to the present. In these several statements as to origin two questions are seen to be especially prominent, namely: (1) What particular kinds or classes of rocks are the sources of petroleum; (2) what is the nature of the chemical processes involved in its production.

"In answering the first question, we find the views of Hunt and Newberry distinctly opposed to each other. Hunt counts limestone as the principal source of petroleum, and denies that it has been produced by distillation from bituminous shales; while Newberry finds in these shales the main source of both oil and gas, and vigorously opposes the view that limestones are ever an important source of either. It is not necessary to follow the discussion in relation to these points further. It is enough to say that in the light of present knowledge each statement is sustained as to its particular affirmations, and, in its conclusion, as to general denials. Petroleum is undoubtedly indigenous to and derived from certain limestones, as Hunt has so strongly asserted. On the other hand, Newberry's doctrine that the great supplies of the Pennsylvania field are derived from Devonian shales is becoming more firmly established and widely accepted every year, though it seems likely that he has laid too much stress on bituminous shales. In other words, the theories are not incompatible with each other. Different fields have different sources. We can accept without inconsistency the adventitious origin of the oil in Pennsylvania sandstones and its indigenous origin in the shales of California, or in the limestones of Canada, Kentucky, or Ohio.

"The double origin of petroleum from both limestones and shales—and it is not necessary to exclude sandstones from the list of possible sources—deserves to be universally accepted. In confirmation of this double origin, it is coming to be recognised that the gas and oil derived from these two sources—limestones and shales—generally differ from each other in noticeable respects. The oil and gas derived from limestones contain larger proportions of sulphur and nitrogen than are found in the oil and gas of the shales. Nitrogen renders the oil unstable, and sulphur compounds import to them a rank and persistent odour from which they can be freed only with great difficulty. In the case of the oil-bearing shales of California the petroleum is evidently derived from the animal remains with which the formation was originally filled. In composition this oil agrees with the limestone oils already described. It contains more than four times as much nitrogen as the Mecca oil of North-eastern Ohio, and its percentage of sulphur is very high." Peckham, referring to these California oils, states—

"'The exceedingly unstable character of these petroleums, considered in connection with the amount of nitrogen that they contain, and the vast accumulation of animal remains in the strata from which they issue, together with the fact that the fresh oils soon become filled with the larvæ of insects to such an extent that pools of petroleum become pools of maggots, all lend support to the theory that the oils are of animal origin.'

"It now appers as if oil and gas derived from animal remains can be distinguished from those of the bituminous shales by the characters above described; certain it is that the limestone oils differ in physical characteristics from the Pennsylvania oils, for example, in a marked degree. They are dark in colour; they are heavy oils, their specific gravity ranging from 34° to 36° Beaume, though sometimes falling to 40° or even 42°; they have a rank odour arising from the sulphurous compounds which they contain.

"In the preceding statements the organic matter of the bituminous shales has not been positively referred to a vegetable source. Such a source is highly probable, but it cannot be said to be fully demonstrated until the origin of the so-called 'sporangites' of the shales is finally determined. There are a few geologists who are inclined to refer these forms to hydroid zoöphytes—animal—rather than with Dawson to marine rhizocarps—vegetable. Whatever their origin, they give rise to petroleum and oil of a definite character, which is in marked contrast to that of the limestone oils.

"The propositions in regard to the origin of petroleum that seem best supported may be summarised thus: (1.) Petroleum is derived from organic matter. (2.) It is much more largely derived from vegetable than from animal substances. (3.) Petroleum of the Pennsylvania type is derived from the organic matter of bituminous shales, and is of vegetable origin. (4.) Petroleum of the Canada and Lima type is derived from limestones, and is of animal origin. (5.) Petroleum has been produced at normal rock temperature—in the Ohio fields—and is not the product of distinctive distillation of bituminous shales. (6.) The stock of petroleum in the rocks is now practically complete."

In regard to the petroleum found in the vicinity of New Plymouth, it is difficult to state whether it is of animal or vegetable origin by its mere appearance, but its colour, specific gravity, and thickness seem to point to its being of animal origin, although there are semi-bituminous shales in the district. About forty-five miles to the northwards the coal-measures at Mokau crop out, and a similar formation extends for a considerable distance southward. On going up the Mokau River, about eight miles from its mouth, there is a hard sandstone dyke, running about 10° to the east of north, and 10° to the west of south. This dyke seems to cut clean through the other formation. It can be seen near the mouth of the Awakino River to the northward, and at the Mohakatina River to the southwards. On the easterly side of this dyke limestone and different seams of brown-coal are found, having veins of semi-bituminous coal intesected through it. On the west side of the dyke referred to, the formation is of a calcareous marl, having the beds all dipping southerly. There is very little indication of bituminous shales being found on the west side of the dyke, unless at a great depth; but if this same formation follows on the coast-line to New Plymouth unbroken, it is probable that the bituminous shales has something to do with the origin of the petroleum. It may be that on the west side of the sandstone dyke the carbonaceous matter in the rocks was subjected to a different chemical process than on the eastern side, and resulted in petroleum and gas being produced and stored in a reservoir at a considerable depth. At the same time, the sample of oil obtained from the bore at the breakwater does not coincide with the light oils found in the bituminous shales in Pennsylvania, being more like the dark, heavy oils found in Lima and Canada. It may be termed a good lubricating-oil, but not so well adapted for illuminating purposes.

There are three products of petroleum in the first distillation, namely: illuminating oil, naphtha, and residuum. Each of these products are redistilled—the naphtha into gasoline, benzine, and various lighter oils; the residuum is broken up by a process of redistillation, freezing, and

hydraulic pressure into parafine wax and oil, vaseline, cosmoline, &c. After these are taken from the residuum, there is a coke left, which contains 90 per cent. of carbon, from which carbon points, used in electric lighting, are manufactured.

The question as to whether petroleum will be found in sufficient quantities in New Zealand to pay for working is one which will yet take some years to solve. Even if large quantities of oil be discovered the expense of erecting plants and appliances for distilling the crude petroleum, and bringing out men to carry on operations, will be considerable. We will have many difficulties to contend against which cannot at the outset be seen. However, if the petroleum be found in large quantities, capital will soon be forthcoming to develop the oil-fields; but it has to be borne in mind that crude petroleum must be produced here at a cheap rate before it can compete in markets with the large supplies coming from America and older countries. The price of crude petroleum in Pittsburgh is given as ranging from 2s. 6d. to 3s. per barrel of from 40 to 42 gallons, whilst the crude petroleum from Boku is only worth, at the wells, from 2d. to 8d. per 42 gallons. Referring to the character of petroleum, Jos. D. Weeks, in making an abstract of the mineral resources of the United States, says, "There are great differences in the character of petroleum. The Franklin crude lubricating-oil is worth four times what the ordinary Western Pennsylvania crude oil brings, while the lower country oils of Pennsylvania, which are used chiefly for illuminating purposes, because of their greater yield of illuminating-oil, brings considerably more per barrel than those of the ordinary upper country oils. It is also a fact that every manufacturer has his own methods and processes of distillation, which he regards as valuable secrets. These methods give varying results, not, however, differing greatly when the same product is sought as the result of distillation. It is also true that the percentage of the different products vary, as one or the other of these products is the chief object of the distillation—for example, distillation having as its chief object the production of illuminating-oil would give a larger percentage of illuminating-oil than would be given at works where the chief article of manufacture was lubricating oil. Owing to these facts, therefore, the percentage of the commercial products derived from the crude petroleum vary greatly at different works from different processes of manufacture.

Plant.

The plant used for oil-boring at New Plymouth is far superior to that which was employed in boring for oil at Gisborne. The whole of the machinery is very compact and working all in line. No bevel-pulleys are used for any purpose. The machinery and derrick are covered in, so that no one can get near the place when the bore is going down. When operations are suspended the place is locked up. The bore was commenced 16in. in diameter and carried down this diameter to a depth of 50ft. with iron stove-pipe tubing, after which a bore was put down 14in. in diameter with stove-pipe tubing for another 100ft.; then a 10in. bore was put down for another 150ft. This was tubed with 10in. thread-pipe; and at the time of my visit they were putting down 9in. thread-pipes, the bore being down to a depth of 340ft. The boring operations differ from those at Gisborne to this extent: that in lieu of a manila cable being used for boring, wooden rods 2½in. in diameter are used, made of American white-ash. These rods are in about 30ft. lengths, and have taper screw ends on one end of the rods, and a corresponding screw-boss on the other. The screwed ends are about 3in. long, 1½in. in diameter at the neck, and about 1¼in. at the extremity of the end, thus tapering in 3in. ⅛in. on each side. The boring-bits are in about 3ft. 6in. lengths. On the top of the bit is fixed by a screw-joint a cross-feathered bar, the feathers having the same diameter as the bit. This cross-feathered bar is for the purpose of keeping the bore straight and perpendicular. On top of this the sinker-bar is jointed on. This is a bar of round iron 4½in. in diameter and 45ft. long, and on the top of this the jar-tool rods are fixed. The sand-pump is from 37ft. to 40ft. in length; but a tube is not used for putting water down to the bottom of the hole as was done at the Gisborne wells, the water being emptied in at the top of the tubing. The walking-beam, with connections, and, indeed, all the appliances, work very true and steady. The whole of the winding and boring machinery is driven by a horizontal steam-engine of about 15-horse power. The manager informed me that the tubing was made in England, but it is inferior to that manufactured in America, the iron being of bad quality. During the time of my visit they were putting in the 9in. tubing, which appeared to be in about 16ft. or 18ft. lengths, each length being screwed together and lowered down in about three or four minutes. From the manner in which this work was being done it showed me that the manager is well acquainted with what is required, and he has all his workmen well drilled as to the post that each has to take in carrying on the operations. To a stranger visiting the works, it would seem as though all employed were working for a wager, having no time to talk, but silently attending to their work. The manager was so busy that he had no time to give me much information as to what rate boring was carried down, but if an accident does not occur it will not be long before they get the present hole down to a good depth. They have tools of every description, and everything at hand to meet emergencies when required.

THE EXPLOSIVE NATURE OF COAL-DUST.

Three Royal Commissions have been appointed to report on the best method to prevent explosions in coal-mines, and the safest explosive to use, namely, the English, Prussian, and French Commissions, each of which has gone fully into the cause of explosions, and the evil effect that dry coal-dust produces in a mine where there is firedamp, showing clearly that it is not safe to use blasting-powder in a mine where firedamp is generated; but they all omitted to experiment sufficiently on the effect produced on a mine with a blown-out shot, where blasting-powder had been used, and the mine was full of dry coal-dust. Experiments recently made by Mr. Henry Hall, one of Her Majesty's Inspectors of Mines for the West Lancashire district, show conclusively that under no conditions should blasting-powder be allowed to be used in a coal-mine. In the event of a blown-out shot there is great probability of an explosion taking place where there is a

large quantity of dry coal-dust in a mine entirely free from firedamp. It has been known for many years that dry coal-dust in the presence of firedamp greatly increases the force or intensity of an explosion, but many of our mine-managers will not admit that coal-dust alone is explosive, although they must know that such dust contains carbon and a certain percentage of sulphur. The experiments conducted by Mr. Hall show conclusively that in some instances dry coal-dust is a highly-explosive substance even when entirely free from firedamp, and, that being the case, no explosive should be allowed to be used in a coal-mine where there is dry dust known to produce flame by a blown-out shot, and blasting-powder is known to be one of the explosives which is most likely to do this. Indeed, there is no explosive yet tested which can be considered to insure perfect safety, but the danger can be minimised by using those which do not readily produce flame. The French Commission recommend a dual explosive, such as 30 per cent. of dynamite and 70 per cent. of nitrate of ammonia. Bellite is also mentioned as an explosive not likely to produce explosions, namely: 17 per cent. of dinitro benzol and 83 per cent. nitrate of ammonia, or any explosive that develops a temperature of detonation as low as possible, and in all cases less than 3,992° Fahr.

The following is an abstract of Mr. Hall's official report, taken from the *Colliery Guardian* of the 28th of November last:—

"The first series of experiments was carried out in a disused pit-shaft 50 yards deep and 7ft. in diameter. A cannon 2ft. 6in. long, with a bore of 2in., was fixed at the bottom of the shaft and pointed upwards, and the air in the shaft was then saturated with fine coal-dust, which had in some instances been collected from underground roads and in others from the pit-screens. The cannon was fired by electricity, with the dust in suspension in the shaft.

"The following table shows the results of experiments made:—

No. of Experiment.	Date on which Experiment was made.	Temperature half-way down the Shaft. Deg. Fahr.	Approximate Quantity of Dust used.	Weight of Explosive in Pounds. P., Gunpowder; R., Roburite.	Results.	Name of Mine or Colliery where Experiments were conducted.
	1890.	Deg.	Cwt.	Lb.		
1	April 30	67	2	¾ P.	A.	White Moss Colliery Company's near Ormskirk.
2	" 30	57	2	1 P.		
1	May 21	70	2½	1 P.	B.	White Moss Arley Mine.
2	" 21	68	2½	¼ R.		
3	" 21	60	...	1 R.		
4	" 21	60	3	1 R.		
1	June 26	70	3	1 P.	C.	Southport Pit—depth, 130 yards; diameter, 18ft.
2	" 26	70	3	1 P.		
3	" 26	...	3½	...		
4	" 26	...	3½	1 P.		
5	" 26	...	4	1½ P.		
6	" 26	...	4	1½ P.		
1	July 30	71	3	1 P.	D.	Big Lady Pit—210 yards deep, 8ft. diameter.
2	" 30	...	2½	1¼ P.		
3	" 30	...	3	1½ P.		
4	" 30	65	3	1½ P.		
5	" 30	65	5	1½ P.		
1	Oct. 17	58	2	1½ P.	E.	Big Lady Pit. Same as last.
2	" 17	58	4	1½ P.		
3	" 17	58	4	1½ P.		
4	" 17	56	2	1½ P.		
5	" 17	56	5	1½ P.		
6	" 17	...	4	1½ P.		
1	Oct. 20	Preliminary	...	...	F.	Same pit as last.
2	" 20	54	3	1½ P.		
3	" 20	54	3	1½ P.		
4	" 20	...	3	1½ P.		
5	" 20	54	5	1½ P.		
6	" 20	...	4½	2 P.		
7	" 20	54	6	1½ P.		

"*Results A.*—(1.) Dust was not ignited. (2.) Dust was ignited, and a violent explosion took place in the shaft; a large body of flame rushed out at the mouth of the pit, setting the woodwork on fire on the surface, and ascending into the air about 20ft. The electric firing-cable was burnt and destroyed, and the experiments had to be discontinued.

"*Results B.*—(1.) Dust was ignited, and the flame came out of the mouth of the shaft. The cannon was fired twenty minutes after the dust was put down. (2.) Dust was not ignited. The

roburite was lightly tamped with coal-dust, the same as the gunpowder-shots. (3.) No fresh dust was put in for this experiment, and the cannon was fired two hours after the previous experiment. The dust was ignited, and there was a considerable explosion, but the flame did not reach the top of the shaft. (4.) Dust was ignited, and the fiercest explosion of all followed, a large volume of flame rushing from the mouth of the shaft and ascending about 30ft. into the air.

"The shaft in which these experiments were made was acting as an upcast for a pumping-shaft half a mile distant, so that the air was travelling apparently in the direction of the blast, but the air seemed to reverse whilst the dust was being put down by means of a riddle ¼in. mesh, so that it is difficult to say what speed of air might be passing at the time of each explosion; it would not exceed a velocity of 50ft. per minute.

"The greatest distance traversed by the flame on these experiments was 65 yards, limited, of course, by the depth of the shaft. The violence appeared to increase as the explosions progressed up towards the mouth of the shaft, and would no doubt have reached the surface, however deep the shaft might have been. The following is an analysis of the ventilation of the shaft, taken during the progress of these experiments:—

"Oxygen	20·56
Nitrogen	79·20
Carbon-dioxide	0·15
Sulphur-dioxide	0·09
	100·00

"*Results C.*—There was no ignition of the dust in any of the six trials in this pit. The cause of this is by no means clear, but it may be attributed partly to the wet condition of the shaft, and partly to the fact of the large dimensions of the shaft, which may have prevented the heat given off by the gunpowder-shots being sufficiently confined to effect the ignition of the dust.

"The shaft where these experiments were carried on was in course of sinking, and is connected with another sinking-shaft close by by means of a cut-through in a coal-seam at the depth of 100 yards. The cannon was fixed on a scaffold at the latter depth. The pit sides were wet and dripping, but the lower part of the pit below the scaffold was full of water. A coke fire was placed on the scaffold, causing the experimental pit to act as an upcast, the current of air passing being only at the rate of 30ft. per minute.

"*Results D.*—(1.) Dust was not ignited; both cannons fired. (2.) Both cannons were fired in quick succession. Dust was ignited at first shot, and there were three separate rushes of wind and dust out of the mouth of the shaft, the last being followed by a large body of flame rising about 30ft. above the pit-mouth, and continuing three or four seconds. (3.) Dust was not ignited; both cannons fired. (4.) Dust was ignited, and there was violence in the pit, but the flame did not reach the top; one cannon missed fire. (5.) Dust was ignited, and a large body of flame rushed out of the mouth of the pit, ascending about 40ft., and displacing the wood and framework at the top of the pit. Both cannons were fired in quick succession, but the dust fired at the first.

"These experiments proved to be by far the most important and conclusive. A scaffold was fixed at a depth of 180 yards, and two cannons side by side attached to it. At this depth there was a small arched way leading to another pit—pumping-shaft—21 yards distant; this was lined with bricks, its sectional area being 10ft. There was a similar arched way of larger dimensions at the bottom of the two pits. The experimental shaft was upcast for the other, and the air passing up it was visibly charged with vapour from the water lodged below. Its speed was about 100ft. per minute, but this speed was much reduced when the air was charged with dust, to the extent of reversing from time to time. The ventilation went direct through the openings to the experimental shaft, and was quite free from firedamp.

"*Results E.*—(1.) No violence other than was due to the two shots. (2.) Dust was ignited at first shot; there was no violence in the pit, but the flame did not reach the surface. (3.) Dust was ignited by the first shot, but the flame did not reach the surface on the second shot. There was a great rush of dust from the mouth of the pit, and, after an interval of ten seconds, an explosion and a large body of flame was projected about 20ft. high. (4.) and (5.) Dust was not ignited, and no unusual violence. (6.) There was unusual violence, but no flame appeared at the surface. One cannon missed fire.

"*Results F.*—(1.) No unusual violence. (2.) and (3.) Dust not ignited, and no unusual violence. (4.) Dust ignited, but no flame reached the surface; one cannon missed fire. (5.) No flame, but considerable violence. (6.) Dust was not ignited, and no unusual violence; one cannon missed fire. (7.) Dust was ignited, followed by a continuous roar and a rush of flame, completely filling the mouth of the pit, and ascending 60ft. into the air. This was the most violent explosion since the commencement of the experiments. It is difficult for any one who did not witness this experiment to realise the extent of the explosion. The flame continued to issue from the pit for five or six seconds, followed by dense smoke. The violence of the explosion carried away some of the woodwork 37ft. about the pit-mouth. Only one cannon was fired.

"These experiments conclusively prove that blasting with gunpowder in dry and dusty mines may cause serious disasters in the entire absence of firedamp. It is impossible to clearly explain why many of the experiments failed to cause explosions or ignite the dust, but the fact that at intervals these did occur perfectly justifies the above conclusion. The English Royal Commission on accidents in mines left this subject in doubt. Indeed, the conclusion they arrived at was calculated to give the impression that in the entire absence of firedamp coal-dust was not dangerous (see page 36, final report Gorswood Hall experiments). They say, 'But the most decisive of the results were not of a nature to warrant the conclusion that flame could be carried along to a great distance by coal-dust in the complete absence of firedamp.' The French Commission was entirely adverse to the view which the present experiments prove. The German experimenters were more disposed to

accept the affirmative view than either the French or the English, founding their opinion on the behaviour of certain coal-dust from the Pluto seam.

"All the experiments carried on by the different Commissions were on a small scale as compared with those detailed in this report, and left the important question unsettled as to whether the dust explosion would follow on as it were, or traverse the whole of the workings where dry coal-dust was lodged. It was easily demonstrated that dry dust could be locally ignited. On four occasions during the experiments at the Big Lady pit the flame tavelled more than 200 yards, and only ceased when it reached the mouth of the pit, and there was an undoubted increase of violence as it travelled on its course. Some experiments were tried with roburite shots, and these failed to explode the dust; but although the experience of the experiments went to show that a large flame such as is given off by a blown-out shot of gunpowder, or a local explosion of firedamp, is required to ignite dust, yet further tests of the high explosives such as roburite seem desirable before they can be pronounced actually free from danger in the presence of dry dust."

REPORT OF THE FRENCH COMMISSION ON THE USE OF EXPLOSIVES IN THE PRESENCE OF FIREDAMP IN MINES.

The French Firedamp Commission, instituted by law of the 26th March, 1877, had expressed the wish that the Explosive Substance Commission should inquire if, by modifying the character of the method of using explosives, it was possible to diminish the effect of firedamp explosions resulting from blown-out shots. To that end M. Aguillon, who was willing to give special attention to the question, had temporarily been attached to the Explosive Substances Commission, and made known his conclusions in a report which was approved at their sitting of 2nd December, 1880.

The Commission was of opinion that, the temperature of ignition of firedamp being from 1·112° to 1·292° Fahr., there existed no explosive whose deteriorating temperature was beneath this figure. On the other hand, it was considered as almost impossible to find a process of which it could be definitely asserted that it prevented with certainty contact of the flame of the explosion with firedamp.

The English Firedamp Commission, instituted shortly after the French Commission, only terminated its researches in 1886. Their labours relative to explosive substances were directed by Sir Fredrick Abel, one of the most illustrious members.

It was ascertained that powder enclosed in a shot-hole about 2ft. deep, completely surrounded by water, when blown out, ignited four times out of six a mixture of air and firedamp.

At Sir Fredrick Abel's suggestion, powder was replaced by dynamite, compressed gun-cotton, mixed with a proportion of nitrate—saltpetre or nitrate of barium—necessary for the complete combustion of its carbon. In experiments made with blown-out shots it was ascertained that a charge of 3oz. of dynamite placed at the bottom of a shot-hole, 2ft. deep, tamped only with 6in. of sand, ignited an explosive mixture of air and firedamp. A charge of one of the high explosives above mentioned, placed at the bottom of the shot-hole and tamped by cylinders full of water—McNab process—did not ignite mixtures of air and firedamp non-explosive by themselves, but rendered inflammable by the addition of a sufficient quantity of coal-dust. Under the same conditions, and with the same mixture, powder caused ignition.

Sir Fredrick Abel had proposed in 1873 to fire explosives in the midst of water, so as to produce a perfectly equal distribution of the pressure on the sides of the hole. He considered that safety would be obtained by adopting this process. Experiments made in coal showed that though Sir Fredrick Abel's process had real economical advantages, especially in blasting the coal, it produced almost the same results as McNab's process as regards safety. Mixtures of air and firedamp rendered explosive by dust were never ignited; but out of forty-two shots with dynamite ignition of a mixture of air and firedamp occurred six times.

Mr. Galloway having proposed to place moss saturated with water immediately above the explosives, the Commission ascertained that this process—except a slight advantage in simplicity and cheapness—had nearly the same effect as water. The Commission attained no satisfactory result by the use of a rather singular process suggested by Sir F. Abel and tried by Mr. Galloway, which consisted in placing above the cartridge liquified carbonic-acid gas enclosed in iron cylinders. Furthermore, they rejected the use for stemming of solid materials capable of producing under the influence of heat a considerable amount of water or gas, such as crystallized carbonate of soda, carbonate of lime, &c. Sir F. Abel rightly remarked that there would certainly not be time, owing to the suddenness of the detonation, for the expected disengagement to be produced.

To sum up. The English Commission spoke favourably of the use of gelatine dynamite, as better resisting the action of water. The cartridge being placed at the bottom of the hole, it was recommended that water be poured in to fill the space between the sides of the cartridge and those of the hole; then to stem half the depth of the hole with moss soaked in water, and to complete the filling with water. It was remarked that this process suffices against mixtures of air and firedamp, non-explosive in themselves, but made explosive by the presence of coal-dust, but was more comparatively efficacious when the mixture of air and firedamp was actually explosive in itself. The Commission further clearly pronounced against the use of Bickford fuse, and in favour of electrical firing.

The Prussian Firedamp Commission, instituted October, 1880, have published the results of their researches from time to time. Most of their experiments on explosives were made in the course of 1885, and the results, after having been mentioned in several technical journals, were officially published in 1886. Further experiments were made under the same conditions as the earlier ones from May to September, 1887, and the results were published in the latter number of the *Official Mining Journal* for 1887.

The experiments of the Pussian Commission were made in a long artificial gallery constructed on the waste-heap at the Koinig Colliery, near Neaukirchen, Saarbruck. By means of sheets they

were able to isolate this gallery, a compartment containing about 700 cubic feet, into which firedamp from the mine was introduced to make an explosive mixture. The composition of this mixture was known by the position of the bell of the gas-holder in which the gas was enclosed. The explosive cartridges were either laid on the ground or stemmed at the bottom of the holes 1ft. 8in. to 2ft. deep, drilled in blocks of sandstone or coal 2ft. 8in. to 3ft. 4in. in length, 2ft. 4in. to 2ft. 4in. wide, and 1ft. 8in. thick. The blocks were covered by a layer of coal-dust from 8in. to 1ft. thick. The floor of the gallery was covered with coal-dust from 11 yards to 22 yards in length. The explosion of the firedamp was ascertained by observing through windows suitably placed the flame produced at each explosion.

The results obtained by the Prussian Commission have scarcely been consistent, and its conclusions have notably varied as time progressed. These contradictions, besides those inherent to the subject which have been met with, and the reasons of which will be explained further on, seem to be due to several causes, among which the principal are as follow: First, mixtures were often used too low in firedamp, and almost non-inflammable—5 to 7 per cent. of firedamp; second, there were no means of knowing for a certainty that the explosion had been fired effectually. It will be seen later that this condition is the most important of all to be known.

But, be that as it may, the principal results at which the Commission progressively arrived are as follows:—

Dynamite, which until June, 1885, had, exploding unconfined, only once ignited firedamp almost invariably ignited it in the experiments of July in the same year. The Commission attributed this change to the substitution of dry dynamite—that is to say, one in which the nitro-glycerine is thoroughly absorbed by silica for a wet dynamite, from which the nitro-glycerine had some tendency to exude.

Blasting-gelatine in 1885 had, exploded unconfined, never ignited firedamp, and had only kindled it once, when lightly stemmed at the bottom of a shot-hole with a gaseous mixture containing 9 per cent. of firedamp. In 1887 ignition was effected by unconfined explosion. On the other hand, even with heavy charges—9·88oz.—a mixture of 10 per cent. of firedamp was not ignited when the cartridge was stemmed in shot-holes drilled in blocks of sandstone.

Gelatine Dynamite No. 1 did not ignite firedamp in 1885; in 1887 it ignited firedamp and coal-dust, exploding unconfined; but a charge of 10·58oz. stemmed at the bottom of a shot-hole, did not ignite a 10-per-cent. mixture of firedamp, although, under the same conditions, an 8·11 oz. charge of powder caused ignition.

Gelatine Dynamite No. 3, which is exploded with difficulty, exploded unconfined, ignited firedamp in 1885 and 1887.

Compressed Gun-cotton did not ignite firedamp on detonation, either unconfined or stemmed at the bottom of a hole, either in 1885 or in 1887.

Hellhoffite did not ignite fire-damp in 1885, either exploding unconfined or stemmed at the bottom of a shot-hole. The experiments were not repeated in 1887.

Gun-cotton, mixed with 50 per cent. of nitrate of barium, untried in 1885, had, exploding unconfined, ignited firedamp in 1887.

Carbonite consists of saltpetre-cellulose and a mixture of nitro-glycerine, with a peculiar sulphurous oil, sulphureted benzol. The inventors have introduced two varieties of this substance. No. 1 ignited coal-dust alone; No. 2 proved thoroughly safe in forty-two experiments made with 3·53oz. cartridges, fired amongst mixtures containing up to 9 per cent. of firedamp. It was then used on a large scale in the Koinig Colliery for driving three drifts to the coal of the gassy Carlowitz Pit. Explosions occurred five times in a very feeble explosive mixture of firedamp and dust. The presence of the firedamp was barely shown on the benzine lamp, and there was a little coal-dust. In four out of these five cases the shots worked well; in the fifth the shot was blown out, which appears to be not uncommon with carbonite, securite, and roburite. Four of the charges were from 4 to 4½—3·53oz.—cartridges; for the blown-out shot and for another of the five shots the charge was only from 2oz. to 2½oz. cartridges. Although four successful shots only caused local explosions, the blown-out shot ignited coal in place.

Further tests were then made in the experimental gallery, and, with 14·11oz. of carbonite, coal-dust was ignited twice out of five times. It should be added that the lower power of the explosive, which otherwise gave it in working coal a superiority over other blasting explosions, did not permit the employment of small charges in a mine.

Kinetite, a complete composition, containing chlorate of potash, did not ignite gas. The presence of chlorate of potash makes this substance too dangerous for its use to be recommended.

Securite, consisting of dinitro-benzol and nitrate of ammonium in various proportions, with nitrated resin, and traces of naphthaline and nitrate of soda, two different mixtures, have given safe enough results in April and May, 1887; but in August in the same year a 3·53oz. cartridge suspended in 10-per-cent. mixture of firedamp produced explosion twice out of thrice.

Roburite consists of a chlorinated nitrated hydrocarbon and nitrate of ammonium, in various proportions: (1.) Roburite of the old composition, containing piric acid, ignited gas when the cartridge was inclined at 40 degrees. (2.) Torpedo-roburite ignited the mixture containing 5 per cent. of firedamp. (3.) Mine-roburite I., dinitro-chloro-benzol and nitrate of ammonium, without piric acid, ignited once. (4.) Mine-roburite II., similar to the last, but containing phenol besides, did not cause ignition even when the cartridge was inclined at 40 degrees.

Lithotrite, from Demense, Aix-la-Chapelle, caused an ignition.

Schultz-powder, from Messrs. Voltz, Lichtenberg, and Company, of Ludwigshafen, did not prove itself safe in a finely-divided state. The powder slightly compressed caused ignition with 8 per cent. of firedamp. The powder strongly compressed never caused ignition.

The Bornhardt 15-grain detonators did not cause ignition even with 8 per cent. of firedamp.

Mr. Hugo Lohmann, after having given—in the Zeitschr. für Berg-Hutton-und-Salinen Wessen

—a summary of the experiments of the Commission on the various explosives, concludes with these words: "After the experiments just described, the author is of opinion that the use of the actually-known blasting-explosives in the presence of firedamp, and more particularly in workings containing coal-dust, is much more dangerous than has hitherto been usually believed, and the prohibition of the use of powder and analagous explosive substances would have but an insignificant influence on the number of explosions of firedamp or coal-dust."

The Prussian Commission did not spend much time in considering the best means of firing the explosion. Some experiments were made in May and August, 1887, with safety-fuse. The experimental gallery was filled with mixtures of air, firedamp, and coal-dust, in which the firedamp varied from 4 to 6⅔ per cent. One of the ends of the fuse was inserted in a shot-hole, the outer end cut off, and the free end then ignited inside the gallery. Nothing occurred when the mixture only contained 4 per cent. of firedamp; when this proportion was exceeded an unsteady flame existed for some seconds, very feeble, bluish or yellowish, in the upper parts of the gallery, adjacent to the fuse; with 6⅔ per cent. a feeble explosion occurred repeatedly; with 10 per cent. an explosion immediately occurred.

The Prussian like the English Commission sought to ascertain if it was possible to insure security by using explosives in any particular method. They only experimented with water-cartridges, previously proposed by Sir Fredrick Abel. Cartridges containing 7·05oz. dynamite were placed in the middle of the "Settle water-cartridge," filled with water and laid on the floor of the gallery. Under these conditions it was impossible to ignite the gas even with high percentage of firedamp, and on firing three such cartridges at once. In one experiment ten 3·53oz. cartridges of dynamite, each enclosed in its water-cartridge were fired at once in a 10-per-cent. mixture of firedamp without iguiting the gas. Ignition of the explosive mixture could only be effected with 2·2lb. of dynamite divided into seven water-cartridges laid on the floor of the gallery and covered with coal-dust.

The Settle water-cartridges are paper bags 1ft. 8in. in length and 1¼in. in diameter for ordinary cartridges, and for larger cartridges 1½in. in diameter. In order to insure the complete surrounding of the cartridge by water a wood plug is slipped into the bottom of the bag, and a tamping of clay is placed above the water before closing the mouth of the bag.

The Prussian Commission gave much attention to the part played by dusts, either alone or in combination with firedamp. Two members of the sub-Commission—MM. Mallard and Le Chatelier—have already studied the Prussian experiments from this point of view, and have shown that they seem rather to confirm the opinion which they had already upheld and supported by independent researches—namely, that coal-dust only plays a subordinate part in mine-explosions. Sir F. Abel, in a recent paper before the London Institution of Civil Engineers, has just given the support of his high authority to this opinion. The inflammability of mixtures of air and coal-dust is, moreover, far inferior to those of air and firedamp, and it is universally agreed that similar mixtures can only be ignited by the influence of intensely hot flame. It has therefore been considered a complication of slight value in the experiments to place coal-dust in a state of suspension in a gaseous mixture.

Some experiments, however, were made with dusts, and are quoted here to avoid repetition. It was ascertained that dynamite exploding unconfined in the presence of coal-dust—very fine and very inflammable—did not ignite these dusts. Dynamite burning without explosion did, on the contrary, ignite the dust, as has been shown by placing a charge of 772 grains of dynamite in a cylindrical hole bored in a block of wood covered with coal-dust, the dynamite being ignited with a Bickford fuse, without a detonator. A dynamite charge of 772 grains, placed in a tin-tube 0·98in. internal diamater and 1·57in. external diameter stemmed 5in. deep with very fine coal-dust, did not ignite firedamp.

Appointment of Commission.

In consequence of the first series of experiments made by the Prussian Commission, which seemed to attribute an almost complete safety to the use of certain explosives, the Minister of Public Works appointed, on the 12th February, 1887, a Commission, consisting of M. Hatton de la Gonpilliere, Inspector-General of Mines; President Sarran, Engineer-in-Chief of Explosives; MM. Mallard, Lorieux, and Aguillon, Inspectors-General of Mines; and Le Chatelier, Engineer of Mines, Secretary. This Commission was charged with the study of questions relative to the use of explosives in firey mines.

From its earliest sittings this Commission considered it necessary to repeat the experiments of the Prussian Commission. After consultation between the Ministers of War and Public Works, it was decided that the Explosive Substances Commission, appointed by the Minister of War, should be charged with this experimental investigation. MM. Mallard, Aguillon, and Le Chatelier were temporarily attached for this purpose. This sub-Commission settled the programme of experiments, which were continued from the 4th April, 1887, without interruption, with the following results:—

Description of Apparatus and Methods of Experimenting.

The experiments would have been of little interest if they had been a repetition of the researches of the Prussian Commission, which were made as nearly as practicable under actual working conditions. It was determined to conduct the observations under conditions as exactly defined as possible, and to carry on the researches as a scientific investigation. It was hoped thus to account for the anomalies noted in the Prussian experiments, and even to be able to formulate laws whose results would be immediately applicable in practice.

Not possessing a natural source of firedamp, recourse was had to marsh-gas artificially made, and the most convenient process employed—that is to say, the action of heat on a mixture of acetate of soda and soda-lime—lime slacked with a solution of caustic soda. It was intended to fire the explosives in a closed vessel, so as to be able to make an exact measurement of the amount of firedamp mixed with air, to be able to study completely the conditions of the detonation of the explo-

sives, and to be always well assured of the ignition or non-ignition of the gaseous mixture. To fulfil these conditions, a steam-boiler of about 350 cubic feet capacity was chosen. Fig. 1 shows the ground-plan of the apparatus used for the experiments; fig. 2, elevation and section of the apparatus used for generating marsh-gas; fig. 3, plan and section of the boiler; and fig. 4, details of the attachment of the cartridge to the lid of the small hole of the boiler. In fig. 1—*a*, apparatus for generating the gas; *b*, a gasometer for the collection of the manufactured gas; *c*, a small Belleville steam-boiler, used to raise steam to work an ejector; *d*, an iron boiler, tested to 8½ atmospheres, provided with an ejector; *e*, a shelter for the experiments.

Apparatus for generating Marsh-gas.—The apparatus for the generation of marsh-gas consists of ten iron tubes or retorts, 7ft. 8½in. long—see fig. 2.—filled with cast-iron plugs at one extremity, and at the other with a screwed extension of less diameter than the body of the cylindrical tube. These retorts, placed in two horizontal ranges above a fire-grate, are held in position by means of three plates pierced with holes fixed in the side walls of the furnace. At the end of the furnace is a receiver, to the bottom of which curved tubes penetrate, connected with the retorts by screwed joints; lastly, a pipe, 2·36in. diameter, traverses the receiver, ending at the dome, and connects it with the little gasometer.

The charging of this apparatus is effected by introducing into the retorts semi-cylindrical troughs, in which the mixture of acetate of soda and caustic soda and lime has been previously placed, each charge consisting of about 4½lb. of the powdered mixture. The retorts being charged, a wood fire is kindled, which is slowly fed, the fuel being distributed uniformly over the surface of the grate. The gases having passed through the water contained in the receiver, are conveyed to the small gasometer *b*.

Experimental Boiler.—The boiler employed for the experiments, fig. 3, measures externally 18ft. 5½in. in length, and 4ft. 11in. in diameter. The thickness of the plates is 0·63in. on the cylindrical part, and 0·55in. on the egg ends; its internal capacity, exclusive of the reservoir for the transmission of pressure to the pressure-gauge, is 359·2 cubic feet. The boiler is provided on its upper part with an elliptical man-hole, T, 1ft. 1¾in. by 1ft. 5¾in., with a rectangular hole, *t*, placed in the middle of the length, measuring 3·94in. by 1·97in., for the insertion of charges, and with a hole, E, 3·94in. diameter, on which the steam-ejector is fixed. On the lower part, at one end is a circular hole, A, 1·97in. in diameter, for filling the boiler with air, and at the other end is a flanged plate, *b*, for the purpose of attaching the lead pipe which connects it with the pressure-gauge. This gauge was found to be useless, and abandoned after the first experiment. On the horizontal section passing through the axis are four cocks 0·39in. in diameter, and two brass plugs. The cocks, R R, one at each end of the boiler, are connected with the gasometer. A third lateral one, *r*, is connected with a tube dipping into the water, which permits the measuring of the vacuum obtained by the action of the ejector. Lastly, a fourth Lateral cock, *r*, is connected with the water-gauge formed by a U tube. One of the brass plugs is provided with two insulated copper wires, which allow either a spark to pass into the gaseous mixture or raise a fine iron wire to red heat.

The cartridges of the various explosives to be tested are introduced through the rectangular hole in the upper part of the boiler. They can also be introduced through the man-hole if their diameter is too great. It is seldom necessary to use this means, which prolongs the operation. Electricity is generally used to fire the explosives for this purpose. The lid of the small hole is provided with two screwed plugs of lignum-vitæ, B and B, fig. 4, which passes through it. Through the axis of each of these a copper rod passes, which is also screwed, projecting outside, and terminated by a hook at the inner end. Lastly, in the centre of the lid are fixed two small copper angle-plates, *e d*, the open arms of which are clamped by a pressure-screw, *v*, which holds the wooden rod *b*, 2ft. 5·53in. long. The deal rods, 1·18in. by 0·2in., in section are fitted with copper wires, *f f*, connecting the detonator with the hooks of the lid, thus forming a closed circuit.

Gasometer.—The gasometer measures 9ft. 2½in. in diameter and 3ft. 3¼in. in height, giving a capacity of 217 cubic feet.

Boiler and Ejector.—The steam-boiler used is twelve-horse power. A cock placed on the steam-pipe drives the ejector by a current of steam of from 10 to 12 atmospheric pressure. This last apparatus will produce a vacuum of 6in. of water-gauge in one or two minutes.

Mode of Carrying out an Experiment.

The boiler was well aired before carrying out an experiment. The plate which closes the hole A in the bottom was raised; steam was turned on to the ejector, and allowed to work seven or eight minutes. All the other openings in the boiler being closed, a current of air traversed the boiler from one end to the other, and upwards from the bottom. This operation being completed, all the apertures were closed, and the explosive to be tested was introduced.

The cartridge, fixed on the wooden rod, was fitted with a detonator, which could be fired by an electric current. The copper wires of the rod were connected with those of the detonator, and with the hooks of the copper rods which pass through the wooden plugs in the lid. To fire the explosive it was therefore necessary to fix the wires of the battery to the ends of the copper rods which project above the lid, and to close the circuit. This method allows the explosive to be tested to be fixed beforehand on the rods. It is then only necessary to fix the rods between the two angle-plates by means of the pressure-screw, and to fasten the wires on to the hooks. This operation can be quickly performed. The lid being in position, the cartridge will be in the axis of the boiler, and in the centre-line. The joints being closed, the ejector is worked, and the water rises in the glass-tube connected by indiarubber tubing.

When the vacuum is seen to be sufficient the cover of the ejector is closed, being previously coated with white-lead, so as to obtain a hermetical joint, and to be assured, by the steadiness of the water-gauge, that the boiler shows no leak. This observation made, the boiler is placed in communication with the small gasometer, and the two cocks placed at the ends of the boiler are simultaneously opened to allow the entrance of the firedamp. The gradual descent of the water in the gauge is observed till the desired proportions of air and firedamp are indicated. The gas

penetrating into the rarified air with a speed of many yards per second produces a first mixing, increasing by the re-entry of air from the same points after shutting off the connection with the gasometer. This re-entry of air is effected by opening the cocks placed at the ends of the boiler. The atmospheric pressure being restored in the interior of the boiler, all the cocks are shut, and the ejector-flange is replaced by a solid cap.

An experiment can now be made. The composition of the gaseous mixture is then obtained by deduction from the volume of gas used. The conducting-wires are attached to the little rods in the lid, by which the explosives are introduced and the circuit is closed. When the explosive tested causes ignition of the gaseous mixture it is indicated by the heating of the boiler-plates, as well as by the considerable pressure which immediately follows the ignition of the air and firedamp, and which is followed by a depression when the water-vapour is condensed. It was intended that the pressure should be registered by means of a recording pressure-gauge analogous to that which had been used in the experiments by MM. Mallard and Le Chatelier on explosive gaseous mixtures, but the readings of the gauge being unreliable, and delaying experiments, its use was given up.

Description of Gas used.

The combustible gas produced in the retorts and stored in the gasometer was analysed as follows: Air, 10·8 per cent.; gases absorbed by bromine, 7·9 per cent.; firedamp, by difference, 81·3 per cent. No tests were made for hydrogen. A second analysis gave nearly the same result.

The presence of air is explained by the fact that, for economical reasons, the gas produced during the first period of heating was used, and which brought over with it the air with which the retorts was filled at the commencement. Except for this quantity of air, which must be taken into account in the preparation of the mixture introduced into the boiler, the gas is almost pure marsh-gas, and should have the same properties. The combustibility, it is true, should be increased by the presence of higher hydrocarbons which are absorbed by bromine, but this increase cannot be considered as very material: indeed, the speed of propagation of ignition in a tube is sensibly the same for this gas as that previously determined by MM. Mallard and Chatelier for firedamp. Besides, it appears possible that natural firedamp contains a notable quantity of hydrocarbons absorbable by bromine, and it seemed advantageous, as regards the accuracy of the conclusions, that the gas used should be a little more combustible than that found in practice.

Nearly the whole of the experiments have been made with a mixture formed by introducing into the boiler a volume of gas producing a pressure of 46·46in. in the water-gauge. With gas containing 10 per cent. of air, the mixture thus found contains about 10·3 per cent. of marsh-gas. This is nearly the most explosive mixture. The mixture formed by the introduction of a volume of gas corresponding to a pressure of 27·56in. of water, or a proportion of 6·1 per cent. of marsh-gas, developed in burning a feeble pressure, and was near the lower limit of ignition. As regards the facility of ignition by explosives, no marked difference was found between mixtures containing 12·5 per cent. and 6·1 per cent. of gas. This is in accordance with the fact ascertained by MM. Mallard and Le Chatelier for hydrogen and carbon monoxide—that the temperatures of ignition of mixtures that these gases form with do not materially vary with the introduction of other gases, notably, of excess of nitrogen and oxygen.

Explosives suspended in midst of Gaseous Mixtures.

Experiments have been made with the following explosives already known and used: (1.) Ordinary blasting-powder. (2.) Military gun-cotton, containing nitrogen corresponding to the production of 0·81 cubic of NO_2 per grain of material; in an analysis of Schlossing process; strongly compressed into cubes of 432gr. (3.) Mining gun-cotton, containing nitrogen corresponding to 0·76 cubic inch of NO_2 per grain of material; strongly compressed into cylindrical cartridges of 463gr. (4.) Gun-cotton, still less nitrogenous, equal to 0·68 cubic inches of NO_2 per grain of material; in compressed cartridges of 772gr. (5.) Dynamite No. 1., Vonges, containing 25 per cent. of randanite. (6.) Dynamite No. 0, of Paulilles. (7.) Ammonia-dynamite, of Paulilles. (8.) Blasting-gelatine, of Paulilles. (9.) Gelatine-dynamite, of Paulilles. All these dynamites are in cartridges of 772gr. (10.) Favier explosive. (11.) Hellhoffite. (12.) Pyroxiline powder, from Moulin-Blanc, similar to schultze-powder, containing gun-cotton and nitrate of barium; in strongly compressed cartridges of 772gr. (13.) A powder of similar composition, made at the Belgian Powder-mills at Wettem. (14.) An explosive, again, of similar composition, formed by a mixture of gun-cotton and nitrate of barium. (15.) Bellite, recently introduced by Mr. Lamm.

Blasting-powder.—The ease with which the deflagration of ordinary powder ignites firedamp is well known that it seemed of little use to make experiments on that point. It has been proved that a cartridge of 463gr. of powder, suspended in the middle of a kind of cylindrical bag of impermeable paper filled with water—the Settle cartridge—has ignited firedamp on explosion. The numerous devices proposed at different times to avoid the danger of powder in firing mines by tamping with water thus appears condemned in a decisive manner.

Dynamite No. 1, Vonges, and No. 0, Paulilles.—The No. 1 dynamite from Vonges, and the No. 0 from Paulilles, consist of a mixture of 75 per cent. of nitro-glycerine and 25 per cent. of siliceous earth. They behave in an identical manner. These explosives, when unconfined, are easily fired by the use of one plugged cap of 23gr. of fulminate, and ignite the gaseous mixture in which the cartridge is suspended. All the very numerous experiments have given the same result. Besides, it has been ascertained that a cartrige of 772grs. of dynamite placed in the midst of a Settle cartridge filled with water ignited firedamp out of two trials.

Ammonia-dynamite, of Paulilles.—Ammonia-dynamite is a mixture in various proportions of nitro-glycerine, nitrate of ammonium, and carbonaceous matter intended to use up, in burning, the excess of oxygen produced by the detonation of the dynamite and that of the nitrate. The Paulilles ammonia-dynamite, on detonation, ignited the gas mixture when the proportion of firedamp was above 6·1 per cent.—that is to say, when it became clearly inflammable.

Gun-cotton.—Military Gun-cotton, equal to 0·81 cubic inch NO_2 per grain, enclosed in a very thin brass, common in army service, ignited firedamp once out of three experiments. Mining gun-cotton equal to 8·76 cubic inch, NO_2 per grain, a little less strongly compressed than military gun-cotton, and without a case, ignited the gaseous mixture ten times in ten tests, both with the larger—12·8 per cent.—as well as the smaller—5·7 per cent.—proportions of firedamp. Gun-cotton equal to 0·68 cubic inch NO_2 per grain, strongly compressed, and without a case, fired by the action of two detonators of 23gr. fulminate, ignited the gaseous mixture in the one experiment which was made.

Blasting-gelatine and Gelatine-dynamite. — Blasting-gelatine is a solution of gun-cotton in nitro-glycerine, forming a sort of gum rather than gelatine. The gun-cotton, only in small proportion, should be just sufficient to be completely burnt by the excess of oxygen of the dynamite. Gelatine-dynamite of much more variable composition is formed of blasting-gelatine, with the addition of a dual mixture, such as nitrate of potash, or of soda, and charcoal, or sawdust. In warm weather, such as is experienced in France in May, these explosives are fired easily. During winter their explosion has almost always been incomplete, if not nil, with caps of 23 gr., and with gelatine-dynamite even of 46gr. of fulminate.

This incomplete explosion can be very simply observed by noting the compression produced in the boiler by firing of the cartridges when the boiler was filled with air, or when filled with gaseous mixture, which was not ignited by the explosion. It is certain, when the gaseous mixture was not ignited, the explosion of the blasting-gelatine, or the gelatine-dynamite, did not cause a higher pressure than a few inches of water. The firing of the detonator did not produce a sensible pressure. The cartridge detonated, therefore, but only in a very partial manner, and, under these conditions, did not ignite the gas. By increasing the power of the detonator the ignition of gas with blasting-gelatine and gelatine-dynamite was insured. It may be said the blasting-gelatine and gelatine-dynamite ignite firedamp in which they are suspended any time that they explode more or less completely. These facts have induced the careful study of the method of firing explosives unconfined. The researches on this matter are recorded subsequently.

Hellhoffite.—Hellhoffite has not been exploded unconfined. This explosive is said to be composed of dinitro-benzol mixed with one and a half to two and a half its weight of nitric acid. The mixture is made just before using, which appears to be an obstacle to its customary employment in mines.

Favier Explosive.—Mr. Favier's explosive, as introduced by him to the Explosive Substances Commission, is essentially composed of a mixture of 9 per cent. of mono-nitro-naphthalene, and of 91 per cent. of nitrate of ammonia, so that the nitro-naphthalene exactly utilises, in burning the excess oxygen in the nitrate. The two substances are intimately mixed, and very strongly compressed. A cylindrical hole in the middle of the cartridge, weighing 849gr. contains 77 of powdered material, which acts as an intermediate detonator, and is principally composed of gun-cotton and nitro-glycerine. The Favier explosive does not explode unconfined. This is rather an advantage than an inconvenience, if there was a certainty of its detonation when it is stemmed in a shot-hole, and if under these conditions there was no fear of missed shots. Experiments made in the mine can alone solve this question. Stemmed in metallic tubes, in the manner which will be described further on, this explosive will only be detonated very incompletely, even with 77gr. of fulminate. It happened once out of two tests that the gaseous mixture was ignited by detonation of three plugged caps of 23gr. fulminate, not of the Favier explosive itself in its compressed state, but the material of the explosive reduced to a fine powder.

It is desirable that new trials should be made upon this substance, which, on account of the similarity with the explosive proper, should not be condemned without further consideration as regards safety. In any case, it would be necessary to modify the nature of the intermediate detonator, which, in itself, appears liable to ignite gaseous mixtures.

Bellite.—Bellite, recently introduced by Mr. Lamm, should be, according to the inventor, composed of 80 parts of nitrate of ammonia, and 20 parts of dinitro-benzol. This explosive, as shown later, is completely detonated when confined. Unconfined, it fires incompletely with a detonator of 19gr. of fulminate. Its detonation is still incomplete, although more marked, with 46gr. of fulminate. Two tests were made under the last conditions on a warm moist day without causing the ignition of firedamp. The composition of bellite, as stated by Mr. Lamm, does not seem to be exact. Experiments made with a bomb have, indeed, at a charging-density of 0·3, shown a pressure of 181lb., whilst the theoretical pressure — according to calculations shown subsequently—should be, at that density, about 239 foot-pounds. The mixture of 20 parts of dinitro-benzo and 80 parts of ammonia gave under the same conditions, a pressure of 275 foot-pounds, which more nearly approximates to the theoretical figure, but which is considerably more than that obtained with bellite. A cartridge of 772gr. made with this mixture did not ignite the gaseous mixture in the midst of which it was exploded.

Gun-cotton with Nitrate of Barium.—A powder manufactured some years ago at the Moulin-Blanc Powder-mill, and which was found in the magazines at Sevran, was tested. According to the analysis of Mr. Bruneau, it consists of—Nitrate of barium, 42·6 per cent.; and gun-cotton, 57·4 per cent. A cartridge of this substance exploding in a gaseous mixture ignited it. A nitrated cotton from the Wetteren Powder mill, Belgium, which is also a mixture of gun-cotton and nitrate of barium, also ignited the gas.

Pyroxyline-powder from Moulin-Blanc.—The pyroxyline-powder is a mixture composed of—Nitro-cellulose, equal to 0·69 to 0·73 cubic inches NO_2 per grain, 60 per cent. nitrate of barium; 30 per cent. saltpetre; 6 per cent. bone-gelatine; 3 per cent. and 1 per cent. of paraffin. The substance which is sold to the public as a granular powder has been used in these experiments in the shape of prismatic cartridges, very strongly compressed and coated with paraffin. It explodes easily when unconfined with a detonator of 23gr. of fulminate. In fourteen experiments made with this substance suspended in the midst of a gaseous mixture it only twice happened that the detonation of the explosive caused the ignition of the gas. These two experiments were made on a very warm

and sultry day—that is to say, very humid, the boiler, strongly heated by the sun, being burning hot on the outside, and the internal temperature exceeding 104° Fahr. On account of these atmospherical conditions, these two experiments should be considered as somewhat abnormal. This point will be considered hereafter.

Study of New Explosives not igniting Firedamp.

The example of pyroxyline powder showed that it was possible to find an explosive which, fired without an envelope, did not ignite gaseous mixtures. The manufacture of similar explosives might be examined, so as to establish the general conditions which should be fulfilled.

Dynamite and Soda Crystals.—As has been seen in the historical introduction, a Prussian explosive manufacturing company has tried a mixture of dynamite with powdered soda. An intimate mixture of No. 1 Vonges dynamite with soda crystals, very freely powdered, does not ignite firedamp, exploding without envelope, when the mixture of the two substances is made with equal weights of both materials.

Dynamite and Crystallized Sulphate of Soda.—The carbonate of soda was replaced by crystallized sulphate of soda, with ten equivalents of water. It was ascertained that the mixture of dynamite and sulphate of soda in equal parts does not ignite firedamp, although the mixture containing two-parts of dynamite to one-part of sulphate does ignite it.

Dynamite and Ammonia-alum.—The sulphate and carbonate of soda are not only effervescent, but are also liable to become deliquiscent under atmospheric conditions which may occur in mines. They may, however, be replaced by a very hydrated salt, very stable, and having the advantage of being almost completely volatised when decomposed at a high temperature—viz., ammonia-alum. A mixture of dynamite and alum in equal parts did not ignite gas, but a mixture of two parts dynamite to one of alum ignited the firedamp once out of three tests. A mixture of four parts to dynamite to one of alum ignited it.

Dynamite and Sal Ammoniac.—If, in the preceding mixtures, the substancess added to the dynamite act by absorbing a part of the heat of the explosion in the volatilisation of water, the use of hydrated salt is not indispensable to procure the same result. It suffices that the salt be susceptible of decomposition at high temperature, thus absobing heat; and it is an advantage, as regards the useful effect of the mixture, that the products of decomposition should be gaseous. Sal ammoniac was considered very stable at ordinary temperatures, and is decomposed wholly into gases only at a high temperature. For such purposes the sal ammoniac should be very finely powdered—which is rather difficult—and very intimately mixed. With mixtures containing 67 per cent. of dynamite and 33 per cent. of sal ammoniac the gas was ignited. With mixtures of 60 per cent. dynamite with 40 per cent. of sal ammoniac ignition occurred once out of three experiments, but with mixtures of equal weight of dynamite and sal ammoniac there was no ignition of gas.

Dynamite and Coal-dust.—Most varieties of coal freely give off volatile products when raised to a low temperature. It was therefore permissible to suppose that mixtures of coal-dust and dynamite might produce the same effect as the mixtures as previously described. Dust of three kinds, from difierent coals, were supplied—one from Blanzy gave, on calcination in a closed vessel, 40 per cent. of volatile matter; the second, from Drocourt, Pas de Calais, contained 27·86 per cent. of volatile matter; lastly, the third, from Dourges, Pas de Calais, contained 23·6 per cent. of volatile matter. Mixtures containing one part of dynamite and one part of Blanzy—two tests—two parts dynamite and one part coal-dust—one test—and even four parts dynamite to one part of coal-dust—one test—did not ignite the firedamp. With equal weights there was no ignition either with the Drocourt or the Dourges coal-dust.

These experiments are interesting, but there is not much prospect of finding, in mixtures of dynamite and coal-dust, an explosive showing any security, for, in spite of the results of the experiments, it seems possible that with coal a little more inflammable, or under peculiar circumstances difficult to define, the coal raised to a high temperature may burn in the air. The result obtained with lignite renders this reservation necessary.

Dynamite and Lignite-dust.—Brown Coal.—Lignite yields a still larger proportion of volatile matter than coal. A brown coal coming from Germany, powdered under rollers at the Sevran Powder-mill, was used, containing 62·4 per cent. of volatile matter. A mixture of two parts dynamite and one part of lignite ignited firedamp. This result, although apparently contradictory to the former, is easily accounted for, if it is considered that not only is lignite much more inflammable than coal, but also that, on distillation, a kind of charcoal inflammable at a low temperature is produced.

Dynamite and Nitrate of Ammonia.—Guided by the theoretical reasons subsequently explained, experiments were made with mixtures of dynamite and nitrate of ammonia. These mixtures differ, however, from those which are known under the name of ammonia-dynamite, in that, not desiring to increase the mechanical effect of the explosive, the excess of oxygen in the dynamite and in the nitrate was not utilised by the addition of any carbonaceous substance. An intimate mixture of 20 per cent. of dynamite—No. 1 Vonges—and of 80 per cent. of nitrate, exploded unconfined, in two experiments did not ignite the gaseous mixture. Nitrate of ammonia does not play here altogether the same role as substances like sal ammoniac, because it is itself an explosive, and gives off heat in decomposing into nitrous oxide—N_2O—and water—H_2O—but it gives off less than dynamite, and explosive effect of the mixture is consequently diminished. The theory of this phenomena will be hereafter considered.

Gun-cotton and Salammoniac.—Gun-cotton has been mixed with various substances. This mixing is most difficult, and was effected under the lightest stones at the powder-mill. The first experiments were made with mixtures of mine gun-cotton and salammoniac. A mixture of 80 per cent. of mine cotton with 20 per cent. of salammoniac did not ignite firedamp; but a mixture of 75 per cent. of cotton and 25 per cent. of salammoniac did ignite it. It would be necessary, in order to insure a sufficent degree of security, to increase the proportion of salammoniac, but in doing so a non-explosive point is soon reached. Similar mixtures were, therefore given up.

Gun-cotton and Nitrate of Ammonia.—Mixtures of cotton and nitrate of ammonia were next tried. Messrs. Sarran and Vieille made an exhaustive study of a mixture containing 60 per cent. of endeca-nitric cotton and 40 per cent. of nitrate of ammonia, in which the oxygen of the nitrate suffices, with a very small excess, to complete the combustion of the cotton. Cartridges manufactured with this combustion some years ago at Moulin-Blanc do not explode or explode imperfectly. New cartridges were made at Serran by employing either military gun-cotton, equal to 0·81 cubic inch No_2 per grain, or a much less nitrated cotton, equal to 0·68 cubic inch NO_2 per grain.

Cartridges containing 30 parts of military cotton and 70 parts of nitrate have ignited firedamp twice out of thrice. Cartridges containing 20 per cent. of military cotton and 80 per cent. of nitrate have ignited firedamp once out of two experiments. A cartridge containing 20 per cent. of cotton of 0·68 cubic inch, and 65 per cent. of nitrate ignited the fire-damp Cartridges containing 20 per cent. of cotton of 0·68 cubic inch and 80 per cent. of nitrate did not ignite the gas. In seven experiments the detonation was effected easily enough in all of them with two caps of 23gr. of fulminate.

It appears, therefore, that cartridges containing 20 per cent. of lowly-nitrated cotton are practically secure. It is possible that security will be still better insured, without compromising the completeness of the detonation at least when confined, by still further diminishing the proportion of cotton. Lastly, it is evident from the experiments that it is possible, by mixing an explosive with substances which are non-explosive in themselves, or which produce a smaller explosive effect than the explosive itself, to diminish their power, and thus to manufacture dual explosives which, while producing sufficient mechanical effects, do not cause, at least in the majority of cases, fired without envelope, the ignition of the gaseous mixtures which surround them. Attention may be directed to an important point: with simple explosives such as dynamite, the ignition of firedamp, if the explosive is liable to effect it, is always and certainly produced. For certain dual mixtures the phenomena appear to be constant; but for many others the ignition occurs capriciously, being produced on one day and not on another.

Theoretical Inquiries.

Ignition of Gaseous Mixtures.—Two members of the Sub-Commission in previous researches estimated the temperature of the ignition of firedamp at about 1,202° Fahr. These observers, however, laid great stress on the considerable retardation of ignition which may occur in mixtures of firedamp with air, or even with oxygen. This retardation is naturally greatest when the temperature to which the mixture is heated is about 1,202° Fahr. At this temperature even the retardation may amount to ten seconds. This allows the perception of the possibility of this fact, in appearance paradoxical: that with a gaseous mixture inflammable at 1,202° Fahr., gases may be produced without causing the explosion of the mixture whose temperature is, as shown hereafter, above 3,632° Fahr. But as these gases have been formed by the detonation of an explosive, they are suddenly given off, and under very high pressure; they expand and cool with extreme rapidity—in some thousandths of a second—before having had time to ignite the mixture of air and firedamp with which they come in contact. Would the experiments have given a different result had they been made in a mixture of any other gas than firedamp?—a cartridge made of equal parts of dynamite and Blanzy coal-dust, which does not ignite mixtures of firedamp, and does ignite mixtures of air and coal-gas. These mixtures, however, still show a certain retardation of ignition. With mixtures of air and hydrogen this phenomenon, if it exists, is less marked; and it has been found that a plugged cap of 23gr. fulminate, which ignites neither firedamp or coal-gas, ignites hydrogen.

Temperature of Detonation of Explosives.—Formula for Calculation.—It is customary to look on explosives as regards their force—that is to say, the intensity of the mechanical effects which they may produce. They are now to be considered from a different point of view. The chief consideration now is not on the force developed, but the temperature produced. This leads us to endeavour to calculate the temperature of detonation of a mixture whose composition, the laws of its decomposition, and thermo-chemical phenomena by which it is characterized are known.

The process of these calculations is well known. As it is important to obtain figures as near as possible to the real temperature of detonation the increase of the specific heat of the gases, as established by experiments of MM. Berthelot and Vieille, and by those of MM. Mallard and Le Chatelier, is introduced. The formula given by the latter for carbonic acid, aqueous vapour, and the so-called perfect gases—elementary gases, carbon, monoxide, hydrochloric acid, &c. have also been used. These calculations have been applied to numerous explosive substances, and more particularly to mixtures of dynamite and nitrate of ammonia endecanitric celulosle, with nitrate of ammonia and octonitric cellulose with nitrate of ammonia. The results are graphically shown by the curves in fig. 5, 6 and 7. For each of the three above-named mixtures two curves are shown; having for abscissas the weight of the nitrate contained in ten parts by weight of the mixture. One of the curves has for ordinates the temperatures of detonation, t, the other the quantity, f, which somewhat defines the power of the explosive, and which is expressed by the equation $f = \frac{vo\ T \times 1{\cdot}033}{w \times 273}$ in which vo = the volume of the gases produced by the explosion, reduced to 0° centigrade, and 760mm (29·92in.) mercury; w = the weight of these gases; T = the absolute point of explosion. With mixtures of dynamite and nitrate of ammonia the decomposition occurs with excess of oxygen, and the gases are completely burnt with mixtures of nitric-cellulose and nitrate of ammonia. The mode of decomposition described in the note by Messrs. Mallard and Le Chatelier, added to the report is adopted. When the amount of oxygen is not sufficient to completely burn the combustible gases to carbonic-acid gas and water it is supposed that the oxygen after converting the whole of the carbon into carbon-monoxide, is divided between this gas and hydrogen.

Pressure developed by Explosives.—Formula for Calculation.—The exactness of the results given by calculations have been compared with the pressure-readings of Messrs. Sarran and Vieille. The pressure, P, developed in the volume, v with a charging-density, d, may be obtained by using the

formula of Clausius, $\left[\frac{P}{Po} + \frac{b}{T\left(\frac{V}{vo}+c\right)^2}\right]\left(\frac{vo}{00} - w\right) = \frac{T}{273}$ Where b, c, and w are coefficients peculiar to each gas. For high temperatures, and as long as the ratio $\frac{V}{vo}$ is not too small, the expression $\frac{c}{T\left(\frac{V}{vo}+b\right)}$ may be practically eliminated. The coefficient w, which may be called the Co volume, is nearly the same for all gases, as shown by the experiments of Mr. Amagat and the calculations of Mr. Sarran, and may be taken as equal to 0·001. Therefore $\frac{P}{Po}\left(\frac{V}{vo} - w\right) = \frac{T}{273}$. It is remarked that with a charging density d, then $V = \frac{w}{d}$; then this formula becomes

$$P = \frac{\frac{Po\ vo\ T}{w \times 273} d}{1 - \frac{u\ vo}{w} d} = \frac{fd}{1 - ad},$$

in which the coeffiicients f and a can be calculated, so that the theoretical figures may be compared with the experimental values.

Comparison of Theoretical with Experimental Pressures.—This comparison is made more simple if the last equation is put in form $\frac{p}{d} = a\,p + f$ The line which has $\frac{p}{d}$ for ordinates and P for abscissar should be a straight line, whose angular coefficient is a and the ordinate at the commencement f. Fig. 8 shows the positions of these straight given by this equation for nitrate of ammonia, dynamite, gun-cotton, a mixture of 60 per cent. of nitrate of ammonia with 40 per cent. of military cotton, the Favier explosive, endecanitric cellulose, and piric acid. Each of these lines has been traced with the calculated angular coefficient a. The dotted line in the figure is a theoretical line; the continuous line is drawn as near as possible to the experimental points, always with the same angular coefficient a.

The difference between the theoretical and the experimental lines for nitrate of ammonia, the Favier explosive, and the mixture of cotton and nitrate is less than the possible errors of observation and calculation. For dynamite the difference is only $\frac{1}{30}$. This concordance is closer than might have been expected. For gun-cotton the difference is as much as $\frac{1}{10}$, taking the latest pressure-readings quoted by Messrs. Berthelot and Vieille in their paper on fulminates of mercury, in which the results are not perfectly concordant. But in this case a substance is being considered whose chemical composition is uncertain, and, moreover, whose method of decomposition on explosion is doubtful. The calculations have been made by accepting the mode of decomposition not actually observed but assumed by Messrs. Sarran and Vieille as being the limit towards which the observed mode tends. The observations relative to piric acid are found to lie very nearly on a line, having the calculated inclination a. The difference between this line and the theoretical line is similar to that shown by gun-cotton. Piric acid is also a substance whose manner of decomposition is doubtful.

These examples amply prove that the method of calculation represents the facts almost exactly. The temperature and pressure developed by the detonation of any explosive of known composition can therefore be calculated with sufficient exactness, provided that the method of decomposition of this explosive when detonated is known. The calculated curves in 5, 6, and 7 therefore represent the phenomena somewhat correctly if the decomposition of the explosive occurs conformably with that assumed in the calculation.

Experimental Study of the Unconfined Detonation of Explosives.

Incomplete Detonation of Unconfined Explosives.—Experiment has shown that a mixture containing 67 per cent. of dynamite and 33 per cent. of sal ammoniac ignites firedamp; that a mixture of 40 per cent. of sal ammoniac ignites it seldom, and that a mixture of 50 per cent. of sal ammoniac does not ignite it. Now, if the curve which represents the temperatures of detonation of these mixtures be continued downwards the mixture of 33 per cent. of sal ammoniac will develop a temperature of 2,732° Fahr.; the 40-per-cent. mixture a temperature of 2,012° Fahr., and the 50-per-cent. mixture 743° Fahr., if the decomposition can be considered as complete in each case. Moreover, this assumption is certainly incorrect for the 50-per-cent. mixture, because at the temperature of 743° Fahr., sal ammoniac is not decomposed. Admitting the correctness of the hypothesis for other mixtures, it may be concluded that the temperature which the gases from the explosive should not surpass to ignite the firedamp is lower than 2,912° Fahr. This deduction is not correct, as will be shown hereafter. Lastly, it may be said that explosives, especially if they consist of dual mixtures, on the contrary, are not always decomposed in a complete manner when exploded unconfined.

Method of Experiment.—It is interesting to study this fact with precision. For this purpose the amount of heat developed by the detonation of an unconfined explosion was measured in some way, transforming the boiler into a calorimeter. A cartridge, exactly weighed, is fired in the boiler, closed, and filled with air. A water-gauge is used to measure at known intervals, starting from the moment of firing, the excess pressure, P′−P, of the air in the boiler above the initial pressure. A curve representing these observations is used to determine, by extension, the pressure exerted at the moment of detonation, which cannot be correctly observed on account of the shock imparted at the moment to the water in the water-gauge. Fig. 9 shows examples of the curves so drawn. The precise significance of the figured curves will be indicated further on.

N=the curve of the pressure for a cartridge containing 772gr. of dynamite unconfined; T=curve for a cartridge 772gr. dynamite contained in a tube of 0·98in. and 15·7in.

The measurements thus made are evidently inexact; however, they are sufficient for the desired object.

The volume of the boiler being 359·2 cubic feet, the volume of the gases resulting from the explosion of the cartridge—the weight of which is from 772 to 1543 gr.—is relatively insignificant.

The increase of the pressure of the air inside the boiler is therefore almost entirely due to the increase of temperature of this air raised from t to t^1 by the effect of heat, Q, developed by the detonation. If w be the weight of air in air-boiler, and c the specific heat, with constant volume, then $wc(t'-t) = Q$. Moreover, P and P′ being the pressure expressed in metres of air before the detonation, $T = t + 273$, the absolute temperature of the air before explosion; P its pressure in metres of water, then $\frac{P'-P}{P} = \frac{t'-t}{T}$ whence $P'-P = \frac{P}{T} \times \frac{Q}{wc}$ Again $P = 10{\cdot}33 \times \frac{H}{760}$ and $w = 10{\cdot}71 \times 1{\cdot}293 \times 1{\cdot}293 \times \frac{273}{T} \times \frac{H}{760}$ whence taking $c = 0{\cdot}168$, $P'-P = 0{\cdot}0171Q$, and $Q = 58{\cdot}4\ (P'-P)$, in which H is the height of the barometer in millemetres of mercury, 10·171 cubic metres is the capacity of the boiler, and 1·293 kilogrammes is the weight of one cubic metre of air at normal temperature and pressure.

Experimental Result for Dynamite.—Almost completely detonated unconfined.—Take the case of dynamite: A cartridge (curve N, fig. 9) of 772gr. of dynamite at 75 per cent. Vonges, detonating unconfined, develops a pressure P − P = 0·33; hence Q = 48·5, and for 100 grammes (1,543gr.) Q = 97.

The heat produced by the complete decomposition of dynamite may be reckoned at 1,110 calories, or 55·5 calories for 50 grammes, the temperature of the detonation of dynamite being equal to 5,252° Fahr., and the specific heat of the earth being 0·19. If this quantity of heat is immediately restored to the air in the boiler the quantity of heat, Q, would not be more for 10 grammes than 97·2 calories. The figures differ so little from that observed experimentally, that it may be assumed that the detonation of unconfined dynamite causes its complete decomposition.

Experimental Results of Various Explosives.—If similar calculations are made for other explosives, the results contained in the annexed table are obtained. This table shows that dynamite, as previously mentioned, detonates almost perfectly unconfined. Military gun-cotton, = (0·81 cubic inch) approaches very nearly to complete detonation under same conditions. In mining-cotton, even for certain mixtures, low in nitrogen of cotton of 0·68 and nitrate of ammonia, and for mixtures of dynamite and of sal-ammoniac, the amount of heat disengaged on detonation is greater than the theoretical quantity. With most of the explosives the amount of heat disengaged on detonation is less than the theoretical quantity. It should be concluded from this that these explosives only detonate imperfectly when unconfined. The imperfect detonation is doubtless due to the fact that the reactions assumed in theory, and which are actually produced in a closer vessel, as will be shown further on, have not time to be produced when the explosive is not confined in the infinitely short time during which the gases are kept in contact. Not only are the reactions very incomplete, but they become altogether different reactions from those expected. Mr. Berthelot has laid great stress on this possible variation in the nature of decompositions and reactions, more especially in the case of nitrate of ammonia. Moreover, one imagines that the phenomena would be still more marked with dual explosives, in which it is assumed—(1) That the detonation of one of the two substances entail that of the other; (2) That gases produced by the simultaneous detonation react on each other. These two hypotheses may both fail without the second.

Nature of Explosive.	Weight of Cartridge.	Weight of Fulminate in Detonator.	Pressure (P′ − P) observed in Inches of Water.	Q. Deducted for 1,543gr.	Q. Theoretical for 1,543gr.
	Gr.	Gr.	In.	Units of Heat.	Units of Heat.
Dynamite (75 per cent.)	771·6	23·15	32·68	385·1	385·9
Military cotton (=0·81 cubic inch) ...	771·6	23·15	28·35	349·4	402·9
Mining-cotton (=0·71 cubic inch)	771·6	23·15	58·27	682·8	408·9
Blasting-gelatine (Paulilles)	617·3	23·15	22·05	318·4	609·3
" "	771·6	23·15	27·17	319·9	
Bellite "	771·6	23·15	9·84	115·9	397·8 (1)
" (Paulilles)	771·6	23·15	11·02	129·8	
" "	771·6	46·30	13·39	158·0	
Pyroxyline-powder (Moulin Blanc) ...	771·6	23·15	17·52	202·5	325·5 (2)
" " ...	771·6	23·15	20·47	241·4	
" " ...	771·6	23·15	23·62	277·9	
" " ...	1,003·1	23·15	24·02	217·2	
Cotton, 58; nitrate of barium, 42 ...	771·6	23·15	27·56	325·5	321·6 (3)
" (=0·68), 20; ammonia nitrate, 80 ...	771·6	23·15	5·91	69·5	317·6
" " 25; " 75 ...	771·6	46·30	16·14	190·6	361·3
" " 35; " 65 ...	771·6	23·15	16·93	198·5	404·9
" " 60; " 40 ...	463·0	23·15	13·78	270·4	381·1
" " 80; " 20 ...	463·0	23·15	24·80	488·3	325·5
" " 90; " 10 ...	463·0	23·15	37·01	726·5	301·7
Dynamite, 20; ammonia-nitrate, 80 ...	771·6	23·15	8·86	104·8	198·5
" 67; " 33 ...	771·6	23·15	17·52	206·4	210·4 (4)
" 50; sal ammoniac 60 ...	771·6	23·15	16·54	195·3	39·7 (5)
" 60; " 40 ...	771·6	23·15	17·32	204·4	138·9
" 67; " 33 ...	771·6	23·15	20·87	246·1	194·5

(1) Calculated assuming 17·5 per cent. dinitro-benzol and 8·25 per cent. nitrate of ammonia.
(2) Decomposed to Ba CO_3.
(3) Decomposed to Ba CO_3.
(4) Quantity of heat calculated, assuming complete combustion of the nitro-glycerine and simple dehydration of the alum.
(5) These quantities of heat are calculated on the supposition of the decomposition of the sal ammoniac into $HCl_2 + N + 3H$, and the complete combustion of the nitro-glycerine.

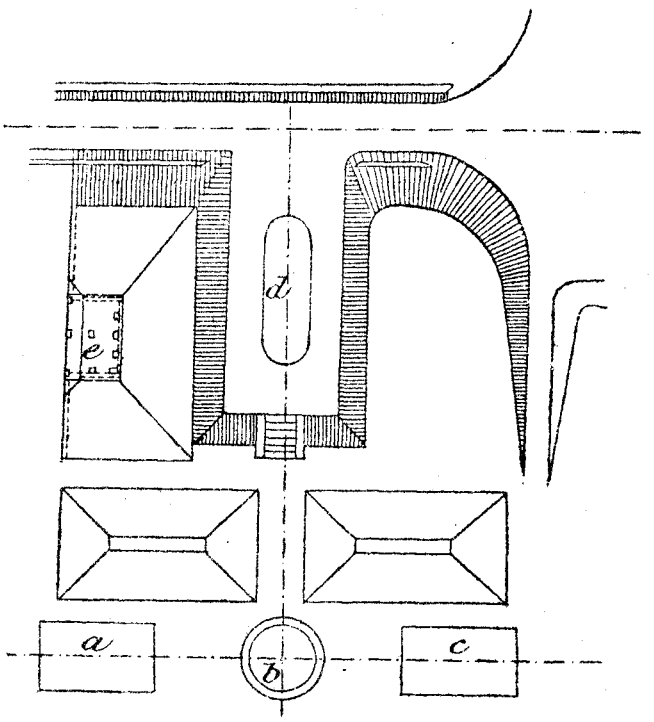


Figure 1.—Ground plan. Scale 1 : 400.

a—Apparatus for generating marsh gas.

b—Gasometer.

c—Belleville steam boiler.

d—Experimental boiler.

e—Shelter for the experimenters.

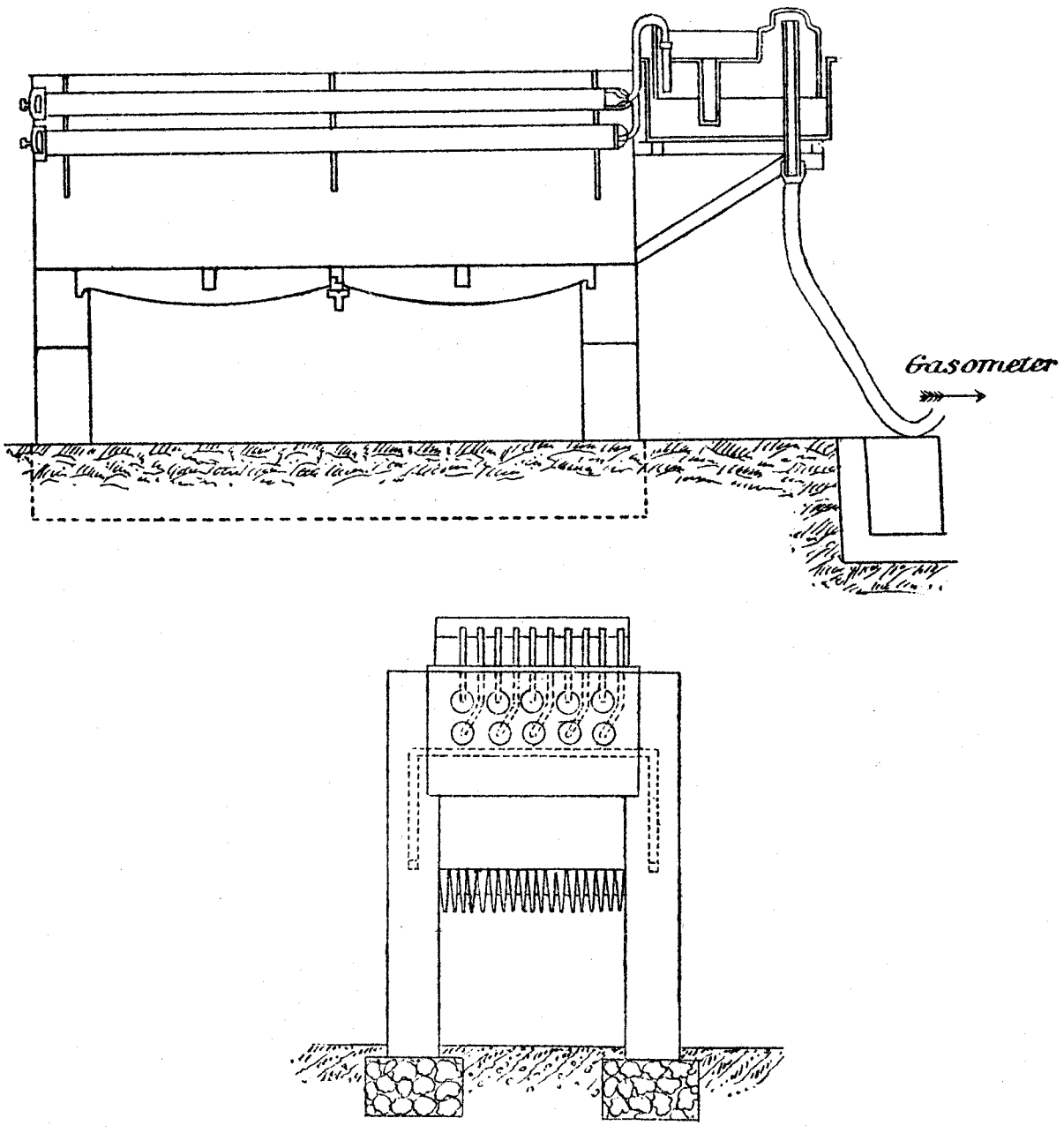


Figure 2.—Elevation and section of the apparatus used for generating marsh gas.

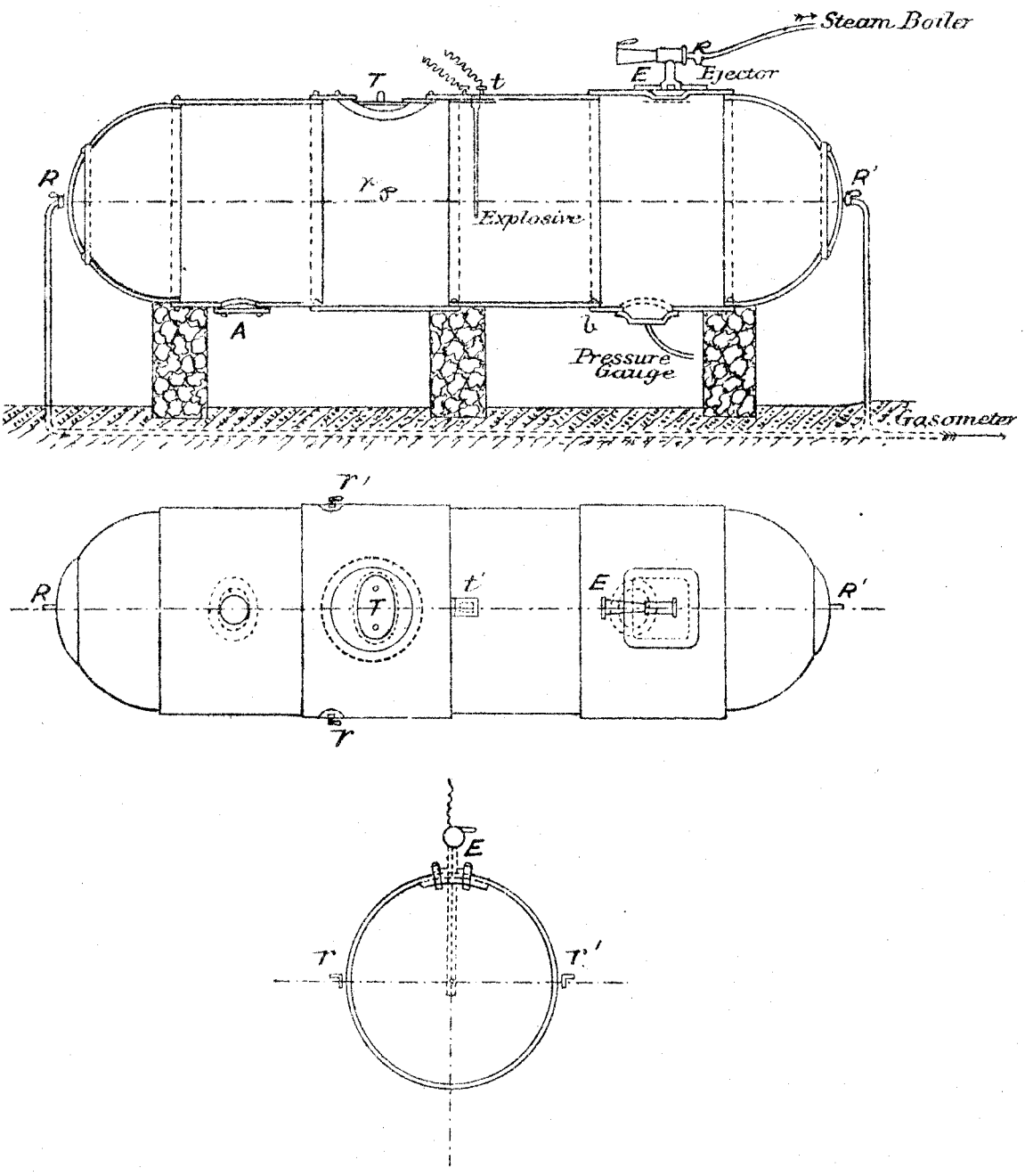
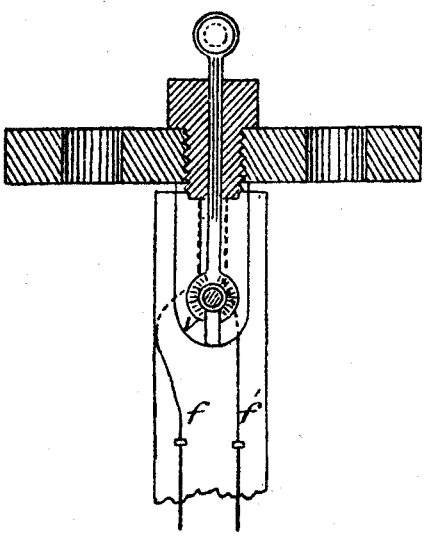


Figure 3.—Plan and sections of the boiler.



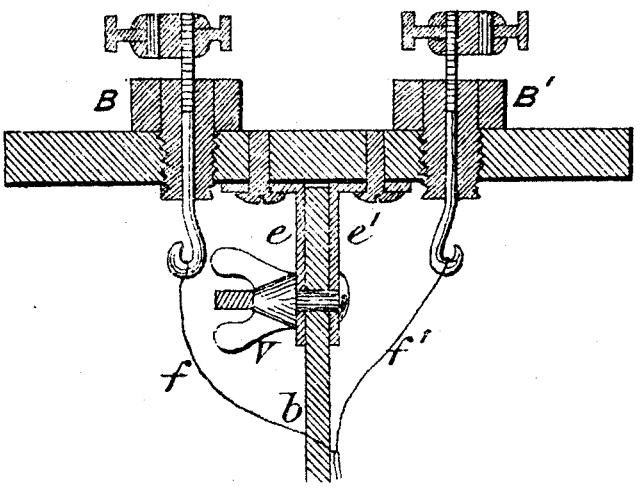
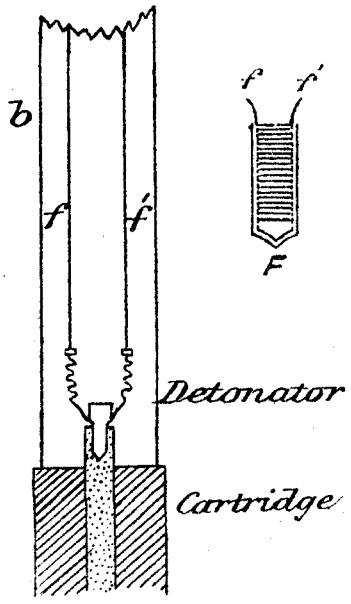


Figure 4.—Details of the attachment of the cartridge to the lid of the small hole of the boiler.



The first case is that of mixtures of dynamite and of sal ammoniac, which develops an amount of heat inferior to that caused by the detonation of dynamite alone. The speed of decomposition of the sal ammoniac is too slow to allow time for that decomposition to be effected, and in the effect of the detonation of the dynamite is doubtless to decompose a very small part of the mixed salt, and to project the rest, which acts as an inert body. It will be seen later on that the decomposition of sal ammoniac has not sufficient time allowed, even when the explosive is stemmed in a tin tube of 0·98 and 1·57in. in diameter.

Ammonia-alum with dynamite seems to act differently to sal ammoniac, as the quantity of heat observed is almost equal to that deduced from the combustion of the nitro-glycerine and the dehydration of the alum. It will be shown, however, later on that there is reason to doubt the correctness of this conclusion. Moreover, these facts may well explain the capricious phenomena that explosives, especially the dual explosives, produce detonating unconfined, as regards the ignition of firedamp. When an explosive is not completely detonated the reactions consequent on its detonation cannot be precisely defined, and may vary a great deal under the influence of secondary conditions.—notably, they will vary when the explosive is fired by a more or less powerful detonator, when the explosive, at the moment of detonation, is raised to a more or less high temperature, the elevation of temperature producing complete detonation, &c.

The anomalies met with in the Prussian experiments and in the French thus receive a satisfactory explanation. It is supposed, consequently, that the safety of an explosive detonating imperfectly when unconfined, cannot be completely assured if among all the possible methods of decomposition for this explosive even one is found liable to ignite firedamp. The object to be attained in the search for an explosive of perfect safety, if one exists, is therefore to find an explosive always detonating completely when unconfined without igniting firedamp, or to find an explosive which, when partially detonating, cannot take any mode of decomposition capable of igniting firedamp.

Peculiar Phenomena exhibited by Low-nitrated Cottons detonating unconfined.

A very curious fact—an apparent paradox—is that compressed mining-cotton always ignites fire-damp, and compressed military cotton, though more highly nitrated, and having a higher temperature of detonation, does not always ignite it. The experiments of detonation explain this anomaly. Indeed, the detonation of a cartridge of 772gr. of military cotton has twice successfully produced a proportionately enormous pressure, which the pressure-gauge could only imperfectly register, but which must have been higher than 58·27in. corresponding to 341·4 units of heat. or 3,097 units per pound. The decomposition of mining cotton—nononitric cotton—should disengage about 1,862 units of heat per pound—aqueous vapour—and the heat from complete combustion is, according to Mr. Berthelot, about 4,232 units. It is therefore perfectly evident that the gases yielded from the explosion of mining-cotton are, after the explosion, burnt almost completely when unconfined. Why does this phenomena not occur with military cotton, whose gases are also combustible? It is difficult to reply. All that can be said is that an equivalent of a nitro-cellulose of n degree necessarily yields—if it be a thing that the decomposition produces only CO_2, CO, H_2, O, H, and N—a volume of combustible gas (CO + 2 H) equal to $\left(48-\frac{5n}{2}\right)\times 22{\cdot}32$.

The volume of combustible gas increases therefore as n diminishes. It is equal to 25·5 + 22·32 litres = 568·7 for enneanitric cellulose, and to 20·5 × 22·32 litres = 457·2 for endecanitric cellulose. The gases from the detonation of the former are therefore a little more combustible than those from detonation of the latter. Nevertheless, it is singular that such a slight difference should have such a marked effect. However this may be, this well-ascertained phenomena immediately explains why cottons low in nitrogen such as that yield 0·68 cubic inches of NO_2 per grain, and whose temperature of detonation should be less than 3,632° Fahr., easily ignite fire-damp, when military cotton yielding 0·81 cubic inches of NO_2 per grain, whose temperature of detonation was about 4,748° Fahr., does not always ignite it. The mixtures of cotton-powder = 0·68, and nitrate of ammonia containing 80 per cent. and 90 per cent. of cotton, when exploded unconfined, disengage an amount of heat greater than the theoretical quantity. The oxygen from the nitrate does not burn off enough of the gases yielded by the decomposition of the cotton for them to remain capable of being completely burnt.

Explanation of the Phenomena presented by Mixtures of Gun-cotton and Nitrate of Barium.—Pyroxyline-powder.—The same phenomena allows the suggestion of an explanation of a fact which has astonished many. Pyroxyline-powder, which contains 60 per cent. of cotton (=0·71), 30 per cent. nitrate of barium, and 6 per cent. nitrate of potash, ignites the firedamp exceptionally, although cotton alone on the one side and mixtures with larger proportions of nitrate of barium on the other side invariably ignite. Gun-cotton containing 0·71 corresponds almost to octonitric cotton; its temperature of detonation is therefore about 3,632° Fahr. This will not ignite the firedamp if the gases from detonation do not happen to burn unconfined, for it will be demonstrated later that the apparent temperature of ignition of firedamp under the influence of explosives is about 3,992° Fahr. If the cotton is mixed with a sufficient quantity of nitrate of barium to burn the gases yielded by the explosion the temperature of the detonation is raised to 4,622° Fahr., if this dissociation of the carbonate after explosion is assumed. This temperature is sufficient to ignite firedamp; but if the proportion of nitrate is diminished the temperature is lowered, and the gases of the detonation are burnt sufficiently by the oxygen of the nitrate to be no longer inflammable, and to act like those of military cotton. Mixtures could therefore be found, like that constituting the pyroxyline-powder, whose temperature of detonation will be so low that they will not ignite firedamp—at least, regularly.

Force of Explosives.—Hitherto the force of explosives have not been considered. This element is not the important element in the matters that have been considered. What the worker of a fiery mine first seeks is an explosion whose temperature of ignition will be so low that the detonation

can never kindle the gas. As for the force of the explosion generally, it is more than sufficient; the worker will be satisfied if the new and safe explosion which will be given him does not cost more per unit of force than the explosive now in use. But it is easy to show that not only does the unit of force cost no more, but that the price may be materially diminished. Take, for example mixtures of dynamite and nitrate of ammonia. It is evident on examining the results of fig. 5 for the mixture of 80 per cent. of nitrate, the quantity, *f*, which measures the pressure obtained is 477 foot-pounds, the same quantity, *f*, for dynamite alone being 680 foot-pounds. The useful effect of the mixture, therefore, is about three-fourths that of dynamite; but if the selling-price of nitrate of ammonia is 4¾d. per pound and that of dynamite is 1s. 1d. per pound, the selling-price of the mixture will be 6·4d. per pound—*i.e.*, less than half that of dynamite.

It is true that the fixed duty of 8·6d. per pound slightly modifies the result and raises the price to 1s. 9½d. per pound for dynamite and to 1s. 3d. per pound for the mixture; but the ratio between these two costs is little less than three-fourths, and doubtless the proportion of nitrate might be increased. The unit of useful effect can therefore be obtained at less cost with this dual explosive than with dynamite. It is true that effects of a great intensity cannot be produced, but these effects are useless and can even become injurious in the working of coal in mines.

Possible Influence of Aqueous Vapour contained in Air on the Inflammability of Firedamp.—In conclusion, an observation which became evident as soon as the atmosphere became high, and which possibly may have a certain importance, should be mentioned. On two occasions—the 19th of May and 4th of the June—experiments were made in warm and sultry weather—on the 19th of May especially; the experiments were made in the morning, the weather was oppressive and seemed to presage the thunderstorm which burst in the evening. Explosives which had never ignited firedamp either before or since did ignite it on this day. Thus, pyroxyline-powder, which produced ignition twice consecutively, has never reproduced the same effect since. On the 4th of June the stormy character of the weather was less pronounced than on the 19th of May, but still it was very marked, and the mixture of 67 per cent. of dynamite and 33 per cent. of ammonia-alum, which had not ignited gas either on the 24th of April or the 1st of June, ignited firedamp on that day; pyroxyline-powder, however, remained unaffected.

It is not believed that the rise in temperature was the only cause of the increase in the inflammability of the firedamp, for on the 1st of June the temperature was higher than on the 19th of May or the 4th of June; but the weather was very dry, and the result in question was not observed. One is inclined to believe that the aqueous vapour, which is present in the air in considerable quantities in warm and stormy weather, would be the preponderant factor. It is possible that the retardation in the ignition of the firedamp may diminish with the increase of the aqueous vapour contained in the air; indeed, it is recognised, and an English chemist (Mr. Dixon) in particular has thrown a light on this phenomenon, that carbon monoxide does not combine with oxygen under the influence of the electric spark when those gases are perfectly dry. A similar fact for firedamp mixtures would be of great importance in mines where the air is most frequently saturated with moisture. Laboratory experiments which are in progress, but not yet completed, can alone make this question clear.

Summary.—In reviewing the first part of the researches, it may be said, without entering anew into details of the experiments, that they demonstrate that it is possible, by mixing certain substances with explosives whose detonation ignites firedamp, to lower the temperature of this detonation so that the resulting gases do not ignite—at least, under ordinary conditions—the firedamp mixtures amongst which they are detonated unconfined. Among the mixtures tested by the Commission, those which are most worthy of examination, are:

(1.) The pyroxyline-powder of Moulin-Blanc, which, however, under circumstances perhaps rather exceptional, has twice ignited firedamp, the total number of trials being nineteen.

(2.) The mixture of 20 per cent. of gun-cotton, low in nitrogen, with 80 per cent. of nitrate of ammonia, whose theoretical temperature of ignition is 3,488° Fahr., with $f = 542$ foot-pounds, which, in seven trials, did not once cause ignition.

(3.) The mixture of 20 per cent. of dynamite with 80 per cent. of nitrate of ammonia, whose theoretical temperature of ignition is 2·732° Fahr., with $f = 453$ foot-pounds, which has not produced ignition of gas, although only two trials were made.

(4.) Bellite, whose composition is not known with certainty, whose detonation is difficult when unconfined, is incomplete, even with 46gr. of fulminate, and which, under these conditions, has only been thrice tested, and did not ignite firedamp. With the composition as given by the inventor, the temperature of detonation would theoretically be 3,967° Fahr., with $f = 217$ foot. pounds.

(5.) Lastly, the Favier explosive, whose theoretical temperature of detonation is 3,848° Fahr., and which apparently does not explode at all when unconfined, even with heavy charges of fulminate, whose practicability of detonation under working conditions is not well known, whose intermediate detonator, such as has been proposed by the inventor, should be suppressed, and which reduced, it is true to a state of fine powder has once ignited a gaseous mixture.

The trials made with bellite and the Favier explosive cannot be considered as finished. It has been thought proper to mention these two explosives here, because the experiments already made do not appear unfavourable, and they seem to theoretically be among the class of substances incapable of igniting firedamp mixtures. The substance which appears the most suitable for diminishing the temperature of detonation of explosives such as dynamite and gun-cotton is nitrate of ammonia.

The other substances which may be mixed with the explosives, such as hydrated carbonate of soda, and hydrated sulphate of soda, ammonia-alum, and sal ammoniac, are only very partially decomposed by the detonation, and their action is, for that reason, most uncertain.

The trials made with mixtures of dynamite, or of cotton, with nitrate of ammonia should be continued, and it is permissible to hope that there may be formed with these substances mixtures in various proportions, possessing, along with great certainty of safety, all the degrees of explosive-power which may be regarded as necessary in practice.

Explosives fired in a Closed Vessel.

Much time has been devoted to the phenomena which explosives exhibit when detonated unconfined, although this method of detonation, for which they are not intended, ought to be prohibited in mines. But it is evidently under these conditions that explosives present the maximum danger, and under which it is easier to classify them as regards safety. Moreover, it may often accidentally happen, in consequence of the imprudence or inattention of the workmen, or from any other cause, that the explosive used in the working may be detonated before being stemmed in the shot-hole. The danger peculiar to unconfined detonation is not, therefore, purely imaginary. It is none the less true that in normal use explosives should be fired in a closed vessel, and the dangers which can arise under these conditions will now be examined.

Process of Experiment.—When an explosive detonates at the bottom of a shot-hole, if the shot is not blown out, fissures more or less great are produced in the broken mass, through which the resulting gases escape. The variety of means by which this effect can occur is infinite, but in almost all, if not in all, cases the gases of the explosion only come in contact with the external air after having exerted a certain mechanical work on the rock.

To realise something analagous in the boiler, but under conditions certainly more dangerous than those which can be met with in practice, the explosive enclosed in a metallic tube of lead, or of tin, closed at the bottom and open at the top, was suspended in the midst of firedamp. The explosive in the tube rested on a 2in. to 2½in. of clay or sand. It was covered with a stemming of clay or sand, or, even in certain cases, with coal-dust, generally 4in. to 4¾in. thick. The detonation, when it occurred, projected a piece of metallic dust, the part of the tube with which it was in contact. The lower and upper parts of the tube usually remained nearly intact at the bottom of the boiler. The nature of the metal—lead or tin—and especially its thickness, could be varied. These observations, however, have not been made, and would be of interest only with unconfined explosives igniting firedamp.

Experimental Results.—Under normal conditions of detonation, the explosive being well rammed against the sides of the tube, and between the two tampings, the facts summarised in the following table were observed.

Nature of Explosive.	Internal and External Diameter of Tube in Inches.	Material of which Tube was made.	Action of on the Gaseous Mixtures.
Dynamite No. 1	1·06, 1·57	Lead ...	N
"	1·18, 1·57	" ...	I
"	1·18, 1·38	" ...	I
"	0·98, 1·57	Tin ...	N
Mining gun-cotton	1·26, 1·65	Lead ...	N
"	1·18, 1·38	" ...	N
Blasting-gelatine	0·98, 1·57	Tin ...	I
Gelatine-dynamite	1·06, 1·57	Lead ...	N
Ammonia-dynamite	0·98, 1·57	Tin ...	N

N, Non-ignition of firedamp. I, Ignition of firedamp.

Doubtless all explosives cease to ignite gas when the thickness of the sides of the tube is sufficiently great, but the thickness adequate to produce this effect varies with the explosive. With gun-cotton a lead tube of 1·18in. and 1·38in. and only 0·10in. thick is sufficient to hinder ignition. With dynamite No. 1 or gelatine-dynamite a lead tube 1·06in and 1·57in., or a tin tube 0·98in. and and 1·57in., is required. With blasting-gelatine the tin tube of 0·98in. and 1·57in. is not sufficient to prevent the ignition of firedamp. This is in accordance with the considerable amount of heat developed by this explosive, which, amongst all those derived from dynamite, should be considered as the most dangerous.

Explanation of the Effect produced as regards the Ignition of Firedamp by the Tube which envelopes the Explosive.—Work developed by the bursting of the Sides of the Tube.—It may be asked what is the cause of the effect produced by the tube, which, on the whole, does not prevent the gases of the explosive from coming very rapidly, and at a very high temperature, in contact with the firedamp mixture. It appears that this cause should be solely attributed to the cooling which the gases undergo in consequence of the mechanical work which has to be expended to impart a certain kinetic energy to the sides of the shattered tube. The mechanical work is considerable, and may be estimated in a very simple manner by exploding the cartridge stemmed in its tube, in the midst of the closed boiler filled with air, and registering the pressure caused by the explosion as has been previously remarked. The observed initial pressure $P' - P$ gives, when multiplied by the coefficient 58·4, the amount of heat, Q′, imparted to the air in the boiler after the explosion. But this amount of heat is equal to that, Q, set free on explosion, diminished by the amount of heat, AU, equivalent to the kinetic energy, U, communicated to the walls of the tube.

If, first of all, by the unconfined detonation of the same, explosive Q has been measured, AU can be formed by subtraction. Under these conditions a cartridge of 772gr. of No. 1 dynamite has

given, when unconfined, a pressure P′—P=0·83 metre of water, corresponding to Q=48·5. In the tin tube of 0·98in. and 1·57in. P′—P=0·525 metre of water, Q′=Q—AU=30·6.

Therefore AU=17·9 and $\frac{AU}{Q}=\frac{17·9}{48·5}=0·37$.

The amount of heat transformed into work by the disruption of the sides of the tube and by the projection of the fragments varies, moreover, with the nature and size of the tube. Other things being equal, it diminishes with the thickness. Working always with dynamite it was found that with a lead tube of 1·26in. and 1·65in. the portion of the heat absorbed in mechanical work is about 0·44. With a lead tube of 1·18in. and 1·38in. this portion is 0·33. In this experiment, therefore, a little more than a third of the total heat is transformed into work. This is about half of the transformation that the expansion of the hot gases resulting from the explosion of dynamite thoroughly stemmed in a close place would theoretically be able to produce.

Apparent Temperature of Ignition of Mixiures of Firedamp and of Air under the Influence of Explosives.—The experiment-results obtained with dynamite, moreover, allow the calculations—at least, approximately—of the temperature which the gases produced by the detonation of the explosive should possess in order to ignite the mixture of firedamp and air. In fact, since the expansion of the gases produced by the detonation of the dynamite has lost, by communicating it as kinetic energy to the sides of the tube, 0·37 of its quantity of initial heat, it preserves no more than 0·63 of it. By a calculation similar to that used to ascertain the temperature of detonation it is found that the gases, at the moment when the tin tube of 0·98in. and 1·57in. has been shattered, come in contact with the inflammable mixture, they have a temperature of 3,902° Fahr. The mixture not igniting by this contact, it can be said that the apparent temperature of ignition is under the conditions of the experiment above this figure.

After the projection of the tube of 1·18in. and 1·38in. the temperature of the gases should be 4,136° Fahr., but they ignite the firedamp. The apparent temperature of ignition of the mixture of firedamp and air will therefore be, as far as can be judged from purely approximate calculations, between 3,902° and 4,136° Fahr., or about 3,992° Fahr. If the same calculation is made for blasting-gelatine fired in a tin tube of 0·98in. and 1·57in. it is found that the temperature of the gases after bursting the sides of the tube should be about 4,352° Fahr. These gases consequently ignite the firedamp mixture. It must be recollected that the high value of the apparent temperature of ignition of firedamp deduced from observations is due—at least, in great part—to the considerable delay of the ignition displayed by firedamp mixtures, and to the very rapid expansion of the gases resulting from the detonation of the explosives, which causes an extremely quick cooling. It consequently applies only to the particular experimental conditions under which it was obtained.

Explosion Amongst Water.—Trials were made as to what effect can be attributed to the Settle cartridges formed, as previously mentioned, of an impermeable paper tube, closed at the bottom, which can be filled with water, and in the midst of which the explosive is placed. This tube is intended to be placed in the shot-hole which it fills. It has a greater diameter than that of the explosive cartridge, which is isolated from the sides by metal projections. It was found on suspending the Settle cartridge in the midst of a firedamp mixture, and placing a cartridge of powder in the midst of water, that the detonation of the latter caused the ignition of the external gas. When powder was replaced by a cartridge of 772gr. of dynamite the same effect was produced one in two trials.

Variation of Work developed by the Gases of the Explosion with Density of Charging.—Tests were made as to what effect an empty space left between the explosive and the tube could produce, or, to put it more generally, the variation—the variation of what may be called the density of charging: that is to say, the proportion between the weight of the explosive and the volume which it occupies in the tube. With this object, 401gr. of dynamite were rammed into a tube of thin glass of an external diameter less than 1in., and in this little tube was placed inside a tin tube of 0·98in. and 1·57in., closed at one end, and above a plug of clay 2in. thick; the upper part of the tin tube was stemmed from 4in. to 4¾in. thick with clay. The method of charging is shown in fig. 10, where *t* is the internal glass tube filled with dynamite, TT the tin tube, A the clay plug, and B the stemming.

Under these conditions the two curves of the variation of pressure are shown by fig. 11. The initial pressure developed by 401gr. of dynamite, detonating unconfined—curve T—may be deduced. P′—P=0·420 metres of water, whence Q′=24·5. This result is in accordance with the experiment made with 772gr. As to the detonation in the internal tube inside the tin tube, the initial pressure is found to be P′—P=0·330 metres of water, whence Q″=19·3. By referring to fig. 11: T=curve of pressure for a cartridge of 401gr. of dynamite, detonating unconfined, and E=curve of pressure for a cartridge of 401gr. of dynamite, filling a thin glass tube stemmed inside a tin tube of 0·98in. and 1·57in. Under these new conditions of charging, the quantity of heat, AU, expended in mechanical work is equal to 5·2 calories, and the proportion of this quantity to the total amount of heat given off from the explosion is only $\frac{5·2}{24·5}=0·21$.

The mechanical efficiency, which with ordinary stemming was about $\frac{1}{3}$, is now no more than $\frac{1}{5}$. This difference can be accounted for by noting that, the density of charging being diminished, the gases of the explosion expand themselves in the tin tube before exerting pressure on its sides and maintaining their temperature, because there has been no work effected. The pressure exercised by the gases on the walls of the tube being less, these sides are projected with less force and acquire less kinetic energy, whence there results a less production of mechanical work. It follows naturally for that reason that the temperature of the gases, after the destruction of the tube, is less reduced, and, in consequence, higher than under the normal conditions of stemming.

Under the preceding conditions the internal glass tube inside the tin tube of 0·98in. and 1·57in., it was found that the temperature of the gases of the explosion, after the mechanical work effected, was equal to 4,568° Fahr. The gases of the explosion which do not ignite firedamp under normal conditions of stemming can therefore ignite it under these new conditions. This has been

verified with a lead tube of 1·06in. and 1·57in. A cartridge of 463gr. of dynamite, which stemmed in the metallic tube in the ordinary way does not ignite firedamp, ignites it every time when it is placed in an internal glass tube stemmed into a lead tube, as has been observed. For a similar reason, dynamite simply poured into a lead tube of 1·26in. and 1·65in. and then stemmed ignites firedamp, although under the same conditions dynamite rammed down does not ignite it.

From this the very important conclusion is deduced that it is always necessary to ram down and carefully stem, though not excessively, the explosives in the shot-hold; they work better, and are less dangerous. By varying the shape of the vessel which contains the explosive the density of charging is not effected, but the work imposed per unit of volume of the gases produced by the detonation is varied. For example, by flattening the tube the work is increased. Thus the observed fact that dynamite enclosed in a lead tube of circular section of 1·18in. and 1·57in. ignites the gas, although ignition is not produced when the same tube is flattened. It has been shown that the gases of the detonation issuing from the tin tube of 0·98in. and 1·57in., which contains the internal glass tube filled with dynamite, should possess a temperature of 4,568° Fahr. They no longer ignite the gas, but this effect must be on the point of production, for with a lead tube of 1·06in. and 1·57in. ignition took place. It appears, consequently, that the apparent temperature of ignition is a little above 4,568° Fahr. By another method it was found to vary between 3,902° and 4,136° Fahr. The discordance between these two estimates will not appear considerable if the numerous sources of error which might affect them are considered. The latter value is a special function of very numerous variables, such as the dimensions of the internal glass tube, the space left between the sides of the tube and those of the metallic tube, and possibly even the shape of this space. For these various reasons, the first estimate, which fixes the apparent temperature of ignition of firedamp mixtures at about 3,992° Fahr., appears to deserve most confidence.

Method of Detonation of Various Explosives in a Closed Vessel—Experimental Researches.—The results given by the detonation of explosives in tubes have been made use of, in order to gain some notion of the method of decomposition of these explosives in a closed vessel. Indeed, if an explosive properly stemmed in a tin tube of 0·98in. and 1·57in. is detonated in the boiler, and if the compression produced is measured, this compression will correspond to about 0·63 of the heat developed by the explosion, which can thus be, at least, approximately measured. The results in the following table have been so obtained.

Explosive.	Weights of		Tubes.		$P'-P$, Pressure in Inches of Water.	(*a.*) Q.	(*b.*) Q.
	Cartridges.	Detonators.	Metal.	Diameters.			
	Gr.	Gr.		In.			
Dynamite, 75 per cent. ...	771·6	23·5	Tin	0·98, 1·57	20·67	...	385·9
	771·6	23·5	Lead	1·26, 1·65	18·11	...	
	771·6	23·5	„	1·18, 1·38	22·24	...	
Blasting-gelatine, Paulilles ...	771·6	23·5	Tin	0·98, 1·57	24·41	456·5	609·3
Bellite	771·6	23·5	Lead	1·18, 1·38	18·50	393·0	397·8
	771·6	23·5	Tin	0·98, 1·57	20·08	377·1	
Pyroxyline-powder, Moulin-Blanc	771·6	23·5	„	0·98, 1·57	18·50	345·4	325·5 to 397·0
20 per cent. dynamite, 80 per cent. ammonia-nitrate	771·6	23·5	„	0·98, 1·58	11·02	205·6	198·5
67 per cent. dynamite, 33 per cent. ammonia-alum	771·6	23·5	„	0·98, 1·57	14·96	281·9	131·0
60 per cent. dynamite, 40 per cent. sal ammoniac	771·6	23·5	„	0·98, 1·57	14·57	271·9	138·9
67 per cent. dynamite, 33 per cent. sal ammoniac	771·6	23·5	„	0·98, 1·57	16·54	309·7	194·5
60 per cent. cotton (0·68), 40 per cent. ammonia-nitrate	463·0	23·5	„	0·98, 1·57	11·81	369·2	381·1
80 per cent. cotton (0·68), 20 per cent. ammonia-nitrate	463·0	23·5	„	0·98, 1·57	11·02	345·4	325·5
90 per cent. cotton (0·68), 10 per cent. ammonia-nitrate	463·0	23·5	„	0·98, 1·57	9·05	281·9	301·7

(*a.*) Q deduced, reckoned the fraction lost in mechanical work per 1,543·2gr.
(*b.*) Q theoretical, per 1,543gr.

This table shows that blasting-gelatine is not perfectly detonated even when steamed in a tin tube of 0·98in. and 1·57in. The complete detonation of this substance—that is to say, the complete combustion of the gases of the cotton by the oxygen of the dynamite—require stronger vessels, capable of keeping the gases a little longer time in mutual contact. It is probable that gelatine in soft rocks of little resistance only develops a part of its energy. Bellite and pyroxyline-powder detonate completely in a tin tube of 0·98in. and 1·57in.; bellite detonates perfectly even in a lead tube of 1·18in. and 1·38in. Mixtures of dynamite and sal ammoniac detonate in the tin tube of 0·98in. and 1·57in. nearly the same as they detonate when unconfined. The decomposition of the sal ammoniac is not effected, or very partially so, even under comparatively favourable conditions. The speed of the decomposition of the sal ammoniac is too little. Mixtures of dynamite

and ammonia-alum are similar. Mixtures of 20 per cent. dynamite and 80 per cent. of nitrate of ammonia detonate perfectly in a tin tube of 0·98in. and 1·57in. Mixtures of cotton (=0·68) and nitrate of ammonia are similar to dynamite and nitrate of ammonia.

Effect produced by Explosive stemmed in a Shot-hole and ignited with Fuse.—The explosive detonate by the action of the detonators; they may continue to burn—at least, generally—when they are ignited by flame. When this second method of decomposition happens it may be the cause of special danger in fiery mines. If it occurs unconfined the firedamp would be ignited; but it is rather difficult to understand how a similar accident could be produced in practice. When an explosive is placed at the bottom of a shot-hole it may be ignited by the action of the Bickford fuse, if that fuse comes in contact with the explosive before it fires the detonator. These conditions have been reproduced with a dynamite cartridge well stemmed in a tin tube of 0·98in. and 1·57in.; into this cartridge and right to the bottom is inserted the Bickford fuse, carrying at its end a detonator of 23gr. of fulminate. The firedamp is ignited. This effect does not occur if the detonator is not used. Doubtless the detonator has the effect of projecting outside the already-swollen tube the flame, which fills it entirely.

Summary.—General Rule for use of Explosives in a Fiery Mine.—This part of the studies of the Commission may be summarised by saying that explosives which do work are less dangerous than those which do no work, and they are so much the less dangerous as they work better. All the conditions which tend to diminish the useful effect of the explosive, such as the absence of stemming, or imperfect stemming, the space left between the stemming and stemming of the explosive, and contact between the Beckford fuse and the explosive, ought to be avoided with the utmost care.

Method of firing Shots in Mines.

Detonators plugged and unplugged.—Difference of their Effects on the Ignition of Firedamp.—The detonation of explosives necessitates the use of a detonator, which is usually formed of a small cylindrical tube of copper or brass, generally containing fulminate of mercury, more or less mixed with other substances. It was found, as already mentioned, that so-called plugged detonators, with 23gr. and even 31gr. of fulminate, do not ignite firedamp. Plugged detonators, with 23gr. of fulminate, do not even ignite mixtures of air and coal gas, but they do ignite mixtures of air and hydrogen. Plugged detonators containing 77gr. of fulminate ignite firedamp. With unplugged, the charge of 23gr. of fulminate will produce ignition of mixtures of air and firedamp.

The principal difference between the unplugged and plugged detonators is that in the latter the fulminate placed at the bottom of the cylinder is almost covered with a small metallic bonnet with an orifice at the top which exposes the fulminate and allows firing to be effected. Moreover, the thickness of the metal is greater, and the fulminate, being more compressed, has a greater density. According to the principles whose correctness has been demonstrated above, the plugged detonators have a greater metallic mass and a greater density of charging; the gases resulting from the detonation of the fulminate expend more energy in the shape of mechanical work before coming in contact with the external gases; they ought, therefore, as has been observed, with equal charges, to ignite gaseous mixtures with greater difficulty. Moreover, if the unplugged detonator, with 23gr. of fulminate, be lapped externally with contiguous spirals of fine copper wire, the mechanical work that the gases of the detonation must produce is increased, and it has been proved that under these conditions the detonation of the unplugged detonator no longer ignites the firedamp mixture. The experiment is a new demonstration of the principles above stated.

Various Detonators.—It has been found that the detonators from Paulilles, those fired by electricity, as well as those fired by Bickford fuse, do not ignite firedamp. The same may be said of the Abegg detonators, fired by electricity. The Ruggieri and Scola detonator does ignite the firedamp mixtures.

Dangers which characterize the Bickford Fuse.—The detonation of the detonator can be caused by the Beckford fuse, and it has been ascertained that the combustion of this fuse can occur in the midst of firedamp without igniting it, provided, be it well understood, that the end which is lighted be outside the inflammable mixture. The danger attendant on the use of this fuse are, however, very evident. It is safe only when of good quality, and its safety depends on the perfection of its make, which it is impossible to control. Another very serious cause of danger arises from the possibility of a mistake by the workman pushing the fuse too deeply into the cartridge, and thus putting it in direct contact with the explosive. Under these conditions the explosive, burning before detonation, may project gases produced by the combustion outside the hole and produce an ignition of firedamp. The source of danger is so much the more grave as the safety of the mine depends upon an operation performed by a workman, and impossible to control, without speaking of the inconvenience which results from lighting the end of the fuse, which can only be done at a point in the drift where the absence of firedamp is well ascertained. It therefore seems desirable that the use of the Bickford fuse should be suppressed in fiery mines.

Use of Electricity.—Electricity, either tensional or its currents, may then be employed. Without entering into a profound discussion of the various means of electric ignition, the inconvenience of tensional electricity which may give off on its circuit sparks capable of igniting firedamp and which can only be carried to a short distance when the wires are not perfectly insulated, should be considered.

Detonating-strings.—It was proposed to replace the electric wire by a detonating-string of nitro-cellulose, which would be made to explode by means of a plugged detonator placed outside the hole, and ignited either by electricity or a friction-match, or even by a Bickford fuse, which would be much less dangerous, because then it could never come in contact with the explosive. At the same time the inconvenience of stemming upon a detonator which explodes by percussion would be avoided, and that of having after a miss-fire a cartridge with its detonator at the bottom of the hole. Unfortunately, it is certain that these strings, when of small diameter, do not cause with certainty

the detonation of the less sensitive explosives, such as mixtures of cellulose—low in NO_2—and nitrate of ammonia, pyroxyline-powder, &c. On the other hand, by increasing the diameter of the string, there is, perhaps, the risk of too much enlarging the pipe which is formed by the string in the stemming, and which it widens on detonation. The gases resulting from the detonation of the explosive might escape by this orifice, and cause the ignition of the firedamp mixture outside. This idea has therefore been abandoned—at least, until more complete experiments may have been made on this subject.

Friction-detonators. — Lieut.-Colonel Lauer, of the Austrian Engineers, has recently proposed to fire explosives stemmed at the bottom of a shot-hole by a friction-detonator. This detonator, sunk into the cartridge, is set in action by means of a metallic wire enclosed in a small tube embedded in the midst of the stemming. This system is already exclusively employed in a number of Austrian mines, where it would appear to be giving satisfaction. As soon as a number of Colonel Lauer's detonators are available, experiments will be made upon them, and a report made to the Commission.

Conclusions.

The conclusions warranted by the researches of the Commission are as follows:—

(1.) Blasting-powder, even fired in the midst of water, can ignite mixtures of air and firedamp.

(2.) Most of the known explosives, detonating unconfined, are liable to ignite firedamp mixtures Dynamite; military or mining gun-cotton, particularly the latter; blasting-gelatine; gelatine-dynamite; and ammonia-dynamite, of Paulilles, are in this category.

(3.) It is possible, however, to find explosives which detonate at a temeperature low enough not to provoke—at least, in the great majority of instances—detonating unconfined, the ignition of firedamp mixtures. Among the explosives tested by the Commission which realise these conditions more or less perfectly may be mentioned: (*a.*) Intimate mixtures of 50 per cent. of dynamite with 50 per cent. of crystallized carbonate of soda, sulphate of soda with ten equivalents of water, ammonia-alum, or sal ammonia. (*b.*) The pyroxyline-powder from Moulin Blanc. (*c.*) The mixture of 20 per cent. dynamite (75 per cent.) with 80 per cent. of nitrate of ammonia. (*d.*) The mixture of 20 per cent. of gun-cotton (=0·68 cubic inches of NO_2 per grain) and 80 per cent. nitrate of ammonia. (*e.*) Bellite, the composition of which is not known with perfect certainty, and which, as yet, has undergone an insufficient number of tests. (*f.*) Favier explosive, made of about 90 per cent. of nitrate of ammonia and 10 per cent. of mononitro-naphthalene, which appears to equal bellite as regards safety, but whose intermediate detonator, such as has been submitted to the Explosive Substances Commission, should be suppressed, and upon which further experiments should be made.

(4.) By reason of the complexity and the lack of certainty of the phenomena which may attend the detonation of unconfined explosives, it will always be prudent to avoid firing shots—even charged with one of the explosives considered the safest—at a point where the mixture of firedamp and air may be inflammable. The choice of these explosives should be considered as considerably lessening the danger of explosion it should not be considered as absolutey suppressing it.

(5.) Explosives must always be used under the conditions which allow them to develop the maximum of useful work; both economy and safety agree in recommedation of this rule; consequently, the explosive must be carefully stemmed at the bottom of the shot-hole, which must be deep enough. The leaving of an empty space either in front of or behind the cartridge or on one side, must be avoided. Contact must be avoided between the explosive and the Bickford fuse, if the detonator is fired by that means, the danger of which is besides serious enough to make it desirable to replace it by a safer means of firing.

The Commission had not to consider matters of management. It may be seen, however, that the preceding conclusions tend to the abandonment of blasting-powder in fiery mines, and even to throw suspicion on ordinary dynamite, blasting-gelatine, and ammonia-dynamite, as now manufactured, blasting-gelatine appearing to be the most dangerous of all these substances. The explosives which can best be recommended as regards safety are dual mixtures of an explosive such as dynamite, gun-cotton, or dinitro-benzol with nitrate of ammonia. The mode of manufacturing these mixtures, the manner in which they can be protected from atmospheric moisture, and the greater or less duration of their resistance to this influence, ought to be tested. It will also be necessary to test the useful effect of these mixtures in practical experiments—the manner in which they act in breaking down stone, and more particularly coal. The study of these questions will require experiments, most of which can only be made at the mine and by the managers.

The Commission express the desire that the Government powder-mills should manufacture a sufficient number of cartridges of these various explosive mixtures, to be distributed to managers, who would be willing to try them in a practical way. The trials finished, there would remain the question of the manufacture on a large scale. For some of the mixtures which appear to possess good enough guarantees of safety, such as gun-cotton and nitrate of ammonia, the Government powder-mills have the monopoly of manufacture. The mining industry, moreover, would only gain from the establishment of an active competition in the manufacture of the explosives—at present, almost an actual monopoly. The advantage will be still greater when it is a question of mixtures the comparative safety of which depends upon the exact proportion of the mixed substances, which is difficult to regulate. The Commission therefore express the view that the Government powder-mills should take measures to supply to the trade those mixtures, based on gun-cotton, recognised as advantageous as regards the safety of fiery mines.

A second report was made by the Commissioners, and the conclusions arrived at were as follows:—

"The new facts which are herein explained confirm the conclusions of the first report, and allow their definition and completion. The normal temperature of ignition of firedamp mixtures is known within 90° Fahr., but it is necessary that the effect of that temperature should be prolonged for some time, in order that ignition may be produced. The new experiments, in harmony with the present ones, show that, owing to the retardation of ignition characteristic of firedamp mixtures, owing also to the almost instantaneous mixture of the gases resulting from detonation with the surrounding air, and to the quick cooling consequent thereupon, explosives whose temperature of detonation is less than 3,992° Fahr. are incapable of igniting firedamp mixtures when detonated under the normal conditions of their use—that is, in holes properly stemmed. The stemming made with care should always be vigorously enforced as one of the most essential conditions of safe blasting.

"The guarantees of safety diminish, all things being constant, in proportion as the stemming becomes more imperfect. At the limit, and where the cartridge detonates unconfined without envelope, the conditions of safety cannot be formulated with any exactitude. Safety would doubtless be still insured completely if the explosive consisted of one substance only, whose detonation would develop a temperature sufficiently low and only yield incombustible products. Unfortunately, nitrate of ammonia is as yet the only substance known which realises these conditions, and its facility of detonation appears insufficient. Resort must therefore be made to mixtures at least dual, and which are never absolutely intimate, whatever may be the precautions taken. Now, if one of the mixed substances are combustible, or, when detonated alone, is susceptible of developing a temperature higher than 3,992° Fahr., or of giving off combustible gaseous products, it may always be feared that a particle of that substance placed on the surface of the cartridge may happen at the time of detonation to ignite the exterior gas. Such is doubtless the cause of the irregularities which occur in the ignition of firedamp by the unconfined detonation of the same mixtures. These ignitions, in a way accidental, are the more to be dreaded as the substance which may produce them is used in higher proportions as the mixture is less intimate, and as the surface or—which is nearly the same thing—as the weight of the cartridge increases."

The only means by which this happily secondary cause of danger may be avoided is to insure the utmost perfection in mixing, and to diminish as far as possible, without too greatly reducing the facility of detonation and the power of the explosive, the proportion of the substance capable of igniting the gas. Besides, it is important to remark that safety in the use of explosives in the midst of a firedamp atmosphere depends, as has been previously mentioned, upon the almost instantaneous mixture of the gases of the detonation with a sufficient volume of surrounding air. It would be dangerous, therefore, to fire shots in a too limited space, and with a weight of explosive too great for the volume of the surrounding air as compared with that of the gases of detonation. These various considerations justify the recommendation given by the Commission in the first report. In the present state of knowledge the dual mixtures which may be used as explosives suitable for insuring the safety of fiery mines necessarily contain nitrate of ammonia as one of their elements, and can be divided into two categories.

I. Nitrate of ammonia may be mixed with any substance detonating at a high temperature but yielding incombustible products, nitro-glycerine for example. Safety appears to be sufficiently assured when, the nitro-glycerine being used in the state of dynamite, the proportion does not exceed 30 per cent. Two cartridges of 3,086·5gr., containing 30 per cent. of dynamite. with 70 per cent. of nitrate, were detonated unconfined in a firedamp mixture without igniting it. Cartridges of 771·6gr. and 3,086·5gr. of a mixture containing 20 parts of dynamite and 80 parts of nitrate did not produce ignition of the firedamp. A cartridge of 771·6gr of the same explosive can even be detonated unconfined in a mixture of air and coal-gas without igniting it.

II. Nitrate of ammonia can be mixed with a substance combustible in itself, or yielding combustible products on detonation. Mixtures of this nature should satisfy the following conditions:—

Develop a temperature of detonation as low as possible, and in all cases less than 3,992° Fahr. Not yield combustible gases after complete detonation. Possess sufficient explosive-force so as to avoid the use of great weights of explosives. Possess a great facility of detonation—at least, in a stemmed hole—so that the proportion of missed shots may be unimportant. Capable of preservation for a long time against all changes. Lastly, be capable of sale to users at not too high a price.

Among the numerous mixtures based on nitrate of ammonia fulfilling more or less all these conditions, and which the Commission has tested, those which ought apparently to be mentioned in preference are as follows:—

(1.) Mixtures containing at the most 75 parts of nitrate of cuproammonia. This maximum proportion, detonating unconfined, has neither ignited firedamp with cartridges of 3,086·5gr.—three exceptions—nor coal-gas with cartridges of 1,543·2gr.—two exceptions.

(2.) The mixture containing 6 parts of naphthalene, which detonated unconfined, did not ignite firedamp with cartridges of 3,086·5gr.—two exceptions—or coal-gas with cartridges of 771·6gr.—two exceptions—and only ignited coal-gas with cartridges of 3,086·5gr.

(3.) The mixture containing 15 parts of octonitric cotton, which, detonating unconfined, did not ignite firedamp with cartridges of 3,086·5gr.—two exceptions.

(4.) The mixture containing 10 parts of mononitric naphthalene, which, detonating unconfined, in five experiments made with cartridges of 925·9gr., 1543·2gr., and 3,086·5gr., only one ignited the firedamp with a cartridge of 925·9gr.

(5.) The mixture containing 10 parts of dinitro-benzol, which, detonating unconfined, did not ignite firedamp with cartridges of 1,543·2gr—four exceptions—and with cartridges of 3086·5gr. only ignited once in three experiments.

Practical trials made in the mine, and which are now being made, can alone enable mine-owners to choose between the various explosives.

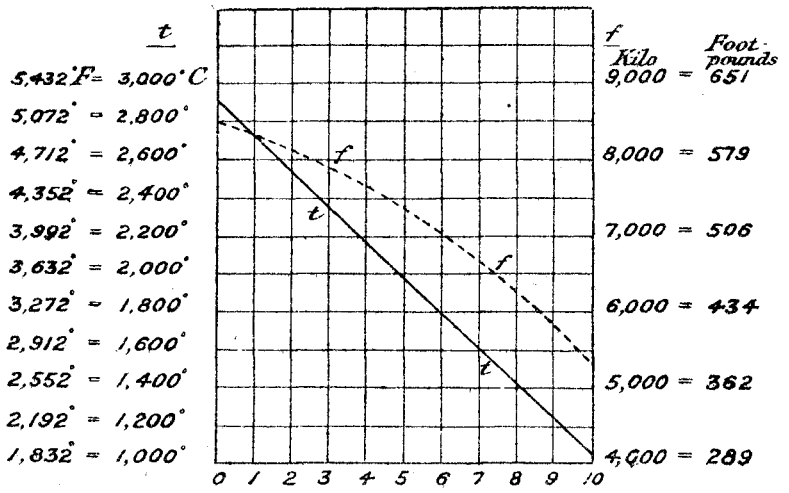
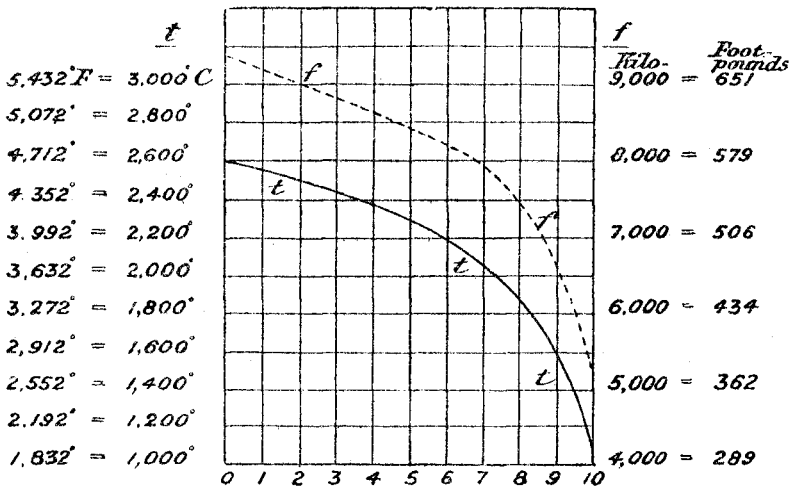
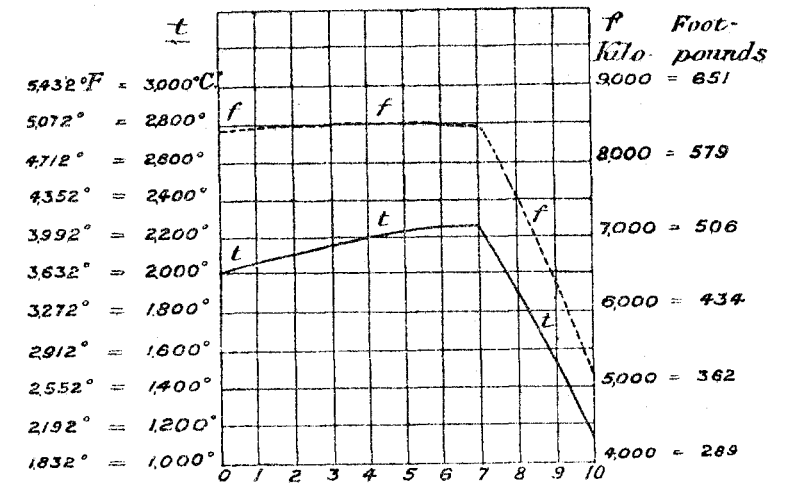


Figure 5.—Dynamite and nitrate of ammonia.



Parts of nitrate of ammonia in ten parts of mixture.

Figure 6.—Endecanitric cellulose and nitrate of ammonia.



Parts of nitrate of ammonia in ten parts of mixture.

Figure 7.—Octonitric cellulose and nitrate of ammonia.

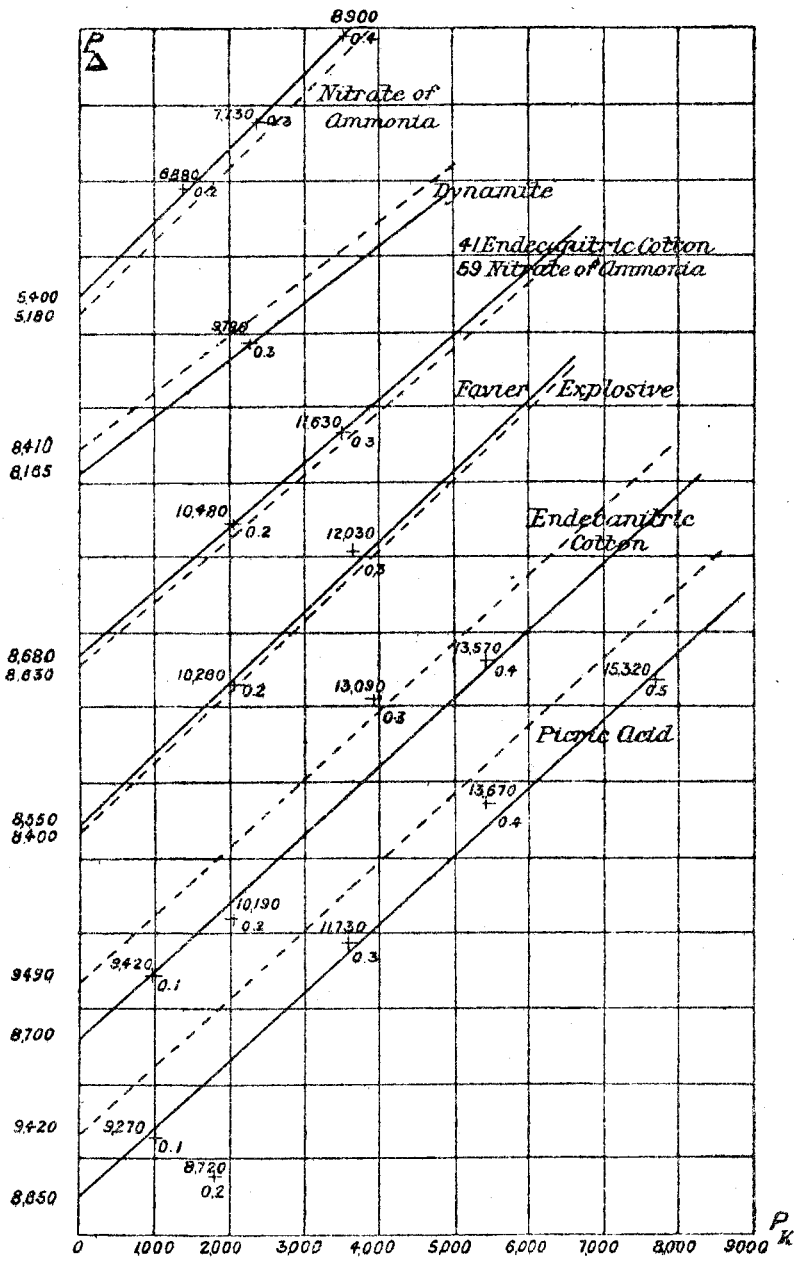


Figure 8.

Lines representing the formula $\frac{P}{\Delta} = a\,P + f$, $a = \frac{u\,v_0}{\omega}$.

Theoretical lines shewn - - - - - - Experimental lines shewn ——

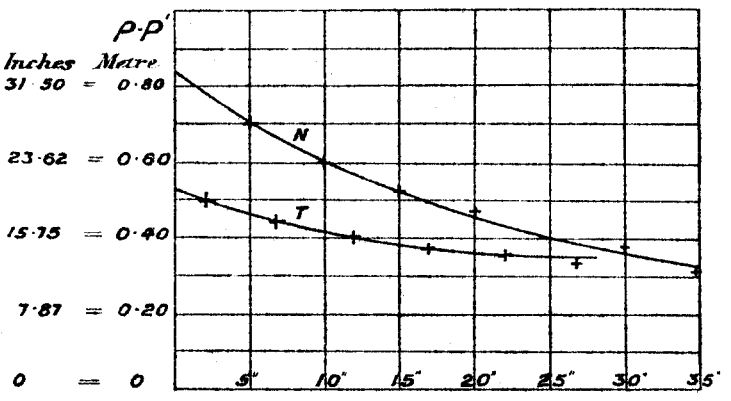


Figure 9.

N, Curve of the pressures for a cartridge containing 772 grains of dynamite, unconfined.

T, Curve for a cartridge of 772 grains of dynamite contained in the tube of 0·98 inch, and 1·57 inches.

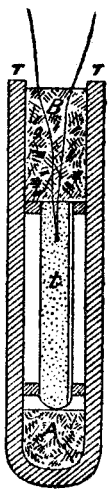


Figure 10.

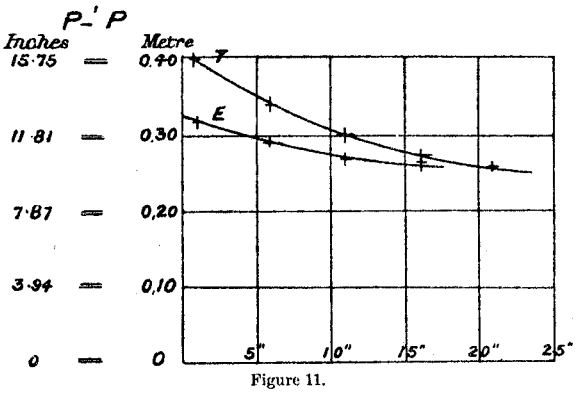


Figure 11.

T, Curve of pressures for a cartridge of 401 grains of dynamite detonating unconfined.
E, Curve of pressures for a cartridge of 401 grains of dynamite filling a thin glass tube, stemmed inside a tin tube of 0·98 inch by 1·57 inches.

The following table shows the experiments made at the Sivran-Levry Powder-mill, with combustible gases containing 0·103 of firedamp and 0·897 of air by volume :—

Number of Experiments made.	Nature of Explosive.	Weight of Explosive.	Weight of Fulminate.	Result of Experiment.
	Dynamite and Nitrate of Ammonia.	Gr.	Gr.	
1	10 dynamite, 90 nitrate	771·6	23·15	N
3	20 " 80 "	771·6	23·15	N
4	20 " 80 "	1,543·2	23·15	N
5	20 " 80 "	3,086·5	23·15	N
1	30 " 70 "	771·6	23·15	N
3	30 " 70 "	1,543·2	23·15	N
4	30 " 70 "	3,086·5	23·15	N
3	40 " 60 "	771·6	23·15	N
1	40 " 60 "	1,543·2	23·15	I
2	50 " 50 "	771·6	23·15	N
2	50 " 50 "	771·6	23·15	I
2	50 " 50 "	1,543·2	23·15	I
1	60 " 40 "	771·6	23·15	N
1	80 " 20 "	1,543·2	23·15	I
9	100 " 0 "	771·6	23·15	I
	Octonitric Cotton and Nitrate of Ammonia.			
5	15 cotton, 85 nitrate	3,086·5	23·15	N
1	20 " 80 "	771·6	23·15	N
15	20 " 80 "	1,543·2	23·15	N
2	20 " 80 "	1,543·2	23·15	I
5	20 " 80 "	3,086·5	23·15	I
2	30 " 70 "	463·0	23·15	N
2	30 " 70 "	1,543·2	23·15	N
2	40 " 60 "	1,543·2	23·15	I
2	60 " 40 "	463·0	23·15	I
3	100 " 0 "	463·0	23·15	N
2	100 " 0 "	463·0	23·15	I
	Mononitric Cotton, Mining-cotton, and Nitrate of Ammonia.			
3	15 cotton, 85 nitrate	1,543·2	23·15	N
1	15 " 85 "	1,543·2	23·15	N
	Mononitro-naphthalene and Nitrate of Ammonia.			
1	9 mononitro naphthalene and nitrate of ammonia	463·0	23·15	N
5	9 " " ...	771·6	23·15	N
4	9 " " ...	1,543·2	23·15	N
	Naphthalene and Nitrate of Ammonia.			
1	9 naphthalene, 94 nitrate	1,543·2	23·15	N
1	9 " 94 "	3,086·5	23·15	N
1	9 " 94 "	3,086·5	69·45	N
1	9 " 94 "	1,821·0	23·15	N
1	9 " 94 "	1,157·4	23·15	N
	Dinitro-benzol and Nitrate of Ammonia.			
11	10 Dinitro, 90 nitrate	1,543·2	23·15	N
4	10 " 90 "	3,086·5	23·15	N
1	10 " 90 "	3,086·5	23·15	I
1	15 " 85 " (bellite)	617·3	23·15	N
4	15 " 85 "	771·6	23·15	N
2	15 " 85 "	1,543·2	23·15	N
1	15 " 85 "	1,543·2	23·15	I
2	20 " 80 "	771·6	23·15	N
1	20 " 80 "	1,543·2	23·15	N
	Picrate of Ammonia and Nitrate of Ammonia.			
2	10 picrate, 90 nitrate	3,086·5	23·15	N
1	20 " 80 "	3,086·5	23·15	N
	Resin and Nitrate of Ammonia.			
5	10 resin, 90 nitrate	3,086·5	23·15	N

Number of Experiments made.	Nature of Explosive.	Weight of Explosive.	Weight of Fulminate.	Result of Experiment.
	Coal-tar and Nitrate of Ammonia.			
4	12 tar, 88 nitrate	3,086·5	23·15	N
2	12 „ 88 „	3,086·5	23·15	I
2	8 „ 92 „	3,086·5	23·15	N
1	8 „ 92 „	3,086·5	23·15	I
	Heavy Coal-oil and Nitrate of Ammonia.			
4	10 oil, 90 nitrate	3,086·5	23·15	N
	Nitrate of Cupro-ammonia and Nitrate of Ammonia.			
4	10 cupro, 90 nitrate	1,543·2	23·15	N
2	20 „ 80 „	3,086·5	23·15	N
4	33 „ 67 „	3,086·5	23·15	N
5	75 „ 25 „	1,543·2	23·15	N
13	75 „ 25 „	3,086·5	23·15	N
8	100 „ 0 „	1,543·2	23·15	N
	Combustible Gases containing 0·103 of Coal-gas and 0·897 of Air by Volume, Dynamite and Nitrate of Ammonia.			
2	20 dynamite, 80 nitrate	771·6	23·15	N
2	60 „ 40 „	771·6	23·15	N
3	70 „ 30 „	771·6	23·15	N
3	80 „ 20 „	771·6	23·15	N
1	90 „ 10 „	771·6	23·15	N
2	100 „ 0 „	771·6	23·15	I
	Various Explosives.			
1	50 dynamite, 50 coal-dust	1,388·9	23·15	I
2	Mononitric cotton	463·0	23·15	I
3	Detonating cellulose string	...	...	N

N signifies that the mixture did not ignite the gaseous mixture. I signifies that the gaseous mixtures were ignited.

MINE-MANAGERS' EXAMINATIONS.

Examinations for mine-managers are held every six months. In addition to being able to pass an examination, the candidate has to produce from his employers a certificate that he has been employed for at least three years in underground workings before he can get a certificate under the Mining Act; and, before any one can get a mine-manager's certificate under the Coal-mines Act, a certificate must be produced to the Board of Examiners that the candidate has been engaged in working in a coal-mine for a least five years. By thus combining the theoretical and practical knowledge there is every reason to believe that mining will be carried on systematically, and that our mineral lodes will receive more attention than they have done in the past. The following are the questions that were used for the examination of mine-managers under the Mining Act and the Coal-mines Act, held in February last:—

"THE MINING ACT, 1886."

FIRST DAY.—TIME: 9 A.M. to 12 NOON.

Subject 1.—The Laying-out and Construction of Shafts, Chambers, Main-drives or Levels, Uprises, and Stopes.

(*a.*) What preliminary operations are necessary before commencing to sink a shaft?

(*b.*) In sinking a rectangular shaft through a tight gravel wash-drift which had to be timbered with planking, when would you commence timbering, and what precautions would you adopt to have the timbering level and plumb, and also to fit close against the excavation?

(*c.*) Describe the method you would adopt in opening out a chamber from the shaft. (1.) If the ground were very heavy, how would you secure the chamber with timber? (2.) What dimensions of a chamber do you consider advisable if thirty men were employed below on each shift, and all the timber for working the mine had to be taken out at the same chamber?

(*d.*) Give the dimensions of an adit-level for a double line of road. (1.) If the level required to be close-timbered, show by sketch how you set the timber; (2) how you would frame the sets. (3.) Describe what precautions you would adopt in keeping up the laths before placing the main set in position.

(*e.*) What is meant by winzes and passes? (1) Describe how you would timber a pass where the ground is heavy. (2.) What do you consider the most enonomical distance for the passes to be apart?

Subject 2.—The various Methods adopted in timbering Shafts and Mines, and in filling in Old Workings.

(*a.*) Show by sketch how you would timber a rectangular shaft—(1) with frames; (2) with planks, say, 4in. thick; and show how you would fit the planking at the corners if battens were not used, and to retain the whole strength of the planks.

(*b.*) Show by sketch how you would place a tank in a shaft, at the change of pump-lifts. (1.) If the shaft was not large enough, show how you would enlarge it at the change of lifts in order to leave room to place the pumps in position.

(*c.*) What precautions would you adopt to keep the sets of timber in an adit-level in position if the ground was bad and the timber liable to cant? Also, if both the roof and floor were soft ground containing water, describe fully how you would secure it with timber.

(*d.*) What dimensions of a cap-piece would you use in heavy ground if the drive were 5ft. in the clear between the timber, and the sets 4ft. apart from centre to centre? (1.) Assuming that each cap-piece had to carry a uniform load of 5 tons, what would be the diameter of a round cap of red-pine sufficient to carry this load, and have 4 of a factor of safety (that is, its breaking-strain would be 20 tons)? (2.) Give the diameter of a round prop of 6ft. in length of red-pine capable of carrying 6 tons, and to have 4 of a factor of safety. Show by calculation how you arrive at this.

(*e.*) In timbering a roadway constructed on an inclination of 1 in 4, show by sketch how you would place the sets in relation to the inclination.

(*f.*) If you were stoping out a quartz-lode, say, 60ft. in width, and the ground heavy, describe fully how you would work a lode of this description, and how you would timber the stopes.

TIME: 2 P.M. TO 5 P.M.

Subject 3.—On the Drainage of Mines, and on Pumping Appliances.

(*a.*) How many different kinds of pumps and appliances are used for draining mines?

(*b.*) From what depth will a pump draw water? Is there any limit? If so, why?

(*c.*) Describe a steam-pump having a reciprocating motion, and where it should be placed for its efficient working.

(*d.*) Describe a pulsometer pump. On what principle does it work, and where should it be placed?

(*e.*) How many tons of water will be raised from a shaft in twenty-four hours—diameter of pump, 22in.; 6ft. stroke; making twenty strokes per minute; single-acting; efficiency of pump, 75 per cent.?

(*f.*) What thickness of metal would be required for cast-iron pipes 12in. diameter, head of water 900ft.? Give thickness of top and bottom lengths.

(*g.*) What would be the weight of pipes in the above question?

(*h.*) What class of pump gives out the highest efficiency?

Subject 4.—The Haulage on Planes and in Shafts, also the Different Systems of Underground Haulage, with Horse-power required to do the Work.

(*a.*) Describe the different methods adopted for underground haulage.

(*b.*) Describe a safety-catch. On what part of a cage is it attached, and for what purpose?

(*c.*) What appliances are used to indicate the position of a truck on a plane, or a cage in a shaft, and where are they situated?

(*d.*) A 3in. steel-wire rope—what is its safe working-load?

(*e.*) A 3in. steel-wire rope—what is its breaking-strain?

(*f.*) What is meant by the term "horse-power"?

(*g.*) How many heads of water would be required to raise 100 tons of stone 450ft. in twenty-four hours—diameter of overshot wheel, 30ft.; efficiency of wheel, 65 per cent. (weight of cage, truck, and rope omitted)?

(*h.*) What "horse-power" would be required to raise 200 tons of stone 500ft. in twelve hours—weight of cage 30cwt., rope 15cwt., and truck 20cwt.; truck to contain 4 tons?

SECOND DAY.—TIME: 9 A.M. TO 12 NOON.

Subject 5.—On Ventilation of Mines.

(*a.*) How is natural ventilation produced? Also, state how you would ascertain the quantity of air travelling through an airway.

(*b.*) If 15,000 cubic feet of air per minute were travelling through an air-course 6ft. by 4ft., and 1,200ft. long, and if this air was divided into two air-courses, and to have the same pressure as in the main air-course, what quantity would pass through each of the following divisional air-courses?—1st division, 5ft. by 3ft., 1,800ft. long; 2nd division, 4ft. by 3ft., 2,500ft. long.

(*c.*) Give the composition of carbonic-acid gas, also carburetted hydrogen gas, and state what means you would adopt to detect their presence in a mine.

(*d.*) What effect does water produce on carbonic-acid gas, and in what part of the workings in a mine where carbonic-acid gas is generated would you expect to find the largest quantity? Explain fully your reason why.

(*e.*) What is meant by mechanical ventilation? Describe the systems in use.

(*f.*) If an ordinary fan, 3ft. in diameter, with a width of 1ft., and making 1,200 revolutions per minute, were used for ventilating a mine, what quantity of air would it put in circulation?

Subject 6.—Tapping Water in Mines; and Mode of Constructing Dams in Underground Workings, to keep the Water back.

(*a.*) If a large body of water was met with in a mine, and there was a suitable place where a dam could be constructed in the solid rock, show by sketches—(1) how you would construct a concrete or brickwork dam; (2) a timber dam. (3.) State the pressure in pounds that there would be on the face of a dam containing 36 square feet if the water was standing to a height of 150ft.

(*b.*) If a large body of water was met with near the surface when sinking a shaft, and an impervious stratum was met with after going through the ground containing the water, show by sketch how you would dam the water back so as to prevent its going down the shaft.

(*c.*) If you were approaching a place where there was known to be a large lodgment of water, what precautions would you adopt (1) in tapping the water? (2.) If you were approaching the water with an adit or drive in alluvial drift, how would you secure the end of the adit or drive on approaching the water?

TIME: 2 P.M. TO 5 P.M.

Subject 7.—On Blasting and the Use of Explosives.

(*a.*) What are the relative strengths of dynamite, rackarock, and blasting-gelatine as compared with blasting-powder by weight, and what are the different effects produced by these explosives?

(*b.*) At what temperature will dynamite become in a frozen condition, and, when in that condition, what is the effect produced as regards the strength of its explosive power? Also, when dynamite is in a frozen state, what steps would you take, and in what manner would you restore it to its normal condition?

(*c.*) Show by figures how you would calculate the quantity of blasting-powder requiring to be used in blasting solid rock where the borehole was 2in. in diameter, 4ft. in depth, and the line of least resistance 2ft. 6in.

(*d.*) If, say, shots had to be fired simultaneously, how would you effect this in order that the whole might go off at the same instant?

(*e.*) If a shot missed fire, what steps would you take? Also, what material and tools would you use in tamping a shot?

Subject 8.—The Effect that Faults, Slides, and Mullock Bars have on Lodes, and how to ascertain the Direction of Slides and Heavals.

Describe what is meant by the terms "faults," "slides," "mullock bars," and "heaves," and give a diagram to illustrate the effect of each on a mineral lode.

THIRD DAY.—TIME: 9 A.M. TO 12 NOON.

Subject 9.—A Knowledge of Underground Surveying, and the Making of Plans of Underground Workings, showing the Dip or Inclination and Strike of the Reefs or Lodes.

(*a.*) The candidate must produce a plan showing the surface-boundaries of a mining-claim not less than twenty acres in extent, on a sufficiently large scale to show also (in different-coloured ink) the underground workings, with all traverse lines, figures, &c., to illustrate the method of survey adopted. Both plan and survey must be the work of the candidate. The plan must be signed and dated.

(*b.*) The original field-notes of the survey must be produced, also the tables showing the distances of all traverse stations on meridian and perpendicular, and a specimen of the calculations from which they are derived.

(*c.*) Describe in writing the method by which the survey has been made, name the instruments used in the measurement of angles, and of distances. Describe how the inclined measurements have been reduced to horizontal.

(*d.*) Describe in writing the method adopted of obtaining the bearings used in the surveys, and say whether they are derived from the triangulation meridian, magnetic meridian, or other, and whether the same meridian is used both above and below ground.

(*e.*) What precautions were taken to insure that the chain or tape was of the right length?

(*f.*) Draw a diagram to show how the surface and underground meridians have been connected, and describe fully how it was done.

(*g.*) State your opinion as to which is the most accurate method of carrying the surface meridian to the underground survey, in the case of a shaft or shafts.

(*h.*) Does the compass give reliable results in underground surveys? State your reasons.

(*i.*) In an underground survey, how would you check a magnetic survey, and compare the meridian used with the surface survey and boundaries of the claim?

TIME: 2 P.M. to 5 P.M.

(*j.*) From the first traverse station used in the underground survey, calculate the distance due north to the nearest boundary of the claim, and show your manner of calculating it.

(*k.*) Describe in writing the adjustments of a plane theodolite, and also those of a miner's dial or compass. (The candidate will also be examined orally in the use and adjustments of these instruments.)

(*l.*) Describe how the traverses, boundaries, offsets, or other features were plotted on the plan.

(*m.*) Describe the method of calculating the areas of irregular figures on the plan.

(*n.*) Give in square feet the area of a figure 800ft. long, 60ft. wide at one end and 140ft. wide at the other; and also the area in square feet of a triangle 200ft. in the base and 300ft. in the perpendicular.

FOURTH DAY.—TIME: 9 A.M. TO 12 NOON.

Subject 10.—A Knowledge of the Different Rocks where Gold, Silver, Tin, Copper, Zinc, Lead, and Antimony are found, and on the Formation of Lodes and Leads.

What are the most commonly worked ores of the following metals: silver, copper, tin, manganese, tungsten, chromium, and antimony? Give a short deseription of each, and mention where they are found in New Zealand, and the mode of their occurrence.

Subject 11.—A Knowledge of Arithmetic, and a Method of keeping Accounts.

(*a.*) The base of a triangle is 36ft., and the perpendicular 48ft.; find the length of the third side.

(*b.*) Find the cube root of 259694072.

(*c.*) Multiply 86785432 by 70169.

(*d.*) How many solid feet are there in a block of stone 6ft. 6in. long, 2ft. 4in. broad, and 1ft. 3in. thick.

(*e.*) If the wages of 6 persons for 21 weeks are £120, what wages would 14 persons make in 46 weeks at the same rate?

(*f.*) In a triangular piece of timber the base is 29in., the perpendicular 17½in., and the length 12ft.: how many solid feet are there contained?

Subject 12.—A Knowledge of Part III. of "The Mining Act, 1886."

Oral examination.

"COAL-MINES ACT AMENDMENT ACT, 1890."

FIRST-CLASS CERTIFICATES.—FIRST DAY.—TIME: 9 A.M. TO 12 NOON.

I.—On the sinking of Shafts and Construction of Main Roadways, opening out a Mine, and the Division of a Mine into Districts.

1. What preliminary operations would you undertake in starting to sink a rectangular shaft?

2. After sinking through soft, water-bearing strata, describe your operations on reaching the solid rock if metal tubbing has been used.

3. In a shaft 200 fathoms deep, what thickness of metal tubbing would you use (1) at 50 fathoms, (2) at 150 fathoms; and show by calculation how you arrive at these results?

4. What size would you drive a stone drift 700ft. long, lying at 1 in 4, which would be used as intake for air, and up which an output of 500 tons per day must be drawn? Enumerate the considerations which would guide you (1) in very hard strata, (2) in soft strata.

5. Give sketch showing how you would lay off your levels and drawing-roads with 50 fathoms cover, dip 1 in 3, coal both to dip and rise. Give the widths and height you would drive them in an 11ft. seam of very soft coal.

6. Give two cases in which you would divide the mine under your charge into districts. Give an instance in which you would not. Explain your reasons fully.

7. Mark on sketch the size of shaft-pillars you would leave to protect a shaft 420ft. deep, a 7ft. seam, and lying at 1 in 3—(1) with a sound floor, (2) with 6ft. of soft fireclay pavement and a strong roof.

II.—The various Methods adopted in securing Shafts and Workings in a Mine, showing the relative Advantage and Efficiency of each Class of Material used.

1. In a shaft 350ft. deep, 14ft. by 6ft., with very soft strata for the first 150ft., what sizes of lining, cover-pieces, and guides would you use? What kinds of timber, and show by sketch how you would secure the buntons, what form of joint you would have for guides, stating why.

2. What are the avantages of brick-lining compared with wood?

3. In opening-out in a very soft seam 5ft. by 5ft. levels, what size and kind of timber would you use, and if the floor were also soft how would you proceed?

4. Sketch how you would put up a 6in. by 8in. cap-piece, and give your reasons.

5. How would you work a 7ft. seam of coal with good roof and pavement?

6. What method would you adopt in working an 18ft. seam free from spontaneous combustion, and with a strong shale roof?

7. In long-wall working, what is the first difficulty you have to contend with? and in working a seam by that method with hard pavement, 1ft. 6in. coal, 1ft. shale, and 2ft. coal, and tough shale roof, explain how you would proceed, giving width of roadways, building, and walls. Where would you get your pack? Would you break the wall-faces or keep them abreast, and why?

TIME: 2 P.M. TO 5 P.M.

III.—The Various Methods of Ventilation, and the Construction of Airways, so as to Produce a good Circulation of Fresh Air in any part of the Mine.

1. State what you know of the principles of natural ventilation.

2. If one of your return air-currents was of an explosive nature, what precautions would you adopt in leading it to upcast when ventilating by furnace? How far from the upcast would you place your furnace?

3. A fan 26ft. in diameter by 8ft. 6in. wide revolves sixty times per minute with a coefficient discharge of 45, what is the discharge per minute?

4. In what cases can you apply the water-gauge in a mine, and why is it not more generally used?

5. A furnace circulates 80,000 cubic feet of air per minute with an upcast 280 fathoms deep, what amount of air would it circulate with the same conditions but an upcast only 100 fathoms deep?

6. In a shallow mine free from gas compare the furnace and fan, and give your opinion at what epth the relative efficiency is reversed?

IV.—On the Areas of Airways, the Velocity and Divisions of Currents, and the Deductions to be made for Friction.

1. An airway 1,000ft. long and 5ft. by 16ft., having a current of 18,000 cubic feet of air per minute; if the head coal were taken down so that it measures 16ft. by 10ft., what volume of air will pass, other conditions remaining the same?

2. What do you consider a dangerous velocity for the air in a highly-explosive mixture of air and firedamp?

3. An air-course 600ft. long and 8ft. by 10ft. has a current of 40,000 cubic feet of air passing per minute: this is split into two, measuring 460ft. by 10ft. by 12ft. and 900ft. by 10ft. by 15ft.: how much will each split pass, and what difference will the water-gauge show?

4. What form of airway offers the least resistance, and why? What is a regulator and an overcast?

5. An airway measures 8,000ft. long by 12ft. by 5ft., and passes 7,500 cubic feet of air per minute, what is the amount of pressure per square foot, and what pressure would be required to produce 12,000 cubic feet per minute?

FIRST-CLASS CERTIFICATES.—SECOND DAY.—TIME: 9 A.M. TO 12 NOON.

V.—On the Nature and Composition of Explosive and Dangerous Gases occurring in Coal-mines, and on Spontaneous Combustion.

1. What is the difference in the effect of breathing carbonic acid and carbonic oxide? What is the specific gravity of the latter, and is it inflammable or not? Does it put out the flame?

2. What is the composition of afterdamp? Explain in what ways it is likely to affect the exploring parties.

3. How can you detect the presence of firedamp in large and small proportions? What is its most dangerous volume in relation to air?

4. Explain fully the bearing of coal-dust on explosions. Is it explosive by itself? How would you cope with it in a mine where it was plentiful and finely divided.

5. How would you detect the starting of spontaneous combustion in a mine or blocked off district, and what steps would you take? Explain its mode of origin, and how iron-pyrites in the coal affects it. Has any other condition of the mine an important bearing on its occurrence? What would you do when it had got a firm hold?

VII.—The Haulage on Planes and in Shafts, also the different Systems of Underground Haulage, with Horse-power required to do the Work.

1. The workings of a colliery have extended far from the pit-bottom, the roads are winding, and the pillars worked out: how would you draw the coal? Explain fully, and give detailed sketch; dip variable.

2. An incline dips at an angle of 1 in 6, length 30 chains, up which must be drawn 180 tons per day, what system of haulage would you use, and how prevent runaways?

3. Explain the merits of wheels loose on axle and keyed fast on same.

4. What angle of inclination is most suitable for a self-acting incline? and sketch how you would connect same with main drawing-road, both with large outputs. What is the best angle to lay off road for drawing by hand?

5. An endless rope draws 200 tons per day of eight hours up 40 chains at 1 in 8, what horse-power is required, and what is the loss by friction? Assume your own weights for boxes, rope, &c.

TIME: 2 P.M. TO 5 P.M.

VI.—On the Drainage of Mines, and Pumping Appliances.

1. Why are columns of pipes divided into lifts?

2. Show by sketch how you would arrange your lifts and lodgments for a shaft 100 fathoms deep. What size of pipes would you use in such a shaft to draw 10,000 gallons per hour? Detail calculations.

3. Explain the principle of the (1) syphon, (2) of the pulsometer, (3) any double-action force-pump you are acquainted with.

4. What form of pump would you use to throw 160,000 gallons per day from a depth of 170ft.? Give sketch, and explain its action.

5. What is (1) a clack-piece; (2) a working-barrel; (3) how are the pipes supported in the shaft; and (4) to what? Give sketch.

6. A rising main is 960ft. deep, what thickness of metal would you use for 10in. pipes?

7. With plunger-stroke of 6ft., six strokes per minute, and a 12in. working-barrel, what would be the discharge in gallons per 12 hours?

8. In 8in. pipes, 330ft. deep, show by calculation what thickness of metal you would use, and how would you specify that they should be cast?

VIII.—The Theoretical and Effective Power of Steam-engines and Boilers; also, on the Strength of Hauling-ropes and Chains.

1. You have to wind 1,000 tons a day of 10 hours from a depth of 260 fathoms, what form of engine would you use? Give size of cylinders, stroke, and steam-pressure, the details of boilers, and what would be the nominal horse-power. Give the data which you assume for weights of ropes, cages, boxes, &c.
2. With a compound engine, 12in. and 24in. cylinders, what tonnage of coal would you wind from 240ft., with a steam-pressure of 55lb., and cut off at $\frac{3}{8}$ the stroke?
3. Winding 450 tons daily, 10 hours, from 32 fathoms, what size of cylinders, and stroke, and what pressure of steam would you employ for a single engine? Give size and kind of rope you would use.
4. What are the relative advantages of flat and round steel ropes? Had the flat hemp ropes anything to recommend them? What were their disadvantages?
5. What is a safe load for a $\frac{3}{4}$in. chain? What factor of safety do you employ?
6. What is a safe load for a steel-wire rope (1) $1\frac{1}{4}$in. diameter, (2) $1\frac{7}{8}$in. diameter?
7. How many gallons a minute will an engine of 120-horse power pump from a depth of 70 fathoms.

FIRST-CLASS CERTIFICATES.—THIRD DAY.—TIME: 9 A.M. TO 12 NOON.

IX.—The Incrustations in Steam-boilers, and the Cause of same, and Remedy therefor.

1. Name the principal substances which form incrustations in boilers. How is this caused? Name the various means you would adopt for preventing this. Give your opinion of the principal cause of boiler-explosions.
2. What class of boiler would you use for a winding-engine of 120-horse power. Give your reasons. Also (1) give the area of heating-surface, (2) surface-area of fire-bars.

X.—Tapping Water in Mines and the mode of Constructing Dams in Underground Workings to keep Water back.

1. How would you approach a large body of water with a head of 200ft.—(1) from the dip, (2) from the rise? What sized rib of coal would you leave in above cases—(1) in a hard coal (2) in a soft coal? Would the thickness of the seam affect the question? Assume that roof and pavement are sound.
2. What distance will water under pressure run in the solid coal? Give your opinion if it is a freely-jointed seam.
3. How would you construct a dam in a seam impervious to water with sound roof and floor?
4. Would you put in dams in roadway leading to workings where you would have a heavy head of water if the coal were soft and pervious?

XI.—Blasting and the Use of Explosives.

1. What explosive would you use (1) in driving a mine in hard quartz grit, (2) in working coa in a fiery mine, (3) and in which firedamp was occasionally met with; and what precautions would you adopt?
2. What is the composition of dynamite fumes? State your arrangements where dynamite would be largely used.
3. What is the composition of rackarock and gun-cotton?
4. Compare blasting-gelatine and dynamite.
5. What is a blown-out shot? Can it be prevented?

TIME: 2 P.M. TO 5 P.M.

XII.—The effect that Faults Produce in Coal-seams, and how to ascertain the Direction of a Coal-seam when severed by a Fault.

1. What is a reversed fault and its cause? Are there any such in your district? if so, describe.
2. How do you measure the amount of throw in a fault in an inclined seam?
3. What is meant by a fault? Give the general rule for finding the coal.
4. Is there any reason for a fault altering the character of a coal-seam? if so, explain.
5. Do faults cause any further inconvenience to a mine than the dislocation and driving they entail.

XIII.—A Knowledge of the Composition and Character of the Different Classes of Coal, and also of the Character of the Rocks and Formation of the Country where Coal is likely to be found.

1. What is an anhydrous coal? Is there any true coal found in New Zealand? if so, where?
2. Give the proximate composition of (1) a good pitch or brown coal, (2) of an English coal.
3. What two bodies are chiefly detrimental to the quality of lignite?
4. How do you account for the dull look of lignite or brown coal and the glossy lustre of pitch coal, in view of them both occurring in the same field.

5. What is (1) the New Zealand coal-formation, (2) its upper stratum, (3) the general character of the lowest beds, (4) are the latter fresh-water or marine?

6. (1) What do you consider the rocks indicative of coal in your district; and (2) explain an instance of unconformity in it?

FIRST-CLASS CERTIFICATES.—FOURTH DAY.—TIME: 9 A.M. TO 12 NOON.

XIV.—A Knowledge of Underground Surveying and of making Plans, showing System of Working, Inclination of Seam, Faults, and System of Ventilation.

1. The candidate must produce a colliery-plan, showing the surface taken up for at least 20 acres in the vicinity of the shaft, and must show the underground workings in different coloured ink, and his method of connecting them with the surface when there is only one shaft. The plan must be the work of the candidate himself, and he must produce the original survey-book. The main roads at least must have traverse calculated, with latitude and departure for each bearing, also the manner in which the other workings have been surveyed and filled in.

2. How would you take up your megnetic meridian? In what circumstances is surveying with the magnetic needle permissible?

3. In making an underground survey with a compass, without appliances for angular measurements, and you were compelled to plant at once within the sphere of attraction of pipes or rails, what would you do?

4. Describe the adjustments of the theodolite, dial, and magnetic compass.

5. What advantages has the dial over the theodolite for ordinary colliery work?

6. You have a heading resting on a fault; from it the road dips at 1 in 4 as follows: bearing 360°, distance 200 links; bearing 357°, distance 160 links; bearing 340°, distance 210 links. Thence you have a stone drift running level to cut the fault bearing 182°, distance 800 links. What is the vertical and horizontal distances between starting-point and finish? [The answer to be calculated from the log-tables.]

7. Describe fully how you plotted your survey in the plan you have produced?

8. Sketch a figure with at least six sides, and show how you would calculate its area?

9. What is the area of a right angle triangle of which the base is 200 links and the hypothenuse 640 links?

TIME: 2 P.M. TO 5 P.M.

XV.—A Knowledge of Arithmetic and the Method of keeping Accounts.

1. Find the square root of 243, 765, 769. What is the cube root of 39, 479, 120? How much is the $\frac{1}{2}$ of $\frac{1}{6}$ of $\frac{1}{3}$ of $\frac{1}{4}$ × 192?

2. In making coke there is a loss of volatile matters of 23 per cent., how much coal is required to make 30 tons of coke?

3. You have an output of 600 tons daily, each box weighs 4cwt., and contains 7cwt. of coal, what is the total amount wound exclusive of other weights?

4. A heap of coal measures 10 yards by 30 at the base, and the sides slope at 45°, and the vertical height is 10ft., what is the cubic amount, and the approximate tonnage?

5. The royalty on 70,000 tons was at the rate of 7½d. on every 22½cwt., what was the sum paid?

6. The radius of a circle is 6ft., what is the circumference?

7. The logs for sole-plates measure 20ft. 6in. by 10in. by 1ft. 2in., what is their bulk?

XVI.—A Knowledge of the Provisions of "The Coal-mines Act, 1886," and Amendment Act, 1890.

Oral examination by Supervisor.

SECOND-CLASS CERTIFICATES.—FIRST DAY.—TIME: 9 A.M. TO 12 NOON.

I.—On the Sinking of Shafts and Construction of Main Roadways, opening out a Mine, and the Division of a Mine into Districts.

1. Describe tools and appliances used for sinking a shaft through both soft and hard ground—(1) through mud or quicksand, (2) through compact clay. Show by sketch the method you would adopt.

2. Give a rough sketch of the top of shaft, with surface appliances for protection of men at the bottom.

3. If you were sinking a shaft through quicksand with metal tubbing and came across large logs in the quicksand which were covered with sand and water, how would you remove these logs, and what precautions would you adopt to keep the tubbing perpendicular; and also what means would you adopt to guard against gas accumulating behind tubbing?

4. What class of pumps would you use in sinking a shaft when there is water, and how would you secure them?

5. Show by sketch the manner in which you would lay out working of a small colliery where twenty men were employed.

II.—The various Methods adopted in securing Shafts and Workings in a Mine, showing the relative Advantage and Efficiency of each Class of Material used.

1. In making provision to secure a shaft 8ft. diameter in the clear, what material would you use? and describe fully how you would secure the shaft as it is being constructed.

2. In securing a shaft 12ft. by 5ft. in the clear with timber, show by sketch the method you would adopt (1) with frames and planks, (2) with planking only, and show how you would divide it so that there was room for two cages to work and one column of pumps.

3. If you had to construct a heading through quicksand or any soft ground, describe the method you would adopt in timbering the ground, and how you would secure the timber so that if one set broke it would not have the effect of weakening the others.

4. State what you know of bord and pillar and longwall workings, with different methods of timbering.

5. How would you timber a heading, say, 10ft. wide and 6ft. high in the clear, through broken ground with a cover of 200ft.? Give dimensions of timber, and state the system you would adopt.

TIME: 2 P.M. TO 5 P.M.

III.—The Various Methods of Ventilation, and the Construction of Airways so as to produce a good Circulation of Fresh Air in any part of the Mine.

1. What is ventilation, and what is the necessity for it?

2. Describe the different methods which have been applied to produce a current of air to pass through the workings of a mine, and the principle on which each method depends.

3. State the safe maximum velocity of an air-current in a fiery mine, and give your reasons for same.

4. How would you proceed to remove an accumulation of firedamp from any part of the mine? What precaution would you take to secure the safety of men engaged in the work? State fully.

5. State the use of an air-crossing, and explain whether it would reduce the number of doors in a mine, and what are the benefits.

6. How many cubic feet of air should you have for each person in a fiery and non-fiery mine?

IV.—On the Areas of Airways, the Velocity and Divisions of Currents, and the Deductions to be made for Friction.

1. How do you ascertain the quantity of air passing through an air-course?

2. What is meant by friction of air, and what means would you adopt to reduce it?

3. State whether you consider the division of air-currents in a mine of any advantage, and give your reasons fully.

4. State under what circumstances you would adopt a furnace for the circulation of air, and also a fan, and give your reasons fully.

5. Show by sketch-plan of a furnace capable of putting 15,000 cubic feet of air in circulation per minute under what circumstances would it be unsafe to allow the return air to come in contact with the fire.

SECOND-CLASS CERTIFICATE.—SECOND DAY.—TIME: 9 A.M. TO 12 NOON.

V.—On the Nature and Composition of Explosive and Dangerous Gases occurring in Coal-mines, and on Spontaneous Combustion.

1. What do you consider the most explosive mixture of firedamp, and in what proportion does it become non-explosive?

2. Give density and composition of black or afterdamp, and state its effects on those who breathe it.

3. How would you ascertain if there were any carburetted hydrogen gas in a mine, and what effect would it have on the flame of a Davy lamp?

4. What is spontaneous combustion, and how does it occur, and what means would you adopt to prevent it?

5. In the event of a fire occurring in a mine, describe fully what steps you would take to extinguish it.

VI.—On the Drainage of Mines, and Pumping Appliances.

1. What is the maximum height that a pump will draw water below the bucket, plunger, or piston?

2. In placing two lifts of pumps in a shaft one above another—say, first a plunger and next a draw-lift—how would you connect them, and what appliances would you adopt in delivering the water from the one to the other?

3. Describe how you would hang pumps in a shaft, and what means you would adopt to keep them securely in position.

4. Describe the manner in which the joints are made in pump-pipes when under high-pressure, and the different materials generally used for making such joints.

5. What is meant by—(1) a bucket-door, and a clack-door, and why these are required; (2) a plunger; (3) a stuffing-box for plunger, and why so required; (4) a wind-bore, and state its use? If you had to put in a new bucket in a pump, and the water was standing 50ft. above the pump-barrel, how would you accomplish it?

6. In mounting a pump-bucket, or placing new leather on valves, what side of the leather would you have next the pump-barrel or valve face? and give your reasons why.

7. Describe the action of (1) a siphon, (2) a pulsometer, (3) a Tangye pump, and the class of valves used in the latter.

TIME: 2 P.M. to 5 P.M.

VII.—The Haulage on Planes and in Shafts; also the Different Systems of Underground Haulage, with Horse-power to do the Work.

1. What appliances are you acquainted with to prevent overwinding from a shaft? and state how they are applied.
2. In the event of a winding-rope breaking while hauling up a cage and loaded tubs, what mechanical appliance is necessary to prevent it falling down the shaft?
3. What precaution would you adopt to stop tubs on an incline in the event of the rope breaking when the loaded tubs are being hauled up?
4. What circumference of plough steel-wire rope would you use—(1) to haul eight loaded tubs up an incline of 1 in 4 at the rate of 500ft. per minute, the tubs and load being 15cwt. each; (2) the circumference of a similar description of rope to haul up a loaded cage in a shaft 200ft. in depth at the rate of 400ft. per minute, the cage and load being 2 tons, so as to allow a factor of safety of 7 in both cases?

VIII.—Tapping Water in Mines, and the mode of constructing Dams in Underwood Workings to keep Water back.

1. If you were to tap a large quantity of water in a heading, having the floor and roof good and the coal hard and compact, (1) explain fully how you would dam the water back, and the material you would use, and show by sketch the manner in which you would construct such a dam; (2) if the coal was of a soft character, and either the roof or floor porous, what advantage would it be to construct a dam? Give your reasons fully.
2. If you were approaching a large body of water by a heading in a coal-seam, what precautions would you take in approaching the water, and also what means would you adopt to secure the heading before tapping the water.
3. In approaching a body of water which stood 100ft. higher than when you were tapping it, and the drive or heading being 6ft. by 8ft., what would be the pressure of the water in pounds on the face of the drive.

SECOND-CLASS CERTIFICATE.—THIRD DAY.—TIME: 9 A.M. TO 12 NOON.

IX.—Blasting and the Use of Explosives.

1. What explosive would you use if carburetted hydrogen gas was generated in a mine? Give your reasons fully, and state what means you would adopt to fire shots.
2. What effect (if any) would a blown-out shot that had been tamped with coal-dust (supposing blasting-powder to have been used) produce if there was a large quantity of finely-divided coal-dust floating about in the mine and no carburetted hydrogen gas generated?
3. At what temperature does dynamite commence to get in a frozen condition? and if you were using it in that condition, what means would you adopt to effect complete combustion? Also, state the manner in which you would thaw frozen dynamite.
4. If a shot of dynamite missed fire, what steps would you take?
5. If you found a large quantity of deleterious fumes produced by incomplete combustion of dynamite, what steps would you take to destroy the evil effects on the workmen if the ventilation was defective?

X.—The Effect that Faults produce in Coal-seams, and how to ascertain the Direction of a Coal-seam when severed by a Fault.

1. What is meant by a "fault"? Give three diagrams of faults you have met with in working coal-seams.
2. In meeting with a fault, how do you ascertain the direction the coal is likely to be again found? Explain fully.
3. What is the difference between a roll and a fault, supposing the coal to be severed in both instances?

TIME: 2 P.M. TO 5 P.M.

XI.—A Knowledge of Arithmetic and the Method of keeping Accounts.

1. If one man is employed at 10s. per day of eight hours to effect repairs to winding machinery, which cost, when complete, is £8 13s. 4d., how long would it take three men to do the same amount of work supposing the amount of work done by each man is equal; and, if each of the three men was only paid 8s. 6d. per day of eight hours, what would be the saving in the cost of repairs?
2. The wages paid to miners are at the rate of 1s. 4d. per hour for each man: what would be the amount paid to forty-eight miners for fifty-four hours' work?
3. If the cost of blasting-powder was $9\frac{3}{4}$d. per pound, how much would 2cwt. cost?
4. If 1 ton of coal was hauled up a shaft 100 yards deep in one minute, but of this period twenty-five seconds was occupied in taking off and putting the skips on to the cage, how many tons of coal would be lifted in eight hours, and at what rate, in feet, would the cage travel during the time of winding?
5. If you paid an engine-man at the rate of £3 10s. per week of forty-eight hours, how long would he have to work before his wages came to £8 17s. 11d.

XII.—A Knowledge of the Provisions of "The Coal-mines Act, 1886," and Amendment Act, 1890.

VALUE OF WORKS CONSTRUCTED.

The total value of works in progress and constructed by this department since the votes were placed under the control of the Hon. the Minister of Mines, taken from the department records, including roads and other worksfor the development of the mining industry, either by way of subsidy or otherwise, has been as follows:—

Nature of Work.	Total Cost of Construction, or Amount authorised to be expended.	Expenditure, by way of Subsidy or otherwise, by Mines Department.	Amount of Liability by Mines Department on Works in Progress.
Up to Years 1882–83 and 1883–84.	£ s. d.	£ s. d.	£ s. d.
Water-races	29,252 1 11	14,853 9 5	14,398 11 6
Roads on goldfields	21,437 11 2	13,089 16 0	8,347 15 2
Roads and tracks undertaken by County Councils, subsidised by Mines Department	52,841 17 0	21,844 16 7	10,207 15 9
Works undertaken by prospecting associations, subsidised by Mines Department	13,216 13 4	3,350 0 0	3,400 0 0
Construction of drainage- and sludge-channels, subsidised by Mines Department	5,750 0 0	2,468 15 4	781 4 8
	122,498 3 5	55,606 17 4	37,135 7 1
1884–85.			
Water-races	4,846 1 9	14,596 2 9	4,648 11 6
Roads on goldfields	13,667 10 1	9,630 9 6	12,384 15 9
Roads and tracks undertaken by County Councils, subsidised by Mines Department	13,566 14 1	6,293 16 6	12,739 17 6
Roads to mines, other than gold, subsidised by Mines Department	4,594 10 0	111 19 0	2,888 1 0
Works undertaken by prospecting associations, subsidised by Mines Department	850 0 0	108 0 0	3,692 0 0
Construction of drainage- and sludge-channels, subsidised by Mines Department	4,050 0 0	1,050 0 0	1,931 4 8
Diamond and other drills	3,600 0 0	1,858 0 0	..
	45,174 15 11	33,648 7 9	38,284 10 5
1885–86.			
Water-races	3,660 4 9	6,063 2 3	6,964 4 4
Roads on goldfields	27,543 18 8	12,360 14 9	27,567 19 8
Roads undertaken by County Councils, subsidised by Mines Department	14,773 2 3	13,043 15 9	12,477 9 2
Roads to mines, other than gold, subsidised by Mines Department	1,551 19 10	4,327 0 10	490 12 8
Works undertaken by prospecting associations, subsidised by Mines Department	11,860 18 0	1,999 5 7	6,389 5 9
Construction of drainage- and sludge-channels, subsidised by Mines Department	10,051 14 9	3,994 16 6	6,995 9 9
Schools of Mines	2,160 9 7	1,260 9 7	900 0 0
	71,602 7 10	43,049 5 3	61,785 1 4
1886–87.			
Water-races	..	1,928 14 4	3,466 0 8
Roads on goldfields	12,453 3 5	22,229 16 1	17,791 7 0
Roads and tracks undertaken by County Councils, subsidised by Mines Department	12,613 4 8	7,415 19 6	10,455 1 5
Roads to mines, other than gold, subsidised by Mines Department	..	306 1 0	110 13 1
Works undertaken by prospecting associations and companies, subsidised by Mines Department	15,671 19 6	4,521 7 3	4,618 4 7
Construction of drainage- and sludge-channels, subsidised by Mines Department	5,549 14 6	6,207 18 0	672 6 10
Diamond and other drills	422 15 6	422 15 6	..
Schools of Mines	3,183 7 1	3,383 7 1	700 0 0
	49,894 4 8	46,415 18 9	37,813 13 7
1887–88.			
Water-races	6 6 6	6 6 6	..
Roads on goldfields	6,860 4 3	17,281 11 3	7,370 0 0
Roads and tracks undertaken by County Councils, subsidised by Mines Department	2,998 15 0	8,012 5 2	3,942 4 2
Roads to mines, other than gold, subsidised by Mines Department	..	14 5 4	..
Works undertaken by prospecting associations and companies, subsidised by Mines Department	6,456 8 0	2,838 19 11	924 8 0
Construction of drainage- and sludge-channels, subsidised by Mines Department	..	1,110 4 11	2,054 10 6
Schools of Mines	1,859 3 7	2,221 19 4	337 4 3
Aids to treatment of ores	1,200 0 0	390 18 3	209 1 9
	19,380 17 4	31,876 10 8	14,837 8 8

VALUE OF WORKS CONSTRUCTED—*continued.*

Nature of Work.	Total Cost of Construction, or Amount authorised to be expended.	Expenditure, by way of Subsidy or otherwise, by Mines Department.	Amount of Liability by Mines Department on Works in Progress.
1888–89.	£ s. d.	£ s. d.	£ s. d.
Roads on goldfields	10,253 5 3	4,304 3 9	13,218 11 6
Roads and tracks undertaken by County Councils, subsidised by Mines Department	7,318 1 0	2,466 16 8	5,195 6 1
Works undertaken by prospecting associations and companies, subsidised by Mines Department	474 0 0	236 0 0	687 8 0
Construction of drainage- and sludge-channels, subsidised by Mines Department	..	54 10 6	..
Wharves, contributions by Mines Department	589 19 5	96 6 0	343 13 5
Aids to treatment of ores, subsidised	..	209 1 9	..
Schools of Mines	895 16 10	1,188 6 10	44 14 3
	19,531 2 6	8,555 5 6	19,489 13 3
1889–90.			
Roads on goldfields	3,834 9 7	9,148 5 9	8,005 5 4
Roads and tracks undertaken by County Councils, subsidised by Mines Department	8,507 15 8	3,451 17 11	5,928 1 3
Works undertaken by prospecting associations and companies, subsidised by Mines Department	..	..	663 0 0
Water-races	2,200 0 0	719 0 0	681 0 0
Wharves	..	150 0 0	193 13 5
Schools of Mines	1,040 0 8	1,034 0 11	50 14 0
Aids to treatment of ores	142 8 9	142 8 9	..
Tracks to open up mineral lands	1,000 0 0	207 3 6	792 16 6
Diamond drills	425 14 5	425 14 5	..
	17,150 9 1	15,278 11 3	16,314 10 6
1890–91.			
Roads on goldfields	8,811 14 4	10,815 14 8	5,201 5 0
Roads and tracks undertaken by County Councils, subsidised by Mines Department	2,703 5 0	2,252 5 5	5,027 8 4
Work undertaken by prospecting associations and companies, subsidised by Mines Department	..	..	663 0 0
Water-races	5,542 19 8	6,234 4 6	..
Wharves	..	39 9 9	..
Schools of Mines	3,847 10 0	3,898 4 0	..
Tracks to open up mineral lands	..	78 4 7	419 19 5
	20,905 9 0	23,319 2 11	11,311 12 9
SUMMARY.			
Roads on goldfields	104,861 16 9	98,860 11 9	5,201 5 0
Subsidised roads and tracks	115,322 14 8	64,781 13 6	5,027 8 4
Subsidised roads and tracks other than on goldfields	6,146 9 10	4,759 6 2	..
Prospecting	48,481 2 10	13,054 12 9	663 0 0
Water-races	45,507 14 7	44,400 19 9	..
Wharves*	435 15 9	285 15 9	..
Schools of Mines	12,986 7 9	12,986 7 9	..
Drainage-channels	21,401 9 3	14,885 5 3	..
Diamond drills	4,448 9 11	2,706 9 11	..
Treatment of ores	1,342 8 9	742 8 9	..
Tracks to open up mineral lands†	705 7 6	285 8 1	419 19 5
	361,639 17 7	257,748 19 5	11,311 12 9

* £154 3s. 8d. deducted this year on wharves, which was included in previous statements, but since cancelled.
† £444 12s. 6d. included in previous statements for Port Pagasus track has been cancelled.

The above statement shows that the value of new works authorised last year in mining districts was £20,905, as against £17,150 for the year previous; while the money paid either as grants or by way of subsidies to local bodies towards such works, and in payment of liabilities previously entered into, was £23,319, as against £15,279 for the former year. The liabilities on works in progress, and on those authorised but not yet in course of construction at the end of March last were £11,312. The total value of works constructed and in progress, including those authorised but not yet in course of construction, that have been carried on under the department since the votes were placed under the control of the Hon. the Minister of Mines, is £361,640, and the actual expenditure by the department amounts to £257,749, the balance due on constructed works and those in progress being paid by the local bodies.

Notwithstanding the large expenditure already made on works within mining districts to afford facilities to develop the mineral resources of the colony, there is yet a great deal to be done in the construction of roads and tracks. There are many places where there are no means of getting supplies and machinery brought near the ground where mining operations are carried on. This refers more to the working of auriferous, argentiferous, and mineral lodes than to the parts of the colony where the auriferous alluvial drifts are worked. These lodes generally are found in mountainous districts; and these districts are always so broken up with deep gullies and ravines, with steep mountain sides, that there is no opportunity of getting machinery to work the ground before roads are constructed. The extremely rough and broken nature of the country makes the mineral

districts of New Zealand difficult to get access to, as it requires almost a road or track to be constructed up every gully where mining is carried on. Had it not been for the construction of roads and tracks by the department many of the present quartz mines would not yet have been discovered, and, even if they had been found, it would have been a difficult matter to obtain capital to work them, inasmuch as a large portion of the capital would have had to be spent in getting access. It is to this class of mining that we shall eventually have to look to in order to give employment to the mining population; and it is gratifying to find that the yield of gold from the quartz-mines shows a slight increase over the previous year, notwithstanding the large decrease in the total quantity obtained. The falling-off in the yield last year from the alluvial mines and hydraulic-sluicing claims is due in a great measure to the extremely dry season, which caused a great scarcityof water, and it is only by having a plentiful supply that hydraulic sluicing can be carried on successfully.

It may seem an anomaly to state that mining in general is looking better than it did at the end of the previous year, seeing the large falling-off in the yield of gold last year, but, nevertheless, this is a fact. A large amount of capital was expended last year in mining machinery and in plant which has not yet been brought into operation. It must be borne in mind that the shallow placer workings are fast becoming a thing of the past; more capital is required to open up and work the ground. The day is almost gone when mining can be carried on by the individual miner, who formerly required no appliances but a pick, shovel, cradle, or sluice-box to enable him to make his claim a payable concern. Capital and labour must now be combined, improved appliances procured for working, and large quantities of material operated on, with a corresponding method of recovering a fair percentage of the gold from the material treated, in order to make the large areas of alluvial drifts which are still left pay for working.

The dredging operations have not proved so successful as was at first anticipated; but this class of mining is like every other new system which is adopted, it takes some time to find out the defects and get them remedied. The chief defects in the dredges that have been constructed are that the pontoons or hulls for carrying the dredging machinery have been constructed too small to be able to erect corresponding washing appliances to recover the gold from the quantity of material lifted. As far as the actual dredging appliances are concerned, they are successful in lifting a large quantity of material; but it is a well-known fact that in the beds of rivers, and on the ocean-beaches, where these machines are generally placed, the gold is of a fine scaly character, and cannot be recovered by rushing it through a common sluice-box in a wholesale manner. A large surface of tables is required, and it is difficult to have these of sufficient superficial area to properly treat the fine sands after separation from the gravel and shingle, unless large pontoons are made to place them upon. More attention is required to be directed to this than heretofore has been done.

In regard to the treatment of auriferous and argentiferous ores, better methods are coming daily into use, and there is every reason to believe, from the results of the ore already treated by what is known as the Cassell process, that many of the lodes hitherto given up as valueless on account of containing ores of a complex and refractory character will be worked and made good-paying ventures. This will, however, take time, as the present royalty now proposed to be charged for this process will greatly militate against it being used by mill-proprietors.

New Zealand, in comparison with other mining countries, offers many advantages which they do not possess—its numerous large rivers, creeks, and streams can be utilised for carrying on mining in all its branches. There is scarcely a place where an abundant supply of water cannot be obtained within a reasonable distance of mining operations as a motive-power to work machinery; and now that it is proved by the actual demonstration of workings on a large scale that so long as water can be obtained at a reasonable distance from a mine, or from the place where machinery has to be erected, electro-motive-power can be transmitted for long distances, as is done at Skipper's, for the purpose of driving a crushing-plant and air-compressor, and also for working the dredging and pumping machinery at the sandhills on the Shotover River. This motive force, when generated by water-power, is a great saving to that of steam-power, and, consequently, the cost of working machinery of any description can be made cheaper in this colony than any of the Australian Colonies, or many other mining countries in the world; besides the climate cannot be excelled in any part of the globe. Taking all these favourable circumstances into consideration, together with the large quantity of mineral lodes, mining is, in the future, bound to remain the leading industry in the colony.

I am, &c.,

HENRY A. GORDON, M.A.Inst.M.E.,
Inspecting Engineer.

LIST of WORKS on GOLDFIELDS undertaken wholly by the Mines Department, or by Subsidies to County Councils, Local Bodies, and Prospecting Associations, in Progress on the 31st March, 1891.

Locality and Nature of Works.	Total Cost, or Amount authorised.	Amount of Contribution paid by Mines Department.	Amount due by Mines Department on Works still in Progress.
NORTH ISLAND.			
ROADS (SUBSIDISED).			
Bay of Islands County.			
Road from Tuamarere Railway-station to Puhipuhi Township	£ s. d. 410 0 0	£ s. d. 110 0 0	£ s. d. 95 0 0
Coromandel County.			
Mercury Bay Road	1,300 0 0	420 0 0	230 0 0
Wainaru to Kuaotunu Road	450 0 0	..	225 0 0
Kapanga to Paul's Creek	200 0 0	..	100 0 0
Sea-beach to Kuaotunu	200 0 0	..	100 0 0
Kuaotunu–Coromandel Road	300 0 0	..	150 0 0
Pumpkin Flat–Just-in-time Road	300 0 0	..	150 0 0
Mercury Bay to Kuaotuna	360 0 0	..	180 0 0
	3,110 0 0	420 0 0	1,135 0 0
Thames County.			
Puru Creek to Horne and Wilson's Claim	50 0 0	..	25 0 0
Hikutaia towards Maratoto	200 0 0	..	100 0 0
Thames to Tapu Road	600 0 0	..	300 0 0
Upper Tararua to Sylvia Mine	750 0 0	57 1 0	317 19 0
Te Papa Gully Road	100 0 0	..	50 0 0
Thames to Hikutaia	52 4 10	..	26 2 9
	1,752 4 10	57 1 0	819 1 5
Ohinemuri County.			
Waitekauri Lower Road	360 0 0	..	180 0 0
Karangahake Hill Track	200 0 0	..	100 0 0
Karangahake through Gorge (bridges and culverts)	200 0 0	23 0 0	77 0 0
	760 0 0	23 0 0	357 0 0
Piako County.			
Premier Mine to Katikati	500 0 0	..	250 0 0
MIDDLE ISLAND.			
ROADS (SUBSIDISED).			
Waimea County.			
Repairing horse-track, Baton to Karamea Road	100 0 0	..	50 0 0
Inangahua County.			
Globe Hill to Merrijigs	1,560 0 0	698 13 0	81 7 0
Larry's Creek to Lyell Road	1,080 0 0	530 17 6	9 2 6
Mangles Valley to McGregor's Station	1,200 0 0	300 0 0	300 0 0
Horse Terrace to Hunter's Station	1,280 0 0	..	640 0 0
	5,120 0 0	1,529 10 6	1,030 9 6
Buller County.			
Waimangaroa to Sea-beach	240 0 0	87 0 0	33 0 0
Addison's to Wilson's Lead	400 0 0	..	200 0 0
Cedar Creek Road towards Coalbrookdale	100 0 0	..	50 0 0
Road from Basan–Charleston to Ballarat Creek	100 0 0	..	50 0 0
Track from county road to United Alpine Mine, Lyell	100 0 0	..	50 0 0
	940 0 0	87 0 0	383 0 0
Grey County.			
Track to New Rush, Cape Terrace	200 0 0	..	100 0 0
Westland County.			
New Rush, south side Hokitika River	100 0 0	18 19 3	31 0 9
Track from Hokitika Borough (eastern) boundary to Shallow Rush	120 0 0	..	60 0 0
Taack to New Rush, Back Creek	100 0 0	..	50 0 0
	320 0 0	18 19 3	141 0 9
Lake County.			
Pembroke Flat to the County Nursery	240 0 0	..	120 0 0
Road from Miller's Flat to join Skipper's Road at Dan O'Connell's	280 0 0	..	140 0 0
	520 0 0	..	260 0 0
Taieri County.			
Nenthorn Road	600 0 0	..	300 0 0
Southland County.			
Waikaia to Whitcombe	200 0 0	80 13 4	19 6 8
Waipapa to Six-mile Beach	175 0 0	..	87 10 0
	375 0 0	80 13 4	106 16 8

LIST of WORKS on GOLDFIELDS, &c.—*continued.*

Locality and Nature of Works.	Total Cost, or Amount authorised.	Amount of Contribution paid by Mines Department.	Amount due by Mines Department on Works still in Progress.
ROADS CONSTRUCTED WHOLLY BY MINES DEPARTMENT.	£ s. d.	£ s. d.	£ s. d.
Repairs to Nile Bridge	300 0 0	..	300 0 0
Tapu to Waikawau	770 0 0	610 3 0	159 17 0
Aorere to Karamea and Mokihinui	26,738 13 9	25,063 13 9	875 0 0
Jackson's Bay to Cascade and Gorge River District	5,309 10 11	5,159 10 11	150 0 0
Garston to Nevis	1,545 18 8	788 18 6	757 0 2
Wakatipu–Milford Sound Road	2,000 0 0	1,328 17 10	671 2 2
Contingencies	326 18 4	326 18 4	..
Puhipuhi Road	1,339 10 0	912 6 3	427 3 9
Rimu to New Rush	722 0 0	..	722 0 0
Track Wakamarina Forks to Wairau Valley	150 0 0	..	150 0 0
Kuaotunu–Coromandel Road	500 0 0	..	500 0 0
Road up Dart River	200 0 0	..	200 0 0
Improving roads and tracks, Collingwood to Takaka and Motueka	11,194 10 10	10,905 8 11	289 1 11
	51,097 2 6	45,095 17 6	5,201 5 0
SCHOOLS OF MINES.			
School of Mines	9,986 7 9	9,986 7 9	..
School of Mines (Otago University)	3,000 0 0	3,000 0 0	..
	12,986 7 9	12,986 7 9	..
PROSPECTING SUBSIDIES.			
Kapanga Gold-mining Company (Limited)	20,000 0 0	337 0 0	663 0 0
TRACKS FOR OPENING UP MINERAL LANDS.			
Foot Bridge, Ngakawau River	500 0 0	80 0 7	419 19 5
WATER-RACES.			
Nelson Creek Water-race	957 16 7	957 16 7	..
Waimea–Kumara Water-race	16,628 19 7	16,628 19 7	..
Mount Ida Water-race	3,400 0 0	3,400 0 0	..
Mikonui Water-race	13,997 1 4	13,997 1 4	..
Contingencies	639 12 8	639 12 8	..
	35,623 10 2	35,623 10 2	..

Summary of Works.

	£ s. d.	£ s. d.	£ s. d.
Roads (subsidised)—			
Bay of Islands County	410 0 0	110 0 0	95 0 0
Coromandel County	3,110 0 0	420 0 0	1,135 0 0
Thames County	1,752 4 10	57 1 0	819 1 5
Ohinemuri County	760 0 0	23 0 0	357 0 0
Piako County	500 0 0	..	250 0 0
Waimea County	100 0 0	..	50 0 0
Marlborough County	..	..	..
Inangahua County	5,120 0 0	1,529 10 6	1,030 9 6
Buller County	940 0 0	87 0 0	383 0 0
Grey County	200 0 0	..	100 0 0
Westland County	320 0 0	18 19 3	141 0 9
Lake County	520 0 0	..	260 0 0
Taieri County	600 0 0	..	300 0 0
Southland County	375 0 0	80 13 4	106 16 8
	14,707 4 10	2,326 4 1	5,027 8 4
Roads wholly constructed by Mines Department	51,097 2 6	45,095 17 6	5,201 5 0
Water-races	35,623 10 2	35,623 10 2	..
Prospecting subsidies	20,000 0 0	337 0 0	663 0 0
Schools of Mines	12,986 7 9	12,986 7 9	..
Tracks to open up mineral lands	500 0 0	80 0 7	419 19 5
	134,914 5 3	96,449 0 1	11,313 11 11

LIST of WORKS on GOLDFIELDS constructed wholly by the Mines Department, or by Subsidies to County Councils, Local Bodies, and Prospecting Associations, and completed prior to the 31st March, 1891.

Locality and Nature of Works.	Total Cost.			Amount of Contribution paid by Mines Department.		
	£	s.	d.	£	s.	d.
NORTH ISLAND.						
ROADS (SUBSIDISED).						
Coromandel County.						
Improving road to Iona and Just in Time Companies' Mine	200	0	0	133	6	8
Making and improving track from Tokatea towards Kennedy Bay	320	0	0	213	6	8
Golden Belt Track	100	0	0	50	0	0
Tokatea Road (repairs)	300	0	0	150	0	0
Making and improving track from Golden Belt to Tiki	239	3	3	159	8	10
Making road from Ring's Bridge to Kapanga Mine	150	0	0	100	0	0
Making road to Kapanga Mine	132	0	0	88	0	0
Temporary track from Tokatea Saddle to Waikoromiko	50	0	0	33	6	8
Continuation of track from Success Company's Mine to top of main range	80	0	0	53	6	8
Completion of road from Tokatea Saddle to Tokatea Battery	50	0	0	33	6	8
Widening road from Matawai to Vaughan's Claim	357	0	0	238	0	0
Improving track, Mercury Bay to Waitai	100	0	0	66	13	4
Continuation and improving Waikoromiko Track	150	0	0	100	0	0
Emily Battery to Rocky Creek	60	0	0	40	0	0
Track, Bismarck Battery to Kennedy Bay	200	0	0	133	6	8
Road up Manaia	675	10	6	450	7	0
Extension of Vaughan's and Vizard's Tracks	150	0	0	100	0	0
Vizard's towards Marebel	200	0	0	133	6	8
Extending and widening Waitaia Road	100	0	0	66	13	4
Makarau to Waiau	1,600	0	0	1,066	13	4
Waikawau to Tiki	500	0	0	333	6	8
Paul's Creek to Cabbage Bay	200	0	0	133	6	8
Waikawau Creek Track	100	0	0	50	0	0
McLaughlin's Road	100	0	0	50	0	0
Manaia to McGregor's new find	100	0	0	50	0	0
Manaia to Tiki	500	0	0	250	0	0
Old saw-mill towards Matawai	200	0	0	100	0	0
Extension of Paul's Creek Track	300	0	0	150	0	0
Matarangi Track	400	0	0	200	0	0
Thames Coromandel Road, *viâ* Manaia	300	0	0	150	0	0
Harbour View Extension	210	0	0	105	0	0
	8,123	13	9	4,980	15	10
Thames County.						
Making new road from Ohinemuri River to Karangahake Quartz-mine	650	0	0	433	6	8
Dray-road to connect Otanui Mines with crushing-battery at Maungawherawhera Creek	710	0	0	473	6	8
Improving roads from Waitekauri Road to Katikati Road	250	0	0	166	13	4
Improving road up Karaka Creek to Lucky Hit Company's Mine	263	1	0	175	7	4
Improving road to upper mines, Waitahi	258	18	10	172	12	7
Karangahake to battery	300	0	0	200	0	0
Ralph's Battery, Waitekauri	399	1	0	199	10	6
Otanui Road to mines	299	18	0	199	18	8
Road to Wick's Battery	70	0	0	46	13	4
Rocky Point Road, Tararu	300	0	0	200	0	0
Thames Borough boundary to hematite mine	350	0	0	233	6	8
Widening road from bridge over Hape Creek to Otanui Mines	183	17	0	122	11	4
Track, Karangahake Goldfield	784	1	0	522	14	0
Kauaeranga Valley to Otanui	470	7	0	313	11	4
Tapu Road to mines	81	17	9	54	11	10
Tauranga Road to Karangahake Bridge-site	341	5	0	227	10	0
Karangahake Bridge	229	6	6	152	17	8
Track up Maungakerikeri Creek	93	4	4	62	2	11
Thames Borough boundary to Hape Creek No. 2	600	0	0	300	0	0
Upper Karaka Road	179	13	0	119	15	4
Repairing flood damages, Waiotahi, Moanataiari, Karaka, and Collarbone Roads	350	0	0	175	0	0
Sea-beach to Waiomo	750	0	0	375	0	0
Te Papa Gully Road	75	0	0	37	10	0
New Find to Waiomo Battery	110	0	0	55	0	0
Rocky Point Road	429	11	10	214	15	11
Waiotahi towards Mercury Bay	522	11	0	261	5	6
Te Mata Road	178	17	6	89	8	9
Waiomo Creek to Tapu	1,499	0	0	749	10	0
Alabama Creek Track	100	0	0	50	0	0
Road from Prospectors' Mine, Puriri, to Battery	50	0	0	25	0	0
Karaka Creek to Lucky Hit	365	0	0	182	10	0
Bullion Mine, Tapu, to Battery	36	5	0	18	2	6
Track to Hikutaia Goldfield	147	15	2	73	17	7
	11,428	10	11	6,683	10	5
Ohinemuri County.						
Jubilee Mine Track	118	0	0	59	0	0
Track up Tui Creek	306	0	0	153	0	0
Prospecting-track, Whangamata and Waitekauri	200	0	0	166	13	4
Tramway, Karangahake to Railey's Reduction-works	400	0	0	200	0	0
Strengthening bridges, Waihi Road	200	0	0	133	6	8
Paeroa to Hikutaia	400	0	0	200	0	0
Repairs, flood damages	34	13	8	17	6	10
Hikutaia River to Maratoto Mine	180	15	0	90	7	6
	1,839	8	8	1,019	14	4

LIST of WORKS on GOLDFIELDS, &c.—*continued.*

Locality and Nature of Works.	Total Cost.	Amount of Contribution paid by Mines Department.
Piako County.	£ s. d.	£ s. d.
Extension and completion of Te Aroha Tramway	18,000 0 0	12,000 0 0
Tramay to Fergusson's Battery, Waiorongomai	1,500 0 0	1,000 0 0
Road, Waiorongomai	497 17 0	331 18 0
Track to claims at Buck's Reef	55 5 6	36 17 0
Track, Fern Spur to Butler's Spur	231 17 9	154 11 10
Tracks up Stony Creek, Te Aroha Goldfield, &c.	54 0 0	36 0 0
	20,339 0 3	13,559 6 10
Hutt County.		
Road to connect Otorongo Bay with Albion Company's battery, also to connect Terawhiti Quartz-mine with battery	509 16 6	210 17 0
Road, Makara Junction to Terawhiti	450 0 0	225 9 0
	959 16 6	435 17 0
SOUTH ISLAND.		
ROADS (SUBSIDISED).		
Tuapeka County.		
Making road from top of Terrace to Waipori Bush	300 0 0	200 0 0
Road, Beaumont to Remarkable Bush	300 0 0	200 0 0
Improving road from Waipori Township to antimony-mines, Lammerlaw Ranges	200 0 0	133 6 8
Waipori Township to Waipori Bush	200 0 0	133 6 8
Clutha River to Campbell's	76 9 0	50 19 4
Waitahuna to copper-mine	200 0 0	133 6 8
Road to open up quarry for Waitahuna Bridge	160 9 10	106 19 11
Waipori Road, *viâ* Bungtown	566 8 10	283 4 5
	2,003 7 8	1,241 3 8
Southland County.		
Improving tracks from Mataura to Nokomai	75 0 0	50 0 0
Improving road, Waikaka to Leatham	150 0 0	100 0 0
Improving road from Waikaka Township to Leatham Creek	30 0 0	20 0 0
Improving road from Waikaka to Waikaka railway-siding	150 0 0	100 0 0
Widening and improving bush-track to Waikawa	150 0 0	100 0 0
Waikaia to Whitcombe	150 0 0	100 0 0
Waikaka to Switzer's	150 0 0	100 0 0
Road near Waikaka Township	150 0 0	100 0 0
	1,005 0 0	670 0 0
Westland County.		
Improving track, Butchers' Creek to Gentle Annie Terrace	225 10 0	163 13 4
Bridle-track to Kanieri Lake	719 11 0	350 5 6
Bridle-track to Eel Creek	168 9 0	84 4 6
Tunnel-track, Galway Beach to Gillespie's Beach	437 5 0	218 12 6
Road from Duffer's Creek, Greenstone Road, to fifteen-mile peg, Christchurch Road	726 9 0	480 4 6
Continuation of track, Back Creek to Eel Creek	249 4 0	166 3 4
Bridle-track, Duffer's Creek, Bowen and Okarito Road, to sea-beach	333 18 0	222 12 0
Ross Borough boundary to Mount Greenland	1,280 15 0	853 16 8
Track, Kanieri Lake to Humphrey's Gully	279 2 0	186 1 4
Track, Larrikins' to Loop-line Dam	449 11 0	299 14 0
Rough Wainihinihini to Upper Dam	450 0 0	300 0 0
Browning's Pass to Reefs	3,311 6 0	2,207 10 8
Okarito Forks to Teal Creek	600 0 0	400 0 0
Road, Christchurch to Baldhill Range reefs	500 0 0	250 0 0
Extension of Tucker's Flat Road to New Rush	170 19 6	85 9 9
	9,901 19 6	6,277 8 1
Grey County.		
Road from Notown to Deep Creek	1,100 0 0	550 0 0
Road from Langdon's to Moonlight	1,600 0 0	800 0 0
Contribution from goldfields vote towards main road	2,296 6 6	2,296 6 6
Track, Waipuna to Clarke's River	1,200 0 0	800 0 0
Track, Cameron's to Cape Terrace	700 0 0	466 13 4
Road, Limestone to Maori Creek	800 0 0	533 6 8
Red Jack's to Nelson Creek	601 17 6	401 5 0
Barrytown to Deadman's	2,240 0 0	1,493 6 8
German Gully to Arnold's Flat	120 0 0	60 0 0
Baird's Terrace to Lake Brunner	400 0 0	200 0 0
Hatter's Terrace Road	1,000 0 0	500 0 0
Irishman's to Lake Brunner	2,400 0 0	1,200 0 0
Hatter's Terrace	600 0 0	400 0 0
Track, Baird's Terrace to Irishman's	250 0 0	125 0 0
Deep Creek to Bell Hill	1,331 0 0	665 10 0
Track to Blackball Diggings	790 0 0	395 0 0
	17,429 4 0	10,886 8 2

LIST of WORKS on GOLDFIELDS, &c.—*continued.*

Locality and Nature of Works.	Total Cost.			Amount of Contribution paid by Mines Department.		
Buller County.	£	s.	d.	£	s.	d.
Deviation of road from Candlelight Flat to Deep Creek, Charleston	370	0	0	246	13	4
Road from Orowaiti Lagoon to North Terrace	256	18	6	171	5	8
Prospecting track from Razorback to Paparoa Range	100	0	0	66	13	4
Track from Seatonville to Larrikins'	438	9	6	292	6	4
Waimangaroa to Denniston	787	0	0	393	10	0
Road to connect alluvial workings with Charleston Road	400	0	0	266	13	4
Track, Four-mile Creek towards Grey Valley	300	0	0	200	0	0
Road to connect alluvial diggings north of Deadman's Creek	278	0	0	185	6	8
Ngakawhau to Mokihinui, *viâ* beaches	100	0	0	66	13	4
Road to connect Ngakawhau Railway with Mokihinui Coal Company's workings	193	0	0	128	13	4
Lyell Bluff to Victor Emmanuel Claim	650	0	0	433	6	8
Beach, Little Wanganui to Mokihinui	300	0	0	100	0	0
Cape Foulwind Road	450	0	0	300	0	0
Road up Nile Valley	56	16	4	28	8	2
Denniston extension	850	0	0	425	0	0
Promised Land towards Motueka	380	0	0	190	0	0
Road over Gentle Annie	200	0	0	100	0	0
Extension, Lyell Creek to Low-level Tunnel	60	0	0	30	0	0
Extension of track 50 chains south of Brighton	140	0	0	70	0	0
Continuation of road, Deadman's Ceeek	437	17	0	218	18	6
Ngakawau Railway-station to Mokihinui	50	0	0	25	0	0
Addison's Flat towards ranges	20	0	0	10	0	0
North Terrace to Oparara Diggings	500	0	0	333	6	8
Extension of Croninville Road	100	0	0	50	0	0
Waimangaroa to sea-beach	80	0	0	40	0	0
Extension of track, Oparara to Fenian Creek	100	0	0	50	0	0
Con's Creek to Beaconsfield	80	0	0	40	0	0
Addison's Flat to Caroline Terrace	200	0	0	100	0	0
	7,878	1	4	4,561	15	4
Marlborough County.						
Track, Deep Creek to Dead Horse Creek	68	0	0	45	6	8
Mouth of Gorge to Forks, Cullensville to Mahikipawa Diggings	450	0	0	225	0	0
Formation of road at Cullensville, Mahakipawa	217	4	0	108	12	0
	735	4	0	378	18	8
Waimea County.						
Road to open up Table Diggings	260	0	0	130	0	0
Punt over Motueka River	100	0	0	50	0	0
Repairing Baton to Tableland Track	40	0	0	20	0	0
	400	0	0	200	0	0
Inangahua County.						
Dray-road from Soldier's Creek to Devil's Creek	647	0	0	431	6	8
Dray-road from Inangahua to Rainy Creek Battery	900	10	0	606	6	8
Dray-road from Capleston up Little Boatman's Creek	379	0	0	252	13	4
Dray-road from Capleston up Main Boatman's Creek	697	0	0	464	13	4
Dray-road from Westport Road to Inangahua River	224	5	0	149	10	0
Track from Devil's Creek to Big River	134	3	6	89	9	0
Track from Waitahu River to Capleston	358	0	0	238	13	4
Survey and expenses	250	0	0	166	13	4
Track from Cariboo to Big River	728	0	0	364	0	0
Dray-road up Murray Creek to United Inglewood Claim	3,472	0	0	2,314	17	4
Road from Reefton to Big River *viâ* Devil's Creek	614	0	0	307	0	0
Road up Big River	922	19	0	615	6	0
Continuation of dray-road up Little Boatman's Creek	169	7	6	112	18	4
Road from Capleston to Larry's Creek	640	0	0	426	13	4
Track to connect Capleston with Lone Star	75	0	0	50	0	0
Crushington to Globe Company's workings	403	0	0	201	10	0
Snowy Creek Track	85	15	0	42	17	6
Reefton to Big River	1,792	0	0	1,194	13	4
Glenroy to Horse Terrace	254	0	0	122	10	0
Devil's Creek to Globe Hill	917	6	2	458	13	1
	13,672	6	2	8,610	4	7
Taieri County.						
Mullocky Gully to Silver Peak	499	15	0	333	3	4
Lake County.						
Track, Skipper's to Phœnix and Scandinavian Reefs	292	2	3	194	14	10
Track to connect scheelite mine with Lake Wakatipu	225	0	0	150	0	0
Arrowtown to Macetown, construction	225	0	0	150	0	0
Arrowtown to Macetown, maintenance	150	0	0	100	0	0
Invincible Quartz-reef Track, Rees River	300	0	0	200	0	0
Rees Valley to company's workings	61	7	6	30	13	9
Pack-track, Criffel Diggings	50	6	6	33	11	0
Left-hand Branch Road, Skipper's	63	9	10	31	14	11
Old Morven Ferry Road	283	0	0	144	10	0
	1,656	6	1	1,035	4	6

List of Works on Goldfields, &c.—*continued.*

Locality and Nature of Works.	Total Cost.	Amount of Contribution paid by Mines Department.
	£ s. d.	£ s. d.
Wallace County.		
Track, Colac Bay to Round Hill	200 0 0	133 6 8
Pack-track to Round Hill, Colac, and Orepuki	1,050 0 0	500 0 0
	1,250 0 0	633 6 8
Maniototo County.		
Road to Serpentine Diggings	136 10 0	91 0 0
Pig and Whistle to Clarke's Diggings	200 0 0	133 6 8
Shepherd's Hut Flat to Vinegar Hill	100 0 0	66 13 4
Kyeburn Peninsula to Main Road	82 0 0	41 0 0
	518 10 0	332 0 0
Collingwood County.		
Road, West Wanganui	300 0 0	200 0 0
Bridge over Aorere River	173 14 0	115 16 0
Extending Anotoki Bridle-track	160 0 0	80 0 0
	633 14 0	395 16 0
Fiord County.		
Dusky Sound Tracks	300 0 0	200 0 0
Waitaki County.		
Road, Naseby to Livingstone	41 12 0	20 16 0
Diamond and other Drills.		
Inangahua County Council (diamond)	2,000 0 0	1,000 0 0
Springfield Colliery Company (diamond)	1,250 0 0	625 0 0
Westland County Council (tiffin)	350 0 0	233 0 0
Diamond drills for prospecting purposes	848 9 11	848 9 11
	4,448 9 11	2,706 9 11
Wharves.		
Repairs to wharf, Coromandel	300 0 0	150 0 0
Anikiwi Jetty, Marlborough	135 15 9	135 15 9
	435 15 9	285 15 9
Aids to Prospecting.		
Construction of low-level tunnel, Terawhiti	750 0 0	150 0 0
Queen of Beauty Company, prospecting deep-levels	200 0 0	150 0 0
Caledonian Low Level Company, prospecting deep levels	300 0 0	150 0 0
Red Hill Gold-mining Company, prospecting deep levels	600 0 0	300 0 0
Caledonian Low Level Company, low-level tunnel	2,700 0 0	300 0 0
Lyell Creek Extended Company, low-level tunnel	300 0 0	150 0 0
New Cromwell Gold-mining Company	250 0 0	100 0 0
Deep Level Association, Waipori	450 0 0	300 0 0
Little Boatman's deep-level tunnel	600 0 0	300 0 0
Oterongia Prospecting Association	198 17 2	99 8 7
Vincent County	137 9 0	68 14 6
Tapanui Prospecting Association	25 0 0	12 10 0
Tuapeka County	12 0 0	6 0 0
Maniototo County	500 0 0	250 0 0
Pullar, Shelmerdine, and Basan	400 0 0	200 0 0
Royal Oak Association	300 0 0	150 0 0
Star of the East Quartz-mining Company	150 0 0	75 0 0
West Coast Prospecting Association	300 0 0	150 0 0
McBride and party	169 2 2	84 11 1
McLean and party	66 0 0	33 0 0
Deep-level Tunnel, Tokatea	700 0 0	350 0 0
Deep-level Tunnel, Owharoa	300 8 0	200 5 4
Deep-level Tunnel, Tapu	1,200 0 0	600 0 0
Deep-level Tunnel, Cedar Creek	1,207 10 0	603 15 0
Manuka Flat Prospecting Association	200 0 0	100 0 0
Red Hill Minerals Company	437 19 10	218 19 11
Tuapeka Prospecting Association	277 0 0	138 10 0
Cardrona Prospecting Association	800 0 0	400 0 0
Cromwell Prospecting Association	500 0 0	250 0 0
Coromandel County	550 0 0	275 0 0
Thames County	309 18 0	154 19 0
Thames Borough	200 0 0	100 0 0
Buller County	146 12 6	73 6 3
Inangahua County	488 7 0	244 3 6
Westland County	1,000 0 0	500 0 0
Grey County	871 15 2	435 17 7
Deep-level Prospecting Association, Waipori	432 9 8	216 4 10
Waipu Prospecting Association	180 0 0	90 0 0
Hokianga County	100 0 0	50 0 0

List of Works on Goldfields, &c.—*continued.*

Locality and Nature of Works.	Total Cost.	Amount of Contribution paid by Mines Department.
Aids to Prospecting—*continued*	£ s. d.	£ s. d.
Vulcan Smelting Works, Onehunga	30 0 0	15 0 0
Ohinemuri County	100 0 0	50 0 0
Waitaki County	29 5 0	14 12 6
Waihemo County	85 9 0	42 14 6
William Fox and party	711 1 8	355 10 10
Kirk and party	176 0 10	88 4 11
Hodge and party	98 13 8	49 6 10
Carey and Hyndman	441 9 4	220 14 8
Don, Boyce, and party	107 16 0	53 18 0
Quentin McKinnon	58 10 0	29 5 0
Bullion Mine, Deep-level Tunnel	300 0 0	150 0 0
Sutherland and party	30 0 0	150 0 0
Contingencies	484 15 10	242 7 11
Inangahua Low-level Tunnel	6,966 0 0	3,000 0 0
Deep-level Tunnel, Manaia	451 4 0	225 12 0
	28,481 2 10	12,717 12 9
Water-races.		
Water-main, Bull's Battery	350 0 0	100 0 0
Round Hill, Water-race	200 19 0	133 19 4
Tomkiss's Water-race	100 0 0	100 0 0
Cardrona Sludge-channel	100 0 0	50 0 0
New Water-mains, Thames Water-race	1,479 10 4	739 15 2
Argyle Water-race	7,653 15 1	7,653 15 1
	9,884 4 5	8,777 9 7
Drainage- and Sludge-channels.		
Drainage-channel, Lawrence (total cost, approximate)	3,000 0 0	2,000 0 0
Subsidy towards purchase of Messrs. Laidlaw and Crawford's freehold in Spotti's Creek, to allow tailings to be deposited (Tinker's Diggings)	500 0 0	400 0 0
Damage by floods, Thames	1,000 0 0	500 0 0
Sludge-channel, Smith's Gully, Bannockburn	1,000 0 0	251 1 0
Round Hill Sludge-channel survey	52 19 7	52 19 7
Compensation to J. Costello, damage done by tailings	788 0 0	788 0 0
Long Gully Sludge-channel	150 0 0	100 0 0
New Pipeclay Gully Sludge-channel	1,547 18 0	773 19 0
Kumara Sludge-channel, No. 2	2,762 17 2	2,762 17 2
Ophir Tail-race	2,300 0 0	1,150 0 0
Lawrence Drainage-channel	1,150 0 0	956 14 0
Muddy Creek Channel	2,000 0 0	1,000 0 0
St. Bathan's Channel	2,000 0 0	1,000 0 0
Tailings-outlet, Maerewhenua	1,595 4 0	1,595 4 0
Ross Sludge- and Storm-water-channel	1,554 10 6	1,554 10 6
	21,401 9 3	14,885 5 3
Aid towards the Treatment of Ores.		
Testing-plant, School of Mines, Thames	1,200 0 0	600 0 0
Testing minerals, Dunedin Exhibition	142 8 9	142 8 9
	1,342 8 9	742 8 9
Roads wholly constructed by Mines Department.		
Construction of road, Arrowtown to Macetown	9,270 6 8	9,270 6 8
Road to open up Woodstock Goldfield	1,000 0 0	1,000 0 0
Ahaura to Amuri	2,504 19 7	2,504 19 7
Waikaia Bush Road	1,000 0 0	1,000 0 0
Waitahuna Bridge	750 0 0	750 0 0
Merrivale Tracks	500 0 0	500 0 0
Mokihinui to Specimen Creek	1,238 7 5	1,238 7 5
Wilberforce Quartz-reef Road	1,830 17 7	1,830 17 7
Opening Mokau River	552 8 0	552 8 0
Lyell to Mokihinui	5,098 8 6	5,098 8 6
Brighton to Seventeen-mile Beach	1,789 7 2	1,789 7 2
Whangapeka to Karamea	2,000 0 0	2,000 0 0
Hatter's Terrace to Bell Hill	500 0 0	500 0 0
Cedar Creek Road	3,000 0 0	3,000 0 0
Owen Valley Road	2,208 9 2	2,208 9 2
Cobden to Seventeen-mile Beach	3,036 1 4	3,036 1 4
Cedar Creek Road	1,500 0 0	1,500 0 0
Bridle-track to Upper Anatoki	722 8 0	722 8 0
Whangamata Road	141 10 6	141 10 6
Waikawau to Manaia	1,000 0 0	1,000 0 0
Karangahake through Gorge	1,000 0 0	1,000 0 0
Arthur's Point to Skipper's	12,167 4 1	12,167 4 1
Tracks to Coal Island	54 6 3	54 6 3
Grey Valley to Teremakau	900 0 0	900 0 0
	53,764 14 3	53,764 14 3

LIST of WORKS on GOLDFIELDS, &c.—*continued.*

Liability and Nature of Work.	Total Cost.	Amount of Contribution paid by Mines Department.
ROADS TO OPEN UP MINES OTHER THAN GOLD.	£ s. d.	£ s. d.
Aniseed Valley to Champion Copper-mine	4,963 10 6	4,116 10 6
Richmond Hill to Copper-mine..	315 16 0	209 4 0
Track, Ohinemuri Coal-seam	267 3 4	133 11 8
Road, Kanieri Coalfield	600 0 0	300 0 0
	6,146 9 10	4,759 6 2
TRACKS TO OPEN UP MINERAL LANDS.		
Glory Harbour to Kopack	50 0 0	50 0 0
Port Pegasus Track	155 7 6	155 7 6
	205 7 6	205 7 6

Summary of Works.

	£ s. d.	£ s. d.
Roads (subsidised)—		
Coromandel County	8,123 13 9	4,980 15 10
Thames County	11,428 10 11	6,683 10 5
Ohinemuri County	1,839 8 8	1,019 14 4
Piako County	20,339 0 3	13,559 6 10
Hutt County	959 16 6	435 17 0
Tuapeka County	2,003 7 8	1,241 3 8
Southland County	1,005 0 0	670 0 0
Westland County	9,901 19 6	6,277 8 1
Grey County	17,429 4 0	10,886 8 2
Buller County	7,878 1 4	4,561 15 4
Marlborough County	735 4 0	378 18 8
Waimea County	400 0 0	200 0 0
Inangahua County	13,672 6 2	8,610 4 7
Taieri County	499 15 0	333 3 4
Lake County	1,656 6 1	1,035 4 6
Wallace County	1,250 0 0	633 6 8
Maniototo County..	518 10 0	332 0 0
Collingwood County	633 14 0	395 16 0
Fiord County	300 0 0	200 0 0
Waitaki County	41 12 0	20 16 0
	100,615 9 10	62,455 9 5
Diamond and other drills	4,448 9 11	2,706 9 11
Wharves	435 15 9	285 15 9
Aids to prospecting	28,481 2 10	12,717 12 9
Water-races	9,884 4 5	8,777 9 7
Drainage- and sludge-channels	21,401 9 3	14,885 5 3
Aid towards treatment of ores	1,342 8 9	742 8 9
Roads wholly constructed by Mines Department	53,764 14 3	53,764 14 3
Roads to open up mines other than gold	6,146 9 10	4,759 6 2
Tracks to open up mineral lands	205 7 6	205 7 6
	226,725 12 4	161,299 19 4

HENRY A. GORDON, M.A.Inst.M.E.,
Inspecting Engineer.

RETURN showing the VALUE of the SALES of WATER, and EXPENDITURE on, and COLLATERAL ADVANTAGES derived from, the Working of the WATER-RACES constructed and maintained by GOVERNMENT, during the Year ending 31st March, 1891.

Name of Water-race.	Value of Sales of Water and Channel-fees.	Expenditure on Maintenance.	Profit or Loss.	Cost of Construction.	Total Cost of Construction.	Percentage on Capital invested.	Average Number of Men employed.	Approximate Amount of Gold obtained.	Value of Gold obtained.	Average Weekly Earnings of Men after deducting Value of Sales of Water and Channel-fees.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£		Oz.	£ s. d.	£ s. d.
Waimea	1,388 17 5	933 3 3	455 14 2*	118,762 11 8		0·4	88	3,072	11,673 12 0	2 4 11
Kumara	7,579 11 0	1,766 4 3	5,813 6 9*	38,521 4 9	179,248 14 7	15	155	9,935	37,753 0 0	3 14 10
Kumara Sludge-channel	1,117 11 5	1,108 1 1	9 10 4*	21,964 18 2		..	62½	..	..	..
Nelson Creek	570 5 0	939 19 8	369 14 8†	..	90,722 10 8	..	28	965	3,691 2 6	2 2 10
Argyle	242 0 10	635 18 6	393 17 8†	..	14,701 15 3	..	19	283	1,089 11 0	0 17 2
Mikonui	50 0 0‡	..	50 0 0*	..	25,644 9 6	..	..	..	..	..
Totals	10,948 5 8	5,383 6 9	5,564 18 11	179,248 14 7	310,317 10 0	1·79	352½	14,255	54,207 5 6	2 7 0

* Profit. † Loss. ‡ Rent.

HENRY A. GORDON, M.A.Inst.M.E., Inspecting Engineer.

APPENDIX I.

WARDENS' AND WATER-RACE MANAGERS' REPORTS.

No. 1.

Mr. Warden BISHOP to the UNDER-SECRETARY of MINES.

SIR,— Warden's Office, Whangarei, 6th June, 1891.

I have the honour to report as follows upon the state of mining matters in the Puhipuhi Mining District, of which I assumed charge as from the 1st January, 1891:—

Being a new field, very little has been done to develop the various mines outside of the Prospectors'. In this latter a very great deal of most important work has been done, and this, too, in the face of enormous difficulties, the principal of which was the want of a road to get machinery conveyed on to the ground. However, assisted by the Government, a road has now been completed by the directors of the Prospectors' Company, and the field is fairly accessible.

The Prospectors' Company has erected machinery capable of treating about 60 tons of stone per week, and experimental crushings have been carried out. The stone, so far, has averaged 55oz. of silver to the ton, and this, too, from stone that was not picked. The machinery works fairly well, and, although on a small scale, has fully carried out the objects for which it was erected. These objects were—first, to prove that the stone could be successfully treated by the process adopted; and, second, to prove that silver could be extracted in payable quantities. The machinery is worked by water-power, but, as water is very limited in that locality, some other motive-power will require to be sought before long.

The success attending the Prospectors' efforts has given an impetus to mining matters generally, and operations in various mines are now being vigourously pushed ahead. Very promising reefs have been discovered in several of the claims, and steps are being taken to develop them. The field can only be successfully worked by the expenditure of considerable money, and its advancement must, therefore, be necessarily slow.

The Courthouse here was destroyed by fire in March last, together with all records. I am therefore unable to supply any statistics of the amount of work done by the Warden's Court.

I enclose Mr. George Wilson's annual report upon the various mines.

I have, &c.,

The Under-Secretary, Mines Department, Wellington. H. W. BISHOP, Warden.

No. 2.

Mr. G. WILSON, Inspector of Mines, to the UNDER-SECRETARY of MINES, Wellington.

SIR,— Inspector of Mines' Office, Thames, 1st May, 1891.

I have the honour to forward the following report of mines in the Puhipuhi Mining District:—

Prospectors' Mine (Mr. George Kerr, mine-manager).—The principal works carried on during the year were the opening of No. 3 and Wilson's Reefs, and constructing a tramway, water-race, and crushing-mill.

No. 3 Reef.—The level on this reef, which was opened at about 50ft. under the outcrop, has been driven for about 300ft. The reef, which was about 7ft. in thickness when intersected at the cross-cut, appears to have varied in size, and at the south end is split into two parts, about 9in. of quartz in each branch. A great portion of the reef at this end remains intact, the drive being put in on the foot-wall, and the quartz not broken down. At the north end it cannot be said what the thickness may be, as very little of the quartz has been broken, the drive being in the foot-wall of the reef. The quartz is stripped, ready to be broken out and sent to the mill when the tramway connected is completed. Another cross-cut has been made to cut the reef 70ft. deeper, and a winze sunk from the level above, but, as the quartz has not been broken in the winze, the size and appearance of the reef is not known. About 17ft. has been driven on the reef at this level, which appears to be broken up, and only a few inches in thickness. A drive has been put in, and the Wilson Reef cut near the tramway. This reef is about 18in. in thickness. Several reefs have been opened near the surface, but the chief work has been done on No. 3 reef. Four tons of quartz from No. 3 reef, treated at the School of Mines, Thames, yielded 128oz. 17dwt. of silver; and a half-ton treated by the Watson and Denny pans, at the Onslow Works, Thames, yielded 26oz. of silver, in each case value 3s. 6d. per ounce.

Tramway.—A tramway 18 chains in length is being constructed from the low level towards the battery, but, as the fall would be too great, a shoot of about 130ft. will be used to carry the quartz from the upper portion of the tramway to the lower, which connects with two calcining kilns excavated in the rock near the mill, and calculated to hold 40 tons each. Half-ton trucks are to be used on the tramway.

Water-race.—The race, when completed, will be 18 chains in length, in two branches, and is constructed of fluming of kauri timber, and 330ft. of 14in. wrought-iron piping will connect with a Pelton wheel 7ft. 2in. in diameter. It is expected that a dam will be required for storing water, as there is not a great deal in the creek, and a sluice-head and a half is required to drive the mill, the pressure being 165ft.

Crushing-mill.—The mill consists of a 40-ton stone-breaker, rigid rolls, to run at thirty-five revolutions per minute; Askham Wilson pulveriser, to run at 400 revolutions per minute; four Wheeler pans 5ft. 7in. in diameter; two settlers, 7ft. 2in. in diameter; one vertical boiler, for steam required in amalgamation. The machinery is being erected under the supervision of Mr. John Marks, engineer.

Treatment of Quartz.—The quartz will first be calcined in the kilns, and from thence passed through the stone-breaker, thence through the rolls, and from thence to the pulveriser; it will then be amalgamated in the pans, heated by steam, and chemicals will be used to aid amalgamation. The mill-house is so constructed that the quartz will pass from each process to the next by gravitation, the stone-breaker being on the highest floor and the settlers on the lowest. The plant should be ready for crushing about the end of May, and a return may be soon expected, and, as silver sulphides show freely in portions of the reef, it is to be hoped that the result may be remunerative. Small specks of native silver and also ruby silver are occasionally found in the quartz. A considerable amount of prospecting has been done in other mines in the vicinity of the Prospectors', and most of the reefs cut show the presence of silver.

Prospectors' No. 2.—Two reefs have been worked on, one 7ft. and the other 3ft. in thickness. A hundredweight of quartz from each reef, crushed at Waiorongomai, yielded fair prospects of silver.

Ophir.—One hundred and twelve feet of driving has been done in prospecting, and a reef 1ft. 6in. thick discovered carrying silver.

Kamo and Kamo Extended.—Two hundred feet of driving has been done, and several reefs discovered, all carrying silver.

Just in Time.—A drive has been put in 40ft. on a reef 2ft. 6in. thick, and a cutting put in 22ft. above the drive. Several cuttings have shown the reef further up the hill. Sixteen hundredweight of quartz crushed at the School of Mines, Thames, yielded 9oz. 3dwt. of silver.

Young Colonial.—About 72ft. of a cross-cut was driven, and a reef cut. A lower cross-cut was then driven about 160ft., and two reefs cut, one 12in. and the other 3ft. in thickness, both carrying silver in the stone.

Wai Maria.—Two hundred feet of cross-cut has been driven, and two reefs, one 3ft. and the other 7ft., have been cut, carrying silver.

Try Fluke.—One hundred and thirty feet has been driven, and three small reefs about 9in. thick have been cut, carrying silver.

United.—Eighty feet has been driven, and two reefs cut, carrying silver.

Silver Fleece.—One hundred and fifty feet driven, and a reef cut.

Caledonian.—Eighty feet driven and surface workings. Small leaders found carrying silver.

Tupono.—Two hundred feet of driving done, but no reef yet cut, but a 5ft. reef shows silver-bearing quartz at the outcrop.

Comstock No. 3.—Two hundred and eight feet driven, but no reef cut.

Alameda, Alburnia, Albion, Little Agnes, and several other claims have been prospected on the surface.

Wairiki District.

Jubilee.—One hundred and fifty feet driven, and two reefs cut carrying silver.

No. 3 Company.—Two hundred feet of driving done, and a 4ft. reef and small leaders cut carrying silver.

Luminary.—Two hundred feet driven, and several reefs cut carrying silver.

Ruby.—One hundred and twenty feet driven, and a 3ft. reef cut carrying a little gold and silver.

Caledonian.—A cross-cut 89ft. has been driven to cut a reef 18in. to 3ft. thick. The reef, which carries a ittle gold and silver, has been driven on 45ft., and other surface drives, 170ft. in all, put in at different places. Sixteen hundredweight of quartz crushed at the School of Mines, Thames, yielded 4oz. 5dwt. of gold and silver bullion.

Lone Hand.—One hundred feet driven, but no reef cut.

Khartoum.—One hundred and ten feet of driving done, but no reef cut.

Caberfeigh and Comstock.—Forty feet driven, but no defined reef cut.

Several parties have prospected in various parts of the Puhipuhi Forest, but I have not heard of any valuable discoveries.

There is no doubt that silver has been proved to be present in the quartz in most of the reefs worked on in the district, but no large parcels have been sampled. It is probable that those reefs have been overestimated, as small parcels, or select pieces of quartz only, have been assayed, and the results published. This method is very misleading, as the value of reefs can only be ascertained by sampling large parcels of the quartz.

The average number of men employed in mining at Puhipuhi during the year I estimate to be about seventy. During the earlier months of the year a greater number of men were on the field, but later the majority of them left, and the Prospectors' Mine was the only one where continuous work was carried on with six men. The other mines where work was being done employed from two to four men. The total number of men engaged in mining on the field during my last visit in March last was fifty-five, forty of whom were employed on the Prospectors' Claim. The number of gum-diggers in the district during last March were (as near as I could ascertain) from two hundred to two hundred and fifty.

The Air-line Road has been made fit for wheel-traffic from the main road at the south end of Puhipuhi to the Comstock Hotel, on the tableland near the mines, and a sledge-road from the Air-line to the Prospectors' battery-site on the Tangiapakura Creek.

Taumarere to Puhipuhi Road.—The Bay of Islands County Council has improved the road to Tirohanga, and made side-cuttings on both sides of the Tirohanga Gorge, and also cleared and formed portions of the track from Tirohanga to Parson's and from Parson's towards the tableland. The roads from both the north and south ends to the mines will be very much cut up during the winter, as the formation is chiefly in soft soil and clay.

I have, &c.

GEO. WILSON, Inspector of Mines.

The Under-Secretary, Mines Department, Wellington.

No. 3.

Mr. Warden NORTHCROFT to the UNDER-SECRETARY of MINES, Wellington.

SIR,— Warden's Office, Thames.

I have the honour to forward herewith statistical returns for the Hauraki Mining District for the year ended 31st March last, and also the following report on the mining industry n the district for the same period :—

The operations throughout the district have, compared with those of the last few years, been fairly successful. The quantity of gold produced shows a slight increase on the last year for the whole district, with the exception of Te Aroha, in which locality, I regret to say, mining has been almost at a standstill. The mining population has not this year been decreased, as during the previous year or two, by the exodus of miners to the goldfields of Australia and South Africa; neither do there seem to be any men in the district out of employment. With the exception of the recent development of the Waihi Company's mine at Waihi, Ohinemuri, and some of the mines at Kuaotunu, there is not any change of importance in this district to notice. The great want of some process at once efficient and cheap, by which the refractory and complex ores of this peninsula may be profitably treated, is still one of the causes which militate against a greater prosperity in the mining industry throughout the whole district. This is more especially the case at Te Aroha and Ohinemuri, where silver in chemical combinations largely predominates. At Kuaotunu, owing to the fineness and lightness of the gold, it is found impossible, with the ordinary treatment by stampers and grinding-pans, to save more than about 60 per cent. of the bullion. The Cassell process, which, judging by its results, seems to hold out the promise of greater success than any other method yet introduced, has, unfortunately, not yet been adopted elsewhere than at the Crown Mine at Karangahake. This is owing chiefly to the restrictions imposed on its use by the conditions on which the patent rights are held in this colony. That it is successful in the treatment of auriferous and argentiferous ores difficult to treat by any other process is proved by its application to quartz from Karangahake and Waihi.

For the treatment of free but fine gold the Watson and Denny grinding-pans, first introduced into this district by the Paroquet Company at Waiomo, have proved more successful than the old berdans in use, and have been effectively applied to the extraction of gold from the tailings on the Thames foreshore—the produce of years of crushing by the mills in the vicinity.

These pans, as well as others perfected and introduced by Mr. George Fraser, of Auckland; Mr. Fraser, of Coromandel; and Messrs. Price Brothers, of Thames, each possessing a modification of the same principle—that of a continuous still discharge—have been adopted by several of our batteries, particularly those of recent construction.

Though mining in this peninsula is still successfully prosecuted, and works are being carried on in various parts with vigour, yet it is the opinion of those qualified to judge that the latent capabilities of the district are such as to justify operations on a larger and more expensive scale than those usually attempted. To do this capital is essential, and, as the necessary funds cannot be obtained in this colony, efforts have been made from time to time to obtain the assistance of capital from England and Australia. Occasionally the endeavour has been successful, but, unfortunately, in many cases the results have not been such as to induce capitalists at a distance to invest in our mines. In some instances, no doubt, the investors were misled as to the nature and value of the property acquired; and it is to be deplored that men, actuated solely by motives of selfishness, should be able to foist upon strangers a valueless property, to the irreparable injury of the district, and loss to the country at large. There are in this colony numbers of perfectly legitimate ventures in mining awaiting the advent of capital to turn them into profitable investments; but, so long as such practices obtain, so long will it be difficult to attract the necessary capital to our shores. In other cases failure has resulted more from the ill-advised expenditure of the funds in premature and, frequently, unnecessary outlay, as, for example, the erection of costly and elaborate buildings, water-races, tramways, &c., before any practical attempt was made to carry on the more essential operations in the mine itself. Several of these companies were floated with a large capital, a great proportion of which was paid to the promoters, but which, as far as the property itself is concerned, would have been more profitably and advantageously employed in opening out and working the mine. A few mines—such as the Kapanga at Coromandel, Crown at Karangahake, and Waihi at Ohinemuri—are still being worked by foreign companies; but most of the others which have from time to time been so taken up are either abandoned or have ceased operations. Such, for instance, has been the fate of the Kimberley special claim and Crawford's special claim, both in the Thames district, which were disposed of by their owners to companies formed in Sydney, New South Wales. Very little work has been done on the former, but on the latter pumping and winding machinery, steam-boilers and engines, houses, &c., have been erected, and considerable work done in the mine. Owing to the large proportion of paid-up shares in the company, the burden of carrying on work in the mine fell

upon the few contributing shareholders, who were unable to bear it. Several creditors having obtained judgment against the company, it has been wound up, and all further operations in the mine are at a standstill. There is good reason to believe that the further prosecution of the work at the expenditure of a small amount of capital would have rendered the mine payable. These failures of foreign companies are much to be regretted, as our mines suffer in reputation, often undeservedly, and the district generally is deprived of the opportunity of obtaining capital, which is so greatly needed for the development of its resources.

The Mining Inspector has, in his report, so fully entered into the details of work done in the various mines of the district that it will be unnecessary for me to allude more than generally to the operations carried on in the many mines of this district during the past year.

Coromandel.

At Coromandel the number of men employed has been less than usual, owing to so many having gone to Kuaotunu. Early in the year the Kapanga Company came upon rich gold in their mine, and for some months the returns were very good. Lately, however, they have fallen off. Work is now confined to the 320ft. level, but the quartz obtained is hardly payable. The shaft is now down 560ft.

Scotty's Mine is owned by a Sydney syndicate. They have now opened out a good block of ground, from which fair specimens have been obtained. It is their intention to purchase or rent Mayne's battery, and to sink 200ft. or 300ft., so as to cut the run of gold obtained in the Kapanga at this depth. The Tokatea and Royal Oak (formerly among the richest mines at Coromandel), which have for some time been carried on by tributers, have been almost deserted, the tributers having found more profitable employment at Kuaotunu. It is intended to form a company to work this ground more energetically. In the meantime the reduction of the percentage charged to tributers from 25 per cent. to 10 per cent. will induce many to return.

In the Waikoromiko district several parties of prospectors have lately been at work, and Lillis and party have found rich stone on the Kauri Timber Company's land. In the Coromandel Mine, near the beach, work is at present suspended. This mine (which formerly yielded large quantities of gold) has been worked for the past three years by an English company. They have erected powerful pumping machinery, and spent a considerable sum in developing the mine, but so far their returns have been inconsiderable. It is their intention to sink deeper. At the Tiki, mining is almost suspended. Vizard's Mine, at Matawai, has been worked during the year, and several crushings of small quantities have given good results. Manaia may be said to be deserted, most of the miners having gone to Kuaotunu.

Kuaotunu.

Since my last report the Try Fluke battery has been completed. Another battery of ten stamps has been erected about a mile from the landing by the Kuaotunu Quartz-crushing Company, and two other ten-stamp batteries are in course of erection. A new principle has been introduced in these batteries—viz., the doing-away with the blankets, and, instead, running the tailings from the copper tables through pipes into continuous-acting grinding- and amalgamating-pans. These batteries are all erected on the same principle, and are driven by steam. The principal gold produced has been from the Try Fluke licensed holding, which yielded 5,077oz. from 3,083 tons of quartz. A fresh reef has been discovered in the levels worked, and rich prospects have been recently obtained in the main reef, adding materially to the value of the mine. With the exception of the Great Mercury, Red Mercury, Carbine, Otama, and Just in Time Claims, crushings from which have given good results, the returns from other mines have not been altogether satisfactory. A good deal of work is being carried on in the district, and, though all the mines now being worked will not probably prove payable, I believe the permanence of the field is assured; and, with the introduction of some method of saving a higher percentage of the fine gold characteristic of this locality, I look forward to a prosperous future for this portion of the district. Since my last report the Native owners of Kuaotunu No. 1c and No. 2a, on which a great portion of the mines of the district are situated, have ceded to the Crown the right to mine over the land. In consequence, licenses under "The Mining Act, 1886," have in all instances been issued by the Warden, in lieu of the unsatisfactory and illegal titles under which they had been held. The change is much appreciated by the miners and the public generally, as security of title and freedom from irksome conditions have encouraged the occupation of the land and the consequent development of its resources. A Government township has been laid off, and many of the sections have been granted to applicants, and substantial buildings erected thereon. Ample reserves have at the same time been laid off for Native use and cultivation.

Kauri Timber Company's Land.

A considerable amount of prospecting has been done on this land, but the unpopularity of the company's regulations has caused most of the miners to abandon it. The Owera and Lanigan's Mines are, however, still working. The first mentioned is situated on the Owera Creek. A large reef has been opened out and several parcels of quartz have been treated at the Thames with satisfactory results. Six tons crushed at Fraser's, in Auckland, yielded, 30oz. of bullion, worth £2 per ounce. Lanigan's Mine is on the Opitonui Creek, under north-east side of Castle Rock. A large reef from 2ft. to 10ft. in width is being worked. A Pelton wheel and battery of ten stamps have been erected, and a large quantity of quartz has been crushed.

Cabbage Bay District.

For some time past Vizard and party have been prospecting in the neighbourhood of Cabbage Bay, and a few weeks ago discovered a reef 2ft. thick, showing gold freely. They are breaking down the leader, and intend sending a crushing to the Thames in a few weeks. The find has caused some

excitement at Coromandel, and the surrounding ground has been marked off and several licensed holdings applied for. The find is situated on a leading spur running from the main range towards Cabbage Bay, and is distant about ten miles from Coromandel and five from Cabbage Bay.

Tapu Creek and Waiomo.

A few mines have been at work at Tapu Creek, principally Sheridan's, from which very good quartz has been obtained; Bull's claim, the owners of which have erected a small battery; and Burke and party (the Centennial), working on Newby's homestead selection, recently excluded from the goldfield. Other parties are working small claims, but the total yield of gold from the district has not been large.

At Waiomo, which, owing to the collapse of the Paroquet Company and the sale and removal of the battery from the district, has been almost neglected during the past two years, operations have again commenced. This has been caused by the discovery of a large reef averaging about 40ft. in width, which contains silver in the form of sulphides, and from which small parcels have yielded, under suitable treatment, excellent results. Three licensed holdings have been applied for on this reef, and steps are being taken for the re-erection of a battery in the district; but the find is so recent that very little further can be said of it at present.

Thames.

This is still the principal centre of mining in the district, and contains the greatest number of gold-producing mines. In a district so long and continuously worked there is not much change to notice from year to year. The yield of gold for the past twelve months compares favourably with that of recent years. The mines from which the gold has been obtained are chiefly those which have been in operation for many years, such as the Moanataiari, Waiotahi, Saxon, Cambria, and others. The Fame and Fortune and the Occidental (old mines reopened) may be mentioned among the newer mines which have contributed materially to the gold returns for the year. There are no new discoveries of any importance to mention. During the year a great many licenses have been granted for land which for some years has lain unoccupied, or on which very little mining has been carried on. Prospecting has been resumed on these lands, but so far with not much success; and the small capital raised by the sale of promoters shares, supplemented by one or two calls, having become exhausted, it is probable that much of the land will be surrendered or forfeited, and become once more unoccupied until it can be again taken up with a gaurantee of sufficient capital to survive the shock of a temporary disappointment.

In the Upper Tararu several licensed holdings have been granted. Gold-bearing reefs exist in the locality, and rich specimens are occasionally met with; but the distance from a battery, and the patchy nature of the reefs, have tended to discourage prospecting, and work is carried on at present by only a few parties in a desultory manner. Land has been taken up at the head of the Puru Creek, and machine-sites and water-races granted, but, though a few specimens have been met with, no work of any importance has yet been attempted. The principal interest in the Tararu district has for some time centred in the Sylvia special claim, concerning which the most varying reports have been circulated. Many of the shares have been sold in Melbourne, and the mine is now largely held in Melbourne. Assays from the reefs have given the most astonishing results; but, as the ore contained a large percentage of silver, and is of a nature that cannot be profitably treated with the appliances in use here, the directors decided to erect on the ground crushing and concentrating machinery, with the intention of exporting the concentrates for treatment elsewhere, probably at Freiberg, in Germany. This machinery consists of a series of separators, jiggers, revolving concentrating-tables, and buddles. The machinery has now been working for about two months; and the returns so far are 501 tons quartz crushed and concentrated, yielding gold—30oz. valued at £3 14s. per ounce, and 35 tons concentrates worth £1,200. It must be admitted that the result so far has been disappointing, but the shareholders still express confidence in its ultimate success.

Puriri.[1]

During the last two or three years this portion of the field, abandoned previously for many years, has again been tried. Two batteries have been erected and water-races and other works constructed. Operations have not, however, proved payable, and it is almost again abandoned, only a few men being employed.

Karangahake, Owharoa, and Waitekauri.

Karangahake still continues to be a disappointment. Valuable reefs are known to exist in the locality, but year after year no progress seems to be made, owing, in a great measure, to the inability to turn to account the valuable ores of the district. The Crown Mine is the only one that has employed any number of men during the year. A new reef has been discovered in the creek-level, and so far has yielded excellent crushings. The English company owning the mine has lately been re-formed, with the idea of carrying on more vigorously the working of the mine. It is in contemplation to remove the Cassell reduction-works (employed in connection with the mine) from the present unsuitable position to to the flat near the junction of the Ohinemuri and Waitawheta Rivers. The situation will be more central, and render the plant available for other mines in the district. The Woodstock Company have continued work during the year, but there is nothing new to report in respect to their mine.

At Owharoa work has been carried on in the Smile of Fortune and a few other mines, but only a limited number of men have been employed. A movement is now on foot to amalgamate a number of mines in this district, to be owned and worked by one company. It is proposed to erect improved crushing machinery, to be driven by water-power, of which there is an abundant supply in the immediate vicinity, the object being to turn to account the low-grade ore found in the locality.

At Waitekauri an activity is apparent which contrasts favourably with the state of things during the last few years. Mr. T. H. Russell has purchased from the owners the Waitekauri licensed holding, battery, water-races, &c., and has also applied for a special claim for the purpose of working the large but poor reefs within the area. Extensive alterations and improvements have been made to the battery, water-races have been repaired, and tramways re-erected. Work has been resumed in the mine, and is being energetically pushed forward. The Jubilee special claim is being vigorously worked by Mr. E. Kersey Cooper, and the results have been so far very encouraging, although nothing of any great value has yet been discovered.

WAIHI.

At Waihi the principal work of the district centres in the Waihi Company's mine. This mine, with its extensive battery and crushing-plant, water-races and tramways, and the enormous reef, yielding throughout its extent payable ore, is unique in the history of mining in this peninsula. The principal operations are confined to the Martha Reef, a large body of ore ranging from 20ft. to 60ft. in width, and yielding stone averaging about £3 per ton. During the year 34,324oz. of bullion, valued at £22,540, have been produced, and, so far as can be judged, this mine will afford profitable employment for many years to come. The only other mine in the district from which payable returns have accrued is the Silverton licensed holding, now worked on tribute; 270 tons of ore were sold for £1,058, and treated at Waihi and Karangahake.

Encouraged by the success of the Waihi Company, applications have been made for several licensed holdings and special claims in the immediate vicinity, the object being to determine whether the reef extends into the plain beyond the hill known as the "Martha Hill," where it is now being worked, and, if so, to obtain the necessary capital essential to the expensive operations which will be necessary for the development of this reef.

TE AROHA.

Very little mining has been carried on at Te Aroha. During the past year a few tributers have been employed on the New Find licensed holding, and a limited number of men on Ferguson's New Era special claim. Work has been resumed on the Old Colonist ground, now known as the Warrior. The extensive battery and plant and all the mining properties of the Te Aroha Gold- and Silver-mining Company have been sold to Wick and party, who intend to recommence operations on the New Find portion of the property.

At the Tui Creek, the Champion Company have been putting in a low level to cut the reef at a greater depth.

I have, &c.,
H. W. NORTHCROFT, Warden.

The Under-Secretary, Mines Department, Wellington.

No. 4.

Mr. GEORGE WILSON, Inspector of Mines, to the UNDER-SECRETARY of MINES, Wellington.

SIR,— Inspector of Mines' Office, Thames, 4th May, 1891.

I have the honour to forward the following report on mines in the Hauraki Mining District, with a schedule showing returns of quartz crushed and yield of gold and number of men employed for the year ending the 31st March, 1891:—

The quantity compared with last year's returns of gold shows an increase in the Coromandel County, Thames Borough and County, and Ohinemuri County; but a decrease in the Te Aroha District, Piako County. The increase in Coromandel is due to the excellent returns from the Try Fluke Mine, at Kuaotunu; but there has been a falling-off in the Coromandel district, which is in a great measure owing to a number of miners who were chiefly engaged in tributing having gone from thence to Kuaotunu. The returns also from the Kapanga Mine are much less than those of the last year. In the Thames district the yield from the Moanataiari, Fame and Fortune, Trenton, Dives, Occidental, Saxon, Cambria, and Waiotahi Mines have materially aided the increase in the returns. In the Ohinemuri district the returns for the Maratoto, Crown, Silverton, and the Waihi Company's mine have been satisfactory, and added greatly to the yield.

COROMANDEL COUNTY.

Tokatea Range (Coromandel).

Tokatea Mine (Mr. John Benney, manager).—Mining operation have, as formerly, been entirely carried on by tributers, who have been working on small veins, chiefly on the surface. This mine, which for many years was owned by the Tokatea Company, has lately been transferred to Mr. J. H. Whiteford, who intends to float a company and raise capital to construct a water-race to drive the battery by water-power. It is expected that large quantities of quartz which have hitherto been valueless on account of the want of necessary crushing appliances convenient to the mine will be profitably worked when water-power is available for crushing purposes. In the meantime, tributes are let at 10 per cent., which is more reasonable than the 25 per cent. formerly charged by the Tokatea Company.

Queen of the North Mine (Mr. Carlo Blasch, manager).—Very little work has been done in this mine. A party of two tributers obtained 54oz. of gold from 3 tons of quartz.

Royal Oak Mine (Mr. Peter Reid, manager).—Work has been carried on in this mine partly by wages-men and partly by tributers.

Rob Roy Mine (Mr. John Mayn, owner).—A party of tributers have been engaged working on small veins in the low level of this mine.

Bismarck Mine (Mr. Benjamin Dunn and party).—The mine has been entirely worked on tribute. The workings are on a reef 2ft. in thickness, and a run of gold has been worked from the low level to a height of 75ft.

Harbour View Mine.—The surface portions of the mine have been worked by small parties of tributers.

The Stanley, Bennett's, Connor's, Gibb's, Rockliff's, Ness-side, and Horne's Claims are worked in this locality, but the returns of gold could not be ascertained. An average of fifteen men is working in these claims.

Kapanga (Coromandel).

Kapanga Mine (Mr. W. H. Argall, manager).—The shaft in this mine has been sunk 12ft., and is now 572ft. in depth. Sinking was discontinued on account of the large quantity of water, more powerful machinery being required to keep it under whilst sinking below the 550ft. level. The chief work carried on has been between the No. 2 and No. 3 levels, where 1,273ft. of driving has been done on reefs and 160ft. in cross-cuts. Ninety-seven feet of sinking winzes, and 325ft. of rising on reefs (the Scotty and Kapanga), both of which average 15in. in width, and on which 163 square fathoms of reef have been stoped out. The length of drives open on which rails are laid is 4,131ft. Three steam-engines are used for winding, crushing, and pumping; coal is the only fuel used.

Scotty's Mine (Mr. John Benney, manager).—Operations in this mine were chiefly driving on reefs at the adit-level, and clearing up and opening old drives. The drives in all are 1,470ft., with rails laid. Four reefs are worked on and 30 fathoms stoped out. The prospects of the mine are such that the owners are in treaty to lease or purchase Mayn's battery, which is near the mouth of the drive.

Kapanga and New Kapanga Mines (Mr. Henry Beeker, manager).—This mine adjoins Scotty's. A considerable amount of driving cross-cut tunnels has been done. Several reefs have been cut and driven on for a short distance, but no quartz has been crushed.

The South Kapanga Mine is abandoned.

La Mascotte Mine (Mr. C. Burder, manager).—Seventy-nine feet of driving has been done.

Kauri Block (Coromandel).

Coromandel Mine (Mr. W. H. Argall, manager).—Operations at the low level, which is at a depth of 280ft., have been suspended, and pumping is now confined to keeping the water down to the 180ft. level. The chief work has been at the 80ft. level, between the Pah shaft and Union Beach shaft. Seven hundred and eighty-three feet of driving has been done, and 165ft. of winzes sunk. Four fathoms of leaders were stoped out.

Tiki (Coromandel).

There is no one steadily employed in this part of the field, although occasionally small parties are prospecting.

Matawai (Coromandel).

Castle Rock Mine (Mr. James Vizard, manager).—This mine has lately been sold to a company. Very little work has been done lately, but in the early part of the year a block of the reef was worked and good returns obtained.

Manaia.

This district is deserted, but occasionally one or two prospectors give it a turn.

WHANGAPOUA DISTRICT (KAURI TIMBER COMPANY'S LAND).

Opitonui.

Lanigan's Mine.—This mine was worked continuously during the year. A ten-stamper battery, driven by water-power, was erected on the Opitonui Creek, about 300 yards from the mine. A low level was driven from the creek, but did not reach to the place under which gold was discovered at the surface.

Hilda Mine.—Another party are driving on a reef to the south of Lanigan's.

The Maiden, Matron, Zealandia, Australasian, and Scotia Claims have been taken up in this district, but very little work has been done.

Otanguru.

Murphy's Claim.—This claim is situated on a ridge near the Whangapoua–Kuaotunu track. A large reef 12ft. wide, which gives fair prospects of gold, has been discovered. The owners are at present driving a low level, which will give 130ft. of backs on the reef. Several small parties are employed in this district, but no payable quartz was found.

Owera.

Owera Mine (Prospectors' Claim).—A reef 4ft. to 2ft. 6in. was discovered on the range on the eastern side of the Owera Creek. Rich prospects of gold were obtained, and a drive put in to cut it below the surface. A low level was then driven on the reef. A winze has been sunk 120ft. to connect with the low level, where the reef maintained the same thickness.

The Kauri Timber Company have done a considerable amount of prospecting on both ends of the Owera Claim, but with indifferent success. Several Maoris and others occasionally prospect in the district, but I have not heard of any valuable discovery.

Waikoromiko

Lillis Claim is situated near the old Plutus Mine. Other claims have been applied for to the north and south of Lillis Claim.

The mining regulations under which land can be taken up on the Kauri Timber Company's land are not popular with miners and prospectors, and no doubt much more prospecting would have been done and claims taken up in the Opitonui and Otanguru districts had the terms been easier. (A copy of the regulations is attached.)

Matarangi.

One licensed holding was taken up during the year, but very little work has been done.

KUAOTUNU DISTRICT.

Try Fluke Mine (Mr. John Goldsworthy, manager).—The chief workings in this mine have been driving on the reef at No. 2 level, and stoping upwards. Six hundred feet have been driven on the reef, which is from 3ft. to 7ft. in thickness. Two hundred and sixty-five fathoms of reef have been stoped out. A branch reef was discovered from 1ft. to 2ft. in thickness, and has been driven on for about 100ft., the quartz being worth from 1oz. to 2oz. per ton. Another cross-cut, No. 3, has been driven about 500ft., and the main reef cut. This level will be 116ft. below No. 2. The reef is about 8ft. in thickness, and the quartz gives payable prospects. The prospects of this mine are very good, and a profitable yield of gold may be expected to last for years. A wire-tramway 1,800ft. in length conveys the quartz from No. 2 level to the battery, but a ground-tramway is to be laid from No. 3 level to the crushing-mill. The mill consists of eleven stampers and three berdans, driven by a portable steam-engine; but the gold is so extremely fine that much of it is lost in floatage. It is the intention of the company to erect an additional ten head of stampers, with the latest improvements in amalgamation.

Carbine Mine (Mr. John A. Dobson, manager).—Work in this mine has been confined to a small vein, a branch from the main reef.

Red Mercury Mine (Mr. Alexander Peebles, manager).—The low-level cross-cut was driven 180ft., and the reef cut; average thickness, 2ft. About 50ft. have been driven on the reef on each side of the cross-cut, and a winze sunk from the level above. A wire-tramway 1,100ft. in length is being erected to convey the quartz to the main road, from whence it can be carted to the battery.

Great Mercury Mine (Mr. Alex. Peebles, manager).—This mine is being well opened up. A low-level cross-cut is being put in on the western side of the spur to cut the reef 125ft. below the outcrop, from whence a winze is being sunk to the low level. Five hundred and thirty feet of level tramway, and 450ft. of self-acting incline tramway are constructed to connect the low level with the battery. A tramway 1,089ft. in length is constructed on the eastern side, and through a tunnel driven near the top of the spur. A shoot 250ft. in length will be used to send the quartz down from this tramway to the winze, connecting with the low level. The battery consists of ten head of stamps similar to those in use at Waihi, and suitable for wet or dry crushing, with foundations erected for another ten head. Copper amalgamating-tables will be used. The crushed quartz will be conveyed from the tables to four amalgamating-pans, three of which are Price's patent, and one John Fraser's patent, both of which pans are continuous, acting with still discharge. There is one berdan for grinding. The machinery will be driven by a horizontal engine, 18in. cylinder, and 3ft. 6in. stroke. The boiler is a steel tubular, 14ft. by 6ft. The battery will soon be ready to crush, and, as there are a great number of reefs and leaders in the ground which are gold-bearing, it is anticipated that payable returns will be obtained.

Just in Time Mine (Mr. Arthur Richards, manager).—This mine has been continuously worked during the year. A level has been put in on the reef, which is 18in. in thickness, and a little of the reef stoped out.

Otama Mine (Mr. George Comer, manager).—Work in this mine was fairly carried on during the year. About 300ft. of driving has been done, and a winze sunk 50ft. to connect with a low level, but the reef does not appear to carry gold down to this level, and the quartz obtained was from near the upper level.

Secret Mine.—A low level is now being driven.

Lady Carrington Mine (Mr. John Campbell, manager).—A considerable amount of work has been done in prospecting this mine. About 500ft. of driving has been done, and one reef cut, from which a parcel of 60 tons of quartz is stacked ready for crushing.

John Bull Mine.—A cross-cut drive has been put in for 110ft., and the reef, 3ft. in thickness, cut. A large parcel of quartz is ready for the battery.

Mariposa Mine.—The reef was cut at the low-level cross-cut, and driven on 175ft. The quartz is gold-bearing, and about 100 tons is ready for the battery.

Kapai Mine (Mr. James R. S. Wilson, manager).—A low-level cross-cut has been put in for 280ft., and the reef, 3ft. 6in. in thickness, cut and driven on for 30ft.

Hidden Treasure.—A shaft 60ft. in depth has been sunk.

Kuaotuna Mine (Mr. Alex. Wilson, manager).—A surface-drive was put in for 100ft., and a reef cut, but at no great depth from the surface. A winze was then sunk for 100ft., and 100 tons of quartz stacked ready for crushing. This reef is apparently the same as the branch reef cut in the Try Fluke No. 2 level. The future workings will be through the Try Fluke level, and a drive 400ft. in length is to be driven by the two companies conjointly.

The Pride of the Hills, Napier, Maori Dream, Surplus, and Wairoa have done a considerable amount of driving. The Hope, Ceres, Victory, Bendoleen, Jubilee, and several other claims have been taken up, but little or no work has been done on them.

McPherson's Land (private property).—A considerable amount of work has been done in several claims taken up on this land.

Keystone.—One hundred and ninety feet have been driven, the greater part on the reef or leader, which does not appear to be of any great value.

Arizona.—A considerable amount of work has been done. A drive was put in 26ft. on a reef 4ft. thick, and another drive 96ft. on a leader 3in. in thickness. A little gold was found on the surface on this, but none in the drive.

Bonanza.—A considerable amount of work has been done in this claim. A reef about 6in. in thickness has been driven on 76ft., and 5 fathoms of reef were stoped out.

Comer's Land (private property).—*Waitaia Mine* (Mr. Charles H. Bennett, manager).—A considerable amount of work has been done in this mine during the year. Five reefs, varying from 6in. to 2ft. in width, have been opened, and 400ft. of driving done, and 28 fathoms of reef stoped out. About 100 tons of quartz are ready for carting to the mill when an opportunity for crushing occurs.

A battery for public crushing has been erected on the flat on Comer's land. The battery is on the same principle as that erected by the Great Mercury Company. Another battery of a like description has been erected on the goldfield near the road, and has been working for a few days. When completed, there will be four batteries of forty-one stamps in all in the district, two of which are for public crushing.

Mahakirau.

Mahakirau Claim.—Two men have been working during the year, and half a ton of quartz crushed yielded 24oz. of gold. No other work has been done in the district.

Moewai.

Several claims have been marked out in this district near the old road from Coromandel to Mercury Bay, and about five miles from the bay. A party of Maoris are the prospectors, but so far the results are not very promising. About ten Natives and three white men have been prospecting during the year.

Whanwhau.

McGregor and party have been prospecting in this district, and have met with favourable prospects in quartz.

Boat Harbour.

Several parties have been prospecting here, but no payable reefs are yet discovered.

THAMES COUNTY.

Mata.

This district has been altogether abandoned during the year.

Tapu.

Kelly's Claim (Mr. Robert Kelly, manager).—The work carried on in this mine has been driving 140ft. on the reef at the upper tunnel; putting in three cross-cuts on the east or hanging-wall side of the reef, which have intersected another parallel reef from 3ft. to 6ft. in thickness. A rise was put up on a run of gold in the main reef.

Sheridan's Mine (Mr. Daniel Sheridan, manager).—Work has been chiefly confined to driving a cross-cut level to cut the reef about 60ft. below No. 2 level.

Broken Hill Mine.—Operations in this mine were driving a low level, but the rock became hard, and this was suspended. Small crushing were obtained in different parts of this district by Manuel's, Hawke's, and Wills's parties.

Centennial Mine (Messrs. McCormick and Burke).—These men have built a dam for the purpose of storing water, with the intention of sluicing the surface of the claim at a place where coarse gold has been obtained in times past. They will not be in a position to sluice before the winter months.

Waiomo.

Gem and Waiomo Mine (Mr. Alfred Howe, manager).—A considerable amount of work has been done in this mine, and the reef shows good prospects of both gold and silver. The ore is, however, of a complex nature, and requires special treatment, and the owners have not yet decided what process to adopt, but are of opinion that the MacArthur-Forrest process would be suitable. Five hundred tons are ready for treatment. Two tons have been successfully treated by Cassell's Company at Karangahake.

Other claims have lately been taken up in this district, but very little work has been done on any of them. A large reef has been traced for a mile, the quartz being of a complex nature, carrying both gold and silver.

Puru.

Puru Mine.—A considerable amount of driving has been done in this mine on a reef expected to be payable, but no large parcels have been treated, owing to the inaccessible nature of the place.

Montgomery and party have also been prospecting in their claim.

Karioi.

The Lady Mary Claim has been abandoned.

Tararu.

Norfolk Mine (Mr. Edward Quinn, manager).—A large amount of work has been done in this mine, chiefly on the Star of California Reef. A wire-tramway about 300ft. in length is used to convey the quartz from the level to the road.

Dunedin and Opal Mine (Mr. John Bowler, manager).—Three hundred feet of driving has been done on the reef, which varies from 1ft. to 5ft. in thickness. A wire-tramway 828ft. in length has been erected at Tinker's Gully to convey the quartz to Darrow's Mill, at the junction of Tinker's Gully and Tararu Creek.

Sylvia Mine (Mr. William Tregoweth, manager).—The battery and aerial tramway mentioned in last year's report have been erected, and operations carried on in stoping out quartz over the low level of the mine. The method for treating the ore at the battery is most complete. The quartz, after being crushed by the stamps, passes over a copperplate table, where the gold is caught. It afterwards undergoes several processes, for the purpose of concentrating the heavier parts of the slimes. These concentrates will afterwards be treated, to save the gold and silver. Five hundred tons have been crushed and 30oz. of gold obtained, and 33 tons of concentrates, valued at £1,200, collected. (A full description of the plant has been furnished to Mr. H. A. Gordon, Inspecting Engineer.)

Shellback.

Nordenfeldt.—This mine has been worked by the owners. An old level, formerly known as the John o' Groat's low tunnel, has been cleaned out for 800ft. A reef not previously worked has been discovered, and 25 tons of quartz crushed, for 33oz. 15dwt. of gold.

Several licensed holdings have been taken up, but no further returns are to hand from this district.

Kurunui.

Hansen's Kurunui No. 3 Mine (Peter C. Hansen, manager).—The operations for the year have been the same as last year, sending down large quantities of mullock and quartz from an open cutting about 50ft. in depth. Several leaders have also been driven on and worked. The quartz is conveyed to the mill over 350ft. of ground-tramway, and tipped into a pass which has been opened to the battery-level, which is 1,150ft. in length.

Comer's Kurunui No. 2 Mine (Mr. Robert Comer, owner and manager).—Operations in this mine are the same as last year. The whole of the mullock and quartz from an open cutting is sent to the mill and crushed. Provision is now being made to extend the workings to another channel of country near the old All Nations shaft. A ground-tramway 600ft. in length is being erected to bring the crushing-stuff to the pass leading to the battery-level. The returns from the open cutting have been very small—about 21½gr. per ton—but the facilities for mining and crushing are such that the work has paid expenses, although leaving no profits. It is expected that the new ground opened will yield stuff of a higher grade, and which when crushed will leave a satisfactory margin of profit. About twenty tributers are employed in working leaders, chiefly near the surface.

Kurunui No. 1 (Mr. James Coutts, manager).—This mine is now owned by the Hazelbank Company. The workings are at present from No. 1 level of the Caledonian Mine, a depth of 203ft. from the surface. Two reefs have been worked on—the Young American Reef, which is about 12in. in thickness, and a cross-reef, which is 2ft. thick in the hanging-wall. Cross-cut drives have been made for 350ft. and 240ft., driven on the reefs. One hundred fathoms of reef stoped out. There are two men working on tribute on the surface portions of the mine. Three hundred and seven tons of quartz was crushed by them, for 77oz. 9dwt. of gold.

Deep Level Cross Mine (Mr. Thomas A. Dunlop, manager).—This mine is now owned by the Victoria Company. The chief work carried on has been driving a cross-cut from No. 3 level of the New Prince Imperial shaft towards the northern end of the mine. This drive has been put in for a distance of 572ft., chiefly through hard rock. A small party of tributers were working at the surface on the Tookey section of the mine. The Big Pump is now clearing the water from the 500ft. level. The cost of maintenance is about £350 per month.

Moanataiari Mine (Mr. George S. Clark, manager).—The principal operations in this mine have been in the Reuben Parr section of the ground. The main tunnel was driven a further distance of 50ft., and a rise 12ft. by 4ft. put up in the rock for a distance of 200ft., to connect with the workings below the Point Russell, or No. 1 level. This rise is well timbered and divided into three compartments. The middle one is used for a ladder-way, and for drawing up timber and tools; and the end compartments for sending down mullock and quartz respectively. A level (No. 3) has been opened 100ft. above the tunnel, and the main reef and a cross-reef are worked on. The greater portion of the quartz crushed was obtained from the stopes between the Point Russell level and the No. 2 level, 200ft. over the tunnel. There is, however, a winze sunk on one of the reefs on this level to the No. 3 level, and stoping operations will be continued from that level. In the block of ground opened up there are six different veins, from 2in. to 12ft. in thickness. The amount of work done in opening these blocks is very great—1,100ft. of driving, 700ft. in sinking and rising, and 550 fathoms of reef stoped out. Tributers' workings are chiefly on leaders and reefs near the surface. The mine is carefully worked, and the ventilation good.

Junction Mine (Mr. D. Loughlin, manager).—The only work done since the present owners occupied the mine has been driving a level from the Moanataiari tunnel through very hard basaltic rock. Two hundred and eighty-eight feet of driving has been done.

Mountain Flower Mine (Mr. Charles D. Waite, manager).—This mine has been in the occupation of the present company about six months. The chief work done has been driving on a small reef and sinking a winze 86ft. to connect with an old tunnel, which was cleaned out and repaired. A few pounds of picked stone have been obtained, but no quartz crushed.

Alfred Mine (Mr. Charles Whisker, manager).—A tunnel 290ft. in length was cleared up and repaired, and a reef 18in. in thickness worked on, and 130 feet of driving was done on this reef. Sixty feet of a winze was sunk, and 20 fathoms of reef stoped out.

Coliban Mine (Mr. Charles Whisker, manager).—A considerable amount of work has been done in this mine. One hundred and sixty-two feet of driving on two leaders, and a winze sunk 49ft., but the quantity of gold obtained has been small.

Freedom Mine (Mr. William Mears, manager).—The mine is worked from the old Sons of Freedom tunnel, which has been cleared and repaired for 500ft. About 200ft. of driving has been done on the reef. In the upper workings a considerable amount of driving has also been done, and quartz taken out. A party of tributers were also employed at the surface.

Flying Cloud Mine (Mr. James Jobe, manager).—This mine is also worked from the Sons of Freedom tunnel, which has been cleared and repaired for 400ft. A considerable amount of work has been done in rising and stoping on the Sons of Freedom Reef, but no quartz has been crushed.

Orlando Mine (Mr. Charles McLean, manager).—The chief work has been driving a new level 600ft. on the reef, which will in future be used instead of the old Independent level. A considerable amount of driving has been done on other reefs, and 60 fathoms stoped out.

New Alburnia Mine (Mr. A. Thomas, manager).—This mine is situated near the head of the Moanataiari Creek, and has been gold-producing for the past twenty-three years. The present owners are working from No. 2, a battery-level, 1,200ft. in length; and No. 3, a Whau level, 1,500ft. in length. Three reefs and two leaders were worked on during the year. Five hundred feet have been driven on reefs, and a winze sunk 50ft., and 130 fathoms of reef stoped out.

Whau Mine (Mr. G. Downie and party, owners).—This mine is adjacent to and worked from the same level as the New Alburnia. The principal work has been done by tributers.

Forster's Claim (Mr. Forster and party, owners).—The work done in this mine is confined to sluicing the surface-stuff and mullock, and sending the headings to the battery.

Dixon's No. 1 (Mr. Edward Waite, manager).—Very little work was done by the owners, but a party of tributers had a small crushing. The surface portion of the ground is let to Darrow and party, who have named that portion of the mine Dixon's Extended.

Dixon's Extended (Mr. John Wilcox, manager).—Operations in this mine have consisted in clearing out old stopes and workings on the Dixon's No. 1 and No. 3 reefs. A large tonnage of low-grade stuff has been crushed. An aerial tramway, three-quarters of a mile in length, conveys the crushing stuff from the low level on Tinker's Gully side of the range to their ten-stamp mill erected at the junction of Tinker's Gully and Tararu Creeks.

Grahamstown.

New Prince Imperial Mine (Mr. Thomas A. Dunlop, manager).—The work in this mine has been partly by wages-men and partly by tributers, who have been employed on leaders and reefs in the upper levels. The Prince Imperial Gold-mining Company is about to be amalgamated with the Victoria Company, and the mines will be worked in conjunction, as the Prince Imperial shaft is the most suitable one for working the ground.

Saxon Mine (Mr. Thomas A. Dunlop, manager).—The shaft in this mine has been cleared out to the No. 6 level, 461ft. from the surface. There was considerable difficulty in carrying out this work, and it was not until the drive from the No. 6 level of the New Prince Imperial shaft cut a break or watercourse in the rock that the water could be drained from the shaft. This drive is 134ft. in length, through hard blue rock. When the shaft was cleared and repaired driving was carried on continuously on No. 2 reef, and a cross-cut continued to cut No. 1 reef, and to obtain ventilation through the No. 1 winze, which was sunk 75ft. from No. 5 level. Stoping was carried on on the No. 2 and No. 3 reefs at this level. Driving and stoping have also been carried on at No. 5 and No. 4 levels on the different reefs and branches. Six reefs are worked on in the mine, varying from 6in. to 8ft. in thickness. The amount of driving done on reefs and leaders has been 1,500ft., and winzes sunk 291ft.; 5,240 fathoms of reefs and leaders stoped out. The mine is well ventilated, the workings being connected with the Trenton shaft, which is upcast. The battery is in good order. Eight of the berdans have been removed, and one Price's patent pan and two Watson-Denny pans substituted.

Caledonian Mine (Mr. James Coutts, manager).—Operations in this mine have been chiefly on the No. 1 and No. 2 levels. One hundred feet of cross-cut driving has been done, and 500ft. of reefs and leaders, and upwards of 300 fathoms have been stoped out. The reefs worked on were No. 1 and No. 2 each about 6ft. thick, and a small leader about 6in. in thickness. Small parties of tributers are also employed.

Waiotahi.

Waiotahi Mine (Mr. James E. Smith, manager).—The workings in this mine are of the same nature as last year in the main-shaft levels, and driving at No. 1 level in the Mary Ann shaft. One hundred and fifty feet of cross-cuts have been driven, 1,000ft. on reefs, and about 1,000 fathoms stoped out on reefs and leaders which vary in thickness from ¼in. to 4ft., and running in every direction.

New Manukau Mine (Mr. James E. Smith, manager).—The workings in this mine are of the same nature as those in the Waiotahi. Cross-cut drives have been put in for 50ft., and 360ft. on reefs and leaders, and 250 fathoms stoped out.

Cambria Mine (Mr. William Baker, manager).—The workings in this mine are chiefly at No. 3 and 4 levels. Seven different reefs and leaders have been worked on, varying from 2ft. to 3in. in thickness. Cross-cut drives 100ft., on reefs 570ft., rising 152ft., and about 245 fathoms stoped out.

Trenton Mine (Mr. John G. Vivian, manager).—Operations in this mine have been working on two reefs 2ft. thick and two leaders 3in. in thickness. Two levels have been opened up above No. 5 (a low level), which is 557ft. from the surface. No. 4 level is 497ft. and No. 3 level 422ft. from the surface. Cross-cuts 200ft. have been driven, and 500ft. on reefs and leaders, and about 185 fathoms of reef stoped out.

Fame and Fortune Mine (Mr. E. K. Cooper, owner).—The chief work in this mine has been driving the main adit-level. This is now in 1,175ft., and a winze has been sunk from the Balmoral level, thereby securing good ventilation, and a means of passing quartz to the low level. Seven reefs are worked in the mine, averaging 3ft. in thickness. The total amount of driving done was 1,065ft., and six winzes sunk 380ft. in all, and 2,000 fathoms of reef stoped out.

Blanche (Mr. Thomas Mangan, manager).—This mine was occasionally worked by the owners, but very little quartz taken out.

Mount Edward.—A low level was driven about 100ft.

West Coast.—A party of tributers have worked occasionally in this mine for a small return of gold.

Pinafore (Mr. James Langford, manager).—About 200ft. of driving was done, and a winze sunk about 70ft.

Calliope.—The chief work in this mine has been driving a low level on the reef from the Orlando Mine, 160ft.

Several other small claims in the vicinity have been worked, but the returns have been very small.

Bright Smile Mine (Mr. Thomas H. Crawford, manager).—About 353ft. of cross-cut tunnel has been driven. The mine was sold under warrant of distress, and two different parties are commencing to work the ground.

New Fearnought Mine.—This mine has been occasionally worked, and considerable amount of driving done, but no reef of any value has been discovered.

Berry Claim.—This claim is steadily worked, with fair results. The leaders are near the surface.

Waiokaraka.

May Queen Mine (Mr. H. W. Moore, manager).—The reefs worked on at No. 1 level, 294ft. from the surface, have been profitably worked, although the returns did not come up to the expectations formed as to their value. Two hundred and sixty feet of cross-cuts were driven, and 710ft. of drives on reefs, 112ft. of winzes sunk, and about 315 fathoms of reef stoped out. The shaft is being sunk for another level.

Crawford's Special Claim (Mr. Thomas H. Crawford, manager).—The main shaft was sunk 74ft., making a total depth of 174ft. A steam-engine, 16in. cylinder, 3ft. stroke horizontal, and of twenty-five-horse power, was erected, suitable for winding and pumping. Operations were, however, discontinued, owing to financial difficulties, and the necessity of providing a pump. Work was also carried on the reef in Collarbone Creek, and about 1,000ft. was driven on the course of the reef at the low level, but the quartz was not payable. A small block of the reef was stoped out at the upper level.

The Queen of Beauty Mine is protected, sufficient capital not being yet raised to commence operations on the necessarily large scale required, as the shaft is over 700ft. deep.

Karaka.

Adelaide Mine (Mr. G. W. Bull and party, owners).—This mine, which has been continuously worked for the past sixteen years, was protected for some months, the blocks of the reef above the adit being apparently worked out. It is intended to form a company to further work the reef by sinking a shaft. In the meantime arrangements have been made to work portions of the surface on tribute.

Lone Hand (Mr. Thomas Moyle, manager).—This mine has been steadily worked during the year. The main drive has been continued in the Manchester Reef, and a large block, 250 fathoms, stoped out.

Little Nell (Mr. James Senior, manager).—Upwards of 400ft. of driving was done in cross-cuts, and several leaders cut and driven on, but the returns of gold have not been satisfactory.

Prosperity (Mr. Henry Goldsworthy, manager).—A low-level tunnel, near the Karaka Creek, was driven 180ft., and a winze sunk 64ft. from another level above, but the reefs and leaders found have not been payable, although driven on for 200ft.

Atlantic (Mr. John Ross, manager).—A considerable amount of work has been done in clearing out old drives. A reef has been driven on for about 80ft.

Claremont Claim (Mr. G. Briant, owner).—Work in this claim was confined to working on small leaders. The gold is found when cross-leaders, or "flinties," come in contact with the veins worked.

E. and M. Claim (Messrs. Fieney and Johnson, owners).—The quartz worked in this claim is of the same nature as the Claremont.

Hopeful Claim (Mr. Artha and party).—The workings are of the same nature as the E. and M. and Claremont.

Hokianga (Mr. Jenkins and party, owners).—The workings in this mine are of the character peculiar to this locality, the gold being found at the junction of the "flinties" and leaders.

Hongkong (Mr. David Brigham, manager).—The workings are of the same local characteristics, working at the junctions.

Lucky Hit, Martini Henry, Ophir, Crackshot, and Croesus have been worked occasionally. The Auckland, Lincoln, and Eminence, and others have done little or no work. F. White and party are constructing a water-race to drive the old Halcyon battery.

Una Hill and Te Papa.

Dives Mine (Mr. John Williams, manager).—This mine has been well worked during the year. A cross-cut on the main flinty at No. 3 level was driven 400ft., and 230ft. driven on the leader, which is 1ft. in thickness, and about 300 fathoms have been stoped out.

Occidental Mine (Mr. Thomas Black, manager).—The drive on the reef at the low level was extended 340ft., and a winze sunk 50ft. under the level. A cross-cut for the purpose of obtaining ventilation has been driven 650ft., and communication will be effected with the stopes on the reef. Two hundred fathoms of reef were stoped out. Ventilation is at present obtained by means of a fan driven by a small Pelton wheel.

Oriental Mine (Mr. W. H. Potts, manager).—The workings in this mine were driving a cross-cut tunnel across the line of the Occidental Reef. The reef was not cut where expected, and operations have ceased.

Pride of Karaka (Mr. J. E. Hardman, manager).—A low level tunnel has been driven for 360ft. through the hard rock.

Success.—A low-level tunnel has been driven from the Karaka Road for a distance of 400ft. A small lode of quartz-stringers and mullock was cut, but is worth only 4dwt. to the ton.

Magnolia (Henry Rabe, manager).—A low-level tunnel has been driven from Block 27, and is about 950ft. A large east and west reef, about 22ft. in thickness, was cut. Another reef was cut and followed. Communication will shortly be effected with the workings in the level above. The depth from the upper level to the lower is 110ft., and a large block of reefs will be opened. Ventilation whilst driving the tunnel was effected by a water-jet forcing the air through a pipe.

North Star (Mr. Ronald McDonald, manager).—This mine has been entirely worked by tributers, who are employed in the upper levels.

Several small claims are worked in the Te Papa Gully, but the returns are very moderate.

Hape Creek.

Consols (Mr. John Carter, manager).—Several parties of tributers have been employed working on leaders in the surface drives. More extensive operations have been carried on since the beginning of January. A contract was let to erect a winding- and pumping-engine and winding gear at the main shaft, which is 275ft. in depth, but at present full of water up to water-level. The engine is a 20in. cylinder, 3ft. 6in. stroke, the steam supplied by a multitubular boiler, 14ft. by 5ft. 6in. It is expected that the machinery will be ready for work towards the end of May.

Souvenir.—A considerable amount of work has been done in this mine.

Several small claims were worked in this locality, with moderate returns.

Otanui.

New Eureka.—This mine has been occasionally worked by a few tributers.

Puriri.

Old Prospectors' (Puriri Prospectors' Association, owners).—A battery of sixteen stamps was erected on the Puriri Creek, about three-quarters of a mile from the mine. Forty-five chains of a water-race has been constructed, and a road 73 chains in length from the mine to the battery. The quartz did not prove payable, and the mine was idle for a time. The property has changed hands, and the owners intend prospecting further.

Puriri, late *Bedfords* (Mr. F. McLiver, manager).—The workings in this mine are chiefly on reefs and leaders at the surface.

Tairua.

Bonnie Scotland (F. McLiver, manager).—Operations have been confined to workings on a reef, 4ft. in thickness. One hundred and twenty feet have been driven, and a portion stoped out.

OHINEMURI COUNTY.

Maratoto (Mr. John H. Moore, manager).—The grinding and amalgamating plant was erected early in the year, and the quartz stacked at the mine, treated. Work was continued in driving and stoping out those portions of the reef which appear to be rich in silver.

Silver Queen and Perseverance.—Licensed holdings were again occupied, but no great amount of work has been done.

Karangahake.

Ivanhoe and Truro (John McCombie, manager).—The work done in this mine has been driving a cross-cut 160ft., at a depth from the surface of 150ft.; and a level on the reef 350ft., at a depth of 100ft. from the surface. Two winzes were sunk, 70ft. and 30ft.; and 100 fathoms of reef stoped out.

Woodstock (Mr. John McCombie, manager).—This mine comprises the ground formerly known as the Kenilworth and Woodstock. A low-level cross-cut has been driven from the Woodstock low level to cut the Kenilworth Reef. The length of this drive is 300ft., and the reef has been cut from 2ft. to 3ft. in thickness, giving good prospects. Tributers have been working on this reef at the higher level. Twenty-six tons of quartz yielded 71oz. of bullion, and 60 tons were sold at 45 per cent. on the assay-value, which was £50 per ton.

Crown Mine (Mr. Geo. N. McGruer, manager).—The chief work carried on in this mine has been in driving on the reef opened near the Waitawheta Stream. This has been driven on both sides of the stream. The prospects are very encouraging. The mill, which is erected on the side of a hill, and some distance above the Crown workings, is found to be unsuitable for treating large parcels of quartz; and it is intended to construct a tramway down Waitawheta Gorge to the flat, where a better plant is to be erected.

The Cassells Company works, which are adjacent to the mill on the Crown Mine, are found to be too inaccessible; and I understand it is their intention also to move their plant down to the flat, where it will be near the main road, and convenient for receiving any parcels of quartz brought from different parts of the Hauraki District. Their method of extracting gold and silver from quartz is apparently very satisfactory.

Adeline Amalgamated.—This mine is chiefly worked by tributers.

Several other licensed holdings are worked in this district, but no returns of any consequence have been obtained.

Owharoa.

Smile of Fortune (Mr. Charles S. Farmer, manager).—This mine is entirely worked by tributers. They have been engaged in stoping out a block of the reef near the surface, and further up the hill than the last workings. This reef is a mass of small quartz veins and mullock, averaging 6ft. in width.

City of Edinburgh and City of Glasgow (Mr. Alexander Mackay, manager).—The old Annie tunnel has been cleared out and repaired, and a reef worked on. A winze was sunk from the surface, and a parcel of quartz taken out and crushed, but the return was poor, and operations were suspended.

Waitekauri.

Waitekauri Mine (Mr. Wm. Hollis, manager).—This mine has lately been purchased by Mr. Thomas Henry Russell. The battery of forty stamps has been thoroughly overhauled, and the blanket-tables dispensed with, instead of which the crushed quartz and slimes are run into large settling-pits, the water from which will be pumped back and again used for crushing. Pans are to be used for amalgamating instead of berdans as formerly. The water-races are being repaired, and the tramway from the mine to the mill renewed. It is expected that everything will shortly be ready for crushing. A few hands are clearing up the old levels and workings in the mine.

Jubilee Special Claim (Mr. H. Baker, manager; Edward K. Cooper, owner).—An old tunnel named the Horne level has been cleared out and repaired, and 100ft. of driving done on the dip of the Waitekauri Reef. A little gold is found, but not in payable quantities, although the quartz has a favourable appearance.

Mangakara.—This mine has changed hands during the year, but very little work has been done.

Waihi.

Waihi Mine (Mr. Thomas Gilmour, manager).—The Martha Mine was purchased by the Waihi Company, and is now the locality where the bulk of the quartz crushed is obtained. A horse-tramway has been constructed from the Martha low level to the calcining kilns near the battery. The reef worked on is a large reef, 8ft. to 50ft. in thickness, which was left in the hanging-wall of the old Martha workings as being too poor to pay by the old process of crushing and amalgamating, but which is now payable by treatment at the Waihi Company's plant. A large amount of work has been done in this mine, 427ft. of driving, 230ft. of winzes, and 324 cubic fathoms of reef being stoped out. The battery is being enlarged by the addition of thirty stamps, and new high-level water-races are being constructed. A new steam-engine, 100-horse-power, has also been erected to drive the mill when water is scarce.

Silverton Mine (Mr. John McCombie, manager).—This mine has been let on tribute. A block of reef under the level was worked out and stoping done over the level. A winze 25ft. is sunk on a fresh run of gold. The reef is about 6ft. in width. Two hundred and seventy tons of quartz was obtained, and sold at a certain percentage on its assay-value, the amount realised being £1,508.

Gladstone.—About 500ft. of driving (prospecting) has been done, but no quartz has yet been discovered.

Whangamata.

Several licensed holdings and claims have been taken up, but very little work has been done. A parcel of about 5cwt. of ore taken from the Goldwater and sent to Sydney gave favourable results.

PIAKO COUNTY.

TE AROHA DISTRICT.

Waiorongomai.

Te Aroha Silver- and Gold-mining Company's Mine.—Very little work has been done in this mine. A few parties of tributers only have had small parcels of quartz crushed. The berdans have been working on tailings. The mine and plant have been sold to a local party, who intend to surrender all the holdings with the exception of the New Find and Silver King portions.

Ferguson's Syndicate Company's Mine (Mr. P. Ferguson, manager).—A considerable amount of work has been done in this mine. One hundred and twenty feet of driving done on reef, and 20 fathoms of reef stoped out. Two hundred and one tons of quartz was crushed, for 172oz. bullion, worth £1 9s. per ounce.

Warrior Licensed Holding, late *Colonist* (Mr. Thomas Gavin, owner).—This mine was taken up in January last, and 60 tons of quartz is broken out ready for the mill.

Tui.

Champion Mine (Mr. Clement A. Cornes, manager).—The only work done in the mine for the past year was driving the May Bell tunnel 270ft. A further distance of 117ft. has to be driven to cut the main reef. A suitable method of treating the ore has not yet been decided on. The mine is well opened up, and the aerial tramway ready to send quartz down when it can be profitably treated.

No fatal or very serious accidents have occurred during the year.

I have, &c.,

GEORGE WILSON, Inspector

The Under-Secretary, Mines Department, Wellington.

No. 5.

Mr. Warden ALLEN to the UNDER-SECRETARY of MINES, Wellington.

SIR,— Blenheim, 14th April, 1891.

I have the honour to enclose you herewith my returns for the Marlborough goldfields for year ending the 31st March, 1891. I have very little to report as to the progress of my district for the last year.

In Cullen's Valley there is nothing new to report. Some of the claims in this valley have yielded fair returns, and I believe something over 5,000oz. of gold has been obtained from alluvial, creek, and terrace claims during the past year.

In Waikakaho a large number of the alluvial miners have left, and very few creek claims are now worked. There is good payable gold to be found in this district, but the expense and difficulty of working will for a time tend to stop further work.

In Onamalutu, Arm Chair, Bartlett's Valley, Sutton's Valley, Wakamarina, and other places, there are small parties of miners working alluvial ground, but not doing much more than making wages. The Gorge Claim, Wakamarina, is now being worked, but to an outsider it would appear that this company are not sufficiently availing themselves of the present dry, fine weather to push on their work. The problem of gold or no gold has not yet been proved.

REEFS.

I am informed that the Southern Cross Company have not yet struck a reef at the low-level tunnel.

Messrs. Turner and Logan, on behalf of the Ravenscliff Company, are so well satisfied with the prospects they have opened out that they are now busily engaged in bringing machinery on to the ground for working their claims. They are erecting an aerial tramway, crushing plant, sheds, and other appliances, and before very long the question will be settled as to whether they have discovered payable reefs or not. The samples of silver I have seen are very good.

I can conclude my report by repeating my opinion given on other occasions—viz., that there is no doubt about payable reefs existing in the district. It is a question of time as to when they will be worked.

There are several alluvial claims outside my district. It is reported to me that one or two are now finding gold. They certainly deserve all that they find, for two or three of the companies working these claims have continued their work under great difficulties and discouragement, and have done their work faithfully and well.

I have, &c.,

The Under-Secretary, Mines Department, Wellington. J. ALLEN, Warden.

No. 6.

Mr. Warden KENNY to the UNDER-SECRETARY of MINES, Wellington.

SIR,— Warden's Office, Westport, 5th May, 1891.

I have the honour to forward my annual report on the Karamea Mining District for the year ending the 31st March, 1891.

WESTPORT.

Applications for ordinary registered rights (fifteen of which were objected to), 230; for licensed holdings and special claims (three objected to), 12; for registration as mining advocate, 8; for cancellation of licensed holdings and special claims, 19; complaints heard, 4; licensed holdings and special claims forfeited for non-payment of rent, 27.

I will now proceed to give some detailed information as to the position and prospects of some of the claims in this district, and as to the work done on them during the past year.

The Fairmaid Gold-mining Company (Limited).—The total number of cubic yards of material handled by this company during the year was 62,201 cubic yards for 1,873 working-hours. The dry weather during 1890 seriously retarded the work; but an extra water-supply has been brought in from the ranges at the back, and ample water is now secured. The plant has worked in a very satisfactory manner since the elevator has been fitted with cast-steel liners. Considerable trouble has been caused and much time lost by the appearance of a bed of cement in the face overlying the wash but the manager now reports this is thinning down.

Messrs. Mace and Bassett's Sluicing Claim at Addison's Flat.—The method of working this claim is by means of an elevator-jet and water-balance lift. These have been kept constantly at work during the year, with the exception of several short periods, when the water-supply gave out. This will probably not occur again, as Mace and Bassett have increased the storage-capacity of their reservoirs and improved their water-races. They have lately been making preparations for shifting their appliances, as they were out of fall, and have had nine men engaged on this work. Sluicing has been stopped until this work is completed, which will be in about a month's time. Messrs. Mace and Bassett anticipate bringing on another water-supply, and constructing another large reservoir, to enable them to work the ground in two faces at the same time. The survey for this work has been made, and the work itself will be completed during the ensuing year.

The South Pacific Extended Quartz-mining Company (Limited).—This company is still engaged in prospecting its licensed holding situate at Seatonville, Mokihinui, and have had in hand the extension of the tunnel under two contracts—viz. (1) for 100ft., and (2) for 150ft. The contractor for No. 1 was enabled to duly complete the distance contracted for; but those for No. 2 could carry the work of extension a distance of 87ft. only, when they were forced to cease operations owing to the presence of foul air in quantity, and consequent inability to get rid of the dynamite-fumes. This contract was cancelled, and fresh tenders have been called, to close at an early date, for extending the tunnel 100ft. from the present face, the specifications for which include the necessary works required in ventilating the tunnel, the total length of which is now about 415ft. The company does not contemplate the erection of a crushing plant for the present, as the main reef has not yet been struck. The indications, however, continue promising.

White Cliffs Dredging Company.—This company's property is situated on the Buller River, abou 22 miles from Westport, and forms, probably, one of the best places in the whole stretch of river for dredging purposes. The physical features of the river at this company's claim are very favourable—

the river is a moderate width; the shingle or wash-dirt averages from 15ft. to 20ft.; the banks are high, well studded with timber, offering good mooring. There are sheltered places in which the dredge can be kept during floods. The depth of water is about 6ft. on an average. The current at ordinary water-level would not exceed, probably, two knots per hour. The company was registered in Dunedin in June, 1890, with a capital of £10,000, in 20,000 shares of 10s. each. Five thousand of this number were reserved to the promoters of the company, paid up to 7s. 6d. A stipulation was made that none of these shares should be transferred before the dredge was on the river and at work—so that in the event of the dredge not paying promoters can receive no benefit; on the contrary, they are liable for 2s. 6d. per share. The company lost no time in applying themselves to the putting-on of a good dredge. A contract was entered into with Sparrow and Co., Dunedin, to build a steel dredge, the hull of which is 93ft., the beam 20ft. Her displacement is about 2ft. 4in. The whole of the machinery about this dredge appears to be of the latest and most substantial kind. The boiler is a part Cornish and tubular, 15ft. long, 5ft. 6in. diameter, and weighs about 7 tons. The engines for driving the elevatory gear, working the winches, &c., are about thirty-five-horse power nominal. The cost of the dredge was about £4,000. The water necessary for washing the stuff and carrying away the stones is supplied by a powerful centrifugal pump, 11in. suction and discharge. A separate set of engines are employed to drive the pump, specially imported. The gold-saving tables consist of a series of riffles and plush tables. The total spread of tables will be about 24ft. No wash-dirt, stones, or water is allowed to be discharged from the dredge without first passing over some gold-saving appliance. The dredge is expected to be at work in about three months from the present time. From the properties obtained, and the fact that the Buller is known to be a good gold-bearing river, the venture should prove remunerative, and, if successful, it will probably be the initiation of an industry which will give employment to a very large number of men.

Nile Gold-mining Company.—Defunct, and company wound up. Assets, including interest in lease, bought by Mr. John Hughes.

Great Republic Gold-mining Company.—This company during the past year have extended their low-level drive 215ft. without cutting the reef. The directors, at their last meeting, reduced the hands to two, and are now doing prospecting, pending a meeting of shareholders to be held on the 9th of May.

Red Queen Gold-mining Company.—In the early part of this year this company resumed operations. They let a contract of 100ft., with option of making it 200, for extension of No. 2 drive. By last advice from the mine (4th April) the reef was small—viz., 6in.—and carrying good gold. The gold met with in this extension is similar to that worked in the higher levels—viz., rough gold. The company have also employed four ordinary hands, exclusive of their mine-manager, in effecting out and inside repairs essential to a mining property left idle for some time. Two sawyers have also been employed. The one thing now necessary for the Red Queen Company is means of crushing. It is estimated that there is quite as much stone left in the stopes as has already been mined—*i.e.*, 1,560 tons, which averaged 29dwt. to the ton; and, till battery is put in order, little further need be done in the mine. To this end tenders were called for removing the water-race, but the prices tendered were far in excess of the estimate, and none were accepted. The question is now hung up, pending a meeting of shareholders on the 13th of May next, when the idea of tunnelling through to Maori Gully will again be mooted. Some time ago the Government offered to assist in this, and it is hoped that the assistance will be obtained.

The New Era Gold-dredging Company.—This claim is situated on the beach, 15 miles north of Westport, and consists of shingle, black and grey sand, the black sand carrying very fine gold. The plant is a powerful steam-dredge on the endless-bucket principle. The hull is built entirely of steel, and is 100ft. long by 18ft. wide, with the bucket-ladder 60ft. long, and buckets going into a well between pontoons from the centre forward, and discharging 18ft. above the deck. The boiler is a multitubular one, 14ft. long and 5ft. diameter. The engines are compound surface-condensing, with inverted cylinders of 12in. and 22in. diameter, and 18in. stroke. The winches are worked from the main engine by means of friction-clutches. The gold-saving plant now consists of blanket-tables, having a gold-saving surface of close on 800 square feet. Two pontoons have been placed one on each side of the dredge, towards the after end, to assist in carrying the tables. The gold-bearing sand is separated from the shingle by a patent screen, which can be regulated to any desired pitch, and the shingle is carried aft by a shoot discharging clear of the dredge. The water for washing the material is lifted by a centrifugal pump, having a discharge-pipe 20in. diameter. Little or no dredging has yet been done, as great alterations have had to be made, in the gold-saving plant principally; but as everything is now in working-order it is hoped that there will soon be some return for the large amount of capital expended.

Charlestown Sub-district.

Very little change has taken place in this district during the past year. The population keeps about the same; but, owing to the continued spell of fine weather during the winter months, the yield of gold has not been so great as it would have been had there been a plentiful supply of water. Nevertheless, all those who were able to work made good average wages.

The Argyle Dam, I am sorry to say, has been of very little benefit to the miners, owing to the feeding-races being completely out of repair, and the maintenance being so heavy that the Government did not feel justified in going to the expense of building them up again. The residents in the district held several meetings to consider the best means of bringing in a permanent supply of water. It was ultimately decided to request the Government to hand over the Argyle Race and reservoir to the Buller County Council, which has been done, surveys having been made from the Four-mile Creek to the dam. The county thereupon decided to raise a loan of £4,500, under "The Local Bodies Loan Act, 1886," and "The Government Loans to Local Bodies Act, 1886," the loan to be paid off in twenty-six years by the revenues derived from the Argyle Water-race; and the proposed

extension, and a special rate of 3¾d. in the pound on all rateable property of the Riding of Charleston (exclusive of Crown and Native lands), was also proposed to be pledged as security for the loan. A poll of the ratepayers took place on the 18th April instant, when the proposal was carried by a small majority. It is expected that when the extension is completed, and a permanent supply of water available, things will brighten up again in this once very prosperous district. The Shetland beaches have not been giving such satisfactory returns as heretofore to the industrious men of the North, who have been settled there for close on twenty years. Many experienced Charleston miners attribute the paucity of gold thrown up on the beach to the fact of the reduced quantity of tailings coming down the Nile River and outlets from Candlelight by reason of the want of a permanent water-supply. If this theory is correct, when the above-mentioned race is brought in we may hope to see the hardy Shetlanders, than whom there are no more frugal and industrious settlers in the colony, in full swing again.

The Totara River to the north of the Shetland Beach is attracting some dredging speculators. The Totara River Gold-dredging Company are making a start in two of their dredging claims to work the river and the auriferous sand-hills on its banks. A taking prospectus, with substantial names on the board of directors, has been issued to the public, and lithographic maps have been printed and circulated over the colony, and also in Australia. This company, if equipped with a good dredge, ought, in the opinion of competent judges, to yield handsome returns to the lucky shareholders, the river itself being one of the most advantageous in the colony for dredging purposes—well sheltered, free from snags and large stones, and having an almost inexhaustible supply of timber in close proximity, besides having the Charleston coal close at hand, which can be delivered at a cost of about 12s. per ton. Already there is a small spoon-dredge on the river, and intending investors are requested, before taking any shares, to ascertain for themselves the prospects of the venture, which is undoubtedly a *bonâ fide* one.

The cement claims at Charleston are still turning out good gold. Weir and party, with their force-pump, are also doing well; and Gregory and Horner are catching most of the stray gold in the creeks with their tables.

I understand that the Brown's Terrace Cement Company have every hope of getting their claim taken up when a new and more accessible water-supply than that from the Nile is available. A good deal of prospecting has been done by the company, and the returns from the Geological Department, and the assays from the cement made in London, show a very high percentage. Brown's Terrace is always spoken of as a rich cement-field, and some time ago excellent stone was obtained, which gave substantial yields. Of late years, however, owing to the prevailing cause—want of water—and the expense of erecting machinery, the ground has been lying idle. Three leases have been applied for—by Messrs. Moynihan and Shepherd and Warne—and an engineer from a large firm in London is daily expected to report upon the field. I confidently anticipate that next year the annual report will give a much more favourable account of operations in the Charleston sub-district.

Several licenses to search for mica have been granted during the year, but I have heard nothing more of these enterprises.

Lyell Sub-district.

Work has been steadily carried on during the past year in the United Alpine Mine, which is, indeed, the mainstay of the place. Since the last annual report the reef was struck in No. 7 level, at a distance of 2,400ft. from the mouth of the tunnel, and the prospects of the company are materially improved by this piece of good fortune, for not only does it augur well for the success of future operations at a lower level, but, by increasing the extent of backs, it is also a guarantee of successful operations in the present level for some time at least. The company has now turned its attention towards prospecting for what is known as the north block, and for this purpose has let a contract for the extension of the main level 80ft. The block referred to has hitherto proved very rich, so that its rediscovery, so to speak, would much enhance the value of the company's property. The battery has been kept pretty continuously employed, but, owing to the poorness of the stone, and the indebtedness of the company—this latter the result of a long period of dead-work—the year's operations have resulted in two dividends only, of 6d. each. But it is anticipated that the present month will see the first of a long string of regular monthly dividends. Considering the other two mines at work—United Italy and Tyrconnell—there is little to report. Both are leader claims, and are being worked by small parties of men—the United Italy by tributers and the Tyrconnell by a party of two, who are the lessees. A crushing was taken out of the United Italy by a party of tributers in June last, and it yielded at the rate of 3oz. 12dwt. per ton. At the date of the last report some prospecting was being done on this lease, but it has since been discontinued.

In the matter of alluvial mining nothing of importance has occurred. Reports of a discovery of gold on Mr. Courtney's land at the Inangahua Junction were current lately, and there was a small rush to that locality, which ended, as far as I can gather, in disappointment.

The Murchison and Owen Sub-district.

In the Murchison district the only thing calling for special mention is the construction of two large dredges for the purpose of working the Matakitaki and Buller Rivers, near Murchison and Fern Flat respectively. The Matakitaki Gold-dredging Company's dredge is being erected near Murchison, whilst tenders have been called for by the Alexander Gold-dredging Company for the cartage of their materials to the site near Fern Flat.

Mining at the Owen appears to have collapsed altogether. There is but one company—the Wellington and Silverstream Gold- and Silver-mining Company (Limited)—holding ground there now, and they are doing no work. The Extended Wakatu Company is in liquidation, and its battery has

been sold to a Mahakipawa company and removed there, whilst the Enterprise battery has gone to Reefton. Owen is now entirely without machinery, and at the present time, to the best of my knowledge and belief, also without a single miner.

I have, &c.,
H. Eyre Kenny, Warden.

The Under-Secretary, Mines Department, Wellington.

No. 7.

Mr. Warden Kenny to the Under-Secretary of Mines, Wellington.

Sir,— Warden's Office, Reefton, 15th April, 1891.

I have the honour to forward to you herewith the usual statistical returns for the year ended 31st March last, and submit the following general report upon this portion of the district under my charge:—

The district during the past year has been dependent to a great extent upon its own resources, having received but very little outside aid. The result, nevertheless, of the year's operations may be looked upon as successful and encouraging. The calls made have been less than for any similar period during the last ten years, whilst the yield of gold obtained, and value of it, is larger than for any like period for the previous six years. There have been several important developments in different parts of the district—notably, in the Cumberland, No. 2 South Keep It Dark, and Sir Charles Russell Claims, to which I shall call more particular attention later on.

The calls during the year have been less than the previous one by £7,127 3s. 4d., whilst the dividends have been larger by £9,075. This year the dividends have exceeded the calls by £6,920 16s. 8d. There was 7,249 tons more stone raised during the year than the previous one, the yield being greater by 5,717oz. For the year ended the 31st March, 1890, 1,764oz. of alluvial gold, valued at £6,704 4s., was omitted from the returns, which would raise the quantity of alluvial gold for that year to 4,479oz., valued at £17,018 19s. 2d. The yield of alluvial gold for last year is greater than its predecessor by 150oz.

From the opening of the district to the 31st March last, 506,557 tons of quartz have been crushed, yielding 384,023oz. of gold, representing a value of £1,492,134, out of which dividends to the extent of £485,106 have been declared. The yield of alluvial gold is, approximately, 105,063oz., valued at £384,217, making the total gold-production of the district 489,086oz., representing a value of £1,876,351.

In order to show clearly the result of the operations for the year, I attach a list showing the principal claims in the district, with a detailed statement of the calls made, dividends declared, &c., by them during the period mentioned.

Name of Company.	Calls made.	Dividends declared.	Stone crushed.	Yield.	Value.
	£ s. d.	£	Tons.	Oz.	£ s. d.
Wealth of Nations	812 10 0	.	1,997 Tailings	594 101	2,705 8 7
Inglewood	200 0 0	...	1,000	463	1,780 0 0
Argosy	500 0 0	..	...	...	...
Merrijigs	300 0 0	...	85	35	167 0 0
Reform	100 0 0	...	...	...	...
Murray Creek	250 0 0	...	...	...	...
Empress	50 0 0	...	...	...	...
Hard to Find	300 0 0	...	...	...	...
Oi Polloi	100 0 0	...	...	...	...
Dauntless	50 0 0	...	...	...	...
New Golden Point	100 0 0	...	...	...	...
Globe	...	12,100	8,407	5,752	22,721 0 0
Keep It Dark	...	1,000	5,081	1,769	6,900 0 0
No. 2 South Keep It Dark ...	...	1,800	1,347	1,190	4,700 0 0
Supreme	1,300 0 0	...	...	...	...
General Gordon	50 0 0	...	...	...	...
Hercules	1,300 0 0	300	262	211	836 11 6
Homeward Bound	600 0 0	...	...	...	...
Venus Extended	200 0 0	...	840	475	1,839 12 8
Gallant	600 0 0	...	674	141	541 11 0
Happy Valley	200 0 0	...	...	...	...
Golden Lead	100 0 0	...	52	67	262 11 2
Golden Lead	2,700 0 0	...	...	...	...
Triumph	50 0 0	...	...	...	...
National	200 0 0	...	66	12	46 13 9
Progress	...	4,800	*11,500	5,296	21,032 6 7
Welcome	1,125 0 0	...	144	319	1,273 19 6
Big River	1,800 0 0	...	...	...	...
Specimen Hill	666 13 4	...	...	...	...
Golden Treasure	1,100 0 0	900	700	587	2,313 8 9

Name of Company.	Calls made.	Dividends declared.	Stone crushed.	Yield.	Value.
	£ s. d.	£	Tons.	Oz.	£ s. d.
Sir Charles Russell	500 0 0	...	17	34	119 10 0
Inkerman	...	2,000	4,083	2,754	10,690 5 10
Walhalla	250 0 0	...	...	...	...
Resolution	300 0 0	...	...	...	...
Inangahua Low-level Tunnel ...	200 0 0	...	...	...	...
Exchange	400 0 0	...	...	...	...
Caledonian Extended	233 6 8	...	...	...	...
United Devonshire	366 13 4	...	...	...	...
Sir Francis Drake	600 0 0	...	396	99	386 2 0
Blue Sky	100 0 0	...	...	...	...
Scotia	1,100 0 0	...	...	...	...
Cumberland	600 0 0	1,200	609	630	2,533 4 9
South Hopeful	600 0 0	...	...	...	...
Energy	...	...	777	377	1,471 0 0
Royal	400 0 0	...	22	15	57 15 3
Fiery Cress	...	3,225	1,722	2,302	9,136 7 6
A1	...	...	6	124	484 0 0
	20,404 3 4	27,325	39,787	23,347	91,998 8 10
Alluvial gold	...	...	...	4,629	17,594 0 3
				27,976	109,592 9 1

* In this case the tonnage is only given approximately.

I now propose to give a short account of the work done during the year in some of the principal mines.

MERRIJIGS DISTRICT.

Inkerman.—The main shaft having been sunk to a depth of 150ft., a drive was started towards the winze, which had been sunk 138ft., and the reef was struck in about 100ft. from the main shaft. The main level north was driven on for 220ft., when the reef pinched out. The stone averaged about 2ft., and yielded 1oz. per ton. Only a few feet have been driven south from the shaft, although there is a well-defined track of a reef showing. No. 2 level has been stoped north to the floor of No. 1, giving a total of some 1,890 fathoms of stoping. The stone yielded about 13dwt. per ton. The sinking of the main shaft for No. 3 level was started last January, and is now down about 80ft., and the winze to connect with it is down about the same distance. It is expected that both these will be finished to a depth of 100ft. early next month, when driving north for the reef will be commenced. Last July a new make of stone was found on the company's south lease. A crushing of about 90 tons of stone was obtained from it, and yielded at the rate of 3oz. to the ton. Unfortunately, the solid reef has not yet been found. This stone is on the same line as the rich quartz taken from the Scotia some two years ago. The company gave £2,000 in dividends during the year.

Cumberland.—Operations in this mine commenced in June last. Prospectors were sent out to prospect this ground with a view of proving the Golden Lead formation found in the claim. Their operations in this direction were not, however, satisfactory; they therefore turned their attention towards discovering a quartz-reef. It was known that quartz existed in the ground. After about three weeks prospecting stone was discovered carrying good gold. Where discovered on the surface the reef was lying very flat. A winze was sunk on it 12ft. or 14ft., but this resolved itself almost into a drive, owing to the flatness of the reef. A tunnel was then put in 30ft. below the outcrop, and after driving 130ft. the reef was met with. This has now been driven on 150ft., showing an average width of 4ft. A tramway was made to connect the mine with the Sir Francis Drake battery. Only 6d. per share of the company's capital was called up, and so good was the quality of the stone that a dividend of 1s., amounting to £1,200, was declared out of the second crushing. The third crushing is now proceeding. The manager is of opinion that there is about 3,000 tons of stone yet on this level. A lower level is now about to be put in, which will be about 133ft. perpendicular below present level. The stone is showing stronger under foot, so that the company has excellent prospects.

Scotia.—With a view of picking up the stone struck in a cross-cut from the winze at a depth of 45ft., another cross-cut was put in at a depth of 75ft. This cross-cut having been carried in 80ft. without finding the reef, work in this portion of the mine was discontinued. The main level has been extended 250ft. without meeting with the reef. The company are now cross-cutting from the level. From November to January last surface-prospecting was carried on under the bonus system, on the northern portion of the lease, adjoining the Inkerman South lease, with a view of picking up a continuation of the very rich but small body of broken stone found in that lease. Several small outcrops of loose stone have been found, but nothing solid. It is the intention of the company to continue surface-prospecting.

O.K. and Golden Lead.—These companies have amalgamated under the name of the Golden Lead Mining Company. Mention has been made in previous reports of the immense body of a peculiar formation, being a conglomerate of sandstone and quartz leaders, within the boundaries of

these claims. It will be remembered a crushing of 100 tons of the stuff gave 4½dwt. to the ton. Another crushing of a smaller parcel has since been made, 52 tons giving 67oz. of gold, or about 25dwt. per ton. In this instance, however, care was taken to separate the quartz as much as possible from the sandstone before crushing. However, the true test will soon be applied, as a ten-head battery is now in course of erection for the purpose of treating the stuff, and will be out of hand shortly. As showing the extraordinary richness of some of the quartz leaders in this locality, I may mention that a crushing of 6½ tons of stone obtained from a very small leader in the A1 lease yielded 124oz. gold.

Devil's Creek.

Globe.—The battery has been almost continuously employed during the year crushing stone from the No. 3 level, having put through 8,407 tons of quartz, which yielded 5,752oz. gold, representing a value of £22,721, out of which dividends were declared to the extent of £12,100. The main shaft has been sunk from No. 3 to No. 4 levels to a depth of 125ft. A winze was sunk on the reef 60ft. or 70ft. west of the shaft from No. 3 level to a depth of about 110ft., disclosing a large body of stone of good quality. On the completion of the main shaft to No. 4 level a drive was put in from the bottom for a distance of about 120ft., when the reef was struck. The reef has been driven on 60ft. or 70ft., and a connection made with the winze. A large body of stone is now being operated upon. One of Denny and Watson's grinding- and amalgamating-pans was erected during the year, but did not prove a success, and work with it has consequently been discontinued. The Triumph concentrators, erected some fifteen months ago, have also been stopped for the same reason. The total quantity of quartz obtained from the mine is 41,756 tons, which have yielded 22,290oz. of gold, valued at £87,736, from which the shareholders have received £30,100 in dividends.

Progress.—The eastern reef has been driven on a distance of 200ft., 60ft. of which has been driven during the last twelve months. About 36ft. beyond the eastern reef another reef, supposed at the time to be what is known as the Dam Block, was struck. This stone was driven on along the foot-wall for 100ft., but was not found to be payable. Between the east and west blocks, on the upper level, was a block of stone 100ft. in length, known as Black's Block. A cross-cut has been driven 80ft. on the present level to intersect this block, but without success. The operations for the past year have been satisfactory, 5,296oz. gold having been obtained, valued at £21,032, out of which the shareholders have received £4,800 in dividends. The stone from which such good results have been obtained has been taken chiefly from the eastern block. It is said that there is at least six months' work remaining on this block from the present level, and, as this work proceeds, steps will be taken to open a new level. A winze is being sunk on the eastern block, and is now down 20ft., carrying a fine body of stone with good prospects. The method of winding from deeper levels is now occupying the attention of the directors. The cap of the Dam Block has recently been cut in the upper level, and will be sunk on for the purpose of ascertaining the underlay, thereby giving the information necessary to pick up the reef on the present level. The total quantity of stone crushed by the company, I believe, would be about 21,600 tons, from which 9,799oz. gold have been obtained, worth £38,818, and the total dividends would amount to £7,200.

Big River.

Big River.—During the year the main shaft has been sunk 220ft. In the course of sinking, a new make of payable stone, about 2ft. 6in. in width, was struck, at a depth of about 110ft. On the shaft being bottomed, a tunnel was driven north, for the purpose of intersecting this stone, and it was found after driving a distance of 65ft. Where found on the level the stone averages 5ft. in width, and maintains that average after having been driven on for 30ft. A tunnel has been driven from the bottom of the shaft for the purpose of striking a rich block of quartz left in the old workings. The reef was struck after driving 202ft. A small crushing of stone taken from this block when it was originally sunk on gave a yield of nearly 2oz. per ton. This block is about 3ft. 6in. wide and 60ft. in length. The present level will give about 180ft. of backs. An uprise of about 120ft. will be necessary to connect the drive from the main level with the bottom of the winze. The battery will in all probability start crushing in about a month or six weeks, and, I think, with a reasonable prospect of profit to the shareholders.

Painkiller.

Sir Charles Russell.—The reef in this ground was discovered on the surface about two years ago. This was sunk on to a depth of 30ft., and a short level was put in on the reef. A low level was then opened, which struck the reef at 50ft. This reef has now been driven on a distance of 190ft., carrying stone (more or less) the whole distance, averaging from 18in. to 2ft. The value of the stone was ascertained by trial crushings, at the Keep It Dark battery, taken indiscriminately from the heap of quartz obtained in driving a small uprise of 18ft. The first crushing was 6 tons and the second 11 tons, resulting in 2oz. of retorted gold to the ton. A rise is now being put up to the surface, in order to obtain thorough ventilation, when it is proposed to sink a winze on the reef to a depth of 80ft. or 100ft. Should this winze carry the reef down, the company will proceed to erect crushing machinery, a splendid water-power being available. This is considered a promising venture, and is of importance, as it is apparently the connecting link between Murray Creek and Boatman's.

Boatman's.

Fiery Cross.—The block of stone in the south end of the mine above the 600ft. level has been taken out with profit to the company. A winze has been sunk to a further depth of 120ft. The branch winding-shaft has also been carried down to the same depth, and a connection made between it and the winze. This has proved and opened up another block of what is considered highly payable quartz. The prospects from this block so far are said to be better than those

from higher levels, which looks well for the payable character of the lodes as they go down. Some prospecting has also been done in the north end of the mine, a winze having been sunk from one of the higher levels on a block of quartz which is situated further north than any of the previous workings; but, as very little work has been done, and no crushing taken from this block, the value of it is not yet known. The battery and grinding machinery, after undergoing extensive repairs, have commenced crushing from the newly-opened block of stone. The claim has given £3,225 in dividends during the year.

Welcome.—The work in this mine during the year has been confined to the baling-out of the shaft, repairing it, and the cross-cut to the line of reef, which has proved a most expensive and difficult job. A contract has now been let for retimbering No. 9 level, and driving it another 100ft.

Murray Creek.

Keep It Dark.—During the year work has been prosecuted on No. 4 level. At date of last report the middle block had been stoped up 40ft. This was continued, and the block has been stoped up to No. 3 level. The eastern block was stoped up another 30ft., making 80ft. in all, when the stone ran out. Only three stopes were taken up on the western block, as the stone was found unpayable. On the No. 4 level 500ft. of tunnelling has been driven in various directions, in order to thoroughly prospect the mine. Search was continued for the north block, from which good returns were obtained in the upper levels, but it has not so far been found on the present level. A winze 90ft. from the inside shaft has been sunk 110ft. below No. 4 level, and 4ft. 6in. of payable stone has been found at the bottom. In order to work this stone, the company intend sinking the inside shaft a further depth of 120ft. The total depth of this shaft will then be 240ft., or 720ft. from the brace on the surface, and 900ft. from the outcrop. A block of payable stone was discovered on the battery-level, and has been stoped up 40ft. This block is about 30ft. in length, and averages about 10ft. in width. During the year 5,081 tons of stone has been crushed, yielding 1,769oz. of gold, valued at £6,900, out of which dividends to the extent of £1,000 have been declared. The total amount of stone raised from this mine is 107,906 tons, which has yielded 58,220oz. of gold, worth £226,506, from which the shareholders have received dividends to the extent of £107,583.

Wealth of Nations.—The chief part of the work in this mine at present is opening up the quartz discovered in the early part of 1890 on the 200ft. level, which is about 160ft. below the level of the Inangahua River. The principal block is 900ft. from the main shaft, the average width of the reef being about 10ft. by about 60ft. in length. The quartz has been taken out to a height of 40ft. above the level, but, owing to its getting poorer going up, the work is now limited to the construction of an uprise, and driving the level above, so as to make a connection for the purpose of properly opening up and ventilating the mine, in order that the work may be carried on profitably at deeper levels, it having been proved that payable quartz exists on and below the 200ft. level. Prospecting has been carried on in the low level to 100ft. north of the present block, where another reef is supposed to exist.

Venus.—A connection was made with the winze sunk from the eastern cross-cut, 70ft. below No. 3 level, and the bottom of the winze, 115ft. below No. 3 level, and 75 tons of stone were taken out, giving a return of 31oz. of gold. This portion of the mine is now let on tribute. The company then started to work on the top level, which has been extended 200ft., and stoped out 610 tons of stone, from which 395oz. of gold resulted. Work is still proceeding in this portion of the mine.

Hercules.—The shaft was sunk to the required depth of 125ft., from No. 6 level to No. 7. The No. 7 level has been driven on north and south. The reef was obtained in the south drive at about 160ft. from the shaft. From the stone obtained here two small crushings have been taken. The reef was of the same broken character as in the upper levels. The level is now being extended south, in the direction of the No. 2 South Keep It Dark, with the view of picking up a continuation of the reef now being worked in that claim.

No. 2 South Keep It Dark.—A main shaft was sunk 280ft. some two or three years by this company, in conjunction with the Pandora and South Wealth of Nations Companies. This company worked a block of stone from the Pandora, but, as the reef was of small extent, it was decided to extend the level north. After driving 500ft., an entirely new make of stone was found. This reef has now been driven on about 125ft., and maintains an average width of about 4ft., and is being stoped up above the level. The stone is of good quality, 1,347 tons having produced 1,190oz. gold, enabling the company to give £1,800 in dividends. Should the stone live to the surface there will be not less than 300ft. of backs.

Golden Treasure.—During the last twelve months driving, sinking, and stoping has been carried on between Nos. 3 and 4 levels; 700 tons of stone has been put through the battery, yielding 587oz. gold. The quartz has now mostly made into antimony, which, although carrying the same amount of gold, is not payable, owing to the difficulty of separation by the present battery treatment. There is a very large quantity of antimony-ore now showing in the mine. The manager was despatched in October last to the New Zealand Antimony Company's Mine, Picton, in order that he might obtain an insight into the practical method of treating and working the ore. Since his return he has built a small test-furnace, which acts satisfactorily. Ten tons of the ore were sent to Auckland some time ago for proper treatment, and to ascertain its true value. Works at the present time are confined to stoping under No. 3 level, and driving north for the Westland Block, which was worked on the surface about fourteen years ago.

General.

There has been a considerable amount of work done in a number of other mines, but nothing has transpired worth recording. The good fortune of the Cumberland has induced other claims in the neighbourhood to start work, and, as it is promising country, good results would not be surprising. The current year opens with what may be considered fair prospects.

I have to thank managers of companies for their courtesy and kindly assistance in furnishing information with reference to the various claims under their management, and Mr. Lucas, the Clerk of the Court at Reefton, for his valuable aid in the preparation of this report.

I have, &c.,
H. Eyre Kenny, Warden.

The Under-Secretary, Mines Department, Wellington.

Mr. J. Gow, Inspector of Mines, to the Under-Secretary of Mines.

Sir,— Dunedin, 31st March, 1891.

I have the honour to forward my report on the quartz-mines visited since my removal from the Kumara.

Lyell.

Alpine Quartz-mine (4th October, 1890).—The seventh level struck the reef at 2,400ft. from the mouth of the tunnel on the 29th July last, and from that time up to the day of my visit the reef had been driven on a distance of 44ft. to the north and 20ft to the south in solid reef. Stoping is now going on in the intermediate level at 170ft. above No. 7 level, and at 120ft. below No. 6 level. The approximate estimate of backs now available is 400ft. Should the reef continue the same thickness throughout as where exposed it will take some years to work it out to the present level. The number of men employed were fifty-eight, but many more were to be put in the mine when there was sufficient room for them. The workings are very wet in places, but it is thought it will drain away in time. The mine is strongly timbered and the air good.

United Italy Mine (6th October, 1890).—This mine is worked out on the old level, and Potter's level is driven from the level of the Eight-mile Creek to a distance of 800ft., where prospecting is being done to the north from this drive without finding any trace of a reef up to the date of my visit. The men, however, are very hopeful of finding the reef in another 40ft. driving. There are only two men employed in the mine. There is an overshot wheel and small battery at the mouth of this tunnel.

Tyrconnel Mine (6th October, 1890).—In this mine No. 5 level is driven in 700ft, where there is a winze now being sunk 25ft. following a very small leader carrying gold. The workings are dry and in good order. There are only two men employed.

Devil's Creek Mine.

Progress Mine (16th October, 1891).—I examined the upper level workings on what is known as Smith's Block, 18ft. below the old workings, where four men are employed. A pass was being timbered from the lower level to this at the time of my visit, when there was a large vacant space to be immediately filled in on completion of the pass. I next visited the eastern block, which is being stoped out from the lower level to within 90ft. of the old upper workings. There is a large body of stone between these two levels not yet touched. There is a tunnel being driven under what is known as the "dam site," where there is a quantity of stone, supposed to be payable. The manager, Mr. Wilson, however, thinks this block is the foot of a new reef, and not a continuation of the block under the dam site worked by the Globe Company on the Progress boundary, which boundary at that spot the Progress workings have not yet, he thinks, reached. A very large body of stone is now known to exist above the low-level tunnel, which is estimated to keep the battery fully employed for two or three years at the present rate of crushing—equal to 250 tons per week, There are now thirty men employed in the mine, and fifteen outside on the surface and at the battery, which consists of twenty-five stamps worked by a fifty-horse-power engine, the finest in the field. The fuel used is coal, which is obtained from the company's mine, about a half or three-quarters of a mile from the battery. The coal heretofore has been conveyed to the battery by a tram laid round the hillside, at a more or less heavy gradient in places, but this laborious work is shortly to be done away with and an aerial tram made to do the work, and which is now nearly completed. This new work should reduce the cost of fuel very much. The several workings throughout the mine are well timbered and well ventilated. No copy of the Act at the mine, and no books kept. The manager promised to do what is required without delay. The loss of gold per ton at this battery is supposed to be great, and to avoid which several plans have been tried and failed; other appliances are to be tried forthwith. I again visited this mine on the 29th October, and inquired of the manager if the stoped ground, where the four men were employed and the pass was being timbered on the 16th, was yet filled, and he replied that it was being filled in to-day and the pass timbered well up.

Crushington Mines.

Keep It Dark Mine (18th October, 1890).—I inspected the workings in No. 3 level, where the stone is from 3ft. to 30ft. thick, and will average about 20ft. Stoping in No. 4 level (600ft. from the surface) is now going on. The workings are dry and the ventilation is good. There are twenty-two men employed in the claim. Saw tracings of workings of the mine. The Act is well observed.

Wealth of Nations Mine (18th October, 1890).—This mine is being worked on the 200ft. level, where a large body of stone was lately discovered. The lode appears to lead to the north, but a large "horse" has been followed to the east for 60ft., where it pinches out. The new find is not yet sufficiently opened to enable any one to estimate its probable extent in any direction. In the meantime the main level tunnel is being pushed on to the north in a solid reef, which is believed to be payable. The air is good, and the winding appliances in good order. The general rules were posted up at the mine, but no copy of the Act to be seen. The manager said it had been lost. I requested him to procure another copy without delay.

Keep It Dark Mine No. 2 (20th October, 1890).—No. 2 level, 280ft. from the surface, is now

driven 600ft. north, and the last 13ft. driven is on stone 2½ft. thick, and widening steadily as the work proceeds. No. 3 level is driven 200ft. north, which is within 30ft. of the boundary, and the stone proves to be in detached blocks all the way. Stoping is now going on at 46ft. back from the end of the drive, and will be continued up to within 30ft. of No. 2 level. The reef here is thin, and will not average more than 18in. The nature of the walls are soft and flaky, requiring close timbering in places. The water (11,200gal. per day) has to be lifted in tanks. There are seven men employed. The general rules are posted up at the mine, and a copy of the Act kept there. There has been nothing done yet towards providing safety-catches for the cage. The manager, Mr. Lawn, stated that he had repeatedly spoken to the directors about them.

Murray Creek Mines.

Inglewood Mine (21st October, 1890).—I went into the top level of the mine, where I found C. Rogers, manager, and another miner working. These are the only men employed in the mine. The stone is all taken out between the top and low-level tunnel. The two men purpose prospecting in the footwall in the intermediate level in the hope of finding stone. No arrangement has yet been made by the directors to follow the reef below the low-level tunnel.

Golden Fleece Extended (21st October, 1890).—The manager is the only man on the ground, who does the pumping to keep the mine dry, and does all the coal-hewing in the coal-mine close by to supply the engine with fuel. All this work is simply to keep possession of the mines till some money is procured to prospect for the long-lost reef. The engine and surface-plant is kept in good order. I called Mr. Mutrie's attention to the dilapidated state of the horse-whim used for hoisting and lowering the coal from the coal-mine to the battery, but he assured me that it was strong enough for what it was required to do, and, if it did carry away, there was no one thereabout to be injured.

Golden Treasure Mine (22nd October, 1890).—The present workings are confined to one face, which is 80ft. below what is known as the "battery-level." The stone is very irregular and uncertain in quantity. It varies in thickness from 2ft. to 10ft., and in places consists of a little quartz and a large body of antimony-ore, which I noticed was being stowed away in quantity in the worked-out ground in the hope of some day getting a buyer for it. In the meantime a quantity has been shipped to England and Germany to be tested. I understand there is a large lode of antimony cropping out of the surface on some part of this company's lease. No copy of the Act kept at the mine.

The Royal Mine (22nd October, 1890).—Steady progress has been made with the tunnel since my previous visit. It is now driven 1,300ft., and supposed to be near the reef. Prospecting-levels or cross-cuts have been put in at several places from the main level as the work proceeded, but faid to find any quartz. The air was very bad on the day of my visit, and I requested the two men to remedy this as quickly as possible, which they promised to do. There is only the one shift of two men in the twenty-four hours.

Venus Mine (22nd October, 1890).—Quite lately a fresh find of stone was made in No. 1 level, and was driven on for 100ft. at the time of my visit. Stoping from this was proceeding, and the level was being continued at the same time; and at the time I was there the stone changed from yellow to blue in the level tunnel and showed gold. The manager thought it very promising. The Act is well observed.

Energy Mine (23rd October, 1890).—The old workings are still being searched for blocks of stone with fair success. Isolated blocks are found here and there close to the old stopes, and are fairly payable. The stone is trucked straight out from the mine to the Venus battery. The work in the mine is very dirty and wet in places. The air is good, and a copy of the Act kept at the mine.

Happy Valley Mines.

Sir Francis Drake Mine (24th October, 1890).—Very little work has been done in this mine for some time past, and quite lately work ceased altogether. I did not see any one about the mine on the day of my visit, and the battery (which crushes for other mines) was idle for the want of water.

Scotia Mine (24th October, 1890).—Since my previous visit a winze has been sunk on the track of the reef to a depth of 140ft. without finding any reef. Cross-cuts were put in 80ft. to the east and 30ft. to the west without finding any stone. Four men are now extending the main level to the north, and 60ft. is already driven since the work in the winze ceased. The extension is under contract for 140ft. Much surface prospecting has lately been done towards the Inkerman boundary. One tunnel of 70ft. and another 180ft. has been driven without finding any reef.

Gallant Mine (24th October, 1890).—This reef is still being followed by the main-level tunnel in the hope of finding more gold in it. It appears that a short time ago 160 tons of stone were crushed at the Drake battery, but the result was not payable after deducting 10s. per ton for crushing. The reef is as much as 42ft. thick in places. There are only two men employed.

Inkerman Mine (24th October, 1890).—Stoping is now going on between No. 1 and No. 2 levels. Some of the stopes are within 65ft. of No. 1 level, but it will take about seven months to get out all the stone between these two levels. The reef is 6ft. and 7ft. thick in places, but thins out to 5in. at the north end of the workings. All the stopes have to be well timbered, as the sides are disposed to flake heavily. There are forty-nine men employed in and about the mine. This mine is paying dividends. The general rules and Act kept at the mine, and engine-signals are posted up to be seen. The Act is very well observed.

Deep Creek Mines.

Cumberland Mine (24th October, 1890).—This is a new discovery made three months ago, and is situated on the water-shed of Deep Creek not far from the head of Happy Valley Creek, and quite close to the new pack-track just completed past the Merrijigs (east side of range), and joining

the Big River track. The new find has exposed two flat reefs about 14ft. apart, having a slight dip to the west. The top reef was the first discovered, and, while driving a tunnel to intersect the reef at some distance in from the face of the hill, the second reef was met with laying at about the same inclination. They are both about 4ft. thick. The top one is of a reddish-brown colour, and the bottom one is a nice bluestone; and I learn from the manager, Mr. McMasters, that they both give promising prospects to pay well. The level is now driven 170ft., and is supposed to be close to the reef. The ground is very loose and wet overhead. Nearly all the work now going on on the surface is let by contract. A tramway is being laid from the new Merrijigs track to the reef to enable the company to get a few tons of stone without delay to the Drake battery for a trial crushing. Prepartions are being made at the tunnel mouth to build stone paddocks, &c. The mine is in the midst of a lofty forest of birch-trees, which are being felled as rapidly as possible all round the tunnel mouth to allow the sunlight to reach the ground.

Golden Lead Mine (24th October, 1890).—Since taking out the second crushing all work in the mine itself has been suspended. The only stone taken out of this mine is that which was procured by the extension of the adit-level, where there is now exposed to view a large body of sandstone containing innumerable small quartz-veins intersecting one another in every direction. It is in this formation that the gold is found, and now proved by the last crushing to be payable. The company has lately purchased a battery plant at the Owen, and the same is now being conveyed from there to the mine on the new pack-track just referred to, from which place it is to be conveyed down into Deep Creek, where there is a site being prepared for it. The battery is to be driven by a Pelton-wheel, and the race to convey the water to it is now under construction. The stone is to be conveyed from the mine to the battery by an aerial tramway, which is also under construction. Several plans of the proposed works to be put in hand at once are now being prepared by Mr. Sutherland.

The Merrijigs Mine (27th October, 1890).—I did not see any one at the mine and there did not appear anything freshly done since my previous visit. I stated in my last report that some stone for a trial crushiug was being got out; I now learn that it yielded 8dwt. to the ton, and that this yield is considered payable. A crushing-plant has therefore been purchased, and is to be erected in Deep Creek immediately below the mine, and above the Golden Lead plant in the same creek. The prospects of the mines in Deep Creek are now considered very promising, and likely to lead to a considerable extension of the quartz-field to the south, even to the Big River mines.

Big River Mines.

Big River Extended Mine (27th October, 1890).—The contract for sinking the 250ft. shaft will be completed about the end of the present month. This shaft quite unexpectedly went through a payable reef 3ft. thick at 134ft. from the surface. It is intended to drive a tunnel from the bottom of the 250ft. shaft to the old reef, which work is likely to occupy a month. A reversible overshot water-wheel, 36ft. in diameter, for winding from the shaft is just completed, and all the gearing ready for the ropes. The manager, Mr. Black, expects to be hoisting quartz to the surface at the beginning of the new year. The pans at the battery are employed grinding up the old tailings with satisfactory results. There are seventeen men employed about the mine. The Act is fairly observed.

There are several other mines in this district, but as there had been nothing yet found worth reporting I did not visit them.

Inangahua River.

Supreme Mine (28th October, 1890).—This is the largest reef in the district, and a very large body of stone was crushed from it some few years ago, but eventually it did not pay and all work ceased. Some of the shareholders, however, have faith in it yet, and are now driving a prospecting-drive, which is now driven 260ft. in a nearly east and west direction, but they find the stone curving quickly to the south. Quartz is found in quantity everywhere in the hill, but generally leading to the main reef, which is said to be 100ft. thick. There are only two men employed in the mine. A few tons of stone are crushed at the mine battery from time to time to test the value of the stone passed through in their drives.

Boatmans.

Specimen Hill Mine (29th October, 1890).—There is no stone being taken out of the mine just now. There are two men employed prospecting on the surface for the reef by cutting a trench up the hill 6 chains in length from No. 1 level, but up to the time of my visit they had not found any trace of the reef.

Homeward Bound Mine (29th October, 1890).—This company is now sinking a winze within about 200ft. of the north boundary of the Welcome Mine, where a small leader containing gold has been found and is being followed; but the winze was down only a few feet at the time of my visit. There are only two men employed.

Welcome Mine (29th October, 1890).—There has been very little quartz taken out of this mine for some time past, and none at the time of my visit; but the water was being baled out from No. 9 level where the shaft has pinched in so much as to prevent the tank passing up and down easily. When the water is out and the shaft repaired it is intended to drive north and south in search of stone. There are only five men employed in the mine just now.

South Hopeful Mine (29th October, 1890).—There is a winze being sunk in this mine in the hope of finding the reef worked by the Reform Mine. It is calculated that the four men now employed will reach the required level in two or three weeks.

Just-in-Time Mine (29th October, 1890).—A prospecting drive is being put in at about 400ft. below the surface with a view of cutting the western reef, which is supposed to exist there. There are four men employed at this work, but I did not see any of them about,

Fiery Cross Mine (29th October, 1890).—The mine is being worked at No. 3, or 450ft. level, where fairly good stone is being stoped out under-foot, 650ft. north. At No. 4 level, south, a winze is being sunk below the level, south of the shaft, 300ft. The monkey-shaft on No. 4 level is being sunk to a depth of 100ft. There are eighteen men employed in the mine. The mine is in good order, and the Act is well observed.

Devil's Creek Mine.

Globe Mine (30th October, 1890).—On No. 3 level (400ft.) a winze is being sunk, and is now down about 80ft. The shaft is sunk 120ft. below this level, and the first set of timber in the new chamber is now being put in. This chamber will be 60ft. or 70ft. on the west side of the reef at that level. Stoping is going on above No. 3 level, where the stone is from 12ft. to 25ft. thick. It will take about five months to work this level out, by which time No. 4 level will be on the reef, and everything made ready for the men to get out stone. There are forty men employed in and about the mine. The engine lifts about 4 tons of water by means of a tank every hour from the No. 3 level. The air and the timbering is good throughout the mine. No copy of the Act kept at the shaft mouth.

Westport Mines.

Beaconsfield Mine (6th November, 1890).—This mine and workings are immediately below the Waimangaroa Stream, a short distance above the lower end of the Coalbrookdale incline-tram. A water-race, 38½ chains in length, has been constructed, and a overshot wheel built at the shaft to do the winding and pumping from the mine. A plunger-pump had been erected a few days before, and was working very well on the day of my visit. The main-level tunnel was being retimbered and repaired after several years abandonment. The manager, Mr. Edwards, expects to be getting out stone at an early date.

COLLINGWOOD.

Johnstone's Mine (22nd September, 1890).—I inspected this mine specially on account of an accident by which one Pryer was killed by a fall of stone and clay on the 16th September. I arrived at Collingwood from Greymouth on the 20th, the day after the funeral. The finding of the jury was accidentally killed and no one to blame. On the 22nd I inspected the face where Pryer was killed, and found the gad and hammer lying on the spot; and from information received from the man in charge of the men at the time, and who had been with Pryer a few minutes before the accident, I am of opinion that Pryer had been using the gad, and that it fell out of the roof, and while in the act of picking it up the block became detached and fell on him. Had he observed ordinary care the accident would not have happened. The block exposed a smooth and glossy backing in the roof. Pryer was considered an experienced miner. I examined the mine workings carefully, and instructed the manager to use more timber in places. I also ordered side-rails at the side of the truck track, where there was a dip excavation, not over safe if a truck ran off the rails. I instructed the manager to put up a shifting-bar at the mouth of the pass where the stone is tipped, which would prevent an accident to men who might lose their light there. All these things were promised to be done immmediately. The mine is very dry and comfortable to work in, and the air is good.

ROSS.

Mont d'Or Sluicing Claim (10th October, 1890).—I visited this mine specially to inquire into the accident to Geomini Bissinilli, who was killed in the claim on the 8th instant. One of the two men who was working in the open sluicing-face by the side of the deceased pointed out to me the positions they were in when it was suggested by my informant to get out of the face a few minutes to avoid a fall of *débris* that was supposed to be coming down. The two mates of the deceased lifted their tools and went up toward the nozzle-piece (the water was not on this face at the time), but on looking round they saw the deceased was only then making a move from where they had left him, but too late to save himself, as the fall was then coming, and the *débris* overtook him in his flight down toward the tail-boxes. As he ran he called out in Italian to his mates to save him. He must have been killed immediately after he fell. The mates cannot account for the deceased not moving away when they did. He was told to move away, and could hear the flakes of clay and gravel falling as they had done. This is the best paying sluicing claim on the West Coast; and since this company purchased the Greenland Company's Claim and water-rights, they have had a fair supply of water. For the twelve months ended on the 30th November last, the yield of gold was 1,191oz. 22gr., value £4,516 3s. 6d., and the working expenses during that period was £1,501 19s. The payable ground in sight will require many years to wash away, and they have a splendid tailing-site capable of holding all they have to wash into it.

The Ross United Gold-mining Company, Ross (10th Obtober, 1890).—The upper end of Ross Flat, between the old Scandinavian and Morning Star Claims and the terrace, is being steadily sluiced away by tributers with satisfactory results. They are now sluicing round an enormous heap of stones lying on the original surface, which has been tipped there from claims previously worked at a higher level. As to whether it will pay to remove this heap remains to be proven. Should it, however, prove to be payable with their present appliances, then there are very many years' work before them. The company's claim at Donaghues is, I understand, working steadily, and at a profit.

The two fatal accidents referred to herein are the only accidents brought under my notice in the gold-mines during the year.

I have, &c.,

J. Gow, Inspector of Mines.

The Under Secretary of Mines, Wellington.

No. 9.

Mr. Warden KEDDELL to the UNDER-SECRETARY of MINES, Wellington.

SIR,— Warden's Office, Greymouth, 25th May, 1891.

I have the honour to forward the annual statistical returns showing the position of mining matters in the district under my supervision, and the other information asked for in your Circular No. 5, 6th March, 1891.

There is not an incident of interest to be recorded as having occurred during the past official year. The depression consequent on the strike and the labour complications have no doubt affected this industry to a certain degree, and the great interest evinced in the last general election, which engrossed the attention of all persons for two or three months prior to the polling-day, also militated against vigorous development of the mining properties.

Blackball.—Matters here have remained quiet. On a special claim held by a company called the Minerva a very large quartz-reef has been discovered, and the directors have sufficient faith in it to purchase a mining plant at Ross, formerly belonging to the William Tell Company, and they are now engaged in its transport, an undertaking of some difficulty, from Ross to its position on the claim, about seven miles up the Blackball Creek, at an elevation of about 900ft. from the level of the junction of the creek and the Grey River. The reef is of considerable width, 22ft. from the hanging-wall, and the foot-wall has not been reached yet in the cross-cut made to ascertain its proportion. If this large bulk of stone should prove to be honest in its yield—that is, should it contain a thorough admixture of gold, as is sometimes found in these large reefs, a very small percentage of gold would repay the enterprising propriety handsomely for their outlay, which has been going on for the last two years, and must continue for at least six months more. The test of the stone at the cross-cut mentioned shows 12dwt. to 15dwt. right through. A smaller percentage than this would pay, but, whatever good fortune may result, their perseverance and the indomitable energy of the managing director, Mr. Perotti, well deserve it.

All through this district quartz specimens are found, rough and unwater-worn and cannot therefore have travelled far, but the development of the place is blocked for want of roads, and in the present condition of the finances of our local bodies help of this kind does not appear within reach. Should any money be voted by the Legislature for the purpose of assisting mining research, some portion might be beneficially and profitably expended in the Blackball district. While at this point it may not be out of place to mention that the Blackball Coal Company have succeeded in striking the seam of coal, a work on which they have been engaged some time, and the result has been the verification of the engineer's predictions, and the proof that they possess a property that, for quality of coal, for ease and economy of hewing, and bringing to the market, is not surpassed by any in Australasia.

At Moonlight, some heavy gold specimens have been found at Garden Gully, and it is possible that some defined lead will be found, and very profitably worked. At present it is all in the future, and though they give very meagre facts to found an opinion on, miners, who know the country, always speak hopefully of it as a part of the district that will sooner or later take the lead as a rich gold-producing locality.

On the South Beach, from Greymouth to the Teramakau, no change has taken place. The Golconda, a large alluvial claim, on which a great deal of money has been spent in water-races, has not yet made any return to its proprietors, who find that they will require a further supply from the New River to work the machinery for bringing their wash-dirt to a suitable level for sluicing.

The Paroa Dredging Claim never recovered the loss through the breaking down of their punt. Their machinery was dismantled and sold early in the year, and the company, I believe, in liquidation. It is a great pity they had so much misfortune at the start, for I am given to understand that the prospects obtained during the short time they worked were perfectly satisfactory.

While on the subject of dredging, I regret much to report that I cannot write hopefully of this branch of mining, from which so much was anticipated three years ago. There has not been a single successful trial of any dredging machine on the Coast. The Greymouth Company (English) is still under the management of Captain Parker. The machinery as at first designed made a start about nine months ago, but, as is not unusually the case with entirely new and complex machines, new in design as well, it was not found a success, and some modifications of some parts, and some additions, have just lately been completed, and a new start is daily expected. One of the additions is another large centrifugal pump, 10in. in diameter, it being found that the 8in. pump did not give a sufficient supply of water. With the two it is anticipated there will be sufficient. The manager has also introduced a novelty by the way of having some moving plates, which are worked by an endless band, to assist to clear the tailings away from the front of the tables into the tail-race. The tail-race is carried out on rafts, which can be disconnected, or connected, as required, to allow for the fall of the tide out seaward.

Taylor's Claim has still been worked, but to no great advantage. The claim has been made over to a company, of which I understand the former proprietor is the principal shareholder. This claim also lacks a greater supply of water, and is now about to bring in some from a neighbouring lagoon.

The Carlobun, a special claim on the Seven-mile Creek, is about to make a start with a double pontoon dredge, with central ladder-buckets, the capital being supplied from England. None of the other special claims appear to have any vitality, and seem discouraged by the failure of the pioneers.

At Ahaura, the business for the past year has not been so great, in the Courts especially, the last five months. Possibly the work offered on the Midland Railway may account for the lull in mining matters. The yield for some years has not been of startling average, and no doubt there are many who would for a change prefer steady employment.

Kumara is the only portion of the district which seems to hold its own, and has been undisturbed by the outside disturbances of the past year. The year throughout has been favourable for sluicing, the rainfall being exceptionally great. One notable event has been the transfer by the Government to certain trustees of the Kumara Sludge-channel No. 1 to the trustees of Channels Nos. 2 and 3. Although there is a good water supply, and the natural supplies to the Government water-race have been, as I have said, very favourable this year, a great deal more water would be rented and used if available, and frequent applications are made (unopposed) for protection, because water is not available.

In the Waimea Valley mining has been very dull, though I do not think there is any falling-off of the population.

Prospecting.—Early in the year two miners (Livingstone and Robertson) made an application for a prospecting-area, their intention being to sink on the Arnold Flat, and to determine the question of there being any deep leads of gold there. The prospecting regulations do not provide a sufficiently extensive area, nor for a proportionately large prospecting claim for such an arduous undertaking as this. I suggested that they should apply for a special claim, and that, in consideration of the public advantages which would ensue on their success — as I believed it would be the means of opening up a great extent of ground hitherto unbroken— I would recommend the Government to grant them the first year free of rent. It is the opinion of some of the experienced miners that deep-sinking on the flats, which naturally exist near the mouth of the small rivers and creeks emptying into the Grey, and from the surface working, of which in the early days of the West Coast settlement such rich returns were made, might disclose runs of coarser gold; and it seems probable that this drift, the upper strata of which has been found to be so highly auriferous—drift that has been accumulating for ages, poured down from their sources in countless tons—would probably contain at a lower bottom rich auriferous deposits. Such work must be costly, but the timber in the neighbourhood is suitable; the chief difficulty to be apprehended is water. An attempt has been made by an enterprising party at No Town Creek—Ryan's Creek. They have bottomed two shafts, and have found encouraging prospects. One was, I consider, too large for prospecting purposes, and the increase of the diameter of a shaft increases the danger. The cost of the first shaft was about £300. They found gold all the way down this shaft, and of such a nature as to convince them that it was highly payable. It was then suggested that they should sink a shaft by means of cylinders, and, with the assistance of an engine and an air-lock, lent them by the New Zealand Midland Railway Company, they did so. They sank four holes by this means, finding gold from top to bottom, sinking about 29ft. deep. The prospects were not so good as in the first shaft they sank, but sufficiently good for the purposes of dredging—the mode of working their claim was taken up for. They are now deliberating as to the character of the machinery they will adopt. There is an elevating machine now at work at Nelson Creek, in which some of these shareholders are interested, and the success of that machine might decide the party to adopt that. Another miner named Manson has also started on the No Town Creek with a steam-engine, to work the lower levels of this creek. His method is by means of a winze, up which he hauls the dirt, and will treat it on the surface.

These leads, if found, may not, however, prove continuous, as experienced in Victoria; indeed, here it by no means follows that gold struck in a creek with a payable result, that another party could with certainty set in higher to find gold at all. Strangely enough, instead of the runs of gold being in the course of these creeks, or in blind gullies, the runs are very often met with transversely crossing these gullies or creeks. Whatever may be the success of these claims, it is certain that there is a large area of ground which, except on the surface or in very shallow-sinking or working, has not been tested.

Arnold, Dunganville, and Barrytown.—About these outlying places there is really nothing whatever to be noted. Mining is continued at all of them; but I have not heard of any falling off of the population. I fear the district will suffer from the loss of county revenue, owing to the abolition of the gold duty. The assessment of mining claims is not easily made. In the Grey County this was done, but in Westland County the Council did not make any assessment, believing the cost of preparing the list would exceed the amount obtainable.

I have, &c.,

JACKSON KEDDELL, Warden.

The Under-Secretary, Mines Department, Wellington.

No. 10.

Mr. Warden MACFARLANE to the UNDER-SECRETARY of MINES, Wellington.

SIR,— Warden's Office, Hokitika, May, 1891.

I have the honour to forward herewith statistical returns for the Westland Mining District for the year ending 31st March, 1891, together with the annual report on the districts under my charge.

HOKITIKA.

As indicated in my last year's report, the Back Creek rush, near Rimu, has developed into an extensive and promising goldfield, the limits of which being bounded only by the labour and capital available for its further exploration. Seddon's Terrace at present commands most attention, twenty-seven claims, employing over a hundred men, being on payable gold of various values, the exact returns from which cannot be ascertained until the completion of the preliminary works, such as tunnels, tramways, and races, now in course of construction by those on gold. A break in the continuity of the lead has occurred near Stephens and party's claim—one of the best on the field—and opinions vary as to the direction taken. That it will be recovered there is little doubt, as a

number of parties are at work proving the ground in various directions. The various levels on which gold has been found, and the fact that very few of the shafts have been sunk to bed rock, makes it somewhat difficult to assess the value of the field, either as to extent or richness. In sinking, some of the claims show heavy deposits of drift, from 15ft. to 20ft. thick, that will give from ½dwt. to 2dwt. to the load; mostly coarse gold, but the runs are very irregular both in level and value, and consequently somewhat difficult to trace; some shafts show a little gold all the way, but nothing payable for working by the ordinary methods, whilst in others the runs are well defined and highly payable. The prospects obtained in many of the shafts from the surface to the depths sunk—at most 100ft. and no bottom—proves the existence of an immense field admirably adapted for hydraulic sluicing. From Stephens's claim, on Seddon's Terrace, to Fisherman's Creek, near the mouth of the Hokitika River, we have a terrace face following the trend of the river for a distance of over four miles; this includes Rimu Flat and Brighton Terrace, into which tunnels have been driven over 3,000ft. and shafts sunk with satisfactory results, and in which men are still at work. The undulating nature of the sandstone bottom, where the ground has been worked by tunnels, shows that the gold is not confined to one run on the bottom nor one level in the shafts, hence the probability of the same bottom being found—and similar runs of auriferous wash—to the south and west of Stephens's claim, on Seddon's Terrace. As a rule, the best gold is found on the western slope of the hone-like ridges on the sandstone bottom. Many of the men who came to the rush, having exhausted their means, are unable to prospect further without assistance; however, the Remu Miners' Association has taken the matter in hand, and sufficient money has been raised in the district as will enable them, with the assistance provided by the regulations, to put three parties to work to prove the terraces to the south. I understand that the men are already at work on ground specially selected by members of the association. In the expenditure of money for prospecting, it should be an instruction to—and the Government should insist on its being honestly carried out—those to whom the expenditure is intrusted that a correct record be kept of the work done, which should be available at the Warden's Court and the rooms of the association, for the convenience of the public and for future reference. Prospecting on such lines will soon set at rest the question of the extent and payable nature of the field. Mr. Newton, surveyor, by instruction of the Minister of Mines, is doing useful work in opening-up lines through the bush and giving the levels of the different runs of gold-bearing drift. At Craig's claim, at the extreme western end of the terrace, excellent returns are being obtained from the bottom layers, whilst it is known that numerous runs are overhead untouched. Even within known limits the field is of great extent, consisting of immense deposits of what may be called low-grade driftal wash, that can only be handled to pay by the application of well-directed hydraulic effort. It is to be hoped means will be taken to bring this large area under contribution in a more wholesale manner than is now possible with our present water-supply.

At Kanieri Forks, the Kanieri Lake Company are now in full work ten hours per day, and as they have a steady supply of thirty heads of water a great quantity of stuff is put through the boxes. Since the claim has been opened up the returns show a steady improvement, the last month giving 63oz. The method of working followed by this company is, with one exception, somewhat similar to that at Humphrey's Gully. Hydraulic jets playing on the gravel face—which averages 70ft. in height—brings it down and breaks it up, and is then washed into and passes through the usual block-paved boxes; the boxes measure 3in. by 3ft. and are set at a grade of 8in. to the 12ft. Stones and boulders too large to enter the boxes are broken and sent through—some of the boulders all but filling the boxes. These, with the finer gravel and sand, are carried down with great velocity, and ultimately shot into the river. That gold is lost by this method is well known to most miners. The fine gold, being held in suspension in the muddy water, has little chance of being caught in the boxes, as wooden blocks are used for false bottoms, and the volume and velocity of the current carrying it, with the tailings, into the river.

In order to prevent this loss of fine gold the company have adopted, with modifications, D. McArthur's patent tables, as exhibited at the Dunedin Exhibition. Near the end of the run of boxes a grating is inserted in the bottom of the box, 2ft. 9in. long, with ½in. spaces for the sand and water to pass through into boxes, feeding two 15ft. tables, which are in cross-section 30ft. over all, and covered with cocoa-nut matting. A portion of the water and sand passing through this grating flows over the tables, and the fine gold is caught in the matting, the tailings and water being returned to the main boxes to assist in carrying the rough material passing over the grating over the tip-head. In this case the success has been so pronounced that companies, having the interests of their shareholders in view, would do well to adopt similar methods. The following are the results of experiments to date:—

Date.	Amount of Gold taken from boxes.	Amount taken from Tables.
	Oz. dwt. gr.	Oz. dwt. gr.
Dec. 7	8 1 18	Nil, tables not erected
" 24	15 5 8	" "
	23 7 2	
Jan. 31	16 3 12	7 10 6
Feb. 28	24 12 0	5 18 7
Mar. 28	40 9 0	6 0 6
	81 4 12	19 8 19

Thus showing a saving of about 20 per cent.

The above return shows that a large percentage of gold would be lost by using the block-paved boxes only. That further improvements can be made in this direction will be apparent to any one acquainted with the saving of fine gold. Increased length of grating in the bottom of the box and increased area in cross-section of tables is clearly necessary where so much stuff is being run through, so that the whole of the fine drift and muddy water may come in contact with the matting on the tables; and to do this properly regularity of feed is as necessary as breadth of surface. If this was more carefully looked to in hydraulic workings the results would be very much better. The Kanieri Company, although greatly hampered for want of capital, have done good work, and they are now increasing their capital to enable them to extend their race in other directions, to ground which their magnificent water-supply commands. The steadily-increasing returns from the claim they are now working will enable them very shortly to appear on the dividend-paying list.

The outlying gullies carry about the same number of men. Gold has been found on the Upper Hokitika, and there are indications that point to important discoveries in that neighbourhood. A number of dredging-claims have been taken up on the Hokitika River, near the Kanieri, on one of which a powerful bucket-dredge is about to be placed. The whole of the plant has been manufactured by Anderson Brothers, Christchurch, and is now on its way here, the builders being under contract to have the dredge at work in July next. This machine has been built under the superintendence of Mr. James Durward, the company's engineer, who, after visiting all the dredging companies at work in Otago, was able to avoid the mistakes made in the construction of the first machines, and to suggest many improvements, all of which have been carried out by the contractors, making this the most complete machine yet built for gold-dredging purposes. This company starts under very favourable conditions, as in prospecting their claim 23oz. of gold was taken out of a paddock 12ft. by 15ft., and the claim is highly thought of by those best able to give an opinion—namely, the old miners who have been on the Kanieri since it was opened. The success of this company will no doubt govern the actions of the others, as until the results are known very little will be done by them. The guaranteed capacity of the above dredge is 70 tons per hour, delivered 25ft. above water level. The total cost of the plant, when ready for work and in position, will be over £4,000.

The Humphrey's Gully United Gold-mining Company (Limited) are still at work, but owing to their present water supply being far short of their requirements, the returns—after paying wages and current expenses—leave but a small balance to be carried to the credit of the company. This, after an outlay of some £90,000, is anything but satisfactory to the shareholders. Given the fact that the company are the holders of a large area of auriferous ground, suitable for hydraulic sluicing; the next, and most important factor, is the command of water; this the company have so far failed to secure, having, it knows, in the first instance, over-estimated the quantity obtainable from their present sources of supply. To meet this difficulty the directors propose raising an additional £25,000 to enable them to extend their race to the Arahura River—length, 4 miles 63½ chains. From this source the water-supply is inexhaustible, and seeing that the whole of this work has been surveyed, it would be an advantage to the company to immediately undertake the work.

Ross.

The alluvial workings in this district show very little improvement on last year's returns. The elevators at the Ross United and the Prince of Wales are still at work, the ground being worked on tribute, paying small wages. The directors of the company are still negotiating with capitalists to provide suitable machinery for working the lower levels of Ross Flat, and if, as I understand, they are prepared to make large concessions in the way of reducing values and the number of shares upon which dlvidends would be payable, there probably would be no mining venture on the Coast that promises better returns for the money required to put the company's property in working order.

The Mont d'Or and Greenland Sluicing Companies are still at work giving, I understand, fair returns. A scarcity of water in fine weather keeps dividends much lower and fewer than the richness of the ground warrants. In this as in other sluiclng claims in the district the same disregard to the saving of fine gold is manifested, resulting in heavy loss to the shareholders. Attempts are being made to get the Government to carry through the Mikonui race, the Borough Council of Ross having undertaken to fix the tunnel so as to enable the Government Inspector to examine and report.

In quartz-mining there is very little doing. The total collapse of the William Tell Company, after the expenditure of a large amount of capital in the erection of a battery and aerial tramway, has completely paralysed further effort in opening up any of the numerous claims held on the Cedar Creek reefs. I have heard that Mr. Perotti, of Greymouth—the purchaser of the William Tell and a large shareholder in the Swiss Republic—proposes to utilise one of the Tell tunnels to further prospect the Swiss.

The owners of the Mount Rangitoto mine are still engaged in the preliminary work of prospecting and testing their property. Every effort is being made to aim at the true commercial value of the ore. Samples have been sent to various parts of the world, and crucial tests have been made by the Holmes-Pollock process, the Cassell process, and the Chlorination process, all of which have given very satisfactory results, and, in consequence, there is every prospect of large and important operations being started at an early date. From specimens of ores now in my possession, obtained from localities further south, I am satisfied that the Rangitoto mine is situated near the northern end of an important mineral belt, striking almost due south, in which, in the near future, valuable discoveries will be made under systematic and intelligent prospecting.

Okarita.

This district keep its population, and if anything is improving, this applies especially to the gold-workings near Lake Mapanika, where a number of men are on good gold. Park and Reeves

have been exploring the head waters of the Calary—one of the branches of the Waiau—but failed to discover anything of importance in the upper reaches of the river. Lower down, on Mount Mueller, they discovered and are opening out a quartz-reef showing gold. The water-power available is unequalled, and with such facilities even low-grade ore would pay. The claims on Cook's River are also giving fair returns for the labour expended, and beach-working by individual miners remain as before.

Dredging.—This industry, that promised so much for our beaches has so far proved a failure. The Five-mile Company have for the second time gone into liquidation, and I understand the present holders, to whom the claims and plant were sold, propose using the water from the Alpine Lake for the purpose of working the ground, either by using the water direct from the pipes, or to drive a dynamo to work other machinery.

The New Zealand Beaches Company are also in liquidation, the plant, a powerful Welman dredger, having been sold. This very powerful and complete plant is still on the company's claim, and lying idle. The small amount of work done by this dredge—namely, dredging a paddock containing 12,000 cubic yards—was hardly a fair test of what machines of this class can do, especially seeing that Mr. Welman has overcome the principal difficulty, as far as the protection of his pumps are concerned; but it is to be regretted that, notwithstanding the returns from the first paddock—namely, 33oz. of gold—did not come up to expectation, that the work was not continued for some time longer, or, at least, until all the fuel—some 200 cords of wood—was used up. The same fate befel the Saltwater: the valuable plant belonging to that company is now lying sunk in the lagoon.

Another attempt is being made on Gillespie's Beach. There a Christchurch Company are erecting a Von Schmidt dredge, I believe, guaranteed to lift and deal with 60 tons of solid matter per hour. Good progress is being made with this machine, all the plant being on the claim, and it is likely to be at work shortly. As this is also a pump-dredge, it remains to be seen whether this one will answer for beach-workings. Mr. Welman's experience of the cutting and grinding power of the shingle on our beaches led him to make special provisions in his machines to meet the difficulty; and if Von Schmidt has not made some provision for this contingency, disappointment will follow. But a great deal depends upon the way the drift is treated after delivery from the pipes. The gold-saving appliances, and the mode of disposing of the tailings, are matters requiring more careful consideration than is usually bestowed on them. It is to be hoped the company will profit by the experience of the last few years, and, by avoiding the mistakes then made, make the venture the success the quality and quantity of sand on the beach warrants; for, notwithstanding repeated failures, I am confident our beaches will yet be worked and yield a handsome profit. Considerable interest is being manifested in the discovery of mica, and four prospecting areas have been granted or applied for in connection therewith. Samples submitted to me are too small to be of any commercial value, but the search now being prosecuted may bring to light a more valuable sample. The Great South Road is being gradually constructed. A further contract has been let.

Jackson's Bay.

In alluvial workings no new discoveries have been reported during the year just ended, but there is a strong desire manifested by the settlers of Jackson's and Martin's Bays, and by miners from districts further north, to go to work on the block of country lying between Big Bay and Barn Bay. A great portion of this block is auriferous, and portions of it would probably pay for working if it was easier of access. The Main South Road is available as far as the Cascade River, and the construction of a horse-track from the main road to Barn Bay would enable the settlers and others to pack tools and stores on to the ground with very little trouble; this would render them independent of the subsidised steamer that goes only to Jackson's Bay. The certainty of communication is most important to outlying diggings, where only small wages have so far been earned; but the area known to be auriferous, and also as containing other soluble minerals, would probably be opened up if persons were satisfied that communication by road was always available. Mr. R. Paulin reports having discovered a payable quartz-reef in the Sara Hills between Big Bay and Martin's. He says, "Here we find a formation largely composed of serpentinan slate with quartz-veins, very rich in pyrites, and showing gold all through." Trial crushings were made at the Exhibition battery in Dunedin, giving good returns. I understand a lease of 60 acres has been obtained from the Warden in Dunedin, the country being in Otago. That similar reefs will be found in Westland in the auriferous block above alluded to there can be little doubt, as the underlying rock belongs to the Maitai slates or Reefton series. Mr. Paulin concludes his letter by saying that "There is no doubt that the serpentinan rocks of the Red Hill district resembles rocks found on the silver-fields of Tasmania and Australia, and also the diamond-fields of Africa, and I have every confidence that it is a mere question of time before there is a large mining population profitably employed between Milford Sound and Jackson's Bay." Mr. Paulin, having spent three seasons in the district with well-equipped parties, is in a position to give an opinion that should be entitled to some weight, and as he is now organising his fourth expedition, and this at his own expense—as has been the case in all his previous efforts—I am sure he is entitled to the best thanks of the country for his persistent efforts in trying to develop the mineral resources of the Southland coast. Mr. C. E. Douglas, one of the oldest and most indefatigable explorers and prospectors on the coast, is now at work on the upper Waiatoto River, where he has done, and is now doing, topographical work for the Survey Department. Towards the head-waters of some of the branches, the terminal moraines, at the foot of the great glaciers, are alive with rabbits, having made their way through the eastern watershed by one of the passes near the head of one of the branches; although swarming in this quarter they do not make their way down very fast; they are still a long way from the coast. It is otherwise with the weasel. This pest has already reached the coast in all directions, and is fast becoming a dangerous nuisance; that it has left the rabbits and taken to the ground occupied by birds and

game, is made painfully apparent to our explorer and prospector, who are, in consequence of the depredations of the vermin, unable to find the usual means of support in emergencies.

In conclusion, I would point out that, notwithstanding the decrease of population in this district, as shown by the late census returns, our gold, as against last year, shows an increase of 3,500oz.

I have, &c.,

The Under-Secretary, Mines Department, Wellington. D. MACFARLANE, Warden.

No. 11.

Mr. Warden STRATFORD to the UNDER-SECRETARY of MINES, Wellington.

SIR,— Oamaru, 14th April, 1891.

I have the honour to forward herewith the statistical returns for the Maerewhenua Mining District for the year ending the 31st March, 1891, and to add a general report on the field.

During the year steady work has been going on, notwithstanding the unprecedentedly dry weather which has prevailed.

For many years the miners have been disquited by the threatenings of property-holders on the banks of the Maerewhenua River; and the knowledge that they were only working on sufferance, and that the freeholders could, at any time, commence action for damages against them, prevented any further attempt to bring in a supply of water, which the district so much requires. Happily this state of affairs has terminated by the recent Proclamation declaring the Maerewhenua a water-course for the discharge of tailings.

The only branch of gold-mining carried on in this district is hydraulic sluicing. The sluicing is not on such an extensive scale as obtains in similar districts, yet the methods employed in saving the gold, and the appliances used for separation are the same, except that the tail-races, are paved with hissocks, which act as ripples, and arrest the fine gold which is of a light scaly nature, and difficult to save. It is more or less evenly distributed throughout the formation, generally known as the greensand or marine formation.

Notwithstanding very careful attention to gold-saving details, I have been told that from 15 to 25 per cent. of the gold is lost, evidenced by the fact that miners have earned fair wages by rewashing the tailings. Surely some more effective methods than those in use of saving the fine gold could be devised, and so avoid the heavy loss?

The want of water, the main factor in hydraulic mining, retards the advancement of this district. To increase the water-supply several schemes have been proposed and rejected as being too costly, and somewhat impracticable. Until an increased supply of water is brought on to the field no great progress can be looked for.

This is essentially a poor man's diggings. No fortunes have been, nor are likely to be, acquired here. At the same time, with care and industry, combined with frugality, a man may honestly support himself and family.

Tha land taken up by occupation licenses has been fenced, and is being utilised for the purposes for which granted. Occupation licenses, where they do not interfere with legitimate mining, are useful as an auxiliary in supporting a large family.

The miners are fairly comfortable and contented. The family-men have small vegetable gardens attached to their homes, and a few head of cattle running on the mining reserve. There are about seventy-five miners on the field, and their families, including a few business people, make the total population about 275.

The beneficial effect of declaring the Maerewhenua River a water-course will not be felt until more water is brought to the field, an event likely to happen within the current year.

The business I have transacted during the year may be summed up as follows: Complaints heard, 16; applications heard, 137; objection cases, 27; occupation licenses applied for, 7; occupation licenses granted, 4; miners' rights issued, 129; race licenses issued at 5s., 5; race licenses issued at 2s. 6d., 30; general registrations, 141: total revenue, £107 1s. 6d.

I have, &c.,

H. A. STRATFORD, Warden.

The Under-Secretary, Mines Department, Wellington.

No. 12.

Mr. Warden REVELL to the UNDER-SECRETARY of MINES, Wellington.

SIR,— Warden's Office, Lawrence, 30th April, 1891.

I have the honour to forward herewith the usual statistical returns with the following general report on that portion of the Otago Mining District under my supervision during the twelve months ending the 31st March, 1891.

The workings of the Blue Spur and Gabriel's Gully Consolidated Gold Company at the Blue Spur have considerably improved. Although still confined to the tailings they have yielded very fair returns, close on 2,000oz. gold having been produced during the past year. It is computed that over half a million tons of tailings have been put through the elevator in obtaining this result.

The Fidelity Company, Varcoe and party, and others are working in Munro's Gully with fair results, but have been rather hindered with their workings for want of water. There are also a few claims working alongside of the Tuapeka River from Evans's Flat for a distance of four miles up the river, making ordinary wages. Three special claims and one licensed holding have been taken up near the Beaumont, but so far the occupiers have done no work, they are waiting until they can secure a proper supply of water. Cowan and party have removed their dredge from the river at the

Beaumont to the Pomahaka, just outside the limit of the mining district. Roughan and party are working near the same place, within the mining district, but so far have done very little work.

At Waitahuna the sluicing claims of Thompson and party, Ferris and party, Cullanan and party, in the Waitahuna Gully, and the Waitahuna Quartz Company are the principal claims. These are doing well, except the quartz mining company, which has been rather unsuccessful, but they are still prospecting, and hope to have another crushing shortly. On the Waitahuna Flat there are a few claims at work making little over ordinary wages. The Chinese continue working the river-bed and adjoining flats.

At Waipori dredging claims are being taken up. The Upper Waipori Dredging Company are in full work, with three shifts per day, yielding from 6oz. to 7oz. per day, and are about to construct another dredge, some of the material being already on the ground. The Sutland Flat Company are also constructing a dredge, and, when at work, it is thought that the claim will be as valuable as that of the Upper Waipori Dredging Company.

The Waipori Deep Lead Company have everything in good working order, but operations have been retarded owing to the scarcity of water. The claim was formerly held by O'Brien Brothers, who did not reach the bottom or bed-rock. It is now being worked with the hydraulic elevator, at a depth of 60ft., with an easterly dip of 1 in 7.

There are some six quartz-reefs in the locality, but at present only three are at work. Gear and party, on the Lammerlaw, have, during the last five or six months, been driving a tunnel at a lower level to strike the lode In the upper part of this claim the lode runs from 5ft. to 6ft. wide, and has given a steady return of ½oz. to the ton. Duffy and party have purchased a ten-head battery from the Perseverance Company, and are moving it to their claim in Stoney Creek, where they have a good reef, showing fair prospects. The Maori or Cox's Reef has been reopened. The reef is only 6in. wide, yielding about 1oz. to the ton, and has a five-head battery at work. Ordinary alluvial claims are also being worked with fair returns.

The Antimony Company is about being registered with sixteen shares, and have let a contract for sinking a new shaft, cutting a race, and shifting and removing the pumping and winding gear. In the early part of 1890 the company sent a parcel of 3½ tons to the Dunedin Exhibition which yielded 47 per cent. of antimony. This was afterwards sent to England for sale. After paying all expenses Home the company received a cheque for £60. Some of the ore will go as high as 80 per cent., and will prove a very valuable property. The company consider it advisable to send the crude ore Home for sale at present, instead of erecting necessary smelting-works, which would be rather expensive and beyond their means.

During the year fourteen applications have been made for special claims and licensed holdings over 658 acres. Of these eight were from Waipori, one from Waitahuna, three from Gabriel's Gully, and three on the banks of the Clutha River. Five of these have been granted over an area of 156 acres, two were refused, and the remainder are awaiting survey. Thirty-five applications for extended claims have been granted over 84 acres. The yield of gold is estimated at 14,100oz., which shows an increase of 3,000 over that of last year. This increase is mainly due to the extra return of the Upper Waipori Dredging Company and the Blue Spur and Gabriel's Gully Consolidated Company.

Tapanui District.

Mining operations in this part of the district.—There are only a few claims being worked by Europeans and Chinese at Waikaka, and one or two parties of Chinese at the Scrubby Terraces. These parties hold three or four extended claims covering an area of 8 acres, and ordinary claims covering an area of 5 acres. There are two water-races registered at the Scrubby Terraces.

An ordinary dredging-claim for two men has recently been taken up on the Pomahaka River, near Captain McKenzie's Homestead, and the party are now engaged erecting a suitable dredge to work the ground.

The revenue of this department only amounts to £11 0s. 6d. for the year.

Waikaia District.

Out of a population of 1,200 souls, there are only 200 Europeans and 180 Chinese enployed in mining operations.

The claims on the Hospital Hill, Welshman's and Moffatt Gullies are still being worked, yielding little more than ordinary wages, whilst up the Winding Creek a few parties are earning fair returns when water is available. The dredging-claims taken up in Gow's Creek have been abandoned, as the ground would not pay working expenses. Prospecting parties are now out on the ranges above Gow's Creek, but the results so far are unknown.

At the Nokomai there has been a considerable falling-off in mining operations. The claims held by Messrs. Conliff and Dwyer, together with those held by the Messrs. Cameron, have had little or no work done in them. A few claims are being worked in Paddy's Gully by the Europeans, who are making ordinary wages; and a few parties of Chinese are working in the creeks at the Upper Nokomai.

The revenue from the district amounts to £176 8s. 6d. as against £356 13s., last year. I attach herewith the following returns—viz., estimated yield of gold, estimated population, together with the returns of the number of miners' rights, licenses, registrations, &c., issued by the local Courts and also a return of cases heard, and the revenue collected.

I have, &c.,

The Under-Secretary, Mines Department, Wellington, W. H. Revell, Warden.

The population of the district is estimated at 24,028 souls, and is located as follows: Lawrence Borough—1,100 Europeans; Tuapeka district—2,900 Europeans, 380 Chinese; Waipori—300

Europeans, 50 Chinese; Waitahuna—1,140 Europeans, 60 Chinese; Milton—4,620 Europeans, 25 Chinese; Balclutha—3,700 Europeans, 2 Chinese; Kaitangata—1,120 Europeans; Tapanui, 1,720 Europeans, 30 Chinese; Clinton—1,560 Europeans; Gore—3,300 Europeans, 60 Chinese; Mataura —760 Europeans; Waikaia—1,013 Europeans, 188 Chinese.

ESTIMATED yield of gold during the twelve months ending the 31st March, 1891: Tuapeka district, 14,100oz.; Waikaia district, 3,000oz.; Tapanui district, 400oz.: total, 17,500oz.

RETURN of CASES heard in the RESIDENT MAGISTRATE'S and WARDEN'S COURTS, and REVENUE collected, during the Year ending 31st March, 1891.

—	Civil.	Criminal.	Warden's.	Totals.	Revenue, including Licensing-fees.
					£ s. d.
Lawrence	113	74	19	206	157 16 0
Waikaia	39	27	10	76	41 8 0
Tapanui	88	51	...	139	95 12 6
Outside goldfields—					
Milton	89	39	...	128	69 1 0
Balclutha	153	73	...	226	103 5 6
Kaitangata	16	...	...	16	9 17 0
Clinton	19	28	...	47	15 8 0
Gore	291	71	...	362	343 12 0
Mataura	...	5	...	5	2 4 0
Totals	808	368	29	1,205	838 4 0

RETURN of REVENUE collected during the Twelve Months ending 31st March, 1891.

—	Lawrence.	Waikaia.	Tapanui.	Totals.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Warden's department	1,338 9 2	176 8 6	11 0 6	1,525 18 2
Deferred-payment rents	113 1 11	...	...	113 1 11
Resident Magistrate's Courts (goldfields) ...	137 12 0	37 19 0	84 12 0	260 3 0
Resident Magistrate's Courts (outside goldfields)	...	...	...	543 7 6
Totals				2,442 10 7

RETURN of MINERS' RIGHTS, WATER LICENSES, REGISTRATIONS, &c., issued during the Twelve Months ending 31st March, 1891,

Nature of Right issued.	Lawrence.	Waikaia.	Tapanui.	Totals.
Miners' rights	792	332	24	1,148
Miners' rights consolidated	1	1	1	3
Business licenses, at £3 (yearly)	1	1	...	2
" £1 10s. (half-yearly)	...	...	...	...
Water-race licenses, at 5s.	44	25	4	73
" 2s. 6d.	79	31	..	110
Registrations, at 20s.	3	...	...	3
" 10s.	4	...	...	4
" 5s.	12	...	...	12
" 1s.	331	102	11	444
Applications for special claims	10	...	...	10
Special claims granted	3	...	...	3
Applications for licensed holdings	4	...	...	4
Licensed holdings granted	2	...	...	2
Applications for mineral licenses	...	...	...	...
Mineral licenses granted	...	...	...	...
Applications for occupation licenses	10	5	...	15
Occupation licenses granted	4	2	...	6
Mining applications	209	185	12	406

No. 13.

Mr. Warden Dalgleish to the Under-Secretary of Mines.

Sir,— Warden's Office, Naseby, 30th April, 1891.

I have the honour to forward herewith the annual statistics of the Mount Ida District for the year ending the 31st March, 1891, and to report for your information on the general condition and prospects of the field as follows :—

Naseby and Kyeburn.

The year just closed has been almost a counterpart of the two preceding seasons with regard to the supply of water, and, as a consequence, the mining industry has again suffered very materially. Sluicing operations have in many localities been almost entirely suspended. Quartz-mining has been seriously checked, and agricultural settlers throughout the district have also been great suffers from the same cause. No new discoveries, calling for any special comment, have been reported during the year. Mining generally remaining in somewhat the same condition as at the time of my last report. The miners are looking forward anxiously and hopefully for a break-up of the long continued drought, and to the enjoyment of a larger and more permanent supply of water, which is undoubtedly the one thing needful to place Mount Ida again in a prominent position among the gold-producing districts of the colony, and insure its permanent prosperity, both from a mining and agricultural point of view. It is a matter deeply to be regretted that the work in connection with the reservoir at Eweburn has not been proceeded with, as it would beyond doubt permanently improve mining to a very large extent; and, in addition, the water could be largely utilised for irrigation purposes, as it would command many thousands of acres of agricultural land. The demand for water, I am informed, is steadily increasing, and there are indications of the field being more exhaustively worked towards Upper Kyeburn, as well as towards Enterprise and Coal-pit Gullies, in which latter direction a number of claims have been taken up during the last year in ground which was abandoned many years ago, at a time when the expectations of the miners were based upon larger yields than at the present time. I am led to believe that the yield of gold, although materially lessened on the whole by the scarcity of water, has been remunerative in proportion to the amount of ground dealt with. I have reason to believe that the claims at Mount Burster, which have in past years been so payable, have kept up most favourable yields when water has been available, and good returns are looked for in the future from these claims.

Hamilton's and Sowburn.

At these places mining is and has been for almost the whole year in a complete state of cessation owing to the drough, which has prevented sluicing to be carried on at any time for more than a few days at a time, and, even then, at long and uncertain intervals. In my last report I alluded to certain prospecting operations commenced on the Taieri River and adjacent terraces, which resulted in the discovery of what was considered very payable dredging-ground. Claims were taken up and negotiations entered into for the prosecution of work in a systematic manner; but, I regret to say, that nothing further of a definite character has yet taken place, notwithstanding the apparently payable nature of a large area of the ground, provided suitable machinery were introduced. It is still understood, however, that there is a probability of a trial being made with a Wellman Dredger. I trust that probability may be realised in the near future, as many thoroughly practical miners have expressed their entire belief that successful issues would be attained; and I may say, judging from the prospects reported to have be obtained—viz., 1dwt. to the load, with some 20ft. of auriferous wash to deal with, anticipations of most favourable results are but reasonable to be looked forward to.

Nenthorn.

Little save disaster has been reported from this part of the district during the past year. The sanguine hopes which were indulged in at the outset of operations some two years ago have been rudely shattered; and, notwithstanding the very large expenditure in costly machinery and wages, the returns, I regret to say, have been most disheartening: claim after claim has been abandoned, and a number of the larger companies placed in liquidation.

Whatever the future of Nenthorn may be, there is no doubt that in its infancy it unfortunately fell, to a certain extent, into the hands of men—many of whom were quite unfitted to cope successfully with the difficulties inseparable from a new quartz-field, and others of the class who are always to be found ready to take advantage of freshly-discovered goldfields—actuated by purely speculative motives rather than a determination to fairly develop and establish a permanent field for *bonâ fide* mining. There were doubtless many others who entered into the operations with the utmost confidence, and expended very considerable sums of money on the faith of what appeared to be excellent prospects. These have, unfortunately, in most instances proved fallacious and disastrous in the extreme, causing not only large monetary losses and disappointment to many who could ill afford it, but it has created a wide-spread distrust in mining ventures generally, which will no doubt take some time to eradicate.

During my recent visits to the place I have been compelled to cancel some sixty of the holdings —the majority for non-payment of rent, and a number at the request of the holders. It is more than probable that a number of these will be reapplied for and worked by private parties. I entertain the hope, which is shared by many who know the field, that, at any rate, some of them will be made to pay now that machinery is on the ground, which will be available at moderate rates when water is available. I have heard somewhat favourable reports concerning an antimony lode which is being worked in Nenthorn district. I subjoin, for your information, some details of the work executed at the more prominent mines :—

Crœsus.—This mine was about the first to be systematically opened up. A shaft was sunk to a depth of 100ft., and a drive put in to the westward for a distance of between 300ft. and 400ft.

Much of the reef carried little or no gold. At the end of the drive more promising stone was met with, supposed to be the same as that found at the 50ft.-level, which averaged from 15dwt. to 1oz. to the ton, the reef being 12in. to 15in. in thickness. The water in the mine was heavy, and that, taken in connection with the expense of raising the quartz and crushing, the latter costing £1 to £1 5s. per ton, proved that under the circumstances it did not pay the company, and in July or August they were put in liquidation by the bank. It is expected that ere long the property will be offered for sale. It is probable that in the hands of a party of working miners with a little capital it might be found to pay to work out the present shoot of stone from the 100ft. to the 50ft.-level. There is a ten-head stamper battery owned by the company, with steam-engine for driving purposes.

Blue Slate.—To the west of the Crœsus, and on the same line of reef, the company put down a shaft 80ft., and erected a 5ft. Huntingdon mill on Deighton Creek. Very fair prospects were obtained on the surface; but the first crushing did not turn out equal to expectations, as, when the whole of the stone was treated, it did not average more than 7dwt. or 8dwt. In some seven or eight months after commencing the company went into voluntary liquidation. The crushing-plant has been sold and removed, the mill going to the antimony-works in Nelson. The mine remains unworked. I may mention that one patch from the surface gave the return of 3½oz. for 13 tons, but the remainder of the stone in proximity to this patch proved very poor indeed.

Victoria.—On a reef running nearly parallel with the Crœsus the company has a shaft down 100ft., and took out, principally from the surface, some 600 tons of stone, which was treated at the Consolidated battery. The return is believed to have been between 6dwt. and 7dwt., although trial crushings from the surface gave the promising returns of 3oz. to 4oz. The company became involved in the erection of the battery in connection with the Break of Day and Consolidated Companies. It proved a most costly and extravagant one, and towards the end of the year the Victoria Company was placed in liquidation by creditors. The reef is small, the quartz being of a very broken description. The property has been sold for practically a nominal sum to Messrs. Inder and Mitchell, of Naseby, who, it is understood, will crush some of the stone now to grass, which was not treated when the company went into liquidation; but it is doubtful if they will again open the mine.

Break of Day.—Adjoins the Victoria on same line of reef. About 250 tons of quartz was raised from a depth of 25ft. to 30ft. from this and another reef lying parallel and to the south. I understand none of the stone has been crushed. A trial crushing of 1 ton is stated to have given a yield equal to 6oz; but it is understood to have been simply a patch, and an average of 12dwt. to be a fair estimate of what the stone would yield. The mine, with the stone at grass, was purchased by the same buyers as the Victoria. The reef is of hard stone, about 14in. thick, and was worked by an underlie-shaft and windlass.

Consolidated.—This was one of the earliest to be taken up, and lies to the north and eastward of the Crœsus. Some 600 yards from it there are several small reefs running parallel to each other and crossing Deighton's Creek, where low-level tunnels have been put in for a short distance, but little gold was found, not sufficient, indeed, to induce the holders to save the stone. One of the reefs showed a considerable quantity of antimony. This company was also involved in the erection of the battery of the same name, and went into liquidation at the same time as the Victoria and Break of Day.

Consolidated Battery was erected by the three last-named companies on Deighton Creek on the property of the Consolidated Company. It consists of a ten-head battery imported from America. There is also on the ground, but not erected, grinding-pans, settler, and concentrators, the motive power being a thirty-horse-power compound condensing-engine, which was made by the New Zealand Engineering Company, of Dunedin. It is described as being a first-class piece of work, working economically and well. A water-race was brought in, and a Pelton-wheel procured, but not erected, as the water-supply was found to be insufficient. A road costing some £400 was made to deliver the quartz into a paddock, which was supposed to run it by a shoot to the rock-breaker, but it turned out a failure. The whole plant and accessories cost between £6,000 and £7,000, and had not crushed many hundreds of tons of quartz ere the company was placed in liquidation, and the whole plant sold to Messrs. Inder and Mitchell for £600.

Prospectors' Company, in which Macmillan first discovered gold-bearing quartz, lies to the south of and on same line as the Consolidated. There are two reefs in this property, both somewhat narrow. The company erected a small roller-mill (Huntingdon) and treated, it is stated, some 700 to 800 tons of quartz which averaged about 10dwt., some parts of the reef going as high as 1oz. The best of the stone was taken from the surface. A low-level tunnel was driven for a considerable distance along the line of the reef from Deighton's Creek, but the stone was not considered payable. The mine and plant was sold to the Bonanza Company, the mill being removed to that claim, and the mine now remaining unworked.

Eureka.—This may be said to be, practically, the only claim at work at present on the field. A shaft has been sunk 200ft., worked with a horse-whim. The reef has been driven on at the 200ft. level for some 300ft., and is found to vary a good deal in size. Some 300 tons has been crushed, yielding, it is stated, about 1½oz. to the ton, which is looked upon as satisfactory. The company recently purchased the public battery which was in liquidation, and now crush their own stone when sufficient water con be obtained. The expense of keeping down the water in the mine is considerable, but if the stone continues to yield as in the past the company should ere long be in a position to pay dividends.

Zealandia.—This property lies midway between the Eureka and Crœsus Companies. It is stated that there are two reefs in it. About 160 tons of stone have been raised by windlass and underlie-shafts, and, although the stone has been to grass now for some months, it is still uncrushed, owing to the Public Crushing Company going into liquidation. The trial crushing is believed to have given the satisfactory average of 2oz. per ton.

Hyde.

Macrae's and Highlay.

In these sub-districts the drought has also been most keenly felt. Little work has been possible in sluicing, and miners are waiting for the much to be desired change. Perhaps the most promising undertaking in the neighbourhood is the Bonanza Gold-mining Company. This company's mine and battery is situated between Macrae's and Nenthorn, in a small creek running into Stoneburn. The battery was erected some five months ago, and since then has been pretty constantly at work. The reef is a large one; but the whole of the stone is not yet treated, a portion being of a mullocky nature, heavily impregnated with pyrites, which carries a percentage of gold. Up to date, I am informed, about 600 tons of stone have been crushed, with a stated yield of 638oz. of gold, out of which dividends to the extent of £900 have been paid. The prospects of the reef at the 90ft. level are good, although the gold is difficult to save. The mine now employs some twenty men and the company contemplate putting up grinding-pans.

Golden Point.—This property is situated on the Deepdell Creek to the west of Macrae's. The original owners of the mine failed to make it pay, and it was voluntarily placed in liquidation, and sold to Messrs. W. and G. Donaldson, who are now about to start crushing and give the mine another trial. There is a very large quantity of quartz on the surface, which can be delivered at the battery for a few shillings per ton, so that under good management a small yield should pay. This is thought to be the same reef as Mount Highlay, although they are several miles apart. Traces of stone can be got at intervals all along the supposed line.

Mount Highlay.—Between Macrae's and Hyde there is a large reef. At present it is being worked in a slip. The company has a good ten-head battery erected on the Mareburn Creek, which empties into the Taieri River above Hyde. Considerable quantities of stone have been crushed, ranging in yield from 3dwt. to 7dwt. per ton. The working and other expenses up till the present time have been too heavy to show a profit, but as the motive-power is water, and the expenses in future will not be so great, it is considered that a yield of 5dwt. should allow a margin of profit. The company has not been able to work anything like full time during the year.

Serpentine.

The only workings on a large scale at this place are those of the Golden Gully Company, which, I am informed, have been kept fairly well going. The battery has been removed to a more suitable site for carrying out the work economically; but I am not in possession of any data as to the results of their operations for the year. There are still a limited number of miners working the alluvial deposits.

Blackstone Hill.

No change of any importance to note at Blackstone. Work in the Great Eastern and Progress Companies has not advanced during the past year, beyond having been carefully inspected by an expert from England, acting for the syndicate formed in London to purchase these properties. The result of the inspection is not definitely known, but is believed to be favourable. Hopes are therefore entertained that these properties may again be the scene of activity before long, affording remunerative occupation to many hands. No appreciable change is to be noticed in the number of alluvial miners in this neighbourhood.

Ophir and Ida Valley.

Two companies in these localities have ceased operations—namely, the Ida Valley Deep Lead Gold-mining Company, at Black's No. 3, and Green's Reef-and-seam Company, at Ophir. There are some excellent prospects being obtained just now in the vicinity of the latter company's ground, but whether of a permanent character I am not yet in a position to report. About the usual number of men are at work on Black's, Black's No. 3, German Hill, and Ida Valley, and I am lead to believe that, despite the wonderful drought, many of them are doing fairly well. A somewhat extensive enterprise has been undertaken by Messrs. Morris, Flannery, and others—namely, the construction of a water-race from the Manuherikia River, commencing at a point some six miles above the St. Bathan's and Naseby Roads, commanding ground along the base of Blackstone Hill, where the parties interested are stated to have obtained good payable prospects. The race is in course of construction, and it is anticipated will reach payable ground in a few months. It is contemplated to carry the race ultimately to Ophir, but the undertaking would be most costly, and I fear beyond the means of a private party.

Matakanui (Tinker's), etc.

The work carried on during the past year in this neighbourhood has been interfered with also to a very great degree by the scarcity of water. The only company which has been enabled to clean up to date, so far as I am aware, is the Undaunted, the company reported last year as having purchased the first right from Thomson's Creek at £10,800. In consequence of that purchase, they have been able to work more steadily, and have partially cleaned up, obtaining, it is stated, 1,000oz. of gold, and anticipate a further amount of 600oz. for the year. The Matakanui Company have a good supply of water from the Lauder Creek, and are now said to be on better ground than they have been working for some years. The Sugar-pot Company have excellent ground, but have only been able to work for a few weeks. Smith and Morgan are in new ground further to the southward of any hitherto worked at Tinkers. It is said to be good, proving the payable auriferous formation to extend further than was supposed. Messrs. Ewing and McConnochie's new venture has had a bad year to commence with, only having had an insufficient supply for about three months during the year. Enough, however, has been acomplished to prove the ground to be highly payable with the appliances they possess. They are enabled to treat 1,000

cubic yards of material per diem with eight heads of water. The ground consists of alternate strata of clay, sand, and gravel, and the altitude at which the water has been brought—namely, 500ft., gives ample power to disentigrate the clay, a large portion of which goes away in suspension, although the water-directors are of the most approved description, and have recently been altered. It is well known that in most hydraulic mining a considerable amount of the available head is lost through using pipes of too small a diameter. Messrs. Ewings' main line is 18in. in diameter, the branches chiefly 11in., reducing near the directors to 9in. The directors first in use were similar to those in general use elsewhere, but proved entirely too weak for the pressure. None of them withstood it many days without some of their parts giving way. Fortunately the breaks occurred during momentary absence of the man working the machine, or the parts flew in a direction away from him, otherwise a serious catastrophy would have occurred. The directors now used are constructed with the parts on which the greatest strain comes very much heavier, and are working well.

The set of gold-tables, described by the Inspecting Engineer in his report last year, are also working satisfactorily. Notwithstanding the short time they have been at work, Messrs. Ewing and McConnochie expect to secure enough gold to pay all expenses for the year, and a small percentage on their outlay. They are now beginning to clear up. The Deep Lead Company have not done anything to report on during the year. Their ground has been proved to be good could it be sluiced in the ordinary way, but most of it will have to be elevated. The Tinker's workings are perhaps the most important in the district, and in the recent valuations under the Gold Duty Abolition Act have been valued at a sum greater than all the rest of the district put together.

ST. BATHAN'S AND CAMBRIAN'S.

The usually plentiful supply of water at these centres has been most deficient during the year All of the companies have been working with an insufficient supply. The Scandinavian and M. and E. Companies have not, as a consequence, cleaned up this season.

Mr. John Ewing has during the year erected a new plant on his Kildare Hill claims, consisting of a main line of 18in. steel-pipes, branches 11in. to 9in. He is now elevating 46ft., and, I am informed, is working the richest ground known in the district for many years. He has tested in connection with this elevator Robertson's Patent Atmospheric Nozzle, but it has hardly fulfilled expectations.

Very little is doing at Cambrian's; but one of the claims at Vinegar Flat, that of Watson and party, is still turning out well, giving, I am told, up to £8 per man per week. Messrs. Morgan and Hughes, whose splendid yields have been alluded to in former reports, are now bringing up a tail-race at a deeper level. Mr. J. Ewing's claim at Vinegar Hill still gives fair returns. His water-supply has been too limited to work well in the deeper ground, which has to be elevated 25ft. He has not cleaned that up for over two years; but fair returns have been obtained from the higher ground. This claim has produced 500oz. during the past year, an amount about sufficient to pay expenses and interest on the capital invested. The St. Bathan's Channel Company are proceeding with their work in spite of the dry seasons. It is expected that in less than a year the above claims will begin to benefit by the increased fall the channel will give them. Enough gold is now being obtained to cover working expenses off the tables at the end of the tail-race. For seven months' work gold of the value of £500 has been secured, much of which would have been lost in the ordinary way of working.

I attach returns of the business transacted in the Warden's and Resident Magistrate's Courts and offices throughout the Mount Ida district during the year ending the 31st March, 1891. In conclusion, I may state that since writing about Mount Highlay I have been informed that further developments of the mine have quite recently resulted in much more favourable prospects being obtained.

I have, &c.,

S. MEAD DALGLIESH, Warden.

The Under-Secretary, Mines Department, Wellington.

PARTICULARS of business transacted in the Warden's and Resident Magistrate's Court and offices in the Mount Ida district during the year ending the 31st March, 1891: Warden's Court—Complaints, 51; applications, general, 627; applications opposed, 89; special claims applied for, 41; special claims granted, 31; occupation licenses applied for, 25; occupation-licenses granted, 12; mineral licenses, 3; miners' rights issued, 1,032; water licenses (5s.), 101; water licenses (2s. 6d.), 292; general registrations, 693: total revenue collected, £1,337 4s. 3d.

RESIDENT MAGISTRATE'S COURT.—Number of civil cases, 364; number of criminal cases, 96: total revenue Resident Magistrate's Court, £436 6s. 6d.

The above particulars do not include Maerewhenua districts.

No. 14.

Mr. Warden WOOD to the UNDER-SECRETARY of MINES

SIR, Clyde, 16th May, 1891.

I have the honour to forward herewith statistical returns for Dunstan and Wakatipu districts for the year ending the 31st March last.

There is very little of interest to report, as the unprecedented dry seasons of 1889–90 and 1890–91, and the very light snowfall on the high ranges for two successive winters, left a very limited quantity of water in the creeks after the spring months were over. The springs on the mountains, which have hitherto always kept running, are many of them dry, and the water-holes and swamps at the top of the ranges are comparatively dry, which in previous seasons have been well filled.

This I attribute to the light snowfall. The dryness of the swamps is very likely the cause of the springs drying up. Dredging has not proved quite the success that was expected two years ago, when there was a boom on that method of working; but I think, in most instances, the fault lies in the want of proper gold-saving appliances, and it is not to be wondered at when 40 to 70 tons of gravel per hour is lifted, with a short run of boxes and tables and screens not brought to perfection; but I hope that another year will see better methods adopted. Hydraulic sluicing is very successful in this district when a sufficient supply of water can be obtained, and, under those conditions, is the best method of working alluvial ground yet discovered, but the qauntity of water required is a serious drawback, also the cost of plant. The castings for elevators very soon wear out, and the time in shifting the elevators and heavy plant—about every fourteen days—require a number of hands.

ROXBURGH.

Dredging.—The steam-dredge known as the Dunedin steam-dredge, working in the Clutha, opposite Coal Creek, has paid good dividends during the last twelve months, and is still on payable ground. The dredge on Hercules Flat, just below the Town of Roxburgh (Telford and Co.), has, I hear-given handsome returns; but owing to the best ground being deep, and no current, the owners are now in treaty for a steam-dredge. The gold which they find runs into deep ground is doubtless the same run which the United Hercules Company came on in the upper section of their claim a few weeks since, which, in all probability, runs back into the flat. The Dunedin Company's No. 2 Current-wheeler is lying idle at Dumbarton Rock until an engine is fixed in her, they having no current in the claim sufficient where the known payable ground is to work a current wheel-dredge. On the west beach of the river the Ettrick Gold Steam-dredging Company's punts are nearly completed. These are built of kauri timber, 95ft. long. The machinery is daily expected from Christchurch, and expected to be in working order by the end of June next. A little lower down is the new dredge for the Miller's Creek Company. The engine for the pumps is not quite powerful enough. They expect to have this set right and be at work next week. Below Miller's Creek comes the current-wheel dredge of Aitkin and Co. They have been working with very good results for some time, and intend to put an engine on their boat. The next claim is Brazil and Co. This dredge has been overhauled, and the current-wheel removed, and is to be replaced by a steam-engine from Anderson and Co., Christchurch, which is daily expected. Bennett and Co's. dredge, which was converted from a current-wheel to steam about twelve months ago, is working satisfactorily, and with good returns. Adjoining is Pringle and Co., who are doing well, but the best of their ground lies where there is no current, and they will have to follow the example of Bennett and Co., and substitute steam for the current-wheel. A new dredge, similar to the Ettrick one, is being built just below Steele's farm by Adams and Co. The next dredge, and the lowest down in this district, is the Clutha Dredging Company at McCunn's Beach. They are about starting operations with a small steam-dredge,

Dredging from Coal Creek to Horseshoe Bend has been carried on for years, yielding in almost all cases handsome returns; but in a short time the current-wheel dredge will be a thing of the past. I understand that a small steam-engine suitable for the purpose can be put on board for about £400.

Hydraulic Sluicing.—Private companies are doing fairly well when water is available. Public companies: The Commissioners' Flat, on the east side of the river, near Coal Creek, are sluicing off top-stuff, but up to the present have not got much gold. Water has been scarce, but is now plentiful, and the company will soon sink into the lower wash, and doubtless will be on payable ground. The next sluicing company is the Roxburgh Amalgamated. Their special claim is situate on the east side of the river, opposite the Township of Roxburgh, and north of the Teviot Stream. This company, like the others, has been short of water during the dry season. They only began to elevate about the end of December. They have opened out with good prospects, which appear to improve as they get back into the flat. They are the holders of Dismal Swamp as a dam, but have only constructed the wall about 8ft. high. To render the dam of use in a dry season it should be at least 20ft. high. The foundation and work is very substantial, and fit to carry a wall 30ft. high, which should be done as soon as the winter frosts are over. It is estimated that to erect it up to 20ft. would cost about £1,500, which should not stand in the way of a company with a capital of £30,000 and getting good gold with ordinarily good management. The United Hercules has, like the others, been short of water during the dry season, but has to contend with high floods in the river during the spring, which kept them back; but they are now working and getting good gold. Though with heavy drainage water to contend with, being near the river, they will, it is said, begin paying dividends again within a week or two. The prospects show payable gold as far back in the flat as they have been working, confirming the general opinion that the whole of the flat is more or less auriferous. The value of gold obtained for the eleven months ending the 31st December last was £9,877 4s., and paid dividends during the same period, amounting to £4,800. Though the work was at a standstill for some time they have, since the 1st January last, obtained gold to the value of £1,634. This is without doubt a valuable property. Hercules No. 2 Gold-mining Company is part of the original claim of the United Hercules. They had their first wash-up a few weeks ago, which yielded 36oz. gold. This is considered satisfactory, as no bottom was cleaned up, and according to prospects they have payable ground before them. The Island Block Extended (Miller's Flat)—why so named I cannot understand, as it is miles from the Island Block Claim, and on the other side of the river—have made a fresh start, after being on the verge of liquidation through bad management. This I believe to be a really good property, and with the present management will doubtless be a success. They have had, I understand, a wash-up with satisfactory results. The Island Block and English Company have for some time been on a very rich lead, yielding, it is said, from 700oz. to 800oz. gold per month.

During the year seventeen applications for special claims and licensed holdings were made,

embodying 764 acres, and sixteen granted of this number. Fourteen special claims embracing 627 acres do not show in the list of holdings in force on the 31st March last, but are held over pending the issue of a new form of grant. During the same period 319 miners' rights were issued, which shows an increase over the previous year of forty-five.

Clyde and Alexandra.

Nothing sensational has arisen in mining matters during the past year. I think, however, there has been a slight increase in the return of gold, and judging from the number of applications made at Alexandra, I imagine that more people are turning their attention to this industry than heretofore. The chief water-supplies are drawn from the Earnscleugh River, the Manorburn and Chatto Creeks, all of which streams have been seriously affected by the past two exceptionally dry seasons; but the holders of water-rights, in consequence of the taking-off, are gradually realising the necessity for conserving the water by constructing dams and reservoirs in suitable places, and I feel sure that, when all reasonable efforts in this direction have been made, a dry season or two will not produce any very serious inconveniences.

Cameron and party have not as yet succeeded in floating their extensive sluicing property on the Galloway Run. An expert has, however, been sent out from England to report upon its merits, and final negotiations suspended awaiting the result. This could be made one of the most valuable sluicing properties in Otago, but from want of the necessary capital to construct the reservoir at Greenland Swamp, already granted to them, the proprietors are unable to do more than make fair wages with the limited supply of water at their command.

The Molyneux Hydraulic Sluicing Company has about reconstructed the Oven's Water-race from Chatto Creek, and can now deliver twelve heads of water at Alexandra. Tenders are being called for about a mile and a half of iron-piping elevating plant, and when this is completed, I feel sure that this company, which is almost wholly comprised of local people, will be able to successfully operate upon its valuable claim just above the bridge.

Mr. John Allan at Spring Vale is still on good gold, and his returns continue to form very substantial additions to the escorts from here. The ground below the road is now somewhat limited, but I think some years will elapse before a necessity arises for his removal.

The two current-wheel dredges upon the Molyneux at Sandy Point are still doing well, and the wonder to me is that the number has not increased. The river between Clyde and Alexandra is exceptionally well adapted for dredging, and, if report be reliable, the want of gold will not prove an obstacle to successful operations.

During the year seven applications for special claims and licensed holdings were made, embodying 459 acres, and eight were granted including 456 acres. Of this number, six special claims, embracing 412 acres, do not show as being in force on the 31st March last, but are held over pending the preparation of a new form of grant. During the same period 216 ordinary mining applications were dealt with, and 383 miners' rights issued, showing an increase of 106 in the former and 46 in the latter over the figures of the previous year.

Bald Hill Flat.

The increase in the Warden's Court business during the past year was mainly contributed from this locality, and, next to Roxburgh, I think mining matters here assume a more prosperous appearance than any portion of my district. Hesson and party have just completed their race from Gorge Creek, a distance of eight miles, including 3,000ft. of iron piping. They have also constructed a very large dam and a tail-race 600 yards in length, the whole at a cost of slightly over £2,000, and, within a week or so, will be ready to commence sluicing operations upon their special claim at Obelisk Creek Flat. Their prospects are known to be exceedingly good, and the party, consisting of five working-men, are hopeful of enjoying many years of profitable work.

The claims which are at present in full operation on the flat are Wilkinsons, Carroll, and another, and McLoskey and another, all of which are doing well.

The Baldwin Sluicing Company commenced work in Mr. Butler's freehold a few months ago, after an expenditure of close upon £2,000, but, from shortness of water and other impediments, the shareholders have not as yet reaped much benefit. The water-race which has been leased by the company takes its rise in Gorge Creek, at an altitude of about 3,500ft., and, as this is considerably above the snow-line, water is only available about eight months in the year. I believe it is intended, however, to apply to shift the right so as to head about 1,500ft. lower down, and although this will entail the expenditure of a considerable sum, the prospects of the company are so good that the enhanced value of the water-supply will soon recoup the shareholders for the outlay.

The property known as White's Reef has during the year passed into the hands of a private party. The price paid at auction for the claim and plant was £250; and, although many months have elapsed since the sale, I believe this amount with a handsome surplus has been got out of the ground. The purchaser of the property is Mr. Robert Symes, who was mine-manager when the company ceased operations, who of course was in a position to form the best estimate of its value.

There are several parties doing well upon the eastern slope of Obelisk Range in close proximity to White's Reef, notably Crossan and party and Baker and others; and I feel sure that this locality is worthy of more attention from the legitimate miner.

Bannockburn.

As sluicing is most in vogue here the want of sufficient water has told most disastrously on the gold-mining industry. The whole of the water is in very few hands, who let it out to claim-holders, and they have been obliged to be satisfied with less than a third of the supply usually obtainable. Under normal conditions at least twenty heads of water are available whereas of late

not more than five or six heads could be depended on. In consequence of this many of the claims have been protected from time to time, whilst others have only worked for short periods daily, say, from two to four hours. Ball, Paterson, and Company, mentioned in former report, have now, after nearly three years' work, constructed a tail-race up to their ground, and are now opening out, and judging from their present prospects they have a valuable property, which will last for many years.

The present owners of the Carrick water-race resolved to cut in another creek to supplement their supply of water, but, unfortunately, the levels were incorrect, and the whole work will have to be done again. This is much to be regretted, as it is not only a serious loss to the owners, but many miners have patiently waited in expectation of having a steady supply of water. A few parties are still at work on various parts of the Carrick Range, but I do not hear of any rich finds.

Quartz-mining on the Carrick is very much in the same position it was a year ago, and I do not hear of any new discoveries.

NEVIS.

The expectations entertained last year have hardly been realised, notwithstanding the greater facilities enjoyed by miners in obtaining water than are obtainable in other portions of the district, nor have the special claims taken up eighteen months ago turned out as expected. No very determined attempts at prospecting the Upper Nevis are reported, and the miners seem to have contented themselves with working quietly on with the ground they already held.

ROARING MEG.

The mining here is confined nearly entirely to Chinese, who seem to do well. They are at present engaged working up a tail-race to work the ground at the upper bridge.

BENDIGO.

The Cromwell Company, in driving the 500ft. level, cut a small reef showing good indications of gold. They are now driving on the line of it, and it has gradually opened out to a width of over 2ft., and carrying payable gold.

CRIFFEL.

Notwithstanding the great dearth of water several parties have had very satisfactory washings, notably Lot Brothers and Hawthorne and party. The water on this goldfield is all in the hands of one party, and I fail to see how more could be brought in.

FIVE-MILE CREEK AND QUARTZ-REEF POINT.

Very little change has taken place during the year at either of these localities. The old residents still keep on, and as one claim is worked out they quietly start in another, and, judging from their still remaining, they must be getting enough to keep them contented. Most of them have comfortable homes and cultivation-sites, with a few cattle and horses, and seem to make a very comfortable living if they do not manage to lay money past. At Quartz-reef Point one extended claim of two acres has exchanged hands for £250; so there must be some ground there of a promising description. Although a number of special claims were taken up at the boom eighteen months ago, both on Kawarau and Clutha, not a great deal seems to have been done with any of them. Two have been granted near Albert Town and one at the Lowburn. The latter is in connection with the dredge owned by Kloogh and Co., who own a dredging-claim above the Lowburn Punt, which has been steadily worked all the year. During last winter a considerable amount of gold was obtained from cradling the beaches of the Clutha and Kawarau Rivers. Chinamen mostly went in for this style of work, and seem to have done fairly well at it.

WAKATIPU GOLDFIELDS,

QUEENSTOWN SUBDIVISION.

Head of Lake, Wakatipu.

Alluvial.—There is nothing special to report in alluvial mining. About the same number of miners are at work as have been for the past two or three years scattered about in the various gullies, and some of them doing fairly well. The country around the head-waters of the Dart River is attracting a few miners, who are reported as satisfied with their prospects. A trigommetrical survey of this country is now being made by the District Surveyor, and, when it is better known and tracks are cut to facilitate getting provisions, &c., on the ground, no doubt there will be an opening for a number of miners.

Quartz.—The only quartz-mine in this locality is owned by the Rees Valley Quartz-mining Company (Limited) (49 acres), held under amalgamated licensed holding. The mine was owned by the Invincible Quart-mining Company (Limited), which was formerly a dividend-paying company, but, the stone giving out, the company was wound up voluntarily, and the mine sold to the present company, who are prospecting it thoroughly with every indication of success.

Dredging.—Six dredging-claims were applied for in this locality comprising 220 acres. One on the twenty-five mile (23 acres) was not taken up. Three on the Buckleburn (98 acres), one cancelled, and no work done on the other two. Two on the Dart (125 acres), one cancelled, and one not yet issued. So far dredging in this part of the country has been a total blank.

Moke, Twelve-, Seven-, and Five-mile Creeks.

The population engaged in mining in these scattered portions of the district remains about stationary, and all devote their attention to alluvial mining. There are nine claims held under license (181 acres), on none of which work, other than what may be termed "shepherding," has been done.

Upper Shotover.

Alluvial.—The individual workings of the alluvial miners have been a good deal curtailed through the extensive operations of the larger companies—alluvial, dredging, and quartz—requiring so much labour, giving sure and certain returns in the shape of wages. This, too, until these companies get into full swing, reduces the "findings," and consequently shrinks the gold returns. However, the earnings of those who prefer working on their own account are well up to the average of the past few years. The Londonderry Terrace Sluicing Company (no liability) have now about finished bringing on their water and got all their plant into "going" order at a cost of about £10,000; and no doubt in my next report I shall be able to give a good account of their workings. Davis Brothers', whose operations are also on a very large scale, have worked steadily, but with results of rather a disappointing nature. However, they have got through a large area of old abandoned ground, and are getting close up to where they hope to recoup themselves for their large outlay of both time and money. Johnson's claim has been systematically worked, but with what results is only known to himself. The Pleasant Creek Terrace Company's license has been forfeited for non-compliance with the regulations, &c., and the ground is now under application by three applicants. This ground, some of which has been proved to be exceptionally rich, has been locked up for some years, the company in the meanwhile endeavouring to beguile the British public to find the requisite capital. The area included in these four holdings amounts to 183 acres. The total area held under license for alluvial mining being 264 acres.

Quartz.—There are only two quartz-mines at present at work on the Upper Shotover—the Phœnix and the Gallant Tipperary Companies. Both mines are in thorough good going order. At the Gallant Tipperary Company's Mine (31 acres) everything has had a thorough good overhaul, and the machinery improved. The yield per ton is not quite so good as formerly, but this is accounted for by all the stone at present being got out going into the paddock without any sorting. Of the Phœnix Mine (114 acres) it is needless to enter into detail as it is so well known. The machinery, worked by electricity, is all of the very best and latest type. The enterprising owner, who has worked the mine for a quarter of a century, has now determined to endeavour to float a company in London to take over the mine, and for this purpose has sent his general manager Home. Other holdings are being prospected, but of them there is nothing of importance to mention. The total area held under license is 213 acres.

Dredging.—Dredging operations on the Upper Shotover may be termed preparatory, there being as yet only two dredges at work—the Shotover Company about two miles up stream from Arthur's Point Bridge, and the Sandhills Gold-dredging Company. Both dredges have only just commenced work, the latter with very encouraging prospects. This dredge is the only one in this district worked with electricity. The companies holding the remainder of the claims are all supposed to be in a more or less forward state with their dredges, none of them appearing to be over anxious to build until the vexed question of which is the best pattern and the best gold-saver has been solved. The area taken up is 600 acres in fourteen claims.

Arthur's Point.

Dredging here is in full swing, the Sew Hoy Big Beach Gold-dredging Company (Limited) having four dredges at work—one on the Morning Star Beach and the other three on Big Beach. The takings are very variable, and I am unable to give exact amounts; but it is a pleasure to be able to record that the results are payable. The area held is 226 acres in three claims.

Lower Shotover and Upper Kawarau.

Dredging claims numbering nine, comprising 812 acres, are here situated. There are four dredges on the ground; two at work, but one only, the Golden Link, paying. One company, the Golden Bar, is in liquidation. The cost of the dredges on an average is between £4,500 and £5,000. The Sand Hill's dredge and electric plant cost £7,500.

ARROWTOWN SUBDIVISION.

Arrowtown.

Alluvial operations have shown but little alteration since last year's report. Messrs. Davies and Moodie have at last completed their rock-tunnel, at the Arrow River Falls, 1,100ft. in length, but have not yet broken through into the river-bed. This enterprise is generally considered to be one of the most likely payable speculations in the district; but of this, as of many other ventures in the district under my charge, I can only say that I hope to be able to give good accounts in my next report. There have been a number of applications lodged for permission to enter private lands on the edge of the Crown Terrace for gold-mining purposes, where payable gold is alleged exists. I hope to report favourable of this matter in my next report. Area under license, 13 acres.

Dredging.—Some 46 acres of the river-bed alongside the town have been taken up in three claims; but, beyond paying the survey fees, first year's rent, &c., nothing has been done.

Quartz.—No working of any kind.

Arrow Junction and Kawarau.

Alluvial.—Nothing has been done in this portion of the district for the past year requiring any notice.

Dredging.—Twelve licenses have been issued over 500 acres. There are only two dredges on this portion of the river, neither of them at present paying.

Gibbston.

Nothing worthy of notice has occurred in this district in alluvial operations. Some six dredging-claims, containing 163 acres, were applied for and granted, four of which have not been taken up; and no work, other than prospecting, has been done on the others.

Macetown.

In alluvial mining there is no change to report. The number of men employed in alluvial mining and the yield of gold remain much the same as for the past few years. Three alluvial claims, containing 14 acres, are under license. There is nothing sensational to report as regards quartz-mining. The Sunrise Lease Gold-mining Company (Limited) (26 acres) have been prospecting their mine with good results, and have erected a new battery. Their returns from quartz crushed this season averages about 1oz. 5dwt. to the ton. The Premier Consolidated Gold Company (Limited) (44 acres) have also been vigorously opening up their mine. This Company is working with English capital. The Tipperary Gold-mining Company (Limited) (75 acres) has also just been floated on the London market. Several applications for cancellation of old gold-mining leases are before the Court, made by a private individual, who intends to apply for same when cancelled as a special claim. Taking into consideration the exceedingly good and encouraging prospects of the Sunrise Lease Gold-mining Company, and the advent of much British capital, I may safely say my report next year on this promising portion of my district will be of a very satisfactory nature. One hundred and fifty-five acres are held under eight licenses.

Cardrona.

The alluvial returns are hardly up to the previous year, owing in a certain degree to scarcity of water. The number of miners remain about the same. There is only one license in force of 10 acres.

Dredging.—The area granted under special-claim licenses, twelve in number, aggregates 1,190 acres; but seven of these, 678 acres, have not been taken up, and three, 303 acres, are under application for cancellation. Some of these claims have been prospected with boring-rods, but nothing in the shape of actual dredge-building has been attempted. About eighty miners are employed on this field, all doing fairly well. About twelve men are working on the Matatapu, Frenchman's, and Mid Run, and a few cradling on the Upper Clutha River banks.

I have, &c.,
J. Nugent Wood, Warden.

The Under-Secretary, Mines Department, Wellington.

No. 15.

Mr. Warden Carew to the Under-secretary of Mines, Wellington.

Sir,— Warden's office, Dunedin, 8th May, 1891.

I have the honour to forward herewith the annual returns relating to the Hindon Subdivision of the Otago Mining District for the year ending the 31st March, 1891, embracing also mining privileges on the mining reserve at Waikouaiti and portions of the west coast of the Otago Provincial District.

Since the opening up of workings at Coal Island, Preservation Inlet, a number of privileges appertaining thereto have been granted at Dunedin. It was, however, with considerable reluctance that I exercised jurisdiction in respect of that goldfield, because the Warden's Court, at Riverton, is much nearer to it, and also exercises jurisdiction, consequently there is danger of applications for grants relating to the same land or privileges being dealt with by both Courts; but when the goldfield was first started certain miners claimed the right that their applications should be dealt with in the Dunedin Court, and pointed out that it was the most convenient Court for their purposes, and that they would have to incur considerable expense if they had to attend the Riverton Court. Both Courts are within the Otago Mining District, in which the Coal Island Goldfield is included, and there is nothing in the Mining Act appointing that in such case any particular Court shall have jurisdiction. I felt therefore compelled to accede to the applicants' wishes. I think provision should be made that the Governor may appoint that some particular Court shall alone have jurisdiction over a division of a goldfield.

The workings are now extending from Coal Island to the mainland, and a fair quantity of gold seems to have been obtained during the year, but I am unable to furnish even an approximate estimate of the total amount.

As regards Hindon there is not much to report. With the quartz-mines and the mining plant which fell into the hands of Begg and party just previous to the date of last year's report, and in connection with which great expectations were formed, very little has been done, owing chiefly, I am led to believe, to requisite alterations in the machinery and the difficulty in obtaining an adequate water-supply. From the crushing of upwards of 250 tons of stone an average yield of 7dwt. of gold has been reported. Small trial crushings for other than the mill-owners are reported to have yielded 7dwt. to 15dwt. to the ton.

Kenny and party, who are working at what was known as the Zealandia Reef, are reported as having obtained an 1oz. to the ton from a trial crushing of some 30 tons of stone. The operations of this party have also been seriously delayed by scarcity of water, and by the necessity of removing their battery to a more suitable site.

At Barewood, on the portion of the University endowment, land recently brought under the operation of the Mining Act, a number of licensed holdings have been taken up on a well-defined

quartz-reef. It is understood that arrangements are in progress for the development of this field. About 680 tons of stone were conveyed from this reef to the Saddle-hill Battery during the year, and yielded, it is said, an average of 14dwt. to the ton.

Special claims for dredging have also been taken up on the Deep Stream and Taieri River, where good prospects were said to be obtainable, but up to the present time the holders have not completed the necessary preparations for working the same.

The number of miners in the several localities before referred to remain much about the same as before.

I have, &c.,

The Under-Secretary, Mines Department, Wellington. E. H. Carew, Warden.

No. 16.

Mr. Warden Rawson to the Under-Secretary of Mines, Wellington.

Sir,— Warden's Office, Invercargill, 27th May, 1891.

I regret that I am behind time with my report this year. There are the returns for Wyndham district to be sent yet, and the portion of report *re* the mining operations connected with that district. I have wired to Mr. Carfield, Gore, to-day to send me them at once.

As I mentioned in my G.A.P. wire to you to-day some delay has been occasioned by Mr. Carfield not getting a circular or forms until a few days ago. I was not aware of this until I saw him at Wyndham last Court day. He had not got the information ready before, because the information required might not be the same as for last year. I did not myself receive a circular at Invercargill, so that some time was lost until I saw Mr. Eyes at Riverton. A friend of Mr. Carfield was going to drive him out to Waipapa, &c., so that he might obtain information for me as I had not time to go myself, and I expect the rough weather has delayed him. I will make a note in my diary for next year, so that I shall not forget to obtain the information I require earlier.

I have the honour to forward herewith the annual returns, and to submit the following report on mining matters in the sub-districts under my charge for the year ending the 31st March, 1891:

Longwood.

The Longwood Sluicing Company (Limited) have steadily progressed during the last twelve months with the work of bringing up a deep tail-race to their special claim, and are still persevering with it in the hope of getting on to the known auriferous ground.

Orepuki.

With respect to the Orepuki Goldfield there is nothing new to report since last year. About the same number of miners are still at work, and I think the majority of them have been making fairly good wages. The grantees of the four special claims for sea-beach ground in Te Waewae Bay, near Orepuki, mentioned in my last report, have not yet commenced to work.

Coal Island, Preservation Inlet.

During the spring and summer months from one hundred to one hundred and twenty miners were working on this field, but many have left lately, owing to the approaching winter, with the intention of returning in the spring. I am informed that the ground is very patchy, yet some of the miners are doing very well.

Roundhill.

This alluvial goldfield employs about the same number of miners as usual. Much of the gold-bearing ground is at present unworkable for want of sufficient fall for sluicing, the main gullies having been sludged up to a depth of from 20ft. to 40ft. I mentioned in my last year's report that this serious hindrance to the further development of this goldfield was likely to be overcome by a company about to be floated in England. A syndicate, termed the Roundhill Syndicate (Limited), with a working capital of £30,200, has lately commenced operations. The company have bought up nearly all the principal water-races bringing water to the Roundhill. They are about to make a cutting four miles and a half in length through the sand-hills and solid country, commencing at a point on the Wakapatu sea-beach, about 40 chains east of the present outlet of the Orewera Creek, and terminating at the Roundhill diggings. By cutting this channel in a straight course the syndicate will gain a good deal more fall for the disposal of the enormous accumulation of tailings (estimated by experts at 4,000,000 tons) collected in the bed of the Orewera Creek during the last seventeen years. The channel will be in the form of a double sluice-box, about 13ft. wide and 4ft. 6in. in depth, and whilst one box is being used for carrying and reducing tailings the other will be cleaned up. For the latter purpose trams are provided on each side of the boxes to run trucks with the black sand to the washing-site, where it will be treated by the latest improved methods for gold-saving, including an abundant supply of clear water. In addition to the above, the syndicate hold two special claims at Roundhill of 30 and 20 acres respectively, which they intend to work by Perry's system of elevating. The plant for this is being constructed, and the manager informs me that he expects it to be on the ground in a few months. An electric-light plant is also to be erected, which will enable the syndicate to work their claims and sludge-channel by night and day.

The syndicate is now surveying the line for a big water-race from Pourapourakino River to the Roundhill, about thirty miles in length, to carry fifty Government heads of water, and the syndicate propose to let the water to the miners at a small rental, so as to open up the country. If the company's operations result in a financial success, which I think they will, the result will be not only the full opening up of an important goldfield, which is at present partially closed, but also the finding employment, directly and indirectly, for a great number of men, both miners and labourers.

WAIPAPA.

The Waipapa Creek Gold-mining Company, to which I made reference in my last year's report, has been wound-up and reformed under the name of the Waipapa Dredging Company (Limited). The yield of gold for the year ending the 31st March last was 190oz. 14dwt. The Lake Brunton Gold-dredging Company (Limited) is a beach-dredging company. Work was not commenced until February last. The Six-mile Beach-dredging Company (Limited) commenced work last month. The machinery for the Otara Gold-dredging Company (Limited) has just arrived from England, and operations will shortly be commenced. I have, &c.,

The Under-Secretary, Mines Department, Wellington. C. E. RAWSON, Warden.

No. 17.

Mr. A. AITKEN, Manager, Waimea-Kumara Water-races, to the UNDER-SECRETARY of MINES, Wellington.

SIR,— Kumara, 22nd April, 1891.

I have the honour to submit the following report on the Waimea-Kumara Water-races and Sludge-channels for the year ending the 31st March, 1891.

WAIMEA RACE.

The total sales of water from this race for the year amounts to £1,388 17s. 5d., and the total expenditure on maintenance for the same period £933 3s. 3d., thus leaving a credit balance of £455 14s. 2d. on the year's transactions, or about £10 more than the previous year. The average number of miners supplied with water from the race was eighty-eight, and the approximate quantity of gold obtained was 3,072oz.

The sales of water are greater than for the preceeding year by £148 7s. 10d., and the yield of gold from claims supplied from the race, so far as can be ascertained, shows an increase of 469oz. The expenditure on maintenance is greater than for the previous year by £137 15s. 8d. Considerable repairs had to be made on the tressel-work, flumes, and tunnels to make the race carry its full compliment of water with safety. Twenty-eight new legs, varying from 14ft. to 50ft. in length, were put in the tressel-work. New bracing was necessary in many instances, and the frames and planking of the flumes required extensive renewal. In the tunnels 104 new sets of timber, with the necessary slabs, were obtained and placed in position. One small bridge was constructed, and the race and flumes throughout cleared where necessary. With the exception of one of the short tunnels, about 2½ chains in length, near Stoney Creek, the whole of the race is in a fair state of repair, and will require very little expenditure on maintenance during the present year. As the tunnel referred to passes through very bad ground, and would be difficult to repair, I propose to substitute a piece of open race in the place of the tunnel, as it will be safer and less costly.

The principal workings on which the race-water is used is at Tunnel Terrace between Goldsborough and Stafford. There are still large blocks of gold-bearing wash from 60ft. to 80ft. in depth in this locality, but much of it is poor and difficult to open up.

The demand for water from the race is not equal to the ordinary supply, and a considerable quantity of water, averaging recently five sluice-heads, has been disposed of as waste water, for which only £2 per month has been received. It would be of more advantage to the district and the colony to be liberal with this waste water, and give it free, or at a nominal rate, to any parties who would open up new ground, or do other work that would tend to revive mining in the district. This course should be adopted, or the surplus water should be turned into the Kumara Race, where it would have a much larger value than it has at present.

I have recently been instructed by the Hon. the Minister of Mines to examine the country in the vicinity of Callaghan's and on the north side of the Waimea Creek, and report fully on the area and character of the ground that a branch of the Waimea Race would command, with fall for tail-races, and area and level of available ground for the deposit of tailings. Along with the report is to be sent in an estimate of the carrying capacity, length, and cost of a branch race in this direction. This branch race would also supply water to all the gullies lying between the discharge end of the large syphon and Callaghan's, where there are very large areas of slucing-ground without water except during wet weather.

In the Waimea district there are still a considerable number of miners working on ground for which the race-water is not available, many of them making a comfortable living, and some doing better than that.

Of the parties using water from the Waimea Race more than one-half the number are Chinese, and they are nearly all located at Stafford at lower end of the race.

The inaccessible position of most of the timber structures on the Waimea Race, and the great scarcity of suitable timber, renders repairs to tressel-work, fluming, and tunnels very costly in comparison with work of a similar kind in other localities.

Kumara Race.

The value of water supplied from this race during the year, for which cash has been received, was £6,665 12s. 8d. paid to public account and £913 18s. 4d. paid to trustees of No. 3 Channel for completion of channel deviation. Water to the value of £793 0s. 5d. was supplied to parties as subsidies on the cost of deviations of race; which, in all cases, consisted of the substitution of steel- and iron-pipings for portions of race in open cutting in earthwork, Water was also supplied to parties for assistance in opening up new ground, &c., to the value of £409 5s. 5d. The total value of water supplied from the race during the year was £8,781 16s. 10d.

The quantity of water supplied daily for twelve hours per day, exclusive of thirty-four sluice-heads for flushing purposes, has averaged 62·72 sluice-heads during the year, and the average quantity supplied daily for twelve hours per day, exclusive of flushing water, for the previous seven years was 51·22 sluice-heads. The average daily supply for last year was therefore 11½ sluice-heads in excess of the average daily supply for the previous seven years, and this quantity represents £1,610 per annum.

The average number of miners supplied from the race was 155, and the approximate quantity of gold obtained was 9,935oz. The number of miners supplied from the race was twenty less than during the previous year, and the quantity of gold obtained was 2392oz. greater. This result is largely due to the regularity of the water-supply, the employment of a smaller number of men in the claims, the use of larger quantities of water, the use of larger pipes, and a general improvement in the manner of conducting sluicing operations.

During the year the supply of water was short for about three weeks, and the claims running into the channels were stopped in consequence for about that period. The claims running into No. 3 Channel were also idle for about fourteen days while the connection was being made between the old channel and the new deviation. Besides the above stoppages the miners observed nineteen holidays on their own account at Christmas, New Year, Easter, &c., during which time no water was supplied from the race, although there was abundance of water to keep all the claims at work and it was running to waste down the creeks.

The expenditure for maintenance during the year was £1,766 4s. 3d., as against £1,424 13s. 3d. for the previous year, being an increase of £341 11s. No work was done that was not absolutely necessary for the welfare of the race, and the improvements made and the increased facilities now afforded for the better distribution of the water has already and will in the future more than compensate for the increased expenditure. The proportion of expenditure on maintenance to value of water supplied for the year is 20·11 per cent., against 24·12 per cent. for the previous year, or the increase on cost of maintenance is 10·96 per cent. of the increase of moneys paid to public account.

The whole race, with its branches and syphons, are in a very good state of repair, but so long as the present demand for water continues and the gaugers are fully employed every day, it will be necessary to employ extra labour to carry on the work of maintenance and keep the whole of the works in an efficient state of repair. In some instances where breakages occurred in pipes and flumes, the property of sluicing parties, assistance was rendered to repair the damage without delay, but the cost was repaid many times by getting them sooner to work and keeping up the sale of the full supply of water. Great care and attention has been bestowed on the dams, and hundreds of pounds' worth of water have been saved by promptly closing them in cases of sudden rainfall.

At the loop-line dam the outlet-culvert requires to be strengthened, and the by-wash lengthened and improved so as to put a stop to the scour. The tunnel from the lower dam to Kumara requires new inlet-gates and widening for about 2½ chains at the upper end to enable it to carry more water; and the Kapitea Hill Race will probably have to be enlarged at an early date, as several new claims are being opened up that will derive their supply of water from this race. The race was constructed to carry fifty sluice-heads, but, with the alterations already made, it now carries more than sixty sluice-heads, but still more will be required.

In regulating the amount of flush-water, and water for working the claims running into the channels, I have made it a rule to take no instructions respecting changes of any kind from individual parties, but have given notice that any instructions or suggestions from the trustees, sent in writing through their respective secretaries, would receive every attention and consideration.

There are no Chinamen at work on the Kumara Goldfield.

Kumara Sludge-channel.

The Kumara Sludge-channel was maintained by the Government from the 1st April, 1890, to the 15th July, 1890, when all the Government men were withdrawn from the work of maintenance. Immediately on the withdrawal of the Government men the trustees of No. 3 Channel took possession by virtue of certain deeds by which Her Majesty the Queen transferred the Kumara Sludge-channel and other mining rights to the said trustees of No. 3 Channel under certain conditions.

The Government men continued to take gold from the lower 30 chains of the Kumara Sludge-channel under clause 3 of the Kumara Sludge-channel Act 1889 Amendment until the 30th October, 1890, when all Government men were withdrawn finally from the channel. On the 31st October, 1890, I handed over all trucks, tools, &c., connected with the channel to the trustees, and left them in possession. Prior to the 30th October, 1890, the lower 30 chains of the channel were centred in accordance with an arrangement made with the trustees.

The expenditure on maintenance, &c., was £1,108 1s. 1d. The amount of channel fees received was £274 5s. 5d., and the value of gold obtained was £843 6s.

I have, &c.,

Alexander Aitken, Manager, Water-races.

The Under-Secretary, Mines Department, Wellington.

No. 18.

Mr. John McNaughton, Manager, Nelson Creek Water-race, to the Under-Secretary of Mines, Wellington.

Sir,— Nelson Creek Water-race, Hatters' Terrace, 15th April, 1891.

I have the honour to forward my annual report on the working of the Nelson Creek Water-race for the year ending the 31st March, 1891.

The receipts are not so satisfactory as I anticipated at the beginning of the year, owing chiefly to the numerous slips and breaks that occurred during the year, causing a loss of nearly two months' sales.

Mining operations are now getting limited, being chiefly confined to the lower end of Try-again Terrace, Brian Boru, and Wards' Gullies. All the claims in these localities are paying very well, and are likely to continue doing so as long as they can be supplied with water. All the payable ground that the race commands along the terraces of No. 3 Creek and its tributaries is now completely washed away; and although there is still a large extent of the bed of No. 3 Creek unworked, with the exception of Mr. Roche's Hydraulic Claim, no one seems inclined to give it a trial, as this ground can only be worked by hydraulic pressure. There is no doubt that the large outlay required to provide a suitable plant, taking conjointly with the fact that some of the bridges on the race may collapse at any time, has so deterred parties from making the venture.

Mr. Roche in the working of his hydraulic claim in No. 3 Creek has had many difficulties to contend with during the year owing to various causes, such as frequent breakages in the pipes and castings, and the whole workings have been levelled on several occasions through heavy floods, also to the total collapse of the drainage-race in June last. Since then sluicing can only be carried on in fine weather, as the slightest amount of rain causes to much drainage for the machine to cope with. This state of affairs cannot be altered until the workings are some 60ft. further ahead, then the whole plant can be shifted to a new site where any extra drainage can then be cut off.

There has been very little prospecting done during the year, consequently no great extent of payable ground has been discovered, the most of it having proved to be small patches situated on steep sidelings where there is plenty of fall, and therefore easily worked out. There is still a large area of ground that the race commands in the vicinity of Sutherland's and Kelly's Creeks, on the left-hand branch of Nelson Creek, where large deposits of wash-drift are known to exist that has not yet been sufficiently prospected, and probably may yet be found to be payable for working.

Nearly all the flume bridges, from the six-mile peg to the end of the race, that have been constructed of rimu and red-pine are now getting in such an advanced state of decay that a collapse of any one of them may occur at any time within the next twelve months. Although most of these have been strengthened and repaired to a considerable extent—and no doubt many of them can be kept good for some time to come—some of the largest of them, such as Gow's Surprise and Wishart's cannot be further repaired without incurring a larger outlay than the present prospects of the future sales of water will justify. The tunnels at the upper end of the race, owing to frequent breakages, are now getting filled up to such an extent that it has become necessary to have them cleaned out. For this purpose about 2,000ft. of rails has already been sawn and brought on to the ground, and a start made to clean out the 28-chain tunnel below Evan's Creek bridge. There are also several bridges on this part of the race that require immediate attention, and all possible haste is being made to get necessary material to renew the most important parts of these to prevent an accident.

I have, &c.,

The Under-Secretary, Mines Department, Wellington. J. McNaughton, Manager.

No. 19.

The Chairman, Mount Ida Water-race Trust, to the Hon. the Minister of Mines.

Sir,—

Naseby, 11th June, 1891.

In accordance with the requirements of section 25 of "The Mount Ida Water-race Trust Act, 1878," I have the honour to forward the annual report and balance-sheet for the year ended the 31st December last.

The year 1890, like the preceding years, was characterized by long and continued drought, which, through the reduced water-supply, materially affected the revenue of the Trust.

Although the greatest economy was practised, only three men being employed to keep in repair and maintain sixty-seven miles of head-race, the income was insufficient to cover the expenditure, and an application for assistance was made to the Government, which granted the sum of £200, which enabled the Trust to meet its liabilities and to carry on operations.

A further reduction has been effected in connection with the sludge-channel. Hitherto its care and maintenance has cost the Trust about £140 per annum. Only occasional work, as required, on day wages, has been decided on for the future. It will thus be seen that the working expenses have been reduced to a minimum, and that any further reduction would be incompatible with the safety and efficiency of the works.

The race and channel are both in a fair state of repair, although on the former a considerable sum might be expended to advantage in clearing it out, but the funds at the disposal of the Trust are insufficient in the meantime to warrant the expenditure.

The demand for water still continues to be far in excess of the supply, and double the quantity delivered could easily be disposed of.

The sales of water for the year amount to £1,027 17s. 8d.; cash received (less grant), £825 10s. 11d.; expenditure for same period, £1,061 9s. 5d.

The construction of the reservoir at the Eweburn becomes each year more and more a work of the greatest importance and necessity to the district, and should be undertaken at an early date either by direct appropriation or under the Loans to Local Bodies Act.

I have, &c.,

The Hon. the Minister of Mines, Wellington. W. Guffie, Chairman.

Balance-sheet of the Mount Ida Water-race Trust for the Year ended 31st December, 1890.

Receipts.	£	s.	d.	*Payments.*	£	s.	d.
To Amount received on account of water sales	825	10	11	By Balance, 1st January, 1890	74	3	11
Gold from channel	26	9	6	Maintenance of head-race	363	14	0
Government grant	200	0	0	Extra labour on head-race	29	17	6
Balance, unpaid cheques £172 4 6				Cleaning head-race and extension	120	15	6
Balance at bank, 31st December, 1890 88 11 7				Maintenance of channel	128	6	8
	83	12	11	Extension of head-race	12	9	0
				Washing up channel	38	1	0
				Timber, carpenters' and blacksmiths' work, tools, and sundry expenses	88	17	2
				General management	224	5	0
				Printing and stationery	1	4	6
				Clerk's salary	15	0	0
				Office-rent	19	9	0
				Law costs	15	19	0
				Petty cash	3	11	1
	£1,135	13	4		£1,135	13	4

Statement of Water Sales.

	£	s.	d.		£	s.	d.
To Amount owing for water, 31st Dec., 1889	1,346	4	1	By Cash received for water during 1890	825	10	11
Water sold during year 1890	1,027	17	8	Owing for water, 31st December, 1890	1,548	10	10
	£2,374	1	9		£2,374	1	9

William Guffie,
James Mitchell,
N. P. Hjorring,
} Members of the Mount Ida Water-race Trust.

APPENDICES TO WARDENS' REPORTS.

No. 1.

STATEMENT showing the REVENUE of the GOLDFIELDS collected in the several DISTRICTS, and the GOLD DUTY of the COLONY of NEW ZEALAND, for the Period from the 1st January to the 31st December, 1890.

District.	Miners' Rights.	Business Licenses, Machine and Residence Sites.	Water-races, Sluices, &c.	Gold-mining Leases, Rents, and Royalties.	Registration.	Fees and Fines, Wardens' Courts.	Miscellaneous.	Totals.
AUCKLAND.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Coromandel ..	302 0 0	121 10 0	2 0 0	315 10 0	7 16 0	18 6 0	26 18 6	794 0 6
Te Aroha ..	16 0 0	..	..	777 2 0	5 13 0	0 15 0	10 4 6	809 14 6
Thames and Ohinemuri	216 0 0	222 15 0	49 10 0	1,537 6 1	11 17 0	6 2 0	141 9 0	2,184 19 1
Totals ..	534 0 0	344 5 0	51 10 0	2,629 18 1	25 6 0	25 3 0	178 12 0	3,788 14 1
NELSON.								
Collingwood ..	33 15 0	1 0 0	8 10 0	228 10 0	9 12 0	4 6 0	164 1 4	449 14 4
Westport ..	127 15 0	9 0 0	14 15 0	335 10 0	9 11 0	1 18 0	267 10 0	765 19 0
Charleston ..	70 6 0	..	17 12 6	81 9 6	12 5 0	0 18 0	18 15 8	201 6 8
Ahaura ..	227 15 0	9 0 0	29 0 0	274 4 0	41 5 0	4 3 0	72 15 0	658 2 0
Reefton ..	195 15 0	67 10 0	20 2 6	1,449 5 0	8 15 0	4 14 0	363 17 0	2,109 18 6
Wangapeka ..	20 0 0	2 10 0	1 0 0	30 0 0	2 14 0	5 5 0	0 19 6	62 8 6
Lyell	58 15 0	1 10 0	2 15 0	169 5 0	3 1 0	0 16 0	2 16 6	238 18 6
Motueka ..	4 5 0	..	..	..	0 2 0	..	..	4 7 0
Murchison and Owen's	100 0 0	..	11 5 0	100 0 0	5 3 0	0 2 0	6 18 0	223 8 0
Totals ..	838 6 0	90 10 0	105 0 0	2,668 3 6	92 8 0	22 2 0	897 13 0	4,714 2 6
MARLBOROUGH.								
Havelock ..	116 17 0	..	3 10 0	120 0 1	9 4 0	14 10 0	0 14 6	264 15 7
Picton ..	6 10 0	..	..	..	..	..	0 14 0	7 4 0
Totals ..	123 7 0	..	3 10 0	120 0 1	9 4 0	14 10 0	1 8 6	271 19 7
WESTLAND.								
Hokitika and Kanieri	186 15 0	9 0 0	15 5 0	30 0 0	12 14 0	1 19 0	7 4 6	262 17 6
Greymouth ..	290 17 6	17 15 0	38 2 6	277 15 6	35 17 0	13 3 0	30 3 6	703 14 0
Ross	50 11 0	..	11 7 6	294 5 0	9 0 0	2 18 0	84 4 0	452 5 6
Stafford ..	58 5 0	..	8 0 0	141 15 0	3 2 0	1 5 0	6 16 6	219 3 6
Kumara ..	244 17 0	12 0 0	7 7 6	203 15 0	27 1 0	11 3 0	9 1 0	515 4 6
Jackson's Bay ..	4 0 0	..	0 10 0	..	0 2 0	..	..	4 12 0
Goldsborough ..	49 15 0	..	17 0 0	..	6 3 0	0 10 0	5 11 0	78 19 0
Okarito ..	24 15 0	8 5 0	6 12 6	61 16 4	2 17 0	0 12 0	1 13 0	106 10 10
Totals ..	909 15 6	47 0 0	104 5 0	1,009 6 10	96 16 0	31 10 0	144 13 6	2,343 6 10
OTAGO.								
Black's ..	57 0 0	1 10 0	8 10 0	105 3 3	5 19 0	5 17 0	121 14 0	305 13 3
Tapanui ..	5 0 0	..	0 10 0	..	0 6 0	0 5 0	1 19 0	8 0 0
Hindon ..	71 11 0	6 0 0	4 7 6	29 10 0	3 14 0	2 16 0	32 3 5	150 1 11
Naseby ..	185 10 0	65 0 0	40 17 6	486 1 10	26 14 0	19 13 0	3 12 6	827 8 10
Roxburgh ..	72 5 0	0 5 0	11 12 6	392 9 0	9 4 0	15 16 0	186 0 6	637 12 0
Alexandra .. / Clyde	88 15 0	17 0 0	20 10 0	96 12 0	10 3 0	15 15 0	9 0 6	257 15 6
Pembroke ..	16 10 0	..	0 15 0	1 15 0	0 10 0	..	0 1 0	19 11 0
Cromwell ..	154 15 0	12 0 0	41 17 6	388 0 9	26 16 0	25 16 0	81 16 6	731 1 9
Queenstown ..	108 15 0	20 10 0	13 15 0	1,296 3 5	13 7 0	26 4 6	278 13 6	1,757 8 5
Arrowtown ..	88 5 0	7 15 0	19 10 0	788 10 4	16 3 0	6 0 0	190 16 9	1,117 0 1
Lawrence ..	200 0 0	9 10 0	23 10 0	1,026 7 2	17 8 0	22 13 0	234 0 8	1,533 8 10
Waikaia ..	83 15 0	3 10 0	9 12 6	52 10 0	10 13 6	5 11 0	..	165 12 0
Orepuki, Longwood and Riverton	117 0 0	21 10 0	13 10 0	194 12 0	9 17 0	13 17 0	0 10 0	370 16 0
Maerewhenua ..	30 15 0	..	4 12 6	36 2 0	6 5 0	10 0 0	1 9 0	89 3 6
Totals ..	1,279 16 0	164 10 0	213 10 0	4,893 16 9	156 19 6	170 3 6	1,091 17 4	7,970 13 1
Grand Totals ..	3,685 4 6	646 5 0	477 15 0	11,321 5 3	380 13 6	268 8 6	2,314 4 4	19,088 16 1

T. H. HAMER,
Accountant.

No. 2.

STATEMENT showing the REVENUE of the GOLDFIELDS collected in the several DISTRICTS, and the GOLD DUTY of the COLONY of NEW ZEALAND, for the Period from 1st January to 31st March, 1891.

District.	Miners' Rights.	Business Licenses, Machine & Residence Sites.	Water-races, Sluices, &c.	Gold-mining Leases, Rents, and Royalties.	Registration.	Fees and Fines, Wardens' Courts.	Miscellaneous.	Totals.
AUCKLAND.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Coromandel ..	43 15 0	20 10 0	..	124 0 0	0 7 0	2 8 0	17 13 6	208 13 6
Te Aroha ..	11 5 0	5 0 0	..	269 0 0	1 1 0	..	..	286 6 0
Thames ..	50 5 0	64 10 0	5 15 0	397 0 0	4 9 0	10 0 0	45 6 0	577 5 0
Totals ..	105 5 0	90 0 0	5 15 0	790 0 0	5 17 0	12 8 0	62 19 6	1,072 4 6
NELSON.								
Motueka ..	0 10 0	..	0 15 0	..	0 4 0	..	..	1 9 0
Collingwood ..	10 0 0	1 0 0	3 10 0	70 15 0	3 7 0	..	11 4 0	99 16 0
Westport ..	32 0 0	0 15 0	1 15 0	137 15 0	1 13 0	..	22 0 6	195 18 6
Charleston ..	28 15 0	..	3 10 0	28 0 0	3 9 0	2 13 0	1 6 0	67 13 0
Ahaura	80 0 0	..	7 2 6	13 10 0	9 19 0	..	16 11 0	127 2 6
Reefton	41 15 0	1 10 0	3 15 0	364 15 0	1 9 0	1 16 0	4 3 0	419 3 0
Wangapeka ..	5 0 0	..	0 5 0	15 0 0	0 3 0	..	..	20 8 0
Lyell	8 15 0	..	1 17 6	24 10 0	0 5 0	..	0 10 0	35 17 6
Murchison ..	21 0 0	..	3 5 0	2 10 0	1 10 0	0 2 0	0 19 0	29 6 0
Totals ..	227 15 0	3 5 0	25 15 0	656 15 0	21 19 0	4 11 0	56 13 6	996 13 6
MARLBOROUGH.								
Havelock ..	31 15 0	..	0 5 0	130 13 0	1 18 0	2 9 0	0 3 6	167 3 6
Picton	1 0 0	..	..	..	..	..	..	1 0 0
Totals ..	32 15 0	..	0 5 0	130 13 0	1 18 0	2 9 0	0 3 6	168 3 6
WESTLAND.								
Hokitika and Kanieri	66 15 0	16 10 0	2 17 6	10 6 0	3 5 0	..	1 18 6	101 12 0
Greymouth ..	62 0 0	0 5 0	5 7 6	75 8 0	5 13 0	3 6 0	5 3 0	157 2 6
Ross	14 0 0	1 10 0	2 7 6	270 0 0	2 0 0	..	22 10 0	312 7 6
Stafford	17 10 0	..	2 2 6	..	1 18 0	0 6 0	..	21 16 6
Okarito	6 0 0	3 10 0	1 1 6	51 10 0	0 17 0	..	0 1 0	62 19 6
Kumara ..	62 15 0	6 0 0	1 2 6	76 0 0	6 2 0	1 16 0	0 5 0	154 0 6
Goldsborough ..	12 10 0	..	3 17 6	..	2 19 0	..	0 1 0	19 7 6
Jackson's Bay ..	2 0 0	..	0 5 0	..	0 1 0	..	..	2 6 0
Totals ..	243 10 0	27 15 0	19 1 6	483 4 0	22 15 0	5 8 0	29 18 6	831 12 0
OTAGO.								
Black's	16 5 0	0 5 0	5 2 6	158 0 3	2 1 0	1 3 0	17 7 6	200 4 3
Tapanui ..	1 5 0	..	0 10 0	..	0 5 0	..	..	2 0 0
Hindon	14 1 0	0 5 0	0 5 0	163 9 0	0 2 0	1 2 0	3 16 0	183 0 0
Naseby	65 1 0	3 15 0	13 10 0	175 13 6	7 8 0	5 19 0	0 9 0	271 15 6
Alexandra } Clyde .. } ..	31 10 0	..	5 2 6	20 10 0	3 10 0	7 3 6	28 19 10	96 15 10
Roxburgh ..	19 10 0	..	4 7 6	162 6 0	2 9 0	3 19 0	1 12 6	194 4 0
Cromwell ..	47 15 0	0 15 0	9 10 0	27 4 0	6 14 0	1 10 0	1 0 0	94 8 0
Queenstown ..	27 5 0	5 10 0	17 12 6	211 13 9	5 17 0	1 0 0	15 16 6	284 14 9
Arrowtown ..	32 15 0	..	2 7 6	182 0 6	4 3 0	6 19 0	23 5 6	251 10 6
Lawrence ..	48 15 0	0 10 0	3 5 0	144 16 6	4 14 0	2 6 0	0 7 0	204 13 6
Orepuki and Longwood	34 14 0	6 5 0	4 7 6	38 4 0	2 1 0	2 5 0	0 2 0	87 18 6
Pembroke ..	6 15 0	..	..	..	0 1 0	..	..	6 16 0
Maerewhenua ..	5 5 0	..	1 2 6	17 16 0	2 4 0	1 18 0	0 2 0	28 7 6
Waikaia ..	17 0 0	3 0 0	1 15 0	..	2 13 0	0 11 0	..	24 19 0
Totals ..	367 16 0	20 5 0	68 17 6	1,301 13 6	44 2 0	35 15 6	92 17 10	1,931 7 4
Grand Totals ..	977 1 0	141 5 0	119 14 0	3,362 5 6	96 11 0	60 11 6	242 12 10	5,000 0 10

T. H. HAMER,
Accountant.

No. 3.

COMPARATIVE RETURN of REVENUE derived from the GOLDFIELDS in the several DISTRICTS of NEW ZEALAND during the Years 1889 and 1890, showing INCREASE or DECREASE under each Head of Revenue.

District.	Miners' Rights.	Business Licenses, &c.	Water-races, Sluices, &c.	Gold-mining Leases, Rents, and Royalties.	Registration.	Fees and Fines, Wardens' Courts.	Miscellaneous.	Gold Duty.	Totals.
AUCKLAND—	£	£	£	£	£	£	£	£	£
Year 1889	479	272	65	2,762	26	54	884	2,852	7,394
Year 1890	534	344	52	2,630	25	25	179	3,555	7,344
Increase	55	72	..	..	..	..	..	703	..
Decrease	..	..	13	132	1	29	705	..	50
WELLINGTON—									
Year 1889	..	..	..	..	..	..	..	..	..
Year 1890	..	..	..	..	..	..	..	..	..
Increase	..	..	..	..	..	..	..	..	..
Decrease	..	..	..	..	..	..	..	..	..
NELSON—									
Year 1889	774	209	130	3,099	112	70	865	3,970	9,229
Year 1890	838	91	105	2,668	92	22	898	286	5,003
Increase	64	..	..	..	..	..	..	..	..
Decrease	..	118	25	431	20	48	33	3,684	4,295
MARLBOROUGH—									
Year 1889	128	6	11	433	19	36	342	519	1,494
Year 1890	123	..	4	120	9	15	2	608	881
Increase	..	..	..	..	..	..	..	89	..
Decrease	5	6	7	313	10	21	340	..	613
WESTLAND—									
Year 1889	801	60	91	1,503	93	60	260	6,911	9,779
Year 1890	910	47	104	1,009	97	32	145	9,001	11,345
Increase	109	..	13	..	4.	..	..	2,090	1,566
Decrease	..	13	..	494	..	28	115	..	..
OTAGO—									
Year 1889	1,454	270	232	4,479	185	155	784	6,510	14,069
Year 1890	1,280	165	214	4,894	157	170	1,092	6,170	14,142
Increase	..	..	..	415	..	15	308	..	73
Decrease	174	105	18	..	28	..	..	340	..
Total Increase	49	..	..	..	..	..	..	..	..
Total Decrease	..	170	50	955	55	111	885	1,142	3,368

T. H. HAMER,
Accountant.

No. 4.

COMPARATIVE RETURN of the TOTAL AMOUNTS of GOLDFIELDS REVENUE (exclusive of Gold Duty) collected in the several Districts during the Years 1889 and 1890, and the Quarters ending 31st March, 1890 and 1891 respectively, showing the INCREASE or DECREASE in respect of each District.

District.	Years 1889 and 1890.				Quarters ending 31st March, 1890, and 31st March, 1891.			
	1889.	1890.	Increase.	Decrease.	1890.	1891.	Increase.	Decrease.
AUCKLAND.	£	£	£	£	£	£	£	£
Coromandel	302	794	492	..	147	209	62	..
Te Aroha	1,484	810	..	674	150	286	136	..
Thames	2,756	2,185	..	571	709	577	..	132
Puhipuhi	..	..	..	..	321	..	..	321
NELSON.								
Motueka	4	4	..	..	3	2	..	1
Collingwood	273	450	177	..	87	100	13	..
Westport	1,195	766	..	429	238	196	..	42
Charleston	199	201	2	..	61	68	7	..
Ahaura	701	658	..	43	199	127	..	72
Reefton	2,080	2,110	30	..	459	419	..	40
Wangapeka	45	62	17	..	15	20	5	..
Lyell	297	239	..	58	75	36	..	39
Murchison and Owen's ..	465	223	..	242	98	29	..	69
MARLBOROUGH.								
Havelock	974	272	..	702	161	168	7	..
WESTLAND.								
Hokitika ..	324	263	..	61	59	102	43	..
Kanieri ..								
Greymouth	719	704	..	15	116	157	41	..
Ross	463	452	..	11	113	312	199	..
Stafford	384	219	..	165	33	22	..	11
Okarito	448	107	..	341	50	63	13	..
Kumara	438	515	77	..	192	154	..	38
Jackson's Bay	5	5	..	..	2	2	..	..
Goldsborough	86	79	..	7	22	19	..	3
OTAGO.								
Hindon	136	150	14	..	27	183	156	..
Naseby and Black's ..	2,317	1,133	..	1,184	318	472	154	..
Alexandra ..	257	258	1	..	91	97	6	..
Clyde ..								
Roxburgh	485	638	153	..	162	194	32	..
Cromwell	579	731	152	..	141	94	..	47
Arrowtown	609	1,117	508	..	102	252	150	..
Queenstown	1,159	1,757	598	..	220	285	65	..
Pembroke	42	20	..	22	6	7	1	..
Lawrence	1,020	1,533	513	..	408	205	..	203
Waikaia	332	166	..	166	61	25	..	36
Tapanui	10	8	..	2	5	2	..	3
Orepuki and Longwood ..	389	371	..	18	67	88	21	..
Maerewhenua	54	89	35	..	20	28	8	..
Wyndham	170	..	..	170	76	..	..	76
WELLINGTON.								
Wellington	..	..	..	..	..	..	..	..
CANTERBURY.								
Christchurch	..	..	..	..	..	..	..	..
Totals	21,201	19,089	2,769	4,881	5,014	5,000	1,119	1,133
Net decrease ..	..	..	..	2,112	..	..	..	14

T. H. HAMER,
Accountant.

No. 5.

RETURN of GOLD DUTY credited to LOCAL BODIES for the Year ended 31st December, 1890, and Quarter ended 31st March, 1891.

Local Body.	For the Year ended 31st December, 1890.	For the Quarter ended 31st March, 1891.
	£ s. d.	£ s. d.
COUNTIES—		
Bruce	7 1 10	..
Buller	1,181 16 3	319 16 1
Clutha..	4 2 0	..
Collingwood	264 2 2	8 0 10
Coromandel	636 8 9	252 10 9
Fiord	27 12 3	13 0 0
Grey	2,172 15 4	578 4 8
Inangahua	2,458 1 6	267 4 6
Lake	1,005 12 5	1 8 6
Marlborough	608 4 6	..
Maniototo	602 3 6	0 5 0
Ohinemuri	541 8 1	354 10 11
Piako	101 2 1	7 4 0
Sounds	..	..
Southland	368 0 4	3 14 0
Stewart Island	1 2 6	..
Taieri	81 7 0	3 3 0
Thames	1,111 10 2	202 6 1
Tuapeka	1,737 0 6	99 6 0
Vincent	1,300 15 0	4 4 0
Waihemo	107 18 2	..
Waikouaiti	188 4 0	1 18 6
Waimea	21 16 10	..
Waitaki	167 6 10	46 4 0
Wallace	556 12 6	..
Westland	2,699 17 10	696 4 4
BOROUGHS—		
Alexandra South	15 17 0	..
Brunnerton	4 19 5	0 12 0
Hokitika	17 5 11	4 19 6
Kumara	173 13 11	44 15 11
Naseby	..	..
Ross	292 10 6	97 9 0
Te Aroha	..	..
Thames	1,164 19 6	126 13 0
Reefton	0 3 3	..
Totals	19,621 11 10	3,133 14 7

Treasury, 2nd July, 1891.

ROBERT J. COLLINS,
Accountant to the Treasury.

No. 6.

RETURN of the QUANTITY and VALUE of GOLD ENTERED for DUTY for EXPORTATION from NEW ZEALAND, from 1st APRIL, 1857, to 31st DECEMBER, 1890.

PRODUCE OF THE GOLDFIELDS IN		DURING THE QUARTER ENDED 31ST DEC., 1890.		ENTERED FOR EXPORTATION TO THE 30TH SEPT., 1890.		TOTAL ENTERED FOR EXPORTATION FROM NEW ZEALAND TO THE 31ST DEC., 1890.	
County or Borough.	District.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
		Oz.	£	Oz.	£	Oz.	£
County of Coromandel	Auckland	1,300	5,200				
" Thames ..		1,482	5,924				
" Ohinemuri..		946	5,948				
" Piako ..		150	600				
Borough of Thames ..		1,808	7,230				
		5,686	22,902	1,633,671	6,099,571	1,639,357	6,122,173
County of Hutt ..	Wellington ..	..	..	188	706	188	706
County of Marlborough	Marlborough ..	800	3,200	66,135	255,886	66,935	259,086
County of Collingwood	Nelson	382	1,526	1,653,667	6,559,912	1,654,049	6,561,438
County of Buller ..	West Coast	2,175	8,700				
" Inangahua..		4,065	16,261				
" Grey ..		1,941	7,762				
" Westland ..		5,730	22,921				
Borough of Kumara ..		694	2,776				
" Hokitika ..		46	182				
" Ross ..		303	1,213				
		14,954	59,815	3,658,722	14,534,991	3,673,676	14,594,806
	Canterbury ..	..	..	24	96	24	96
County of Taieri ..	Otago	186	750				
" Tuapeka ..		3,761	16,053				
" Vincent ..		1,162	4,581				
" Maniototo ..		826	3,240				
" Waihemo ..		119	460				
" Waikouaiti		470	1,884				
" Waitaki ..		851	3,405				
" Lake ..		1,076	4,318				
" Wallace ..		1,644	6,437				
" Fiord ..		242	956				
" Clutha ..		21	80				
" Southland ..		907	3,622				
Borough of Alexandra		35	150				
		11,300	45,936	4,772,655	18,840,942	4,783,955	18,886,878
	Unknown ..	13	50	24	96	37	146
Totals		33,135	133,429	11,785,086	46,292,200	11,818,221	46,425,629

Department of Trade and Customs,
Wellington, 13th January, 1891.

W. T. GLASGOW,
For Secretary and Inspector.

No. 7.

COMPARATIVE RETURN of the QUANTITY and VALUE of GOLD ENTERED for DUTY for EXPORTATION from NEW ZEALAND for the YEARS ended 31st DECEMBER, 1890 and 1889.

PRODUCE OF THE GOLDFIELDS IN THE DISTRICT OF	DURING THE QUARTER ENDED—				TOTALS FOR YEAR 1890.		TOTALS FOR YEAR 1889.	
	31st March, 1890.	30th June, 1890.	30th September, 1890.	31st December, 1890.	Quantity.	Value.	Quantity.	Value.
	Oz.	Oz.	Oz.	Oz.	Oz.	£	Oz.	£
Auckland ..	9,706	7,239	9,114	5,686	31,745	125,760	28,655	113,191
Marlborough..	3,740	1,533	..	800	6,073	24,285	5,189	20,167
Nelson ..	1,326	427	721	382	2,856	11,049	3,252	12,310
West Coast ..	22,396	23,476	28,270	14,954	89,096	356,368	101,696	406,451
Otago ..	21,772	17,066	13,272	11,300	63,410	255,926	64,419	256,430
Unknown ..	..	..	..	13	13	50	..	..
Totals for 1890	58,940	49,741	51,377	33,135	193,193	773,438	..	..
Totals for 1889	60,391	44,337	40,907	57,576	..	..	203,211	808,549

Department of Trade and Customs,
Wellington, 13th January, 1891.

W. T. GLASGOW,
For Secretary and Inspector.

No. 8.

RETURN of the QUANTITY and VALUE of GOLD ENTERED for DUTY for EXPORTATION from NEW ZEALAND, from 1st APRIL, 1857, to 31st MARCH, 1891.

PRODUCE OF THE GOLDFIELDS IN		DURING THE QUARTER ENDED 31ST MARCH, 1891.		ENTERED FOR EXPORTATION TO THE 31ST DEC., 1890.		TOTAL ENTERED FOR EXPORTATION FROM NEW ZEALAND TO THE 31ST MARCH, 1891.	
County or Borough.	District.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
		Oz.	£	Oz.	£	Oz.	£
County of Coromandel	Auckland	2,525	10,075				
" Thames ..		6,707	25,653				
" Ohinemuri ..		3,546	14,574				
" Piako ..		72	288				
Borough of Thames ..		3,741	14,861				
		16,591	65,451	1,639,357	6,122,473	1,655,948	6,187,924
County of Hutt ..	Wellington ..	..	..	188	706	188	706
County of Marlborough	Marlborough ..	..	..	66,935	259,086	66,935	259,086
County of Collingwood	Nelson ..	80	320	1,654,049	6,561,438	1,654,129	6,561,758
County of Buller ..	West Coast	3,198	12,791				
" Inangahua ..		2,672	10,689				
" Grey ..		2,711	10,842				
" Westland ..		10,033	40,127				
Borough of Kumara ..		448	1,792				
" Brunnerton		6	24				
" Hokitika ..		50	199				
" Ross ..		974	3,898				
		20,092	80,362	3,673,676	14,594,806	3,693,768	14,675,168
	Canterbury ..	..	..	24	96	24	96
County of Vincent ..	Otago	42	170				
" Waitaki ..		22	82				
		64	252	4,783,955	18,886,878	4,784,019	18,887,130
	Unknown ..	..	..	37	146	37	146
Totals		36,827	146,385	11,818,221	46,425,629	11,855,048	46,572,014

NOTE.—Gold duty abolished in the South Island on the 31st March, 1891, by "The Gold Duty Abolition Act, 1890."

Department of Trade and Customs,
Wellington, 14th April, 1891.

W. T. GLASGOW,
For Secretary and Inspector.

No. 9.

COMPARATIVE RETURN of the QUANTITY and VALUE of GOLD ENTERED for DUTY for EXPORTATION from NEW ZEALAND for the QUARTERS ended 31st MARCH, 1891, and 31st MARCH, 1890.

DISTRICT OF	QUARTER ENDED 31ST MARCH, 1891.		QUARTER ENDED 31ST MARCH, 1890.	
	Quantity.	Value.	Quantity.	Value.
	Oz.	£	Oz.	£
Auckland	16,591	65,451	9,706	37,533
Marlborough	..	..	3,740	14,953
Nelson	80	320	1,326	4,963
West Coast	20,092	80,362	22,396	89,569
Otago	64	252	21,772	87,484
Totals	36,827	146,385	58,940	234,502

NOTE.—Gold duty abolished in the South Island on the 31st March, 1891, by "The Gold Duty Abolition Act, 1890."

Department of Trade and Customs,
Wellington, 14th April, 1891.

W. T. GLASGOW,
For Secretary and Inspector.

No. 10.

STATEMENT showing the PRICE of GOLD per OUNCE, PRICE charged per TON for CRUSHING QUARTZ or CEMENT, and PRICES charged for WATER per SLUICE-HEAD per WEEK, during the Year ending 31st March, 1891.

Mining District.		Price of Gold per Ounce.	Price charged per Ton for crushing Quartz or Cement.	Price charged for Water per Sluice-head per Week.	Remarks.
		£ s. d.			
AUCKLAND—	North Hauraki	£2 2s. to £3 1s.	8s. to 14s.	..	..
	South Hauraki	£2 10s. to £3 10s.	5s. to 7s. 6d.	£3	40in.
	Ohinemuri	8s. to £2 18s.	5s. to 7s. 6d.	£3	40in.
	Te Aroha	2 14 0	7s. 6d. to 12s. 6d.	..	..
MARLBORO—	Pelorus and Wairau ..	3 16 0	..	..	..
NELSON—	Wangapeka	£3 16s. to £3 18s.	..	..	..
	Charleston	3 19 0	..	£2 15s.	40in.
	Inangahua	£3 18s. to £4 1s.	8s. to 10s.	..	..
	Collingwood	3 13 0	..	..	..
	Westport	3 19 0	..	..	..
	Murchison	£3 15s. to £3 17s.	12s.	..	..
	Lyell	£3 15s. to £3 17s.	12s.	..	..
WESTLAND—	Hokitika and Kanieri Waimea	3 18 0	..	£3	40in.
	Totara and Ross	3 18 0	15s.	£1 10s.	40in.
	Stafford	3 18 0	..	£1 10s.	Per week.
	Greymouth	3 18 0	..	£3	..
	Kumara	3 18 0	..	£2	For 48 hours.
	Ahaura	3 18 0	..	..	..
	Okarito	3 18 0	..	..	..
	Jackson's Bay	3 18 0	..	..	..
OTAGO—	Hindon	3 17 6	10s. to 13s. 6d.	..	..
	Tuapeka	3 15 0	..	£1 4s. to £1 10s.	For 8 hours.
	Dunstan	..	..	..	..
	Longwood	3 10 6	..	£1	40in.
	Orepuki and Roundhill ..	3 18 6	..	£1	40in.
	Arrow (Wakatipu Goldfield) and Queenstown	3 17 6	12s. 6d. to 15s.	..	..
	Mount Ida	3 17 0	..	£1	16in.
	Macrae's, Hyde	..	..	..	..
	Hamilton, Serpentine ..	..	..	..	..
	Maerewhenua	3 15 0	..	£1 6s. 8d.	..
	Cromwell	£2 7s. 6d. to £3 15s.	12s.	5s.	..
	Waikaia	£3 10s. to £3 15s.	..	10s.	For 60 hours.
	Tapanui	3 15 0	..	..	..
	Wyndham	3 15 0	..	..	..
	Roxburgh	3 17 0	12s. 6d.	..	..
	Clyde and Alexandra ..	3 17 0	12s. 6d.	..	..
	Black's	3 17 0	12s. 6d.	£1 10s.	40in.

No. 11.

RETURN showing the AVERAGE PRICES of PROVISIONS and LIVE STOCK for the Year ending 31st March, 1891.

Mining District.	Beer.	Brandy.	Bread—Wheaten.	Butter—Fresh.	Butter—Salt.	Cheese.	Coffee.	Flour.	Grain—Wheat.	Live Stock.					Meat.			Milk.	Rice.	Salt.	Sugar.	Tea.	Tobacco.	Wine.
										Cattle—Horned.	Goats.	Horses.	Sheep.	Swine.	Beef.	Mutton.	Pork.							
	Per. hhd.	Per gall.	Per lb.	Per lb.	Per lb.	Per lb.	Per lb.	Per 100lb.	Per Im. bushel.	Per head.	Per head.	Per head.	Per head.	Per head.	Per lb.	Per lb.	Per lb.	Per qt.	Per lb.	Per lb.	Per lb.	Per lb.	Per lb.	Per gallon.
AUCKLAND—			d.							£		£			d.	d.	d.	d.	d.	d.	d.			
North Hauraki	100/	25/	1½	1/2	/10	/8	2/	15/	..	5–15	10/–20/	3–50	10/–20/	20/–60/	4–6	4–6	6	6	3	1	4–6	1/8–3/	6/6	24/
South Hauraki	90/	28/	1¾	/10	/7	/6	1/8	13/	4/	6	15/	3–50	12/–15/	30/–60/	2–5	4	5	4	3	1	3	1/6–3/	6/	25/
Te Aroha	90/	25/–30/	3–3½	/6	/9	/7–/8	1/8–2/	12/–14/	4/–4/3	50/–190/	15/	2–25	9/–14/6	2/6–80/	3–5	2–5	4–6	3	3½	1½	3–4	1/6–2/6	6/–7/6	10/–35/
MARLBOROUGH—																								
Queen Charlotte Sound																								
Pelorus ..	100/120	25/	2	/8	/7	/6	1/8	12/6	4/6	1–6	20/–120/	4–50	10/–20/	5/–15/	2–5	2–4	2–4	3–6	4	3¾	1¼	3/6	6/	15/
Wairau ..																								
Baton	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sherry and Tadmor ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
NELSON—																								
Wangapeka	..	..	2	/8	/7	/6	2/	15/	..	30/–100/	8/	7–20	15/	10/	3	3	4	4	4	1½	4	2/–3/	6/	..
Collingwood	100/	25/	2	1/	/7	/8	2/	15/–18/	6/	4–7	..	130/–250/	7/–10/	6/–50/	3–4	2–3	5	6	4	2	4	2/9	6/	16/
Inangahua	130/	24/	2½	1/9	1/3	/9	1/9	16/	7/	6–10	30/	10–30	7/6–10/	60/–80/	6	5	8	6	4	2	4	3/6	7/6	20/
Lyell	130/	25/	2¼	1/	1/	/9	1/6–2/	16/	9/	5	15/–20/	10–15	12/	30/	4	3½	6	6	3½	2	4	2/6–3/	6/–7/	18/
Murchison	140/	25/	2½	1/	1/	/10	2/	17/	9/	5	..	5–15	16/	30/	4	4	6	..	4½	2	5	3/	6/6	16/
Westport	100/	25/	2	1/–2/	/9-1/3	/7	1/9	13/–16/	5/–7/	6–10	20/	10–40	16/	20/–60/	6	6	6	6	3	1½	4	2/–3/6	7/	16/–21/
Charleston	130/	26/	2	1/6	1/3	/8	1/9–2/	14/–16/	6/	9	15/	20–30	16/–20/	30/	6	6	8	6	5	1	5	2/–3/6	5/6–7/	16/
Ahaura	105/	25/	2	1/3	1/	/9	1/6	15/	5/6	60/–75/	20/	6–25	13/–16/	110/	5	5	8	4–6	4	2	5	2/6	6/	15/
WESTLAND—																								
Stafford	110/	24/	1½	1/	1/	/8	1/6	13/–14/	5/	150/	20/	5–20	10/–16/	30/	4½	4½	6	6	4	1	4½	2/	6/	17/
Waimea ..	100/	25/	2	2/	1/6	/8	2/	15/–20/	5/	5–10	15/	8–20	12/–18/	20/–60/	6–8	6	8	6	4	2	6	2/–3/	6/–7/	20/
Hokitika and Kanieri																								
Ross	110/	24/6	1½	1/6	1/	/9	1/6	14/	6/	4	5/	10–20	12/	40/–50/	5	5	6	6	4	1½	4	2/	6/	20/–30/
Okarito	60/	39/	6	1/6	1/	/10	2/	15/	7/	6	10/	13	15/	80/	4	4	5	6	5	3	5	2/6	7/6	16/
Kumara	120/	23/6	2	1/6	1/	/10	1/6	18/	6/	7–12	20/	10–30	15/	40/–100/	6	5	8	6	3	2	5	3/	6/–8/	22/
Greymouth	80/–85/	24/–36/	2	1/6	1/-1/9	1/–1/3	1/6–2/	12/–15/	6/–6/6	6–9	10/–20/	7–50	12/–18/	15/–100/	5–6	5–6	6–8	6	3–4	2	4–6	2/–3/6	6/–7/	15/–35/
Jackson's Bay	..	30/	..	1/3	1/	1/	1/6	18/	5/	2–8	..	5–15	20/	20/–100/	4	6	6	6	4	2	4–6	2/6	6/6	..
OTAGO—																								
Hindon	95/–150/	25/	1½	1/2	1/	/8	1/6	15/–20/	4/	3–6	..	7–30	10/	..	6	5	6	4	3	2	4–6	3/	6/6	..
Tuapeka	80/–160/	26/	1½	/9	/8	/6	1/6–2/	10/–11/	4/	50/–140/	..	4–20	1/6–12/	5/–45/	6	3	6	2	3	1½	3¼	2/	5/6	18/–25/
Tapanui	90/	24/	1½	/8	/7	/6	2/	9/	3/6	20/–150/	..	2–20	3/–10/	10/–50/	6	5	6	3	4	1	4	2/6	6/	8/
Cromwell	100/	27/	2	1/3	1/	/8	1/9	10/	3/3	150/	..	7–10	10/	50/	5	4	7	6	4½	2	4	2/–3/	6/	20/
Clyde ..	120/	30/	7	1/3	1/	/6	1/9	14/	4/6	3	..	6–25	3/–20/	10/	6	5	8	5	4	2	4½	3/	7/	18/–30/
Alexandra ..																								
Roxburgh	110/	28/	6	1/	1/	/6	1/6	12/	4/	3	..	5–30	4/–15/	60/	5	4	6	5	3	1½	4	2/6	6/6	20/
Black's	120/	28/	2	1/3	1/	/8	1/9	12/	4/6	85/	..	5–25	3/–15/	20/–100/	6	5	8	6	4	2	5	2/	6/–8/	18/
Queenstown	110/	28/	2	1/3	1/	/9	2/	13/	3/6	190/–200/	..	10–30	5/–15/	20/–60/	6	4	7	6	3	2	4–5	2/–3/	6/	16/–30/
Wyndham	80/	36/	3½–4	/10	/10	/6	2/	12/	2/2-3/6	70/–100/	..	5–12	7/–10/	15/	4–6	3–5	6	4	3	1½	3½	2/6–3/	5/6–7/	30/
Arrow (Wakatipu Goldfield)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Mount Ida ..	90/–120/	27/	1¾–2	1/3	1/3	/10	2/	..	3/3	..	15/	..	..	..	6	4	8	4	5	2	4	2/9	6/–7/	16/
Nenthorn ..																								
Waikaia	140/	28/–30/	2	1/	/10	/8	2/	14/	4/	2–6	..	5–6	4/–7/	15/–20/	4	3	6	4	5	2	6	3/6	6/	20/–30/
Orepuki and Longwood ..	90/	27/	1½	/7	/6	/5	2/	15/	4/	4–6	20/	8–18	9/–14/	30/–50/	5	5	6	3	4	1	4	1/6–3/	6/	24/
Maerewhenua	130/	26/	1½	/10	/10	/7½	1/9	11/	3/8	4	..	14	10/	30/	4	3	4	4	4	2	4	2/6	6/	..

No. 12.

TABLE showing the AVERAGE RATE of WAGES per WEEK for the Year ending 31st March, 1891.

Mining District.	General Managers.	Legal Managers.	Mining Managers.	Engineers.	Engine-drivers.	Stokers.	Blacksmiths.	Carpenters.	Miners.	Labourers.	Boys.	Chinese.	Agricultural Labourers.	Domestic Servants.
AUCKLAND—	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	
North Hauraki ..	£5 to £10	£1 to £2	£3 to £6	£3 to £5	£2 8/ to £3	2 8 0	£2 10/ to £3	£2 8/ to £3	2 8 0	2 0 0	..	..	2 2 0	[8/ to 15/
South Hauraki ..	£250 to £400*	1 0 0	£3 to £6	3 12 0	3 0 0	2 9 0	3 0 0	2 14 0	2 5 0	1 16 0	10/ to 30/	..	£1 10/ to £1 16/	7/ to 10/
Te Aroha	..	1 0 0	4 0 0	..	..	..	3 0 0	3 0 0	2 8 0	1 16 0	10/ to 20/	..	1 10 0	8/ to 10/
MARLBOROUGH—														
Wairau ..	..	1 0 0	3 15 0	..	..	..	3 0 0	3 12 0	2 14 0	2 2 0	0 10 0	..	1 5 0	8/ to 12/
Pelorus ..														
NELSON—														
Collingwood	4 10 0	1 0 0	4 10 0	3 10 0	2 14 0	2 8 0	2 14 0	2 14 0	£2 8/ to £2 14/	2 2 0	..	..	£1 to £1 5/	8/ to 15/
Inangahua	6 0 0	£1 to £3	£5 to £6	4 10 0	3 10 0	3 0 0	4 0 0	4 0 0	3 0 0	3 0 0	2 0 0	..	1 10 0	20/
Charleston	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Westport	..	1 0 0	£4 10/ to £5	..	3 10 0	3 0 0	3 10 0	3 10 0	3 0 0	3 0 0	15/ to 30/	1 10 0	£2 to £2 10/	12/ to £1
Lyell	..	10/ to £2 10/	6 0 0	..	..	..	4 15 0	4 4 0	3 3 0	3 0 0	2 10 0	..	1 5 0	15/
Ahaura	..	..	..	..	..	..	3 12 0	3 12 0	3 0 0	£1 5/ to £3	0 15 0	..	£1 5/ to £1 10/	8/ to 10/
Murchison	..	0 10 0	£5 to £6	..	..	..	3 0 0	3 0 0	3 0 0	2 8 0	1 0 0	..	1 5 0	12/
WESTLAND—														
Waimea and Stafford ..	..	..	3 0 0	..	..	..	3 0 0	3 0 0	2 10 0	£2 10/ to £3	1 15 0	1 0 0	2 10 0	8/ to 10/
Hokitika and Kanieri ..	4 0 0	1 0 0	£4 to £5	5 0 0	3 0 0	..	£3 to £4	4 0 0	3 0 0	3 0 0	1 10 0	1 10 0	1 0 0	10/ to 15/
Ross	..	1 1 0	5 0 0	5 0 0	..	..	4 0 0	4 0 0	3 0 0	3 0 0	2 0 0	2 0 0	..	15/
Kumara	..	£1 to 30/	4 10 0	..	4 0 0	..	4 0 0	4 10 0	3 0 0	3 0 0	1 10 0	1 0 0	3 0 0	19/ to £1
Greymouth	..	1 0 0	£4 to £6	£4 to £5	£3 to £3 10/	£2 5/ to £3	£3 to £3 10/	£3 to £4 4/	£2 10/ to £3	£2 2/ to £3	10/ to 12/	£1 to £1 10/	£1 to £2	..
Okarito & Jackson's Bay	5 0 0	4 0 0	4 0 0	4 0 0	3 0 0	2 10 0	3 10 0	3 10 0	£2 10/ to £3	3 0 0	15/ to 20/	..	£1 10/ to £2	7/ to 15/
OTAGO—														
Hindon	4 0 0	..	4 0 0	3 10 0	3 0 0	..	2 8 0	3 0 0	2 8 0	2 0 0	1 0 0	..	£40 to £50*	£30 to £35*
Tuapeka	£3 to £4	£1 5/ to £2 10/	£3 to £5	£3 to £3 10/	2 10 0	£1 15/ to £2	2 5 0	£2 8/ to £3	2 2 0	£1 16/ to £2 2/	0 10 0	£1 to £1 10/	15/ to £1	12/6
Tapanui	..	..	..	..	..	..	3 6 0	3 0 0	2 8 0	2 2 0	10/ to 15/	15/ to £1	1 6 0	8/ to 10/
Cromwell	5 0 0	£25 p. ann.	4 0 0	3 10 0	3 0 0	2 10 0	2 10 0	3 0 0	£2 8/ to £3	£2 2/ to £2 14/	1 10 0	1 5 0	15/ to £1	6/ to 12/
Clyde ..														
Alexandra ..	5 0 0	12/6 to 30/	4 10 0	3 0 0	2 8 0	2 0 0	3 10 0	3 10 0	0 9 0	0 7 0	0 10 0	1 10 0	£1 to £1 10/	10/ to 15/
Roxburgh ..														
Black's	4 10 0	£50 p. ann.	4 0 0	3 10 0	2 8 0	2 2 0	3 10 0	3 10 0	2 14 0	£2 2/ to £2 8/	1 0 0	1 10 0	£50 p. ann.	7/6 to 12/6
Waikaia	2 10 0	..	2 10 0	3 10 0	2 10 0	..	2 5 0	2 10 0	2 0 0	2 0 0	0 12 0	1 5 0	1 0 0	10/ to 12/
Orepuki and Longwood	5 0 0	£40 p. ann.	3 0 0	..	2 10 0	..	..	2 5 0	2 2 0	1 16 0	0 15 0	1 10 0	15/ to £1	10/
Arrow	5 0 0	1 0 0	5 0 0	3 0 0	3 0 0	3 0 0	3 0 0	4 0 0	3 0 0	2 8 0	10/ to £1	1 16 0	1 0 0	10/ to 15/
Queenstown	6 0 0	1 0 0	5 0 0	4 0 0	3 0 0	2 10 0	4 0 0	4 10 0	3 0 0	2 8 0	10/ to 15/	£1 to £1 10/	£1 to £1 5/	12/ to 15/
Mount Ida	..	..	£3 10/ to £4	..	..	..	3 0 0	£3 to £3 12/	£2 8/ to £2 14/	2 2 0	0 15 0	2 8 0	1 0 0	10/ to 15/
Maerewhenua.. ..	..	..	3 0 0	..	..	..	..	..	2 0 0	2 0 0	..	..	1 0 0	8/
Wyndham	3 0 0	1 10 0	..	2 0 0	3 0 0	..	£2 10/ to £3	2 15 0	£2 5/ to £2 15/	7/6 to 8/6 p.d.	10/ to 15/	..	1 16 0	7/6 to 10/

* Per annum.

No. 13.

NUMBER of MACHINES employed in ALLUVIAL and QUARTZ-MINING, and the VALUE thereof, for the Year ending 31st March, 1891.

Mining District.	Machinery employed in Alluvial Mining.														Machinery employed in Quartz-mining.								Approximate Value of all Mining Plant included in this Return.
	Steam-engines employed winding, crushing, &c.		Puddling Machines.	Whims.	Whips or Pulleys.	Sluices, Toms, and Sluice-boxes.	Water-wheels.	Hydraulic Hose.	Pumps.	Dredges.	Quicksilver and Compound Cradles.	Derricks.	Stamp-heads crushing Cement.	Boring Machines.	Steam-engines employed winding, crushing, &c.		Crushing Machines.	Stamp-heads.	Water-wheels.	Whims.	Whips or Pulleys.	Derricks.	Berdans.	
	No.	Aggregate h.p.													No.	Aggregate h.p.								
AUCKLAND—																								£
North Hauraki ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	15	510	32	463	38	..	..	55	270	82,500
South Hauraki ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	10	225	8	96	4	..	..	..	..	33,000
Te Aroha	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	40	10	..	..	..	40	50,000
Totals ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	25	735	42	599	52	..	..	55	310	165,500
MARLBOROUGH—																								
Wairau ..	4	42	..	..	..	144	22	..	21	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1,550
Pelorus ..																								
NELSON—																								
Sherry and Tadmor	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Baton	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Wangapeka ..	..	..	..	..	..	103	2	1	6	..	..	..	..	..	..	..	1	4	1	..	..	..	..	200
Takaka	..	..	..	..	..	500	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	250
Collingwood ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	20	2	20	1	..	..	..	..	9,000
Inangahua ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	18	363	20	315	17	2	3	..	64	142,330
Charleston ..	..	..	..	..	..	80	6	80	..	1	50	..	30	..	..	..	..	..	..	..	..	..	..	3,000
Lyell	..	..	..	..	..	40	..	20	..	..	..	..	..	..	..	..	6	63	2	..	..	..	..	16,000
Murchison ..	..	..	..	..	..	62	..	22	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	700
Westport	1	15	..	7	..	64	6	40	1	1	..	..	..	..	..	..	3	25	3	..	..	..	..	12,300
Ahaura	2	25	..	..	..	1,500	2	550	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1,000
Totals ..	3	40	..	7	..	2,349	16	713	7	3	50	..	30	..	19	383	32	437	24	2	3	..	64	184,780
WESTLAND—																								
Stafford	..	..	..	..	1	400	1	120	1	..	..	..	..	..	..	..	1	2	1	..	..	..	..	2,450
Ross	5	200	..	..	..	60	..	40	..	2	..	..	..	..	..	..	2	15	2	..	..	..	..	16,000
Hokitika and Kanieri	..	..	..	..	30	80	..	50	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3,000
Greymouth ..	6	87	..	..	..	2,760	2	940	48	1	30	..	..	10	..	..	..	..	..	..	..	..	..	16,000
Kumara	..	..	..	7	20	150	6	92	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3,000
Okarito	2	45	..	..	..	..	2	1	12	2	20	..	..	2	..	..	..	..	..	..	..	..	..	7,500
Totals ..	13	332	..	7	51	3,450	11	1,243	61	5	50	..	..	12	..	..	3	17	3	..	..	..	..	47,950
OTAGO—																								
Tapanui	..	..	..	..	..	10	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	150
Hindon	..	..	..	..	..	26	..	2	..	..	..	..	..	..	2	60	4	20	2	..	..	..	..	8,000
Tuapeka	..	..	..	..	..	500	15	11	30	3	..	..	..	..	..	..	3	25	1	..	..	..	..	9,000
Cromwell	2	20	..	..	..	..	..	50	..	1	..	..	..	..	..	..	4	27	2	..	..	..	..	12,000
Clyde, Alexandra, and Roxburgh	..	..	..	2	2	890	7	12,500	10	13	..	2	..	..	..	..	3	18	1	..	..	..	..	70,800
Black's	..	..	1	2	2	700	3	9,000	5	..	..	..	..	..	..	..	2	14	..	..	..	..	..	40,000
Orepuki and Longwood	2	30	..	..	..	550	1	160	..	..	..	..	..	..	..	..	1	2	1	..	..	..	..	2,500
Waikaia (Switzer's)	1	5	..	..	..	506	6	34	5	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4,000
Arrow	..	..	..	..	..	300	..	60	..	3	..	..	..	..	1	4	4	10	3	..	..	..	..	30,000
Queenstown ..	..	..	..	..	..	450	..	50	..	10	..	..	..	..	1	8	5	70	..	..	..	..	..	80,000
Naseby	..	..	..	..	..	250	..	85	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2,000
Kyeburn and Clarke's	..	..	..	..	..	70	..	50	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3,400
Hamilton's and Sowburn	..	..	..	..	..	65	..	25	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	450
Hyde and Fullerton's	..	..	..	..	..	15	..	10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	200
Macrae's, Strath-Taieri, and Shag Valley	..	..	..	..	..	65	..	15	..	..	..	..	..	..	..	..	3	15	..	..	..	..	..	1,675
Maerewhenua ..	..	..	..	..	..	40	..	40	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	600
Serpentine ..	..	..	..	..	..	20	..	5	..	..	..	..	..	..	..	..	1	5	1	..	..	..	..	1,000
St. Bathan's, Ida Valley, and other lacalities	..	..	..	..	..	120	..	80	..	..	..	..	..	..	..	..	3	30	1	..	..	..	..	1,500
Wyndham ..	3	50	..	..	..	..	..	..	..	3	..	..	..	..	..	..	..	..	..	..	..	..	..	8,500
Totals ..	8	105	1	4	4	4,577	32	22,177	50	34	..	2	..	..	4	72	33	236	12	..	..	..	..	275,775

SUMMARY.

Auckland	..	..	..	..	..	..	..	..	..	..	..	..	..	..	25	735	42	599	52	..	..	55	310	165,500
Marlborough ..	4	42	..	..	..	144	22	..	21	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1,350
Nelson	3	40	..	7	..	2,349	16	713	7	3	50	..	30	..	19	383	32	437	24	2	3	..	64	184,780
Westland	13	332	..	7	51	3,450	11	1,243	61	5	50	..	..	12	..	..	3	17	3	..	..	..	..	47,950
Otago	8	105	1	4	4	4,577	32	22,177	50	34	..	2	..	..	4	72	33	236	..	..	..	..	..	275,775
Totals ..	28	519	1	18	55	10,520	81	24,133	139	42	100	2	30	12	48	1,190	110	1,289	79	2	3	55	374	675,555

No. 14.

TABLE showing approximately the NUMBER, DESCRIPTION, and VALUE of the WATER-RACES, TAIL-RACES, DAMS, RESERVOIRS, and GROUND-SLUICES in Operation during the Year ending 31st March, 1891.

Mining District.	Water-races.				Tail-races.		Dams.		Reservoirs.		Ground-sluices.		Approximate Total Cost.
	No.	Length in Miles.	No. of Sluice-heads.	Approximate Cost.	No.	Approximate Cost.	No.	Approximate Cost.	No.	Approximate Cost.	No.	Approximate Cost.	
AUCKLAND—				£		£		£		£		£	£
Hauraki North ..	12	5	28	2,000	1	70	2	135	..	..	..	..	2,205
Hauraki South ..	19	18	113	20,000	4	2	5	800	..	..	..	..	20,802
Te Aroha ..	6	5¾	21	8,200	..	..	..	..	..	..	..	..	8,200
Totals ..	37	28¾	162	30,200	5	72	7	935	..	..	..	..	31,207
MARLBOROUGH—													
Pelorus	86	60	146	10,000	60	3,000	25	500	16	360	..	..	13,860
NELSON—													
Wangapeka ..	55	95	241	59,212	36	320	15	30	3	15	..	..	59,577
Collingwood ..	96	113½	445	62,615	48	545	58	1,605	..	..	..	..	64,765
Inangahua ..	169	149	1,530	44,794	388	21,988	447	16,839	..	..	..	..	83,621
Charleston ..	200	100	200	20,000	220	8,500	450	11,000	1	3,000	80	3,000	45,500
Westport ..	139	215	1,050	16,100	83	8,300	159	5,200	..	..	..	..	29,600
Lyell	33	24	117	3,696	10	368	20	1,206	..	..	..	..	5,270
Murchison ..	90	57½	258	5,206	41	1,453	39	1,129	..	..	..	..	7,788
Ahaura	606	582¾	2,123	104,777	629	63,800	602	18,318	..	..	..	..	186,895
Totals ..	1,388	1,366¾	5,964	316,400	1,455	105,274	1,790	55,327	4	3,015	80	3,000	483,016
WESTLAND—													
Hokitika & Kanieri	300	160	240	14,200	189	1,560	175	1,400	..	..	..	..	17,160
Ross	136	99	241	25,000	163	1,800	56	1,300	23	1,500	50	600	30,200
Kumara ..	193	105	380	25,000	186	15,000	60	4,500	11	7,000	50	800	52,300
Greymouth ..	900	740	2,019	50,000	687	8,550	800	7,500	..	..	43	972	67,022
Jackson's Bay ..	..	..	..	..	..	..	..	..	..	..	..	..	..
Okarito	42	41	249	2,270	21	120	12	240	..	..	..	..	2,630
Stafford	190	150	400	12,000	120	9,600	200	4,000	..	..	..	..	25,600
Totals ..	1,761	1,295	3,529	128,470	1,366	36,630	1,303	18,940	34	8,500	143	2,372	194,912
OTAGO—													
Hindon	47	64	150	6,557	17	700	36	1,025	..	..	56	250	8,532
Tuapeka	275	736	1,593	14,720	348	5,220	249	4,980	..	..	..	..	24,920
Tapanui ..	4	5	10	110	1	20	2	40	..	..	..	..	170
Clyde & Alexandra	135	582	514	25,000	94	7,850	58	3,500	..	..	..	..	36,350
Black's	93	417	393	34,716	101	2,500	81	9,000	..	..	..	..	46,216
Arrow	100	200	250	15,000	200	500	30	1,500	30	..	..	..	17,000
Roxburgh ..	130	274	885	26,462	94	9,300	59	3,950	1	850	15	1,500	42,062
Cromwell ..	327	923	1,101	64,610	159	7,950	105	7,350	..	..	..	..	79,910
Waikaia ..	168	393	627	16,150	295	3,515	162	3,851	..	..	38	275	23,791
Orepuki and Longwood	250	280	555	16,500	120	6,000	128	1,580	..	..	130	2,500	26,580
Wyndham ..	27	20	110	3,400	16	2,527	26	1,634	..	..	..	..	7,561
Queenstown ..	120	200	600	65,000	150	5,000	40	1,700	11	550	..	..	72,250
Naseby	65	290	208	46,000	..	..	..	..	..	..	..	..	46,000
Kyeburn & Clarke's	85	300	315	10,300	..	..	..	..	..	..	..	..	10,300
Hamilton's and Sowburn	32	116	20	7,300	..	..	..	..	..	..	..	..	7,300
Hyde & Fullerton's	18	90	64	10,150	..	..	..	..	..	..	..	..	10,150
Macrae's, Strath-Taieri, and Shag Valley	31	50	55	4,150	..	..	..	..	..	..	..	..	4,150
Nenthorn ..	..	..	..	..	..	..	..	..	..	..	..	..	..
Serpentine ..	36	88	93	5,000	..	..	..	..	..	..	..	..	5,000
Maerewhenua ..	21	175	49	15,500	40	1,000	30	2,000	..	..	..	..	18,500
St. Bathan's and Ida Valley	96	320	350	32,400	..	..	..	..	..	..	..	..	32,400
Totals ..	2,060	5,523	7,942	419,025	1,635	52,082	986	42,110	42	1,400	239	4,525	519,142

SUMMARY.

Auckland	37	28¾	162	30,200	5	72	7	935	..	..	..	..	31,207
Marlborough ..	86	60	146	10,000	60	3,000	25	500	16	360	..	..	13,860
Nelson	1,388	1,366¾	5,964	316,400	1,455	105,274	1,790	55,327	4	3,015	80	3,000	483,016
Westland	1,761	1,295	3,527	128,470	1,366	36,630	1,303	18,940	34	8,500	143	2,372	194,912
Otago	2,060	5,523	7,942	419,025	1,635	52,082	986	42,110	42	1,400	239	4,525	519,142
Totals ..	5,332	8,273½	17,743	904,095	4,521	197,058	4,111	117,812	96	13,275	462	9,897	1,242,137

No. 15.

RETURN showing the REVENUE and EXPENDITURE on account of CONSTRUCTED WATER-RACES maintained by the Government, from 1st April to 30th September, 1890, and from 1st October, 1890, to 31st March, 1891.

Name of Race.	1st April to 30th September, 1890.				1st October, 1890, to 31st March, 1891.				Balance due on Water Account.
	Revenue.		Expenditure.		Revenue.		Expenditure.		
	Water sold.	Actual Receipts.			Water sold.	Actual Receipts.			
	£ s. d.	£ s. d.	£ s. d.		£ s. d.	£ s. d.	£ s. d.		£ s. d.
Nelson Creek ..	325 5 10	325 5 10	449 13 1		244 19 2	244 19 2	490 6 7		..
Waimea-Kumara ..	3,650 19 11	3,004 9 3	771 16 9		3,928 11 1	3,988 13 11	994 7 6		114 18 7
Kumara Sludge-chan'l	841 19 11	567 14 6	980 9 1		*	275 12 6	127 12 0		..
Argyle, Charleston ..	109 17 9	109 17 9	293 7 3		32 3 1†	32 3 1	342 11 3		..
Mikonui	25 0 0	25 0 0	..		25 0 0	..	..		..
Totals ..	4,953 3 5	4,032 7 4	2,495 6 2		4,230 13 4	4,541 8 8	1,954 17 4		114 18 7

* Channel handed over to Trustees. † For month of October only, the race being handed over to the Buller County Council on the 1st November, 1890.

No. 16

RETURN of CASES in the WARDENS' COURTS, and COSTS AWARDED, for the Year ending 31st March, 1891.

Mining District.	Number of Mining Disputes adjudicated on.	Aggregate Amount of Value.		Amount of Costs awarded.	Cases wherein Judgment has decreed Specific Performance.
		Claimed.	Recovered.		
AUCKLAND—		£ s. d.	£ s. d.	£ s. d.	
North Hauraki	85	698 0 9	647 0 1	109 5 6	..
South Hauraki	38	768 18 8	..	78 2 0	..
Te Aroha	..	..	..	..	..
MARLBOROUGH	27	854 0 6	231 0 0	43 9 0	..
NELSON—					
Collingwood	4	30 0 0	30 0 0	19 6 0	1
Inangahua	7	73 5 0	29 0 0	16 3 0	..
Lyell	1	..	..	..	..
Westport	4	..	..	5 13 0	..
Charleston	3	..	..	2 1 0	..
Ahaura	14	250 0 0	89 11 0	81 17 0	..
Murchison	..	..	..	..	..
WESTLAND—					
Kumara	15	213 0 0	..	13 13 0	..
Greymouth	15	70 0 0	25 0 0	37 0 0	..
Hokitika and Kanieri ..	18	52 4 0	11 0 0	12 0 0	..
Waimea					..
Stafford	1	..	..	4 10 0	..
Jackson's Bay	..	..	..	..	..
Ross	8	26 0 0	7 0 0	4 1 0	1
Okarito	1	3 0 0	0 1 0	0 6 0	1
OTAGO—					
Tapanui	..	..	..	..	..
Hindon	4	50 0 0	..	4 1 0	3
Tuapeka	21	..	..	20 5 0	..
Cromwell	19	151 0 0	32 0 0	51 3 0	3
Roxburgh	16	100 0 0	5 0 0	48 16 0	..
Black's	9	5 0 0	..	6 2 0	..
Clyde and Alexandra ..	29	5 0 0	..	30 15 6	..
Waikaia	7	..	..	5 5 0	..
Orepuki and Longwood ..	20	165 0 0	20 1 0	40 18 6	..
Arrow (Wakatipu Goldfield) ..	19	25 0 0	..	11 9 0	..
Queenstown	25	88 0 0	..	26 13 6	..
Mount Ida	42	775 0 0	50 0 0	23 3 0	2
Maerewhenua	15	72 10 7	25 1 8	13 10 0	..
Wyndham	3	..	..	..	..
Totals	470	4,514 19 6	1,201 14 9	709 8 0	11

No. 17.

RETURN of the NUMBER of MINING LEASES or LICENSES and AGRICULTURAL LEASES in Force on the 31st March, 1890, the EXTENT of GROUND LEASED or held under LICENSE, and RENTAL per ANNUM.

Mining Leases.								Agricultural Leases.							
Mining District.	No.	Gross Acreage. A.	R.	P.	Rental per Annum. £	s.	d.	Mining District.	No.	Gross Acreage. A.	R.	P.	Rental per Annum. £	s.	d.
AUCKLAND—								AUCKLAND—							
Hauraki North ..	143	2,393	0	21	1,413	10	0	Hauraki, Ohinemuri	54	2,821	2	32	219	10	0
Hauraki South ..	..	..			..										
Te Aroha ..	16	491	3	9	327	15	0								
MARLBOROUGH—								MARLBOROUGH—							
Wairau and Pelorus	37	1,418	0	5	465	10	0	Marlborough ..	2	72	3	8	3	13	0
NELSON—								NELSON—							
Collingwood ..	17	268	3	28	175	10	0	Collingwood ..	..	..			..		
Inangahua ..	62	885	3	26	925	0	0	Inangahua ..	1	17	2	11	1	16	0
Charleston ..	11	64	0	37	73	0	0	Charleston ..	6	61	0	19	5	10	0
Ahaura	4	81	0	10	50	0	0	Westport ..	5	381	0	12	40	8	6
Westport	7	67	0	4	65	0	0	Lyell	4	75	1	24	7	12	0
Lyell	6	76	2	1	79	0	0	Murchison ..	..	..			..		
Murchison ..	1	15	2	6	16	0	0	Ahaura	3	219	3	17	22	2	0
Owen's	..	..			..			Hokitika & Kanieri	..	..			..		
WESTLAND—															
Jackson's Bay ..	..	..			..										
Okarito	5	350	0	0	113	0	0								
Hokitika and Kanieri	6	188	0	0	102	15	0								
Kumara	12	343	0	21	175	0	0	WESTLAND—							
Stafford	15	452	0	0	196	10	0	Greymouth ..	8	241	2	8	22	14	0
Greymouth ..	44	1,718	2	6	415	0	6	Kumara	1	24	3	13	3	2	6
Ross	42	1,943	0	0	693	5	0	Ross	..	..			..		
OTAGO—															
Waikaia	..	..			..										
Cromwell ..	..	..			..			OTAGO—							
Hindon	31	944	0	0	444	10	0	Waikawa ..	..	..			..		
Tuapeka	56	1,971	2	38	959	17	6	Tuapeka ..	159	46,411	2	27	2,536	16	0
Black's	15	318	0	0	193	15	0	Cromwell ..	18	2,328	3	1	292	2	6
Clyde and Alexandra	12	257	0	0	127	5	0	Black's	12	233	0	0	17	7	6
Roxburgh ..	28	950	0	0	450	5	0	Clyde, Alexandra, and Roxburgh	..	..			..		
Naseby	..	..			..			Mount Ida District	26	2,617	0	0	247	0	0
Arrow (Wakatipu Goldfield)	..	..			..			Arrow (Wakatipu Goldfield)	8	524	2	12	65	11	3
Queenstown ..	..	..			..			Queenstown ..	20	308	2	1	39	12	6
Maerewhenua ..	1	5	0	0	2	10	0	Hindon	6	135	2	0	8	12	3
Tapanui	..	..			..			Maerewhenua ..	20	434	0	0	43	8	0
Mount Ida ..	84	1,597	0	0	917	0	0								
Totals ..	655	16,799	2	12	8,380	18	0	Totals ..	353	56,908	3	25	3,576	18	0

H. J. H. ELIOTT,
Under-Secretary of Mines.

APPENDIX II.

COAL-MINES OF NEW ZEALAND.

NORTH ISLAND.

Mr. H. A. Gordon, F.G.S., Inspector of Mines, to the Under-Secretary of Mines.

Sir,— Mines Department, Wellington, 1891.

I have the honour, in compliance with section 59 of "The Coal-mines Act, 1886," to forward, for the information of the Hon. the Minister of Mines, my annual report on the coal-mines in the North Island, namely:—

Kawakawa District.

1. *Kawakawa Mine.*—The workings in this mine during the whole of last year have been confined to taking out pillars, so that they are now considerably circumscribed, but there is still a considerable quantity of coal likely to be got before the mine is abandoned. This mine has been very carefully worked. The pillars are in most instances, taken completely out, and log-cribbing is used to support the roof. Everything has been done to comply with the provisions of the Act. The pillar-workings are likely to occupy another twelve months before they are all taken out. The daily output at the time of my visit was about 100 tons. There are forty miners employed in the workings and thirty men on the surface, employed in connection with the haulage of coal from the incline, and the workshops, including engineers, engine-drivers, and manager. The output last year was 26,624 tons.

Whangarei District.

2. *Kamo Mine.*—The ventilation in this mine is slightly improved since my last visit, but it is still yet very defective. A new air-shaft has been sunk to the level of the workings 244ft. It is 9ft. by 6ft. in the clear inside the timbering. This shaft should give good ventilation to the workings, but the return air-way has not a clear entrance into the air-shaft, and there is a considerable quantity of water coming down the shaft, which requires to be cut off, as this tends to make it a down-cast shaft instead of an up-cast. The quantity of air circulating in the mine in the main air-way leading from the down-cast shaft measured 4,700 cubic feet per minute, and there were forty-four men and one horse underground. This quantity of air complies with the Act, but very little attention has been paid to its circulation through the working-faces. On pointing out the defective system to the manager, Mr. Redshaw, he promised to have it at once remedied. In other respects the provisions of the Act were fairly complied with.

On the 7th November a fatal accident occurred at this mine, but no blame could be attached to any one. A miner, A. McGregor, came to work in the morning as usual, and from the evidence given at the Coroner's inquest, and information obtained by me at the mine, it appears he opened the gate at the mouth of the shaft and jumped down to the bottom, over 200ft., and was killed instantaneously. The manager's attention was drawn to the condition of the cages; there being neither safety-hooks nor safety-catches used, although on my former visit the previous manager, Mr. Geary, assured me at that time that he was getting a safety-cage constructed. Mr. Redshaw promised to have this done at once. There are thirty miners employed in hewing coal, fourteen men, exclusive of two deputies, underground in connection with the haulage to the shaft, and thirteen men on the surface, making a total of fifty-seven men. The output from this mine for the year ending the 31st December last amounted to 19,133 tons.

3. *West Bryan Mine.*—This is a new mine situated at Hikuranga. It was opened out during the strike of the coal-miners. The coal is much superior to that from the Kamo, being semi-bituminous, resembling the coal found in the Kawakawa Mine. The coal was first found close to the surface, but the proprietor, Mr. Charles Smith, who is also the manager, constructed an incline and put in a main level for about 150ft., working the coal by bord and pillar. There is very little cover on the top, but the bords are driven very narrow, and the roof, so far as the workings are in, is very good. The attention of the manager was called to the fact that all coal-mines where over four men are employed required a certificated manager, and that the provisions of the Coal-mines Act must be complied with. Mr. Smith pleaded ignorance of the conditions under which coal-mines had to be worked, but he was anxious to do anything required by the Act. He has since made application for a mine-manager's certificate. He first opened up and managed the Kamo Coal-mine, but not being actual manager of a mine at the the time "The Coal-mines Act, 1886," came into force, he did not apply for a service certificate of competency. There were at the time of my visit eight men employed in the mine, and one man and boy on the surface, the average output being 50 tons per day. The coal was carted from the mine in drays and wagons seven miles to the railway at Kamo. The total output for the year was 2,533 tons.

4. *Walton and Graham's Mine, Hikiranga.*—This mine, or it may be so far termed a quarry or open cutting, was opened by Mr Thomas Graham, formerly manager of the Whauwhau Mine at Whangarei. The coal is similar to that in the West Bryan Mine, being semi-bituminous and of excellent quality. The seam is fully 7ft. thick, and there is about 7ft. of stripping on the top. The output from this cutting at the time of my visit was 30 tons per day, six men being employed. The total output for the year was 1,210 tons.

There is a considerable field of coal at Hikuranga, easily worked; but it will scarcely be possible for the proprietors to compete with coal from the mines at Kamo and Kawakawa, as the cost of transit by drays and wagons to the railway is considerable; but if the Kamo Railway were extended, or a tramway laid down, there is little doubt but the coal from this locality would find a ready market, and more mines would be opened up. A railway to this field would also, by extending it a further distance of five miles, be the means of getting out the kauri timber from the Puhipuhi Forest.

WAIKATO DISTRICT.

5. *Waikato Mine.*—The workings in this mine are confined to main headings and bords. As stated in my previous report, the mine is not systematically laid out, but the workings are carried on with due regard to safety, and the provisions of the Act are complied with. There were at the time of my visit twenty men employed underground and eleven men on the surface, and the average output was about 30 tons per day, the total output for the year being 8,653 tons.

6. *Ralph's Taupiri Mine.*—This is the mine that was formerly worked by the Taupiri Extended Company. Their lease expired in April last year, and Mr. Ralph, the proprietor, has been carrying on operations since then, Mr. William Collins being the manager. I have on several occasions had to order the withdrawal of the men from this mine on account of the dangerous nature of the workings when the pillars were being taken out; and on my last visit I called the manager's attention to the unsafe state of one part of the mine where the pillars were being withdrawn. The manager at once ordered the men to stop further work, and stated that it was the intention to entirely suspend operations in the old workings and open up new workings from a dip-incline then in course of contruction. On examining this incline I found it was constructed for some distance and well-timbered; but at the bottom of it the heading was full of water, and I observed the timber had been lowered. On calling the manager's attention to this, he informed me that the men had left off working in the heading until the engine and boiler were erected, but as soon as work was resumed the timber would be taken out and reset in proper position The heading was going through sandy ground, and, when once below water-level, it would require to be carefully proceeded with; from my knowledge of constructing adits through this class of ground there is no danger so long as the face, sides, and bottom are close slabbed, the timber carefully set in position, and each set with cup-pieces tied to one another. The timber, so far as the heading was constructed, at the time of my visit, with the exception of some few sets below the water-level, was well fixed fn position, but not braced. There were fourteen men employed in the underground workings and five men on the surface, and the total output for the year was 9,108 tons.

A serious accident occurred in the incline-dip on the 22nd December, whereby five men lost their lives—namely, John Tracey, John Casby, Alexander Harris, and James Smith, and Samuel Hyndman was also fatally injured. The men were engaged at the bottom of the incline getting ready to place a set of timber in. The floor being of a soft character the false set shifted, and the main sets not being properly stayed, the end set of lathes in breaking down made six cap-pieces come down one after another, falling on the four men before they could get out. Samuel Hyndman was injured in trying to rescue Casby and Harris. Instructions were issued to prosecute both the contractors and manager for negligence in not properly securing the timber as it was put in, resulting in a conviction in both cases. The following is a subsequent report from Mr. G. Wilson, the local Inspector of Mines:—

"I inspected this mine with Mr. H. A. Gordon on the 12th November, 1890. The mine was worked by the lessees, the Taupiri Extended Company, up to the 27th March last, and from that time until the end of the year by Ralph Brothers. The chief work consisted of drawing pillars, which was continued until it was dangerous. Mr. Gordon whilst at the mine on the 12th November last caused the manager to cease operations on the west side of the incline. Work was still continued on the eastern side until the end of the year, when, on my recommendation, the manager stopped all work, and abandoned this part of the mine. A new incline, which had been commenced by the previous lessees, was continued by Ralph Brothers, the work being done by contract.

"On the 11th November last Mr. Gordon and myself visited this incline or dip, but at that time no work was being carried on, and the water was up to within about 100ft. of the mouth. The ground through which the incline was made required to be close timbered, as it consisted of sandy drift and soft sandy fireclay. The timber used for the sets was sawn kauri—cap-pieces, 10in. by 7in., 10ft. long; legs, 6in. by 6in., 6ft. long; and sole-pieces 9in. by 2in., 11ft. long. The sets were placed 4ft. apart from centre to centre, and sheathed with laths or slabs 9in. by 2in., 4ft. 6in. long, also of sawn kauri timber. Sinking this incline was subsequently carried on, a pulsometer being used for pumping.

"A very serious accident happened on the 22nd December. The men were engaged at the bottom of the incline in getting ready to put in a main set of timbers, when the false set which was in use gave way through being placed on a soft bottom. The false set giving way, caused the cap-pieces on the first main set behind to topple off the legs, and allow the roof-slabs to fall, which had the effect of dislodging the cap-piece on the second set. The third, fourth, fifth, and sixth cap-pieces were also dislodged in the same way, allowing all the roof-slabs and the clay above to fall. Four men named John Tracy, John Casby, Alexander Harris, and James Smith, were entombed. Great exertions were made to save the lives of Casby and Harris, who had both been caught by the last cap-piece falling, but heavy falls of clay continued, which rendered it impossible to extricate them, and their bodies were not recovered untill the morning of the 24th. The bodies of Smith and Tracy were not got out until the 25th. A miner named Samuel Hyndman was fatally injured whilst endeavouring to rescue Casby and Harris. I was present at the mine on the 24th, and attended the inquest, which finished on the 31st December. The Coroner's jury returned a verdict of accidental death, and that no one was to blame; but subsequent proceedings under subsection (9) of

section 26 of "The Coal-mines Act, 1886," have resulted in a conviction for negligence against two of the contractors, James McLellan and John Kay, whilst a charge of negligence under section 46 against the manager, William Collins, is still *sub judice*."

7. *Taupiri Extended Company's Mine.*—The mine is now getting opened out to such an extent that a large output could be made if there was a market for the coal. The workings are carried on with bords and pillars. The former is taken out 14ft. wide, and the latter is left 24ft. thick, but, owing to the very uneven floor, the bords are started away at all angles, so that there is no regularity in the thickness of the pillars, there being so many acute angle corners. The workings are carried on with due regard to the safety of the workman, and the ventilation is fair. The manager's attention was called to section 35 of "The Coal Mines Act, 1886," and section 7, subsection (9), of the Amendment Act, 1890, which provide for two distinct openings to the surface being made within twelve months after commencing work. Eighteen months was allowed for this to be done by the Act of 1886, but the Amendment Act of 1890 reduced the time to twelve months. The manager stated that cast-iron cylinders had been ordered from England, and as soon as they arrived sinking a new shaft would be commenced. The workings were commenced in this mine on the 20th March, 1890, and eighteen months from that date will have to be allowed, as it would be unfair to the company to enforce the conditions of the Amendment Act, seeing that they were under the impression, and had made arrangements to comply with the provisions of section 35 of the principal Act.

The ventilation is produced by a fan 36in. in diameter, making 1,200 revolutions per minute. This fan, according to measurement by my anemometer, produces an average of 5,130 cubic feet of air per minute, the number of men employed below ground being forty-six. This gives 111 cubic feet of air per minute to each man employed, and there are fourteen men employed on the surface. The winding is done by a pair of steam-engines, with cylinders of 18in. in diameter and 4ft. stroke, having a winding-drum 10ft in diameter, steel-wire round ropes being used for haulage. Safety-cages are used, and fences with gates around the pit's mouth, but there was no fence around the outside of bank-head or brace; on the manager's attention being drawn to this, he at once promised to have it done. Report-book is kept, and plan was made up to date. The manager, Mr. W. Tatley, seemed anxious to do everything requisite for the safety of the workmen, and to comply with the provisions of the Act. The average output from this mine at the time of my visit was about 130 tons per day, the total output for the past year having been 27,180 tons.

8. *Taupiri Reserve Mine.*—The whole of the workings in this mine are carried on under Lake Kimihia. The main headings are constructed 8ft. 3in. wide and from 6ft. to 7ft. 6in. high, whilst the bords are taken out 14ft. wide, leaving pillars 18ft. thick. This mine is opened out and worked more systematically than any other mine in the Waikato district, and every care seems to be taken as regards safety. As the workings are all under the lake, and there is known to be a sandy roof over the coal, I suggested to the manager the necessity of having the pillars a little thicker, as after a time the coal crumbles down from the sides, thereby reducing their thickness. He agreed to have them 21ft. wide, which will be sufficient. In order to insure a good roof, from 3ft. to 4ft. of coal is always left in the roofs of the bords and headings. There are thirty-four men employed below ground and ten men on the surface. The ventilation was good, there being, according to the anemometer, 4,176 cubic feet of air passing through the air-way, which would give an average of 139·2 cubic feet per minute for each man working in the mine. Plan was made up close to date, report-book kept, and the whole of the provisions of the Act fully complied with. The output from this mine last year was 13,723 tons.

9. *Miranda Mine.*—There is only a small amount of work done at this mine, there being at the time of my visit only five miners employed in hewing coal, three men on the surface, and two engine-drivers. The workings are carried on in a safe manner, and the ventilation is good. Daily report-book is kept, and plan of the workings. Since my last visit a pump has been placed in the shaft to lift the water in lieu of a tank which was formerly used, and the mine is in good working order. The output is variable, depending on the local demand, but averaging about 505 tons per month, the total output for last year being 6,065 tons.

Mokau District.

10. *Mokau Coal Company's Mine.*—This mine is situate on the northern side of the Mokau River, about twenty-two miles up from its mouth. The tide comes up this river for about twenty-four miles, and small steamers, carrying from 25 tons to 100 tons of coal, go up to the mine. The coal-seam crops out about 50ft. above the ordinary water-level of the river. An adit-level is constructed from the side of the hill for about 7 chains before hard coal is met with. As soon as this class of coal is reached the workings are carried forward in a face for a width of from 40ft. to 50ft., having the main roadway in the centre, and the roof shored up with props, or what are termed "sodgers." The mine is not opened out in a manner that will either be advantageous to the company or with a due regard to the safety of those employed therein. Indeed, if the workings were allowed to proceed in the same manner as heretofore, a collapse might take place at any time. The company has been written to concerning this, and requested to have the workings carried on in a proper manner. The ventilation at the time of my visit was also very defective, and would always be so if the same system of working the coal were allowed. In placing the anemometer in the main air-way there was not sufficient current to make it revolve. The company's attention has also been directed to this, and that there is no certificated manager in charge of the mine. A copy of the Coal-mines Act has been forwarded to the secretary of the company, with instructions to comply with the provisions of the Act.

The coal found at Mokau is what may be termed a brown coal, having thin veins of semi-bituminous coal intersected through it, but it contains a good deal of sulphur. It is of a superior class to the Waikato coal, and were it not for the amount of sulphur it contains it should be largely

used for local consumption; but it will never be largely used for marine purposes. The seam is about 8ft. in thickness, having a band of shale in the centre from 2ft. to 3ft. in thickness. This shale is at present all stowed in the old workings, but as there is a great danger of spontaneous combution taking place in this material, it would be much safer to have it cleared out of the mine. At the time of my visit there were eight men employed in the mine. The coal is hauled out by a horse, and dumped into a staith constructed at the side of the river, where the vessels can lie alongside and take the coal from the staith into their holds. The output from the mine during last year was 1,188 tons. HENRY A. GORDON, Inspector.

MIDDLE ISLAND.

Mr. N. D. COCHRANE, Inspector of Mines, to the UNDER-SECRETARY of Mines, Wellington.

SIR,— Westport, 31st March, 1891.

I have the honour, in compliance with section 59 of "The Coal-mines Act, 1886," to report as follows for the information of the Hon. the Minister of Mines:—

Shag Point Colliery, Palmerston (12th November, 1890).—The workings from the main shaft southwards are entirely confined to taking out pillars in the neighbourhood of the old drive. In one part of the latter, which had been cut across, the floor could be seen heaved close against the roof, a fact worthy of notice in considering worked-out areas. To the north of the shaft a dip-drive extended seawards in the upper part of the upper seam, with bords running off on each side. This area had been partly flooded for about a fortnight, but at the time of my visit had been pumped dry, except at the foot of the dip. The water was rising in the floor from the lower part of the seam, and tasted brackish. The volume of air was sufficient in the aggregate but poor at the faces, and the temperature warm. A brick wall, with stone behind, was being built at the shaft as a protection from the fire which existed in that vicinity, and this will probably effectually solve that difficulty. Some two months previously the dam near the shaft had been removed, as Mr. Williams found he could cope with the water so as to admit of the workings on the south side of the shaft being resumed. Reports kept. Plan not dated, but a new survey to be made shortly, when this will be seen to. On the 11th December I revisited the mine in company with Mr. Inspector Gow. Found that the water had risen in the workings on the north side of shaft, but this, we were informed, was owing to repairs to boiler lessening supply of steam. A leakage of steam into intake, which I had formerly pointed out, had been remedied. The air was improved, and a survey had been made the preceding day. The upper seam workings are not to be continued further seaward. The workings from Boat Harbour had been resumed. They employ only a few men, and are in the lower seam, from which a stone mine is being driven to cut the fault; and as the dislocation is probably not a large one, a landward coal-bearing area will likely be developed.

Kaitangata (No. 2) Colliery, Kaitangata (19th November, 1890).—In the north level the upper part of the seam is beginning to be worked. Air sufficient, but slightly warm in the upper side. The vitiated air from this section was mixing with the current which supplied the men in the new mine workings, but I found on pointing this out that steps were already in progress to have it obviated. In the latter section gas was present in one place which was posted "Danger" and properly barred. In the workings on the south side an important change in the dip occurs, forming an anticline, and proving the conformity of the measures with those on the coast. In this section the roof flakes off at places, but the timbering is sufficient. Air fresh. The total volume of air I measured as 23,000 cubic feet per minute. Reports and register kept, plan up to date, and the Act generally well observed.

Nightcaps (No. 1) Coal-mine (21st November, 1890).—Not working for some months past. No. 2.—Only one man working, although five men are usually employed, chiefly in taking down head-coal. The mine was in good order, having an ample current of air and sufficient timber. A copy of the Act and special rules were at mine mouth. The workings are likely to become more extensive, as the No. 4 mine, which supplies most of the coal at present, is nearly worked out. With this in view a stone-mine is being driven to the dip of the extremity of the present workings to tap another seam said to be 10ft. thick. No. 4 mine.—This is an open-cast working employing twenty-two men, but likely to be soon exhausted if the demand continues good.

ACCIDENTS.

1. *Nightcaps No. 4 Mine.*—On the 16th October Daniel Birrell, aged fourteen, came suddenly from behind a heap of stripping at the time a shot was being fired, and was struck on the forehead. He died the following day.

2. *Coalbrookdale Colliery.*—On the 4th December Alexander Tait accidentally fell over a retaining-wall at the middle brake on the Westport Coal Company's incline. He received injuries from which he died the same night. I have, &c.,

The Under-Secretary, Mines Department, Wellington. N. D. COCHRANE, Inspector.

Mr. J. Gow, Inspector of Mines, to the UNDER-SECRETARY of Mines, Wellington.

"THE COAL-MINES ACT, 1886."

SIR,— Dunedin, 14th March, 1891.

I have the honour, in compliance with section 59 of "The Coal Mines Act, 1886," to make the following report for the information of the Hon. the Minister of Mines:—

The present report deals with the period from the 14th June, terminating on the 31st December last, there is therefore less than seven months to be considered. During this period the report will comprise all that I consider worthy of notice regarding the 110 mines of various kinds inspected by me during that time. As there are many other mines I did not have time to visit, I shall not on this occasion refer to them.

I think it my duty to call your attention to the difficulty experienced in obtaining the statistics which by section 60 of the Act are due on the 1st March. On the 7th and 8th January I forwarded to every mine a circular and return-form with an addressed envelope. Notwithstanding all this trouble, forty-three of the 116 had not made this return when they were legally due. I then posted a fresh batch of forty forms, of which there are still ten not returned.

WESTPORT MINES.

Waimangaroa Mine, Westport (21st August).—This mine is very faulty in the present workings and not easily followed. Some prospecting is going on from the main level to the westward, and also in the dip to the north. The working-faces are securely timbered where the coal over head is soft. It is intended to shortly drive another tunnel some depth below the present one to further open up the mine. A main-level tunnel is being put in on the opposite side of the Waimangaroa Stream to test the value of that part of the lease.

Coalbrookdale Colliery, Westport (22nd August).—I visited all the working-faces throughout the mine, and find the mine well ventilated. In parts of the mine the roof requires much attention and timbering to make it perfectly safe, and I am pleased to see that the timber is not spared in order to be on the safe side. The hauling appliances are very complete. One of the travelling-ropes is about worn out, but there is another on the ground ready to replace the old one. The Act was well observed.

I again visited the mine on the 5th October, and interviewed the manager to ascertain what precautions he had taken to prevent possible accidents when new men, perhaps strangers to the work, were employed. Mr. Brown informed me that these contingencies had been duly considered and every precaution taken. Extra axe-men and extra gangs of timber-men were put on and distributed all through the workings to see that the mine was made secure.

Mokihinui Coal-mine, Mokihinui (23rd August).—The seam, 23ft. thick, is exposed by a large open cut in the hill side. It is said this seam is to be seen on the opposite side of the hill, which is 10 chains through. In the open cut there is a very large tunnel driven in a short distance, which has supplied all the coal taken from the mine. It is intended to follow the coal with this large tunnel to the other side of the hill to allow the railway-engine and trucks to pass through to where there is said to be an extensive field of coal, similar to that in view at the face of the tunnel. All mining was suspended at the time of my visit. The output from this mine must be small till there is a railway to Westport,

Smooth-water Coal-mine, Brunnerton (11th September).—There is a small seam cropping out in a gully near Smooth-water Creek, which is now being driven into to test its value. It dips at a steep angle to the east, and would have to be opened from the Smooth-water side of the hill if the seam proved to be any good.

Brunner Coal-mine, Greymouth (9th September).—The work was confined to the far pillars and bottom. The roof was breaking freely and following the workmen closely. The work appeared to be very carefully done. The air was good, and the Act carefully observed.

Coal-pit Heath Colliery, Greymouth.—This mine is now being worked by the same machinery as that used by the Brunner Mine, and the supervision of the workings in the two mines is in the hands of the one man, Mr. Bishop. The mine is in good order, and the Act well observed.

Wallsend Colliery, Greymouth.—At the time of the miners' strike this mine was closed.

Wallsend Colliery, Collingwood (23rd September).—This mine employs the usual number of men steadily. The general strike did not reach this mine, neither did it increase the output of coal to any extent. The roof is good, so also is the air. The mine is in good order.

Motupipi Coal-mine, Kakaka (27th September).—Two tunnels are being driven on the coal from the Motupipi Creek Terrace, which is only a few feet above high-water mark. The seam is about 5ft. thick, in which there is a band of soft shale 2ft. thick in its centre. The roof is very soft, requiring close timbering; it may, however, improve as the tunnel proceeds. A large punt was being built on the spot to carry the coal down the creek to the shipping, three-quarters of a mile distant from the mine.

REEFTON.

Golden Treasure Coal-mine, Reefton (8th October).—Mr. G. W. King has been manager since the 2nd of last month. He pointed out to me the work he had done since he took charge, and how he intended to work the mine in the future. He has now to put in a quantity of timbers to support the roof in the old workings, in the immediate vicinity of where coal is now to be taken out. The manager is the only man employed in the mine.

Phœnix Coal-mine, Reefton (8th October).—There is only one man employed in this mine. The air is good, and the mine in good order.

Murray Creek Coal-mine, Reefton (8th October).—James Lara, manager, and another man were stripping from 2ft. to 3ft. of soil off the coal, which enabled them to get 18ft. deep of good coal. I think the mine is carefully worked.

Inglewood Coal-mine, Reefton (8th October).—I did not find any one at the mine, but learned that one man did work in it at odd times to get a few tons of coal when required for the battery.

Butler's Coal-mine, Reefton (8th October).—I did not find any one about the mine. I afterwards heard that the mine had not been working for some time. The workings were in good order.

Golden Fleece Coal-mine, Reefton (8th October).—Mr. Mutrie, who is in charge of this mine, is also in charge of the Golden Fleece Quartz-mine, and occasionally hews a ton or two of coal for the pumping-engine as may be required from time to time. That is all that is being done in the mine. The old workings are in first-class order.

Sir Francis Drake Coal-mine, Reefton (24th October).—The coal is hewn out of an open face, where the stripping, from 1ft. to 6ft., consists of clay and imperfect sand-stone. The seam dips

from the surface to the west, and its thickness from 3½ft. to 4ft. An open drain to a small creek close by takes away the surface-drainage to a certain level. The coal is very easily procured and is of fair quality.

Inkerman Coal-mine, Reefton (28th October).—This mine supplies the Inkerman battery close by, and is being worked by one man. The seam is 5ft. thick, and stands at about the same angle as an ordinary quartz-reef. It is carefully timbered, and has a good roof and floor. The air is also good.

Supreme Coal-mine, Reefton (28th October).—The only mining done in this mine is the hewing of a few tons from time to time when the Supreme battery is crushing a few tons of stone. No coal had been taken out of the mine for five months previous to my visit. The seam is 8ft. thick, of good quality, and is at considerable elevation above the battery, to which the coal is conveyed by an aerial tramway. The seam dips to the west 6in. in 12ft.

Coghlan's Coal-mine, Boatman's (29th October).—A new opening has been made in this lease, and a good seam from 10ft. to 12ft. opened. The dip is to the west. There is very little coal being consumed in Boatman's at present, and therefore the other mines are not working.

Progress Coal-mine, Reefton (30th October).—A new tunnel has been driven into this mine, and a Brunner miner is now in charge, who has already made some improvements in the mine. The seam is 7ft. thick, so that the one man will be able to get out all the coal required by the mine battery. The coal will shortly be delivered to the battery by an aerial tram, which was nearly completed at the time of my visit.

Brighton Coal-mine, Brighton (23rd December).—Worked by a horse on an inclined tramway. One man hewing coal, which is 7ft. thick. The roof is good, and the mine in good order.

McColl's Coal-mine, Brighton (23rd December).—This mine was not working, and there did not appear to be much doing. I did not see any one about.

Lankey's Creek Coal-mine, Reefton (20th October).—Mr. Lamperton the proprietor, is the only man working in the mine, and his output of coal is about 6 tons per week. Pillars only are being taken out. I have instructed him to use more timber to keep the roof up in his travelling-roads.

Energetic Coal-mine (22nd October).—There is only one man working this mine, who appears to be doing very little work. The amount of coal hewn out since my previous visit is hardly noticeable.

Freeman's Colliery, Abbotsford (16th June).—I inspected the workings and found fault with air. The manager pointed out to me that he was preparing a new air-way, which would be completed at an early date.

Fernhill Coal-mine (15th June).—I complained of the insufficiency of air in the workings. The manager admitted it was not good, but stated that an air-way was being driven to the uprise-shaft, which, when completed, would supply all the air required. There was an accident in this mine on the 9th May to H. Kidd, whose collar-bone was broken by a fall of coal.

Walton Park Colliery, Green Island (17th June).—I spent some time in examining the old and new workings, and found all the mine in good order with a good current of air throughout. The plan showed the workings plotted up to within a few feet of the working-faces. The Act is well observed.

Saddle-hill (Christie's) Coal-mine, Saddle-hill (21st June).—I examined all the working-faces, and found them carefully worked. The air was good. Looked over the journal and the plan of the workings. The last survey was made about two months before my visit.

Glenochiel Coal-mine, East Taieri (21st June).—There are only two men employed in this mine, which I found in good order.

Mosgiel Colliery, East Tarieri (21st June).—I examined all the working-faces in this mine, and found them very well laid out. There are seven men employed in the mine and three on the surface. I examined the plan of the workings and also the journal. The air was good. The engine had to pump only four gallons of water per minute. The Act generally is observed.

Real McKay Coal-mine, Milton (24th June).—This mine was not being worked on the day of my visit. I learned from the manager of the Bruce Mine that the Real McKay Mine had not been worked for the previous two months.

Bruce (No. 2) Coal-mine, Milton (24th June).—There are three men employed in this mine. The coal is very hard and solid. General rules and copy of the Act are kept at the tunnel mouth. I found the workings in good order and the air good.

Benhar Coal-mine, Balclutha (25th June).—While I was inspecting this mine two men narrowly escaped being seriously injured by a heavy fall of coal from the roof near their working-place. On a careful examination of the place it was found to be streaked with white pastings. Coal-hewing in that place was at once stopped till it was well secured with timber for some distance back. Report kept daily, and copy of Act at the mine.

Morrison's Coal-mine, Benhar (25th June).—I found only one man employed hewing coal, and working in bad air. He was, however, driving a small tunnel through a pillar in order to improve the air. The mine, otherwise, was in good order.

Rigfoot Coal-mine, Benhar (25th June).—The owner, Thomas Aitkin, works this mine himself when he finds a sale for a few tons of coal. He makes bricks and uses his own coal to burn them. There is not much coal taken out of the mine. There is only the dip-tunnel in the coal, followed from the surface.

Castle Hill Coal-mine, Kaitangata (25th June).—I examined all the working-faces with the manager, Mr. Carson. There was not any one working in the mine on the day of my visit. The mine was in good order. The shareholders are now sinking a shaft on their lease, which was down 23ft. A good seam of coal had been discovered at the shaft-site by boring 400ft. some time ago. It is intended to open out a mine from this shaft at an early date and work it on a large scale.

Kaitangata (No. 2) Coal-mine, Kaitangata (27th June).—I examined nearly all the open faces in the mine. The workings are well laid out, and the old bords securely timbered where necessary to prevent roof coal falling. I carefully looked for, but did not observe, any indications of gas. The mine is well ventilated. The mine plan is closely plotted up, and the Act well observed.

Wangaloa Coal-mine, Wangaloa (28th June).—This mine was not being worked on the day of

my visit. I did not see Smith anywhere about. The general appearance of the mine mouth and road thereto lead me to suppose that very little coal was disposed of.

Lesmahagow Coal-mine, Wangaloa (28th June).—Examined the mine, and found it in good order throughout. I understood from Mr. Sewell that the out-put of coal was very small, only a ton or two at long intervals. A copy of the Act is kept at the mine.

Twcedie and Stark's Lignite-mine, Gore (30th June).—A large open mine, on Green's land, with a few feet of clay stripping.

W. Smith's Lignite-mine, Gore (30th June).—An open face, with 16ft. of stripping, which was not sloped enough.

Mataura Coal-mine, Mataura (1st July).—Open face, with from 8ft. to 14ft. of lignite, and 8ft. to 9ft. of stripping.

Sleeman's Lignite-mine, Mataura (1st July).—An open face on a flat piece of ground; very little stripping, and 4ft. of coal.

Sleeman's Lignite-mine, Waimumu Creek, Mataura (1st July).—Open stripping at side of main road, and 4ft. seam. A pump is worked by a small water-wheel.

John Beatie's Lignite-mine, Waimumu Creek (1st July).—Open stripping, from 12ft. to 14ft., and 16ft. of lignite. The drainage is lifted by a small water-wheel.

Townshind's Mine, Mataura (1st July).—This mine is an open cutting seam about 8ft., with stripping from 6ft. to 8ft. There appears to be very little doing at the mine. There was no one about.

Nightcaps Coal-mine No. 1, Nightcaps (4th July).—Inspected the workings, and found them in good order. There were only two men employed in the mine on the day of my visit.

Nightcaps No. 2, Nightcaps.—In the low seam there was nothing doing. In the high seam there were three men employed. The principal workings were on the surface, where there was a large body of coal exposed. The Act is well observed.

Morley Village, Nightcaps (4th July.)—The coal is obtained in a flat, quite close to the surface. All the coal mined is delivered to the Nightcaps Company, who run their trucks into the mine.

Wallace Colliery, Nightcaps (4th July).—This is an open cutting joining the last-mentioned claim, and is worked in the same way. The coal is delivered to the Nightcaps Company.

Fairfax Mine, Fairfax (4th July).—Todd and Graham have worked open cutting to the time of my visit, but the stripping is now so heavy they intend to open it out by bord and pillar.

Michael Slattery's Mine, Fairfax (4th July).—Open face, with 12ft. stripping and 6ft. seam. One man.

Orepuki Coal-mine, Orepuki.—This mine had been worked from a shaft at one time. The shaft is now fenced and covered. All the costly plant is idle, awaiting better prices for coal, or better times. There was one man employed hewing out a little coal for local use from a seam near the surface in the back part of the lease.

Popham's Mine, Orepuki (6th July).—This seam is exposed in the bed and bank of the Waimeamea Creek, and very little coal has been removed as yet, no doubt in consequence of the bad state of the road or track—a mud gutter. The seam is in a bad position to mine.

Gipton Coal-mine, Gipton (9th July).—The main-level tunnel is very well timbered, but the workings were very hot and not well ventilated. The quality of coal is very irregular, consequently the mine is not worked systematically. The men (two) are continually prospecting for solid coal, and these prospecting drives wind about in every direction. I instructed these men to connect the leading places to make better air-ways, which they promised to do.

Barrow's Coal-mine, Cromwell (11th July).—The seam stands nearly vertical, and is from 10ft. to 12ft. thick. It is being carefully worked from a level tunnel.

Kawarau Coal-mine, Cromwell (11th July).—The workings in the mine are well laid out, and the mine carefully worked. The coal is hauled out of the mine by a horse in an inclined tunnel. The Act appears to be observed.

Parcell's Coal-mine, Cromwell (11th July).—This mine is reached by an incline-tunnel. I inspected all the workings, but did not find any one there. The mine was in good order, but I think the output must be small.

George Fields's Coal-mine, Blackman's Creek, Clyde (12th July).—This mine has been worked from a tunnel driven from the head of a gully, but all was covered up by a land-slip at the time of my visit. Mr. Fields informed me that no work had been done at the mine for the previous six months. There did not appear to be any prospect of the mine being opened again for some time.

Alexandra Coal-mine, Alexandra (12th July).—This is worked from a shaft 52ft. deep, where the seam is 15ft. thick. There is only 5½ft. of the seam taken out. The mine is in good order.

Macqueenville Mine, Alexandra (12th July).—This mine is reached by a shaft 60ft. deep, where the seam is about 14ft. thick. Several feet of coal is left overhead to protect the roof. The ladder is built in one length, and stands nearly vertical. The shaft is not large enough to admit of a ladder in accordance with the Act, but I learn that the ladder as it is, has been in use for some time. The workings are not well laid out, but safe.

Jackson's Coal-mine, Alexandra (12th July).—This mine is situate on the low flat of the Manuherikia, and is worked from a shaft 25ft. deep. It has not been long opened, and there does not appear to be much doing. I did not see any one about.

Perseverance Mine, Roxburgh (14th July).—This is an open mine in the bed of Coal Creek. There is from 6ft. to 9ft. of stripping and 8ft. of coal taken out, but the depth of seam is not known. The present workings are on a level with the creek water.

Jones's Mine, Roxburgh (14th July).—This is a very large open face, where 20ft. of the surface has been sluiced off to the coal. The good coal is being cut out 20ft. deep, but the bottom of the seam has not yet been reached. There are three men employed in the working-face.

Dungey's Coal-mine, Cambrians (16th July).—This mine is an open face on the crown of a hill; 11ft. of stripping and 20ft. of a seam of very good quality.

J. R. Jones's Coal-mine, Cambrians (16th July).—An open face with 20ft. of a seam of remarkably good quality. A portion has been analysed and proved to contain 90 gallons of kerosene per ton.

Beck and McLean, Rough Ridge (17th July).—Open face with 30ft. of a seam, and very little stripping.

L. McLean's Ida Burn (17th July).—An open face and small workings.

Mrs. Anderson's Ida Mine, Rough Ridge (17th July).—Open face and a large body of coal; shallow stripping.

Archer's Perseverance Mine, Kyeburn (18th July).—The seam is 12ft. thick, and stands at an angle of 45° to the west.

D. McCready and Combs's Mine, Kyeburn (18th July).—This seam is from 12ft. to 14ft. thick, and stands at an angle of about 45°. The coal is very soft in places and appears irregular in quality. The tunnel into the mine is of considerable length, and has a quantity of timber in it, which shows unmistakable signs of decay. I called the proprietor's attention to this, with a request that some of it should be removed and new timber put in its place.

Allendale Mine, Palmerston (28th July).—Mr. Campbell, manager, showed me through all the workings. The seam is from 4ft. to 6ft. thick and of good quality. I was informed that the mine had only been opened in April last. All the coal has to be carted two miles to the nearest railway station—Bushey. The coal is hauled up an incline from the mine workings. An up-cast shaft has been sunk and an air-way driven to it. The air was good, and the mine workings properly laid out. There are, however, some faults already met with, which may disarrange the original plan of work intended to be carried out. I fear there will be many faults found in this mine before long.

Shag Point Coal-mine (29th July).—Examined all the workings where there were men employed, and found some of the faces very hot. I learned from the overseer that the heat arose from fire in the mine only a short distance from the present workings. There were only twenty men employed in the mine. There were no men employed in the submarine part of the mine. Several airways were under construction in order to keep the mine as cool as possible. It is intended shortly to sink to another seam at a considerably lower level, where the coal is known to be 10ft. thick, of good quality, and in good standing ground.

Ngapara Mine, Ngapara (30th July).—I inspected the old and new workings in this mine, and found them all in good order and plenty of air.

Prince Alfred No. 1 Mine, Papataio (30th July).—The long tunnel into the mine workings is very much crushed up in places by reason of the floor having very much risen. I was told it was 6ft. high at one time; it is now only 3½ft. There appears to be no system adopted in this mine. Each man (there are three men in the mine) in his working-face turns to the left or right as it may suit his convenience, without any regard as to the size or shape of the pillar he is leaving. The work is being carried on as if the mine was to be abandoned shortly. I did not visit No. 2 mine, I had not time that day.

Mount Somers Mine, Mount Somers (1st August).—This mine has been very much worked, and, as the coal has been confined to a block, the pillars have been split again and again in order to get a few tons of coal from time to time when it was known to be fairly good. The seam generally is much mixed up with banks of stone and rubbish. Very much of the coal left is of an inferior quality. There were five men employed. The air was good.

Springfield Mine, Springfield (6th August).—There is very little being done in this mine. There are only two men employed in hewing coal by splitting up some of the old pillars in the dip. Fire-clay is being procured from the mine for the pottery works. The Act is being observed.

Canterbury Mine, Sheffield (6th August).—This mine is worked from a shaft 130ft. deep, and the winding is done by a horse-whim. The workmen are lowered and raised by the same means. There is no ladder and no guides or cages. I spoke to Mr. Austin about the necessity of fixing up guides and raising the coal and men by cages. He said he could not do this work just yet for want of funds. The coal has a band of clay 2ft. thick in the centre, which is carefully utilised to fill up the old workings. The air was good.

Glentunnel Coal-mine, Homebush (7th August).—I inspected the working-faces throughout the mine, and found them in good order. The workings are well laid out for working and ventilation. The main roadway is in a bad state with mud from the horse-traffic. The Act is generally observed.

Whitecliffs Mine, South Malvern (7th August).—I hired a trap and started to visit this mine, but met the owner, Mr. Leeming, who informed me that his mine was not working owing to some of the machinery having broken down early that day. I therefore returned to catch the afternoon train to Christchurch.

Accidents.

It is my pleasing duty to report very few accidents this year. There were only three reported to me as having occurred in the mines. These were due to two causes—namely, falls of coal and stone. The former may be debited with two and the latter with one, and they occurred in the mines as follows:—

Fernhill Coal-mine (9th May).—H. Kidd, collar-bone broken by fall of coal.

Coal-pit Heath, Brunnerton (6th June).—P. McMahon leg broken by fall of coal. Also, on the 19th November, R. Mahon got his chest and leg injured by a fall of stone.

Number of Coal-mines.

The number of coal-mines between Springfield, in Canterbury, and Orepuki, in Southfield, is 118. None were struck off the list, but there was one added, an old one restored under a new name.

Methods of Working.

Worked by shafts—			
Steam-power used	4		
Horse-power used	4		
	—	8	
Worked by adit—			
Engine-plane	9		
Horse-power	22		
Hand-power	28		
	—	59	
Openwork		51	
		118	

I have, &c.,
J. Gow, Inspector.

APPENDIX.

No. 1.

STATISTICS of WORKINGS in COAL-MINES, 1890.

NORTH ISLAND.

Name of Mine and Locality.	Name of Manager.	Number of Years worked.	Quality of Coal.	No. of Seams worked.	Thickness of Seams.	Thickness worked.	Dip of Seam.	System of Underground Working.	Number of Shafts.	Dimensions of Shafts.		Output delivered by	Output for 1890.			Approximate Total Output to 31st December, 1889.	Approximate Total Output to 31st December, 1890.	Number of Men ordinarily employed.			Power used for drawing Mineral.	Pumps.			Means of Ventilation.	Date of Inspector's Last Visit.
										Size of Shaft.	Depth of Shaft.		Coal.	Slack.	Total.			Above.	Below.	Total.		Stroke.	Size of Barrel.	Height of Column.		
KAWAKAWA DISTRICT.													Tons.	Tons.	Tons.	Tons.	Tons.									
Kawakawa	Moody, T. P. ..	26	semi-bitum.	1	6′ to 14′	all worked	1 in 6	bord and pillar	2	10′ x 7′	pumping shft. 240′ incline 1,320′	engine-incline	26,624	..	26,624	710,625	737,249	30	40	70	engine	6′	one 8″, two 12′	230′	steam jet	17/11/90
HIKURANGI DISTRICT.																										
West Bryan	Smith, Charles ..	1½	″	1	6′	6′	1 in 8	ditto	..	adit 6′ x 5′	adit 250′	adit	2,533	..	2,533	..	2,533	2	5	7	horse	..	..	..	natural	18/11/90
Walton and Graham's ..	Graham, T. D. ..	1	″	1	7′	7′	1 in 9	open-cast	..	..	..	..	1,210	..	1,210	..	1,210	6	..	6	″	..	..	..	..	18/11/90
WHANGAREI DISTRICT.																										
Kamo	Redshaw, William	14	brown	2	4′ to 14′	4′ to 10′	varies	bord and pillar	5	15′ x 6′ and 9′ x 6′	240′	shaft	19,133	500	19,633	159,146	178,779	13	44	57	engine	3′ to 7′	10″	268′	natural	15/11/90
Whauwhau	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	70,853	70,853	..	..	..	..	..	..	..	..	..
WAIKATO DISTRICT.																										
Waikato, near Huntly ..	Garrett, John ..	14	brown	1	average 17′	15′	varies	bord and pillar	1	adit 6′ x 6′	adit 660′	adit	8,600	53	8,653	113,755	122,408	11	20	31	horse	..	..	..	natural	11/11/90
Ralph's Taupiri, Huntly ..	Collins, William..	15	″	1	6′ to 45′	6′ to 35′	″	ditto	..	adit 10′ x 6′	600′	″	9,108	..	9,108	..	9,108	5	14	19	engine	2′	2″	86′	″	12/11/90
Taupiri Extended, Huntly ..	Tatley, William..	16	″	1	20′ to 48′	7′ to 20′	″	″	1	10′ diam.	170′	shaft	24,000	3,180	27,180	322,207	349,387	14	46	60	″	24″	10″	170′	fan	11/11/90
Taupiri Reserve, Kimihia, Huntly	Ord, John ..	4	″	1	18′	10′ to 12′	1 in 4½	″	1	adit 9′ x 5′	1,056′	adit	13,723	..	13,723	27,646	41,369	10	34	44	″	24″	5″	80′	natural	10/11/90
Miranda, Bridgewater ..	Snow, Thomas ..	3½	″	1	40′ to 53′	40′	1 in 4	″	2	15′ x 5′	210′	shaft	6,065	..	6,065	12,323	18,388	5	5	10	″	24″	4″	200′	″	12/11/90
Mokau	Lobb, Joseph ..	..	″	1	7′ 6″	6′	varies	..	..	..	..	..	1,188	..	1,188	..	1,188	2	6	8	horse	..	..	..	..	..

WEST WANGANUI.																										
Wallsend, Collingwood ..	Walker, James ..	22	bitum	1	2′ 5″	all	N. 60° W. 1 in 10	longwall	..	..	..	adit	3,477	615	4,092	32,694	36,786	6	13	19	hand	*	..	..	natural	..
WESTPORT.																										
Mokihinui, Mokihinui ..	Straw, M. ..	10½	„	2	11′ to 16′ 32′	15′	varies	bord and pillar	..	..	..	„	4,206	..	4,206	3,291	7,697	5	17	22	horse	..	..	..	„	23/8/90
Westport, Ngakawau, Ngakawau	Marshall, John ..	2	„	1	16′	all	35°	ditto	..	9′ x 6′	180′	„	1,873	..	1,873	1,568	3,441	2	6	8	engine	hand	pump		„	24/8/90
Coalbrookdale, Westport ..	Brown, Thomas ..	12	„	2	4′ to 20′	„	varies	„	4	8′ 8′ 8′ 6′	48′ 146′ 90′ 148′	engine-plane	125,780	34,460	160,240	721,618	881,858	103	355	458	„	9″ 12″	6″ 4″	160′ 140′	furnace and steam-jet	22/8/90
Waimangaroa, Westport ..	Elliott, Robert ..	2	„	1	9′ to 30′	„	W. 30°	„	..	..	..	adit	3,987	..	3,987	200	4,187	4	17	21	hand	..	..	..	natural	21/8/90
Wellington, Westport ..	Elliott, Robert ..	..	„	..	..	..	..	reopening	..	..	..	„	..	..	..	..	..	..	2	2	„	..	..	..	„	..
REEFTON.																										
Murray Creek, Reefton ..	Sara, James ..	7	glance	1	18′	12′	W. in 4	bord and pillar	..	..	..	„	983	229	1,212	4,228	5,440	..	2	2	„	..	..	..	„	8/10/90
Golden Treasure, Reefton ..	King, G. W. ..	19	„	1	20′	12′	level	ditto	..	..	..	„	500	300	800	2,400	3,200	2	2	4	„	..	..	..	„	8/10/90
Inkermann, Reefton ..	McAllum, James	5	„	1	5′	5′	35°	stoping	..	..	..	„	500	..	500	1,640	2,140	..	2	2	„	..	..	..	„	–/10/90
Lankey's Gully, Reefton ..	Lamberton, W. ..	13	„	1	8′	varies	varies	stoop & room	..	..	..	„	292	..	292	4,695	4,987	1	1	2	„	..	..	..	„	20/10/90
Burke's, Boatman's ..	Coghlan, John ..	9	„	1	19′ 3″	6′	N. 80° W.	bord and pillar	..	..	..	„	100	50	150	1,886	2,036	1	1	2	„	..	..	..	„	–/10/90
Boatman's, Boatman's ..	Coghlan, John ..	10	„	2	2′ 7″ and 1′ 7″	all	S. 30° W.	ditto	..	..	..	„	200	100	300	1,593	1,893	1	1	2	„	..	..	..	„	–/10/90
Coghlan's, Boatman's ..	Coghlan, John ..	..	„	1	12′	8′	W. 33°	not working	..	..	..	..	..	..	..	38	38	..	..	..	..	..	..	..	..	..
Boatman's Creek, Boatman's	Coghlan, John ..	..	„	..	..	..	..	ditto	..	..	..	..	..	..	..	450	450	..	..	..	..	..	..	..	..	..
Phœnix, Reefton	Fox, John ..	6	„	1	20′	10′	E. 30° to 40°	bord and pillar	..	..	..	adit	936	..	936	2,602	3,538	..	1	1	hand	..	..	..	natural	8/10/90
Inglewood, Reefton ..	Rogers, C. ..	3	„	1	3′ to 5′	all	varies	..	..	..	..	„	..	40	40	204	244	..	1	1	„	..	..	..	„	8/10/90
Progress, Reefton	Radcliffe, W. ..	10	„	1	5′	„	S.E. 1 in 8	bord and pillar	..	..	100′	„	450	450	900	1,494	2,394	..	1	1	„	..	..	..	„	30/10/90
Murray Creek No. 2, Reefton	Butler, John ..	½	„	1	8′ to 14′	varies	1 in 2	ditto	..	..	..		50	400	450	..	450	..	1	1	„	..	..	..	„	8/10/90
Sir Francis Drake, Reefton ..	Gentles, Adam ..	3	„	1	3′	all	flat	open-cast	..	..	..	..	430	..	430	..	430	..	1	1	horse	..	..	..	..	..
GREYMOUTH.																										
Brunner, Greymouth ..	Bishop, James ..	26	bitum.	1	8′ to 10′	„	S.W. 1 in 4	bord and pillar	..	..	..	engine-plane	33,276	14,346	47,622	744,721	792,343	25	100	125	engine	..	..	..	Schiele fan	9/9/90
Coalpit Heath, Greymouth ..	Bishop, James ..	14	„	1	16′	„	S.W. 1 in 4	ditto	2	10′ x 6′ 6′	280′ 75′	ditto	37,187	7,348	44,535	315,864	360,399	40	90	130	„	4′ 3′ 3′ 1′ 3″ 1′ 10″ 10″	10″ 6″ 9″ 6″ 4″ 6″ 6″	250′ 250′ 170′ 90′ 250′ 250′ 250′	ditto	9/9/90
Blackball, Greymouth ..	A. B. Lindon, Gen. Manager; Schofield, R.	1½	„	2	4′ 6″ and 12′	..	S.W. 1 in 5	not opened	..	9′ x 6′	1058′	adit	..	..	..	..	..	2	12	14	..	..	..	..	furnace	..
Wallsend, Greymouth ..	Bishop, James ..	14	„	1	16′	all	S.W. 1 in 4	bord and pillar	2	11′ 14′	670′ 670′	shaft	22,890	3,800	26,690	178,849	205,539	30	70	100	engine	3′ 6″ 8′	10″ 8″	650′ 150′	Guibal fan	..
Tyneside, Greymouth ..	..	13	„	1	16″	„	S.W. 1 in 4	not working	2	10′ 6′ x 6′	116′ 25′+12′	..	..	..	..	18,398	18,398	..	..	..	..	..	..	..	..	..

* 5 syphons varying from 1″ to 2″, lift 18′ to 24′, length 600′ to 700′.

Statistics of Workings in Coal-mines, 1890—*continued.*

Middle Island—*continued.*

Name of Mine and Locality.	Name of Manager.	Number of Years worked.	Quality of Coal.	No. of Seams worked.	Thickness of Seams.	Thickness worked.	Dip of Seam.	System of Underground Working.	Number of Shafts.	Dimensions of Shafts.		Output delivered by	Output for 1890.			Approximate Total Output to 31st December, 1889.	Approximate Total Output to 31st December, 1890.	Number of Men ordinarily employed.			Power used for drawing Mineral.	Pumps.			Means of Ventilation.	Date of Inspector's Last Visit.
										Size of Shaft.	Depth of Shaft.		Coal.	Slack.	Total.			Above.	Below.	Total.		Stroke.	Size of Barrel.	Height of Column.		
Malvern.													Tons.	Tons.	Tons.	Tons.	Tons.									
Springfield, Springfield ..	Lindop, A. B. ..	14	brown	1	4′ 6″	all	S.E. 1 in 6	bord and pillar	1	12′ x 5′ 2″	246′	shaft	1,951	732	2,683	65,529	68,212	2	4	6	engine	1′ 10″	8″	246′	steam	5/8/90
Canterbury, Sheffield ..	Austin, J. ..	28	″	2	2′ 3″	″	S.70° E. 21°	narrow	1	5′7″diam	160′	″	2,000	40	2,040	34,109	36,149	3	7	10	horse	1′	6″	140′	natural	5/8/90
Homebush, South Malvern ..	McIlraith, J. A., Gen. Manager	18	″	1	7′	″	E. 10° S. 1 in 3	bord and pillar	2	5′ x 6′ 3′ 6″ x 3′	40 chain 60′ & 20′	adit	2,772	276	3,048	82,578	85,626	2	7	9	″	..	..	..	″	7/8/90
Snowdon, Rakaia Gorge ..	Gerard, W. (owner)	..	″	1	9′ 3″	″	N. 80° E.	narrow	..	..	40′	″	50	..	50	240	290	..	1	1	hand	..	..	..	..	5/10/89
Acheron, Lake Coleridge ..	Murchison, John (owner)	22	anthracite	1	5′ 3″	″	S.W. 18°	″	..	..	..	″	30	..	30	195	225	1	..	1	″	..	..	..	..	4/10/89
Stobwood, Rockwood ..	Levick, H. ..	5	brown	1	7′ to 10′	″	S. 12°	″	1	3′x1′10″	16′	″	..	..	..	843	843	..	..	..	″	..	..	..	..	3/10/89
Whitecliffs, South Malvern ..	Leeming, W. ..	10	″	2	7′ & 5′ 6″	6′ & 5′	E. 5° S. 35°	″	1	4′ x 2′	80 shaft 8 chain	″	4,079	98	4,177	12,478	16,655	2	7	9	″	1′ 6″	4½″	55′	natural	7/10/89
Mount Somers, Mount Somers	Jebson, D. ..	26	″	1	30′	10′ to 20′	S. 60° E. 10°	bord and pillar	..	5′ x 6′	..	″	2,855	200	3,055	10,338	13,393	..	6	6	″	..	..	..	..	1/8/90
Duke's, Kakahu	Duke, James ..	1	″	1	3′	all	..	..	..	..	..	″	..	..	..	300	300	..	..	..	″	..	..	..	..	..
Timaru.																										
Wharekuri, Wharekuri ..	Cairns, W. B. ..	24	″	1	25′	14′	S. 60° W. 60°	narrow	1	4′ x 3′	80′	″	150	..	150	8,253	8,403	1	1	2	″	..	..	..	..	6/2/89
Kurow, Kurow	Cairns, W. B. ..	11	″	1	19′	all	N.E. 45°	pillar & stall	1	6′ 2′ 6″	53′	″	1,000	..	1,000	1,675	2,675	2	4	6	horse	8″	4″	25′	natural	6/2/89
Phillips's Kurow	Phillips, James ..	2	″	..	indefinit		..	ditto	1	8′ x 6′	8′	″	280	..	280	45	325	..	1	1	″	..	..	..	″	6/2/89
Otago.																										
Prince Alfred No. 1, Papakaio	Willetts, John	21	″	1	9′	all	N. 50° E. 12°	bord and pillar	1	4′ diam.	42′	″	1,913	..	1,913	29,109	31,022	2	5	7	hand	..	..	..	″	30/7/90
Prince Alfred No. 2, Papakaio		14	″	1	8′	″	E. 10° S. 1 in 5	ditto	2	3′ x 3′ 4′ x 4′	40′ 75′	″														
St. Andrews, Papakaio ..	Nimmo, John ..	12	″	1	6′ 6″	″	E. 15°	″	2	4′ diam. 4′ x 3′	26′ 60′	″	1,621	..	1,621	11,859	13,480	2	2	4	horse	..	..	..	natural	30/7/90
Ngapara, Ngapara	Nimmo, G. S. ..	12	″	1	25′	7′ to 8′	N. 5° E. 1 in 4	″	1	4′6″x2′8″	36′	″	868	..	868	9,408	10,276	1	2	3	″	..	..	..	″	7/2/89
Shag Point, Palmerston ..	Williams, W. H.	27	pitch	2	2′ to 12′	all	E. 1 in 4	″	3	3′ diam. 13′ x 5′ 6′ x 4′	100′ 242′ 164′	shaft	11,137	975	12,112	208,316	220,428	15	60	75	engine	2′	6″	170′	steam	11/12/90
Allandale, Palmerston ..	McIntosh, A. ..	3½	″	1	8′	6′ 6″	N. 60° W. 14° to 30°	″	1	5′ x 4′ 5′ 6″ x 5′	65′ 370′	engine-plane	5,256	1,390	6,646	4,762	11,408	5	36	41	″	6″	5″	56′	natural	28/7/90

Hill's Creek, Hill's Creek ..	McKnight, J. ..	26	lignite	1	8′	all	E. 25°	open	..	..	..	..	70	..	70	709	779	1	..	1	..	8″	3″	10′	..	15/2/89
Beck and McLean, Rough Ridge	McLean, L. ..	4	″	1	24′	″	N. 5°	″	..	..	..	..	1,206	..	1,206	2,045	3,251	2	..	2	..	..	..	..	..	17/7/90
Idaburn, Rough Ridge ..	White, John ..	20	″	1	25′	″	N. 30° W. 3°	″	..	..	..	..	1,600	..	1,600	20,543	22,143	2	..	2	..	6″	2″	20′	..	17/7/90
Ida Valley, Rough Ridge ..	Turnbull, G. ..	20	″	1	18′	″	N.W. 20°	″	..	..	..	..	117	..	117	1,796	1,913	1	..	1	..	9″	3″	15′	..	18/7/90
Blackstone Hill, Hill's Creek	Dunsmuir, A. ..	24	″	1	8′	″	N. 70° W. 5°	″	..	..	..	..	80	..	80	285	365	1	..	1	..	..	..	..	..	16/2/89
Cambrian (Jones's), Cambrian	Jones, J. R. ..	29	brown	1	40′	25′	W. 10°	″	..	..	..	..	1,177	..	1,177	11,688	12,865	2	..	2	..	..	..	..	..	16/7/90
Cambrian, Dungey's ..	Dungey, C. ..	6	″	1	20′	20′	N.W. 3°	″	..	..	..	..	1,035	..	1,035	3,811	4,846	2	..	2	..	..	..	..	..	16/7/90
Kyeburn, Kyeburn ..	McCready, D. ..	17	″	1	25′	14′	S. 45° W. 40°	narrow	1	3′ x 2′	60′ & 4′ x 5′ 500′	adit	121	60	181	14,064	14,245	..	2	2	hand	..	..	..	natural	18/7/90
Perseverance, Kyeburn ..	Archer, C. ..	12	″	1	8′	all	S. 45° W. 40°	″	..	6′ x 4′	500′	″	473	..	473	5,337	5,810	1	1	2	″	..	..	..	″	18/7/90
Commercial (No. 2), Kyeburn	Archer, C. ..	8	″	1	10′	″	S. 45° W. 70°	open	..	6′ x 4′	25′	″	450	..	450	1,185	1,635	1	1	2	..	..	..	..	″	18/7/90
Commercial (No. 1), Kyeburn	Archer, C. ..	2	″	1	5′	″	2 in 6	narrow	..	6′ x 4′	200′	″	148	..	148	20	168	1	1	2	hand	..	..	..	..	18/7/90
Alexandra, Alexandra ..	Thomson, W. ..	11	″	1	15′	6′	N. 20° E. 1 in 7½	bord and pillar	2	4½′ x 2½′ 5½′ x 2′9″	60′ and 50′	shaft	600	..	600	11,789	12,389	1	..	1	horse	..	..	..	natural	12/7/90
Macqueenville, Alexandra ..	Lett, R. ..	..	″	1	10′	5′	S. 75° W. slight	ditto	1	4′ x 3′	62′	″	365	..	365	5,309	5,674	1	1	2	″	bucket			″	12/7/90
Earnscleugh, Clyde ..	Field, G. ..	14	″	1	14′	8′	S.W. 1 in 8	″	1	4′10″ x 3′	35′	adit	..	..	..	3,700	3,700	..	..	..	hand	..	..	..	″	12/7/90
Waikerikeri, Clyde ..	Holt, W. ..	9	″	1	20′	5′	S. 1 in 1	stoping	3	4′ x 3′ 6″	100′	shaft	389	..	389	18,060	18,449	1	1	2	horse	..	..	..	″	21/2/89
Dairy Creek, Clyde ..	Marie, T. C. ..	19	″	1	unknown	30′	S. 45° E. 45°	bord and pillar	1	4′ x 3′ 6″	36′	adit	..	..	..	3,723	3,723	..	..	..	hand	..	..	..	″	21/2/89
Excelsior, Cromwell ..	Burrowes, J. ..	9	″	1	12′	10′	E. 6° S. 60°	ditto	..	6′ x 5′	200′	″	600	..	600	2,112	2,712	..	1	1	″	..	..	..	″	11/7/90
Parcill and Jones's, Cromwell	Parcill, W. ..	2½	″	1	10′	6′	S. 40° W. 5°	″	1	6′ x 4′	50′	″	283	..	283	349	632	..	1	1	″	..	..	..	″	11/7/90
Bannockburn, Cromwell ..	Clarke, A. W. N.	19	″	1	12′	6′	N. 70° W. 1 in 9	″	1	6′ x 2′ 6″	..	engine-plane	..	..	..	8,628	8,628	..	..	..	engine	3′	6″	50′	″	21/2/89
Kawarau, Cromwell ..	Pryde, J. ..	13	″	1	8′	6′	N. 1 in 4½	″	1	5′ x 7′	90′	incline	1,500	..	1,500	10,274	11,774	..	3	3	horse	..	..	..	″	11/7/90
Gibston, Gibston	Cowan, J. ..	23	pitch	2	50′	5′	W. 22½°	narrow	1	6′ x 5′ 500′	80′	adit	820	..	820	14,063	14,883	..	2	2	hand	..	..	..	..	9/7/90
Steele's, Gibston	Steele, H. ..	4	″	1	25′	all	S. 60° W. 35° to 40°	″	..	..	..	..	..	..	..	1,274	1,274	..	..	..	″	..	..	..	..	18/2/89
Cardrona, Crown Range ..	McDougall, Robert	6	″	1	20′ +	20′	W. 35°	open	..	..	..	adit	640	..	640	1,200	1,840	3	..	3	..	..	..	..	..	12/2/89
Birch's, Crown Range ..	Thomson, W. ..	4	″	1	10′	10′	W. 35°	narrow	..	..	..	″	..	..	..	212	212	..	..	..	hand	..	..	..	..	18/2/89
Jones's, Roxburgh	Jones, J. ..	20	lignite	1	undefined	20′	W. 1 in 7	open	..	..	..	″	1,000	..	1,000	4,271	5,271	5	..	5	..	..	..	..	..	14/7/90
Perseverance, Roxburgh ..	Craig, James ..	3	″	1	″	8′	..	″	..	..	..	..	835	..	835	1,251	2,086	3	..	3	..	..	..	..	..	14/7/90
Mrs. McPherson's, Roxburgh	Moore, William ..	20	″	1	″	18′	..	″	..	..	..	..	263	..	263	..	263	1	..	1	..	..	..	..	..	14/7/90
Fernhill, Green Island ..	Gray, James ..	13	brown	1	19′ 6″	7′	N. 10° E. 1 in 10	room and rance	1	4′9″x3′6″	..	″	6,181	2,170	8,351	75,378	83,729	2	15	17	hand	..	..	..	..	16/6/90
Green Island, Green Island ..	Allen, E. G. ..	18	″	1	14′	10′	E. 10° N. 1 in 10	ditto	..	..	..	″	..	..	..	108,198	108,198	..	..	..	horse	..	..	..	..	21/6/90
Saddle Hill (Christie's No. 2), Saddle Hill	Christie, J. ..	16	″	1	19′ 6″	10′	E. 1 in 10	″	3	5′ x 2′ 4′ x 4′	50′ and 20′	″	1,373	2,463	3,836	68,611	72,447	1	5	6	″	..	..	..	natural	21/6/90
Glenochiel, Saddle Hill ..	Bryce, D. ..	9½	″	1	16′	7′	varies	″	1	8′ x 4′	43′	″	1,753	242	1,995	3,603	5,598	2	2	4	″	..	..	..	..	21/6/90
Bank, Saddle Hill	Harris, Adam ..	7	″	1	19′	6′	E. 1 in 10	″	1	5′ x 2′ 4″	35′	″	..	..	..	4,123	412	..	..	..	″	..	..	..	..	21/6/90

Statistics of Workings in Coal-mines, 1890—*continued.*

Middle Island—*continued.*

Name of Mine and Locality.	Name of Manager.	Number of Years worked.	Quality of Coal.	No. of Seams worked.	Thickness of Seams.	Thickness worked.	Dip of Seam.	System of Underground Working.	Number of Shafts.	Dimensions of Shafts.		Output delivered by	Output for 1890.			Approximate Total Output to 31st December, 1889.	Approximate Total Output to 31st December, 1890.	Number of Men ordinarily employed.			Power used for drawing Mineral.	Pumps.			Means of Ventilation.	Date of Inspector's Last Visit.
										Size of Shaft.	Depth of Shaft.		Coal.	Slack.	Total.			Above.	Below.	Total.		Stroke.	Size of Barrel.	Height of Column.		
Otago—*continued.*													Tons.	Tons.	Tons.	Tons.	Tons.									
Walton Park, Green Island ..	Loudon, J., General Manager; Shore, T., Mine Manager	20	brown	1	17′	8′	E. 1 in 9	room and rance	3	11′ x 4′ 12′ x 4½′ 6′ x 4½′	175′ 173′ 25′	shaft	14,010	4,690	18,700	369,265	387,965	8	41	49	engine & horse	4′	9½″	170′	furnace	21/6/90
Abbotsford Colliery, Green Island	Freeman, James	9½	″	1	14′	7′	E. 10° N. 1 in 10	ditto	4	4′ x 4′ 4′ x 4′ 6′ x 4′ 5′ x 3½′	80′ 45′ 140′ 120′	engine-plane	10,234	3,497	13,731	135,359	149,090	8	27	35	ditto	2′ 6″	6″	47′	steam	16/6/90
Mosgiel, Mosgiel	Sneddon, James..	7	″	1	15′	7′	S. 1 in 10	″	2	4′ x 4′ 6′ x 6′	27′ 6″ 32′	ditto	3,239	3,229	6,468	17,988	24,456	4	7	11	″	syphon		..	natural	21/6/90
Brighton, Brighton ..	Walker, James ..	4	″	1	6′ to 8′	6′	S. 80° 6° to N. 20° E. 12°	″	1	3′ x 2′ 6″	20′	adit	452	..	452	1,170	1,622	1	1	2	horse	..	..	..	..	11/12/90
McColl's, Brighton ..	McColl, D. L. ..	2	″	1	6′	6′	1 in 12	bord and pillar	1	6′ x 4′	30′	″	105	12	117	12	129	..	2	2	″	..	..	..	..	11/12/90
Bruce (No. 2), Milton ..	Hardwick, N. ..	1	pitch	1	18′ 6″	7′	N. 30° E. 10°	ditto	1	4′ 6″ x 2′ 6″	..	″	..	..	..	..	..	..	..	..	..	..	..	..	..	24/6/90
Bruce, Milton	Hardwick, N. ..	16½	″	1	12′ 6″	6′	varies	″	1	4′ x 3′	20′	″	910	350	1,260	17,377	18,637	1	3	4	horse	..	..	..	..	24/6/90
Real Mackay, Milton ..	Young, A. ..	22½	″	1	20′	10′	N.E. to E. 1 in 8	stoop & room	1	4′ 6″ x 3′	34′	″	768	..	768	14,657	15,425	..	3	3	″	..	..	..	..	24/6/90
Fortification, Milton ..	Reid, T. ..	5	″	1	12′	6′ to 7′	S. 60° E. 5°	bord and pillar	..	..	..	″	..	..	..	1,784	1,784	..	..	..	..	..	..	..	..	..
Wallsend, Lovell's Flat ..	Hewitson, R. ..	20	lignite	1	20′	all	S. 20° W. 1 in 4	open	..	..	..	..	600	..	600	4,790	5,390	2	..	2	..	..	..	..	..	28/8/89
Paskell's, Lovell's Flat ..	Paskell, J. T. ..	26	″	1	8′	″	N.E. 1 in 6	″	..	..	..	..	4	..	4	319	323	1	..	1	..	..	..	..	..	28/8/89
Gibson's, Lovell's Flat ..	Gibson	1	pitch	1	20′	″	..	..	2	11′ x 4′ 8′ x 4′	250′	..	..	..	..	5	5	..	..	..	..	..	..	..	..	27/8/90
Elliot Hill, Lovell's Flat ..	Magee, P. ..	2	″	1	25′	7′	E. 15° to N. 5°	bord and pillar	..	6′ x 6′	100′	adit	391	..	391	600	991	..	2	2	horse	..	..	..	natural	28/8/89
Adams Flat, Adams Flat ..	Reid, J. ..	8	lignite	1	14′	10′	S. 45° E. 12½°	open	..	..	..	..	160	..	160	923	1,083	1	..	1	..	..	..	..	..	28/8/89
Benhar, Benhar	Nelson, J. ..	27	brown	1	30′	8′	S. 17°	bord and pillar	1	4′ x 4′ 8′ x 6′	48′ 462′	engine-plane	2,900	670	3,570	58,740	62,310	1	5	6	engine	steam-jet			natural	25/6/90
Morrison's, Benhar ..	Morrison, J. ..	4	″	1	15′	7′	S. 12°	ditto	..	8′ x 6′	100′	adit	200	..	200	446	646	..	1	1	hand	..	..	..	″	25/6/90
Rigfoot, Benhar	Aitken, Thomas ..	4	″	1	18′	10′	S. 12°	″	..	6′ x 8′	240′	″	604	65	669	1,264	1,933	1	1	2	horse	..	..	..	″	25/6/90

Kaitangata (No. 1), Kaitangata	Watson, P. W., Gen. Manager	15	pitch	2	18′ to 30′	28′	W. 45°	″	1	13′ x 5′ 6″	392′	shaft	48,309	22,559	70,868	499,238	570,106	14	128	142	engine	2′	5″	392′	furnace	27/6/90
Kaitangata (No. 2), Kaitangata	Shore, Wm. M., Mine Manager	7	″	1	6′ to 30′	20′	W. 1 in 4	″	1	6′ diam.	210′	engine-plane														
Castle Hill, Kaitangata ..	Carson, M. ..	3½	″	1	12′ to 14′	7′ to 8′	N. 20° E. 14°	″	1	3′ 9″ x 2′ 6″	54′+4	adit	549	268	817	1,923	2,740	..	3	3	horse	..	..	..	natural	27/6/90
Wangaloa, Kaitangata ..	Smith, J. ..	10	″	1	10′ 6″	6′	E. 1 in 6	″	..	..	..	″	25	5	30	876	906	1	..	1	hand	..	..	..	″	28/6/90
Lesmahagow, Kaitangata ..	Sewell, R. M. ..	9	″	1	5′	all	N. slight	″	..	..	..	″	246	..	246	845	1,091	..	2	2	″	..	..	..	..	28/6/90
Crofthead, Kaitangata ..	Coulter, W. ..	4	″	1	12′	8′	N. 20° E. 10°	″	..	6′ x 6′	300′	″	1,000	40	1,040	2,292	3,332	..	2	2	horse	..	..	..	..	28/6/90
Cullin's, Waikoikoi ..	Cullen, James ..	3	lignite	1	4′	all	N. 5°	open	..	..	..	..	..	..	..	60	60	..	..	..	..	..	..	..	..	12/12/89
Mainholm, Waipahi ..	Lischmer, F. ..	4½	″	1	15′	″	E. 30°	″	..	..	..	..	1,000	..	1,000	1,800	2,800	3	..	3	..	7″	3″	26′	..	12/12/89
Wyndham, Wyndham ..	Genge, T. ..	13	″	1	2′	″	level	″	..	..	..	..	30	..	30	1,958	1,988	1	..	1	..	..	..	..	..	9/12/89
Munro's, Wyndham ..	Munro, E. ..	2	″	1	3′	″	″	″	..	..	..	..	600	..	600	900	1,500	2	..	2	..	..	..	..	..	9/12/89
Parratt's, Menzies' Ferry ..	Kerr, D. ..	5	″	1	6′	2′	″	″	..	..	..	..	150	..	150	454	604	2	..	2	..	Californian			..	9/12/89
Menzies' Ferry, Menzies' Ferry	Kerr, D. ..	10	″	1	6′	all	″	″	..	..	..	..	330	..	330	3,336	3,666	1	..	1	..	6″	3″	20′	..	9/12/89
Smyth's, Gore	Smyth, J. ..	5	″	1	10′+	10′	W. 10°	″	..	..	..	..	200	..	200	350	550	1	..	1	..	..	..	..	..	30/6/90
Lieze's (jun.), Gore ..	Lieze, M., jun. ..	13	″	1	6′ to 7′	6′	S.E. 5°	″	..	..	..	..	43	..	43	982	1,025	1	..	1	..	..	..	..	..	6/12/89
McKinnon's, Gore	McKinnon, A. ..	9	″	1	8′	8′	level	″	..	..	..	..	209	..	209	1,595	1,804	2	..	2	..	6″	3″	12′	..	6/12/89
Hoffmann's, Gore	Hoffmann, J. ..	8	″	1	10′	10′	N. 12°	″	..	..	..	..	40	..	40	2,309	2,349	1	..	1	..	..	..	..	..	..
Gore (Hunter), Gore ..	Hunter, George ..	2	″	1	10′+	10′	..	″	..	..	..	..	..	..	..	2,125	2,125	..	..	..	..	..	..	..	..	6/12/89
Gore, Gore	Hunter, George ..	1	″	1	10′+	10′	..	″	..	..	..	..														
Croydon, Croydon	Smyth, William ..	1½	″	1	12′	12′	S. 60°	″	..	..	..	..	180	20	200	336	536	1	..	1	..	..	..	..	..	..
Heffernan's, Gore	Heffernan, P. ..	12	″	1	12′+	12′	N. 15°	″	..	..	..	..	120	..	120	607	727	1	..	1	..	..	..	..	..	6/12/89
Sarginson's, Waikaka ..	Sarginson, J. H. ..	4½	″	1	9′+	8′	N. 20°	″	..	..	..	..	105	..	105	185	290	1	..	1	..	..	..	..	..	6/12/89
Chatton (Pacey), Chatton ..	Pacey, W. R. ..	14	″	1	34′	14′	S.E. 1 in 6	″	..	..	..	..	400	50	450	4,798	5,248	1	..	1	..	..	..	..	..	7/12/89
Chatton (Pemble), Chatton ..	Pemble, Henry ..	13	″	2	16′ to 26′	16′ to 18′	90° strike N. and S.	″	..	..	..	..	400	..	400	9,865	10,265	2	..	2	..	..	..	..	..	18/7/90
Perseverance, Chatton ..	McKenzie, James	4	″	1	16′	9′	N. 20° W. 15°	bord and pillar	..	8′ x 4′	330′	adit	562	..	562	615	1,177	1	2	3	horse	..	..	..	natural	11/5/89
Pukerau, Chatton	O'Hagan, C. ..	10	″	1	16′	10′	W. 1 in 10	ditto	..	6′ x 7′	496′	″	724	..	724	16,779	17,503	..	2	2	hand	..	..	..	″	12/5/89
Enterprise, Pukerau ..	McKenzie, James	1½	″	1	7′	all	N. 60°	″	..	..	..	..	..	..	..	165	165	..	..	..	″	..	..	..	..	..
SOUTHLAND.																										
Otama, Otama	Hunter, T. ..	5½	″	1	2′ 8″	″	N.E. 5°	open	..	..	..	..	193	..	193	350	543	1	..	1	..	..	..	..	..	7/12/89
Waimea, Riversdale ..	Carmichael, J. ..	5½	″	1	12′	″	N. 10°	″	..	..	..	..	300	..	300	2,786	3,086	2	..	2	..	..	..	..	..	13/5/89
Mataura (Beattie), Mataura ..	Beattie, James ..	15	″	1	16′	″	N.W. 4°	″	..	..	..	..	1,343	..	1,343	15,432	16,775	2	..	2	..	5″	6″	26′	..	1/7/90
Mataura (Town), Mataura ..	Town, C. ..	4	″	1	16′	″	N. 70° W. 5°	″	..	..	..	..	640	..	640	4,494	5,134	2	..	2	..	6″	4″	15′	..	1/7/90
McGowan's, Mataura ..	McGowan, F. ..	3	″	2	4′	″	N. 70° W. 1 in 8	″	..	..	..	..	12	..	12	101	113	1	..	1	..	..	..	..	..	15/5/89
Sleeman's, Mataura ..	Sleeman, C. P. ..	1	″	1	4′	″	N. 70° W. 3°	″	..	..	..	..	2,000	..	2,000	..	2,000	3	..	3	water-wheel	..	..	4′	..	1/7/90
Sleeman's, Mataura ..	Sleeman, C. P. ..	4½	″	1	4′	″	N. slight	″	..	..	..	..	..	..	..	245	245	..	..	..	..	..	..	..	..	1/7/90
Townshend's, Mataura ..	Townshend, E. ..	7	″	1	12′	8′	level	″	..	..	..	..	40	..	40	203	243	1	..	1	..	..	..	..	..	1/7/90
Edge's, Waikaka	Edge, A. A. ..	12	″	2	8′ & 12′	all	N. 60° E.	″	..	..	..	..	305	20	325	565	890	1	..	1	..	..	..	..	..	7/12/89
No. 14, Waikaka	Edge, W. H. ..	3½	″	1	8′ 7″	″	W. 35°	bord and pillar	..	..	..	adit	150	..	150	90	240	1	..	1	hand	..	..	..	..	7/12/89
Nightcaps (No. 1), Nightcaps	Handyside, W., Gen. Manager	10	pitch	1	2′ 4″	″	N.E. 1 in 7 to 1 in 2½	ditto	2	6′ x 3′ 5′ x 3′	135′ 53′	engine-plane adit	20,412	..	20,412	74,544	94,956	30	6	36	engine & horse	3′ 9″	6″	135′	furnace	21/11/90
Nightcaps (No. 2), Nightcaps	Lloyd, J., Mine Manager	8	″	2	15′ and 10′	″	N.E. to E. 1 in 4 to 1 in 6	″	2	4′ x 4′ 5 diam	50′ 46′															
Nightcaps (No. 4), Nightcaps		2	″	1	9′	″	S. 80° E. 50°	open	..	..	..	..														

Statistics of Workings in Coal-mines, 1890—*continued*.

MIDDLE ISLAND—*continued*.

Name of Mine and Locality.	Name of Manager.	Number of Years worked.	Quality of Coal.	No. of Seams worked.	Thickness of Seams.	Thickness worked.	Dip of Seam.	System of Underground Working.	Number of Shafts.	Dimensions of Shafts.		Output delivered by	Output for 1890.			Approximate Total Output to 31st December, 1889.	Approximate Total Output to 31st December, 1890.	Number of Men ordinarily employed.			Power used for drawing Mineral.	Pumps.			Means of Ventilation.	Date of Inspector's Last Visit.
										Size of Shaft.	Depth of Shaft.		Coal.	Slack.	Total.			Above.	Below.	Total.		Stroke	Size of Barrel.	Height of Column.		
SOUTHLAND—*continued*.													Tons.	Tons.	Tons.	Tons.	Tons.									
Flett's (now Reed's), Nightcaps	Flett, S. ..	2	pitch	2	3′ 4″ to 5′ 6″ 2′ 3″	all	S.E. 10°	open	..	..	..	..	..	..	..	50	50	..	..	..	engine & horse	..	..	..	..	7/5/89
Wallace Pit, Morley Village	Reid, William ..	5	″	2	3′ to 9′	9′	S. 80° E. 5°	″	..	..	..	open	300	..	300	1,565	1,865	4	..	4	horse	8″	5″	18′	..	4/7/90
Wairio, Nightcaps	Knight, T. ..	9	″	1	9′	9′	N.E. 50°	″	..	..	..	adit	..	..	..	2,909	2,909	..	..	..	hand	..	..	..	natural	7/5/89
Wairio (No. 2), Nightcaps ..	Knight, T. ..	9	″	1	9′	6′	E. 10°	bord and pillar	..	..	..	″	..	..	..											
Reliable Colliery, Morley Village	Alley, J. ..	3½	″	1	8′	all	S. 80° E. 5°	open	..	..	..	..	213	..	213	717	930	2	..	2	..	..	..	..	..	4/7/90
Reliable Colliery, Morley Village	Alley, J. ..	2	″	1	4′	″	N. 60° E. 5°	″	..	..	..	..				427	427	..	..	..						
Hokonui, Winton	Lindsay, W. ..	4	″	1	8′	5′ 6″	W. 14°	bord and pillar	..	..	..	adit	1,580	..	1,580	7,069	8,649	2	4	6	hand	..	..	..	natural	14/5/89
Fairfax, Fairfax	Graham, P. S. ..	12	lignite	1	5′ 6″	all	N. 60° W. 4°	..	..	..	..	″	736	..	736	6,631	7,367	2	..	2	..	..	..	..	..	4/7/90
McDowall's, Fairfax ..	McDowall, H. ..	3	″	1	5′	″	S.W. 1 in 20	bord and pillar	..	..	..	..	..	..	..	1,384	1,384	..	..	..	..	..	..	..	..	..
Isla Bank, Fairfax ..	Slattery, M. ..	10	″	1	6′	″	N.W. 5°	open	..	..	..	..	530	..	530	890	1,420	1	..	1	..	..	..	..	..	4/7/90
Orepuki, Orepuki	Lindsay, J. B. ..	5	pitch	1	22′	8′	S.E.	stoop & room	1	6′ x 7′	132′	adit	357	..	357	4,471	4,828	..	3	3	horse	15″	5″	..	natural	4/7/90
Popham's Cluny, Orepuki ..	Popham, James ..	2	″	..	10′	5′	S. 12½° W. 80°	open	..	..	..	..	53	..	53	97	150	1	..	1	..	..	..	..	..	4/7/90
													526,217	109992	637,397	5,646,748	6,282,229	512	1334	1846						
Output from mines included in former statements, and whose operations were suspended prior to 1889													..	..	..	..	172,529									
Total output													..	..	..	..	6,454,758									

HENRY A. GORDON, A.M. Inst. M.E., Inspecting Engineer.

ACCIDENTS IN COAL-MINES during the Year ending 31st December, 1890.

No. and Date.	Name of Mine.	Locality.	Cause of Accident.	Above Ground.	Below Ground.	Fatal.	Non-fatal.	Name of Sufferer.	Remarks.
			North Island.						
1. Nov. 7	Kamo ..	Whangarei	Falling down shaft	1	..	1	..	Alex. McGregor	It was supposed that he jumped into the shaft; he opened the gate at the shaft-mouth.
2. Dec. 22	Ralph's, Taupiri	Huntly ..	Incline adit-level broke down	4	..	4	..	John Tracy, Alex. Harris, John Cashy, James Smith	These men were entombed by the breaking-down of the timber in the inclined adit in course of construction.
3. Dec. 22	Ditto ..	„ ..	Ditto ..	1	..	1	..	S. Hyndman	Got fatally injured trying to rescue his mates; died at Hamilton Hospital on 8th April, 1891.
			Middle Island.						
4. May 19	Fernhill ..	Otago ..	Fall of coal ..	..	1	..	1	H. Kidd ..	Got his collar-bone broken by a fall of coal.
5. June 6	Coalpit Heath	Greymouth	„ ..	..	1	..	1	P. McMahon	Got his leg broken by fall of coal.
6. Oct. 16	Nightcaps ..	Southland	Through firing a shot	1	..	1	..	D. Berrell ..	He was coming to the mine, and, being behind a heap of stripping, was not observed when the fuse was set on fire; and, coming towards the place, some of the stone from the shot struck him on the forehead. He died next day.
7. Nov. 19	Coalpit Heath	Greymouth	Fall of stone ..	..	1	..	1	R. Mahon ..	Got his chest and leg injured by fall of stone.
8. Dec. 4	Coalbrookdale	Westport ..	Fall over retaining-wall	1	..	1	..	Alex. Tait ..	Accidentally fell over retaining-wall at middle brake on the Westport Company's incline. He died same night.

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Approximate Cost of Paper.—Preparation (not given); printing (2,300 copies), £185.

By Authority: GEORGE DIDSBURY, Government Printer, Wellington.—1891.

Price, 3s. 6d.]